REPORT
ON
THE MINERAL EXPLORATION
IN
THE WESTERN ERDENET AREA
MONGOLIA

(Phase II)

MARCH 2003

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINIBG AGENCY OF JAPAN

PREFACE

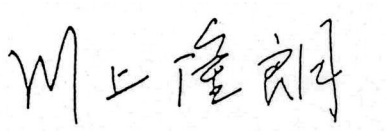
In response to the request of the Government of the Mongolia, the Japanese Government decided to conduct a Mineral Exploration Project in the Western Erdenet Area and entrusted the project to the Japan International Cooperation Agency (JICA) and the Metal Mining Agency of Japan (MMAJ).

JICA and MMAJ sent to Mongolia survey teams composed by 6 members from July 2002 to September 2002 for geological survey and geophysical survey and by 2 members from January 2003 to March 2003 for drilling survey.

The team exchanged views with the officials concerned of the Government of Mongolia and conducted a field survey in the Western Erdenet area. After the team returned to Japan, further studies were made and the present report has been prepared. This report includes the survey results of geological survey, geophysical survey and drilling survey carried out until Phase II.

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

March 2003



Takao Kawakami
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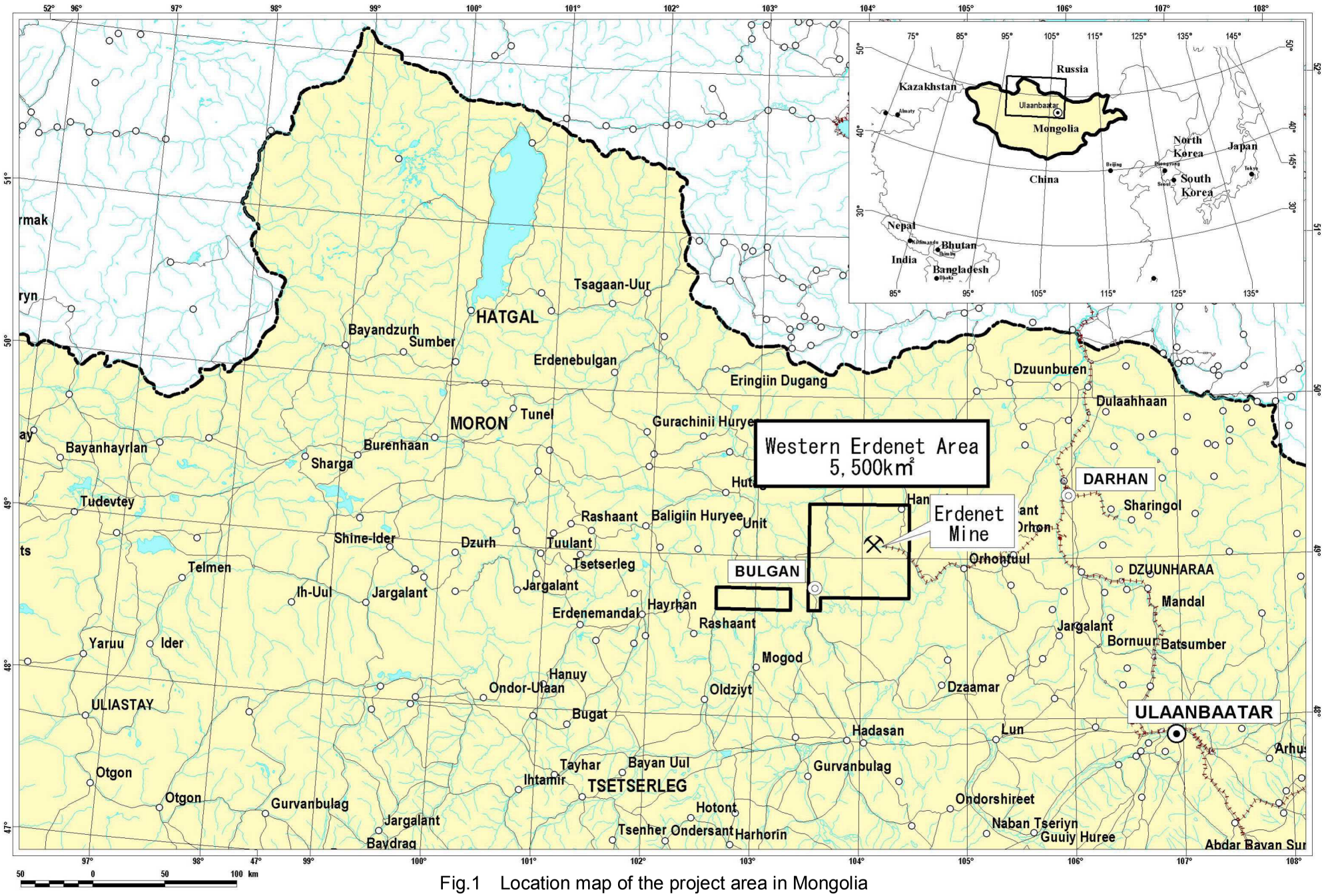

Fig.1 Location map of the project area in Mongolia

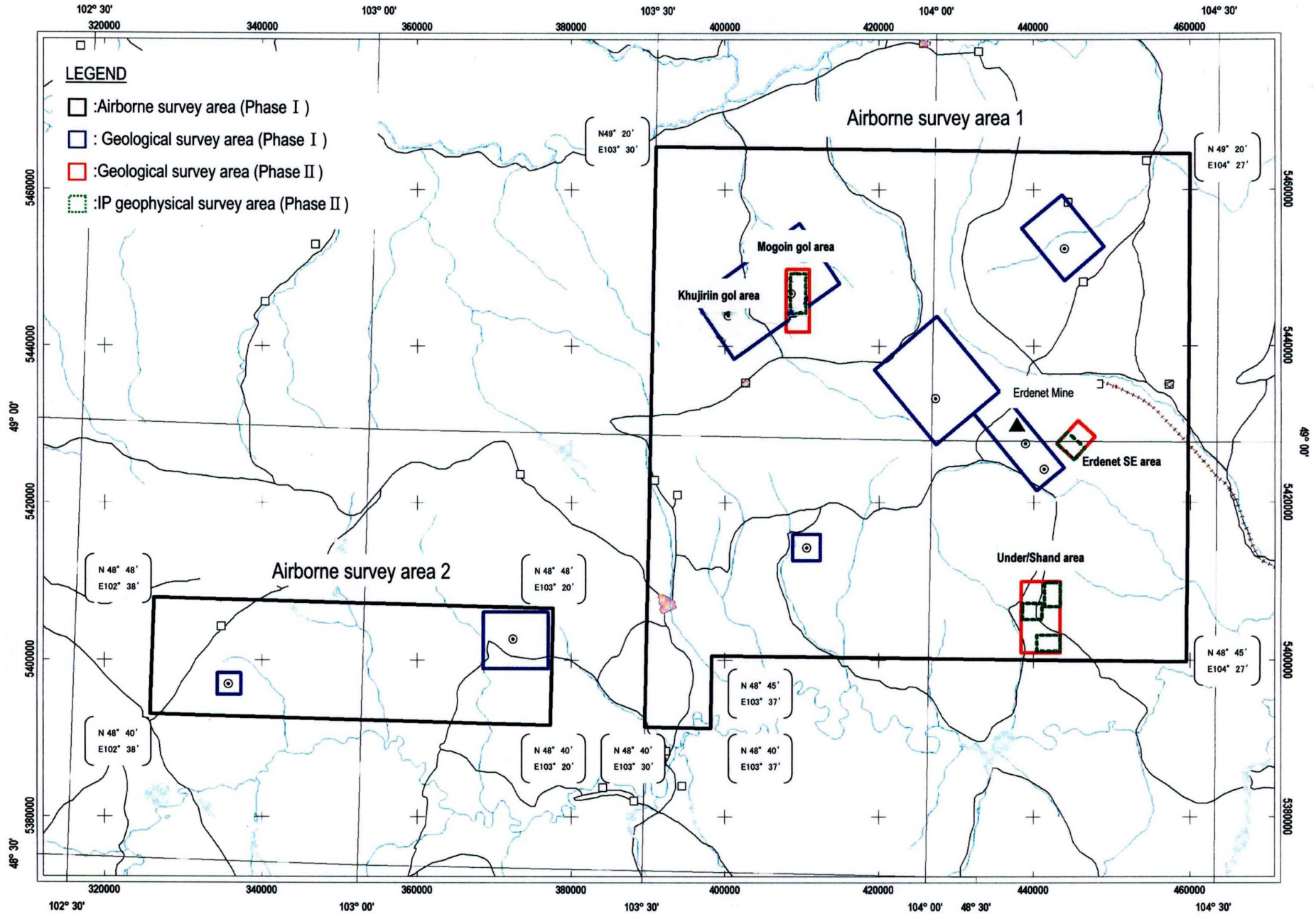

Fig.2 Location map of the survey area in the Western Erdenet area

ABSTRACT

In accordance with the Scope of Work signed on 18th May 2001 between the Governments of Japan and Mongolia, a mineral exploration project was carried out in Western Erdenet area, Mongolia in order to discover new ore deposits in the survey area. This project has started from 2001 with duration of three years. The present report describes the survey results of the second year (Phase II).

During this phase, geological survey, airborne geophysical survey and drilling survey have been conducted in the Erdenet SE area, the Under/Shand area and the Mogoin gol area within the project area that covered an extension of 5, 500 km^2. The results of the survey is summarized the below:

In the northeastern part of the Erdenet SE area, a white silicified zone is confirmed. However, clear IP anomaly could not be detected in the area where IP geophysical survey was conducted. The K-Ar dating indicated that the granodiorite of Selenge complex shows radiometric age of 196 Ma. Rock chemistry shows that a diorite in the area has a nature of adakitic rocks as same rock chemistry as granodiorite porphyry in Erdenet mine area. It is thought that the low magnetic anomaly in the Erdenet SE area detected in last year is caused by intrusion of adakitic diorite. As IP effect could not be, however, detected in the area, it is low possibility that the igneous rock related to the mineralization generally exist in the area. Consequently, no further work is recommended in the area.

Within the Under/Shand area, a clear IP anomaly was detected on the Shand mineral showing in the Under/Shand_3 area. The Shand mineral showing is located at the cross point of the north-south lineament and the NW-SE lineament The mineral showing is a blind deposit covered by Quaternary deposits. Alteration represents sericite-chlorite type that is a part of alterations related to the formation of the porphyry copper deposit. IP anomaly is detected in the showing, which a small-scale low resistivity zone and a high chargeability zone are overlapped in the area. However, the drilling survey with 17 holes had been conducted in the showing and detected the mineralization. On the other hand, in the northwest outside of the Under/Shand_3 area, high ore assay values including copper content were confirmed in the medium grained granodiorite with potassium alteration. In the central east part of the Under/Shand area, white silicified zone accompanied by pyrite dissemination is confirmed. Consequently, no further work is recommended in the Shand mineral showing and the Under mineral showing. It is recommended that the geological survey will is conducted again in order to reassess the central east part at first, and if it is good result, TDIP geophysical survey and drilling survey will be recommended in order to clarify the mineralization and geology.

White silicified zones are distributed in the northern part and southern part of the Mogoin gol area. The area is located in the crossing point of the east-west fault zone and the NW-SE fault zone. The diorite with radiometric age of 208 Ma and the rhyolite porphyry with radiometric age of 210 Ma have a chemical nature of adakitic rock and the radiometric ages are close and similar to the radiometric ages (190Ma to 210 Ma) of sericite occurred in the Erdenet mine. Size of the north silicified zone is 1.2 km in north-south and 2km in east-west. The mineral assemblages of hydrothermal alteration represent the quartz-sericite type in the central part and, the sericite-chlorite type and the chlorite type in the surrounding area. The alteration indicates as some alteration zoning as the hydrothermal alteration model of Erdenet mine. The central part of the south silicified zone

represent the quartz-sericite type alteration including biotite, topaz and andalusite. The alteration zoning cloud not be confirmed in the zone. Generally speaking, the alteration minerals are able to be confirmed in high sulfidation system related to acid hydrothermal alteration. The system is developed in the upper part of the porphyry copper ore deposits system in general. Maximum values of ore assay are Cu:0.026%, Mo:0.001%, Pb:0.021%, Zn:0.004% and FeO_2:1272%, and low vales. Factor scores of factor 5 (Hg-Cu) are high in the north silicified zone and the south silicified zone. The size of low magnetic intensity is large. The IP geophysical survey results indicated that low resistivity, high chargeability and high metal factor represent large and wide scale and are overlapped in center of the Shar Chuluut mountain. Based on the results of the geological survey and geophysical survey, drilling survey with MJME-M1 hole (501.80m in depth) and MJME-M2 hole (500.20m in depth) were conducted in the zone and detected the surrounding mineralization of polymetallic type and porphyry copper type mineralizations including ore minerals of pyrite, chalcopyrite, sphalerite and galena.

According to survey results of Phase II, the following survey programs will be recommended:

(1) The north silicified zone of the Mogoin gol area, the drilling survey will be recommended. If the results will detect good mineralization, TDIP geophysical survey will be recommended in the extended area toward east in order to clarify mineralization, geology and related IP anomalies in total. The soil chemistry exploration will recommended in the phase III survey area in order to clarify the geochemical features related to porphyry copper mineralization such as Erdenet ore deposits.

(2) In phase I survey, a low magnetic anomaly was detected in the Zuukhiin gol area. The crossing point of NW-SE fault zone and NE-SW fault zone is located in the area. The alteration in the central area of the area represents sericite-chlorite type alteration as some alteration as Erdenet mine area. Assay results show that copper values are more than Cu: 50 ppm and Cu: 11.740 ppm in maximum. The factor related to chemical activity of porphyry copper-molybdenum ore deposit is detected in the area and the factor score is high. The mineralization continues up to more than 300 m in depth. The existing data indicated that exploration in the area gave up because of low ore assay caused by drilling survey. However, as EX-EW method can be used, If oxide ores of more than Co: 0.3% are concentrated in the area, there is possibility of development of mine. The re-assessment for the deeper part of the area will expect by geological survey, geochemical survey, geophysical survey and drilling survey.

(3) According to Phase I survey and Phase II survey, it can be indicated that the porphyry copper type mineralization such as Erdenet mine ore deposit is related to the adakitic igneous rock and is located in the low magnetic anomaly in the high magnetic zone detected by the airborne survey. For the other area in the project area during phase III survey, the following programs will be recommended: 1) making a reinterpretation comparing the airborne survey results and the existing geological maps, 2) selecting again the high potential areas from the project area, 3) conducting the geological survey and geophysical survey in the selected areas including the Khujiriin gol area and 4) finally conducting the drilling survey in the high anomalous zones.

CONTENTS

PART II SURVEY RESULTS

PART I GENERALITIES

CHAPER 1 INTRODUCTION

In accordance with the Scope of Work signed on 18th May 2001 between the Government of the Mongolia and the Government of Japan, a mineral exploration project of three years duration began from 2001 in the Western Erdenet area. This year program is the second phase. The members who participated during this phase were sent from Japan and Mongolia respectively.

1-1 Background and Objectives

The purpose of this survey is to clarify geology and a mineral potential in order to find new ore deposits at the western Erdenet area (Fig.1) in Mongolia. The purpose of the project also includes the transfer of technical knowledge to our Mongolian counterpart.

In this second phase, a geological mapping was carried out in the Erdenet SE area, the Under/ Shand area and the Mogoin gol area and derived to construct a mineralization model. A geophysical survey with IP method was also carried out in the Under/ Shand and the Mogoin gol areas to clarify the resistivity and IP anomaly related to the mineralization. In considerations of geological information and interpretations of geophysical data, the areas for drills in the third phase should be focused.

1-2 Coverage and Outline of Phase II

Phase II survey program includes the activities of geological mapping, geophysical survey and drilling survey.

The work amounts conducted in this phase are summarized in Table I-1-1, while the laboratory studies are shown Table I-1-2.

Table I-1-1 Contents and amount of works

Area and Content	Amount of work
Geological Survey (Erdenet SE area, Under/ Shand area and Mogoin gol area)	Reconnaissance Area: 60 km^2 Survey route: 62 km Scale: 1 to 25,000 Semi-detailed mapping Area: 48 km^2 Survey route: 111 km Scale: 1 to 10,000
Geophysical Survey (IP method) (Under/ Shand_1 area, Under/ Shand_2 area: Under/ Shand_3 area, Mogoin gol area)	Area: 41.45 km^2 Survey line: 165.8 km Survey point: 3,325 points
Geophysical Survey (IP method)* (Erdenet SE area)	Area: 6 km^2 Survey route: 24 km Survey point: 380 points

*: carried out by MMAJ

Area and contents	Hole number	Direction	Inclination	Drilling length
Drilling survey	MJME-M1	-	90°	501.80m
	MJME-M2	-	90°	500.20m

Table I-1-2. Laboratory works

Survey Contents	Laboratory work	
Geological napping	Thin section	51 samples
	Polished section	51 samples
	X-ray diffraction analysis (bulk)	161 samples
	Chemical analysis for whole rock samples SiO_2, Al_2O_3 TiO_2, Cr_2O_3 Fe_2O_3 MgO, CaO, K_2O, P_2O_5 MnO LIO, Ba, Nb, Rb, Sr, Y, Zr (major and minor elements)	12 samples
	Chemical analysis for ore samples Au, Ag, Al, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sr, Ti, V, Zn (23 elements)	66 samples
	Chemical analysis for rock samples Au, As, Sb, Hg, Ag, Al, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sr, Ti, V, W, Zn (28 elements)	251 samples
	Fluid inclusion (Homogenization temperature/ Na content)	5 samples
	K-Ar Dating	5 samples
Geophysical survey	Resistivity and chargeability	37 samples
Drilling Survey	Thin section	13 samples
	Polished thin section	20 samples
	X-ray diffraction analysis	58 samples
	Chemical analysis for ore Au, Ag, As, Cu, Mo, Pb, Zn, S, Si, Fe (10 elements)	620 samples
	Fluid inclusion	6 samples
	Resistivity and chargeability	10 samples

Amounts of work for geological mapping consist of the following contents:

Erdenet SE area: Reconnaissance / 10 km, Semi-detailed / 11 km

Under/ Shand area: Reconnaissance / 30 km, Semi-detailed / 46 km

Mogoin gol area: Reconnaissance / 22 km, Semi-detailed / 54 km

Total survey rout: 62 km, 111 km

Amounts of work for geophysical survey consist of the following contents;

Under/ Shand_1 area: 30 km

Under/ Shand_2 area: 20.8 km

Under/ Shand_3 area: 24 km

Mogoin gol area: 91 km

Total survey line: 165.8 km

1-3 Survey Members of the Project

The members who participated during this phase are as follows:

Japanese counterpart		Mongolian counterpart	
Motomu Goto	Team leader, Geologist	Dambiisuren Bold	(MRAM)
Yoshimitsu Negishi	Geologist	Sengee Muuhkbaatar	(MRAM)
David Esukobaru	Geophysics	Chinbat Ganbat	(MRAM)
Susumu Endo	Geophysics	Shiiter Battuvshin	(MRAM)
Masaru Fujita	Geophysics	Purev Tumenbayar	(MRAM)
Kurae Iwaki	Geophysics		
Kazuyuki Kadoshima	Drilling engineer		

1-4 Survey Period

Periods of the field survey in this phase are as follows:

Geological mapping: 22nd July 2002 to 23rd September 2002

Geophysical survey : 22nd July 2002 to 23rd September 2002

Drilling survey: 17th January 2003 to 18th March 2003

CHAPER 2　GEOGRAPHY OF THE PROJECT AREA

2-1 Location and Accessibility

The western Erdenet area is located in the Bulgan District and Erdenet city of the northern-central part of Mongolia. The total area of the project area is 5,500 km^2. Mobilization by vehicles to the project area takes approximately 10 hours for 340 km from Capital Ulaanbaatar to the Erdenet city.

2-2 Topography and Drainage System

The topography is generally gentle hillside and flat grassland with the elevation of 1,000m to 2,000mASL. However, the topography is. The land is covered by plain and forest and outcrops of rocks are very few. As main rivers in the area, there is the Okhon River running northeast in the southern part, and the Selenge River running east in the northern part. The prominent ridges and valleys trending NS to NW-SE develop with crossing these rivers.

2-3 Climate and Vegetation

The weather consists of a typical continental climate. This area presents few rainfalls and a dry weather. As shown in Table I-2-1, temperature has a great difference between summer and winter, as well as between day and night. In winter, minimum temperature is under –40 ℃. Snow damage has been a seriously issue in recent years. It is the best season to live as it continues pleasant days from summer to autumn.

Table I-2-1 Mean monthly Temperature and Precipitation
of Bulgan and Ulaanbaatar in Mongolia

Province center	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (℃)												
Bulgan	-21.3	-19.2	-9.5	0.8	8.6	14.7	16.3	14.4	7.5	-1.3	-11.4	-19.2
Ulaanbaatar	-26.1	-21.7	-10.8	0.5	8.3	14.9	17.0	15.0	7.6	-1.7	-13.7	-24.0
Precipitation (mm)												
Bulgan	1.4	2.1	3.9	9.4	24.5	57.1	10.1	77.9	30.2	11.4	3.6	1.8
Ulaanbaatar	1.5	1.9	2.2	7.2	15.3	48.8	72.6	47.8	24.4	6.0	3.7	1.6

CHAPER 3 EXISTING GEOLOGICAL INFORMATION

3-1 General Geology of the Surrounding Area

(1) General geology and ore deposits in Mongolia

Geographically, Mongolia is a country located between Russia to the north and China to the south. Geologically, Mongolia is located in the eastern edge of orogenic belt (Central Asia Folded belt) between Angara craton (Siberian Block) to the northern side and the Northern China craton to the southern side. The mobile belt of about 2,000km existing from Mongolia to Far East Russia is called the Mongol - Okhotsk Fold Belt or the Ural - Mongol Fold belt. According to several studies, the geological framework of Mongolia is formed by Cordilleran type orogeny or Collision type orogeny (Maruyama et al., 1997). The Cordilleran type orogeny forms accretionary prism – magmatic arc accompanied with subduction surrounding Siberian craton and North-China craton in the Paleo Asia Ocean or Mongolian Seaway. The Collision type orogeny was formed by the approach of two cratons. Recently it is vastly recognized that island arcs and micro-continentals existed in Altaids and that the Mongolian geological formation consists of the assembly of accretionary prism and magmatic arc; however, the stratigraphic correlations between geologic divisions have not been analyzed yet.

Various mineralization types exist in Mongolia due not only to magmatic activity accompanied by a subduction process in the Tuva-Mongol island arc with continental crust existing from early Proterozoic, but to magmatic activity accompanied by the collision process of Angara craton and North-China craton. The porphyry type copper-molybdenum deposits and the gold deposits related to the plutonic rocks are considered to have considerable economic significance.

(2) General geology in the project area.

(a) General geology

The project area is located in the western Tuva-Mongol Unit on the south of the Vitim Structure, which is a large structural line trending east to west. The geology in the area corresponds to magmatic island arc formed by accretion on subduction system from Vendian of Proterozoic to late Permian.

The general geological maps in the project area are shown in the Fig I-3-1(1) and (2) based on the existing geological data and the geological map compiled from the interpretation results of JERS-1 imagery (MMAJ, 2001) is presented at Fig.I-3-2. The generalized stratigraphic columnar section in the project area is shown Fig. I-3-3.

In the eastern project area, trachybasalt, trachyandesite, tuff and sandstone from Permian to Triassic are widely exposed. The Selenge complex from Permian to Triassic, consisting of granite, granodiorite, gabbros, etc., and the Triassic granitic rocks of monzonite, granite, granodiorite and

syenite intrude in the above Permian to Triassic rocks. The Triassic to Jurassic volcanic rocks cover them. Finally, the Quaternary alluvial deposits are distributed along streams.

Around the western area of Bulgan city in the southwestern part of the project area, granite of Paleozoic and syenitic rhyolite, syenitic dacite, comendite, basalt, pyroclastic rocks and sandstone of Permian are distributed. The Jurassic molasse faces of conglomerate, sandstone and mudstone cover unconformable them.

(i) Stratigraphy

In the project area, Devonian to Jurassic volcanic rocks and sedimentary rocks are widely distributed. Permian to Jurassic plutonic rocks intrude into them. Quaternary sedimentary rocks and volcanic rocks cover the above. Followings are brief descriptions on distributions by geology and lithofacies:

Devonian: Middle to early Devonian is distributed in western part (Area 1) of the area and is presented by diabasic porphyry, siliceous porphyry, acidic tuff and tuff breccia, rhyolitic dacite, porphyrite, intermediate tuff and tuff breccia and variegated tuff.

Permian: Early Permian is widely distributed from the north-western part of the project area to the Erdenet mine and to the southern part, and consists of diabasic porphyry, porphyry, rhyolitic dacite, intermediate tuff and tuff breccia, porphyrite and conglomerate. Late Permian is distributed from the northeastern part to southern part of the area and composed of diabasic porphyry, porphyry, rhyolitic dacite, intermediate tuff and tuff breccia, porphyrite and conglomerate like early Permian.

Triassic to Jurassic: Late Triassic to early Jurassic is distributed around the Erdenet mine of the central western part of the project area and in the southern part of the area in an oval shape of 40km on EW and 30km on NS. This formation distributes in the northeastern edge of the project area too and consists of sediments including quartz porphyry, argillaceous rock, silt, greywacke, conglomerates and volcanic rocks including tuff, diabasic porphyry, porphyrite, agglomerate, trachy andesite and rhyolitic dacite.

Quaternary: Quaternary is composed of sedimentary and volcanic rocks. The sedimentary are distributed along the streams and rivers, and composed of clays, silts, sands and gravels. The volcanic rocks are distributed in the western project area and composed of vesicular dark-gray alkali basalt.

(ii) Plutonic Rocks

The plutonic rocks are widely distributed in the western and eastern part of the project area, and consist of Permian to Jurassic calc-alkaline to alkaline granitic rocks. Permian plutonic rock are called as Selenge Complex and composed of mainly granite, granodiorite and diorite, and minor gabbro and syenitic granite to diorite. Around the Erdenet mine, the plutonic rocks are divided into the Selenge Complex and Erdenet Complex. The Erdenet Complex is composed of granite-porphyry and

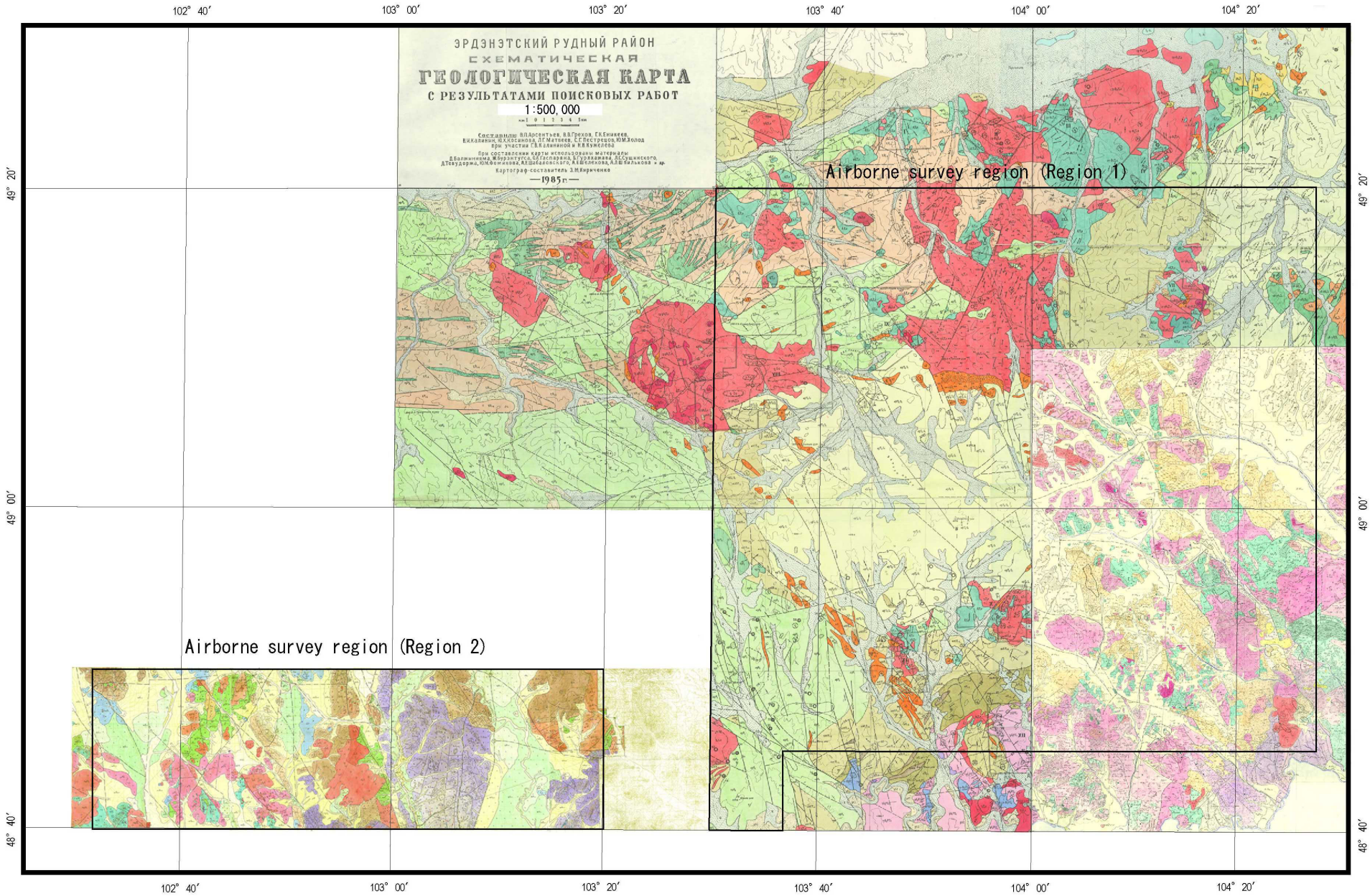

Fig.I-3-1(1)　Existing geological map in the project area in Mongolia

L E G E N D

(Central Area)

CENOZOIC SEDIMENTARY AND VOLCANIC ROCKS

βKZ	Cenozoic basalt
Q	Quaternary deposits; loam, silt, sand and gravel

JURASSIC TO CRETACEOUS SEDIMENTARY ROCKS

J2–K1	conglomerate, gravel stone, sandstone

TRIASSIC TO JURASSIC SEDIMENTARY AND VOLCANIC ROCKS

αβT2–J1	andesite, andesitic basalt, trachy-andesite, trachy-basalt, dacite and tuff-breccia, tuff stone, tuffaceous sandstone
tT2–J1	sedimentary rock: conglomerate, gravel stone

PERMIAN SEDIMENTARY AND VOLCANIC ROCKS

αβP2	andesite-basalt and tuff, trachy-basalt and tuff, tuffaceous conglomerate
tP1–2	tuff, sandy tuff, gravel stone, conglomerate
αγtP1–2	andesite to liparite, liparite, andesitic tuff, tuffaceous stone, tuff
αP1–2	andesite, andesite to basalt, tuffaceous stone

DEVONIAN

RIPHEAN TO CAMBRIAN

V–Э	Riphean to Cambrian; limestone

INTRUSIVE ROCKS

Jurassic	λJ	Jurassic subvolcanic rock; liparite, andesite-dacite
	γ3J1s	Third phase: fine to moderate grained, leucocratic granite
	γξ2J1s	Second phase: moderate to coarse grained, porphyry, biotite granosyenite
	(δ–γδ)J1s	First phase; fine to moderate grained, diorite, biotite granodiorite
Triassic to Jurassic	νβT2–J1	Middle Triassic to Jurassic subvolcanic rocks; gabbro, diabase, diabasic porphyry
Triassic	γ3T1s	Third phase: fine to moderate grained, porphyry, leucocratic granite porphyry, granite porphyry, granodiorite porphyry
	(γ–δ)T1s	Second phase; medium grained, biotite granodiorite, diorite, granite, granosyenite
	(υ–δ)T1s	First phase; medium to coarse grained, gabbro, gabbro to diorite, diorite
	νβP2	Late Permian; Gabbro-diabase, diabase, diabase porphyry, gabbro
	λP1–2	Lower to upper Permian subvolcanic rocks
Devonian		
Paleozoic	γδPZ1	Second phase; medium to coarse grained, biotite granodiorite, granite
	(υ–δ)PZ1	First phase; medium to coarse grained, pyroxene gabbro, gabbro to diorite, diorite

(Southwestern and Southeasteren Area)

αQIV, caQIV, epQIII–IV	Quaternary deposits; loam, silt, sand and gravel
β2QII–III	Cenozoic basalt
J2sh	Jurassic to Cretaceous deposits; conglomerate, gravel stone, sandstone
T3–J1mg	andesite, andesitic basalt, trachy-andesite, trachy-basalt, dacite and tuff-breccia, tuff stone, tuffaceous sandstone
P1uz2	andesite to liparite, liparite, andesitic tuff, tuffaceous stone, tuff
P1uz1	andesite, andesite to basalt, tuffaceous stone
D2ot2	andesite, dacite, it's tuff
ξJ1	syenite
γ3P2–T1sl	Third phase: leucocratic granite porphyry, granite porphyry
εγP2–T1sl	Third phase: fine to moderate grained, porphyry, leucocratic granite porphyry, granite porphyry, granodiorite porphyry
γξ2P2–T1sl	Second phase; medium grained, biotite granite, granosyenite
ξδ1P2–T1sl	First phase; medium to coarse grained, granodiorite, syenitic diorite
δη1P2–T1sl	First phase; medium to coarse grained, gabbro to diorite, diorite
δ1P2–T1sl	First phase; medium to coarse grained, diorite
γ3D2	Third phase; granite, granosyenite and granosyenite.
ιγ3D2	Third phase; leucocratic granite
ειγ3D2	Third phase; fine grained leucocratic alaskite granite and aplite
γ2PZ1	Second phase; granite
γδ2PZ1	Second phase; granodiorite
δ1PZ1	First phase; diorite

GEOLOGICAL MARKS AND PATTERNS

- Fine grained type, basic dyke, moderate dyke, acidic dyke, granite to granodiorite porphyry dyke
- granite, granodiorite, granodiorite porphyry, liparite, andesite to dacite
- contact with hornfels
- strike and dip of strata and bed
- folding of strata and bed
- geologic boundary; certain and uncertain
- boundary of massive part
- Faults and fractures; certain, uncertain, expected
- Thrust fault; certain, expected

ALTERATION

Alterated and metasomatic zone

Limits	Mark	Alteration
	mk	potassic alteration
	q	silicification
	tu	tourmaline
	src	sericitization
	py	pyritization

MINERALIZATION

Copper mineralization area

Area	Copper showing	Geochemical anomaly	Mineral distribution
I	●: Cu > 0.2 % ○: Cu < 0.2 %	Cu > 0.01% Mo > 0.0005%	ch: chalcopyrite
I - Nurain	VII - Zuukhiin	Pb > 0.01 % Zn > 0.03 % Ag > 0.0001%	mo: molybdenite
II - Tarimaliin	VIII - Mujirt		ma: malachite
III - Iitiin	IX - Mogoin		gn: galena
IV - Havchugin	X - Zalugiin	Cu, Mo, Pb, Zn, Ag	ce: cerussite
V - Buhain	XI - Danbatseren		cs: cassiterite
VI - Ingetiin	XII - Haliun		sh: scheelite
			au: gold

Fig.I-3-1(2) Legend of existing geological map in the project area in Mongolia

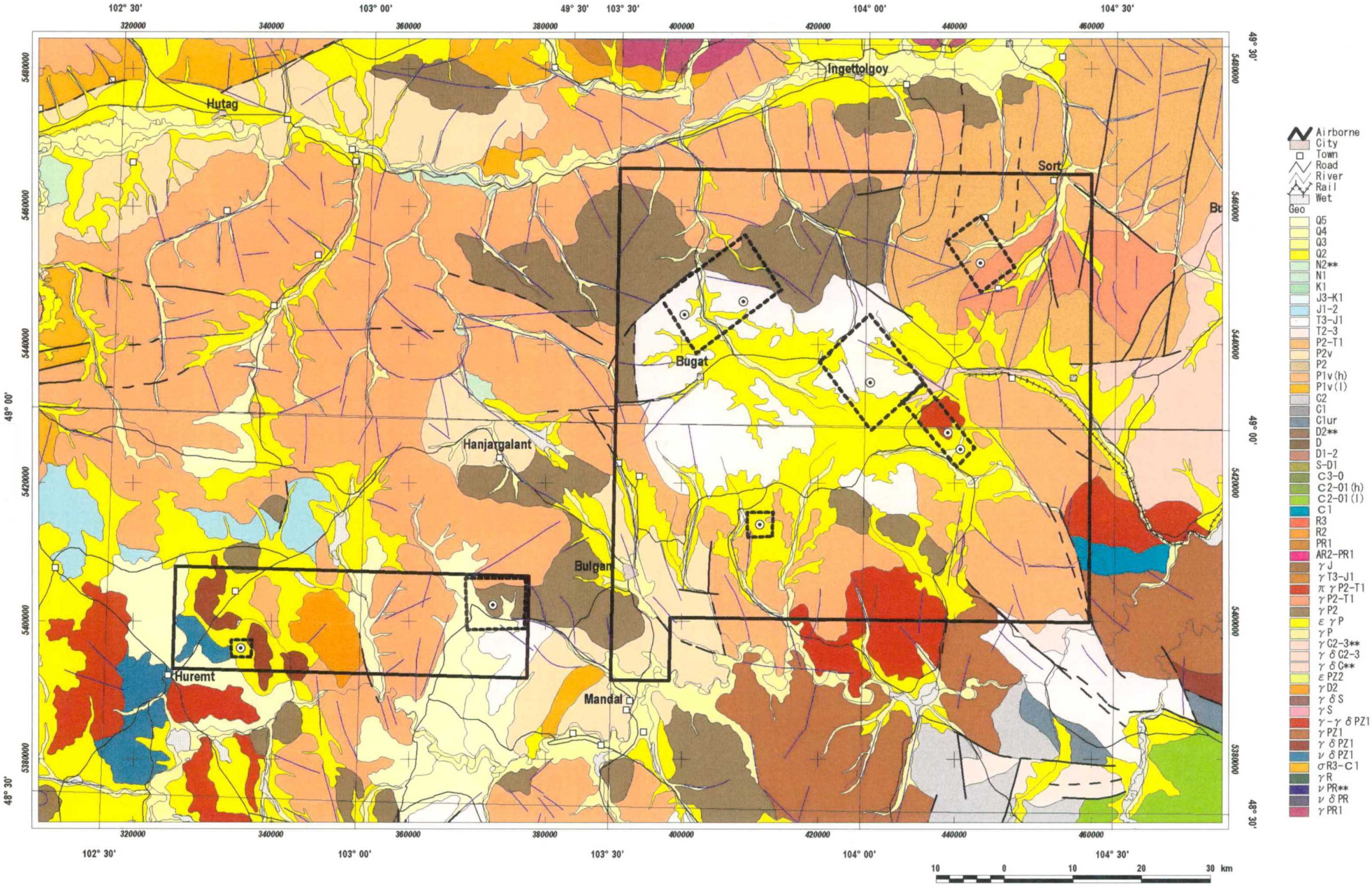

Fig.I-3-2 Geological interpretation map of the Western Erdenet area by JRS-1 image

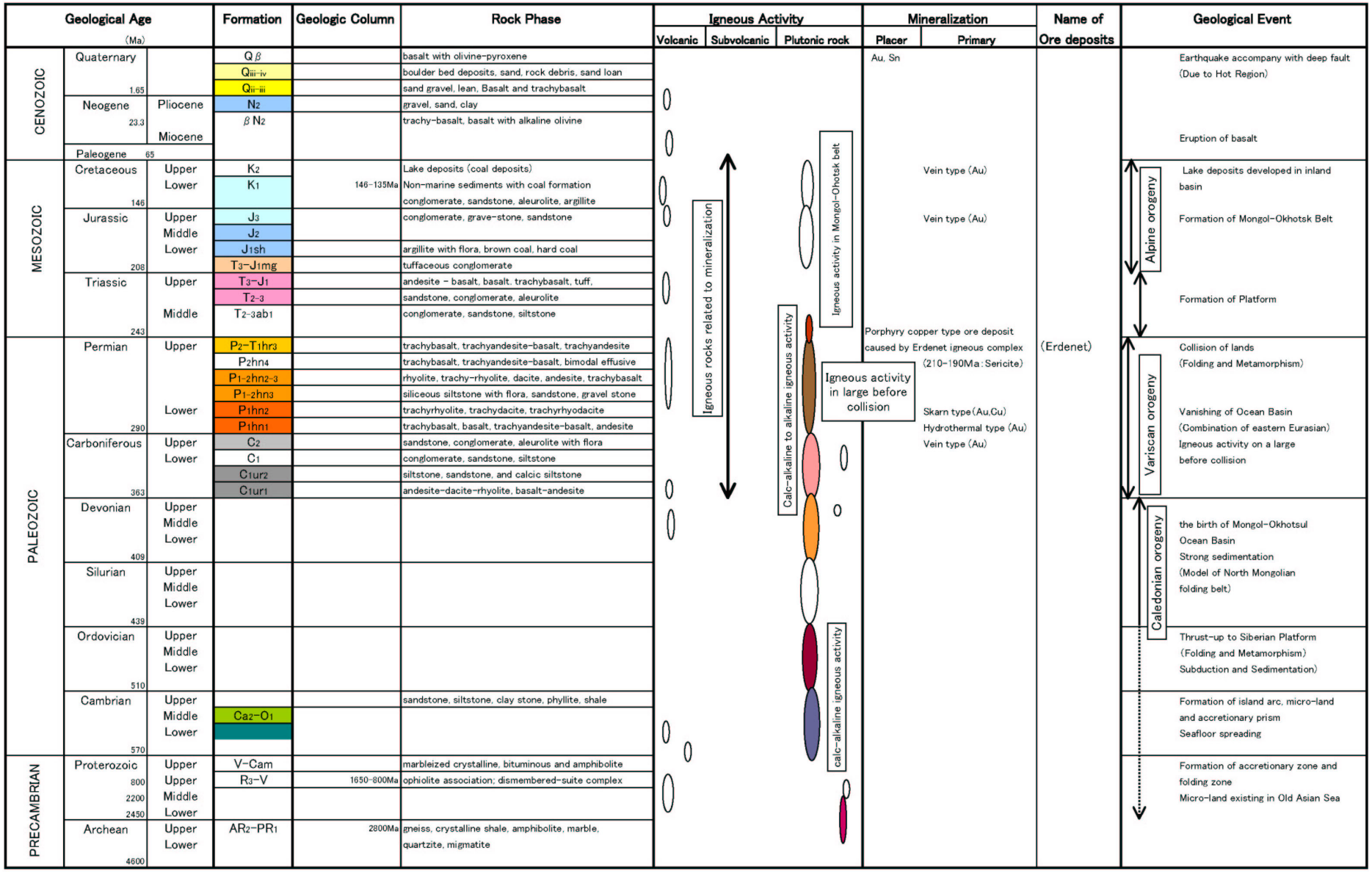

Fig.I-3-3 Generalized stratigraphic columnar section in the project area, Mongolia

granodiorite porphyry. In the Erdenet mine, the host rock of the porphyry Cu-Mo mineralization is the Selenge Complex and the igneous rock related to the porphyry Cu-Mo mineralization is the Erdenet Complex.

(iii) Dykes

Dykes intrude into the volcanic rocks of Devonian, Permian and Triassic volcanic rocks and Permian, Triassic granitic plutonic rocks. The dykes are composed of aplitic granite, liparite, fine-grained diorite, gabbro, dioritic porphyrite, andesitic porphyrite, trachytic andesite, basaltic porphyrite and others.

(b) Geological structure

The project area is geologically located in the western Tuva-Mongol Unit on the south of the Vitim Structure, which is a large structural line trending east to west. The geology in the area corresponds to magmatic island arc formed by accretion on subduction system from Vendian of Proterozoic to late Permian.

In the project area, the structure of plutonic rocks arrangements, the basin structure, dyke arrangement structure and fault structures can be confirmed.

Plutonic rocks arrangements: Permian to Triassic plutonic rocks are arranged along a NW-SE direction around the Erdenet mine area, the Mogoin gol area. On the other hand, the distributions and the arrangements elongate to NS direction in the northeastern part of the area.

Basin structure: Late Triassic to early Jurassic Volcanic rock is distributed in the circular area from the Erdenet mine area to the Mogoin gol/Khujiriin gol area. This distribution shows the basin structure with diameters around 40 km in the EW direction and 30 km in NS direction.

Small body structure: Liparite dyke and stocks are developed surrounding the basin structure including the distribution of the Triassic to Jurassic volcanic rocks. The direction of dykes in the southwestern part of the project area is probably controlled by the existence of deep faults in the area.

Faults structure: Typical faults can be recognized in the existing geological map of the project area. NW-SE faults system is developed in the western part of the area. In the northeastern part of the area, NE-SW faults are developed. The Erdenet mine exists in the junction of the NW-SE faults and NE-SW faults.

3-2 General mineralizations in the Project Area

(1) General mineralizations

Mineral deposits and occurrences in the project area are indicated in the mineral location map (G. Dejidmaa etc, 2001) shown in Fig. I-3-4. Three types of mineralization exist in the project area as

follows;

① Porphyry Cu-Mo deposits and mineralization zones hosted in the porphyry and granitic rocks,
② Copper mineralization related to basalt dykes and
③ Gold vein type and stockwork type related to granitic rocks.

① Porphyry Cu-Mo deposits hosted in the porphyry and granitic rocks

Typical ore deposit distributed in the area is the Erdenet ore deposit composed of the Erdenet NW deposit, the Erdenet Central deposit, the Erdenet Intermediate deposit and the Erdenet SE deposit. In the southeastern part of these deposits, there are the Shand mineral showing, the Tourmaline mineral showing, the SAR188 mineral showing and the SAR200 mineral showing.

Other mineralizations such as the Zuukhiin gol mineral showing, the Mogoin gol mineral showing, the Khujiriin gol mineral showing, the Tsagaan Chuluut mineral showing, the Danbatseren mineral showing and the Undrakh mineral showing are known as same type mineralizations. In the western part of Bulgan city, there are several showings as well.

② Copper mineralization related to basalt dykes

This type of mineralization is distributed around the Bulgan city.

③ Gold vein type and stockwork type related to granitic rocks

This type of mineralization is located in the Tsookher mert gold mineral showing.

(2) Mineralization features of the Erdenet deposit

The Erdenet copper deposits in the project area are the biggest porphyry copper-molybdenum deposit in eastern Asia. The mineralized zones in the area with six known ore bodies including the Erdenet mine and mineralizations show elongated NW-SE trends extending approximately 20km. The mineralization features are follows as;.

Regional background: The Erdenet ore deposits are reported to form in relation with the Permian to Triassic collision process (240 Ma) of the Siberian Block and the Mongol-Northern China block in the Eurasia by Watanabe (1998, 1999). The Selenge complex (290 to 240 Ma) represents deeper lithofacies of the igneous activities in the volcanic arcs that were formed in the northern, central and southern part of Mongol before the collision. At the latest stage of the igneous activity, the Erdenet complex (granodioritic porphyry; 250 to 245 Ma, 250 to 220 Ma and 205 to 195 Ma: Berzina et al., 1999) and the alkali rock (180 Ma) intruded and the Erdenet ore deposits were formed (190 to 210 Ma).

Geology: The Erdenet ore deposits exist in the junction of the granitic rocks arrangements, the dyke and the fault systems in NW-SE direction and the fault systems in NE-SW direction, and also in the southern edge of the Basin structure, late Triassic to early Jurassic deposit. Permian volcanic rocks,

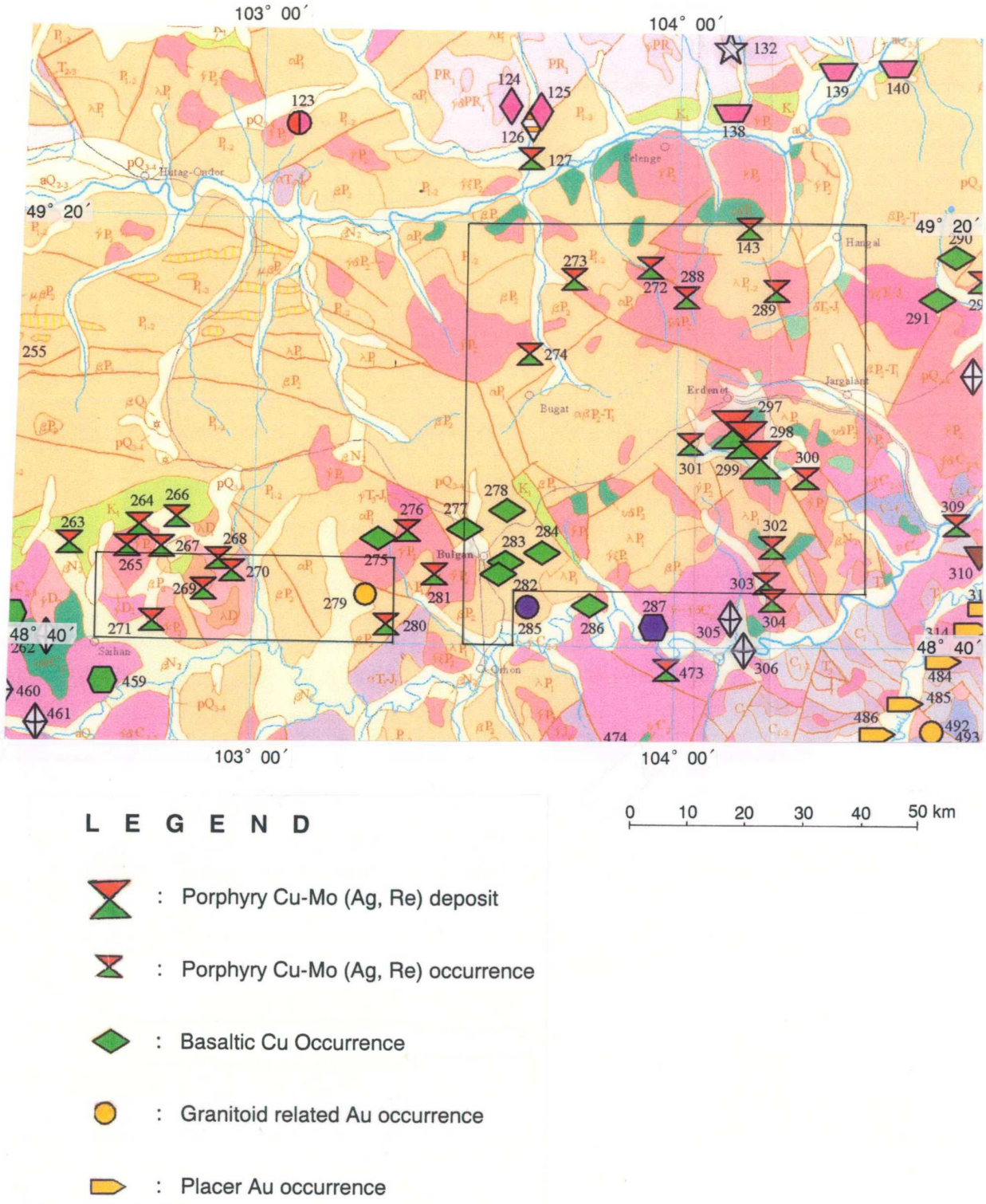

Fig.I-3-4 Generalized mineral location map in Western Erdenet area

the Selenge complex intrusion in the Permian intrusion and the Erdenet complex intrusion in the Selenge complex distributed around the Erdenet mine. In and around the Erdenet mine, the host rock of the porphyry Cu-Mo mineralization is the Selenge Complex, and the igneous rock related to the Erdenet ore deposit, the porphyry cupper-molybdenum deposit, is the Erdenet Complex composed of granite porphyry and granodiorite porphyry. The Erdenet Complex is composed of granite-porphyry, diorite porphyry and granodiorite porphyry.

Geological structure: In the project area, there are the granitic rocks arrangements, the dyke and the fault systems in NW-SE direction and the fault systems in NE-SW direction, shown as Fig. I-3-1. The Erdenet mine exists in the southern edge of the basin structure and also in the junction of these main faults.

Alterations: The alteration assemblages show a zoning of the strong silicification- greisen zone, quartz-sericite zone, sericite-chlorite zone and calcite-epidote-chlorite zone from the center to outward, accompanied with other spotty alterations (Naito and Sudo, 1999). Acid alteration, called as the advanced argillic alteration (the Tsagaan Chuluut area) and sericite alteration (the Mogoin gol area) are recognized related to the formation of porphyry Cu-Mo deposits in the project area.

Mineralizations: Oxide and leached zone is situated on the surface and the secondary enrichment zone composed of chalcocite, bornite, covelite and oxide copper beneath the oxide and leached zone. Primary ores composed of chalcopyrite, bornite, pyrite and molybdenite beneath the secondary enrichment zone.

Results of the airborne geophysical survey: The Erdenet mine is located in the northern part of the lowest small magnetic zone in a lower magnetic anomaly trending NW-SE direction. Porphyry forming the Erdenet complex is located in the lowest small magnetic anomaly and thus it is recognized that the porphyry is of relation with generation of porphyry copper-molybdenum deposits. High potassium content is occupied due on the Erdenet deposits and coincides with the rocks in the open pit and its surrounding waste dumps that reflects the alteration rocks bearing potassium.

3-3 Outline of the Mining History

The biggest porphyry copper-molybdenum deposit in eastern Asia exists is the Erdenet copper deposit. This deposit is composed of the Erdenet NW ore deposit, which is being mined as an open pit, the Erdenet Central deposit, the Erdenet Intermediate deposit and the Erdenet SE (Oyut) deposit, from north to south direction. The Erdenet Central deposit, the Erdenet Intermediate deposit and the Erdenet SE (Oyut) deposit already finished exploration including feasibility studies.

In 1941 the Erdenet deposits were firstly reported when the area was geological mapped by a USSR team. During 1964 and 1969 the exploration program were intensively performed by a cooperative work between the Czech-Slovakia and Mongolian Governments. Ore reserves were calculated with 512,000,000 tons including 4,300,000 tons contained copper.

In 1972 it was decided that the Erdenet mine be developed in cooperation with the Soviet Republic. In 1978 the Erdenet mine started operations with a production of about 4,000,000 tons per year. After that the production was increased to 16,000,000 tons per year in 1983 and 20,000,000 tons per year in 1989. To 1990 the copper concentrate of 30 % to 32 %Cu was produced 350,000 tons.

In 1995 the ores were extracted 20,900,000 tons grading 0.73 %Cu and 0.02%Mo which were equivalent to 152,570 tons copper metal and 4,180 tons molybdenum metal. Cu concentrate produced was 346,300 tons Cu (Cu grade in Cu Conc. is about 40%) and 3,900 tons Mo.

Erdenet Mining Corporation has operated the Erdenet Mine under joint management between Mongolia and Russia. In 2000 production summary of the Erdenet mine was as follows:

- Ore grade: Cut-off grade: Cu 0.25%
- Oxide ore: more than 0.70%.
- Oxide ores are processed by SX-EW, joint venture project with USA.
- Heap leaching: production rate of 5 to 4 tons copper per day.
- Ores mined: 24,000,000 tons/year at 0.69%Cu, 0.02 %Mo
  Including secondary enrichment ore of 40 % and primary ore of 60 %.
- Annual production: 40,000,000 tons/year
- Production of concentrate: 400,000 tons per year at 30%Cu, 1%Mo
  Contained 120,000 tons Cu metal, 2,000 tons Mo metal, 8,000 tons Ag metal.
- Ore reserve in 1999: 1,400,000,000 tons at 0.25%Cu COG
  (7,000,000 tons Cu, 200,000 tons Mo)
- Mine Life: 35 years
- Secondary enrichment zone: surface (1,600mASL) to 400m in depth.
- Oxide ore: surface to 100 to 300m in depth,
- Primary ore zone: Some drill holes with 1000m
  in length confirm primary sulfides at deeper zone
- Current mining level: 1,325mASL (8 levels).

On the basis of exploration surrounding the mine and feasibility study, ore reserves in the Erdenet Central deposit and the Erdenet Southeast (Oyut) deposit were calculated 1,250,000 tons (0.43%Cu, 0.018 %Mo) and 41,890,000 tons (0.40%Cu, 0.007%Mo) respectively.

The tenement of the Erdenet mine is limited in the vicinity of the Erdenet NW only which is currently mined and does not include other deposits such as the Central deposits etc.

CHAPTER 4　SUMMARY OF THE EXPLORATION RESULTS

4-1 Correlation Between Mineralizations and Geological Setting

Erdenet ore deposit, the biggest cupper-molybdenum deposit in the North-east Asia, is reported to be formed in relation with the Permian to Triassic collision process (240 Ma) of the Siberian Block and the Mongol-Northern China block in the Eurasia by Watanabe (1998, 1999). The Selenge complex (290 to 240 Ma) is representative of deeper lithofacies of the igneous activities in the volcanic arcs that were formed in the northern, central and southern part of Mongolia before the collision. At the latest stage of the igneous activity, the Erdenet complex, adakitic granodiorite porphyry related to the Erdenet deposit formation intruded into the Selenge complex.

In the above geological history the Erdenet deposit exists in the junction of the granitic rocks arrangements, the dyke and the fault systems in NW-SE direction and the fault systems in NE-SW direction, and also in the southern edge of the Basin structure, late Triassic to early Jurassic deposit. Alteration assemblages which include the strong silicification- greisen zone, quartz-sericite zone, sericite-chlorite zone and calcite-epidote-chlorite zone from the center to outward accompanied with other spotty alterations (Naito and Sudo, 1999) show a clear zoning. The analytical results of the airborne magnetic survey indicate that the Erdenet deposit and other deposits continuing to the south direction are located in the lowest magnetic zone in the NW-SE trending low magnetic anomaly. The results of the existing geophysical surveys indicate that the deposit area is located in low magnetic zone, high chargeability and low resistivity zone. As shown Fig. I-4-2, the formation model of the Erdenet ore deposit, copper- molybdenum ore deposit, was constructed from the geological and mineralization features around the ore deposit, as referred from Sillitoe (1995) and F. Charles F. (1986).

As the results of this phase, the specularite veins, the oxidized iron zones, azurite and malachite coating and spots are observed on the silicified zones in the northern and southern parts of the Mogoin gol area, where are recognized to be high potential area for ore deposit. The correlations between mineralizations and geological settings are as follows;

The Mogoin gol area is located in the cross point of the EWE-WSW trending faults parallel to the Vitim main structure line, EW trending big scale structure line in the northern part of the area, and the NW-SE trending faults which are arranged as an echelon and elongated from the Erdenet deposit. The main faults in the area are predominantly NNW-SSE, NW-SE and EW direction in the northern part, NW-SE and EW direction in the central part and NE-SW and EW direction in the southern part. The silicified zone in the northern part is distributed at the center of the Shar Chuluut Mt with a size of 2km east west, 1km north south. Alteration assemblages are quartz and quartz-sericite zone, the sericite-chlorite zone and the chlorite zone from the center to outward. This mineral assembles are the same type as the Erdenet deposit having a zoning of the sericite-chlorite zone and calcite-epidote-chlorite zone so that it is recognized these alteration assemblage and zoning are the

result of the acid alteration in association with a porphyry copper-molybdenum mineralization. In the silicified zone in the southern part, the alteration zones are assembled to be the quartz and quartz-sericite and the unaltered rock/ the chlorite zone from center to outward. However, the chlorite alteration zone is absent or extremely narrow.

Especially, the alteration zoning in the north white silicification zone is the same as the Erdenet ore deposit as shown in Fig. I-4-2.

4-2 Correlation Between Geochemical Anomaly and Mineralization

According to the statistical results of the rock chemical analytical data in the Mogoin gol area, the factors related to the mineralization are selected as Factor 2 (Mo), Factor 4 (Au-(Ag-Ni)) and Factor 5(Hg-Cu-(Co-Ni)). Overlapping zone of 3 high factor scores are distributed in the north silicified zone. High factor score of the Factor 5 is distributed in the south silicified zone, but high factor scores of the Factor 2 and 4 aren't. In the elements related to the above factors, the high geochemical anomalies of Au, Cu, Hg, Mo, Pb and Zn are distributed in the north silicified zone. The high geochemical anomaly isn't observed in the south silicified zone while the geochemical values of Au and Cu slightly indicate high. On the other hand, high factor scores of the Factor 2 and high geochemical values of Au, Ag, Cu, Pb, Zn and Mo are distributed in the southern part of the area where upper Triassic to lower Jurassic volcanic rocks and quartz trachytic stocks are distributed.

4-3 Correlation Between Geophysical Anomaly and Mineralizations

IP anomalies overlapped of the low resistivity zone and high chargeability zone detected by the geophysical survey (IP electric method) are distributed in the Under/ Shand_3 area of the Under/ Shand area and the southern and northern parts of the Mogoin gol area.

It is 135Ωm on the low resistivity, 58mV/V on the high chargeability and over 1.4kmX1.0km on the scale in the Under/ Shand_3 area. There is the known Shand ore deposit, porphyry copper deposit, in the area, and the above geophysical anomaly is recognized to indicate the distribution of this deposit. The sericite-chlorite alteration is observed on the surface but the quaternary cover on the almost surface. However, past 17 drillholes were carried out in the area and it is estimated to have geological resources of 500,000 tons contained Cu metal (ore grade: 0.2 %Cu), 5,000 tons contained Mo metal (ore grade: 0.001 %Mo).

IP anomaly, the low resistivity (53Ωm) and high chargeability(121mV/V) zone, are distributed in the north white silicification zone and its size is over 2.0km X 1.6km in shallower zone and over 2.5km X 2.8km in deeper zone. The silicified zone seizing 2km (EW direction) x 1km (NS direction) is distributed here and is assembled to be the quartz and quartz-sericite zone, the sericite-chlorite zone and the chlorite zone from center to outward. This mineral assembles are the same

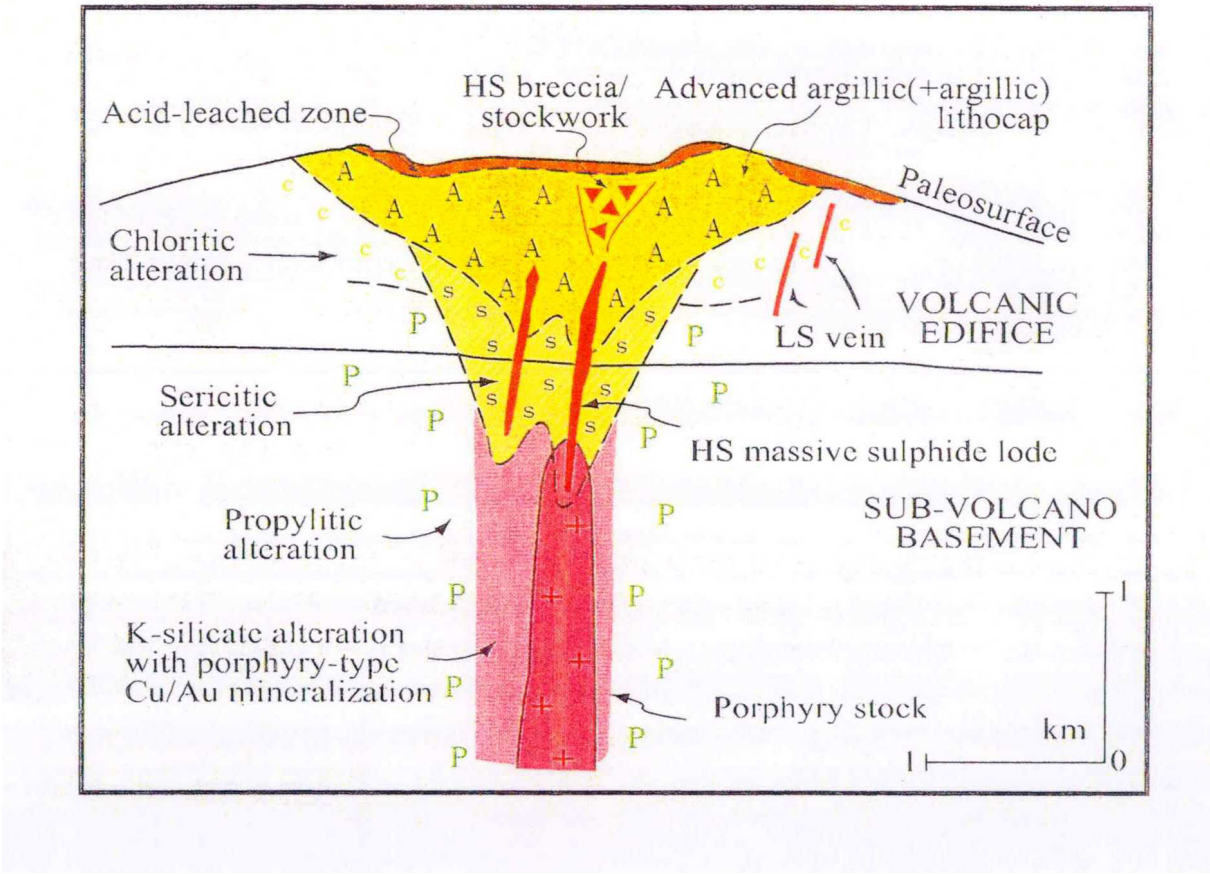

Fig.I-4-1 Idealized advanced argillic alteration (lithocap) and underlying porphyry Cu/Au deposit taken from Sillitoe (1995)

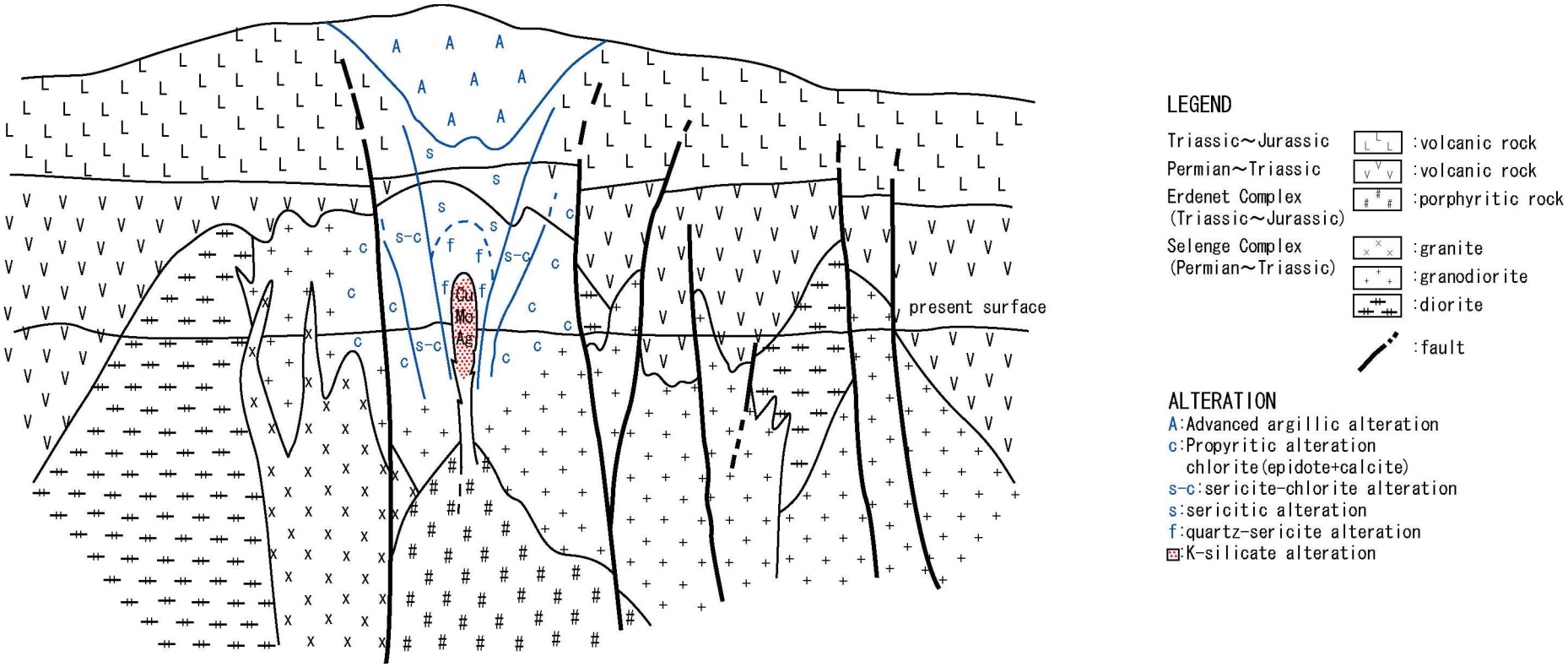

Fig.I-4-2　Genesis model of Erdenet ore deposit in early Jurassic

type as the Erdenet deposit. Geochemical anomaly is also detected.

IP anomaly, the low resistivity(74Ωm) zone and high chargeability(29mV/V) zone, are detected in the south white silicification zone and its size is 1.5km X 1.0km. IP anomaly distributes only at the shallow depth. The silicified zone, over 800m (NS direction) X 1400m (EW direction) on the scale, is distributed around here, and is assembled to be the quartz and quartz-sericite zone and unaltered/ chlorite zone from center to outward except for the chlorite alteration zone. High geochemical anomaly isn't detected, but the geochemical values of Au and Cu are slightly high.

4-4 Preliminary Evaluation of Mineral Potentiality

The Erdenet deposits are known to be located in the cross junction of the NW-SE trending structure zone and NE-SW trending structure zone and also in the edge of the basin structure. Alteration mineral assemblages indicate a zoning such as the quartz-sericite zone, the sericite-chlorite zone, the sericite-chlorite zone and the calcite-epidote-chlorite zone from center to outward. The deposit area coincides with the IP anomaly of the high chargeability and low resistivity zone.

The geological structures, alterations, mineralizations, geochemical anomalies and geophysical anomalies in the Mogoin gol area are similar to those of the Erdenet deposit. The Mogoin gol area, where the TDIP electric survey was carried out on the second phase, turned out to be high potential area for porphyry molybdenum deposits. However, an expected deposit probably exists 200 m below surface.

The Under/ Shand area is known to be the high potential area for porphyry cupper-molybdenum deposits. The IP anomaly overlapped by small-scale low resistivity, high chargeability and high factor score are detected in the Under/ Shand_3 area including the Shand mineral showing in the Under/ Shand area. 17 drillholes were already carried out in this mineral showing and the relationship between the mineralization and the IP anomaly is comprehended. The Shand mineral showing is the blind deposit covered by quaternary deposits so that TDIP electric method is effective to the exploration for the same type deposit. The alteration mineral assemblage is sericite-chlorite around this showing and it is possible to present a part of the mineral assemblages which is similar to that of the Erdenet deposit.

The Zuukhiin gol area is also known to be the high potential area for the porphyry copper-molybdenum deposit in the project area. The low magnetic anomaly is detected by the airborne survey at the first phase. The mineral showings in the area are regionally located in the cross junction of the NW-SE trending fault zone and the NE-SW trending fault zone. The alteration zone in the central part of the mineral showing is the same type as the Erdenet deposit. The values of Cu in rocks carry over 50ppm up to 11,740ppm and the factor scores, related to the porphyry cupper-molybdenum deposit, indicate high values. Existing drillholes indicate mineralization zone continues more than 300 m to depth.

There are several another high potential areas for copper-molybdenum deposits in this project

area. It is necessary to review the results of reanalysis for the previous data, geological mappings, the airborne surveys, geological and the geophysical surveys at the second phase for choose prospective areas.

Of the above areas, using the Mogoin gol area and the Under/ Shand_3 area, where were detected detailed structures by the TDIP electric method, as teachers, it could be possible to evaluate the mineral showing of the another potential areas.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5-1 Conclusions

The conclusions for the second phase for the Erdenet SE area, the under/ Shand area and the Mogoin gol area at the western Erdenet area of the Mongolia are summarized the followings. The results of this phase are also summarized in Table I-4-1 and I-4-2.

(1) Erdenet SE area

Geology is composed of the late Permian volcanic rocks, the quaternary sediment rocks, the Selenge complex intrusion, the late Permian granitic rocks, and dykes in this area. K-Ar age of the granodiorite of granitic rocks in the Selenge complex indicate 196Ma, the early Jurassic. Diorite is adakitic rock and indicates the same feature as the granodiorite observed in the Erdenet mine in the Selenge complex.

The main geological structures indicate the NE-SW direction of the dykes and the NS and NE-SW directions of the fault structures. The NW-SE trending faults are dominant along the river in the southern part of the area.

The mineral showing with the white silicification zone including quartz veins is confirmed in the northeastern part of the area. This alteration zone was formed by acidic hydrothermal alteration composed of quartz, plagioclase, K-feldspar, kaolin and sericite. Ore is of low grade.

In this area, though alterations are composed of quartz-K-feldspar-sericite-(kaolin), quartz-sericite-(kaolin), quartz-sericite-andalusite-(kaolinite), sericite-chlorite-epidote, and chlorite-epidote and chlorite, the alteration zones related to larger scale mineralization was not detected. Resulting from single-element and multi-element factor analysis of the rock geochemical values, geochemical anomalies related to the mineralization was neither detected. However, it is estimated that the adakitic diorite, which is equivalent to suitable igneous rock for generating porphyry Cu-Mo deposits like the Erdenet deposit, is distributed in the area but that there is no mineralization accompanied with the porphyry copper-molybdenum deposit.

As a result of the geophysical surveys (IP electric method), the high to medium resistivity continues to the deep part in the diorite to granodiorite of Triassic to Jurassic Selenge complex. The values of the low resistivity indicate the low possibility for the alteration, and the values of the low chargeability indicate the low possibility for the mineralization. Permian to Triassic dacite to rhyolitic tuffs indicate the high resistivity continuing to the deeper level with no low resistivity and high chargeability anomaly so that the possibility of mineralization and alterations here is low. The low resistivity is distributed in the shallow part of the quaternary which covers the almost area. The low magnetic anomaly detected by the airborne magnetic surveys carried out last year is recognized to be the result of existence of adakitic diorite but it is concluded that there does not exist igneous intrusions

Table I-5-1　Summary of geological survey results for each area

		Country rocks	Intrusion	K/Ar Dating (Ma)	Structure	Alteration	Mineralization	Rock Chemistry	Ore assay (in max)
Erdenet SE area		λtfP1hn1 λrhP1hn1rh	δ3P2-T1e γδ2P2-T1s Dαπ Dα	196	NE-SW NNW-SSE	Alteration zone 1)Qz-Kf-Ser 2)Qz-Ser 3)Chl Other 1)Ser-Chl 2)Chl-Epi	Pyrite Hematite Limonite	Cu: >40ppm Mo: -- Au: <1 ppb Ag: <1 ppb Factor 4(Hg): >1.5 Factor 7(Mo): >1.0	Cu: 0.003 % Mo: <0.001 % Pb: 0.004 % Zn: 0.002 % Au: <0.01g/t Ag: <5 ppm
Under/Shand area									
	Under/Shand_1 area	αP1hn1 αtfP1hn1 λαtfP1hn	λαtfP1hn γδπ2P2-T1s δ1P2-T1s Dλ		NE-SW	Under shouwing 1)Qz-Ser 2)Ser 3)Ser-Chl Other 1)Qz-Kf 2)Qz-Kf or Qz-Kf-Bi 3)Qz-Ser 4)Ser-Chl	Goethite Hematite Limonite		Cu: 0.002 % Mo: <0.001 % Pb: 0.003 % Zn: <0.001 % Au: <0.01g/t Ag: <5 ppm
	Under/Shand_2 area		ξπ3P2-T1s γδ3P2-T1 s ξπ2P2-T1 s γδπ2P2-T1s γδ2P2-T1s δ2P2-T1s	235-239	NW-SE	1)Fresh 2)Smec			
	Under/Shand_3 area		γδπ2P2-T1s γδ2P2-T1s γδ1P2-T1s		NW-SE	1)Ser-Chl 2)Chl-Epi 3)Fresh	Malacite Azurite Hematite Limonite		Northwest area Cu: 1,599 % Mo: <0.001 % Pb: 0.011 % Zn: 0.019 % Au: <0.01g/t Ag: 9 ppm
	Pyrite disseminated zone	αP1hn1 αtfP1hn1	γδπ2P2-T1s		EW	(Center to outside) 1)Qz-Bi 2)Chl-Epi Other 1)Qz-Ser 2)Ser or Ser-Chl 3)Chl-Epi	Pyrite Chalcopyrite Hematite Limonite		Cu: 0.014 % Mo: 0.003 % Pb: 0.005 % Zn: 0.002 % Au: <0.01g/t Ag: <5 ppm
Mogoin gol area									
	All area	αβanT2-J1 αβltT2-J1 αβtfT2-J1 αβanP2 αβtfP2	λJ1 γπJ1 δJ1 γδπ3T1s γδ3T1s δ3T1s ξγ2T1s γδ2T1s δ1T1s Dα	210 208	NNW-SSE Nw-SE EW WSW-ESE	South part area 1)Qz 2)Chl-Epi 3)Fresh	Qz Vein Limonite	Cu: >50ppm Cu max.: 140ppm Mo: >8ppm (max.12) Hg: >20ppb Au: >7ppb (max.65) Ag: >0.8ppm (max.1.0) Pb: >70ppm (max.272) Zn: <110ppm (max.304) Factor 2(Mo): >0.5 Factor 4(Au-Ag-Ni): >1.5 Factor 5(Cu-Hg): >1.0	
	North silicified zone	αβanP2 αβtfP2	λJ1 γπJ1 δJ1 γδπ3T1s γδ3T1s δ3T1s ξγ2T1s γδ2T1s δ1T1s Dα		NNW-SSE Nw-SE EW	(Center to outside) 1)Qz-Kf-Alu-Pyro 2)Qz or Qz-Ser 3)Ser-Chl 4)Chl 5) Fresh	Azurite Pyrite Specuralite Goethite Hematite Limonite	Cu: >50ppm Cu max.: 165ppm Mo: >8ppm (max.35) Hg: >90ppb (max.615) Au: >7ppb (max.11) Ag: <0.5 ppm Pb: >70ppm (max.208) Zn: <110ppm (max.244) Factor 2(Mo): >1.5 Factor 4(Au-Ag-Ni): >1.5 Factor 5(Cu-Hg): >1.5	Cu: 0.026 % Mo: 0.001 % Pb: 0.021 % Zn: 0.001 % Au: <0.01g/t Ag: <5 ppm
	South silicified zone	αβanP2 αβtfP2	λJ1 γπJ1 δJ1 γδπ3T1s γδ3T1s δ3T1s ξγ2T1s γδ2T1s δ1T1s Dα		NNW-SSE EW	(Center to outside) 1)Qz or Qz-And 2)Qz-Bi 3)Qz-Ser or Qz-Ser-And 4)Fresh or Chl	Azurite Pyrite Specuralite Goethite Hematite Limonite	Cu: >16ppm Mo: >1ppm Hg: >20ppb Au: >4ppb Ag: >1 ppm Pb: >40ppm Zn: <8ppm Factor 2(Mo): non Factor 4(Au-Ag-Ni) : >0.5 Factor 5(Cu-Hg): >1.5	Cu: 0.009 % Mo: <0.001 % Pb: 0.006 % Zn: 0.002 % Au: <0.01g/t Ag: <5 ppm

Table I-5-2　Summary of IP geophysical survey results for each area

		Geology			Airborne magnetic Survey (Phase I)	Rock Magnetic Intensity	TDIP Electric Survey		
		Country rocks	Intrusion	Structure			Resistivity	Chargeability	Metal Factor
Erdenet SE area		λtfP1hn1 λrhP1hn1rh	δ3P2-T1e γδ2P2-T1s Dαπ Dα	NE-SW NNW-SSE	Low Intensity (<59100 nT) 1.5km x 3km	Silicified Zone Low Intensity (1.00 – 0.01SI) 0.7km x 0.7km Acidic Volcanics Low Intensity (1.00 – 0.01SI) 0.6km x 0.6km	High Resistivity	Low Chargeability	Very Low
Under/Shand area	Under/Shand_1 area	αP1hn1 αtfP1hn1 λαtfP1hn	λαtfP1hn γδπ2P2-T1s δ1P2-T1s Dλ	NE-SW	Low Intensity (<59200 nT) 1km x 0.6km		High Resist.	Moderate Charg. max: 32mV/V 0.5km x 1.0km (Area:>18mV/V)	Very Low
	Under/Shand_2 area		ξπ3P2-T1s γδ3P2-T1s ξπ2P2-T1s γδπ2P2-T1s γδ2P2-T1s δ2P2-T1s	NW-SE	Low Intensity (<59300 nT) 1.2km x 0.6km		Low Resist.	Low Charg.	Very Low
	Under/Shand_3 area		γδπ2P2-T1s γδ2P2-T1s γδ1P2-T1s	NW-SE	Low Intensity (<59200 nT) 0.6km x 0.6km		Low Resist. Min.:135Ωm	High Charg. max: 58mV/V 1.4km x >1.0km (Area:>18mV/V)	Very High max: 38
Mogoin gol area	North silicified zone	αβanP2 αβtfP2	λJ1 γπJ1 δJ1 γδπ3T1s γδ3T1s δ3T1s ξγ2T1s γδ2T1s δ1T1s Dα	NNW-SSE NW-SE EW	Low Intensity (<59300 nT) 4km x 2km	Silicified Zone Low Intensity (1.00 – 0.01SI) 2.5km x 1km	Low Resist. Min.:53Ωm	High Charg. Max.:121mV/V 2.0km x >1.6km to 2.5km x >2.8km (Area:>18mV/V)	Very High
	South silicified zone	αβanP2 αβtfP2	λJ1 γπJ1 δJ1 γδπ3T1s γδ3T1s δ3T1s ξγ2T1s γδ2T1s δ1T1s Dα	NNW-SSE EW	Low Intensity (<59600 nT) 0.6km x 0.3km	Silicified Zone Low Intensity (1.00 – 0.01SI) 1km x 1km	Low Resist. Min.:74Ωm	High Charg. Max.:29mV/V 1.5km x >1.0km to 1.0km x 1.0km (Area:>18mV/V)	Moderate to low

accompanied with mineralization because of no IP effect.

The mineralization relating to the porphyry copper-molybdenum deposit could not be detected in the area by geological and geophysical surveys. Therefore, it is considered not necessary to continue explorations in the area.

(2) Under/ Shand area

Geology is composed of the late Permian volcanic rocks, the quaternary sediment rocks, the Selenge complex intrusion, the late Permian granitic rocks, and dykes in this area. Ages of the granodiorite ($\gamma\ \delta$ 1P2-T1s) and the granodiorite porphyry ($\gamma\ \delta\ \pi$ 2P2-T1s) indicate 235 Ma (medium Triassic; T3) and 239 Ma (medium Triassic; T3) respectively.

Main geological structures are the NW-SE, the NS and the NE-SW trending faults. The NW-SE trending potential fracture zones are estimated in the southern part of the area, from the distributions of the syenite porphyry ($\xi\ \pi$ 2P2-T1s) which arrange to the NW-SE direction. The NW-SE trending lineaments are predominantly distributed in the southern part of the area, and the NS and the NE-SW trending lineaments are predominantly distributed in the northern part from the satellite imagery. The Under mineral showing is located on the NS trending lineament and the Shand mineral showing exists on the cross junction of the NS and the NW-SE trending lineaments.

At the center of the acidic alteration zone in the Under mineral showing, the quartz-sericite alteration is present and the sericitization exists outward. Alteration mineral assemblages are considered the results of the acidic hydrothermal alteration. The size of the mineralization is small as 100m X 100m and the ore grades indicate low values such as 0.002 %Cu, less than 0.001 %Mo, 0.003 %Pb, less than 0.001 %Zn and 0.83 %Fe.

The Shand mineral showing is the blind deposit covered by quaternary deposits. Mineral assemblage is sericite-chlorite around the showing and is widely distributed. It is possible that this alteration assemblage indicates a part of alteration assemblages in relation with the porphyry copper-molybdenum deposit in the Erdenet mine.

The greenish oxidized coppers of the film-like malachite and azurite are observed in the potassium metasomatized medium-grained granodiorite, and the maximum ore grades carry 0.119 %Cu, 0.036 %Pb, 0.116 %Zn and 24 ppm Ag.

The pyrite dissemination zone with the silicified zone in the western central part of the area is the oxidized zone which is composed mainly of limonite. Quartz, K-feldspar, biotite, alunite, andalusite and kaolin are present in the central part of the mineralization, and chloritization occur outward. Ore minerals such as spotty azurite and chalcopyrite, the disseminated pyrite, goethite, hematite and limonite were observed. Ore grades returned 0.001 to 0.014 %Cu, less than 0.001 to 0.003 %Mo, 0.003 to 0.005 %Pb, less than 0.001 to 0.002 %Zn and 0.40 to 8.55 %Fe.

As a result of the geophysical surveys, the medium IP anomaly was detected in the Under

mineral showing, the Under/ Shand_1 area, but there are high resistivity and low factor scores. IP anomaly overlapped by small-scale low resistivity/high chargeability and the high factor scores was detected in the Shand mineral showing, the Under/ Shand_3 area. The feature of mineralizations with above geophysical structures were intersected and understood well by the existing 17 drillholes.

Therefore, it is considered not necessary to continue explorations in the Under and the Shand mineral showings in the Under/ Shand area. On the other hand, a geophysical surveys (IP electric method) and semi-detailed geological mapping in the northwestern part of the Under/Shand_3 area and in the central western part of the Under/Shand area are recommended in order to understand the mineralization and delineate ore deposits.

(3) Mogoin gol area

Geology in this area is composed of late Permian alkali volcanic rocks, the late Triassic to early Jurassic volcanic rocks, the Permian to Triassic granites, Jurassic dykes, dykes and quaternary. K-Ar ages of the diorite and the rhyolitic porphyry indicate 208 Ma and 210Ma respectively, the late Triassic ages (T3). These ages are close to the radiometric ages, 190 Ma to 210 Ma, of the sericite minerals from the Erdenet mine. Diorite and the rhyolitic porphyry for the K-Ar measurements are adakitic rocks to which have been recently reported that the porphyry copper-molybdenum deposit is attributable.

The area is regionally located in the cross junction of the EW trending faults and the NW-SE trending faults. The main faults indicate the dominant NNW-SSE, NW-SE and EW direction in the northern part, the dominant NW-SE and EW direction in the central part and the dominant NE-SW and EW direction in the southern part. The Erdenet ore deposit is also known to be in the junction of the NW-SE and the EW trending structure zones and the white silicification zone in the Mogoin gol area is similar to that of the Erdenet deposit.

The mineralization zones, which are silicified zones with the oxidized copper minerals, are confirmed around the Mt. Shar Chuluut and in the southern part of the mountain. The alteration zoning in the north alteration zone is formed with the quartz or quartz-sericite zone, the sericite-chlorite and chlorite zone from the center to outward. This alteration zoning is the same as the Erdenet ore deposit. The center part of alteration zoning in the south silicified zone is the quartz-sericite alteration zone include biotite, topaz and andalusite. There is no alteration zone in its surroundings. These alteration features indicate the epithermal acidic alteration zone in high sulfidation system that develops at the upper part of mineralizations in the porphyry copper- molybdenum deposit.

The north white silicification zone is 1.2km NS direction and 2km EW direction. The white south silicification zone with the secondary silicified rock is small-scale alteration zone with 800m NS and over 1400m EW. The magnetite zone, as another alteration zone, is produced by liparite and diorite intrusion. In the white silicification zone, azurite and malachite are present as film and spotty. The maximum ore grades in the mineralization points are low as 0.026 %Cu, 0.001 %Mo, 0.021 %Pb,

0.004 %Zn and 12.72 %Fe. The maximum ore grades in the mineralization point of the south silicified zone are also low as 0.009 %Cu, less than 0.001 %Mo, 0.006 %Pb and 0.002 %Zn. The ore grades in the magnetite zone are low.

According to the statistical results of the rock chemical analytical data, three factors related to the mineralization were detected as Factor 2 (Mo: the south silicified zone), Factor 4 (Au-(Ag-Ni): the north white silicification zone, the rhyolitic porphyry and the southern part of the area) and Factor 5 (Hg-Cu: the north white silicification zone and the south white silicification zone). High factor scores are confirmed in the north silicified zone. Analytical values of Mo, Au, Ag, Ni, Hg and Cu are relatively high. The results of the rock chemical analyses are also suggested to be the zone of element leaching.

Rock magnetic intensity map also detected various sizes of the airborne magnetic anomalies. IP electric surveys detected a large-scale IP anomaly overlapped low resistivity, high chargeability and high metal factor scores on the center of Mt. Shar Chuluut.

Based on the results of geological survey and geophysical survey, the drilling survey was conducted in the western end and the eastern end of the north silicified zone. Drilling depth of MJME-M1 is 501.80m and Drilling depth of MJME-M2 is 500.20m. The drilling survey detected the marginal parts of the hydrothermal mineralization such as polymetallic type or porphyry copper type mineralization including pyrite, chalcopyrite, sphalerite, galena, etc..

As the results of the geophysics and geological mapping, the north and south white silicification zones have high potential for host porphyry copper-molybdenum deposits, and it is highly probable that the ore bodies are located in relatively deeper level. Accordingly, it is recommended to conduct the drills in the north white silicification zone. It is also recommended to extend the IP electric survey area to the eastern side of the second phase survey area and continue an exploration programs because high chargeability zone increases and continue to the eastern deeper zone in order to delineate total IP structure related to the mineralization and construct the mineralization model in more detail.

5-2 Recommendations to the third phase program

As the results of the geological and geophysical surveys, the recommendations for the third phase are summarized as follows.

(1) Mogoin gol area

The white silicification zones are distributed at the center of and around Mt. Shar Chuluut and an alteration zoning similar to that of the Erdenet deposits was detected. While the values of chemical analysis are low, relatively high geochemical anomalies are detected on the white silicification zone. Low airborne magnetic anomalies and low rock magnetization zones are also detected. As the results of IP electric surveys, the large-scale anomaly overlapped by the low resistivity, high chargeability and

high metal factor is detected at the center of Mt. Shar Chuluut. So, it is probably high potential to host a porphyry copper-molybdenum deposit in the area. Therefore, conducting a drill survey in the north white silicification zone is recommended as presented in Fig. I-5-1. As high chargeability increases and continues to the eastern deeper zone, it is also recommended to widen the IP electric survey area to the eastern side of the second phase survey area and to continue an exploration in order to get understand an IP anomaly structures related to the mineralizations and construct mineralization model in detail.

It is recommended to conduct a soil geochemical sampling program for the third phase project area to clarify the geochemical features related to the mineralization of porphyry copper-molybdenum deposits same as the Erdenet deposit. Soils are preferable to be taken by a grid-sampling applied to the IP electric survey lines.

(2) Under/ Shand area

The ore with filmy malachite and azurite were observed in the potassium metasomatized medium grained granodiorite from the area outside the northwestern part of the Under/Shand_3 area (0.119%Cu, 0.036%Pb, 0.116%Zn and 24ppmAg). The pyrite dissemination zone in the white silicification zone was confirmed in the central western part of the area. It is thought be necessary to carry out a geophysical surveys (IP electric method) and a semi-detailed geological mapping in the pyrite dissemination zone of the north-western part of the Under/Shand_3 area and the central eastern part of the Under/ Shand area to confirm and delineate mineralizations. However, the exploration priority in the area for phase III is low compare with the other areas as the Zuukhiin gol area, etc..

(3) Zuukhiin gol area

The results of the first phase programs indicate that the low airborne magnetic anomalies were detected in the Zuukhiin gol area. The Zuukhiin gol mineral showing is regionally located in the crossing point of the NW-SE and the NE-SW trending fault zones. The sericite-chlorite alteration zone, which is similar to that of the Erdenet zone, is distributed in the central part of the showing. Rocks returned 50 to 11,740 ppm Cu in this showing. Several factors related to the elements behavior for the porphyry copper-molybdenum deposit were detected and factor scores are high values. Existing drilling data indicate that the ore body continues over 300m in depth. At the previous surveys the exploration activities were abandoned because of its low grade. However, it is estimated to be possible to the mining development using SX-EW if the oxidized resources grading approximately 0.3%Cu were distributed. It is desired to reevaluate the deeper zone using a geological survey, a geochemical sampling, and an IP electric survey with drills in order to understand mineralizations at the deeper zone.

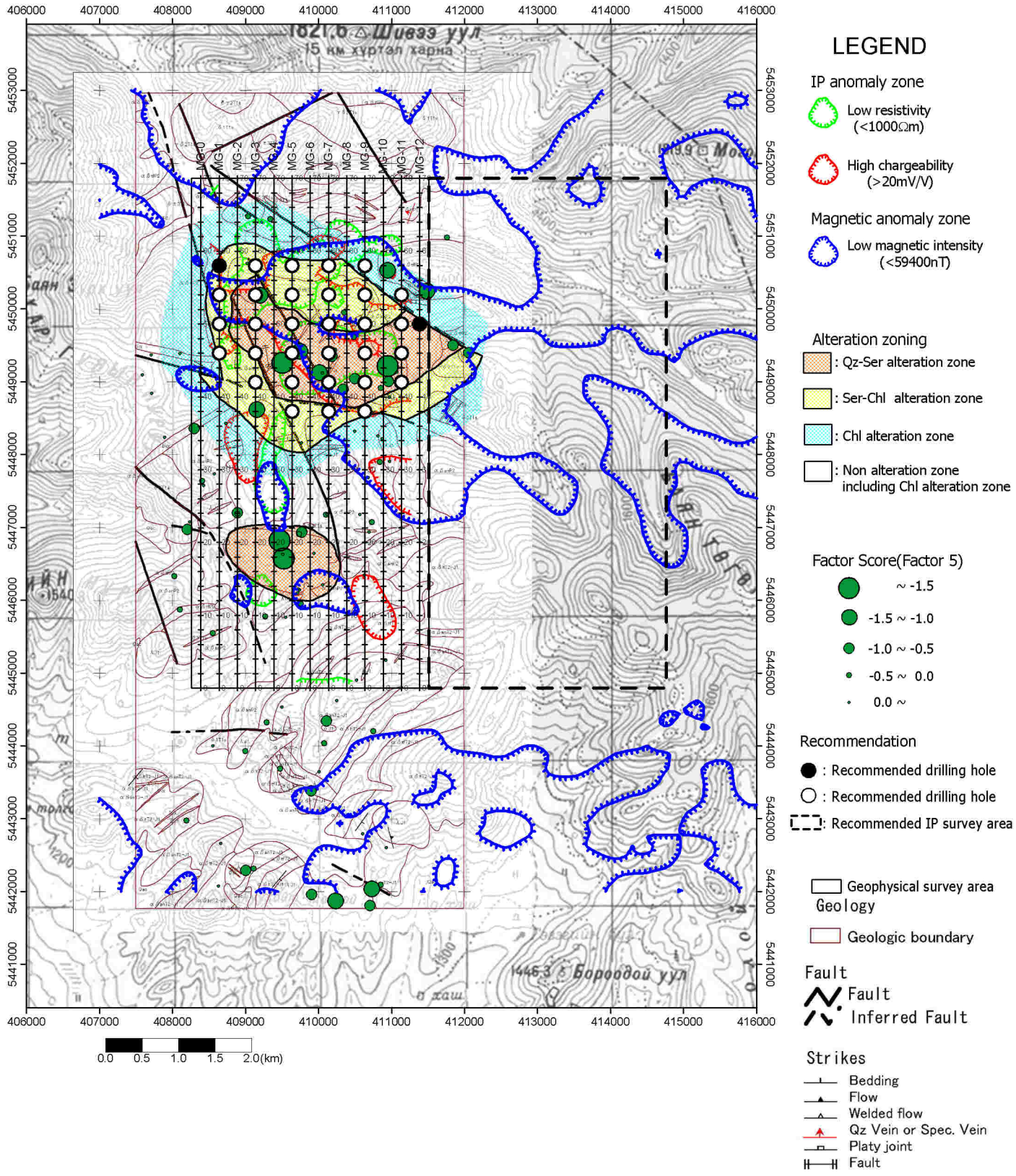

Fig.I-5-1 Recommendation in Mogoin gol area for Phase III

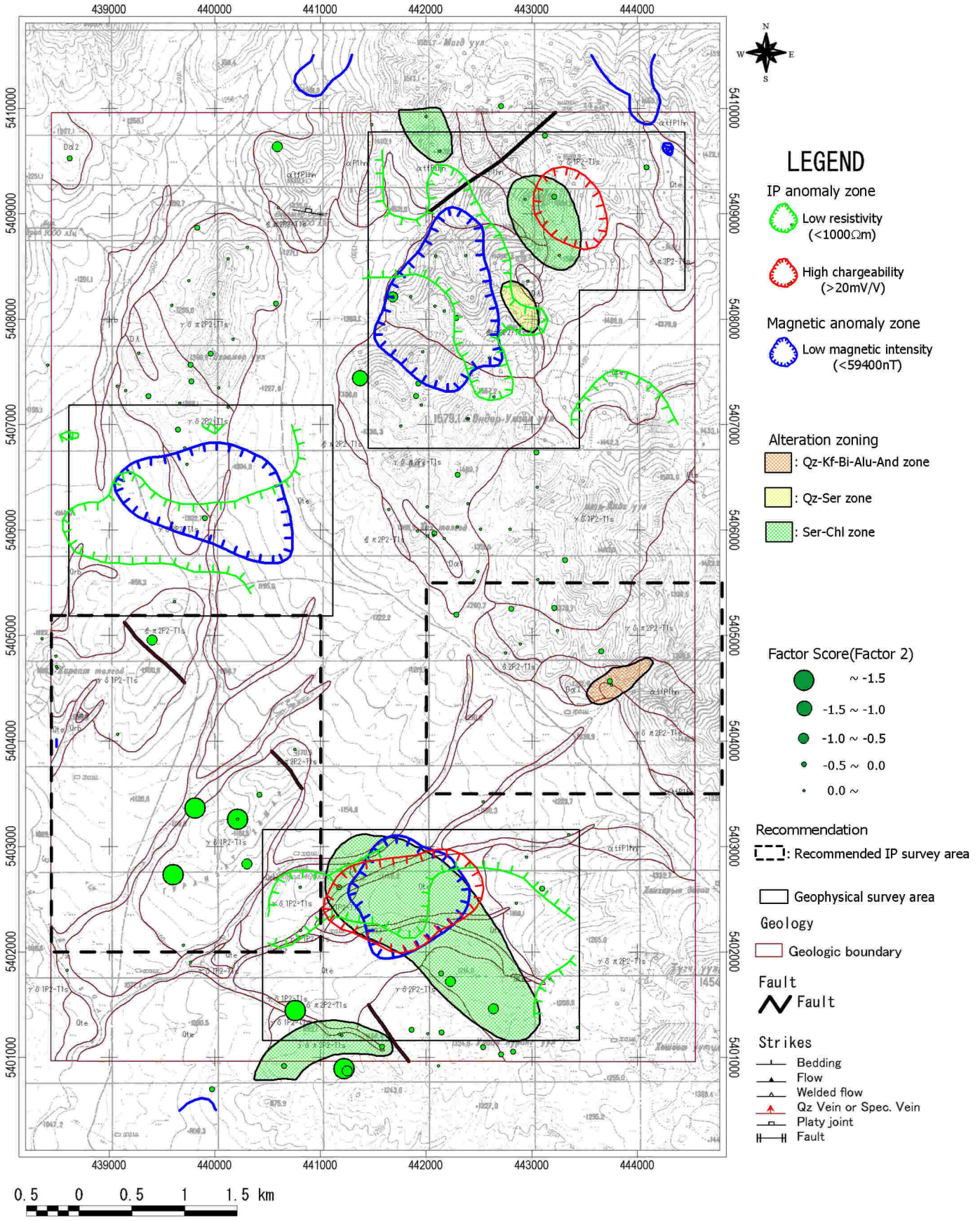

Fig.I-5-2 Recommendation in Under/Shand area for Phase III

(4) Other areas

As the results of the previous data analysis, a geological mapping, an airborne survey for the first phase and a geological mapping and a geophysical survey for the second phase, it is confirmed that porphyry copper-molybdenum deposits are related to the adakitic plutonic rocks of the Erdenet complex and are located on the low magnetic anomaly in high magnetic zone. Therefore, it is recommended for the phase three survey that the target generation (including Khujiriin gol area) by comparison airborne geophysics results with existing geologic maps would be necessary for selecting potential areas in which should be carried out a program including a geological mapping, a geophysical survey (IP electric method) and drills at the potential areas to host ore deposits.