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

CONSOLIDATED REPORT

MARCH 1997

JAPAN INTERNATIONAL COOPERATION AGENCY

METAL MINING AGENCY OF JAPAN

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

CONSOLIDATED REPORT

MARCH 1997

JAPAN INTERNATIONAL COOPERATION AGENCY

METAL MINING AGENCY OF JAPAN

PREFACE

In response to the request of the Government of the Republic of Uzbekistan, the Government of Japan determined to conduct a series of survey involving geological survey, geochemical survey and other studies related to exploration of ore deposits, for the purpose of examining the potentials of mineral resources in the Eastern Bukantau Area, situated some 500km northwest of Tashkent, the Uzbek capital city, and entrusted the survey to the Japan International Cooperation Agency (JICA).

In view of the geological and mineralogical nature of the intended survey, the JICA commissioned the Metal Mining Agency of Japan (MMAJ) to execute the survey.

The surveys were implemented for the three years from FY1994 to FY1996 and completed as scheduled, under close collaboration with the Uzbek government agencies concerned and the State Committee of Geology and Mineral Reserves.

This Consolidated Report summarizes the overall results of the three-year survey.

We should like to take this opportunity to express our sincere gratefulness to the Uzbek government agencies and persons concerned for their valuable cooperation. We are also thankful to the Japanese Ministry of Foreign Affairs, the Ministry of International Trade and Industry, Embassy of Japan in Tashkent, and all the persons concerned who have rendered assistance and support for the survey.

March, 1997.

Kimio Fujita
President
Japan International Cooperation Agency

Shozaburo Kiyotaki
President
Metal Mining Agency of Japan

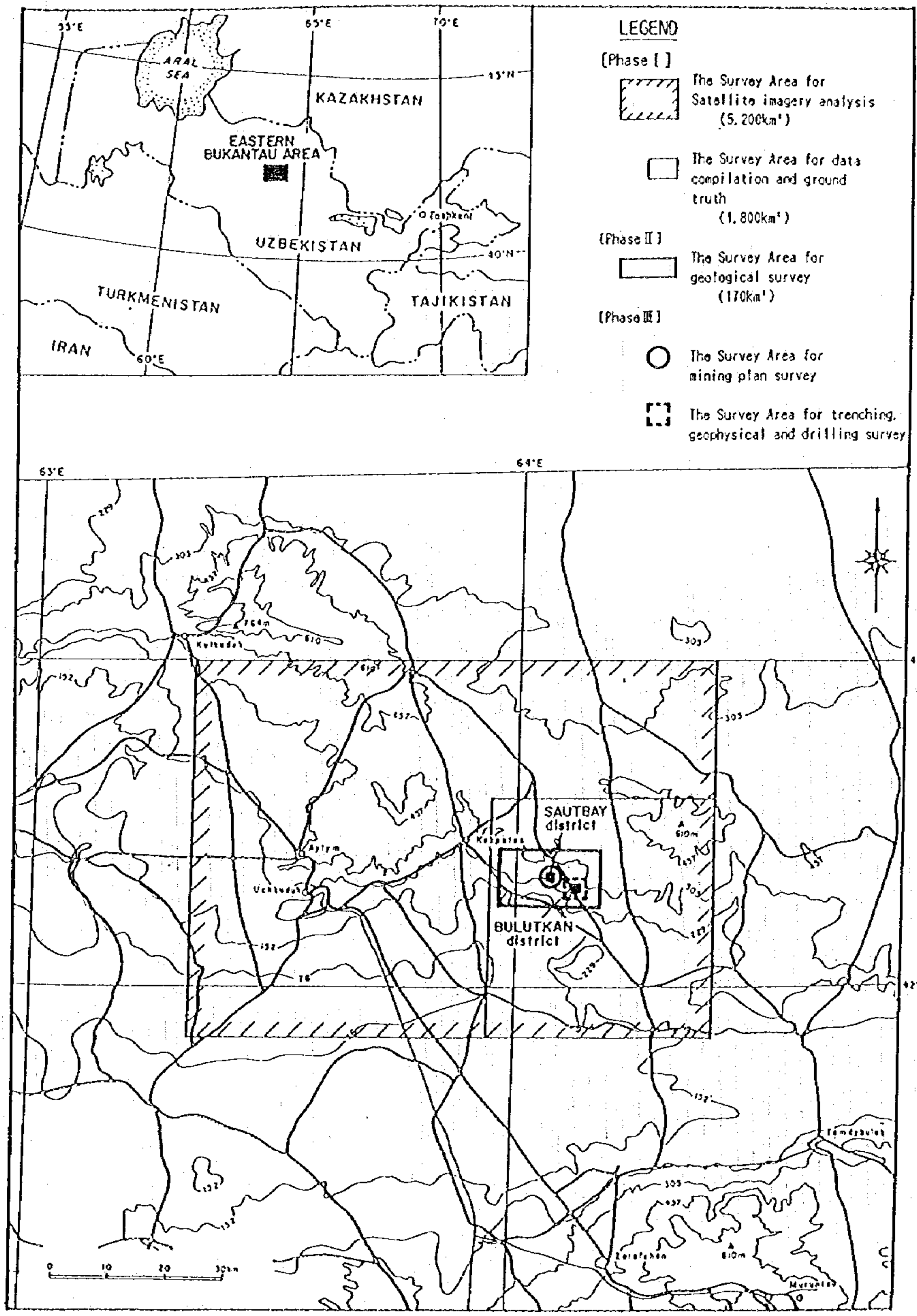


Fig. I -1 Location Map of the Survey Area

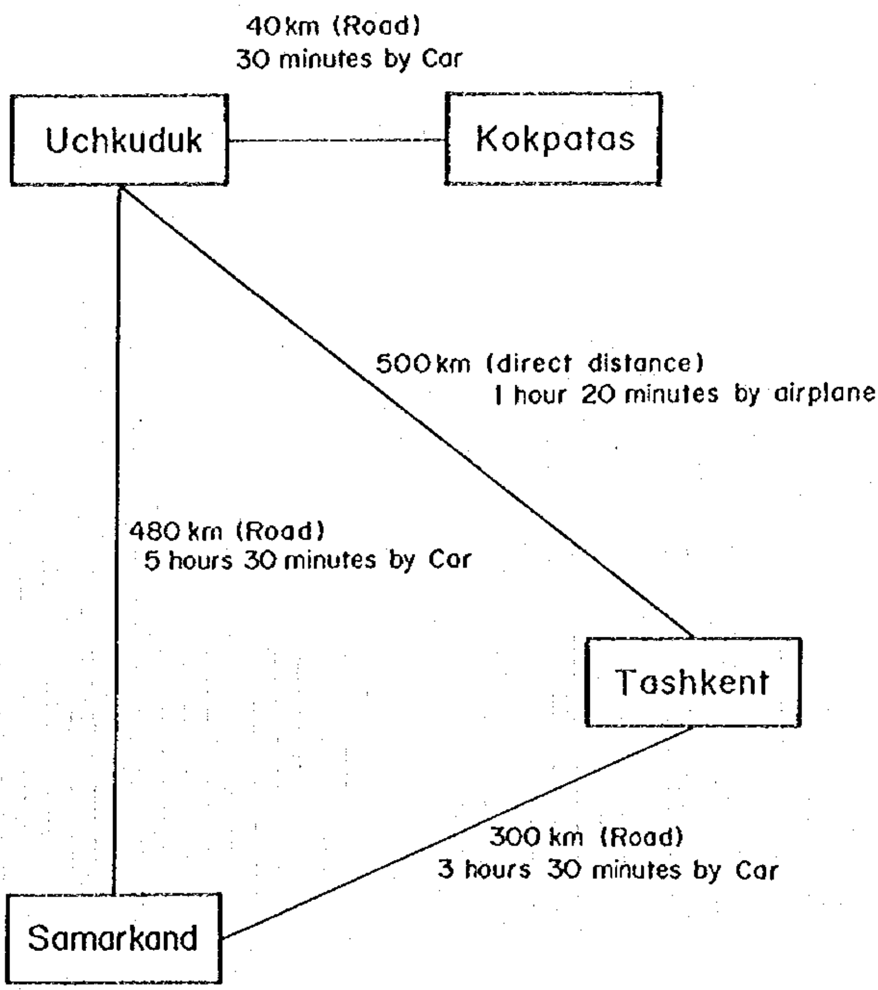


Fig. I −2 Accessibility of the Survey Area

СВОДКА

Настоящий отчет представляет собой сводку результатов геологоразведочных работ, проведенных в районе Восточного Букантау республики Узбекистана в течение 3 лет с 1994 г. по 1996 г. на основе Соглашения о сотрудничестве по оснвоным исследованиям для оказания помощи в разработке ресурсов. Целью этих работ - выяснить геологическое строение и рудоносность данного района и разработать направление дальнейших геологоразведочных работ, и тем самим оказать помощи исследованным странам в разработке ресурсов. Ниже дано содержание геологоразведочных работ, проведенных в каждом году.

Первый год:

Анализ изображений, полученных при помощи ИСЗ : 5.200 км2

Анализ существующих сведений и исследование методом "грандтурс" : 1.800 км2

Подсчет рудных запасов Саутбайского и Бургутского месторождений

Второй год:

Геологоразведочные работы Саутбайского и Булутканского районов : 170 км2

Саутбайский район:

Разведка бурением: 4 скважины, 1.509,9 км

Подсчет рудных запасов Сагынканского месторождения

Булутканский район:

Поиски канавами: 10 канав, 6.300 м

Геофизическая разведка: 10 линий по методу ТЕМ, 6 линий по методу TDIP

Разведка бурением : 7 скважин, 1.011,0 м

Третий год:

Саутбайский район:

Подсчет рудных запасов Саутбайского, Бургутского и

Сагынканского

месторождений

Геологическая разведка для составления плана разработки

Булутканский район:

Поиски канавами: 19 канав, 2.010 м

Геофизическая разведка: 13 линий по методу ТЕМ

Разведка бурением: 14 скважин, 2.119,0 м

Ниже дано описание результатов работ и предложения для геологоразведки, осуществляемой в будущем, по районам.

1) Все районы

(1) Месторожнения в районе Восточного Букантау классифицируются на нижеуказанных 7 групп по видам руды, типам месторождений и т.п.: ① жила с содержанием золота и кварца; ② жила с содержанием золота, серебра и кварца; ③ жила с содержанием золота, серебра, меди и кварца; ④ жила с содержанием серебра и кварца; ⑤ скарновое месторождение вольфрама; ⑥ месторождение вольфрама и кравцевых штокверков; ⑦ скарновое месторождение вольфрама и золота.

(2) Зона изменения, извлеченная на основе анализа изображений, полученных при помощи ИСЗ, может быть зоной с высоким содержанием окисленной железной руды, связанной с золотым оруденением в месторождении с высоким содержанием сульфидов. С другой стороны, в золоторудном месторождении с низким содержанием сульфидов плохо развивается окисленная железная руда. Следовательно, фотодешифрирование считается более пригодным для анализа геологического строения месторождений данного вида.

2) Саутбайский район

(1) Основным типом рудного месторождения является скарновое месторождение с содержанием вольфрама, организованное под действием гранодиоритом. В этом районе расположены Саутбайское, Бургутское и Сагынканское месторождения.

(2) Для Саутбайского, Бургутского и Сагынканского рудных месторождений был проведен подсчет рудных запасов, в результате чего, выяснено, что при бортовом содержании 0,05% (WO_3), рудные запасы составляют 25.257 тыс. тонн. Среднее содержание WO_3 составляет 0,27%, а запасы металла - приблизительно 69 тыс.тонн (WO_3). Среднее содержание Au составляет 0,15 г/т, а запасы металла - приблизительно 3,7 тонны. Содержание полезных ископаемых этих месторождений довольно ниже содержания вольфрамных месторождений скарнового типа, введенных в эксплуатацию в западных странах после 1980 г.

(3) В результате рассмотрения возможности, освоение Саутбайского, Бургутского и Сагынканского рудных месторождений оценивается трудным, судя по рентабельности, рассчитенной на основе содержания, запасов руды и котировки концентрата руды этих месторождений.

3) Булутканский район

(1) Настоящее месторождение представляет собой золотоносные кварцевые и окремненные жилы и скарновое тело. В данном районе известно Булутканское месторождение.

(2) Рудный столб Булутканского месторождения расположен на стыке разрывных нарушений, развитых в направлениях ЗСЗ-ВЮВ, СЗ-ЮВ и ВСВ-ЗСЗ, с горизонтом, содержащим в себе карбонатные породы. Верхняя часть рудного тела

представляет собой окремненную породу в сопровождении железной щляпы, мелкозернистой кварцевой породы и халцедона, а нижняя часть - скарновое тело с колчеданными породами, в котором отмечается золотое оруденение. Самородное золото организуется в кварцевых, кальцитных жилах, и отмечается в состоянии парагенезиса с графитом. Редко обнаруживается парагенезис самородного золота с колчеданными породами в амфиболо-пироксеновых скарнах, но оно не находится в колчеданных породах.

(3) В результате поисков канавами, у канавы Т-2, пробуренной в верхней части Булутканского рудного месторождежния, было отмечено развитое золотое оруденинние. Кроме того, обнаружены породы с содержанием Au выше 1 г/т в следующих 3 местах: у канавы Т-11; у канавы Т-28 и у канавы Т-29. В результате разведки канавами, обнаружено много окремненных или окисленных зон. Но из них мало зон с высоким содержанием Au.

(4) В результате разведки бурением, у скважины MJUB-7, пробуренной в нижней части Булутканского месторождения, обнаружены развитые окремненные золотоносные жилы и золотоносное скарновое тело. У скважины MJUB-1, пробуренной в продолжении нижней части Булутканского месторождения, была подтверждена зона с золотым оруденинием с небольшим содержанием золота. Кроме того, в западном продолжении Булутканского месторождения у скважин MJUB-8 и MJUB-9, также отмечено золотое оруденение. Кроме Булутканского месторождения, зона золотого оруденения с содержанием Au выше 1 г/т была обнаружена у скважин MUJB-3, MJUB-13, MJUB-17 и MJUB-18. Предполагается, что непрерывность и масштаб рудных месторождений Булутканского района невелики (длительностью 50-150 м, глубиной до 100 м).

(5) В результате геофизической разведки по методу TEM,

обнаружено прерывистое распространение зоны с значительно высоким удельным сопротивлением. Эта зона, имеющая вид с падением к северу, коррелируется в основном с участком с густым распространением диоритовой дайковой породы, окремненной зоны, кварцитовых и кварцевых жил, или с окремненной или скарнизированной метосамотической породой, и обладает почти всеми характеристиками породы этих видов.

(6) Температура гомогенизации включения жидкости кварцевой дайковой породы и кальцита составляет от 100°C до 378°C. У образцов, взятых из скарновой породы температура гомогенизации включения жидкости составляет 250°C-350°C, а у образцов с золотым оруденением - 150°C-250°C (В среднем она составляет приблизительно 200°C). Из вышеуказанного предполагается, что после высокотемпературной скарнизации, произошло золотое оруденение при более низкой температуре.

(7) По результатам подсчета, рудные запасы настоящего района составляют 275 тыс.т, содержание Au - 13,1 г/т, запасы золота - 3,6 т.

(8) Выбраны два участка, в том числе и Булутканское месторождение, и рассмотрена возможность освоения этих месторождений в небольшом масштабе по методу открытой разработки. Проведен подсчет на таких условиях, когда руда транспортируется до обогатительного завода №3 в Учкудук по железной дороге и обогащается по поручению, чтобы уменьшить капиталовложение в начале промышленного производства до минимума. Подсчет показывает, что при добыче 115 тыс.т. руды с промышленным содержанием Au 10,0 г/т за один год, обеспечивается прибыль в размере приблизительно 15.000 тыс. сом (300 тыс.долларов). При освоении, рекомендуется управлять данным месторождением в качестве вспомогательного рудника Кокпатасского

золоторудного месторождения.

Ниже даны предложения для геологоразведки, осуществляемой в будущем.

(1) В результате рассмотрения возможности освоения на основе подсчета рудных запасов, освоение Саутбайского месторождения оценивается трудным, с учетом содержания, рудных запасов и котировки концентрата руды данного месторождения. Если продолжить разведку, то можно ожидать увеличение рудных запасов, но значительное улучшение содержания WO3 не ожидается. Следовательно, рекомендуется прекратить разведку в Саутбайском районе и сохранить его в качестве запасного источника снабжения вольфрамными ресурсами в будущем.

(2) Выбраны два участка, в том числе и Булутканское месторождение, и рассмотрена возможность освоения этих месторождений. По результатам подсчета, при добыче 115 тыс. т. руды с промышленным содержанием Au 10,0 г/т за один год, обеспечивается прибыль в размере приблизительно 125 сом (2,5 доллара). Частичное освоение разбросанных месторождений считается возможным. С учетом возможности выявления месторождения в таком же масштабе, как Булутканское, в восточной части канавы T-6, желательно произвести поиски канавами, геофизическую разведку, разведку скважинами данного района, чтобы выяснить состояние минерализации.

Summary

This Report consolidates the results of survey implemented during the three years from FY1994(Phase I) to FY1996(Phase III) in the Eastern Bukantau Area of the Republic of Uzbekistan, under the Technical Cooperation for the Mineral Exploration. The survey was intended to clarify geological conditions and occurrence of ore deposits in the subject area, to provide the guiding principles for future exploration, to revalue the known ore deposits, and also to draw mining plans, thereby assisting the host country in the development of its mineral resources. The contents of the survey performed in the respective years are listed as follows:

Phase I : Satellite imagery analysis (5,200km²); analysis of existing data; and, ground truth (1,800km²).

Phase II : Geological survey in the Sautbay-Bulutkan districts.

Sautbay district - Drilling survey (4 holes; 1,509.9m); ore reserves estimation of the Saghinkan deposit.

Bulutkan district - Trenching survey (10 trenches ; 6,300m) ; geophysical survey (TEM method: 10 survey lines; and TDIP method: 6 survey lines); and, drilling survey(7 holes; 1,011.0m).

Phase III : Sautbay district - Ore reserves estimation and planning of mining operation of the Sautbay, Burgut and Saghinkan deposits.

Bulutkan district - Trenching survey(19 holes, 2,010m); geophysical survey(TEM method:13 survey lines); and, drilling survey(14 holes; 2,119.0m).

Results of these surveys and recommendations are summarized in the following paragraphs:

1) Whole area of survey

(1) Ore deposits and showings in the Eastern Bukantau Area are classified by types of minerals and ore deposits 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, and ⑦ Tungsten・gold・skarn deposit.

(2) The alteration zones extracted by the satellite imagery analysis are likely to correspond to iron oxidation zones, which are related to the high sulfide-type gold mineralization. For low sulfide-type gold deposits with weakly developed iron oxide zones, however, geological structure analysis by means of the photogeological interpretation seems to be better suited.

2) Sautbay district

(1) The major type of the ore deposit is the tungsten-bearing skarn deposit controlled by granodiorite, as represented by the Sautbay deposit, the main ore deposit in the district, as well as the nearby Burgut and Saghinkan deposits.

(2) Ore reserves estimates of the Sautbay, Butgut and Saghinkan deposits, at the cutoff grade of 0.05% WO_3, added up to 25,257,000t, averaging 0.27% WO_3 and 0.15 g/t Au, or approx. 69,000t of WO_3 and approx. 3.7t of Au in terms of metal content. The WO_3 grades of these ore deposits are lower than those of skarn-type tungsten mines operated in the Western countries since 1980.

(3) Feasibility study on the Sautbay, Burgut and Saghinkan deposits indicated that development of these deposits is considered economically unfeasible, under the current levels of the ore reserves, grade and WO_3 price.

3) Bulutkan district

(1) Ore deposits in this district mainly consist of gold-bearing quartz, silicified veins and skarn orebodies. The Bulutkan deposit is located in this district.

(2) The bonanzas of the Bulutkan deposit occur at intersections of the faults with the WNW-ESE, NW-SE and ENE-WSW trends and the horizon including carbonate rocks. The upper portion of the orebody is composed of silicified rocks accompanied by ferrous oxide, fine-grained quartz veins and chalcedony, while the lower portion comprises skarn orebodies associated with sulfide veins, which is accompanied by gold mineralization. Native gold occurs in quartz veins, calcite veins, and siderite veins, associated with graphite. Native gold is occasionally associated with sulfide minerals in skarns but has not been recognized in sulfide minerals.

(3) The trenching survey confirmed dominant gold mineralization at T-2 aimed to explore the upper portion of the Bulutkan deposit. Au grade of 1g/t or higher were confirmed also at T-11, T-28 and T-29. Many silicified and oxidized zones were confirmed by trenching but few of them showed high grade of Au.

(4) The drilling survey captured a prominent gold-bearing silicified vein and a gold-bearing skarn orebody at the hole MJUB-7, aimed at the lower part of the Bulutkan ore body. Also at the MJUB-1, aimed at an extension of the lower portion, a gold mineralization zone, though low in grade, was confirmed. The drilling survey aimed at the western extension of the Bulutkan orebody also resulted in discovery of gold mineralization at MJUB-8 and MJUB-9. The drillholes outside of the Bulutkan deposit, at which gold mineralization of Au 1 g/t or more was confirmed, were MJUB-3, MJUB-13, MJUB-17 and MJUB-18. Ore deposits in the Bulutkan district are presumed to be poor in continuity and small in size(extension 50-150m, depth up to 100m).

(5) The geophysical survey by the TEM method revealed that high resistivity zones, apparently inclined northward, are intermittently distributed at the zone of occurrence of Proterozoic along the northern periphery of the syenodiorite body. The high resistivity area corresponds mainly to zones of diorite dikes, silicified zones, portions where quartzite and quartz veins are densely concentrated, zones of silicified and skarnized metasomatites, etc., which embraces most of the major ore showings in this district.

(6) The fluid inclusions of quartz veins and calcite veins have homogenization temperatures ranging from 100℃ to 378℃. Samples taken from skarns or syenodiorite range from 250℃ to 350℃, while trenching samples with gold mineralization range from 150℃ to 250℃, generally around 200℃. These suggest that high-temperature skarnization was followed by lower temperature gold mineralization.

(7) Tentative calculation indicated that the ore reserves in the district are 275,000t, grading 13.1g/t Au(3.6t of Au content).

(8) Feasibility study was made on small-scale open-pit operation of two selected ore blocks including the Bulutkan deposit, on the assumptions that initial investment is minimized and the ore is transported to the Uchkuduk No.3 ore-dressing plant by rail, for toll-processing. A tentative calculation indicated that, if 115,000t of minable crude ore, grading 10.0 g/t Au, is mined out within one year, operating income of approx. 15 million sum (300,000$) would be gained. If the ore deposit is developed in reality, it should be operated as a subsidiary of the Kokpatas gold mine.

Recommendations may be summarized as follows:

(1) Feasibility study on development of the ore deposits in the Sautbay district based on the ore reserves estimation indicated that mine development in this district is considered to be economically unfeasible under the current levels of ore reserves, grade and WO_3 price. An increase in ore reserves by further exploration may be anticipated but a significant improvement in WO_3 grade is unlikely. It is advisable, therefore, to suspend exploration in this district and to reserve the district as a potential supply source of tungsten resources for the future.

(2) Two ore blocks, including the Bulutkan deposit, were extracted for the tentative feasibility study for development. The study indicates that if 115,000t of minable crude ore, grading 10.0 g/t, is mined out within a period of one year, it would generate operating profit of 125 sum(2.50$) per ton of crude ore. Partial(selective) development of other ore deposits scattered around in the district is considered feasible. As there remains certain possibility for discovery of small ore deposits of a Bulutkan-class in the area east of the trench T-6, it is recommended to carry out further trenching, geophysical and drilling surveys, to ascertain mineralization in the area.

CONTENTS

PART I GENERALITIES

PART II PARTICULARS

PART III CONCLUSIONS AND RECOMMENDATIONS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

PART I GENERALITIES

Chapter 1 Summary of the Surveys

1-1 Survey Area and Purpose of Survey

The Eastern Bukantau Area is located southeast of the Bukantau range of hills in the Central Kizil-kum Desert. In administrative division terms, the area constitutes a part of Uchkuduk District of Navoi Region. The survey area covers an area of 5,200km², defined by the following latitudes and longitudes:

(lat. 42° 30'N and long. 63° 19'E) (lat. 42° 30'N and long. 64° 24'E)

(lat. 41° 55'N and long. 63° 19'E) (lat. 41° 55'N and long. 64° 24'E)

The subject survey of mineral resources in the Eastern Bukantau Area of the Republic of Uzbekistan was conducted by the Japanese Government to comply with the request of the Uzbek Government, in conformity to the Scope of Work agreed to between the two governments on August 10, 1994.

The survey was intended to clarify the geological conditions and mineral resources in the mentioned area, to provide the guiding principles for exploration and to revaluate the known ore deposits, thereby helping development of the mineral industry of the host country. It was also aimed to promote technological transfer to the host nation's organizations through the collaborative survey.

1-2 Survey Methods and Quantities

The survey was conducted for three years starting from the FY1994. The survey methods employed in the respective years are shown in Fig.I-1-1, while the work quantities by survey method are recorded in Table I-1-1. Extraction of areas which have potentialities of occurrence of promising ore deposits were made as shown in Fig. I-1-2.

The Phase I survey comprised the satellite imagery analysis covering an area of 5,200km², collection and analysis of mineral resources-related data and the ground truth over 1,800km² in the selected districts within the designated area of survey.

The Phase II survey consisted of geological survey over an area of 170km² at the Sautbay-Bulutkan district and drilling survey at the Sautbay district (4 drillholes totaling

1,509.9m), as well as trenching survey (10 trenches totaling 6,300m), geophysical survey over 1.8km² and drilling survey (7 drillholes totaling 1,011.0m) at the Bulutkan district.

As regards the Saghinkan deposit adjacent to the northwest part of the Sautbay deposit in the survey area, ore reserves estimation was made for revaluation of the ore deposit.

The Phase III survey, performed on the basis of the Phase II survey findings and recommendations, consisted of the trenching survey(19 trenches, totaling 2,010m), the geophysical survey(TEM method; 13 survey lines) and the drilling survey(14 drillholes, totaling 2,119.0m), at the Bulutkan district. In addition, ore reserves estimation and mining plans were made respectively for the Sautbay, Burgut and Saghinkan deposits, for revaluation purpose.

Table I-1-1 Methods and Contents of the Survey

	Phase I (1994)	Phase II (1995)			Phase III (1996)		Total (1994–1996)
	Whole area	Sautbay-Bulutkan	Sautbay	Bulutkan	Sautbay	Bulutkan	
Satellite imagery analysis(km²)	5,200						5,200
Ground truth(km²)	1,800						1,800
Geological survey(km²)		170					170
Length of route(km)		94.8					94.8
Trenching survey							
Number of lines(line)				10		19	29
Length of trenching(m)				6,300		2,010	8,310
Geophysical survey							
TEM method :							
Number of lines(line)				10		13	23
Total length(km)				10		6.4	16.4
TDIP method :							
Number of lines(line)				6			6
Total length(km)				6			6
Drilling survey							
Number of drill holes(hole)			4	7		14	25
Length of drilling(m)			1,509.9	1,011.0		2,119.0	4,639.9
Laboratory studies							
Thin section(pcs)	11	10	12	46		40	119
Polished section(pcs)	10		14	53		36	113
Whole rock analysis	35						35
Chemical analysis							
Rock(pcs)		91		813			904
Ore assay(pcs)	45	30	200	813		1,214	2,302
X-ray diffraction analysis(pcs)	16		3	62		50	131
Fluid inclusion(pcs)			2	52		35	89
Resistivity and chargeability test				40			40
Planning of mining development(plan)					1	1	2

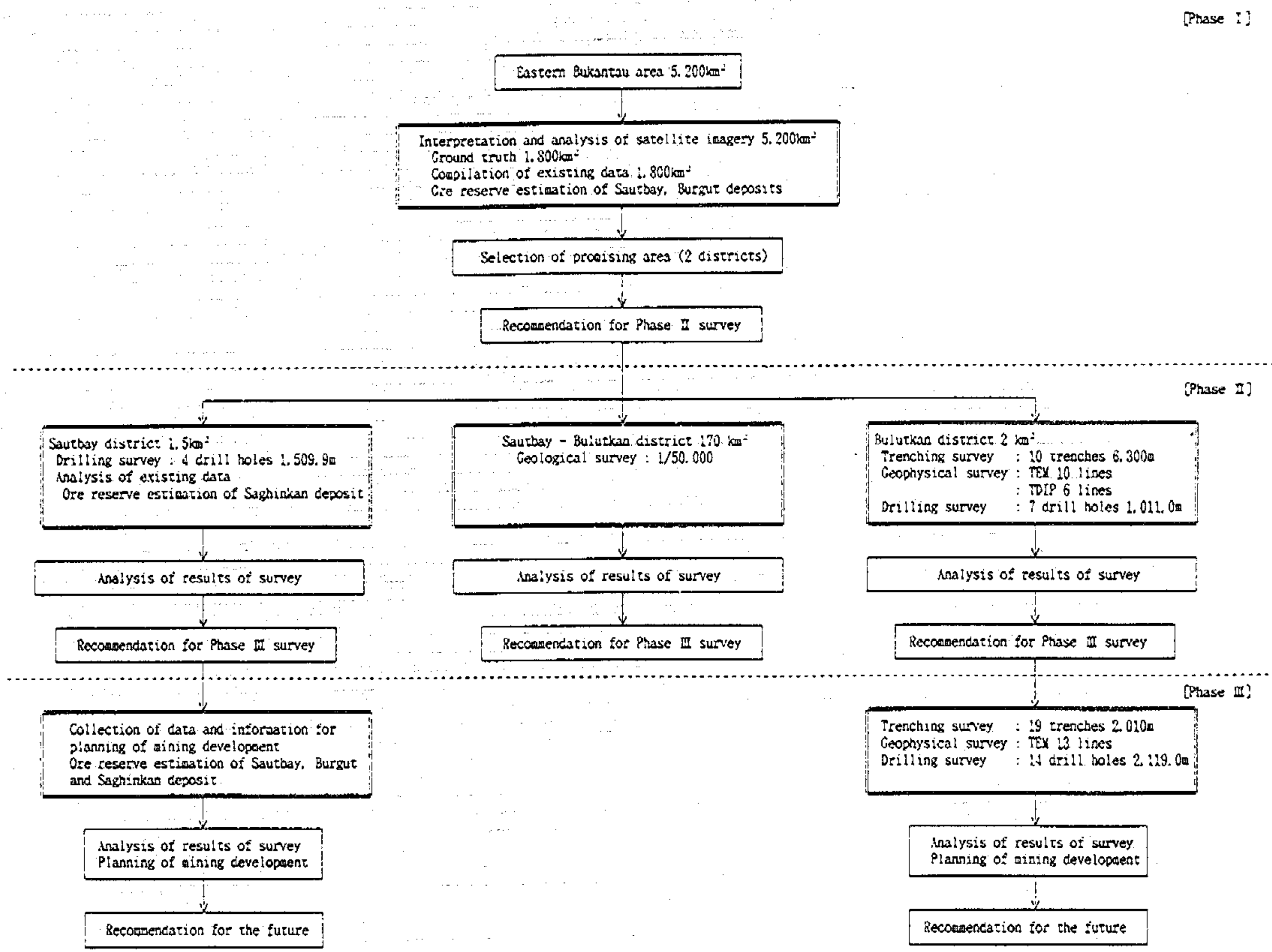


Fig. I-1-1 Flow sheet of the survey

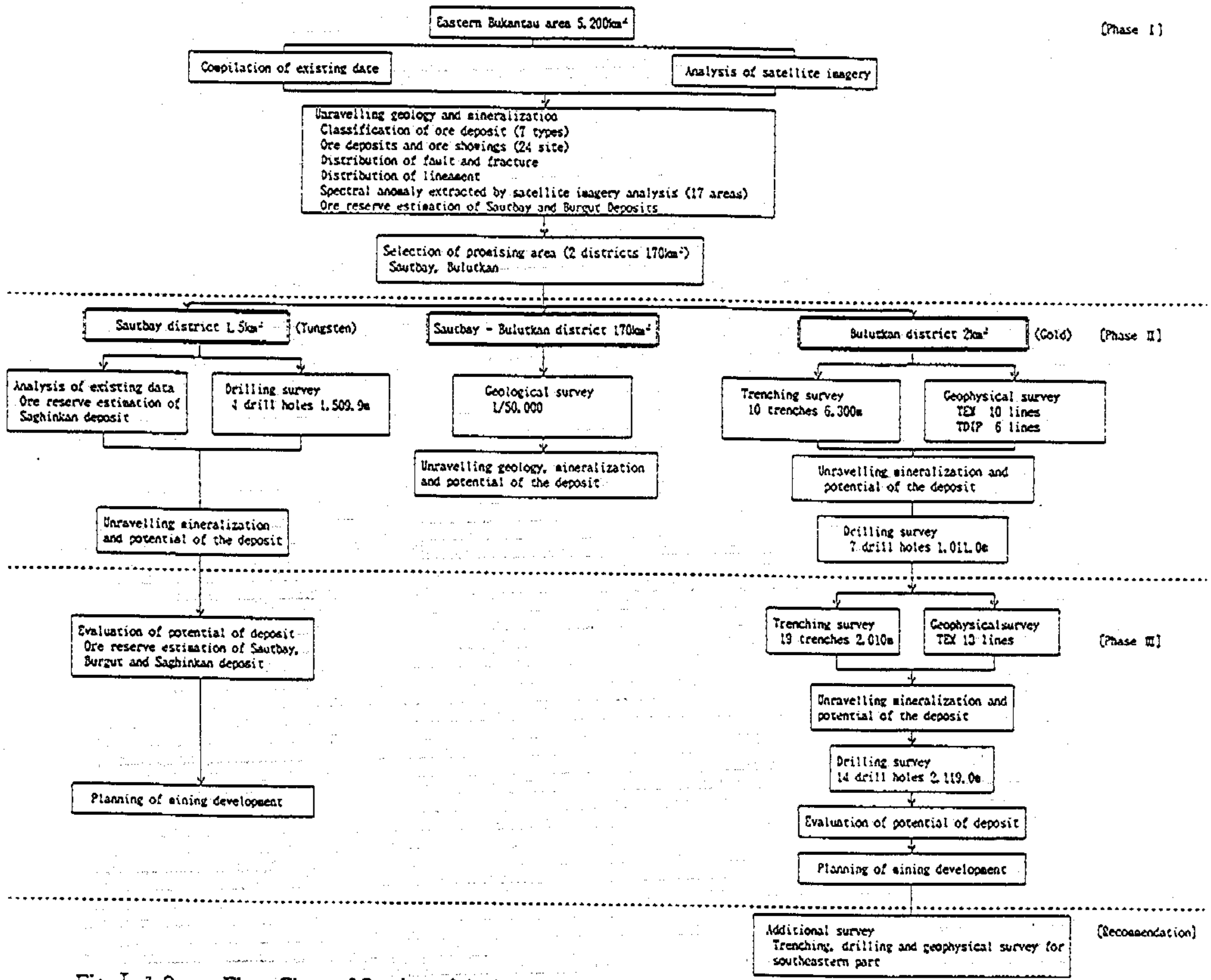


Fig. I -1-2 Flow Chart of Section of the Promising Area

1-3 Period of Survey and Suevey Team

The period of the field suvey and analytical work are shown in Table I-1-2, and Table I-1-3 indicates the members of the survey team.

Table I-1-2 Period of the Survey

Phase	Period of Field Survey	Period of Analysis
Phase I	Nov. 28, 1994 ~ Feb. 17,1995	Jan. 20, 1995 ~ Feb. 28, 1995
Phase II	July 9, 1995 ~ Dec. 23, 1995	Dec. 24, 1995 ~ Feb. 29,1996
Phase III	June 17, 1996 ~ Nov. 2, 1996	Nov. 3, 1996 ~ Feb. 28, 1997

Table I-1-3 Members of the Survey Team(1)

(Planning and negotiation)

Japan		Uzbekistan	
Name	Entity	Name	Entity
(Phase I)		(Phase I)	
Jiro Osako	MMAJ	H. S. Islamkhodjaev	MFER
Kenichi Takahashi	JACA	Remir V. Tsoi	SCG
Taro Kamiya	MMAJ	A. L. Ogarkov	〃
		J. R. Karimov	〃
		A. T. Zakirov	SKG
(Phase II)		(Phase II)	
Junichi Tominaga	MMAJ	Remir V. Tsoi	SCG
Hirofumi Ono	〃	A. L. Ogarkov	〃
		J. R. Karimov	〃
		N. A. Akhmedov	SKG
		A. T. Zakirov	〃
(Phase III)		(Phase III)	
Junichi Tominaga	MMAJ	Remir V. Tsoi	SCG
Hirofumi Ono	〃	A. L. Ogarkov	〃
Tohru Nawata	JICA	N. A. Akhmedov	SKG
		A. T. Zakirov	〃

JICA : Japan International Cooperation Agency
MMAJ : Metal Mining Agency of Japan
MFER : Ministry of Foreign Economic Relations
SCG : State Committee of Geology and Mineral Reserves
SKG : Samarkandgeology

Table I-1-3 Members of the Survey Team(2)

(Survey team)

Japan		Uzbekistan	
Name	Entity	Name	Entity
(Phase I)		(Phase I)	
Katsuji Fukumoto(Leader)	MINDECO	Remir V.Tsoi(Coodinator)	SCG
Osamu Miyaishi(Geologist)	〃	J.R.Karimov(Coodinator)	〃
Yin Jianhua(Geologist)	〃	S.Musaev(Coodinator)	〃
Manabu Kobayashi(Geophysist)	〃	A.L.Ogarkov(Geologist)	〃
		N.E.Kozarez(Geologist)	〃
		V.N.Ushakov(Geologist)	〃
		A.T.Zakirov(Geologist)	SKG
		V.F.Gbizdon(Geologist)	KE
		Lev.A.Sim(Geophysist)	SCG
		A.A.Horsov(Geophysist)	〃
		V.D.Bravichev(Technical engineer)	〃
(Phase II)		(Phase II)	
Katsuji Fukumoto(Leader)	MINDECO	Remir V.Tsoi(Coodinator)	SCG
Haruo Harada(Geologist)	〃	N.A.Akhmedov(Coodinator)	SKG
Nobuhiko Yamamoto (Drilling engineer)	〃	J.R.Karimov(Coodinator)	SCG
		A.L.Ogarkov(Geologist)	〃
Kazuhiko Kinoshita(Geophysist)	〃	N.E.Kozarez(Geologist)	〃
Mitsuyoshi Saito(Geophysist)	〃	A.T.Zakirov(Geologist)	SKG
Masaki Kinemuchi(Geophysist)	〃	V.F.Gbizdon(Geologist)	KE
		Lev.A.Sim(Geophysist)	SCG
		A.A.Horsov(Geophysist)	〃
		I.Shaimardanov(Technical engineer)	〃
		V.S.Protopopov(Technical engineer)	KE
(Phase III)		(Phase III)	
Katsuji Fukumoto(Leader)	MINDECO	Remir V.Tsoi(Coodinator)	SCG
Akimitsu Takebe(Geologist)	〃	N.A.Akhmedov(Coodinator)	SKG
Hirotaro Fujii(Mining Engineer)	〃	A.A.Akramov(Coodinator)	KE
Kazuhiko Kinoshita(Geophysist)	〃	F.M.Bayazitova(Coodinator)	SCG
Nobuhiko Shiga(Geophysist)	〃	A.L.Ogarkov(Geologist)	〃
Yoshiaki Ogawa(Geophysist)	〃	N.E.Kozarez(Geologist)	〃
		E.Tarasov(Geologist)	〃
		A.T.Zakirov (Geologist)	SKG
		V.F.Gbizdon (Geologist)	KE
		Lev.A.Sim(Geophysist)	SCG
		A.A.Horsov(Geophysist)	〃
		I.Shaimardanov(Technical engineer)	〃
		V.S.Protopopov(Technical engineer)	KE

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

Chapter 2 Antecedents of the Survey

2-1 Geological Survey

In the Eastern Bukantau area, many geological and ore deposit surveys have been undertaken since 1939 to date. Table I-2-1 indicates methods employed for principal surveys while the survey areas are indicated in Fig. I-2-1. The survey methods include the surface gological survey, trenching survey, geochemcal survey(rock and mercury), drilling survey of known ore deposits and ore showings such as mapping drilling, coreless drilling and coring drilling, prospecting shaft sinking and tunneling. Prospecting activities have been concentrated especially on the Sautbay deposit(W), and on the adjoining Burgut deposit(W), the Sarytau deposit(W), the Turbay deposit(Au) and the Okjetpes deposit(Ag).

2-2 Geophysical Survey

Geophysical surveys have many times been conducted in the Eastern Bukantau area since 1958. The mainly used survey methods and the dates of surveys are listed in Table I-2-2 while Fig. I-2-2 shows the areas of survey. The survey methods were mainly magnetic survey and gravity survey, and also electrical survey such as self-potential(SP), direct current resistivity(DC), induced polarization(IP) and electromagnetics(EM), as well as gamma-ray, seismic and geoelectrochemical studies. The data obtained by respective surveys were kept at various places but, in the 1990's, they were compiled into two overall reports, one of which is A. A. Horsov's study of the area centering around the Kokpatas deposit further west of the subject survey area, while the other is A. P. Cheshuin's work completed in 1994 concerning the area centering around the Sautbay(W), Turbay(Au) and Sarytau(W) deposits, which covers most of the subject survey area.

Table I -2-1 Existing 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 1970-74	Geochemical Survey Geologic Survey & Prospecting	East of Kokpatas East of Kokpatas	1:50,000 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

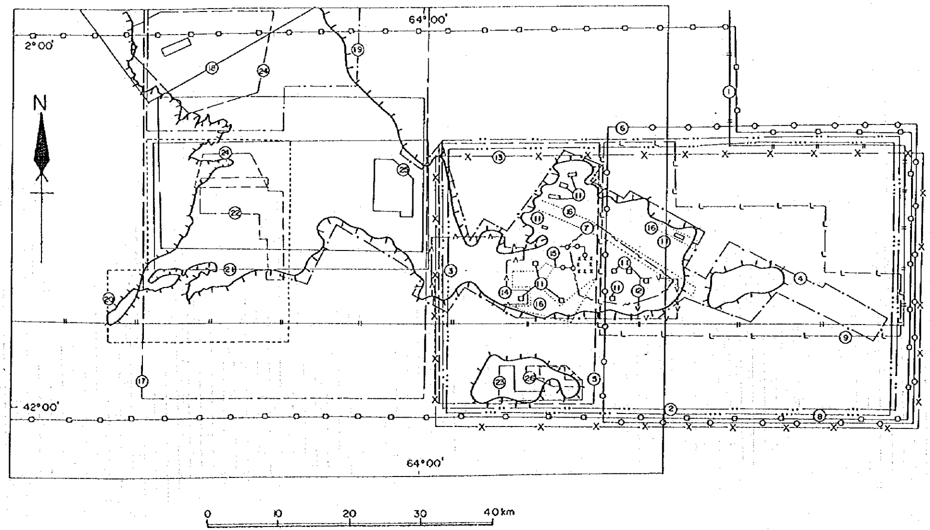


Fig. I -2-1 Area of Existing Geological Data

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	Various 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	1961	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

Table I-2-2 Geophysical Survey History in the Eastern Bukantau Area

Survey No.	Surveyed Year	Survey Method	Survey Scale
1	1960-1964 1964	airborne magnetic survey	1:50,000 1:25,000
2	1964-1965	airborne magnetic survey	1:25,000
3	1965	seismic prospecting	1:100,000
4	1967-1968	seismic prospecting	1:100,000
5	1969-1970	airborne gamma ray survey	1:25,000
6	1970-1974 1974	magnetic survey, SP survey geochemical survey	1:50,000 1:2,500
7	1971-1972	seismic survey	1:50,000
8	1971-1974	gravity survey	1:50,000
9	1972	airborne gamma ray survey, magnetic survey	1:25,000
10	1972-1973 1974	gamma ray survey, geochemical survey gamma ray survey, geochemical survey	1:50,000 1:25,000、 1:10,000
11	1974-1976 1977	electric survey(IP,SP), gamma ray survey, geochemical survey ditto(precise survey)	1:50,000 1:50,000
12	1977-1982 1983	electric survey(IP,SP) ditto(precise survey)	1:50,000 1:25,000、 1:10,000
13	1981-1983 1983	magnetic survey, electric survey(SP) ditto	1:25,000 1:10,000
14	1982-1983 1984	electric survey(EM) ditto	1:50,000 1:25,000
15	1983-1984	airborne geophysical survey(magnetic, electro-magnetic,gamma ray)	1:50,000
16	1988-1989	electric survey(EM)	1:25,000
17	1988-1989	magnetic survey	1:5,000
18	1984-1989 1989	gravity survey, magnetic survey ditto	1:25,000 1:10,000
19	1988-1989	geoelectoro-chemical survey	

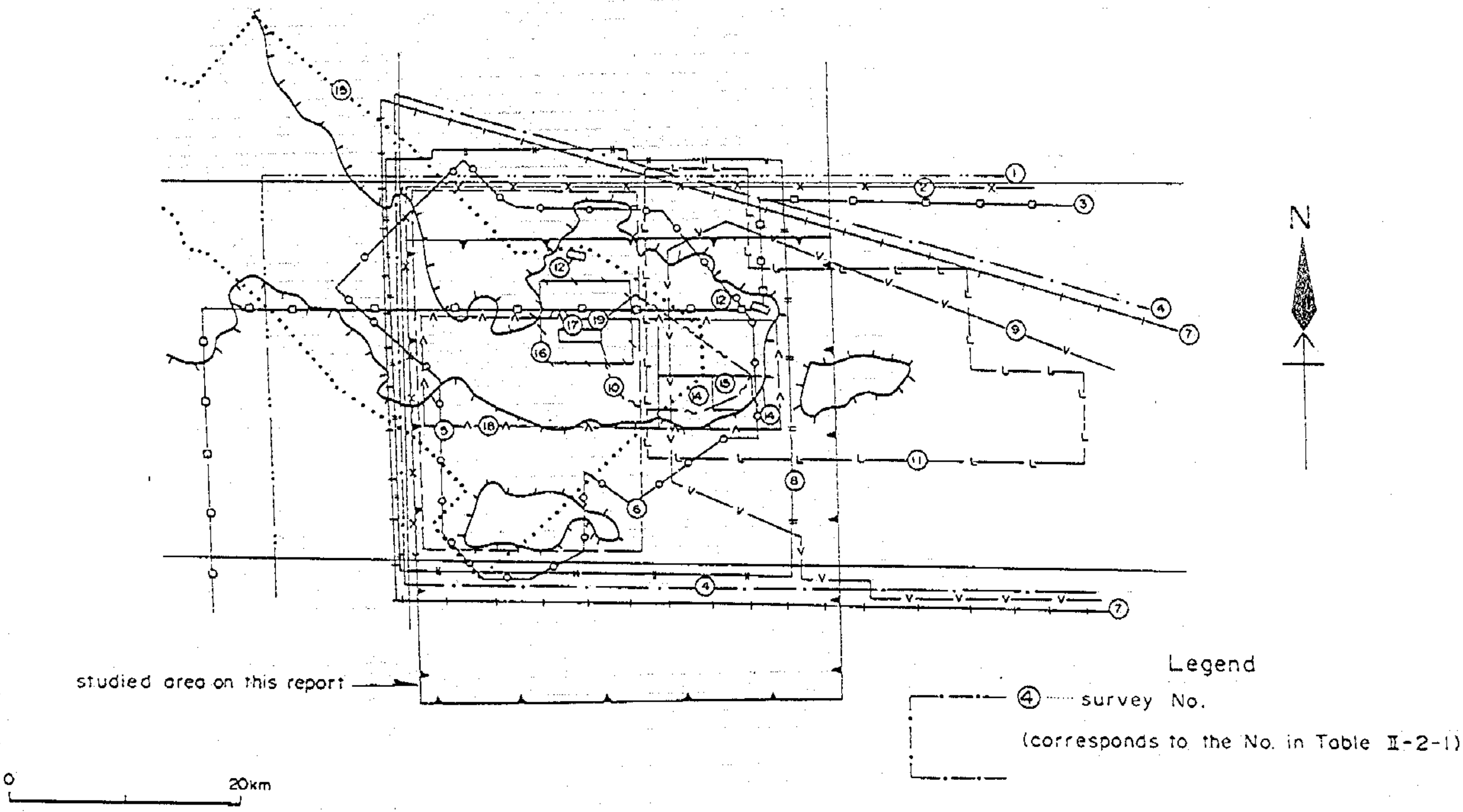


Fig. I-2-2 Geophysical Survey Coverage of the Eastern Bukantau Area

Chapter 3 Geological Outline

The geology of the Eastern Bukantau Area is composed of the basement formations of Proterozoic Ripheian ~ Vendian Systems which underwent Hercynian(Late Paleozoic) folding, and the strata of Paleozoic, Mesozoic and Cenozoic which overlie the basement formations unconformably. Granitic rocks and dikes of Late Carboniferous ~ Early Permian intrude into the strata of Proterozoic and Paleozoic (Fig. I-3-1,2).

(1) Proterozoic

The Proterozoic, composed of schists, quartzite, limestone, dolomite, slate, sandstone, etc., is divided into the four formations: Karashakh, Kokpatas, Khodjaakhmet, and Koksai Formations in ascending order. The overall thickness of the formations is presumed to exceed 3,000m. The Kokpatas and Karashakh Formations are the principal host rocks for occurrence of tungsten skarn deposits and auriferous-argentiferous quartz vein-metasomatite deposits.

(2) Paleozoic

The Paleozoic consists of the Silurian, Devonian and Carboniferous ages. Silurian rocks occur in a narrow area southeast of Okjetpes, consisting of alternation of shale and sandstone. Middle Devonian to Lower Carboniferous rocks occur mainly in the north of Kokpatas, and in Okjetpes, consisting mainly of limestone and dolomite. Continental sedimentary rocks of Middle Carboniferous age occur on the flanks of the Kokpatas Antiform, consisting of shale, sandstone, schist and phyllite. The overall thickness of the Paleozoic rocks are estimated to be more than 1,200m. The Devonian-Carboniferous host auriferous-argentiferous quartz veins.

(3) Cretaceous to Quarternary

Overlying discordantly the Proterozoic and Paleozoic formations, the Cretaceous, Tertiary and Quaternary occur broadly in the survey area. The Cretaceous ~ Eocene of Palaeogene age are the marine sediments of mudstone, sandstone, dolomite and conglomerate, whilst Oligocene of Palaeogene age ~ Quaternary are the continental sediments of silt, sand, gravel and gypsum.

(4) Intrusive rocks

Stocks and dikes of granodiorite, syenodiorite, aplite, diorite, lamprophyre and porphyrite of the Late Carboniferous ~ Early Permian intrude into the Proterozoic and Paleozoic.

(5) Geological structure

The geological structure of the Eastern Bukantau Area is characterized by an overthrust by which the strata of Paleozoic is overlain by the Proterozoic, and by complex overfolding of Proterozoic age. Especially, the Kokpatas Antiform extending from Kokpatas to Okjetpes represents geological structure which chatacterizes the western part of the survey area. The axis of Kokpatas Antiform is extending in NNW-SSE direction. A series of Lower Devonian to Carboniferous are exposed under the Proterozoic in the axis as a window.

In the Proterozoic and the intrusive rocks in the area, faults in the WNW-ESE directions are the most prominent, followed by those in the NE-SW and NNW-SSE directions.

In terms of the direction of folding and the strike of strata, those in the WNW-ESE directions are prominent, which is almost in parallel with the mentioned principal faults.

(6) Ore deposits

The Eastern Bukantau metallogenic zones are characteristic of tungsten and gold-silver mineralization accompanied by copper and molybdenum. At the early and latest stages of Hercynian orogeny, batholithic granitic magmatism took place in the area, where auriferous-argentiferous quartz veins, tungsten-quartz veins and tungsten skarn deposits were formed, accompanying the thermal metamorphism. Wide-spread occurrence of tungsten deposits and showings strongly characterizes the Eastern Bukantau Area.

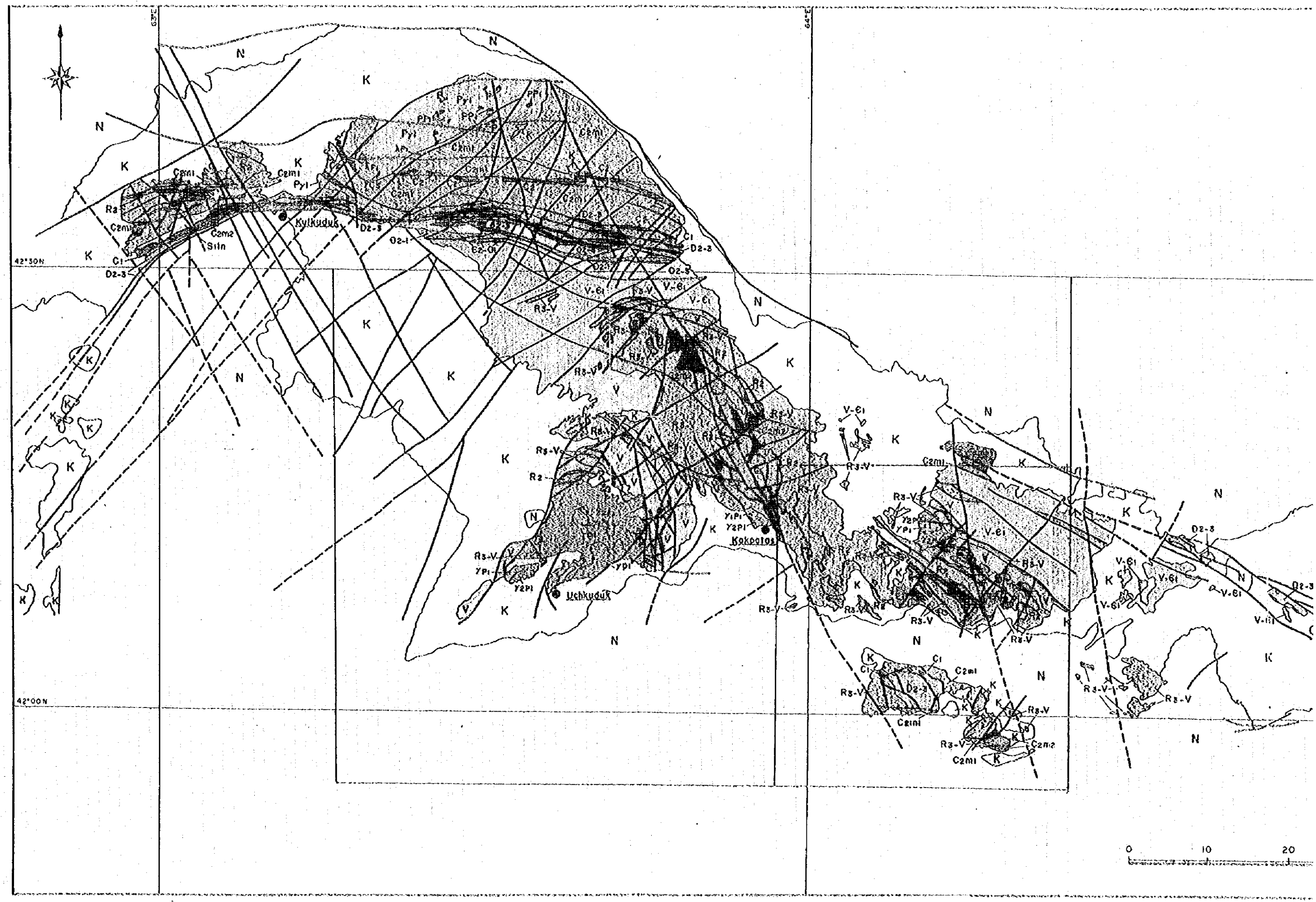


Fig. I -3-1 Geological Map of the Bukantau Region

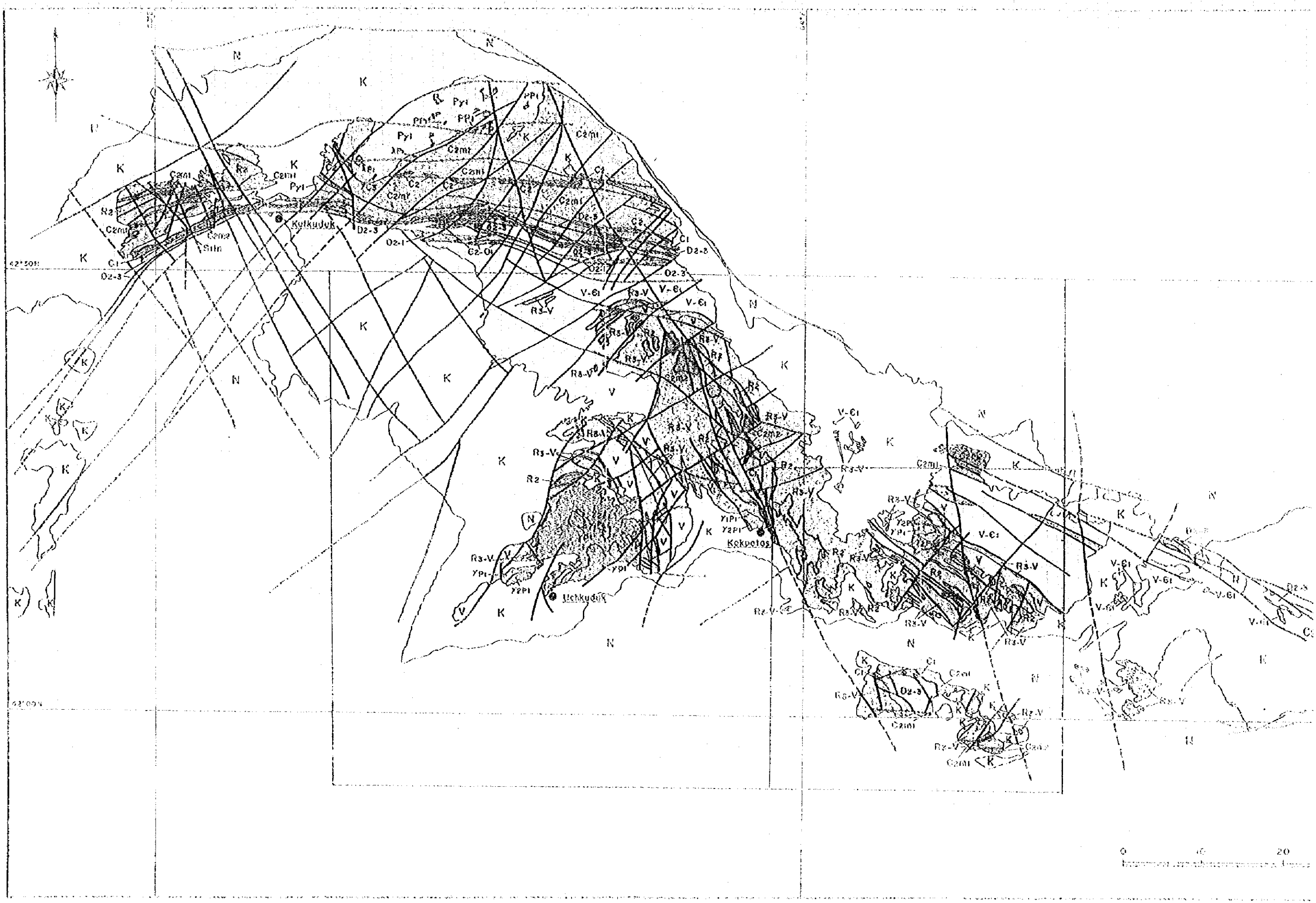
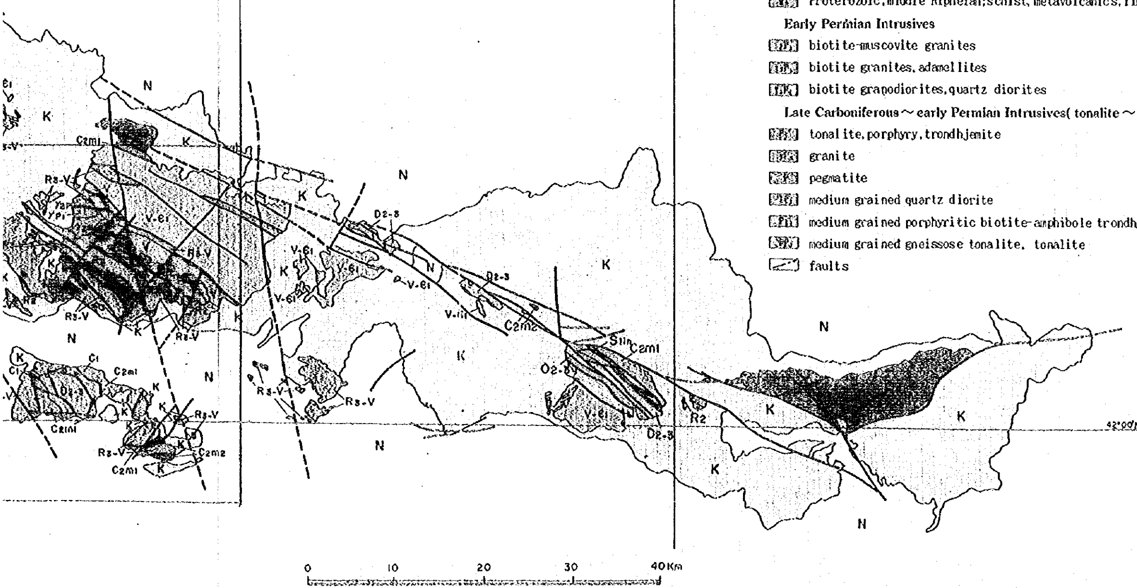


Fig. I -3-1 Geological Map of the Bukantau Region



LEGEND

Sedimentary ~ Metamorphic Rocks

- Cenozoic; conglomeates, sandstones, mudstones
- Cretaceous; sandstones, mudstones, clays, dolomites, conglomerates
- upper Carboniferous; shales, sandstones, conglomerates, limestones, andesitic rocks
- middle Carboniferous; basalts, andesites, rhyolites
- middle Carboniferous; shales, sandstones, conglomerates, cherts, limestones
- lower Carboniferous; limestones, shales, dolomites
- middle~upper Devonian; limestones
- lower Silurian; limestones, sandstones, shales, quartzites, conglomerates, andesitic~dacitic pyroclastics
- middle Ordovician; slates, shales, sandstones, conglomerates, acidic~intermediate pyroclastics
- middle Ordovician; slates, shales, sandstones, quartzites
- upper Cambrian~lower Ordovician; limestones, slates, shales, sandstones, quartzites
- Proterozoic, Vend~lower Cambrian; sandstones and shales, schists, limestones (Koksai formation)
- Proterozoic, Vend; shales, sandstones, limestones, schists (Khodjaakhmet formation)
- Proterozoic, upper Ripheian~Vend; cherts, shales, marls, quartzites, schistslimestones (Kokpatas formation)
- Proterozoic, middle Ripheian; schist, metavolcanics, limestones (Karashakh formation)

Early Permian Intrusives

- biotite-muscovite granites
- biotite granites, adamellites
- biotite granodiorites, quartz diorites

Late Carboniferous ~ early Permian Intrusives(tonalite ~ trondhjemite)

- tonalite, porphyry, trondhjemite
- granite
- pegmatite
- medium grained quartz diorite
- medium grained porphyritic biotite-amphibole trondhjemite
- medium grained gneissose tonalite, tonalite
- faults

(after JMEC, 1994)

Age			Formation	Thickness (m)	Geologic Column	Lithology
Cenozoic	Quaternary			<160		calcareous conglomerate
Cenozoic	Tertiary	Neogene Paleogene		<800		mudstones red sandstones conglomerates
Mesozoic	Cretaceous			<600		mudstones sandstones conglomerates
Paleozoic	Carboniferous	late	Saradar	50~100		sandstones,conglomerates
Paleozoic	Carboniferous	middle	Bostau	>200		basalts, andesites, rhyolite shales-sandstones
Paleozoic	Carboniferous	early	Okjetpes	>1,200		limestones sandstones shales dolomites cherts
Paleozoic	Devonian					limestones
Paleozoic	Ordovician		Lupek			shales,sandstones acidic ~ intermediate pyroclastics
Paleozoic	Cambrian		Koksai	>300		alternations of shales and sandstones schists limestones
Proterozoic	Vendian		Khodjaakhmet	>500		shales,sandstones limestones,schists
Proterozoic	Riphean	end ~ late	Kokpatas	>1,500		cherts, shales, dolomites marls,quartzites, schists sandstones limestones schists,limestones metavolcanics
Proterozoic	Riphean	middle	Karashakh (Cholcharatau)	600		

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

Chapter 4 Outline of the Survey Area

4-1 Location and Accessibility

The Eastern Bukantau Area is located southeast of the Bukantau range of hills in the Central Kizil-kum Desert, some 500km in straight-line distance northwest of Tashkent, the national capital. In administrative division terms, the area constitutes a part of Uchkuduk District of Navoi Region.

Some 30 km west of the city of Uchkuduk, the largest population center in the area, the Kokpatas Expedition, pop.1200, is placed, which is accessible from Uchkuduk by about 30-minute car ride via an unasphalted road.

Some 80km southeast of the area, Zarafshan city is located; 28km east of Zarafshan, there is the Muruntau gold mine and the gold extraction complex for treatment of the Muruntau ore.

Tashkent and Uchukduk are connected by three air-flights a week. The flight takes about 80 minutes. A road from Tashkent to Kokpatas via Samarkand, the ancient capital, has an extension of about 820km, some 10 hours by car (Fig. I-2).

4-2 Topography and Drainage Systems

The Bukantau Range is a narrow range of hills, 230km long and 30-50km wide, protruding through the Kizil-Kum Desert in the WNW-ESE direction. The highest point, alt. 750m above sea level, is located near Kulkuduk in the western side of the range. The altitude of the range diminishes eastward. The Sautbay deposit area, alt. 200-300m, is located in the east side of the range, having gently undulating topography.

The area has no water system with constant flow of water but there are a number of dried stream beds where water flow is seen only when it rains in spring or fall. The water systems represent dendritic or parallel patterns stretching in the NNE direction.

4-3 Climate and Vegetation

The area has the typically continental climate, characterized by dry, hot summer and windy, cold winter. The annual average temperature is 14.7℃. The monthly average temperature comes to the lowest, -1.2℃, in January when the minimum temperature of -

30℃ has been recorded. July is the hottest month when the temperature is 31.3℃ in average and 45℃ at the maximum.

The annual average precipitation is 118mm whereas the humidity varies widely between 18% and 74%.

Northeasterly winds are dominant, with occasional northwesterly and southerly. The annual average wind speed is 6m per second while the maximum is 35m. Sand storms are frequent.

Owing to the desert climate, the area has unique vegetation. In a hilly area covered by earth and sand, a variety of annual and perennial grasses flourish, as well as mushrooms in springtime, whilst various deep-rooted shrubs are observed on flatland covered by aeolian sand.

Chapter 5 Conclusions and Recommendations

5-1 Conclusions

1) Whole area of survey

(1) Geology of the Eastern Bukantau Area is composed of the basement formation of Ripheian to Vendian ages of the Proterozoic, which underwent Hercynian(Late Paleozoic) folding, and the strata of Paleozoic, Mesozoic and Cenozoic ages which unconformably overlie the basement formation. Granitic rocks and dikes mainly of Late Carboniferous to Early Permian intrude into the Proterozoic and Paleozoic.

(2) In the Eastern Bukantau Area, ore deposits and showings of tungsten, gold, silver and copper occur, which are classified by types of minerals and ore deposits 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, and ⑦ Tungsten・gold・skarn deposit.

Ore deposits in the area are hosted in the Karashakh Formation and the Kokpatas Formation of Proterozoic age and in the Devonian to Carboniferous, and mineralization is related with the granitic intrusion of Late Carboniferous to Early Permian and also with the faults and fractures with the WNW-ESE, NE-SW and NNW-SSE trends.

(3) In the light of the field survey findings, the alteration zones extracted by the satellite imagery analysis may possibly correspond to iron oxidation zones, which are related to the high-sulfide type gold mineralization. For gold deposits of this type, the method of extraction of iron oxide minerals around the ore deposits by spectral analysis of satellite images is considered effective.

2) Sautbay district

(1) The Karashakh Formation and the Kokpatas Formation, of Proterozoic, occur in the Sautbay district. Stocks and dikes of the Late Carboniferous ~ Early Permian granodiorite, aplite, diorite, lamprophyre, etc. intrude into the Proterozoic.

The major type of the ore deposit is the tungsten-bearing skarn-type deposit controlled by intrusion of granodiorite, as represented by the Sautbay deposit which is the main ore deposit in the district, as well as the nearby Burgut and Saghinkan deposits.

(2) The drilling survey by four drillholes aimed at the Sautbay deposit resulted in capturing a skarn ore body of more than 2m in true width, grading 0.30% WO_3 or more, at the drillholes Nos. 3 and 4. Consequently, it was ascertained that mineralization of the skarn orebodies including the main orebody No.1 continues up to about 400m below the surface, thereby strengthening the possibility of the mineralization continuing further downward and south-southeastward.

(3) Ore reserves of the Sautbay, Butgut and Saghinkan deposits were estimated, to revaluate these deposits. As the result, the total ore reserves of the Sautbay, Burgut and Saghinkan deposits, at the cutoff grade of 0.05% WO_3, add up to 25,257,000t, averaging 0.27% WO_3 and 0.15 g/t Au, or approx. 69,000t of WO_3 and approx. 3.7t of Au in terms of metal content. The WO_3 grades of these ore deposits are lower than those of skarn-type tungsten mines operated since 1980 in the Western countries.

(4) Feasibility for development of the Sautbay, Burgut and Saghinkan deposits was studied. Since separate development of these ore deposits is difficult due to the small minable ore reserves and low grades, the combined mining operation of plural deposits was pursued. Operation is optimized by combining 700-tpd openpitting of the portions over +100m(above sea level) of the Sautbay deposit for the 6.6-year operation, with 800-tpd underground mining of the Burgut deposit for the 10-year operation.

However, even the optimized operation would leave accumulated deficits of 30 million sum(600,000$) as against the initial investment of about 2 billion sum(40 million$). The estimation was based on the assumptions that the entire investment is catered for by own funds while no escalation of labor and materials expenses nor costs for equipment replacement, mine closure and taxes are considered.

Due to the lack of profitablity even under such exceptionally favorbale conditions, development of the tungsten deposits in the Sautbay district is considered economically unfeasible, under the current levels of the ore reserves, grade and WO_3 price.

3) Bulutkan district

(1) The Kokpatas Formation of the Proterozoic occurs in the Bulutkan district, where stocks and dikes of the Late Carboniferous ~ Early Permian syenodiorite, diorite, granite, porphyrite, lamprophyre, etc. intrude into the formation. The directions of faults dominant in this district are NW-SE ~ E-W and NNW-SSE trends. Ore deposits consist of gold-bearing quartz, silicified veins and skarn orebodies. The known ore deposit in this district is the Bulutkan deposit.

(2) According to results of the exploration conducted by the Uzbek side at the +210m-level tunnel, the bonanza of the Bulutkan deposit occur at intersections of the faults with the WNW-ESE, NW-SE and ENE-WSW trends and the horizon including carbonate rocks. The orebody is presumed to take the shape of a polygonal pyramid or pipe with a broad upper face(the surface portion), upright or inclined sharply northwestward. The upper potion of the orebody is composed of silicified rocks accompanied by ferrous oxide, fine-grained quartz veins and chalcedony while the lower portion comprises skarn orebodies associated with sulfide veins, which is accompanied by gold mineralization. The Uzbek mineralogical study indicates that native gold occurs in quartz veins, calcite veins, and siderite veins, associated with graphite. Native gold is occasionally associated with sulfide minerals in amphibole-pyroxene skarns but not recognized in sulfide minerals.

(3) In addition to the dominant gold mineralization confirmed at the trench T-2 for exploration of the upper portion of the Bulutkan deposit, Au grade of 1g/t or higher were confirmed at the trenches T-11, T-28 and T-29. Many silicified and oxidized zones were confirmed by trenching but few of them showed high grade of Au.

(4) The drilling survey resulted in capturing of a prominent gold-bearing silicified vein and a gold-bearing skarn orebody, at the MJUB-7, one of the three holes aimed at the lower part of the Bulutkan ore body, the other two being MJUB-1 and -2. At the MJUB-1, too, a gold mineralization zone was confirmed though low in grade. The drilling survey aimed at the west extension of the Bulutkan orebody resulted also in discovery of gold mineralization at the drillholes MJUB-8 and MJUB-9. The drillholes outside of the Bulutkan deposit, at which gold mineralization of Au 1 g/t or more was confirmed, were MJUB-13, MJUB-17 and MJUB-18, all of which occur in the

Proterozoic close to the north of the syenodiorite stock. No other drilling came to find mineralization of Ag 1 g/t or more. Ore deposits in the Bulutkan district are presumed to be poor in continuity and small in size(extension 50-150m; depth up to 100m).

(5) Geophysical survey results

The geophysical survey by the TEM method clarified the resistivity structure up to some 200m under the surface or 0m above the sea level. At the zone where syenodiorite occurs in the south of the survey area, the resistivity ranged from the medium to the very high. At the zone where Proterozoic occurs along the northern periphery of the syenodiorite body in the central part of the survey area, the high resistivity zones, apparently inclined northward, are intermittently distributed. Most of the major mineral showings in this district have been found in the high resistivity area. The high resistivity zones correspond mainly to portions where diorite dikes, silicified zones, quartzite and quartz veins are densely concentrated, and also to zones of silicified and skarnized metasomatites.

To the north of the high resistivity area, low resistivity zones spread. The low resistivity zones correspond to zones where limestone and slate occur.

The IP values are zonally distributed in the WNW-ESE direction, showing a striking contrast between the high IP area in the central part and the low IP area in the southern part. The portions where IP values suddenly change correspond to the northern periphery of the syenodiorite.

(6) The fluid inclusions of quartz veins and calcite veins have homogenization temperatures ranging from 100℃ to 378℃. Samples taken from skarns or syenodiorite range from 250℃ to 350℃, while trenching samples with gold mineralization ranges from 150℃ to 250℃, generally around 200℃. Drilling samples of portions of the Bulutkan deposit where gold mineralization is overlapped with skarnization ranges from 150℃ to 330℃. It is presumed from these data that the occurrence of quartz veins have gone through plural stages whilst gold mineralization was accompanied by late low-temperature quartz. Occurrence of the Bulutkan deposit is considered to have followed the process as mentioned below.

① By intrusion of the syenodiotite stock, the hornblende-clinopyroxene skarns were formed, which have paragenetic mineral composition of chalcopyrite-pyrrhotite and pyrite-arsenopyrite in the horizon including carbonate rocks of the Kokpats Formation.

② Subsequently, gold mineralization took place, accompanying quartz veins, siderite veins and calcite veins.

(7) Calculation on the ore portions ascertained by exploration indicated the ore reserves of 275,000t, grading 13.1g/t Au(3.6t of Au content), which is small for a gold deposit in Uzbekistan.

(8) Small-scale open-pit mining is applicable to near-surface orbodies with wide veins in the Bulutkan district. Feasibility for development of two selected ore blocks including the Bulutkan deposit was studied on the assumptions that initial investment is to be minimized and that the ore is to be hauled to the Kokpatas gold mine by 45-t trucks and to the Uchkuduk No.3 ore-dressing plant by rail, for processing. A tentative calculation indicated that, if 115,000t of minable crude ore, grading 10.0 g/t Au, is mined out within one year, operating profit of approx. 15 million sum(300,000$) would be expected. As it is not realistic to newly organize an independent mine only for the one-year operation, the operation would have to be placed under the control and administration of the Kokpatas gold mine as its subsidiary mine, in case the orebodies are developed in reality.

5-2 Recommendations for the Future

1) Sautbay district

Based on the ore reserves estimation, feasibility for development of these deposits was studied, which however led to the negative conclusion that mine development in this district is economically unfeasible under the current levels of ore reserves, grade and WO_3 price, since the operations generate losses even on the most favorable assumptions. A certain increase in ore reserves by further exploration may be anticipated but a significant improvement in WO_3 grade is unlikely.

Under such circumstances, it is advisable to suspend exploration in this district and to reserve the district as a potential supply source of tungsten resources for the future.

2) Bulutkan district

The estimation of the total ore reserves of eight ore blocks indicated 275,000t, grading 13.1g/t Au and 6.5 g/t Ag. Two of the ore blocks, including the Bulutkan deposit, were extracted for the tentative feasibility study for open pit operation. The study indicates that if 115,000t of minable crude ore, grading 10.0 g/t, is mined out within a period of one year, it would generate operating profit of 125 sum(2.50$) per ton of crude ore. It is necessary to study how to deal with the ore deposit in the future.

There remains certain possibility for discovery of small ore deposits of a Bulutkan-class, to the north of the syenodiorite stock in the area east of the trench T-6, where the Phase II trenching and geophysical surveys were conducted. It is recommendable to carry out further trenching, geophysical and drilling surveys in the area, in order to ascertain mineralization in the area. To achieve successful exploration, it is recommended that detailed studies on the structures of the horizon of carbonate rocks and of the faults intersecting the horizon should be made.

PART II PARTICULARS

Chapter 1 Satellite Imagery Analysis

1-1 Method of Analysis

A false color composite image(scale 1/200,000), the best suited for geological interpretation, was produced from computer compatible tapes(CCT) of Landsat TM data. For the spectral analysis, images were produced by the rationing method and decorrelation stretching methods for trial purpose. As the result, the former was considered to be more effective for extraction of possible alteration zones; therefore, rationing images with a scale of 1/200,000 were produced.

The image data used for the survey were the LANSAT TM data of the three scenes, Path 157-158/Row 030-031. The areas of respective scenes are indicated in Fig. II-1-1. The interpretation work was conducted in the following procedures:

1) Photogeological interpretation

(1) Mosaicking

To prepare false color composite image, each band of three scenes was digitally mosaicked to produce one new scene which covers the survey area.

(2) Production of false color composite image

After several trial productions of color composite images, the most adequate result was obtained from the combination of the first band (blue), the fourth band(green) and the fifth band (red)(Fig.II-1-2).

(3) Photogeological interpretation

From the false color composite image, geological units and geological structures (lineaments and folding) were interpreted.

2) Extraction of possible alteration zones

Possible alteration zones were extracted on the rationing image, which was produced by dividing the digital number of the third band by that of the first band, the fifth by the fourth and the fifth by the seventh, and assigning them blue, green and red, respectively(Fig.II-1-2). Before the division, the minimum value of each bands 1, 3, 4, 5 and 7, were deducted from the digital numbers of each band since they were estimated to be equivalent to the path radiance that were 30, 11, 2, 1 and 0, respectively.

3) Ground truth

To complement the results of photogeological interpretation and extraction of possible alteration zones, the ground truth was conducted.

4) Synthetic analysis

Geological information obtained through Landsat data image analyses, ground truth and compilation of existing data were integrated to analyze the relationship of mineralization with geologic unit and geological structure.

1-2 Geological Unit

The survey area is divided into 18 geologic units by satellite imagery interpretation (Fig.II-1-3, Table II-1-1). Of the 18 units, six are correlated to the older metamorphic ~ sedimentary rocks that constitute the mountainous area, nine are correlated to the younger unconsolidated ~ loosely consolidated sediments that constitute foothills and flatlands, while three units are correlated to the Late Carboniferous ~ Early Permian intrusive rocks.

It was ascertained by the ground truth that the petrographic classification on the photogeological interpretation map properly reflects the lithology; therefore, the photogeological interpretation map can be used for the grasping of geology and geological structure.

Comparison of the geologic unit map with the distribution map of known ore deposits and showings revealed the following:

① According to the existing geological maps,the Units γb and γc correspond to Late Carbonieferous ~ Early Permian granitic rocks. In the vicinity of the borders of the units, however, there are many tungsten and gold ore deposits and showings, including the Sautbay, Sarytau, Bulutkan and Turbay deposits. They were possibly formed by contact metamorphism accompanying the granitic intrusion or in relation to hydrothermal activity caused by the granitic rocks as the thermal source.

② The Karashakh and Kokpatas Formations of Proterozoic, which host the gold and tungsten mineralization in the survey area, were lumped together as the Unit R-C, since the two formations are hardly distinguishable by the photogeological interpretation, due presumably to the facts that the source rocks of the formations have undergone alteration to become altered rocks of similar natures, that the both formations are complicately folded and that they are of the contemporaneous heterotopic facies but not in a simple upper and lower relationship. In the latest map with a scale of 1/200000, the two formations are not discriminated but treated similarly to the case of the photogeologic interpretation map.

1-3 Lineament Analysis

Result of satellite imagery analysis revealed that the lineament of each area shows particular direction(Fig.II-1-4). The north to northwestern part of the area is represented by the lineaments of E-W and NE-SW~ENE-WSW directions, the former being superior in length. In the central to western part of the area, or from Kokpatas to Uchkuduk, the lineaments of N-S~NNW-SSE and NE-SW~ NNE-SSW directions are dominant, whilst lineaments of NE-SW and WNW-ESE~E-W directions predominate in the eastern part of the area.

In the eastern area, the ore deposits and showings incuding the Sautbay(W), Sarytau(W), Bulutkan(Au) and Turbay(Au) occur along the lineaments of NE-SW direction and WNW-ESE ~ E-W directions, where the mineralization was possibly controlled by fissures in the same directions.

1-4 Extraction of Alteration Zones

The survey area on the ratio image was classified into 20 units, based on the color tones and textures(Table II-1-2). From a comparison of the ratio image with known ore deposits and showings, it is presumed that the known deposits and showings display high value in the ratio 5/4 and consequently greenish color on the image. Since the color is similar to the one that is often observed at alteration zones in other areas, 17 areas that assume the similar color on the ratio images of the area were extracted as alteration zones(Table II-1-3, Fig.II-1-5). At many of alteration zones near ore deposits in the survey area, the ratios 5/4 are high(those containing ferrous oxide abundantly) and the ratios 5/7 are low; it is presumable that the areas are poor in clay minerals.

Many of the alteration zones extracted occur in the Unit R-C.

Based on the field survey, it can be inferred that alteration zones extracted by the spectral analysis may correspond to iron oxidation zones, such as the Kokpatas deposit, which are related to high-sylfide type gold mineralization accompanied by pyrite and pyrrhotite. For gold deposits of this type, the method to extract iron oxide zones around the ore deposit by spectral analysis of satellite images is considered effective. On the other hand, the method has certain limit at this stage, if applied to extraction of low-sulfide type gold deposits composed mainly of quartz veins, such as the Turbay deposit, because of the weak development of iron oxide zone. For this type of ore deposits, the geological structure analysis by means of photogeologic interpretation appears more adequate.

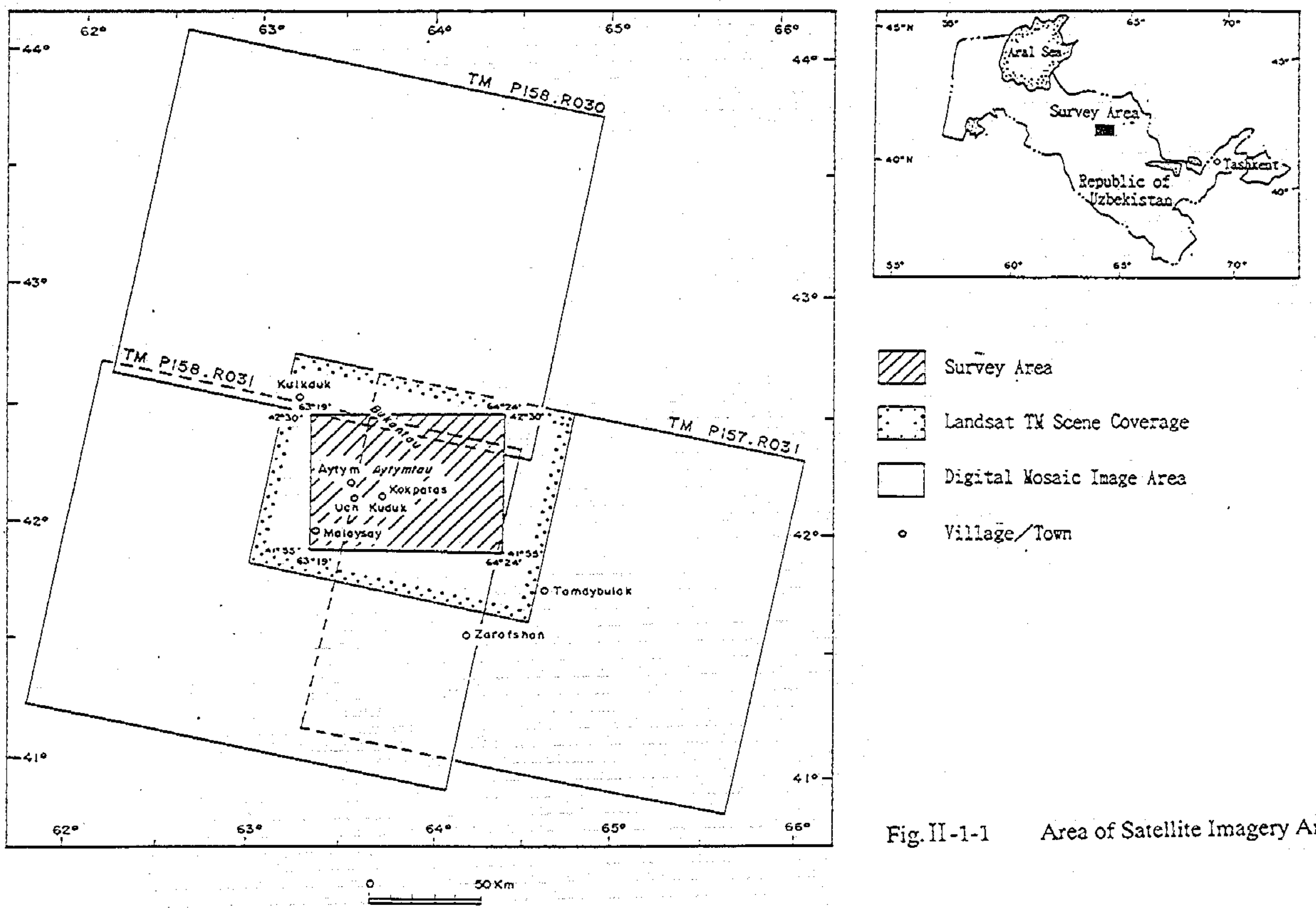
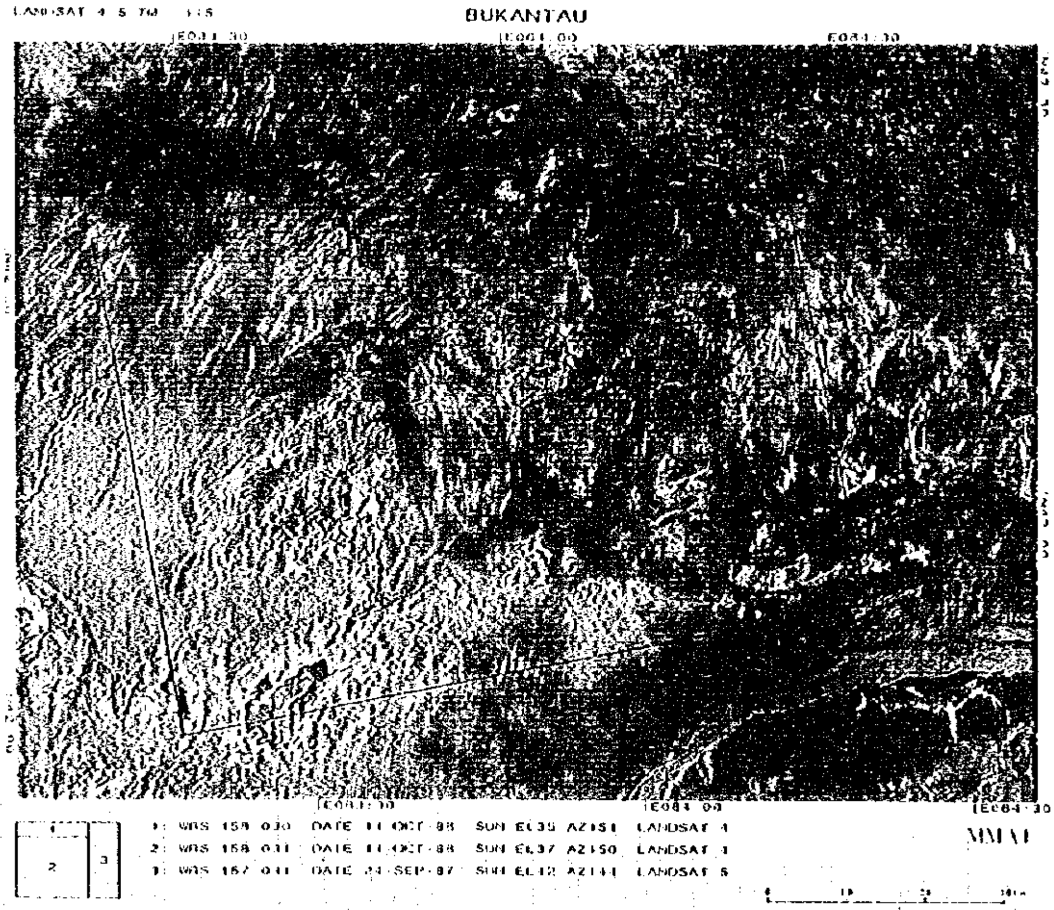


Fig. II-1-1 Area of Satellite Imagery Analysis

LANDSAT TM False Color Composite Image



Ratio Image (Band, 3/1, 5/4, 5/7)

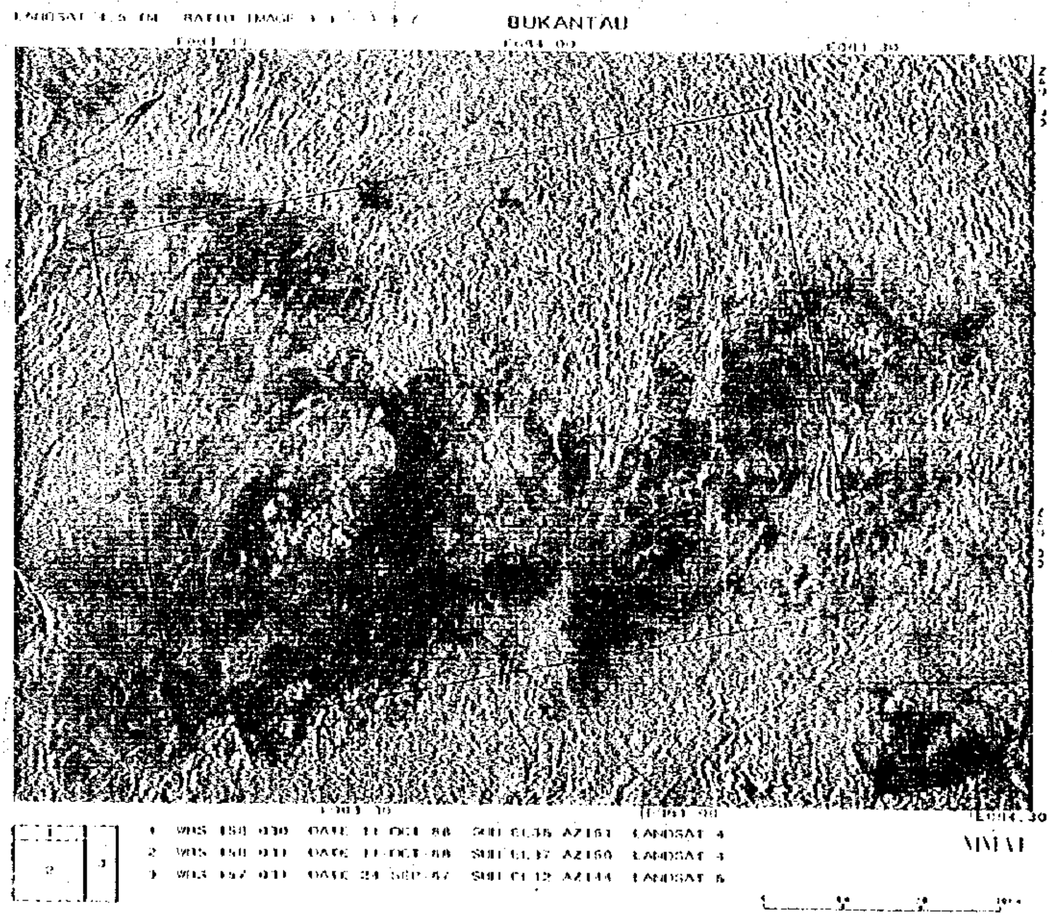


Fig. II-1-2 LANDSAT Image

Table II-1-1 Lithologic Units Classified by Photogeological Interpretation

Unit	Photographic feature		Topographic Features				Lithology Interpreted from Photogeoloy
	Color	Texture	Drainage		Resistivity	Development	
			Pattern	Density		of Bedding	
eb	Yellow, Ocher	coarse	-	-	low	-	aeolian deposits(includes barchans)
el	Whitish, Pale yellow	medium	-	-	low	-	aeolian deposits(includes linear dunes)
en	Whitish, Pale yellow, Reddish brown	fine	-	-	very low	-	aeolian deposits(thinner than 'eb' and 'el')
Qe	Whitish	fine	-	-	low	none	salt lake (evaporates)
Q	Gray, Reddish brown, Dark blue	fine	parallel	moderate	very low	-	alluvium, talus deposits
Nb	Dark blue	medium	sub-parallel	moderate	low	partially well	fine grained sediments (unconsolidated)
Na	Grayish blue	fine	parallel	moderate	low	partially well	medium grained sediments(unconsolidated)
P	Pale pinky-ocher	medium~coarse	parallel	low	low	partially well	fine~medium grained sediments
K	Pale reddish-purplish	medium	parallel	low	low	partially well	fine~medium grained sediments(loosely consolidated)
Ca	Dark grayish blue	fine	pinnate, parallel	high	high	very well	dark colored, fine grained sedimentary rocks
OCa	Pale pinky gray	medium	dendric, parallel	moderate	high	partially well	light colored sedimentary rocks
Oa	Dark green, Dark blue	fine	dendric	high	high	well	dark colored, fine~medium grained sedimentary rocks
R-Cs	Brown	medium	dendric, trellis	high	moderate	well	similar to 'R-C', thicker aeolian sand cover
R-C	Grayish blue, White	medium	dendric, trellis	high	moderate	well	alternation of light and dark colored rocks
R	Dark blue, Black	fine	sub-parallel	moderate	high	well	very dark, fine grained sedimentary~metamorphosed rocks
γ b	Grayish purple	medium	pinnate	very high	high	poor(massive)	granitic intrusive
γ c	Pale pink	medium	parallel	moderate	moderate	poor(massive)	granitic intrusive
M	Pale yellow, White	fine		-	-	-	mine site(open pit and waste dumps)

BUKANTAU

LEGEND

Unit	Photographic Feature		Topographic Feature			Weathering of Bedding	Lithology interpreted from Photogeology
	Color	Texture	Drainage		Resistivity		
			Pattern	Density			
R	Dark blue, Black	fine	sub parallel	moderate	high	well	very dark, fine grained sedimentary-metamorphosed rocks
RC	Grayish blue, White	medium	dendritic, trellis	high	moderate	well	alternation of light and dark colored rocks
RCs	Brown	medium	dendritic, trellis	high	moderate	well	similar to 'RC', thicker aeolian sand cover
Oa	Dark green, Dark blue	fine	dendritic	high	high	well	dark colored fine-medium grained sedimentary rocks
OCa	Pale pinky gray	medium	dendritic, parallel	moderate	high	partially well	light colored sedimentary rocks
Cb	Dark grayish blue	fine	pinnate, parallel	high	high	very well	dark colored fine grained sedimentary rocks
C	Pale reddish purplish	medium	parallel	low	low	partially well	fine-medium grained sediments (loosely consolidated)
P	Pale pinky ocher	medium-coarse	parallel	low	low	partially well	fine-medium grained sediments
Sa	Grayish blue	fine	parallel	moderate	low	partially well	medium grained sediments (unconsolidated)
Sb	Dark blue	medium	sub parallel	moderate	low	partially well	fine grained sediments (unconsolidated)
Q	Gray, Reddish brown, Dark blue	fine	parallel	moderate	very low	-	alluvium, talus deposits
Dr	Whitish	fine	-	-	low	rare	salt lake (evaporates)
eb	Yellow Ocher	coarse	-	-	low		aeolian deposits (includes barchans)
ef	Whitish, Pale yellow	medium	-	-	low	-	aeolian deposits (includes linear dunes)
en	Whitish, Pale yellow, Reddish brown	fine	-		very low	-	aeolian deposits (thinner than 'eb' and 'ef')
γb	Grayish purple	medium	pinnate	very high	high	poor (massive)	granitic intrusive
γc	Pale pink	medium	parallel	moderate	moderate	poor (massive)	granitic intrusive
M	Pale yellow, White	fine	-	-		-	mine site (open pit and waste dumps)

Symbol	Explanation
(m)	Alteration zone or mineralized zone
	Anticlinal axis
	Bedding trace
	Joints
	Lineament (topographically clear)
	Lineament (topographically rather clear)
	Principal road
	rough road
O	Village or town
	Elevation in meter
	lake/salt lake
	Airport/ Air strip

Fig. II-1-3 Photogeological Interpretation Map

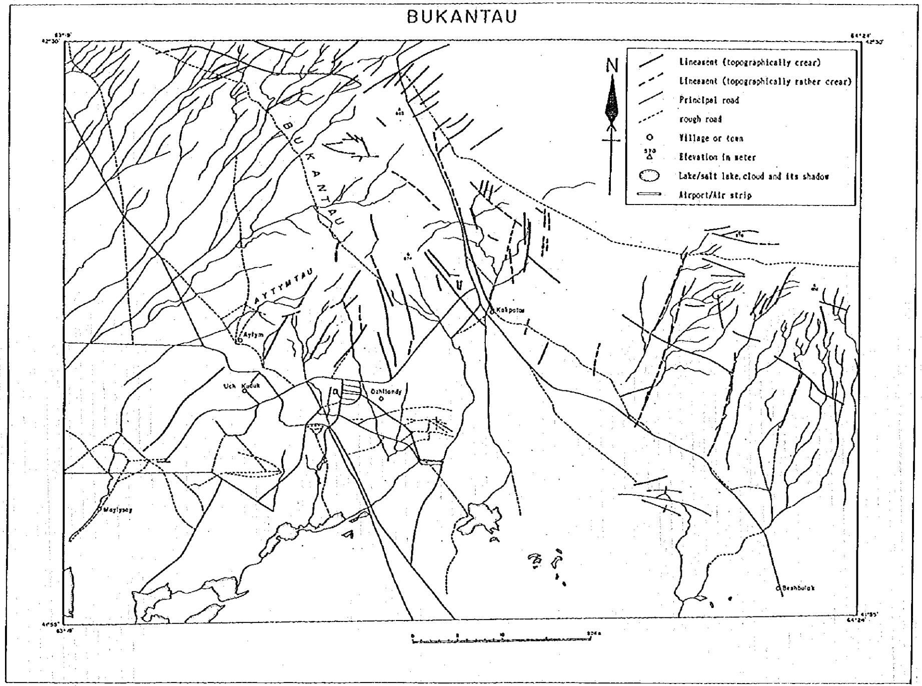


Fig. II-1-4　　Lineaments Extraction Map

Table II-1-2 Units Classified by Rationing Analysis

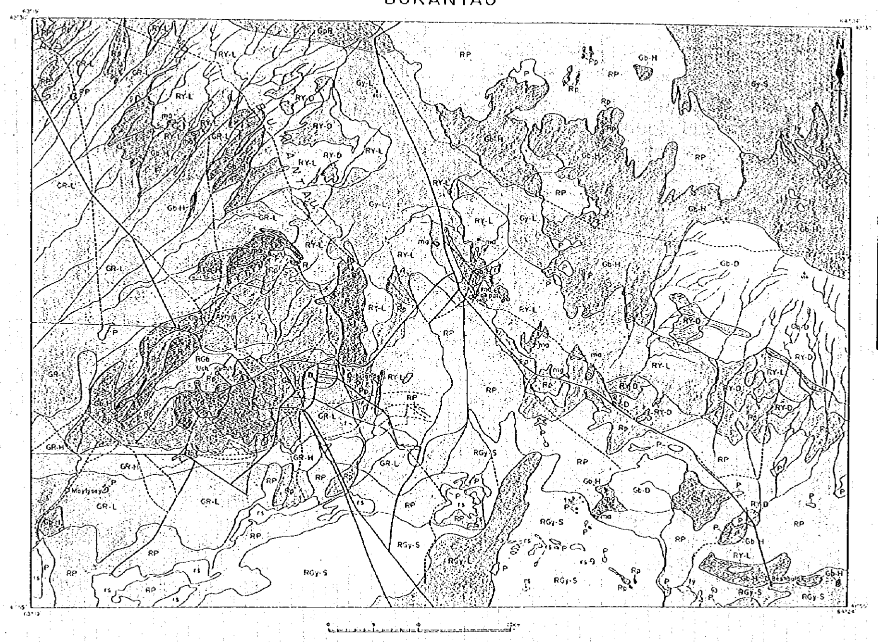
Unit	Color	Texture	Correlation *
R	Reddish	Dotted	R
R Y - L	Red+Yellow	Linear	R – C
G y - L	Yellowish green	Linear	R – C s
G p R	Pale green+Red	Linear	O a
G b - D	Blueish green	Dotted	O C a
R Y - D	Red+Yellow	Dotted	C a
G b - H	Blueish green	Hazy	K
R P	Red+Purple	Hazy	
G R - L	Green+Red	Rather Linear	N a
G R - H	Green>Red	Hazy	N b
R p	Pale red	Smooth	Q
P	Purplish	Smooth	Q e
G y - S	Yellowish green	Sandy	e b
R G y - L	Red+Yellowish green	Sandy, Linear	e l
R G y - S	Red+Yellowish green	Sandy	e n
Y	Yellowish	Dotted	γ b
R G b	Red+Blueish green	Dotted	γ c
Y d	Dark yellow	Dotted	M
rs, ly	Red,light yellow	Smooth	Lake,Salt lake
			Cloud and its shadow
m a	Pale green	Smooth	Alteration zone

* Correlated with Photogeological Interpretation Unit

Table II-1-3 List of Alteration Zone

Alteration Area	Location	Color on Ratio Image	Correlation	
			Geology	Ore Deposit
a 1 a 2	N -NNE of Aytym	yellowish green	R-C	Aytym
a 3	NNE of Aytym	yellowish	R	
a 4	Center of the Survey Area	blueish green	R-Cs	Cholcharatau
a 5 a 6	N of Kokpatos	yellowish	R-C	Kokpatas
a 7 a 8	E of Kokpatos	yellowish green	R-C	Kokpatas
a 9	SE of Kokpatos	yellow green	R-C	
a10 a11 a12	SE of Kokpatos	yellowish green	R-C	Sautbay
a13 a14 a15 a16 a17	NW of Beshbulak	yellowish green	R-C (K)	

BUKANTAU



LEGEND

Unit	Color	Texture	Correlation*
R	Reddish	Dotted	R
RY-L	Red-Yellow	Linear	R · C
Gy-L	Yellowish green	Linear	R · C s
GpR	Pale green-Red	Linear	O a
Gb-D	Bluish green	Dotted	O C a
RY-D	Red-Yellow	Dotted	C a
Gb-H	Bluish green	Hazy	K
RP	Red-Purple	Hazy	P
GR-L	Green-Red	Rather Linear	N a
GR-H	Green Red	Hazy	N b
Rp	Pale red	Smooth	Q
P	Purplish	Smooth	Q c
Gy-S	Yellowish green	Sandy	e b
RGy	Red-Yellowish green	Sandy, Linear	e l
RGy-S	Red-Yellowish green	Sandy	e a
Y-S	Yellowish	Dotted	γ b
RGb	Red-Bluish green	Dotted	γ c
Yd	Dark yellow	Dotted	M
rs, ly	Red, light yellow	Smooth	Lake, Salt lake Cloud and its shadow
[illegible]	Pale green	Smooth	Alteration zone

*Correlated with Photogeological Interpretation Unit

Fig. II-1-5 Results of Spectral Analysis Showing Alteration Zone Extracted by Rationing

Chapter 2 Analysis of Existing Data

2-1 Ore Deposits

In the survey area, ore deposits and showings of tungsten, gold, silver and copper are located. 24 ore deposits and showings were extracted in the survey(Fig.II-2-1 and Table II-2-1). They are divided into the following four ore fields.

(1) Sarytau ore field

① Tungsten･skarn･stockwork deposits (Sarytau deposit, Katirtas showings, etc.)

② Gold-bearing skarn deposits (South Sarytau showings)

③ Gold･silver･sulfide-bearing quartz veins (Central Sarytau showings)

④ Gold･silver･copper-bearing quartz veins (North Sarytau showings)

(2) Sautbay ore field

① Tungsten･skarn deposits (Sautbay deposit, Saghinkan showings, Burgut showings, etc.)

② Gold-bearing quartz veins･metasomatic deposits (Bulutkan deposit)

(3) Turbay ore field

①Gold-bearing stockwork･metasomatic deposits (Turbay deposit, East Turbay showings, South Turbay showings,etc.)

②Gold･silver･sulfide-bearing quartz veins･metasomatic deposits (West Turbay showings, etc.)

(4) Okjetpes ore field

① Silver-bearing carbonate･quartz veins･stockwork deposits (Okjetpes deposits)

② Gold-bearing quartz veins (Barhanny showings)

Tungsten･skarn deposits are the stratiform type in carbonate rocks intercalated mainly in the Karashakh Formation and the Kokpatas Formation of upper Proterozoic age