REPORT
ON
THE MINERAL EXPLORATION
IN
THE TALAS AREA
THE KYRGYZ REPUBLIC

(PHASE I)

MARCH 1995

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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PREFACE

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

The JICA and MMAJ sent to the Kyrgyz Republic a survey team headed by Mr. Masaharu Marutani from December 1, 1994 to January 24, 1995.

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

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

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

February, 1995

Kimio Fujita
President
Japan International Cooperation Agency

Takashi Ishikawa
President
Metal Mining Agency of Japan

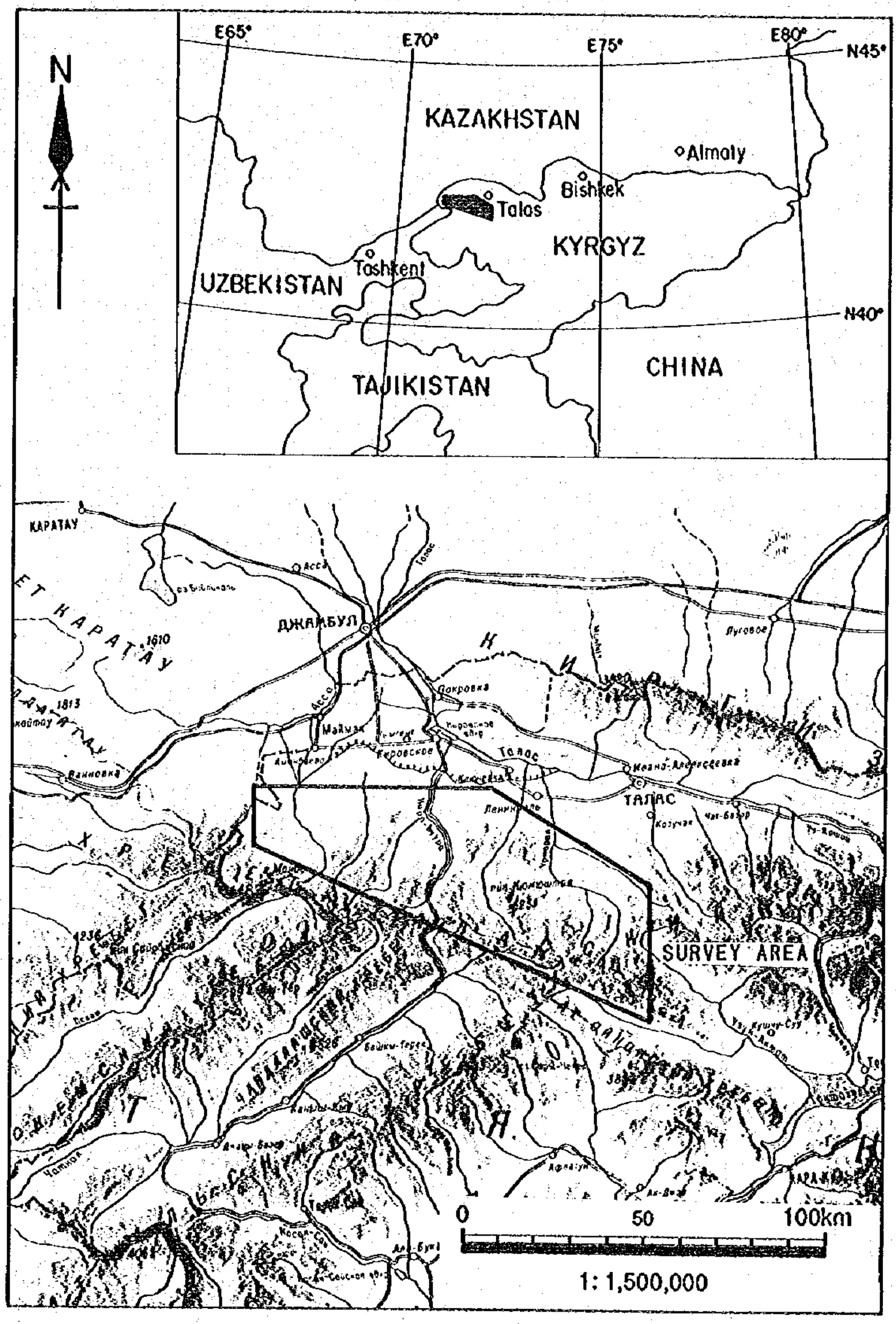

Fig. I-1 Location Map of the Survey Area

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 Таласской области Республики Кыргызстан. Цель исследования, проводившегося с декабря 1994 г. по январь 1995 г., заключалось в выяснении геологических условий и расположения рудных месторождений в названной области.

Исследование на первый год было проведено в пределах 3300 кв. метрового района в Таласской области и сопровождалось сбором, упорядочением и анализом существующих данных и информации о геологии, месторождениях и геохимических поисках, а также получением информации о производственных и перспективных месторождениях и о расположении месторождений в районе исследования. В частности, большой удельный вес в исследовании приходил на Кумыштагский и Бабаханский районы.

В ходе исследования были выделены 40 производственных и перспективных месторождений, которые разделяютя на 6 групп по видам и типам, а именно: ① месторождения с золотосодержащими залежами в кумыштагских гранитных породах (Ширальджинское месторождение); ② месторождения с золото- и свинцесодержащими залежами верхне-рифейской и бендской групп; ③ массивно-сетчатые месторождения мышьяка верхне-рифейской группы; ④ грейзеновые и бериллиевые сетчатые месторождения в кумыштагских породах; ⑤ месторождения с медными залежами вокруг кумыштагских пород; и ⑥ залежные и скарновые вольфрамовые месторождения вокруг кумыштагских пород. Исходя из геологических условий, можно предполагать, что процесс минерализации в данном районе тесно связан с действием кумыштагских гранитных пород и сдвигами по направлению ЗСЗ-ВЮВ.

Анализ результатов геохимических поисков, осуществленных в расширенных пределах, позволил выявить 13 участков с повышенной концентрации золота. В результате отдельно проведенных геохимических поисков были найдены 10 участков с высокими анамальностями, помимо вышеуказанных 13.

Фотодешифрирование спутниковых снимков показало, что существует тенденция к расположению производственных и перспективных месторождений вдоль сдвигов СВ-ЗЮ и линейной структуры СЗ-ЮВ. Исходя из этого, возможно, что производственные и перспективные месторождения в данном районе формировались в связи с сдвигами одной системы (группы).

К тому же, в результате спектрального анализа в трех районах в бассейнах самых верхних течений основных рек были выявлены участки, где, возможно, расположена зона изменения. Возможно, что эти участки показывают последствия гидротермального процесса и скарнизации.

В дальнейшем целесообразно осуществлять пробуривание для уточнения положения минерализации в формациях под ширальдинским месторождением золота, более подробные геологические и геохимические исследования кумыштагского, карабураского, бабаханского, шарбалсайского, Чимташского и табылгатского участков, которые были выявлены как участки, имеющие высокие анамальноости в результате геохимических поисков, геологическое исоледование на 3 участках возможного расположения зоны изменения в верхних течениях Бабахана, Кумыштага и Чимташа, выявленных спектральным анализом спутниковых снимков, а также подробное геологическое исследование уже найденных производственных и перспективных месторождений.

SUMMARY

This report summarized the results of the phase I survey of technical cooperation for mineral exploration conducted in Talas area, Kyrgyz Republic. Purpose of the survey is to clarify the geology and possibility of mineral potential of the area and to explore new ore deposits. The survey has been conducted from December 1994 to January 1995.

In the phase I survey, collection and analysis of the previous data on geology, mineral deposits and geochemical survey in Talas area (3,300 km^2) have been conducted in order to grasp the mineral occurrence of the area. Special attention has been paid to the area covering Kumyshtag and Babahan.

Forty ore deposits or mineral occurrences were selected for study. They are classified into the following six types.

① Gold bearing vein in Kumyshtag granite

② Silver-lead vein in limestone and sandstone of Upper Riphean system - Vendian system

③ Massive and disseminated arsenic deposits in limestone and sandstone of Upper Riphean system

④ Greisen-stockwork type beryllium deposits in Kumyshtag intrusive

⑤ Copper vein around Kumyshtag intrusive

⑥ Vein and skarn types tungsten deposits around Kumyshtag intrusive

Mineralization of the area is related to Uzunahmat-Kumyshtagsky thrust fault, fractures of west-northwest - east-southeast, and intrusion of Silurian Kumyshtag granite.

As the results of analysis on the previous geochemical survey, the gold concentration was found in thirteen sites. Aside from the above study, a semi-detail geochemical survey has revealed ten anomalous sites for gold.

Geological interpretation of the satellite images showed that the ore deposits and mineral occurrences are localized along the northeast - southwest fault and northwest - southeast lineament, suggesting that the mineralization of this area is related to the above faults and lineament.

A spectral analysis of the images has detected three anomalous zone in the upstream of three main rivers. They are presumed to be hydrothermal alteration zone or skarn deposits.

The following survey are advised to be conducted from the phase II survey.

① Diamond drilling to find the downward mineralization of Shyraldzhyn gold deposit

② Geological reconnaissance and semi-detail geochemical survey for Kumyshtag, Kara-Buura, Babahan, Shalbaly-Say, Chymtash and Tabylgaty where gold anomalies have been found in the previous survey

③ Field check geological survey for the possible alteration zones in the upstream of Babahan, Kumyshtag and Chymtash

④ Detail geological investigation for the known ore deposits and mineral occurrences

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PART I

GENERAL REMARKS

CHAPTER 1 INTRODUCTION

1-1 Circumstances and objective of the survey

The Kyrgyz Republic is mainly composed of metamorphic and sedimentary rocks from Precambrian to Paleozoic era which are widely intruded by granite. Potential of existence of metal deposits is high, and gold, silver, copper, lead, zinc, mercury, antimony, tin, tungsten and rare earth are occurred.

Although the Kyrgyz Republic has many kinds of mineral resources, a lot of deposits have been undeveloped and also mining has been not promoted during defunct USSR.

Under these circumstances, the State Committee on Geology, Usage and Protection of Natural Resources (GOSCOMGEOLOGY), requested, through the State Commission on Foreign Investments and Economic Assistance of the Kyrgyz Republic, a technical cooperation from the Japanese Government for the survey in April 1994. In August 1994, a delegation for the preliminary survey and agreement negotiations for this purpose was organized among the Ministry of International Trade and Industry (MITI), Japan International Cooperation Agency (JICA) and Metal Mining Agency of Japan (MMAJ), and was dispatched to the Kyrgyz Republic. On August 11, 1994, the scope of work to the Talas area project was signed between the parties.

The objective of the survey is to explore and to assess the mineral potential of the survey area. by means of previous data compilation, satellite image analysis, geological, geochemical, geophysical survey and drilling.

1-2 Outline of the Phase I survey

According to the scope of work concluded among GOSCOMGEOLOGY, JICA and MMAJ, the region to be surveyed covers an area of approximately 3,300 square kilometers. The Phase I survey was carried out by previous data compilation combined with the satellite image analysis of entire survey area.

Objectives of the Phase I survey are as follows.

(1) To comprehend ore deposits and mineral occurrences and to assess the mineralization through previous data compilation.

(2) To comprehend the regional geological structure by photogeological interpretation, and to extract the alteration zone by spectrum analysis of the satellite image.

(3) To clarify the further prospective problem by summarized survey results.

Previous data compilation was carried out in the office of GOSCOMGEOLOGY in Biskek. Data processing and analysis of the satellite image was conducted before data compilation.

1-3 Organization of the survey team

The representatives from Japanese government for the agreement negotiation and the phase I survey, were dispatched to Kyrgyz during the period from July 21 to August 14, 1994. The delegation members and their counterparts in Kyrgyz are shown below:

From Japan:

Mr. Jiro OSAKO	Metal Mining Agency of Japan
Mr. Hirofumi ONO	Ministry of International Trade and Industry
Mr. Ken-ichi TAKAHASHI	Japan International Cooperation Agency
Mr. Taro KAMIYA	Metal Mining Agency of Japan

From Kyrgyz:

Mr. Sheyshenaly M. MURZAGAZIEV	GOSCOMGEOLOGY*
Mr. Alexander G. KONYUKHOV	GOSCOMGEOLOGY
Mr. M. A. KAREV	GOSCOMGEOLOGY
Mr. K. KANITAEV	GOSCOMGEOLOGY

*GOSCOMGEOLOGY : State Committee on Geology, Usage and Protection of Natural Resources

The field survey team was dispatched from December 1, 1994 to January 24, 1995. The team members from Japan and their counterpart from Kyrgyz are as shown below:

From Japan:

Mr. Masaharu MARUTANI	MINDECO*	; Leader of the field survey team and geology
Mr. Kiyohisa SHIBATA	MINDECO	; geology
Mr. Noboru FUJII	MINDECO	; geology

* MINDECO : Mitsui Mineral Development Engineering Co., LTD

From Kyrgyz:

Mr. Alexander G. KONYUKHOV	GOSCOMGEOLOGY ; general review and geology
Mr. Anatolyi G. RAZBOYNIYOV	GOSCOMGEOLOGY ; geology
Mr. Vasiliy P. PAKHOLUK	GOSCOMGEOLOGY ; geology
Mr. Farid APAYAROV	GOSCOMGEOLOGY ; geology

Data processing and analysis of satellite image were carried out by following members in Japan.

Mr. Kazuhiro ADACHI MINDECO

Mr. Hidehisa WATANABE MINDECO

CHAPTER 2 GEOGRAPHY OF THE SURVEY AREA

2-1 Location and access

The survey area is located at the northern slope of Talas Ala-Too mountains in the Northern Tien-Shan, in the northwestern part of the Kyrgyz Republic. The area has a total area of approximately 3,000 square kilometers, 100 km from east to west, 30 km from north to south. Almost whole area belongs to the Talas region administratively. The following points are of the boundary of the survey area.

42°30' north latitude, 71°00' east longitude
42°30' north latitude, 71°45' east longitude
42°17' north latitude, 72°15' east longitude
41°58' north latitude, 72°15' east longitude
42°22' north latitude, 71°00' east longitude

Talas, where field survey is based, is located at 200 km to the west-southwest of the capital Bishkek. Absolute elevation of the city marks about 1,250 m. The city is the central of the Talas region, with about 30,000 population.

The following two routes are available to move from Bishkek to Talas. One is a route passing through Dzhambul in Kazakhstan, and the other is a route through Kara-Bulta, Teo-Ashuu pass and Otmek pass.

It is available to go to Talas through all year on the former route, taking from 5 to 6 hours. On the other hand, it is available to pass except snowy season on the latter, because of bad road condition by snow, avalanche and fallen rocks. It takes almost same hours.

The main roads in the survey area are constructed along the big rivers. It is available to go upstream using the four-wheel cars. In the highland geological survey is carried out by ridding. The national road is constructed along the river Kara-Buura in the central part of the area. The road connects with the Chatkal region through the Kara-Buura pass, with 3,302 m of elevation.

2-2 Topography and drainage

The Tien-Shan mountain ranges are divided into three parts, that is the Northern Tien-Shan, the Middle Tien-Shan and the Southern Tien-Shan. The survey area is located in the southern part of the Northern Tien-Shan. Talas Ala-Too mountain ranges, being 4,000 m altitude class, locate in the southern part of the survey area. The mountains direct from northwest to southeast. The highest peak is Kumyshtag peak, with 4,251 m of elevation, standing in the central part of the area.

The most high mountains are covered with glacier widely. The rivers, pouring out from glacial troughs, form deep gorges. The most rivers flow to the north and flow into the Talas river, running to the west. The Talas river turns the direction from west to northwest, and separates to the branches and disappears into the Kazakhstan steppe.

The main rivers running in the survey area are as follows from west to east: Kurkureo-Suu, Suluu-Bakayir, Kara-Buura, Kumyshtag and Urmaral rivers.

2-3 Climate and vegetation

The climate and vegetation in the survey area is characterized by changing of elevation because of 3,000 m in elevation difference. The climate in highland of 3,000 m and over is cold, and mainly grows needle grass. The climate of ranging from 1,000 to 3,000 m is highland, and mainly grows bushes besides pine and poplar trees along rivers.

The monthly average temperature in Talas ranges from -5 ℃ to -9 ℃ in January, from +15 ℃ to +20 ℃ in July. The annual rain fall shows 290 mm. The highest monthly rain fall shows 48 mm in April and March, and the lowest shows 9 mm in September. The annual sun shining is 2,772 hours in Talas.

The highest temperature in the survey area is recorded +38 ℃ in July, and the lowest is recorded -39 ℃ in January. The annual rain fall ranges from 230 mm to 320 mm in the area. The thickness of snow show 4 cm in the western part of the Talas basin, and 16 cm in the eastern part. The strong west wind blows in the mountain regions in winter, but the east wind ranging from 5 to 7 m/s blows along the Talas basin.

CHAPTER 3 GENERAL GEOLOGY

3-1 Outline of previous survey

Regional geological survey of the area was firstly conducted by Ministry of Geology in 1963, for Geological Map of USSR, Series of Northern Tien-Shan, "K-42-XIII" and "K-42-XVIII", although a part of the area has been investigated.

Regarding geological investigation of ore deposits, a geochemical survey for heavy sand using panning was done by Ministry of Geology (1963), and geological investigation of the known mineral deposits of the Central part of Talas mountain range with stream sediment geochemical survey have been done by Geological Department, Kyrgyz SSR in 1987.

3-2 General geology and geological situation of the survey area

3-2-1 Regional geological setting of Kyrgyz

(1) Outline of geology

Kyrgyz is located at the junction of several fold mountains including Ural, Tien-Shan and Pamirs. With this reason the geological structure is very much complicated (Fig. I -2).

Four times collision of continents and formation of fold mountain have been taken place around Kyrgyz during geological history. The ages of the collision are ① Baikalian, ② Caledonian, ③ Hercynian and ④ Alpine. After Hercynian orogeny until late Mesozoic Alpine cycle, there was no intense crustal movement and the terrain has changed to peneplain. In early Cenozoic Era, by the crustal movement of Alpine cycle, the block movement and upheaval of the terrian have taken place to form present steep mountain topography. With the above mentioned geological background, Kyrgyz is composed of several massifs and platforms formed by crustal movements and defined by the faults and tectonic lines.

The massifs and platforms are briefly described by Bakirov and Kotov (1988) as follows:

① Tarim platform

Tarim platform is a Precambrian massif extending over Tarim basin of China and to the southeast of Kyrgyz is bordered by Talas-Fergansky fault and Kypchak fault. Tarim platform is a stable block since Proterozoic era, which is located Issyk-Kul region near border to China.

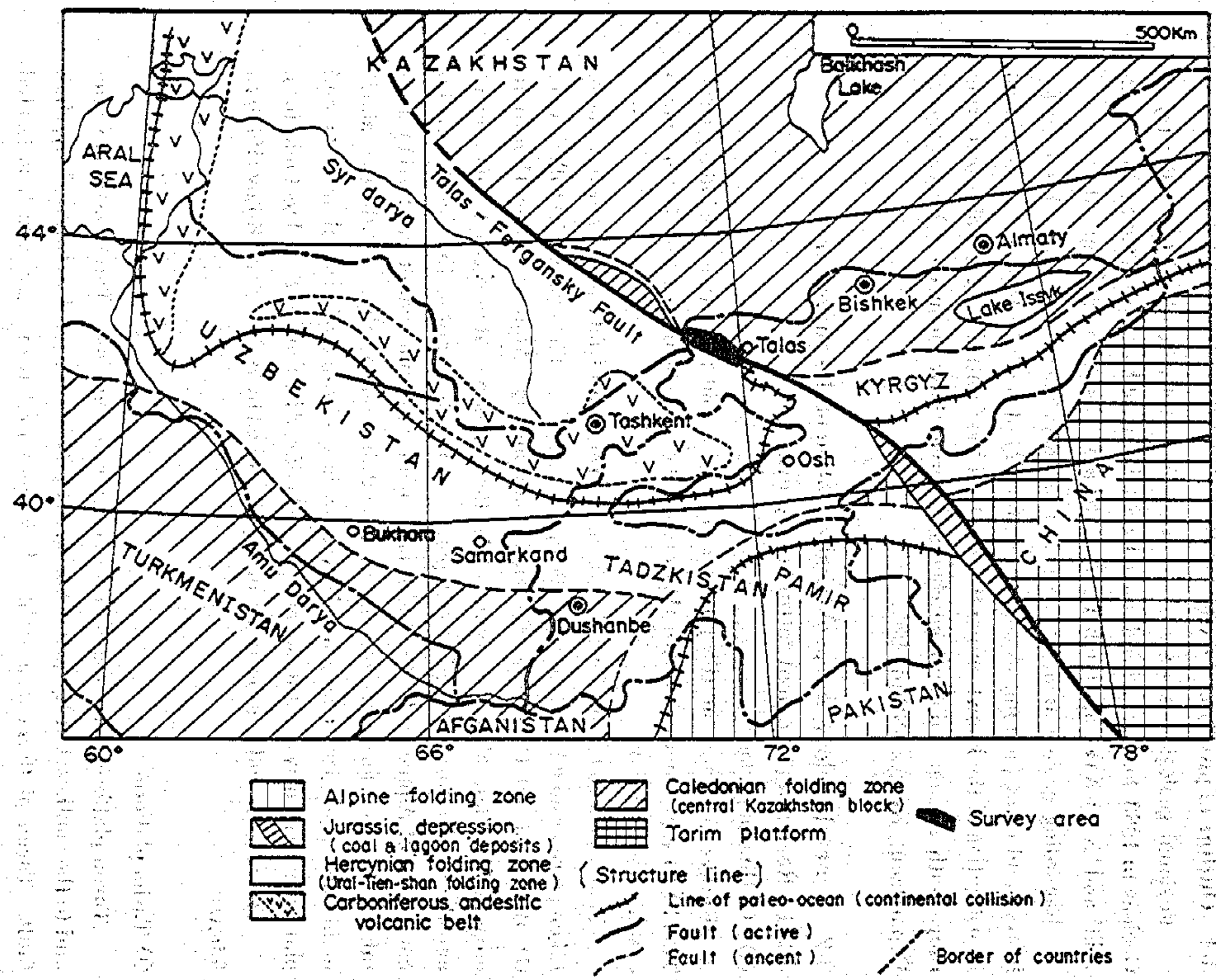

Fig. I-2 Regional Geologic and Tectonic Situation of Kyrgyz

Northern Tien-Shan massif was formed in Caledonian cycle and the massifs of Southern Tien-Shan, Middle Tien-Shan and North Pamirs are formed in Hercynian movement.

The outline of geological structure in the above three massifs of Kyrgyz is described bellow.

① Northern Tien-Shan massif

This massif consist of two stable blocks of Talasky marginal massif in the west and Muyunkumo-Narastky middle massif in the east. These stable blocks are formed by folding of Baikalian movement, and they are surrounded by the fold belt of Caledonian cycle. These basement formations are unconformably covered by the sediments of early Paleozoic post Billion, middle Paleozoic post Caledonian and Mesozoic to Cenozoic era.

The survey area is located in Talas marginal block.

Northern Tien-Shan massif is bordered by Talas-Fergansky fault and Nikolaev fault (they are jointly called Nikolaev tectonic line) with Middle and Southern Tien-Shan massifs in its southern margin. Nikolaev tectonic line, which is the most prominent tectonic line in Kyrgyz, was formed by the continental collision in Caledonian cycle.

② Middle Tien-Shan massif

This massif is formed by the folded formation of lower Proterozoic to Paleozoic era. The folding had taken place in Hercynian cycle. This massif together with Southern Tien-Shan massif are separated into eastern block and western block by Fergansky fault. In the western block the basin sediment of post Hercynian cycle (Syrdarynsko-Fergansky Middle massif) covers the basement formations. Then all of these formations are further covered by the Cenozoic group.

③ Southern Tien-Shan massif

The basement rock of this massif is comprised of the formations of Lower Archean, Proterozoic and Paleozoic era which are folded by the Hercynian movement. The groups of Mesozoic group extend over the west side of Talas-Fergansky fault.

(2) Igneous activity

Various types igneous activity including the igneous activities accompanied by subduction of plate and alkaline magma of Proterozoic to Paleozoic era can be

② Caledonian folding zone

Caledonian fold zone, extending over northern Kyrgyz to Kazakhstan is a block formed by the collision of continents in Caledonian cycle (early Paleozoic) is bordered its south margin by Talas-Fergansky fault and Nikolaevsky fault. A part of this zone consist of middle to marginal massif formed by Baikalian crustal movement of late Proterozoic era. This zone is also called "Central Kazakhstan Block" and in Kyrgyz "Northern Tien-Shan Massif". Another massif formed the same orogenic cycle extend over Turkmenistan.

③ Hercynian folding zone

This fold zone is extending from the southern Kyrgyz through the western Kyrgyz and Aral sea to Ural fold belt. A series of fault such as Atobashsky-Enycheedsky fault - Karansuisky fault - Southern Fergangansky fault extend from east to west and ultrabasic rocks formed by ophiolite and eclogite crops out along the fault. The northern part of the fault is called "Middle Tien-Shan Massif" and the southern part of the fault is called "Southern Tien-Shan Massif". Andesite volcanics is presumed to be formed with subduction of the plate before collisions extending along this tectonic line.

④ Alpine folding zone

This zone is extending from Tadzikistan to Afganistan forming Pamirs massif, formed by the collision of Indian plate and Eurasian plate in early Cenozoic era. The northern margin of this zone with the width of 20 km is a zone of active faults accompanied by a fractured zone.

3-2-2 Geology of Kyrgyz

(1) Geological structure

The basement formation of Kyrgyz shows the general trend of east to west and can be classified into ① Northern Tien-Shan massif, ② Middle Tien-Shan massif and ③ Southern Tien-Shan massif from north to south (Fig. I -3).

Each block is bordered by the tectonic line. Middle Tien-Shan massif and South Tien-Shan massif are delimited by Talas-Fergansky fault, extending northwest to southeast of the central Kyrgyz. Talas-Fergansky fault is a transform fault formed in Alpine cycle of early Tertiary and it is still active at present. The horizontal displacement of this fault is presumed to be about 180 km from the correlation of the formations of both sides of the fault.

observed in Kyrgyz (Fig. I -4).

A wide distribution of granitic rock of Proterozoic to Late Paleozoic is seen in Northern Tien-Shan massif and the small intrusives of gabbro are seen in southeast of the Issyk-Kul lake. Igneous rocks of Late Paleozoic (Carboniferous and Permian) are located in Middle Tien-Shan massif and Southern Tien-Shan massif. Igneous activity of alkaline rock is confined to the Silurian formation of the three massifs.

3-3 Metallogenic situation of the survey area

Variety of ore deposits including mercury, antimony, copper, lead, zinc and tungsten are located in Kyrgyz.

There are ten metallogenic provinces and three geological stages of mineralization in Kyrgyz (Fig. I -4). These mineralization comprise Caledonian folding region mineralization, folding stage mineralization and late orogenic stage mineralization.

Caledonian folding region mineralization had taken place in Northern Tien-Shan massif where various types mineral deposits including lead, zinc, copper and rare earth are located. In Middle Tien-Shan massif, there is a polymetallic province of lead and zinc in the west of Talas-Fergansky fault and a province of tin, tungsten and iron is in the east of Talas-Fergansky fault. A province of antimony and mercury is located in Southern Tien-Shan massif.

The survey area is located in Talas mineral belt of Caledonian folding region mineralization (Magakyan, 1979).

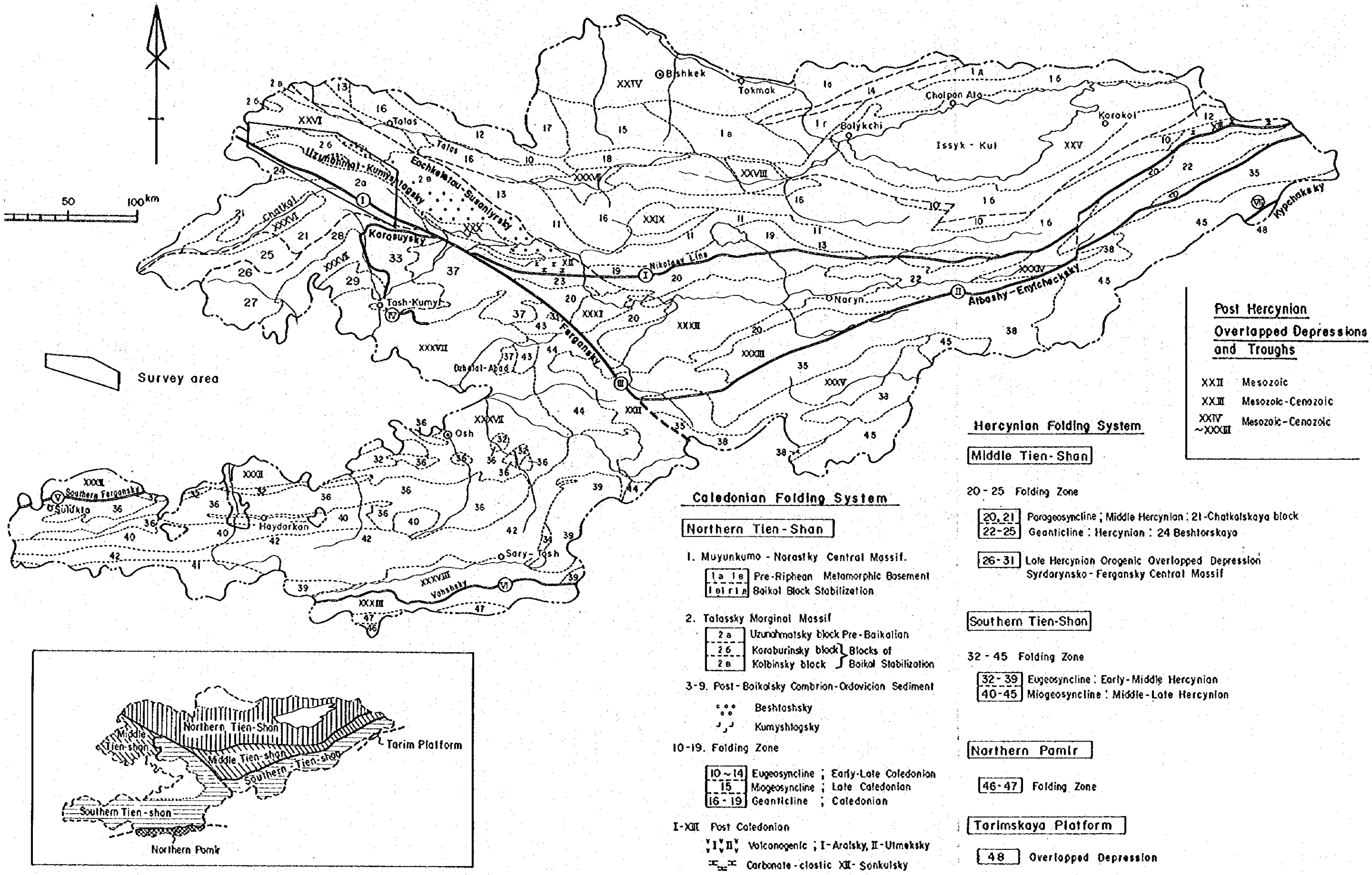

Fig. I -3 Tectonic Regions of Kyrgyz (after Tectonic Map of Kyrghystan of USSR, 1988)

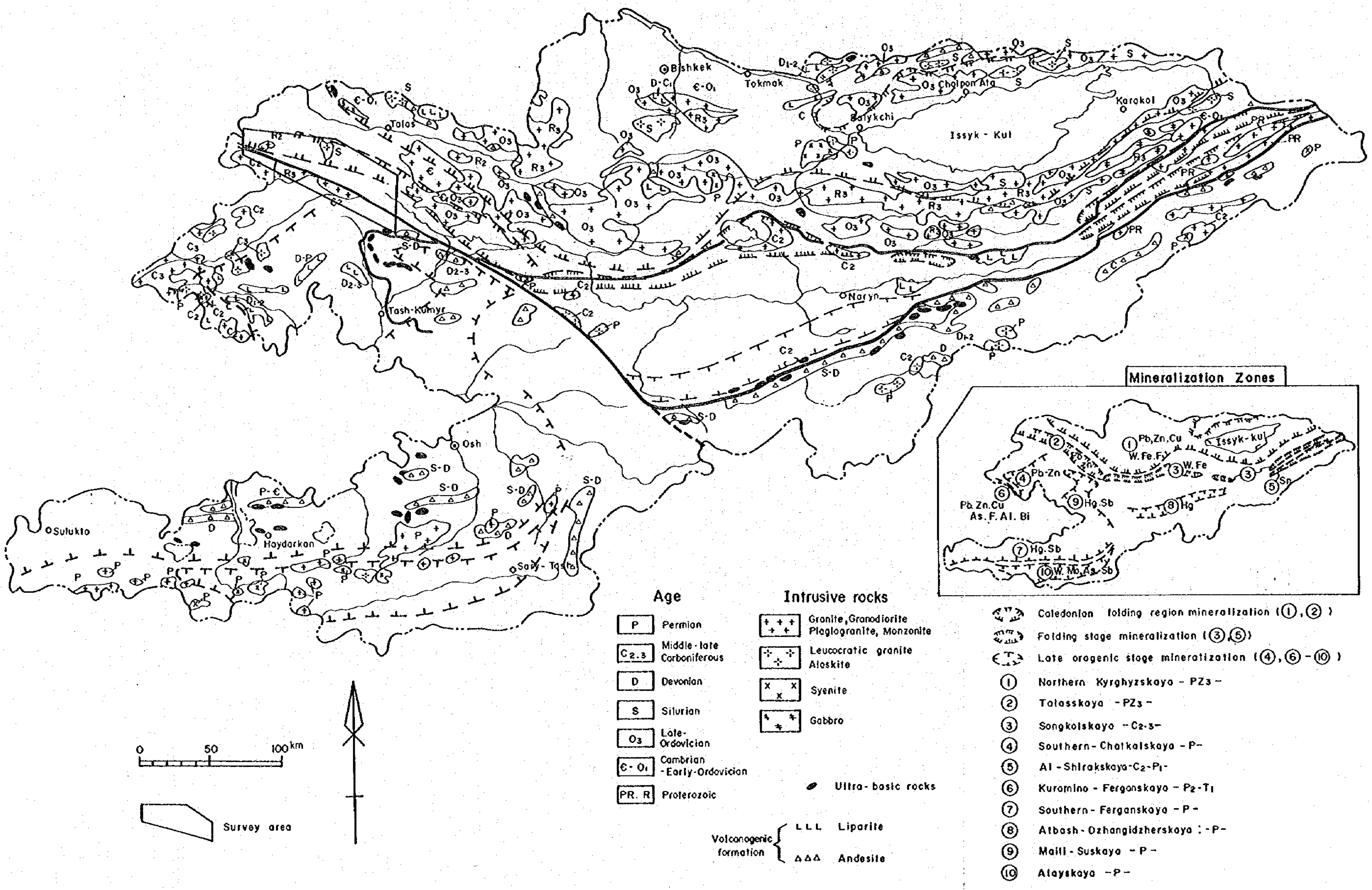

Fig. I-4 Distribution of Igneous Rocks and Mineralization Zone in Kyrgyz (after Atlas of Kyrgyz SSR, 1987)

CHAPTER 4 COMPREHENSIVE ANALYSIS OF THE SURVEY RESULTS

4-1 Geological structure and characteristics of mineralization

The survey area belongs to the Talas marginal massif in the regional geological division of Kyrgyz. The Talas marginal massif is a small massif located at the western end of Tien-Shan range, surrounded by Talas-Ferganskу fault - Nikolaevsky Fault and Eachkeletau-Susamyrsky fault (Fig. I -3). The Talas marginal massif is composed of predominantly sedimentary formations including carbonate rocks which are intruded by acidic igneous rocks. They are folded and thrust faulted to form a complicated geological structure. The principal trend of geological structure is west-northwest - east-southeast which is coincide with Talas-Ferganskу fault.

The results of satellite image analysis clearly showed the principal faults of the area such as Talas-Ferganskу fault and Uzunahmat-Kumyshtagsky fault. It was also recognized that the indicated faults and lineaments are related to the known mineral deposits as described below. In the surrounding area of Dzholsay silver deposits in the western part of the survey area, the ore deposits and mineral occurrences are located along the east - west fault and its subordinate northeast - southwest lineaments. In the area surrounding Kumyshtag in the eastern part of the survey area, where a number of silver, lead, arsenic and tungsten deposits are located, the most of ore deposits and mineral occurrences are confined to the triangular area surrounded by the west-northwest - east-southeast thrust fault, the northeast - southwest faults and the northwest - southeast lineament. From the above mentioned facts, it is presumed that the mineralization has taken place along the fractures related to north - south stress which formed the west-northwest - east-southeast thrust fault.

Ore deposits of this area may be mainly classified into ① vein and massive types mineralization related to the Uzunahmat-Kumyshtagsky thrust fault and its subordinate faults and fractures, ② vein, greisen and skarn types ore deposits related to Kumyshtag granite. The above mentioned interpretation is conformable to the result of lineament analysis suggesting that the mineralization of this area is related to the faults - fractures and Kumyshtag granite.

4-2 Potential of an existence of ore deposits

The various types of ore deposits of gold, silver, lead, zinc, arsenic, beryllium, copper and tungsten are known to occur in the survey area. They are classified into the following six types.

① Gold bearing vein in Kumyshtag granite

② Silver · lead vein in limestone or sandstone of Upper Riphean series · Vendian series

③ Massive and disseminated arsenic deposits in limestone or sandstone of Upper Riphean series

④ Greisen and stockwork beryllium deposits in Kumyshtag intrusive

⑤ Copper vein around Kumyshtag intrusive

⑥ Vein and skarn types tungsten deposits around Kumyshtag intrusive

The various types of ore deposits are known in the survey area, and the area seems to be high potential for mineral resources.

The spectral analysis to reveal alteration zone has been conducted in present survey. As the results of analysis, three anomalous areas were formed in ① upstream of Babahan in the western part of the survey area, ② upstream of Kumyshtag river in the central of the area, and ③ upstream of Chymtash river in the southeast of the area. As these anomalous areas are presumed to be formed by hydrothermal activity taken place along the west-northwest - east-southeast fault or skarn formed in the carbonate rock of Riphean series, it is possible that the ore deposits may exit in these areas.

Furthermore, from the results of geochemical survey, the possibility of existing gold deposits is seem in the following six areas near Uzunahmat-Kumyshtagsky thrust fault. Therefore the areas of Kumyshtag, Kara-Buura, Babahan, Shalbaly-Say, Chymtash and Tabylgaty have a potential for gold. Concerning the types of deposits, it is presumed to exist not only gold bearing veins but gold bearing skarn deposits formed in the carbonate rocks of Riphean series.

4-3 Relation between geochemical anomaly and mineralization

As the results of the reconnaissance geochemical survey, the gold concentration has been formed in the thirteen places near Uzunahmat-Kumyshtagsky thrust fault. The present survey has also revealed that the mineralization of lead and mercury is related to the fault parallel to Uzunahmat-Kumyshtagsky thrust fault and the mineralization of copper, vanadium and arsenic is related to Kumyshtag granite, and the mineralization of tungsten is related to the granite of Kumyshtag, Babahan and Manas.

The semi-detail geochemical survey has revealed that the mineralization of gold, tin, tungsten, beryllium and rare metal is related to Kumyshtag intrusive. The possibility of existence of gold veins but Shyraldzhyn deposit is presumed around geochemical gold anomalies.

As described above, the geochemical anomalies of the area are closely related to Uzunahmat-Kumyshtagsky fault and its subordinate faults and fractures. It is also suggested that the Kumyshtag granite is also closely related to the mineralization of this area.

Schematic metallogenic map including the survey area was already made by defunct Geological Department of Kyrgyz as showing in Fig. I -5. Although the ages of igneous rocks may be changed by further investigation, the original map is referred to in the present report. In this figure, it is also suggested that the Uzunahmat-Kumyshtagsky thrust fault and its subordinate faults and fractures, and the Kumyshtag granite of Silurian are closely related to the mineralization of this area.

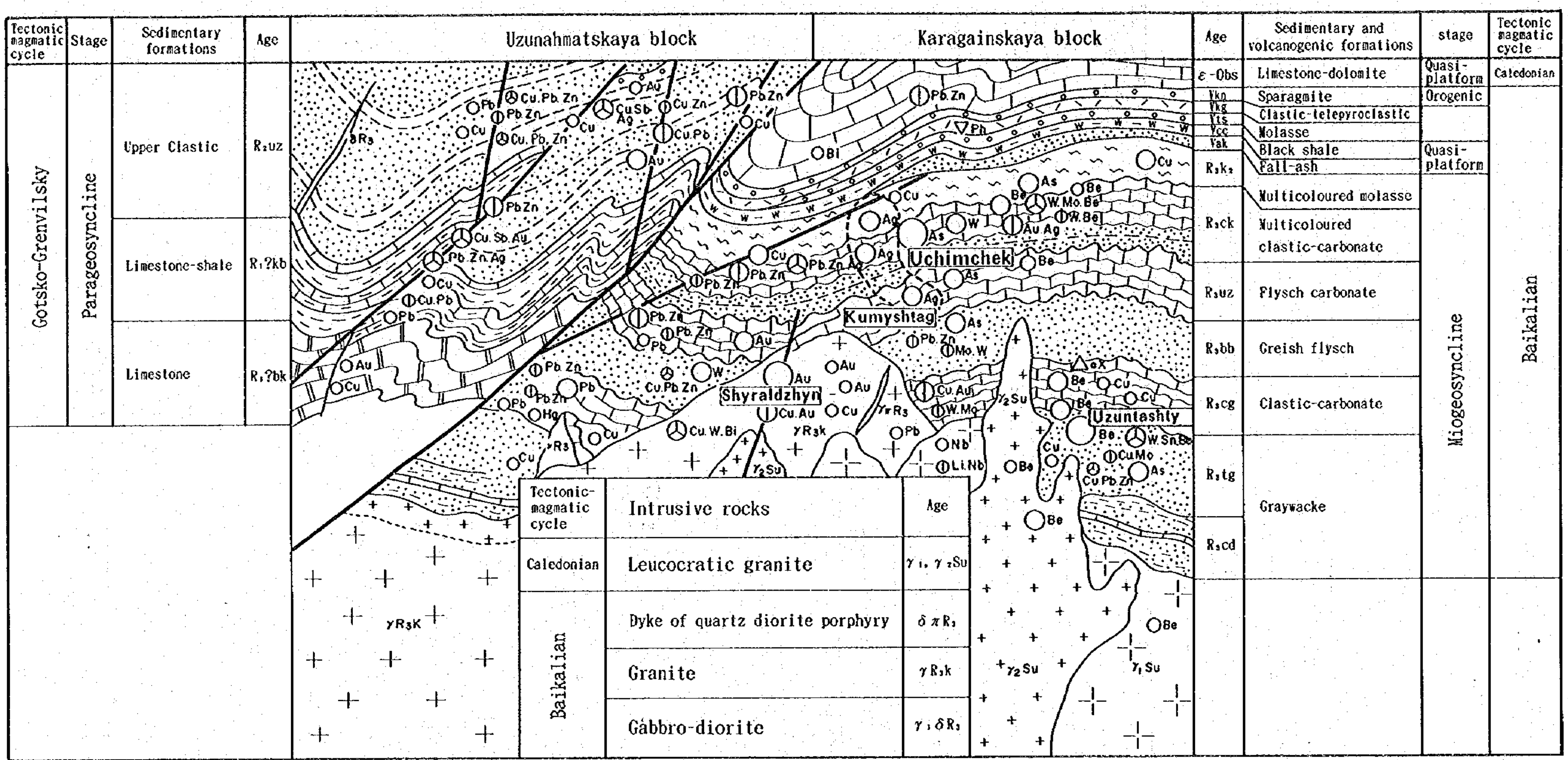

Fig. I-5 Metallogenic Map of in and around the Survey Area

CHAPTER 5 CONCLUSION AND RECOMMENDATION

5-1 Conclusion

The survey area is composed of the various geological units from Proterozoic to Cenozoic Era which are intruded by the granite of Babahan and Kumyshtag. Various type of ore deposits of gold, silver, lead, zinc, arsenic, beryllium, copper and tungsten are located in the area. The mineralization has taken place in the limestone and sandstone of Upper Riphean series - Vendian series of Proterozoic and Kumyshtag granite. From the geological structure and characteristics of ore deposits of this area, the mineralization is classified into ① vein type and massive mineralization related to Uzunahmat-Kumyshtagsky thrust fault and its subordinate faults or fractures, and ② vein type, greisen and skarn type mineralization related to Kumyshtag granite of Silurian.

Shyraldzhyn gold deposit has been investigated by trenching and has not yet explored the downward extension. The reserves of P ore (Probable ore) are estimated to be 16 tones of gold, with average gold grade of 5 g/t. As there are geochemical anomalies for gold around this deposit, the mineralized area could be expanded.

A lineament analysis of the satellite images has revealed that a group of silver deposits including Dzholsay deposits in the western part of the survey area are lined along the east - west fault, and the lineaments of north-northwest - south-southeast to northwest - southeast predominate in the area covering the west of Kumyshtag deposits in the eastern part of the area and Sarymsak deposit in the north central part of the area.

The satellite image analysis has also revealed that the area is composed of thirteen geological units which almost correspond to the existing geological map expect for Kumyshtag granite. The area of Kumyshtag granite in the image is much wider than that of the previous geological map.

A spectral analysis of the satellite images to extract alteration zones has disclosed the existence of anomalous zones in three areas. It is suggested that these anomalous zones may represent the alteration zones produced by the hydrothermal activity along the west-northwest - east-southeast fault or the skarn deposits formed in the carbonate rock of Riphean series.

The results of geochemical survey show that an anomalous gold concentration is located near the Uzunahmat-Kumyshtagsky thrust fault which is considered worthy to conduct further exploration.

5-2 Recommendation for the Phase II survey

Based upon the results of the phase I survey, the following exploration is recommended to be carried out in the phase II survey.

(1) Detailed geological investigation and diamond drilling are to be carried out in Shyraldzhyn gold deposit which are found out by the State Committee on Geology, Usage and Protection of Natural Resources.

(2) Geological reconnaissance and semi-detail geochemical survey are to be conducted in the following six area; Kumyshtag, Kara-Buura, Babahan, Shalbaly-Say, Chymtash and Tabylgaty where geochemical gold anomalies were formed by the State Committee on Geology, Usage and Protection of Natural Resources, with analysis of the previous data.

(3) Geological reconnaissance check survey is to be conducted for the anomalies extracted by the spectral analysis of satellite image in the areas of upstream of Babahan, upstream of Kumyshtag and upstream of Chymtash.

(4) Detail geological investigation for the known forty ore deposits or occurrences is to be conducted.

The above described survey with the priority according to the area (Fig. I-6) are summarized in Table I-6.

Table I-1 Summarized Recommendation for the Future Survey

	Geological & Geochemical Semi-detail Survey	Check Survey for Satellite Imagery	Check Survey for Deposits	Drilling	Priority for Survey Area
Babahan	◎	◎	○		3
Shalbaly-Say	○				4
Kara-Buura	◎		◎		2
Kumyshtag	◎	◎	◎		1
Shyraldzhyn			◎	◎	
Chymtash	○	○			5
Tabylgaty	○				6

Priority of the each surveying method ;
◎ : the First, ○ : the Second

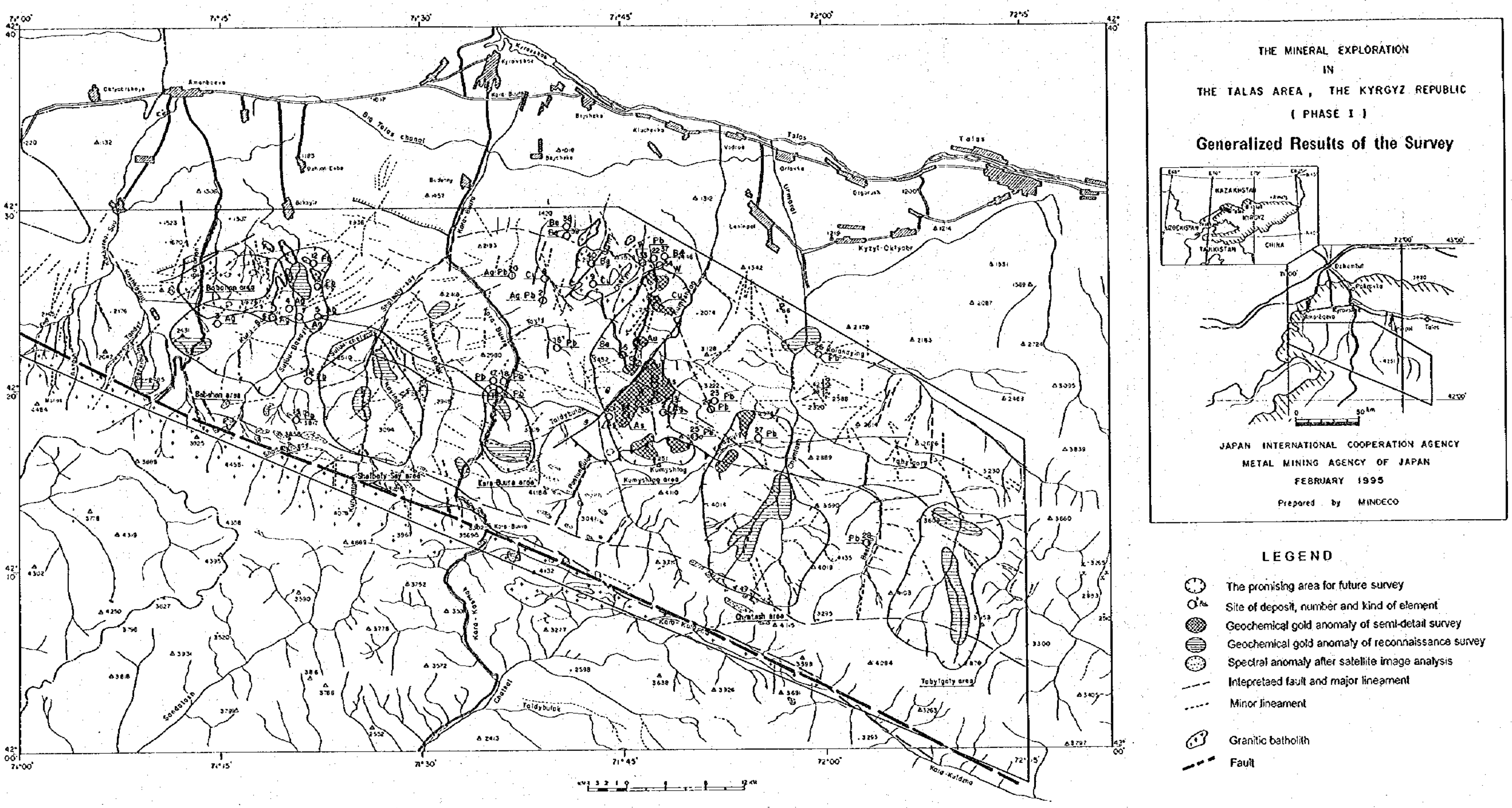

Fig. I-6 Generalized Results of the Survey

PART II

PARTICULARS

CHAPTER 1 ANALYSIS OF SATELLITE IMAGE

1-1 Method of analysis

1-1-1 Objectives

With the objectives to obtain the basic geological data for the next years field survey, a series of satellite image interpretation including classification of geological units, lineament analysis and detecting anomalous area possibility indicating mineralized alteration, has been conducted.

1-1-2 Used data

Four scenes of LANDSAT TM data of Path 152~153 / Row 30~31 have been used for this analysis. The area of these scenes and the data are shown in Fig. II-1-1 and Table II-1-1.

Cloudy area was less than 10% of the total area in each scene. The main ridge of the Talas Ala-Too mountain range, is excluded from the analysis due to the thick cloud cover and snow fall. The pixels of cloud and snow are excluded in the analysis as they cause disturbances in the spectral analysis. Half inches of CCT (Computer Compatible Tape) is used in this analysis.

1-1-3 Details of analysis

The data analysis has been done in the following procedure.

(1) Preparation of digital mosaic.

As the objective area is divided into four scenes in the satellite image, a digital mosaic data to cover the whole area into one scene have been prepared and used for analysis in order to evaluate the whole area uniformly. The digital mosaic data are prepared in the following procedure:

① About thirty GCP (Ground Control Point) were established in the marginal area of P153/R30 overlapping with the other three scenes.

② A geometric correction was made for three other scenes based upon the GCP of P153/R30.

③ Based upon the brightness of each bands of P153/R30, the brightness of all bands of visible to short wave infrared region excluding Band 6 (thermal infrared band) of three other scenes was corrected manually.

④ Delete the overlapping portion from three other scenes of P153/R30 and then combine the data of all scenes.

⑤ The objective area for analysis was selected including the principal cities, roads,

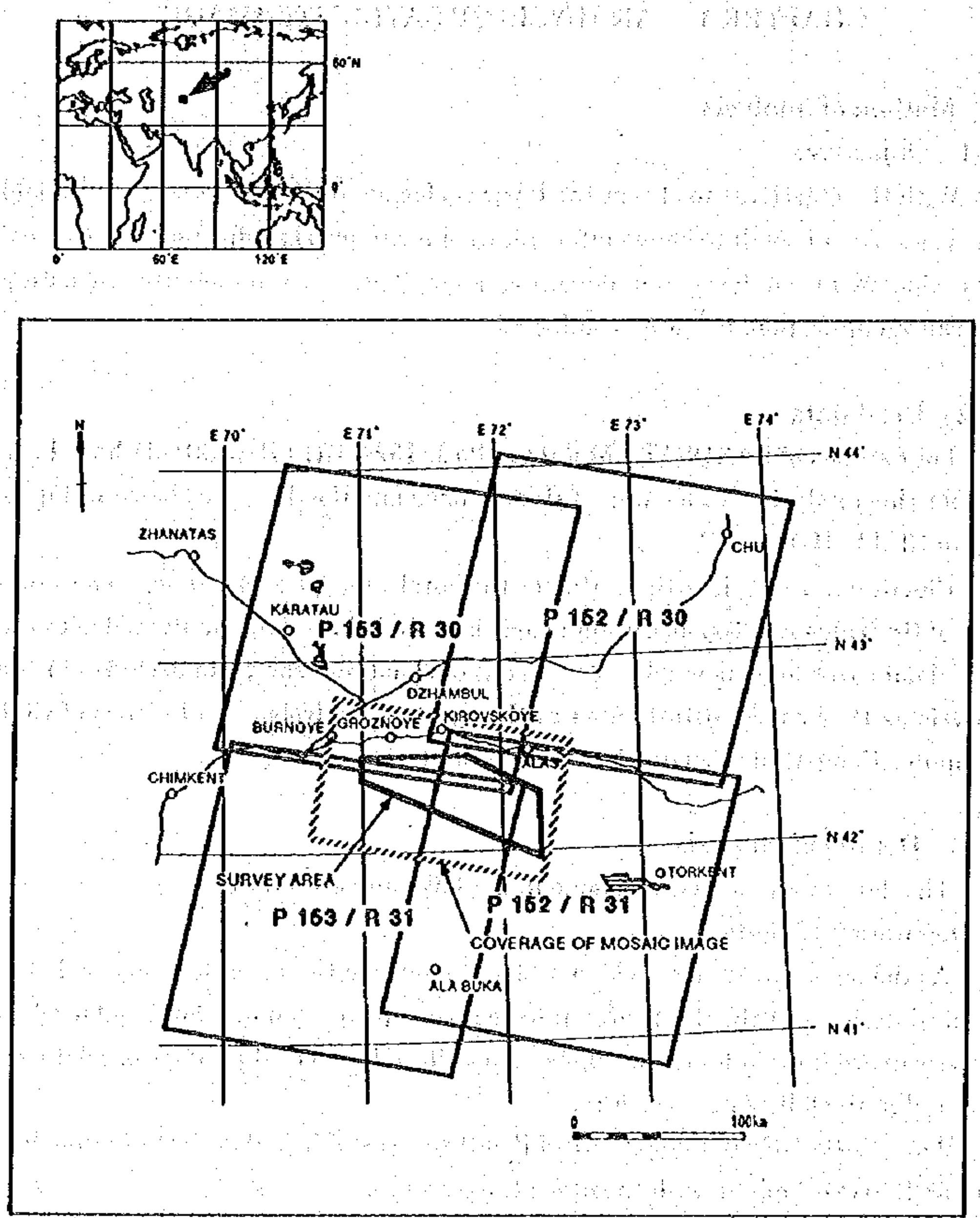

Fig. II-1-1 Ground Coverage of Satellite Data

Table II-1-1 Specification of Original Satellite Data

Satellite	Sensor	Path-Row	Scene I.D.	Date (Y/M/D)	Sun El./ Az. (degree)
LANDSAT 5	TM	152-30	52340000000	90/07/27	55/123
LANDSAT 5	TM	152-31	53412000000	93/07/03	59/117
LANDSAT 5	TM	153-30	52379000000	90/09/04	46/136
LANDSAT 5	TM	153-31	52315000000	90/07/02	59/117

railroad etc., which make possible to determine the exact locations.

(2) Preparation of false color synthetic image

In order to distinguish different geological units in the image, the most adequate combination of spectral information and texture information of the image data was selected. Several different types of false color synthetic image with low correlation coefficient between the different bands and high entropy of information source have been prepared. Then the most adequate combination of bands was selected. As the results, the false color image of Band 1 (blue), 4 (green) and 5 (red) was considered to be reflected the topographic information most well and it was expected that the difference of tone in the image may represent different lithofacies. A false color synthetic image of Band 1 (blue), 4 (green) and 5 (red) processed with linear stretching and edge enhancement was output into film. Then a paper prints with the scale of 1/200,00 was produced and used for interpretation.

(3) Preparation of alteration extraction image

The existing analytical methods effective to extract alteration zone have been studied as follows:

① Ratioing Band 3/Band 1 : Extraction of the minerals of iron oxides and iron hydro- oxides.

② Ratioing Band 5/Band 7 : Extraction of clay minerals and carbonate minerals.

③ Ratioing synthetic image : Assign red, green and blue colors for ratioing Band 3/ Band 1, Band 5/Band 4 and Band 5/Band 7. The area of red color represent the mineral distribution of iron oxide and iron hydro-oxide. Green color represent clay minerals and carbonate minerals.

④ DPCA (Directed principal component analysis)

Ratioing Band 5/Band 7 is also known to represent vegetation. As this area is heavily vegetated, it is necessary to distinguish vegetation and clay-carbonate minerals. A principal component analysis using Band 5/Band 7 and Band 4/Band 3 which has a high reflectance to green vegetation has been conducted. The spectral anomaly caused by vegetation showed good correlation between Band 4 /Band 5 and Band 5/band 7, while the spectral anomaly caused by alteration minerals does not show correlation. In the heavily vegetated area like this survey area, the first principal component in the above mentioned principal component reflect vegetation and the second principal component reflect the alteration minerals.

As there is no available information on the alteration zone, it was not possible to conduct a spectral analysis using the spectral patterns of known alteration minerals as supervisor. Therefore a false color image, assign red for ratioing Band 3/Band 1 and green for the second principal component in DPCA was produced.

In outputting the false color image, if the results of ratioing and principal component analysis are simply put out, the information of topography would be lost and then it would be not available to determine the area of spectral anomaly of the image in topographic map and field survey. In order to dissolve above mentioned weak points, a synthetic false color image, composed of two components, is produced and put out to film. These two components are multiplied Band 5, which is mostly reflected the difference with values of brightness by ups and downs of topography, by the ratioing of Band 3/Band 1 and the second principal component, respectively. The false color image with scale of 1/200,000 was put out to print and used for analysis.

(4) Photogeologic interpretation

Using a 1:200000 false color synthetic image, the following work was carried out by photogeologic technique.

① Extraction of lineaments

Continuances of linear valley, ravine or saddle from the image which were presumed by geological cause, were extracted as lineaments, and drawn on a lineament map of 1:200,000 in scale. In extracting, lineaments were divided into two ranks by clearness (depth or continuity of valley) of topography which formed lineaments. Ridge or valley which was continued as a circular structure was extracted. Structure that was indicated as a fault on the existing geological map and that was extracted as a clear lineament on the image, was marked as a fault in the lineament map. In addition, anticlinal axes which were presumed as anticlinal structure by strike and dip of stratum, were shown in the map.

② Geological units

Based on photogeologic characteristics such as a color tone on the image, a drainage pattern, a texture, a difference of resistance for erosion and development of bedding or schistosity, a 1:200000 geologic interpretation map was made from false color synthetic image. As the direction of strike and dip or the degree of dip of the stratum could be clearly interpreted from the image, their directions were marked on the map. For anticlinal structure which was presumed by the direction of strike