Chapter 3 Ground Truth

3.1 Selection of target survey districts and mineral occurrences/points

Figure II-3-1 shows the survey districts and the survey mineral occurences/points location maps. The survey mineral occurrences/points are listed at the end of this report (Appendix Table A-9). Since the grand truth has a vast survey target area, which is not easily accessible, the survey area was divided into two, east and west. In the Phase-I, the survey of mineral occurrences/points on the east was conducted. The Phase-II survey covered mineral occurrences/points on the west, promising occurrences/points extracted in the Phase-I survey, and the Tavt deposit and the northern part of Zelter River with a concentration of gold mineral occurrences, both of which had not been surveyed in Phase-I.

The mineral occurrences/points where groud truth was implemented through this project amounted to a total of 103. These mineral occurrences/points are distributed in a total of 17 districts.

3.1.1 Selection of target survey districts and mineral occurrences/points for the Phase-I survey

Emphasis of the survey on the east of the survey area is laid on the evaluation of possibility of the existence of porphyry type copper/molybdenum deposits near the Erdenet deposit and the evaluation of potential of the existence of deposits in an area where there is no operating mine. The target deposit type are porphyry type copper/molybdenum deposits having a high potential of existence, judging from the existence of the Erdenet deposit, and a gold deposit with a high added value, taking into consideration the infrastructure condition of this survey area.

Attention was paid to the type and scale of alteration zones and the grade (Cu$\geqq$0.02%, Au $\geqq$0.01 g/t) of copper and gold, based on the mineral occurrence data organized and stored by the Geological Information Center, Mineral Resources Authority of the Mongolia, Ministry of Trade and Industry.

Also, some areas having the following features were extracted from the Erdenet and Bulgan districts.

- Judging from lineaments extracted from the SAR image or the topographic features.
- Area where lineaments were concentrated → Signs pointing to the development of fissures.
- Area where lineaments intersect → Signs pointing to the development of fissures.

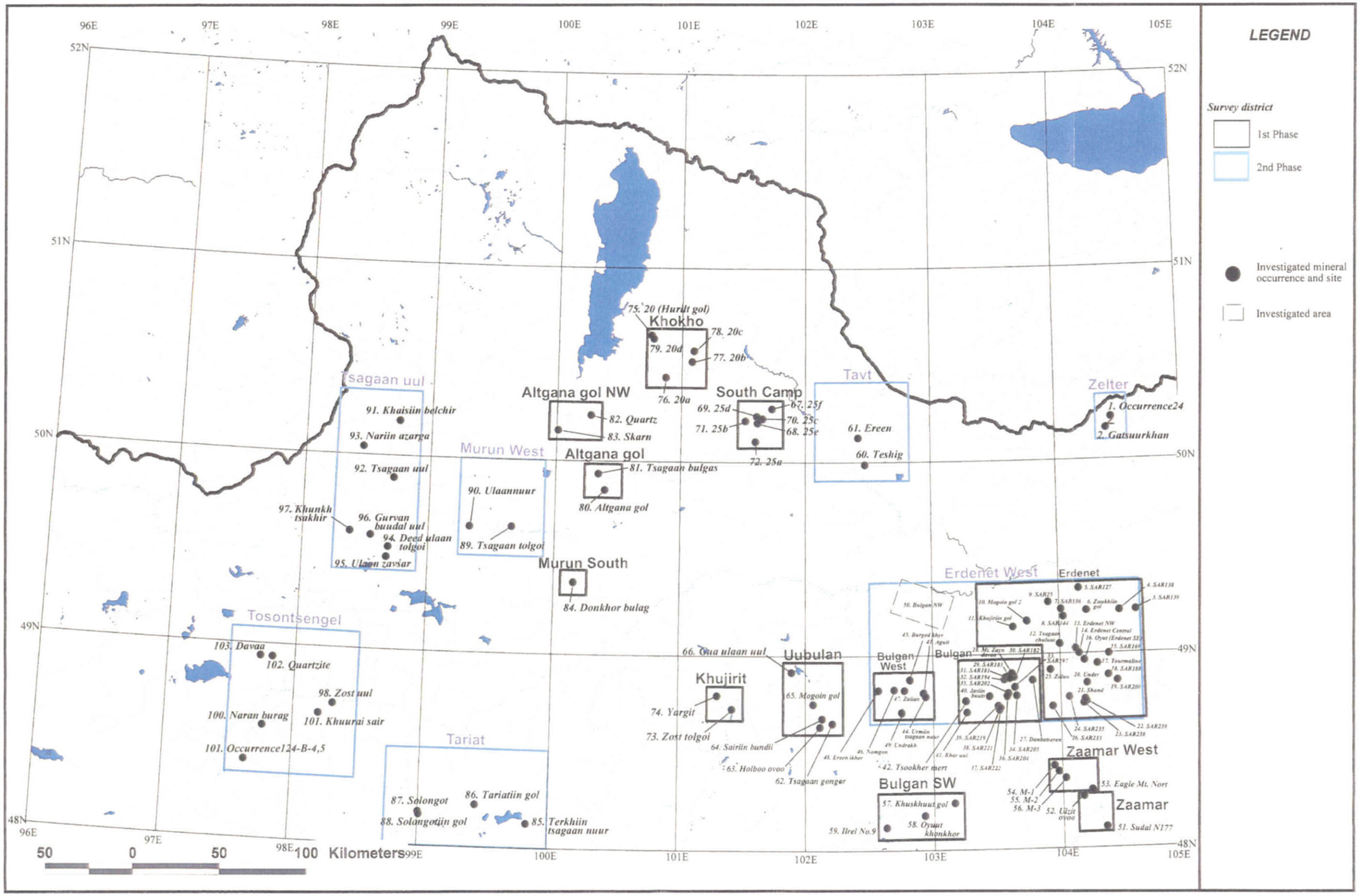


Fig. II-3-1 Location of survey sites of Phase I and II survey in the central north area

- Near the major lineaments → Signs pointing to the development of fissures.
- Annular lineaments → Sings pointing to the existence of intrusive rock below the surface.
- A sharp change in a continuous uniform topography → Signs pointing to the existence of alteration zones.
- Smooth configuration surrounded a steep landform → Signs pointing to the existence of alteration zones.

Mineral occurrences/points where the scale of an alteration zone existing in the above areas has been described or known with a good analysis grade were also selected as a survey point (SAR point).

As for the survey points extracted from the existing data analysis and SAR images described above, a final decision about the survey points was made, based on information such as access condition and requests from the counterpart. In the South Camp district, a mineral occurrence was surveyed under the guidance of a geological engineer of the Mongolian geological survey company, which has been conducting geological survey. In the Erdenet district, a survey was carried out based on the information and data offered by a geological survey engineer who is familiar with the neighboring geology.

3.1.2 Selection of the target districts and mineral occurrences/points for the Phase-II survey

There is no known mine on the west of the survey area. Each mineral occurrence tend to be scattered. These mineral occurrences are more remote from the east of the survey area. For this reason, gold having a higher added value was chosen as an exploration target and gold, copper and gold/copper mineral occurrences were selected from the mineral occurrence list for exploration.

The Tavt (Ereen) deposit located on the east of Khuvsugl Lake in the northern part of the survey area has been described as a gold/copper bearing quartz vein deposit and the exploration is actively conducted. In the Phase-I survey, since this deposit was not easily accessible, the survey was not carried out. Therefore, it was included in the Phase-II survey. The mineral occurrence list shows that gold mineral occurrences are concentrated in the Zelter district on the northeast of the survey area. Therefore, this district was included in the Phase-II survey.

The Phase-I survey revealed that promising mineral occurrences are concentrated in the Erdenet, Bulgan, Bulgan West, and Bulgan SW districts. In particular, the Erdenet, Bulgan, and Bulgan West districts where promising mineral occurrences are concentrated were united into one district as the Erdenet West district. Efforts were made to determine the characteristics of alteration and mineral showings of each mineral occurrence/point in the Phase-I survey. In the

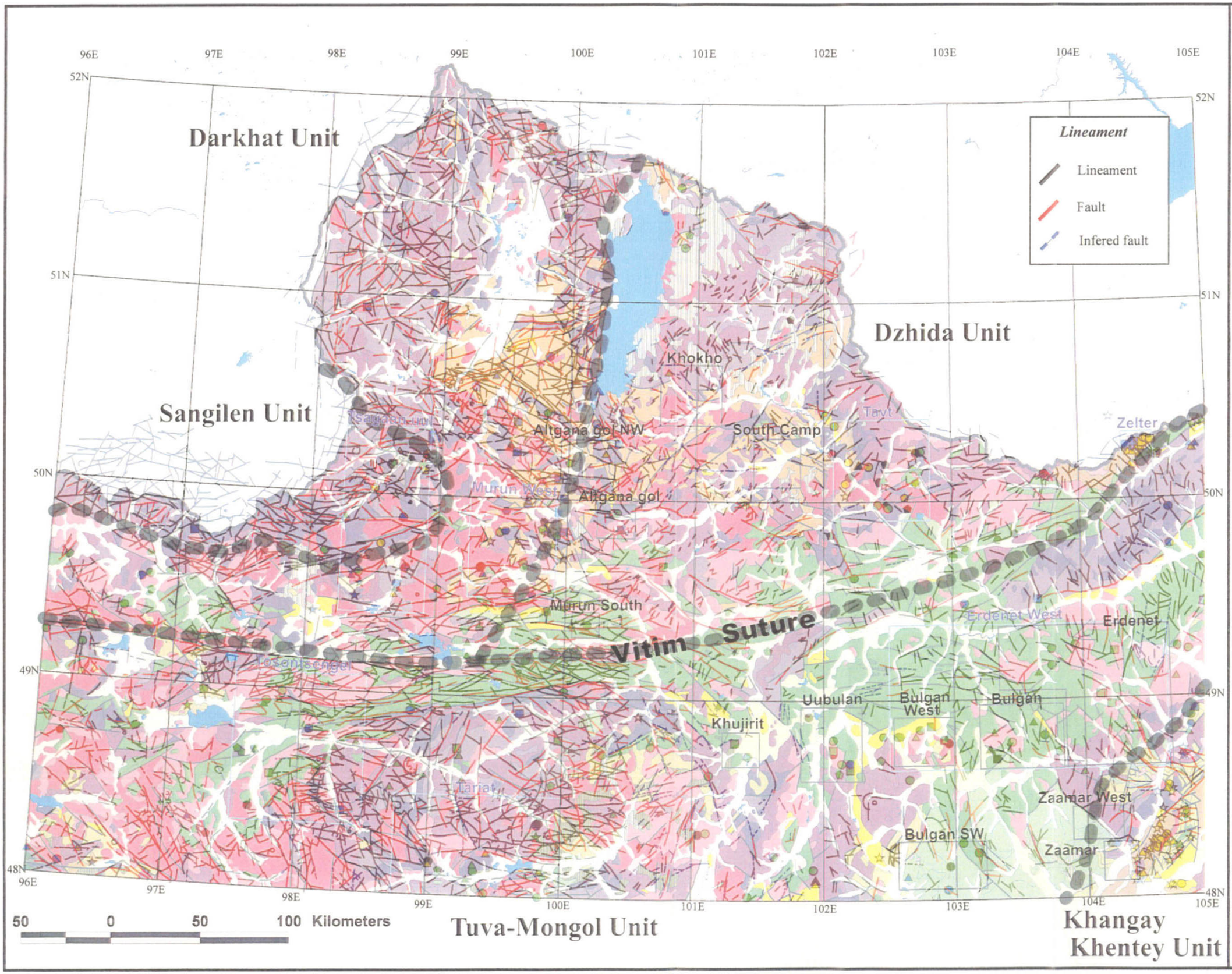


Fig II-3-2 Geological map, distribution of mineral occurrences and lineaments based on JERS-1/SAR mosaic images analysis of the central north area

Table II-3-1 Stratigraphy of the central-north area, Mongolia

Sedimentary and Volcanic rock

	Period	Code		Lithofacies	Local Name
Cenozoic	Quaternary			Recent sediments: gravel, sand, sandy loam and clay	
				Upper-recent sediments: boulder beds deposits, sand, rockdebris, sandy loam, clay	
				Upper Quaternary: boulder, loam and clay	
				Middle-Upper Quaternary: sand, gravel, loam(QII-III), alkaline olivine basalt and trachybasalt	
				Middle Quaternary: gravel, sand, clay	
	Neogene	N2	N2-Q1	Pliocene: gravel, sand, clay(N2), trachybasalt, alkaline olivine basalt(bNII)	
		N1		Miocene: trachybasalt, basalt	
Mesozoic	Cretaceous	K1	K1a	Cretaceous system(lower series): conglomerate, sandstone, aleurolite	
	Jurassic-Cretaceous	J3, J3a		Upper Jurassic-Lower Cretaceous series: conglomerate, sandstone, rhyolite and tuff	
	Jurassic			Middle-Upper serious: sandstone, conglomerate, aleurolite, brown coal	Sharyn gol suite
		J1-2		Lower-Middle series: conglomerate, gravelstone, sandstone, claystone with flora, brown coal and hard coal	Saikhan suite
	Triassic-Jurassic	T3-J1		Upper Triassic-Lower Jurassic series: andesite, andesite-basalt, trachybasalt, tuff, tuffcious conglomerate	Mogod suite(mg)
Paleozoic	Triassic	T2-3	T3	Non segmented sediments: sandstone, conglomerate, aleurolite	
		T2		4th subsuite: siltstone, sandstone with flora	
		T2		3rd subsuite: conglomerate, sandstone	
		T2		2nd subsuite: sandstone, conglomerate, siltstone with flora	
		T2		1st subsuite: conglomerate, sandstone, siltstone	
	Permian	P2-T1		Upper suite: trachybasalt, trachyandesite-basalt, trachyandesite and tuff, tuffcious sandstone with flora	
		P2		Middle suite: rhyolite, rhyodacite, trachyrhyolite, tuff with flora	
		P2		Lower suite: basalt, andesite-basalt, andesite, conglomerate (suite of basic and medial effusive rock)	
		P2		Non segmented sedimentary rocks: conglomerate, gravelstone, sandstone, siltstone with flora, acid tuff	
		P2		4th suite: trachybasalt, trachyandesite-basalt, bimodal effusion of pantellerite composition	
		P1-2		3rd and 2nd suite nonsegmented: rhyolite, trachyrhyolite, dacite, andesite, trachybasalt, basalt and tuff	
				3rd suite: siliceous siltstone with flora, sandstone, gravelstone, conglomerate, trachybasalt, tuff, basic and acid volcanic rock	
		P1		2nd suite: trachyrhyolite, trachydacite, trachrhyoritic dacite with bench of siltstone and sandstone with flora	
				1st suite: trachybasalt, basalt, trachyandesite-basalt, andesite-basalt, andesite, andesitic tuff, sandstone,gravelstone, conglomerate	
	Carboniferous	--	C1-2	Arteel suite: sandatone, conglomerate, aleurolite with flora	Arteel suite
		C1		Nonsegmented sedimentary rocks: conglomerate, sandstone, siltstone with fauna and flora	
				Upper subsuite: siltstone with interbed of sandstone and calcarious siltstone with fauna	
				Lower subsuite: conglomerate, sandstone with fauna	
	Davonian	D2-3		Middle-upper series nonsegmented, sandstone, conglomerate, siltstone with fauna	
		D2		Middle series, Bornuur suite: sandstone, siltstone, andesite, dacite, dacitic tuff	
		D1-2	D1	Upper particle of lower-middle series, nonsegmented: Tariat suite: siltstone, sandstone, conglomerate with fauna	
		S2-D1		Silurian system-lower series Devonian system, nonsegmented: andesite, dacite, rhyolite and rhyolitic tuff (Nariin suite)	Nariin suite
	Silrian	S		Silurian-systems: limestone, organic limestone, calcarious sandstone	
	Cambrian-Ordovician	E3-O1		Upper Cmbrian- Ordovician series, nonsegmented sedimentary rocks: clay-shale, siltstone, phillite, sandstone, gravelstone	
		E2-O1		Middle Cmbrian- Lower Ordovician series: sandstone, siltstone, claystone, phillite, sericite-chlorite-quartz shale	
	Cambrian	E1-2		Lower-Middle series: black limestone with fauna, limestone	Uzhigyn gol suite
		E1		Lower series, nonsegmented sedimentary rocks: layer and massive limestone, dolomite	
				Sandstone, tuffcious sandstone, claystone, shale, limestone, conglomerate	Ukhatol goi suite, Yamat uul suite(jm), Tsokhiryul rock mass
				Limestone, claystone, shale, sandy limestoe, andesite	Hordil suite
				Erkhel uul suite: Limestone, dolomite, sandstone, clay and shale(Xarmain and Bosgot suite), andesite, basalt, basaltic tuff, limestone, sandstone, congromerate(Burgelt suite)	Erkhel uul suite(Xarmain and Bosgot suite, Burgelt suite)
Proterozoic	Vendian-Cambrian	V-E1	V-E2-3	Vendian-Lower Cambrian: Dodnurskay suite(dolomite, limestone), Songinoulinskay rock mass(limestone, sandstone, shale, chlorite+sericite+quartz shale)	Dodnurskay suite(dh), Songinoulinskay rock mass(sh2)
			V		Ilwchirskay suite
		--	R3-E1	Riphean-Vendian: Darkhaskay series(sandstone, dolomite, conglomerate), Urk gol bskay suite(quartzite, dolomite, limestone)	Darkhaskay series, Urk gol bskay suite
		R3	R2-3	Riphean: Dzaokhanskay suite(limestone, shale)	Dzaokhanskay suite
		R2		Middle Riphean: metamorphic rocks(effusive rock, basic-medlian tuff, quartz-chlorite shale, sandstone, quartzite), clystallin limestone	
		PR1		Shale, amphibolite, marble, quartzite	

Intrusion

	Period	Code		Lithofacies	Local Name
Paleozoic	Jurassic	xJ3, xJ2, shJ2, xJ1-2		Granite, Granite porphyry, syenite porphry, diorite and granodiorite	
	Late Triassic-Early Jurassic	xT3-J1		Granite, granodiorite(gd)	
	Late Triassic-Early Jurassic	dT3-J1		Gabbro-diorite, diorite(d)	
	Late Permian	xP2, cP2, dP2, mbP2, shP2		Monzonite(en), monzosyenite, syenite and granosyenite(ge), granodiorite(gd), granite	
	Late Permian		IP1, rioP1, xP1,	Gabbro, gabbro-diorite, diorite(d), gabbro-syenite(ne)	
	Middle-Upper Carboniferous	—	cC3, dC3, shC3, xC3	Granite(g), granodiorite, adamellite, tonalite, quartz diorite	
	Middle Devonian	xD2	xD3	Non segment granite, granosyenite(ge)	
	Middle Devonian			Fine grained lucocratic alaskite granite and aplite (3rd phase)	
	Middle Devonian			Medium grained biotite granite, alkaline alaskite granite (2nd phase)	
	Middle Devonian			Biotite-hornblende granite (1st phase)	
	Early Devonian	mrioD1, shD1		Olivine-augite gabbro, gabbro-syenite, syenite-diorite, monzonite, nepheline syenite, terolite, melteigite, ijolite, urtite	
	Middle Cmbrian	cE2-3, dE2-3, xE2-3, cE2		Gabbro, gabbro-pyroxenite, pyroxenite	
Early Paleozoic		—	cO2, dO2, xO2	Non segment granite, adamellite, granodiorite, diorite	
Proterozoic-Paleozoic	Late Riphean-Early Cambrian	cR3, xcR3, xR3	cV	Metagabbro, leucocratic gabbro, gabbro-diabase	
Proterozoic-Paleozoic	Late Riphean-Early Cambrian			Dunite, harzburgite, werlite, serpentinite(1), serpentinite melange(2)	
Proterozoic	Riphean	cR2, xcR2		Granite, leucocratic granite, gneiss-granite	
	Riphean			Gabbro, gabbro-amphibolite, pyroxenite, serpentinite	
Early Proterozoic		xPR1, cPR1		Granite-gneiss, migmatite, granite, granodiorite	

follow-up survey conducted in the Phase-II survey, the characteristics of alteration and mineral showings of promising mineral occurrences/points were investigated in more detail, and at the same time efforts were made to determine the features of the geology and geological structure and the scale and extension of alteration. Particularly, attention was paid to the "secondary quartzite" described in the past survey documents, and our energies were put into determining the characteristics of its distribution, occurrence, alteration and mineral showing.

3.2 Result of the grand truth

Geology, result of lineament analysis, survey district and known mineral occurrences are shown in Figure II-3-2. Table II-3-1 shows a simplified stratigraphy of the survey area. Note that the codes in the stratigraphical table correspond to the codes used in the geological map of each district.

Since the survey districts were not easily accessible on the whole and there was little outcrop, efforts were made to investigate outcrops that represent typical geology, mineral occurrence/point, mineralization and alteration. Also, energies were put into determining the scale of mineral showing and alteration as much as possible. Samples for laboratory test were collected at each mineral occurrence/point as necessary. Panning samples were collected for analysis from sand flowing out of a mineral occurrence or sand of a stream running near a mineral occurrence in order to determine general geochemical anomaly of the each district and location of mineral occurrence.

For the mineral occurrences where the Phase-I survey was conducted, the outline of the geology and mineral showing in each survey district was described. Each mineral occurrence where the Phase-II survey was conducted was described under the headings of "Representative latitude and longitude," "Topography and vegetation," "Access," "Preceding survey," "Features of SAR image," "Geology and geological structure," "Mineral showing and alteration," "Laboratory test," and "Evaluation." The photographs taken during the field survey were contained at the end of this report.

3.2.1 Zelter district

(1) Outline of the survey district

(1-1) Location

The Zelter district, being located in 50° 06' to 50° 20' north latitude and in 104° 20' to

104° 40' east longitude, covers 400 km^2 extending 16 km in the east-west direction and 25 km in the north-south direction. The northeastern survey area faces near the national border with the Russiaa Federatoion. The center of the district is located about 150 km away from Erdenet city in the north-northeast direction.

(1-2) Topography and vegetation

This district has Zelter River flowing in the northeast direction. Zelter River is agley crossed by NW-SE system tributaries and is surrounded by low mountains of about 1500m above sea level. Conifers and thin forests consisting of white birches are spotted on the low mountains. Valleys have vast marsh land. Long grasses and bushes grow in the marsh in summer.

(1-3) Infrastructure and access

Tushig Town is located at the eastern edge of the Zelter district and along the main road leading to Lake Bykal over the bouder of the Russian Federation. Unpaved roads await you along the north shore of Zelter River to reach the mineral occurrence.

A border police station is located near the mineral occurrence and no other general infrastructure is seen.

(1-4) Features on SAR image

Since the Zelter district is located on mountains with vegetation of conifers and the like, the district is represented as light area in the SAR image. A large number of NW-SE trending lineaments are extracted throughout this district; of these lineaments, a 5 km lineament, found near the central area where granite is intruded, is estimated to be a fault. Arc lineaments are extracted in the granite distribution area in the southern area of the survey district.

(1-5) Outline of the geology and deposit

Figure II-3-3 shows the geology of the Zelter district.

According to geological maps in 1:1,000,000 and 1:200,000 scales, the geology of this district is centered on gneiss and other metamorphic rocks in the Proterozoic, and consist of sandstone, shale, siltstone in the Cambrian through the Ordovician, and sandstone, conglomerate, basalt, tuff, limestone, etc. in the Permian. In addition, diorite, granodiorite, and other granites in the Middle Ordovician, the Upper Permian, and the Triassic through the Jurassic are intruded in this area. In particular, many granites in the Middle Permian are located in the southwestern and northern areas of the survey district.

A fault extending about 40 km in the direction of ENE-WSW bounds between metamorphic rocks in the Proterozoic and sedimentary rocks, intrusive rocks in the Permian and sedimentary rocks in the Cambrian through the Ordovician.

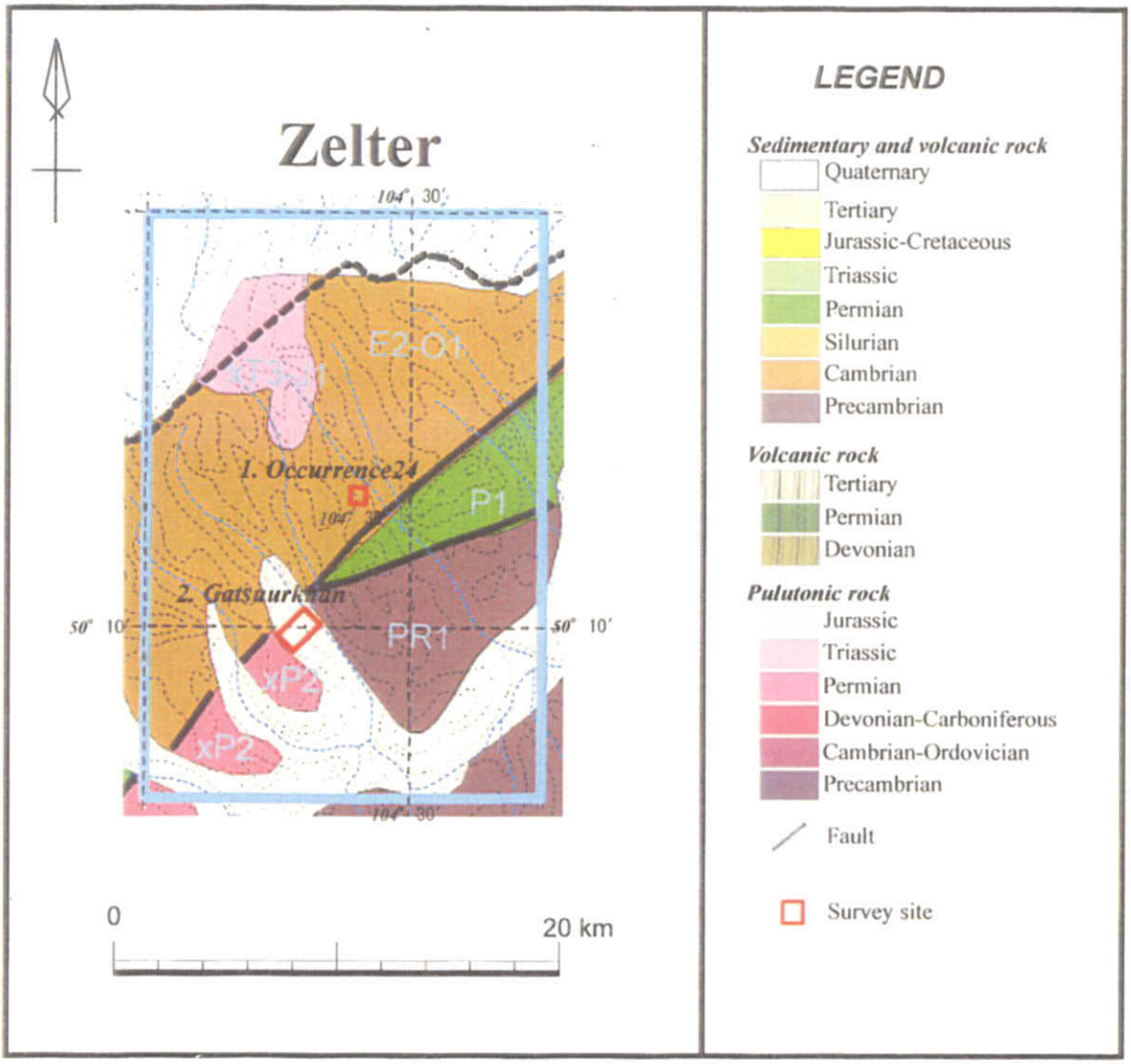


Fig. II-3-3 Geological map of the Zelter district

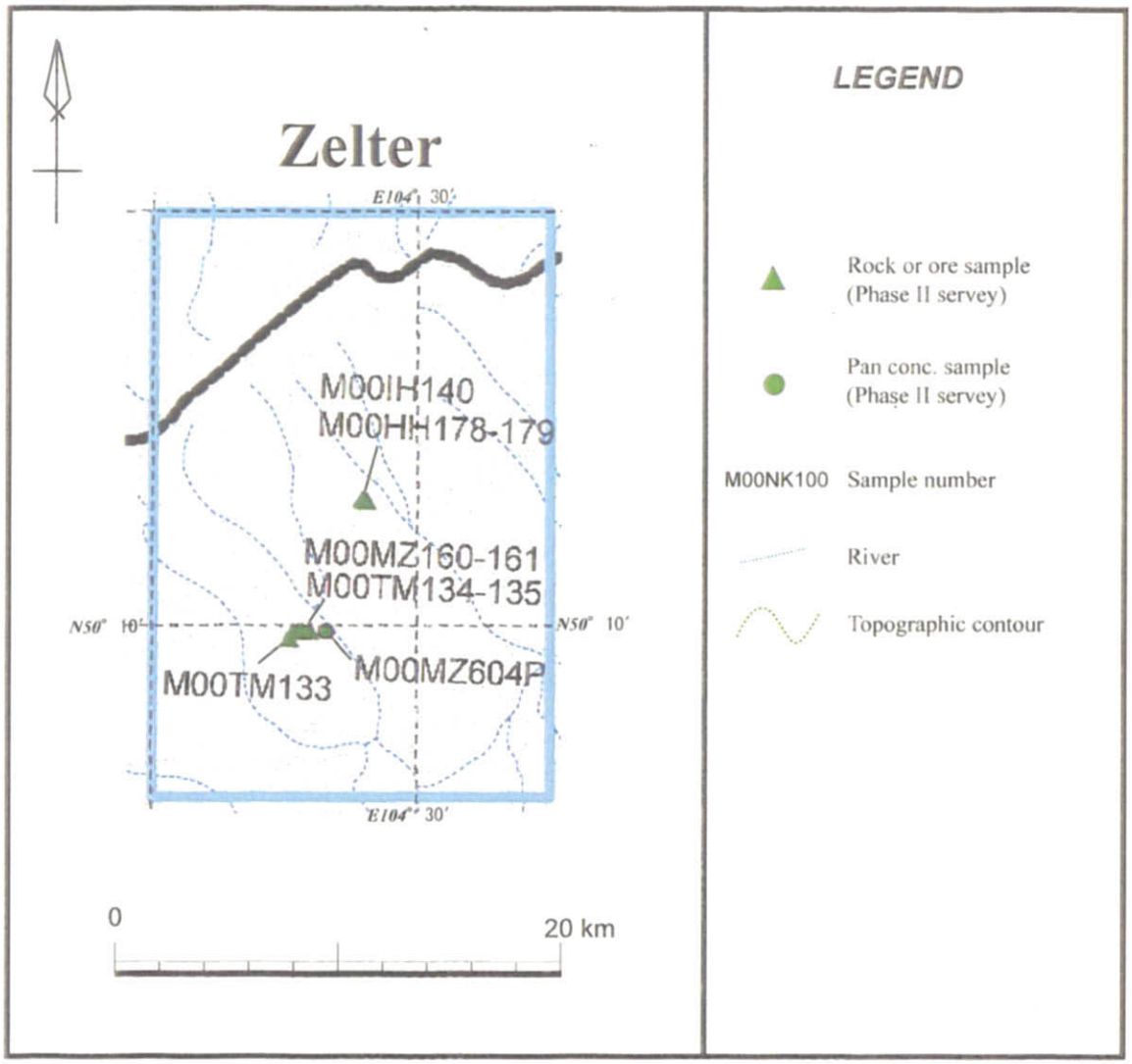


Fig. II-3-4 Sample locations of the Zelter district

According to a list of mineral occurrences, the Zelter district has many auriferous quartz veins, silicification and pyritization. The gold grade from these mineral occurrences is low at 0.02 to 0.2 g/t Au in average and 10 g/t Au at highest.

(1-6) Reason for selection

The Zelter district has many gold mineral occurrences (18 mineral occurrence) although their gold grades are low and the alteration zones are small. Judging from geology of these gold mineral occurrences, however, we selected this district as survey district, like Tavt deposit, because vein type or disseminated type gold deposits is expected as a result of hydrothermal activities related with granitc intrusive rocks.

(1-7) Survey content

We surveyed alteration and mineral showing in neighboring areas in the list of mineral occurrences in occurrence-24 and Gatsuurkhan. Figure II-3-4 shows sample localities in the Zelter district.

(2) Survey results

(2-1) Occurrence-24 (Mineral occurrence No. 1)

[Representative latitude and longitude]

50° 13' 5.5" north latitude, 104° 27'55.4" east longitude (point where oxide copper mineralized andesite sample was collected)

[Topography and vegetation]

The district is located on mountains with of 1500m above sea level. For vegetation, conifers are found on the north slope of the mountains while grasses are observed on the southern slope with no tall trees.

[Access]

The district is located about 150 km to the north northeastern from Erdenet city. Access to this mineral occurrence is as follows. It is to go on a 4 wheel driven vehicle from nearest Tushig town on unpaved roads along the northern bank of Zelter River. It takes about three hours to reach the border police station near the mineral occurrence. From this station, it takes three hours on foot to reach Occurrence-24.

[Preceding survey]

The former Soviet Union and then the Mongolian People's Republic conducted a joint mineral exploration at the age of the former Soviet Union, and found this gold Occurrence-24. According to the list of mineral occurrences collected in the Phase-I survey, the survey held in

1994 covered a geological map in scale of 1:50,000.

[Geology and geological structure]

According to an existing data (document No. 3624) and geological maps in scale of 1:200,000 and 1:1,000, 000, the geology near the mineral occurrences is as follows. The basement is metamorphic rock like gneiss and others in the Lower Proterozoic. Sandstone, shale, and limestone from the Middle Cambrian to the Lower Ordovician, trachybasalt, andesite, acidic tuff in the Permian exist in the ascending orders, and in which granodiorite and leucocratic granite in the Permian through the Jurassic intruded. A NW-SE trending fault is recognized near mineral occurrence as indicated in SAR image (Figure II-3-5).

[Mineral showing and alteration]

An existing data (document No. 3624) states that 0.1 to 3 cm quartz veinlets and quartz stockwork have been developed within the area of 200 m x 200 m and contains 108 kg of gold at 0.01g/t Au. However, the Phase-II survey didn't recognize these kinds of quartz veins. Only a slight stain of copper oxide is found in andesite (M00IH140).

[Features on SAR image] (SAR image unit "Mikhailovka")

The SAR image presents white to canescent colors. The dendritic drainage system in high resistance has developed. Like Zelter River, an ENE-SWS trending lineaments and a parallel NNW-SSE trending lineaments that crosses the ENE-SWS trending lineaments are extracted.

[Laboratory test]

Large amounts of quartz, sericite, chlorite and iron ore as alteration minerals were observed in dacite (M00HH178) under the microscopic observation.

[Evaluation]

As described above many gold-bearing quartz veins are identified in plutonic rocks in surroundings of this mineral occurrence. The gold grade is 10.0g/t at most. Since the Phase-II survey identified neither out crop of quartz vein nor float, the possibility of existence ore deposits having economical value is considered to be low.

(2-2) Gatsuurkhan (Mineral occurrence. No.2)

[Representative latitude and longitude]

50° 09'40.8" north latitude, 104° 25' 09.9" east longitude (point where silicified granite specimen were collected)

[Topography and vegetation]

Near this mineral occurrence, low mountains of about 1500m above sea level run in the northwestern direction. Small Rivers from their valleys run into Zelter River. Thin forests, consisting of mainly conifers and white birches are spotted on these low mountains. Valleys have marsh lands where tall grasses and bushes grow thick.

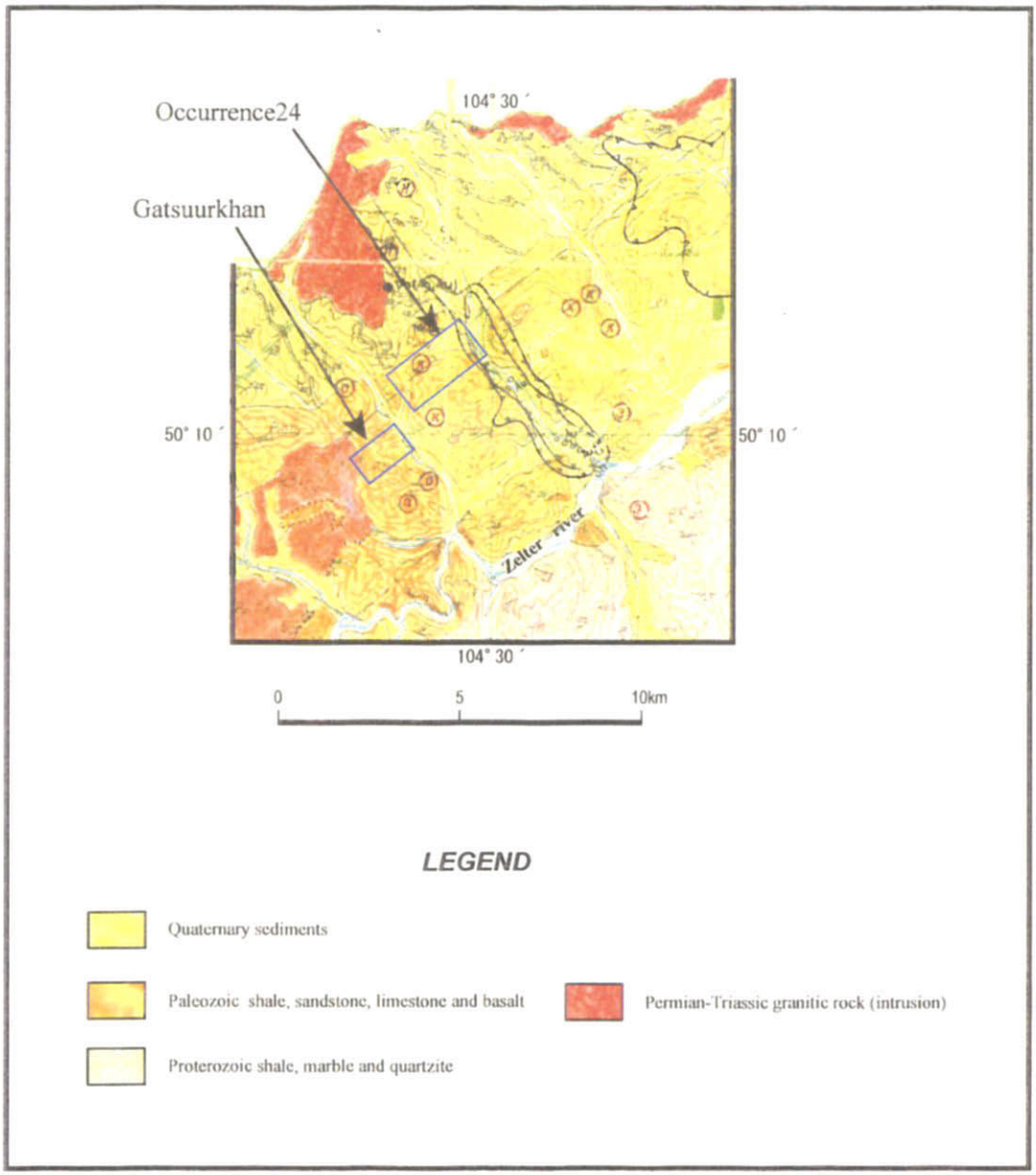


Fig. II-3-5 Geological map around the Occurrence24 and the Gatsuurkhan

[Access]

The district is located about 150 km to the north northeastern from Erdenet city. Access to this mineral occurrence is as follows. It is to go on a 4 wheel driven vehicle from nearest Tushig town on an unpaved road along north bank of Zelter River. It takes about three hours to reach the border police station near the mineral occurrence. The unpaved road is flat and easy to drive though. From this point, roads are muddy and it will take about 60 minutes by vehicle and another 60 minutes on foot to reach Gatsuurkhan.

[Preceding survey]

The former Soviet Union and then the Mongolian People's Republic carried out a joint mineral occurrence survey at the age of the former Soviet Union, and found this gold occurrence. According to the list of mineral occurrences made in the Phase-I survey, the past survey conducted in 1994 on the geological map in scale of 1:50,000. During this survey, a geochemical exploration was also conducted within a 44 m^2 area. An alteration zone featured pyritization has 400 m x 150 m in scale, and the gold grade analysis reported 0.02g/t Au.

[Features on SAR image] (SAR image unit "Mikhailovka")

Thin forests, consisting of mainly conifers, are spotted on low mountains that surround this mineral occurrence, which are represented as light area in the SAR image.

Compared with the central to the southern areas, this district has steep landforms where the resistivity of the distributed geology seems high. In surroundings of the mineral occurrence, a drainage system is found flowing into the southeastern direction, which is extracted as a lineament extending about 20 to 50 km in the NW-SE direction.

[Geology and geological structure]

According to an existing data (document No. 3624 (geological map in scale of 1/200,000)) and a geological map of 1:1,000,000 in scale, the geology of areas near the mineral occurrence is as follows. The basement is metamorphic rock such as gneiss in the Lower Proterozoic. sandstone, shale, and limestone in the Middle Cambrian to the Lower Ordovician, and trachytic basalt, andesite, and acidic tuff in the Permian exist in the ascending orders , and in which granodiorite and leucocratic granite in the Permian through the Jurassic ages intruded. A NW-SE trending fault is recognized near the mineral occurrence as indicated in SAR image (Figure II-3-5).

Although we could not identify a detailed geology and geological structure around the mineral occurrence due to thick vegetation, we identified sandstone, mudstone, calcareous sandstone, basalt, and dacite dykes, and granites.

[Mineral showing and alteration]

Since silicification and pyrite dissemination were observed in the mineral occurrence, we partly identified strongly disseminated silicification in dacite dykes and granites (float rock). Specifically, secondary minerals such as quartz, sericite and calcite were observed in the dacite

dykes with silicification alteration under the microscope.

[Laboratory test]

As the result of geochemical analysis on dacite with silicification (M00MZ161) and granite (M00TM133, TM134), we din not observe any noteworthy anomalous values.

Panning samples (M00MZ604P) collected in a mountain stream flowing into the southeast direction from the neighborhood of the mineral occurrence did not indicate any anomalous values.

[Evaluation]

Silicification and pyrite dissemination were observed and hydrothermal activities were identified in this district. However, no remarkable geochemical anomalies were found. Specifically, the gold grade was lower than the measurement limit, so the possibility of existence ore deposits having economical value is considered to be low.

3.2.2 Erdenet West District

(1) Outline of the district

The Phase-I survey subdivided this district into the Erdenet district, Bulgan district, and Bulgan West district. However, since mineral occurrences/points were concentrated, and a distribution of "secondary quartzite" covers over these three districts on geological map in Mongolia, they were put together and named as the Erdenet West district.

(1-1) Location

This district is located in 48° 40' to 49° 23' north latitude, and 102° to 104° 40' east longitude, covering an area of 12,800 km^2 and extending 160 km in the east-western direction and about 80 km in the north-south direction. Erdenet city and Bulgan city are found in the central area of this district.

(1-2) Topography and vegetation

This district consists of gradual hills of 1300 to 2000m above sea level. In particular, the central to the southern district have rolling landforms, allowing visitors to easily access these areas. The south shore of Selenge River in the north of this district is relatively steep, and thin forests are spotted on the ridge. The major Rivers in this district include Orkhon River in the southern edge, which flows into northeastern direction and Selenge River in the north edge of this district, which flows into eastern direction. Ridges and valleys developed in the N-S to NW-SE direction agley cross these Rivers.

Low vegetations grow thick, covering valleys, bottomlands and hills. Thin forests of

conifers are spotted on low mountains.

(1-3) Infrastructure and Access

In this district it is found Erdenet mine, a most important mine in the Mongolian mining industry. Erdenet is the fourth largest city in Mongolia, which has grown out of mineral exploration and mining operation.

Erdenet city has hospitals and hotels and electric power supply is relatively stable. The streets in the central city area and roads to mines are paved. However, supply of gasoline and other fuels is not sufficient, especially difficult to obtain gasoline in summer season.

Erdenent mine is a state controlled business operated by a joint venture of the Mongolia and Russian Federation. The mine produced 2,2 million tons of copper concentrate and 3000 tons of molybdenum concentrate in 1999. The mine plans to produce 2.4 million tons of copper concentrate in annual production by 2004. Major recent export destinations are Russian Federation (about one-fourth), China (about three-fourths), Japan and Korea. Production of copper by SX-EW for low grade oxide ore in Erdenet mine started in January 1997. A feasibility survey was underway to increase an initial production of 3,500 tons/year of cathode copper in 1997 to 20,000 tons in 2000. The mine has 7,000 employees. The mine plans to replace obsolete facilities with new ones and also reduce the number of employees to 4,200.

Erdenet city is about 200 km away from Ulaanbaatar city in strait distance. It takes one day to travel between the cities by vehicle. The road is a main route in then nation and the condition is relative good although some sections between these cities are not paved. Selenge River has a bridge that vehicles can pass through. An only railway in the survey district is built between Erdenet city and Ulaanbaatar city, from which the railway leads to the trunk line leading to the Russian Federation. The railway is used for transporting copper and molybdenum concentrates to Russian Federation and China.

It takes a half day by vehicle to reach Bulgan city from Erdenet city. The city, having a population of 13,000, is the center of Bulgan aimag. The second largest city after Erdenet city has a hospital and other social structure. Bulgan city and its surrounding areas are not steep and surrounded by a relatively developed road network which allows visitors to easily access. No other towns and cities with well-arranged social infrastructure are found near Bulgan city.

A relatively gradual landform extends from the center to southern areas of this district, so a number of roads allow you to easily access these areas. Meanwhile, the northern area of this district has a relatively steep landform and thin forests are spotted on ridges, so the way to access the area by vehicle is limited.

(1-4) Features on SAR image

On the SAR image this district is in the area of distinctive NW-SE and N-S trending

lineaments in the south from Selenge River (about 10 km in length, respectively). Also, according to SAR image, a NW-SE trending lineament predominates in the southeastern area of this district; a N-S trending lineaments predominate in northeastern area of this district; and concentrated NNW-SSE to E-W trending lineaments are seen in the central to northwestern areas of this district. In particular, a 15km diameter annular lineament is extracted in the northwestern area of Bulgan city located in the northwestern area of this district. Moreover, a NW-SE trending lineament is extracted in the neighborhood of the Erdenet deposit. Selection of alteration zone was tried by using LANDSAT TM. However alteration zone was not extracted due to thick visitations

(1-5) Outline of the geology and deposit

Figure II-3-6 shows a geological map of this district.

This district is located between a Selenge fault in the E-W trending in north and a Bayan gol fault in the E-W trend in south. Also, another fault develops from the NW-SE to the N-S trends.

In the central and eastern area of this district, a broad distribution of volcano-sedimentary rocks, such as trachytic basalt, andesite, and acidic tuff, sandstone in the Permian through the Triassic are found. In addition, granite, granodiorite of Selenge complex inferred as formed in the Permian through the Triassic ages, and monzinite, granite, granodiorite, and syenite in the Upper Triassic intruded. In the southeastern area of this district, a distribution of gabbro and granite, both of which are thought to be as formed in the Cambrian, are found.

The host rock of Erdenet deposit located almost in the central area of this district consists of intrusive rock, such as granite (Selenge complex), estimated as formed in the Permian through the Triassic ages. The host rock is observed in dome shape near Erdenet mine. Mineralization related igneous rock include granodiorite and dioritic porphyry (classified as Erdenet porphyrytic intrusive complex) in the last period of Selenge complex. And, volcanic rocks, such as trachytic andesite, andesite, dacite, and rhyolite, all of which were formed when the Selenge complex was formed, are found in surroundings of Erdenec deposit.

Mineralization is controlled by the NW-SE trending structure, and igneous activities after mineralization seemingly tended to occur in the N-S trend. The mineralization zone in the surroundings of Erdenet Mine extends about 20 km in the NW-SE direction, and 6 known ore bodies and mineralization zones are observed in neighborhoods. Although the Erdenet deposit consists of five ore bodies and mineralization zones, the Erdenet NW (Northwest) ore body alone has been developed so far.

The other four ore bodies are not fit for development judging from their scale and ore grades. Ore reserve of Erdenet Central ore body, almost adjacent to the Erdenet NW ore body, is estimated to be 1/10 of ore reserve in the Erdenet NW ore body.

Moreover, there are many copper occurrences in neighbors of granite intrusive rock adjacent to the Erdenet deposit.

The western area adjacent to Bulgan city located in the central area of this district has monzinite, granodiorite, syenite, and granite in the Upper Permian, and granite and granodiorite in the Lower through Upper Jurassic intruded in areas of trachyte basalt through trachyte rhyolite and sandstone and conglomerate distributions in the Permian. Distinct faults are observed in the NWW-SSE trend.

The southwestern area of this district has distributions of granites in the Lower Paleozoic, and syenite rhyolite, syenite dacite, comendite, basalt, homogeneous pyroclastic rocks, and sandstone in the Permian, and is covered with an irregular distribution of conglomerate, sandstone, and mudstone in the molasse zone of the Jurassic.

(1-6) Reasons for selection

The reason to select this district is as follows. In the Phase-I survey, 10 mineral occurrences/points, which have possibility for porphyry type copper/molybdenum deposits, epithermal type gold deposits and polymetallic vein-type deposits were extracted, indicating possible concentration of potential mineral occurrences. In the Phase-2 survey, silicification called "secondary quartzite" distributed mainly in the adjacent to the Erdenet deposit drew attention of researchers; if this silicification alteration is similar to the "lithocap" described by Sillitoe (1995), the alteration is inferred to represent shallower level of the porphyry system.

(1-7) Survey content

A follow-up survey was conducted for the SARI39 point, Zuukhiin gol mineral occurrence, Mogoin gol 2*mineral occurrence, Khujiriin gol mineral occurrence, Tsagaan chuluut mineral occurrence, Under mineral occurrence, Danbatseren mineral occurrence, Burged kyr mineral occurrence, Undrakh mineral occurrence, and Tsookher mineral occurrence. Also, another survey was conducted for "secondary quartzite" distributing in adjacent to Mogoin gol 2 mineral occurrence and the Khujiriin gol mineral occurrence, Tsagaan chuluut mineral occurrence, Under mineral occurrence, and Danbatseren mineral occurrence. Figure II-3-7 shows sample locations in this district.

* The term Megein gol used in the Phase-I survey is renamed to Mogoin gol 2.

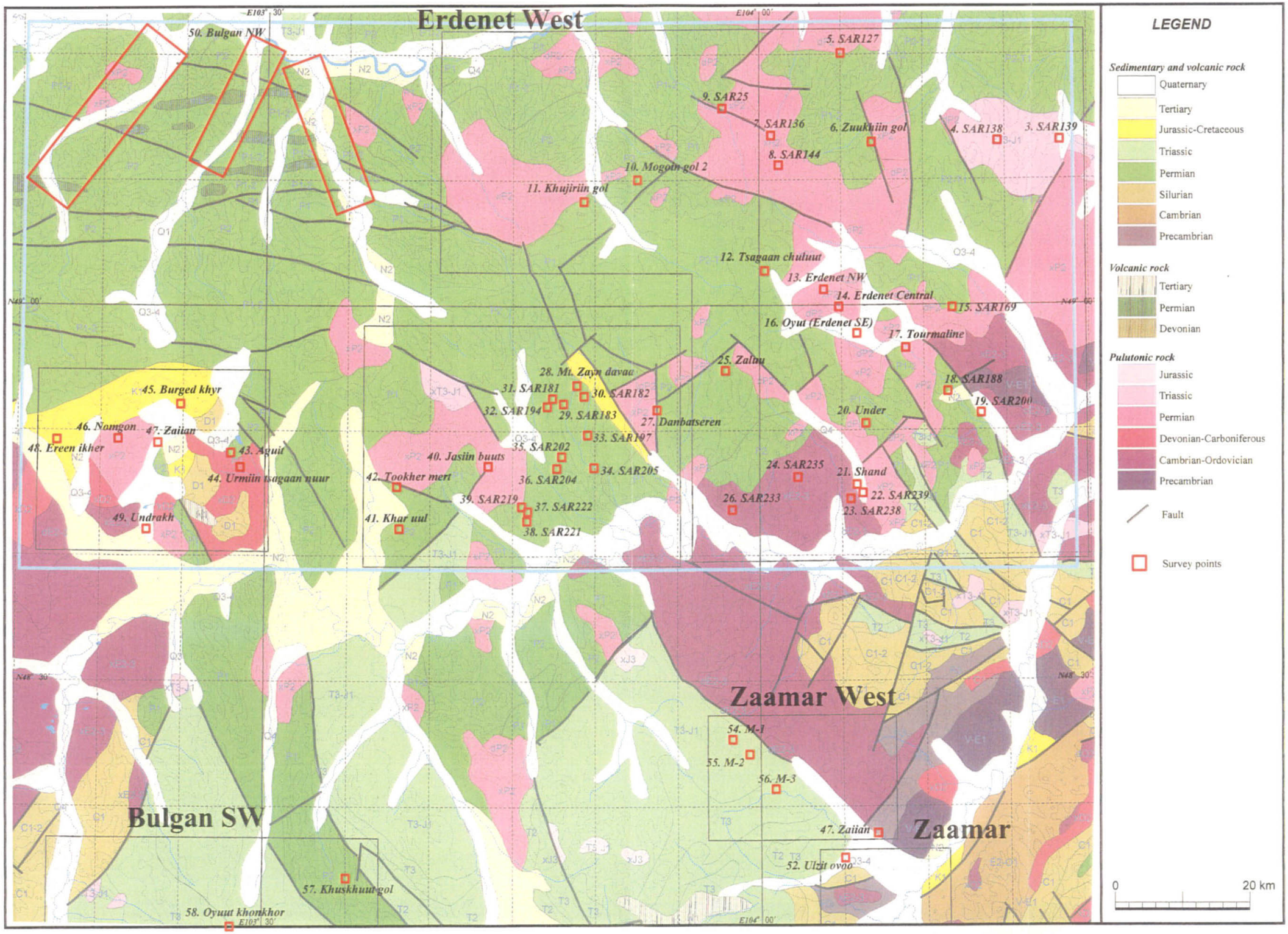


Fig. II-3-6 Geological map of the Erdenet West district

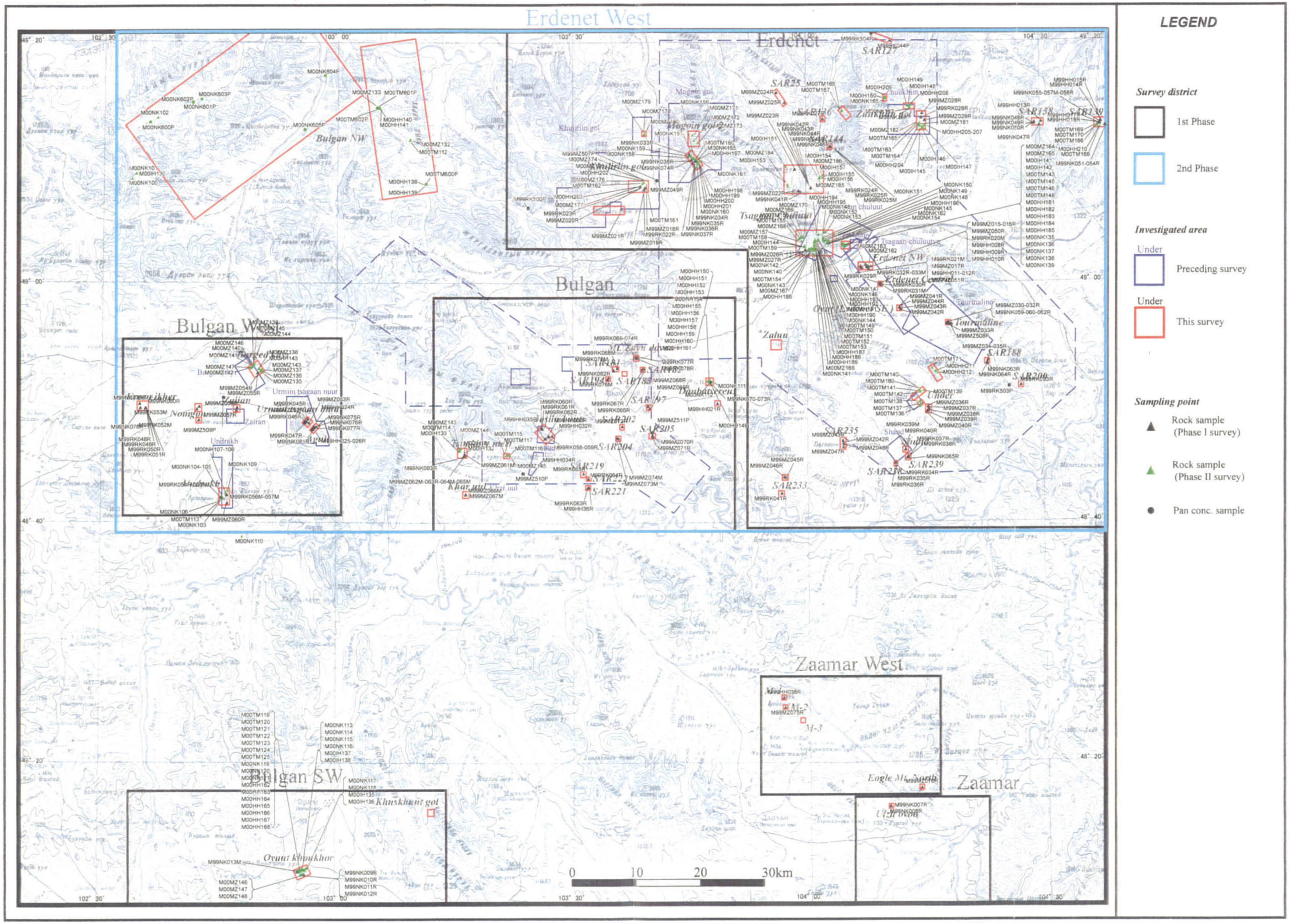


Fig. II-3-7 Sample locations of the Erdenet West district

(2) Survey results

(2-1) SARI39 point (Mineral occurrence No. 3)

[Representative latitude and longitude]

49° 13' 07.7" north latitude, 104° 36' 40.1" east longitude (the part of mineral occurrence in the center trench)

[Topography and vegetation]

This district has a gradual hill. Granites are exposed on the top of hill, and some area of the hill has a cliff. Tall tress grow thick on the north slope of the hill while low grasses grow thick on the southern slope.

[Access]

This district is located 40 km away from Erdenet city in the east-northeast direction. It takes about two and a half hours by vehicle to reach the location. It need to pass through debris site on the ridge and damp ground in lowland to reach this point via SAR138 point in the northern trip and the road condition is not good. Instead, the southern trip has about 70 km in distance from Erdenet city to this point, and takes about two hours to reach since the road condition is good. The mineral occurrence is located on the southern slope and accessible by vehicle.

[Preceding survey]

An alternation zone of 40 m x 0.5 m in scale is reported to exist. Although the analysis value was reported as 1.1% Cu, the situation of the survey is unknown.

[Features on SAR image] (SAR image unit: "Ingettology")

The image indicates dark to gray tones. Resistivity is relatively high and a steep ridge is found. A dendritic drainage system develops, and the NW-SE trending lineaments are observed.

[Geology and geological structure]

This district is located at the junction between a straight valley of N30° W extracted as a lineament in width of several hundreds meters and a small straight valley agley crossing the other valley. The former valley has steep cliffs, indicating the existence of a fault. The geology of this district consists of diorite and gabbro in the Selenge complex, in which basalt dyke, basalt and andesite lava, and their pyroclastic rocks intruded. In the Phase-I survey, these volcanic rocks were inferred as intrusive rocks alone. In the Phase-II survey, however, most of these volcanic rocks were estimated as consisting of lava and pyroclastic rocks with a small area of dyke since the existence of lapilli-tuff (M00NK166) adjacent to the trench was identified in the basalt and andesite which are widely distributed. In the Phase-I survey, K-Ar dating for basalt was conducted. The basalt indicated 282.6±6Ma (Lower Permian)..

[Mineral showing and alternation]

Copper mineralization was observed in north side of the mountain stream dissected in NE-

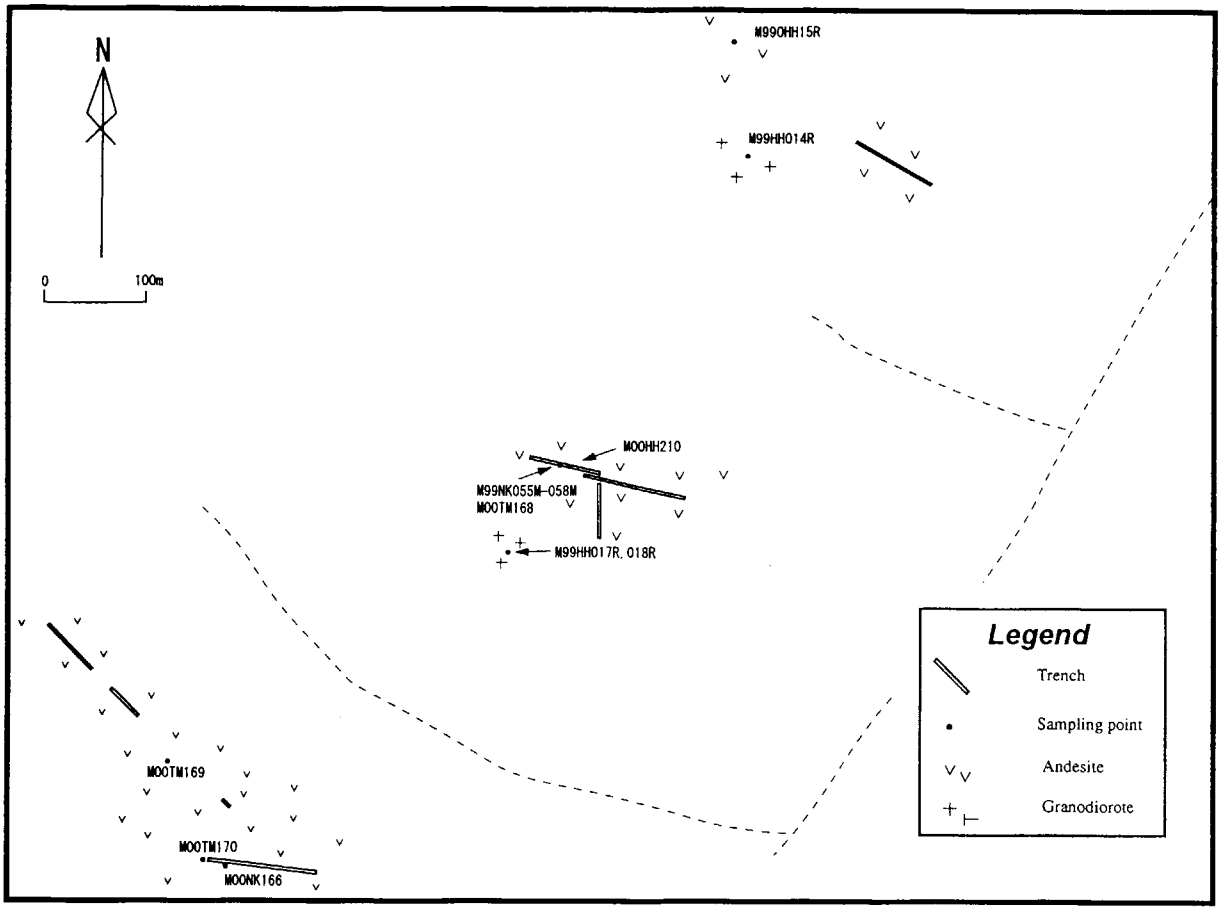


Fig. II-3-8 Route map of the SAR139

SW. Three trenches in about 500 meter distance have been made. This area is covered with volcanic rocks. As indicated in Figure II-3-8, mineral showing was limited mainly to areas adjacent to the Central Trench and the Southern western Trench (the Central Trench alone was surveyed in the Phase-I survey). Quartz-epidote vein was observed in the entire volcanic rocks. The area of 49° 13' 7.7" north latitude and 104° 36' 40.1" east longitude in the Central Trench has two trenches excavated in length of 50 to 100 meters in the N80° W direction. In these trenches hydrothermal breccias consist of clasts of altered basalt, granodiorite, and plagioclase basalt with less. Malachite is observed in the matrixes and along cracks throughout the area. More specifically, in the Central trench, strong silicification, epidote, pyrite, copper oxide in length of about 5 m are also observed together with large quantities of limonite, indicating so-called gossan. In the South western Trench, dark-green and gray volcanic rocks were suffered silicification, epidotization, and chloritization.

[Laboratory test]

Under the microscopic observation, plutonic rocks and hypabysal rocks consist of a variety of rock facies were identified as gabbro, quarts diorite porphyry, quartz diorite, and granodiorite (M99NK051R, M99NK054R, M99HH015R, M99HH017R, M99HH018R). These rocks are suffered hydrothermal alteration and primary minerals are altered to epidote, chlorite, quartz, and iron ore. Meanwhile, basalt dykes are not relatively altered except for those with copper mineralization near the trench. K-Ar dating of (M99NK052R) indicated 282.6±6Ma.

Meanwhile, basalts (M99NK056M, 057M) in the trench indicates malachite and chalcopyrite disseminations, strong alteration is also observed under microscope and large quantities of secondary minerals, including chlorite, epidote, oxide iron ore, biotite, and clay mineral are observed.

[Evaluation]

Areas adjacent to the trench in this district have extremely less outcrops because of the foothills. Distributions of distinctive hydrothermaly altered rocks, hydrothermal breccia, and oxide copper, identified in the Phase-I survey, are limited to the Central Trench surroundings. Since mineralization and alteration is minor in the trenches at both sides of the Central Trench, a series of mineralization and alteration is limited in area and therefore, the possibility of existence ore deposits having economical value is considered to be low.

(2-2) Zuukhiin gol (Mineral Occurrence No. 6)

[Representative latitude and longitude]

49° 13' 02.4" north latitude, 104° 13' 40.5" east longitude, 1,405 m altitude (point where copper showing was observed in the trench and M00MZ182 was collected)

[Topography and vegetation]

This district has rough landforms of mountains. For vegetation, conifers and tall grasses

grow thick.

[Access]

It is to go through a paved road from Erdenet city for Darhan city by vehicle in the northeastern direction until a point where a road for Hyalganat Town is branched. It is to go north on this branch road until another point where an unpaved road is branched, and to go on this branch road until you reach this mineral occurrence.

[Preceding survey]

This mineral occurrence was identified in 1965 when geological survey was conducted. In 1981 through 1985, a systematic exploration, including drilling, was conducted. Specifically, the drilling (20 holes, boring length: 150 to 450m/hole) was conducted for IP anomaly of 5 to 10% and for low magnetic anomaly. However, since ore grades indicated 0.006 to 0.2% Cu and 0.00 to 0.003% Mo, exploration were quitted. According to existing data kept at the Geological Information Center (GIC), ore grades at 11 holes were reported to be 0.11 to 0.17% Cu and 0.003 to 0.007% Mo.

[Features on SAR image] (SAR image unit: "Ingettologoy")

The image shows light gray tone. The district has many small ups and downs. The resistivity level indicates middle to high. The drainage system has developed middle to large in a radial form distribution.

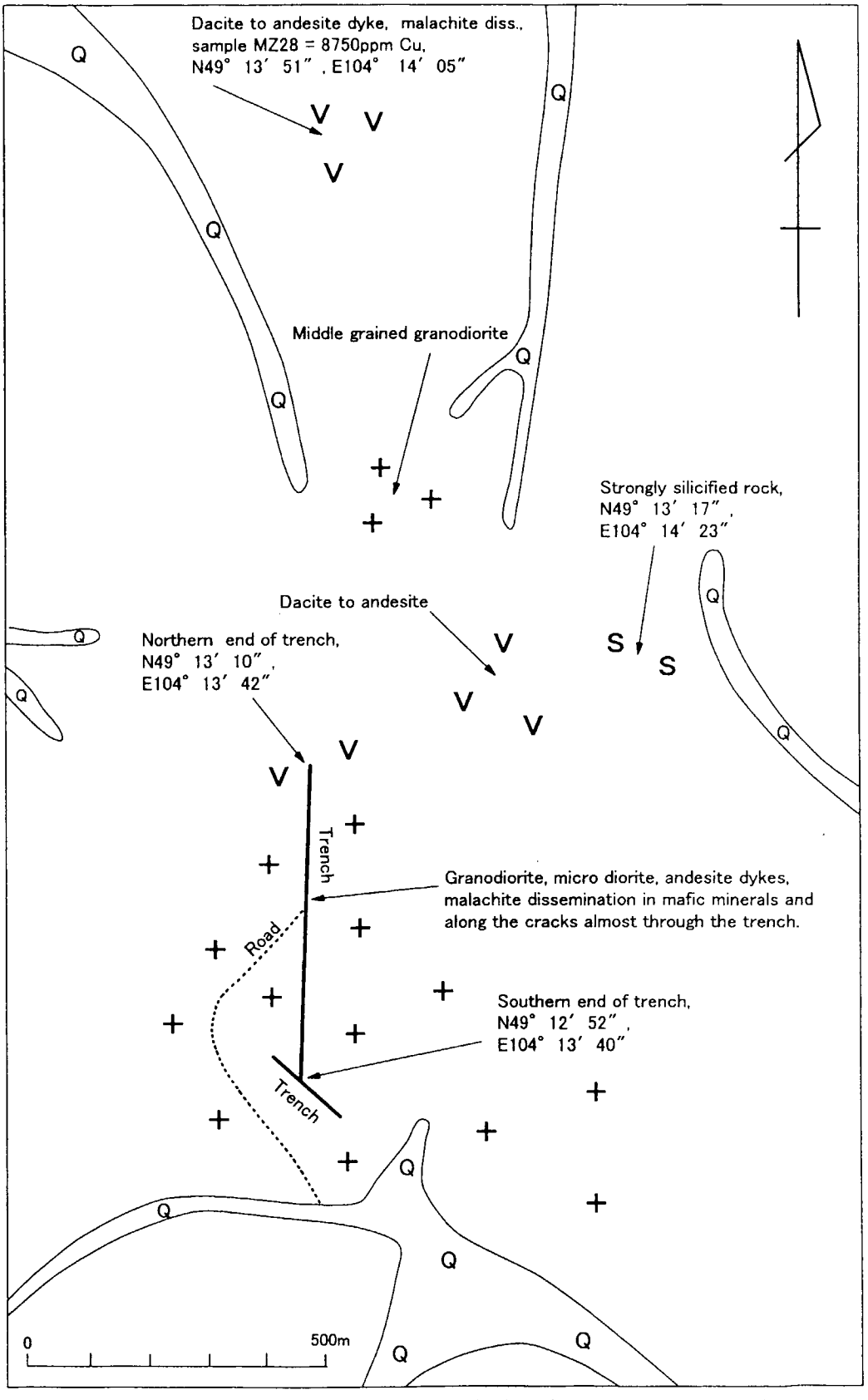
[Geology and geological structure]

Granodiorite, inferred to be the Selenge complex, dominates in distribution where micro diorite, dacite to andesite, dacite porphyry are intruded. These distributions are covered with dacite and andesite lava.

[Mineral showing and alteration]

Mineral showing of malachite disseminating in granodiorite was observed in a trench shown in Figure II-3-9. The granodiorite has a fresh lithofacies and includes light-red potassic feldspar and plate-like biotite, both of which is thought to be affected by potassic alteration. Malachites are divided into two types, malachite in selectively disseminated in mafic minerals and along cracks. The former type malachite is the result of oxidization of chalcopyrite generated by mineralization of hypogene type porphyry copper deposit in the current spot while the latter type of malachite is estimated to have been formed as a result of the malachite that moved secondarily. This mineral showing appears almost entirely in the 470-meter length trench. However, outside the trench has thick vegetation and outcrop wasn't observed, so we could not identify the scale of mineralization. At the sampling point of M00MZ28 shown in Figure II-3-9, malachite and limonite dissemination like spots in silicified intrusive rocks such as dacite and andesite with silicification. The copper oxide is thought to be formed in situ.

Moreover, a silicification zone is distributed at the MM00IH148 collected point in the north of this mineral occurrence while quartz network with 30 cm width at maximum is



Schematic plan of the Zuukhiin gol mineral occurrence. + : Permian to Triassic granitoids of the Selenge complex, V : dacite to andesite dykes, S : strongly silicified rock, Q: quaternary sediments.

Fig. II-3-9 Schematic plan of the Zuukhiin gol

distributed at the M00TM166 collected point in the west of this district.

[Laboratory test]

Under the microscopic observation M00MZ181 is judged as hornblende biotite granodiorite. M00MZ181 is classified as an island arc type granite by Rb-(Y+Nb) diagram. REE pattern indicates relatively similar to granites in the Erdenet deposit (Appendix). Secondary quartz, chlorite, and saussurite are obsereved as alteration mineral under microscope. Since biotite is xenomorphic and its cleavage is bent, we infer that the biotite has been formed from secondary generation due to potassic alteration.

The mineallized rock sample M00MZ182 collected in the trench indicated 2,180ppm Cu, and M00TM163 indicated 2,550ppm Cu. Au and Mo were lower than their detection limit. M99MZ028, minerallized intrusive rock, indicated 8,750ppm Cu, 0.025g/t Au, 14.8g/t Ag, and 1ppm Mo. The northern silicification zone and western quartz network indicated no noteworthy analysis results.

[Evaluation]

This mineral occurrence had mineralization of hypogene-type porphyry copper deposit, where original chalcopyrite seems to have been changed into secondarily oxidized to malachite. The ore grades from this survey and the preceding survey indicates low, 2,550ppm Cu or less, although some points indicates 8,750ppm Cu. The preceding survey was quitted because of low grades. However, we can now use the SX-EW method, and if a mass of oxide minerals at 0.3% Cu or so is distributed, it may lead to mining development. Since this mineral occurrence has thick vegetation, we could not check minealization outside the trench. If systematic reevaluation can be conducted with, for example, soil geochemical exploration, and if a good result is obtained, it may lead to pit, trench, and drilling.

(2-3) Mogoin gol 2 (Mineral occurrence NO. 10)

[Representative latitude and longitude]

49° 10' 03.7" north latitude, 103° 45' 13.5" east longitude ("secondary quartzite"outcrop near the ridge)

[Topography and vegetation]

This mineral occurrence is located at a mountain with altitude of about 1,000m and a relative height of 300m or so. The northern slope has thick conifers while the southern slope has no trees but tall grasses growing thick. Thick vegetation hinders outcrop of rocks.

[Access]

This mineral occurrence is located about 25 km away from Erdenet City in the northwestern direction. It takes about 90 minutes by vehicle to reach the mountain foot from the city, followed by another 30 minutes walk to reach the area where "secondary quartzite" is distributed.

[Preceding survey]

This mineral occurrence was discovered in 1967. A geological survey in 1:50,000 scale was conducted in 1971, followed by another geological survey in 1:25,000 scale in 1981 (document No. 3209). "Secondary quartzite" with slight copper oxide were identified in pyroclastic rocks in the Lower Permian into which the Selenge complex intruded in the areas of 1.5m x 0.5 km and 4 km x 2 km. Ore grade assay indicates 0.034 to 0.074% Cu and 0.002 to 0.018% Mo. A geophysical exploration (IP method) was conducted and detected a high FE anomalous (6%) area. Short drillings were also conducted, but no distinctive copper minerallized zone was detected. The existing data describes distribution of rhyolite, trachyte rhyolite porphyry, and andesite and dacite porphyry, which might be Erdenet porphyritic intrusive complex.

[Features on SAR image] (SAR image unit: "Ingettolgoy")

This district indicates gray to dark gray tones. The resistivity shows relatively low. A round ridge is svisible. The drainage density is low, and an NW-SE trending lineaments, represented by Rivers, is observed.

[Geology and geological structure]

According to existing data (geological map in 1:25,000 scale issued in 1981), granites of Selenge Complex (1st period: diorite, gabbro-diorite, 2nd period: granite, granitic syenite, granodiorite, 3rd period: sub-alkali leucocratic granite, all of which belong to the Upper Permian), the Khanuigol suite consisting of andesite, basalt porphyry, tuffaceous rock in the Permian, and the Mogod suite consisting of trachyandesite, trachyliparite, and basalt porphyry in the Upper Triassic and the Lower Jurassic are distributed (Fig. II-3-10).

[Mineral showing and alteration]

According to existing data (geological map in 1:25,000 scale issued in 1981), "secondary quartzite" in volcanic rocks were found at three zones in an area of 4 km in the south-north direction and 2 km in the east-west direction (hereafter called the "Southern Alteration Zone"). Also, "metasomatic alteration" in diorite in the north side is known in an area of 1.5 km in the east-west direction and 0.5 km in south-north direction (hereafter called the "Northern Alteration Zone"). Most of the "Southern Alteration Zone" consists of dacite andesite, with a seemingly small stock of diorite, are observed. The rock identified as "secondary quartzite" indicates silicified rock in white color and most of them contain much equigranular quartz, and is called sugary quartzite. Some of which may include limonite. According to the existing data, copper oxide was found at a number of points. The Phase-II survey also identified azurite (M00HH198, M00HH200) in a trench remains in southeastern area.

[Laboratory test]

In the Southern Alteration Zone, X-ray diffraction of the white-colored silicified rock (M99NK034R), white-colored silicified rocks with azurite (M00HH198, M00HH200), and

sugary quartzite (M00NK155), detected quartz-kaoline andalusite-sericite. The fluid inclusion homogenization temperature of quartz in the sugary quartzite (M99NK037R) and a quartz veinlets developed in the dacitic andesite (M00NK159) indicated at 179.5℃ and 300.2℃, respectively. Meanwhile, quartz-sericite alunite (kaoline) was detected in the silicified rock (M00MZ171, M00MZ172) in light blown to white colors collected in an area between the Northern Alteration Zone and the Southern Alteration Zone. As a result of under microscopic observation, fine-grained diorite (M00NK156) in stock (?) is determined as porphyritic hornblende quartz diorite. The phenocryst consists of plagioclase, hornblende, and iron oxide; the groundmass is fine-grained holocrystalline and consists of quartz, potasssic feldspar, plagioclase, hornblende, and biotite. These observations show re-crystallization texture, indicating the result of a high temperature thermal metamorphism. The fine-grained diorite (M00NK157) is also metamorphic quartz diorite porphyry, indicating the existence of recrystallized clinopyroxene and large quantities of iron ore. Chemical analysis of M99NK034R, M99NK035R, M99NK036R, M99NK037R, M00NK155 (andesite), M00NK156 (sugary quartzite), M00NK157 (andesite), M00NK159 (fine-grained diorite), M00HH197 (silicified rock), M00HH198 (copper oxide stain), M00HH200 (copper oxide stain), M00MZ171, M00MZ172 and M00MZ173 (both are silicified rocks) indicated no specific anomalous values.

[Evaluation]

As indicated in the existing data, our Phase-II survey also identified the distribution of "secondary quartzite" in the Southern Alteration Zone. Most of the "secondary quartzite" should be called quartzite containing coarse sugary quartz. As indicated above, the quartz in this quartzite was produced in low temperature, while the quartz consisting of quartz vein was produced in high temperature. Since andalusite was found, "secondary quartzite" may also be located at a relatively deeper level of the porphyry lithocap. Fine-grained diorite in stock (?) was affected by thermal metamorphism in high temperature, which seemingly supports the area was once under high temperature environment. Meanwhile, though the Northern Alteration Zone is estimated to have been affected by "metasomatic alteration" according to the description of the existing data, the hydrothermal activity is unknown so far. No andalusite but alunite was detected at the middle between the Northern Alteration Zone and the Southern Alteration Zone. According to the existing data, this area does not belong to the distribution of "secondary quartzite." However, since the existing document identifies the distribution of silicified rock, it indicates that areas adjacent to the Southern Alteration Zone was once under lower temperature and acid hydrothermal activities, which seemingly indicates a relatively shallow part of lithocap. As stated above, surroundings and deep underground zone of this mineral occurrence may have porphyry type copper deposit at deep and high-sulfidation type gold deposit at shallow, a further detailed investigation is recommended to conducted.

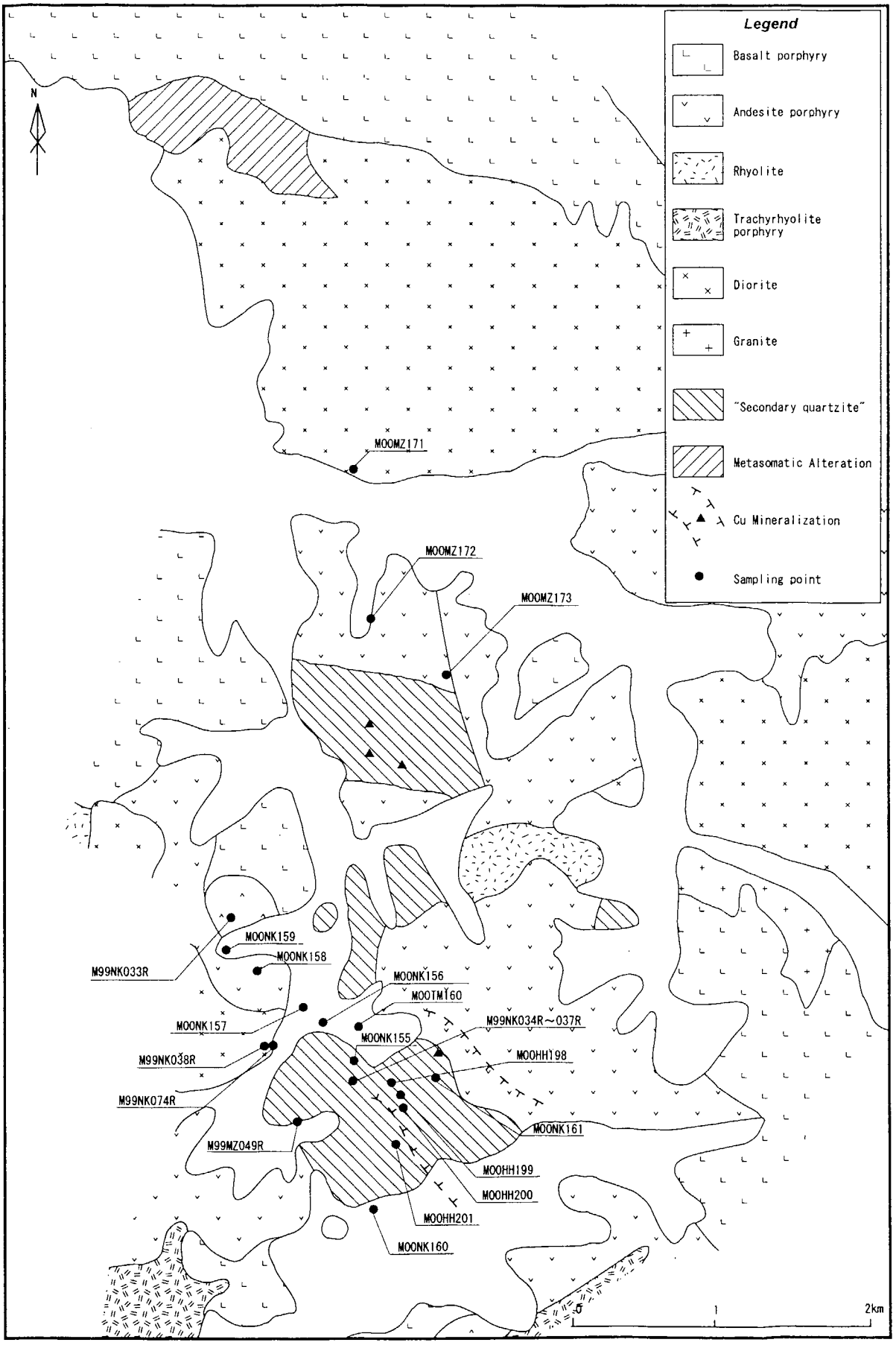


Fig. II-3-10 Geological map of the Mogoin gol 2

(2-4) Khujiriin gol (Mineral occurrence NO. 11)

[Representative latitude and longitude]

49° 08' 18.9" north latitude, 103° 38' 39.3" east longitude, 1,195m altitude (point where copper oxide occurrence exists and M00MZ176 was collected)

[Topography and vegetation]

This area has hills and mountains. Ridges and streams are arranged in the east-northeast direction. Topography is lower towards east-northeast direction. The eastern area of this mineral occurrence faces flatland where a River flows up in the north direction. For vegetation, grasses grow on lowlands and forests cover highlands.

[Access]

Access is relatively easy. It is to go by vehicle on an unpaved road from Erdenet city for about 90 minutes to reach near the mineral occurrence.

[Preceding survey]

A geological survey was conducted in 1967, when this mineral occurrence was identified. Since then, a trench survey and the others were conducted, followed by drilling survey in the 1980s. According to a geologist of the Erdenet Mine, the survey data were taken out of the country, no detailed exploration data remained. However, judging from 6 drilling columnar sections at the Geological Information Center (GIC), this mineral occurrence indicates the existence of pyrite and small quantities of chalcopyrite. The ore grade is low at 0.0X %Cu.

[Features on SAR image] (SAR image unit: "Ingettologoy")

The image indicates gray and white color tones, presenting small ups and downs of landforms. An annular and an NE trending lineaments are identified in the northern area. Resistivity values of rocks indicate middle to high. The drainage system develops middle to high and is distributed in dendritic. No bedding plane is observed.

[Geology and geological structure]

Granodiorite, syenite, monzinite, tonalite, and andesite dykes of the Selenge complex are distributed. Andesite lava, from the Triassic to the Jurassic is distributed in southern areas to this mineral occurrence.

[Mineral showing and alteration]

This mineral occurrence has quartz veins to network, including malachite and limonite, and hosted in granites. The quartz veins run in the strike of N 25° to N 80° E and dip of vertical. The largest width of the quartz vein is 40 cm. The granites, being host rock, consist of much light-red potassic feldspar, and present syenite-like lithofacies due to potassic alteration. As indicated in Figure II-3-11, these minerallized zones are intermittently distributed 300 to 500 meters in apart along the ridge in the ENE direction though each minerallized zone is small in size.

Silicification and argillization have been observed in an area of andesitic pyroclastic rock

distributed, located 7.5 km in north of this mineral occurrence. Also, fine-grained pyrite dissemination is observed in the silicified rock.

[Laboratory test]

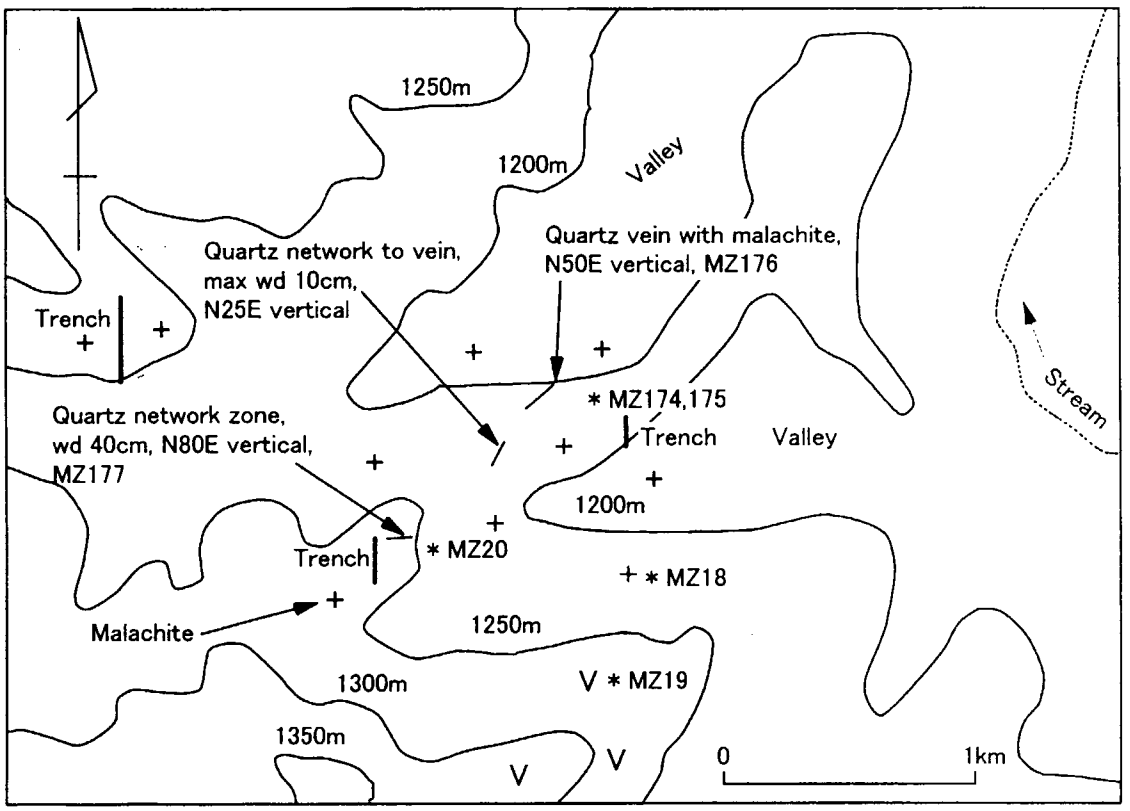
As the result of microscopic observation on the host rock of the quartz vein and network, M00MZ175 is classified as hypersthene and clinopyroxene andesite, while M00MZ176 is classified as biotite tonalite. The degree of the alterations is rather high, and secondary quartz, chlorite, and saussurite are observed frequently. Biotite of the biotite tonalite shows xenomorphic texture, and replaces potassic feldspar, which indicate potassic alteration.

According to chemical analysis of the oxide copper bearing quartz vein, although M00MZ174 and M00MZ177 respectively indicated 1330ppm Cu and 2240ppm Cu, Au and Mo were lower than their detection limit. For fluid inclusion homogenization temperature, the average value of M00MZ177 recorded 239℃ while the average value for another quartz vein M00HH202 recorded 142℃. These temperatures are extremely lower than the formation temperature of porphyry copper deposit. They are equal to epithermal mineralization according to the temperature. Concerning oxygen isotope ratio of quartz, M00MZ177 and M00HH202 indicated -10.99‰ and -8.22‰, respectively. The value of M00HH202 was anomalously low. The extremely light values are thought to be attributed to the inclusion of malachite grains and other foreign substances in quartz.

Meanwhile, the result of X-ray diffraction of silicified rock in the Northern Alteration Zone identified sericite in M00MZ178 and identified sericite, kaoline, and andalusite in M00MZ179. The result of chemical analysis indicated that Au and Ag were lower than their detection limit and indicated 2 to 14ppm Cu.

[Evaluation]

This district has quartz veins including malachite and limonite, which are inferred to be originally chalcopyrite and pyrite. Granites as host rock of quartz veins are thought to be suffered potassic alteration judging from field occurrence of dominated potassic feldspar and the occurrence of the secondary biotite observed under microscope. However, the temperature of forming quartz vein with copper mineralization is extremely lower than the temperature of forming porphyry copper deposit; the temperature is equal to epithermal mineralization. At the time of potassic alteration, no mineralization occurred, and different stage of low temperature hydrothermal activities seemingly caused quartz vein with copper mineralization. These mineralization are small in scale and intermitted, and their ore grade is low. The columnar section of drill hole kept at the Geological Information Center (GIC) also indicates low ore grades at deep. Thus, we don't conclude this mineral occurrence is thought to be promising.



Schematic plan of the Khujiriin gol mineral occurrence.
+ : Permian to Triassic granitoids, Selenge complex equivalent,
v : Triassic to Jurassic andesite lava.

Fig. II-3-11 Schematic plan of the Khujiriin gol

(2-5) Tsagaan chuluut (Mineral occurrence NO. 3)*

[Representative latitude and longitude]

49° 2' 45.5" north latitude, 104° 00' 38.5" east longitude (TV tower in the northern part of Erdenet city)

[Topography and vegetation]

This area has thick conifers on the North Slope, while low grasses grow thick on the southern slope. The point with the highest altitude of 1,709 m where a TV tower is built is located on the southern mountain to Erdenet city. The relative height from Erdenet city is about 300 meters. The mountaintop has an outcrop of rock, like on the top of Mt. Tsagaan chuluut.

[Access]

The mineral occurrence is located in the northern mountainside to Erdenet city. Driveways are relatively developed and it is easy to reach this point from the city.

[Preceding survey]

Since this mineral occurrence is located at a place adjacent to the northwestern area to the Erdenet deposit, a geological survey, geochemical exploration, geophysical exploration, and drilling were conducted in the past (Table II-3-2).

The result of the geophysical exploration shows that a width of about 30 km, indicating IP anomaly and negative magnetic anomaly, extends in NW-SE direction over the mineral occurrence. This is similar to Erdenet NW.

The result of the geological survey indicates that the Selenge complex seems located 150 to 200 meters relatively deeper than the Erdenet NW deposit. Cold springs are found in northern areas, indicating high sulfide contents. The result of grid drillings indicates the sulfide content becomes more concentrated when the hole becomes deeper.

One drilling indicated that the core length of 15 meter at 275 meters or deeper recorded 0.75% Cu.

[Features on SAR image] (SAR image unit: "Ingettolgoy")

In the SAR image, ridges are indicated as white to light gray colors, and valleys and lowlands are indicated as dark gray. The resistivity is rather weak and the development of drainage systems is weak. Lineaments are extracted in the NNW-SSE direction.

[Geology and geological structure]

According to an existing data (geological map in 1:25,000 scale issued in 1972), this mineral occurrence is located at an area extended from the Erdenet deposit in the northwestern direction. This district has a broad distribution of volcanic rocks in the Permian and Triassic. As

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* In the Phase-I survey, the Talbulug mineral occurrence and the Tsagaan chuluut mineral occurrence were classified different. Since these occurrences are close to each other and the Mongolian side had no name of the Talbulug mineral occurrence, these mineral occurrences are put together as the Tsagaan chuluut mineral occurrence in this report.

the distribution of the Erdenet deposits is controlled by the NNW-SSE trending structure, this mineral occurrence also has developed NNW-SSE trending fault. Since the Selenge complex is distributed in a small area in the northeastern direction from Erdenet city, it is estimated to be distributed under volcanic rocks.(Figure II-3-12). Also, N-S trending dykes have developed in northeastern area. The volcanic rocks consist of trachyte andesite, rhyolite lava, and pyroclastic rock. Rhyolite may have developed flow band or a spherulitic structure.

[Mineral showing and alteration]

So-called "secondary quartzite", which source rocks are rhyolitic and andesitic volcanic rocks distributed, like ameba, in an area of about 100 m^2 over Tsagaan chuluut to Talbulag from Erdenet in the NW-SE direction. The existing data (geological map in 1:25,000 scale) shows distribution of "secondary quartzite" (w), kaolinization (k), quartzation (o), alunitization (A), and sericitiztion(c) (Figure II-3-12). Distribution of silicified rock shown in Figure II-3-15 is compiled from those described as "secondary quartzite" in the Mongolian data. We can safely say so although our Phase-II survey didn't conduct all of distributions around this mineral occurrence. In the northern area to Erdenet city, we identified white argillized and silicified rocks overlying the trachy andesite, which contains potassic feldspar, hornblende, and plagioclase phenocryst have developed. We also observed white and flesh-colored kaoline concentrated in pod in white argillized and silicified rocks in surroundings of Mt. Tsagaan chuluut. Almost no sulfide minerals were observed although limonitization was observed in places

[Laboratory test]

As the result of under microscopic observation, M00NK137 (rhyolite) is determined as spherulitie bearing rhyolite affected by strong silicification; M00NK137 (trachy andesite) is as andesite containing phenocryst of hornblende and biotite, and groundmass containing quartz, potassic feldspar, plagioclase, pyroxene, and copper oxide, and M00NK141 (rhyolite) is as also rhyolite judging from their flow structure suffered by strong silicification, which original texture and initial minerals have disappeared. K-Ar age dating of fresh andesite (M99NK41R) indicated 210±4Ma. We also conducted chemical examination of white-colored argillized and silicified rocks (56 specimens) collected from the area of "secondary quartzite" 0.1 to 0.005 ppm> Au, 1.2 to 0.2 ppm> Ag, 156 to 1 ppm> Cu, 114 to 2 ppm> Pb, and 100 to 2 ppm> Zn. We did not gain any other remarkable metal elements grades except for M00MZ165, which consists of quartz and alunite, at 0.1 ppm Au. As the result of X-ray diffraction of altered rocks, the specimens are classified into those consisting of alunite and kaoline (quartz, quartz-alunite, quartz-kaoline, quartz-alunite-kaoline), those consisting of sericite (quartz-sericite (kaoline)), slightly altered rocks (quartz-plagioclase-albite-potassic feldspar), and those consisting of andalusite (quartz-albite-potassic feldspar-andalusite).

We tried to delineate alteration zones by maltivariate analysis based on the result of

chemical analysis (cluster analysis) and X-ray diffraction. The result of alteration zoning is described below:

・Used data:

Analysis data from 56 specimens collected in this mineral occurrence (Phase-I survey: 7 pieces, Phase-II survey: 49 pieces) were used. The analysis includes 26 constituents, such as Au, As, Sb, Hg, Ag, Al, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sr, Ti, V, and Zn.

・Pre-processing of analysis data:

The values of the trace constituents having an analysis value in ppm (Au, As, Sb, Hg, Ag, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, P, Pb, Sr, V, and Zn) are converted into logarithm values, and their constituent names are represented expressed as LogAu, LogAs, Log Sb, LofHg, LogAg, LogBa, LogBe, LogCd, LogCo, LogCr, LogCu, LogMn, LogMo, LogNi, LogP, LogPb, LogSr, Logv, and LogZn. Figure II-3-13 illustrates a histogram of their constituents.

・Analysis method:

Based on the distances between the 26 geochemical samples in multi-dimensional space, we conducted cluster analysis to classify similar samples into groups. The actual calculation was conducted via the Internet by using a subset of the pharmaceutical statistics analysis program package (NAP Ver. 4.0) owned by the Social Information Department of Gunma University.

・Calculation result and interpretation:

Figure II-3-14 illustrates a dendrogram indicating the relationship between the samples obtained from the computer calculation. Also, Table II-3-3 lists groups (5 groups of A, B, C, D, E) based on the geological characteristics of the analyzed samples (sampling point, rock name, etc.) and the dendrogram, estimated SiO_2% calculated from their analysis values, minerals detected from X-ray diffraction, and their quartz indexes (Table II-3-3).

Group A has 14 samples. A half of the samples consist of tuff breccia or tuff. Their estimated SiO_2 percentages range between 65 to 94% (average: 84%) and the degree of silicification ranges from low to high. Group A is characterized as having kaoline, alunite and pyrite. No plagioclase, albite, and potassic feldspar, all of which are rock-forming minerals of igneous rocks, were detected in the samples of Group A:

Group B has 32 samples. The source rocks of Group B are rhyolite, trachyte porphyry, andesite, tuff breccia, and many others. The estimated SiO_2 percentages range between 72 to 93% (average: 82%), belonging to middle and high silicified rock. Group B is characterized as having kaoline, alunite and sericite. The group is subdivided into B1, B2, and B3 when we examine the result of our cluster analysis and X-ray diffraction results.

Subgroup B1 has 8 samples. Their estimated SiO_2 percentages range between 75 to 81%

(average: 79%), belonging to middle silicified rock. Subgroup B1 is characterized as having plagioclase, albite, and potassic feldspar, all of which are rock-forming minerals of igneous rock. The subgroup detected sample with andalusite, which is formed under high temperature.

Subgroup B2 has 17 samples. The estimated $SiO_{2\ percentages}$ range between 80 to 91% (average: 84%), belonging to middle to strongly silicified rock. Subgroup B2 is characterized as having distinct quantities of kaoline and alunite. No rock-forming mineral of igneous rock was detected.

Subgroup B3 has 7 samples. The estimated SiO_2 percentages range between 68 to 93% (average: 80%), belonging to low to high silicified rock. Subgroup B is characterized as having plagioclase, albite, potassic feldspar, all of which are rock-forming minerals of igneous rock.

Group C has 7 samples. The estimated $SiO_{2\ percentages}$ range 85 to 99% (average: 95%), belonging to strongly silicified rock and making it difficult to estimate their source rocks. Group C is characterized by high silicification as having almost no clay minerals.

Group D has 3 samples (2 trachyte andesite, 1 dacite). The estimated $SiO_{2\ percentages}$ range 62 to 65%, having almost no silicification. The group is characterized as having non-altered rock.

・Distribution of alteration zones:

Based on the 56 samples grouped into A to D, we have made an alteration zoning map after taking their landforms into account (Fig. II-3-15).

According to this map, a surface alteration zone extends to the massif (in L-letter) behind Erdenet city. Although the eastern end and southern end of this alteration zone are almost identified with the distribution of non-alteration rock, the western end and the northern end are unknown. However, the area of this alteration zones is estimated as occupying 100 km^2 or more.

The sample rocks extracted in the Tsagaan chuluut district are classified into Group A (kaoline-alunite-pyrite), Group B (kaoline-alunite-sericite), Group C (strongly silicified rock), and Group D (non-altered rock). Group C (strongly silicified rock), Group A (kaoline-alunite-common pyrite), and Group B (kaoline-alunite-sericite) are piled from top to bottom at the ride of the mountain. Although no high sulfidation type mineralization was identified, we estimate that this alteration zone is located in the boundary between advanced argillic lithocap and sericite alteration (Sillitoe, 1995) as shown in Figure I-3-11)

[Evaluation]

White argillized and silicified rock distributed in this district, so-called "secondary quartzite", hardly has sulfide minerals. Combinations of most of the alteration minerals consist of either quartz-alunite-kaoline or quartz-kaoline. From these, we estimate that the alteration zoning has been formed at a relatively shallow level (near paleo water table) by acid hydrothermal solution. As stated above, this silicified rock having poor metal constituents is estimated to be equal to lithocap (Sillitoe, 1995) or "barren quartz-alunite lithocap" (Hedenquist,

Table II-3-2 Summary of drilling logs previously carried out in the Tsagaan chuluut

Hole No.	C-202		C-213		C-214	
Location	Tsagaan chuluut		Tsagaan chuluut		Predgorny (Tsagaan chuluut East)	
Elevation	1410m		1339m		1383m	
Drilling depth (Angle)	200m (vertical)		92.9m (vertical)		47m (vertical)	
Geology	2.5 - 25.2m	Liparite	1.9 - 33.5m	Tuff breccia	1.5 - 18.0m	Granite-gneiss
	25.2 - 41.7m	Andesite-dacite porphyry	33.5 - 58.0m	Clay with fragments and	18.0 - 33.0m	Granodiorite
	41.7 - 76.5m	Andesite-dacite porphyry		layers of tuff breccia	33.0 - 46.7m	Granodiorite
		with dykes of andesite	58.0 - 65.2m	Tuff breccia		
		porphyry	65.2 - 92.9m	Tuff breccia		
	76.5 - 97.5m	Syenite-diorite porphyry				
		with andesite-dacite				
		porphyry				
	97.5 - 115.6m	Andesite-dacite porphyry				
	115.6 - 129.5m	Syenite-diorite porphyry				
	129.5 - 140.5m	Andesite-dacite porphyry				
		with syenite-diorite porphyry				
	140.5 - 171.3m	Syenite-diorite porphyry				
		partly with xenoliths of				
		granodiorite				
	171.3 - 188.1m	Granodiorite				
	188.1 - 200.0m	Syenite-diorite porphyry				
Alteration	2.5 - 25.2m	Sil-Lim-Kao	1.9 - 33.5m	intense Kao-Ser-Iron hydroxides	1.5 - 18.0m	Ser-Kao-Iron hydroxides
	25.2 - 41.7m	Lim. and clay	33.5 - 58.0m	intense Kao-Ser-Iron hydroxides	18.0 - 33.0m	Kao-Iron hydroxides
	41.7 - 76.5m	poor Kao-Chl-Epi	58.0 - 65.2m		33.0 - 46.7m	Veinlets of carbonate
	76.5 - 97.5m	Lim-Cal-Epi	65.2 - 92.9m	Kao-Argillaceous		
	97.5 - 115.6m	poor Chl-Cal-Lim-Epi				
	115.6 - 129.5m	Lim-Cal-Epi				
	129.5 - 140.5m	poor Chl-Cal-Lim-Epi				
	140.5 - 171.3m	poor Cal-Lim				
	171.3 - 188.1m	Chl-Epi				
	188.1 - 200.0m	poor Cal-Lim				
Mineralization	Very poor sulphide mineral. Partly pyrite impregnated.		Pyrite impregnated in the depth		Partly pyrite impregnated.	
Cu-content	Max 0.05%		Max 0.006%		Max 0.03%	

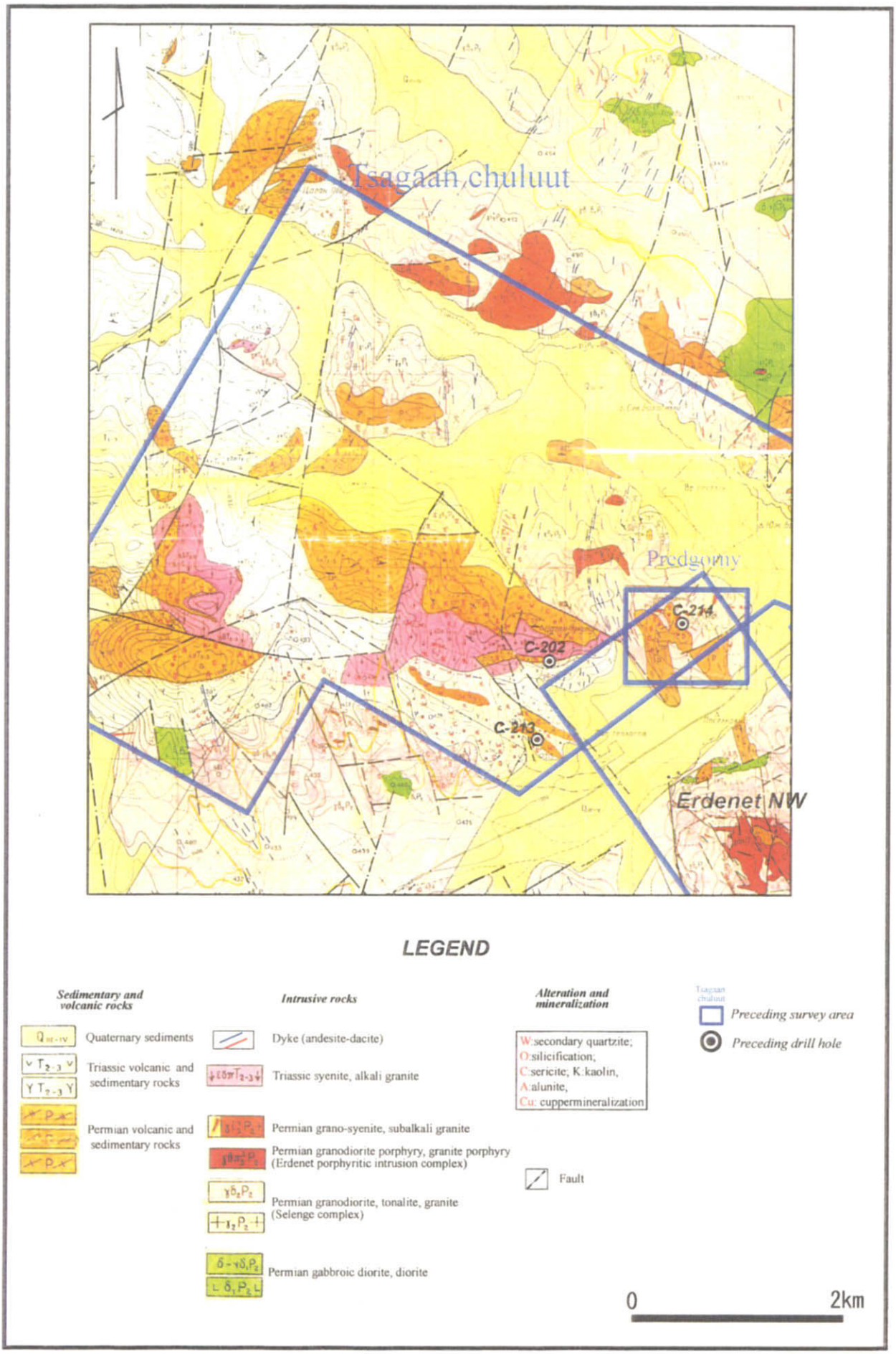


Fig. II-3-12 Geological map of the Tsagaan chuluut

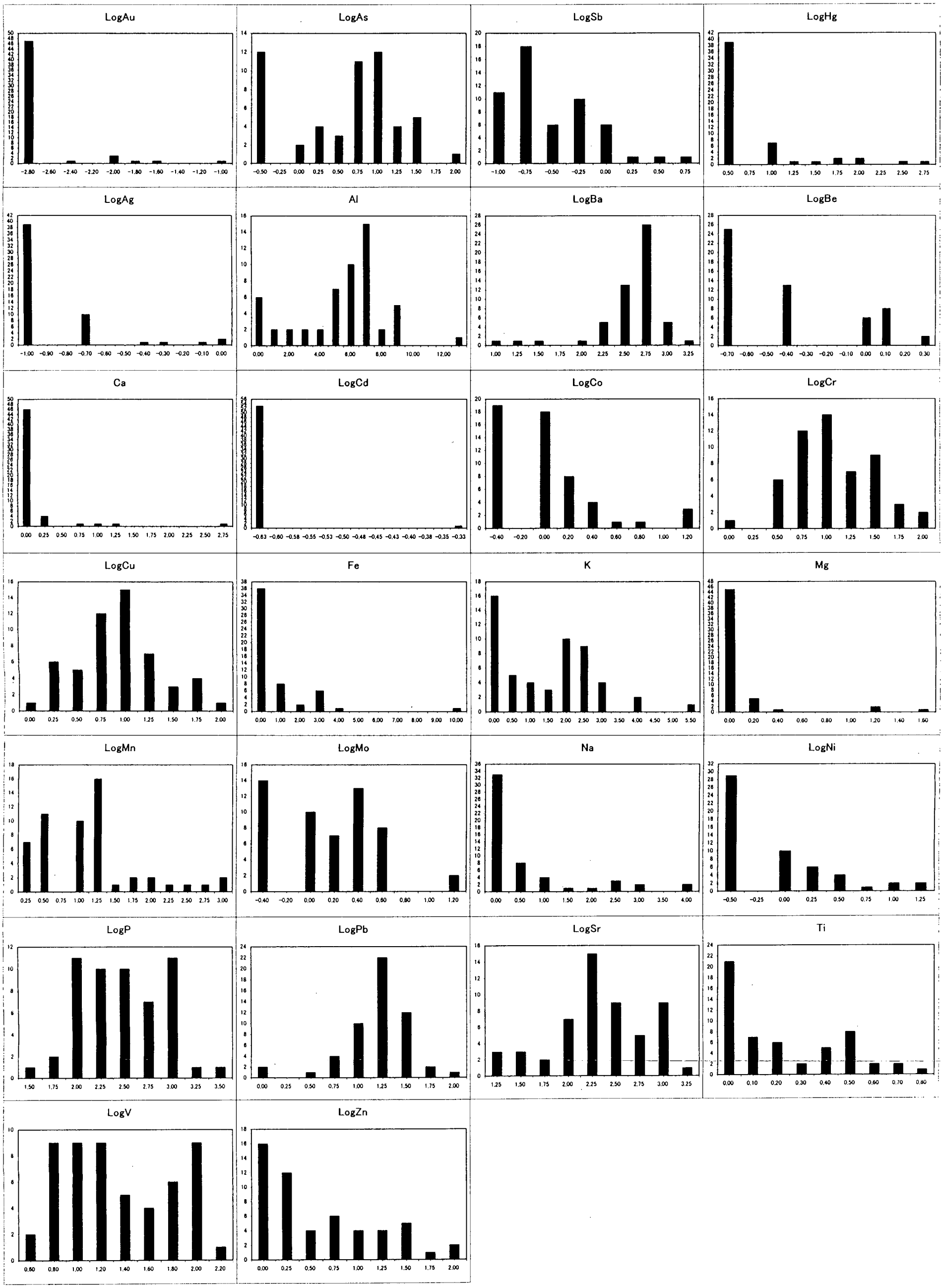


Fig. II-3-13 Histograms of the individual elements used for the multivariate analysis (cluster analysis)

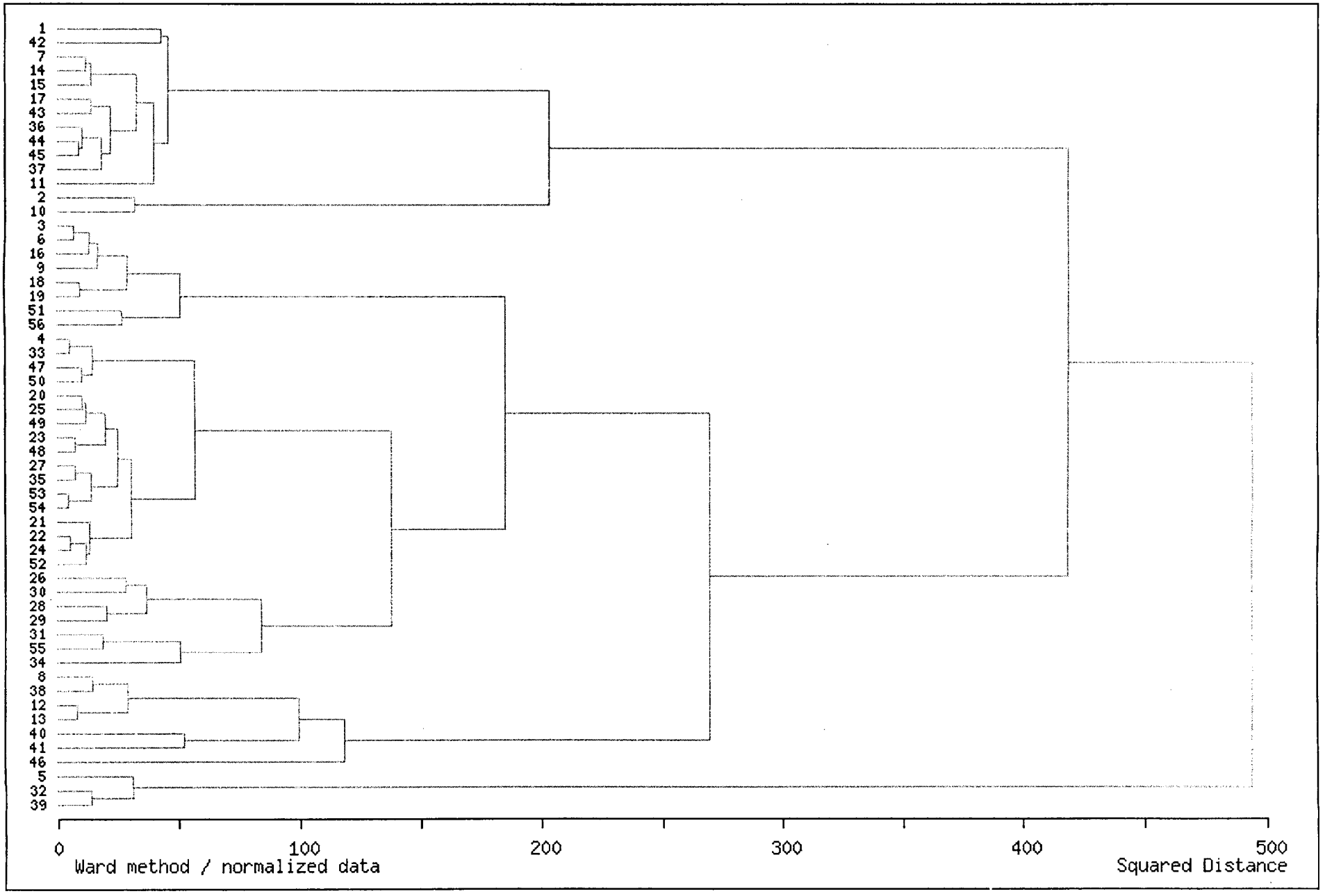


Fig. II-3-14 Dendrogram on the basis of the cluster analysis results

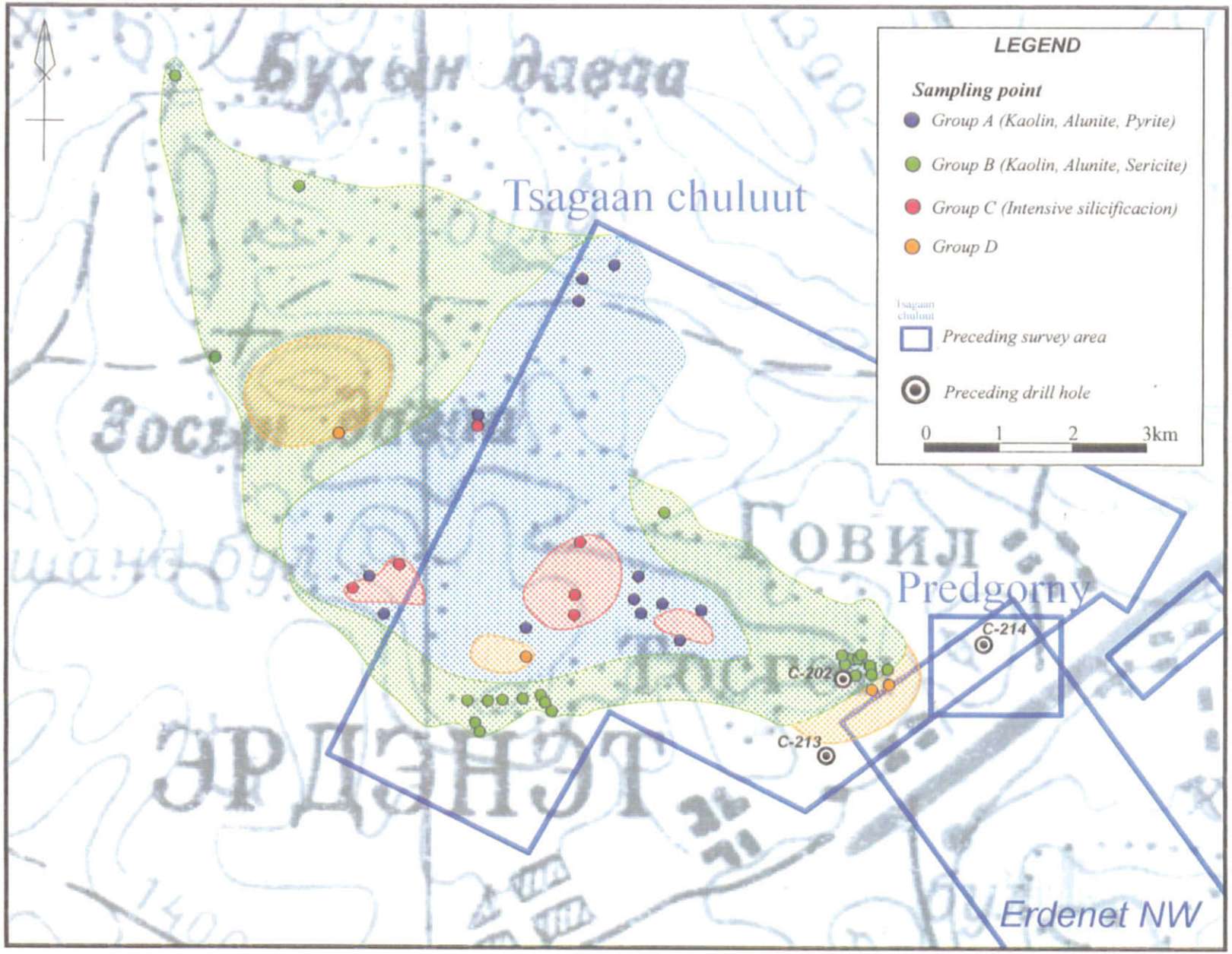


Fig. II-3-15 Geochemical zoning map on the cluster analysis results in the Tsagaan chuluut

Table II-3-3 List of geochemical samples in the Tsagaan chuluut

No.	Sample No.	District	Occurrence	Rock name	General description	Alteration	Cluster	Estimated SiO_2%	Minerals detected by X-ray diffractive analysis											
									Quartz	Plagioclase	Albite	K-feldspar	Hornblende	Sericite	Chlorite	Montmorillonite	Kaolinite	Alunite	Andalusite	Calcite	Pyrite
1	M00IH156	Erdenet West	Talbulag	Altered porphyritic rock	grey altered porphyritic rock		A	79													
42	M00NK148	Erdenet West	Tsagaan chuluut North	tuff breccia	pale pinkish	silicification, argillization	A	65	22									24			1
7	M99NK043R	Erdenet	Talbulag	tuff breccia	andesite	silicification	A	89													
14	M00TM155	Erdenet West	Talbulag South	Tuff breccia	Grey-brown, andesitic?	Silicification, limonitization, translusent-white mineral along	A	80	26								8	20			1
15	M00TM157	Erdenet West	Talbulag South	Tuff breccia	Andesitic tuff breccia?	Silicification, pyritization (limonite)	A	84	36								18				1
17	M00NK162	Erdenet West	Tsagaan chuluut	tuff		strong limonitization	A	87													
43	M00NK149	Erdenet West	Tsagaan chuluut North	tuff breccia	pale pinkish	silicification, argillization	A	85	51									11			
36	M00HH196	Erdenet West	Tsagaan chuluut NE	silicified (altered) rock	Outcrop (light brown~gray~	silicification & argilisation?	A	82	32								3	12			
44	M00NK150	Erdenet West	Tsagaan chuluut North	tuff breccia	pale pinkish	silicification, argillization, white vein (kaolinite?)	A	86	44								7	11			
45	M00NK151	Erdenet West	Tsagaan chuluut North	tuff breccia	pale pinkish	silicification, argillization	A	89													
37	M00HH190	Erdenet West	Tsagaan chuluut North	Breccia of silicified rock	Float (brown~light gray)	silicification	A	82													
11	M00MZ186	Erdenet West	Talbulag East	Altered rock	Light grey	Silicification	A	78													
2	M00IH157	Erdenet West	Talbulag	Silicified rock	grey, highly silicified rock		A	94	68												1
10	M00MZ185	Erdenet West	Talbulag East	Altered rock	Light grey	Silicification	A	93	46								10				
3	M00MZ183	Erdenet West	Talbulag	Altered rock	Light brown	Silicification	Bb1	75	32	5		6		1						2	
6	M99MZ023R	Erdenet	Talbulag	volcanic rock	reddish gray	silicification	Bb1	80													
16	M00TM158	Erdenet West	Talbulag South	Rhyolite	Grey-white	Weak silicification, white argillization, limonitization along cruck	Bb1	78	34		4			1							
9	M99NK046R	Erdenet	Talbulag	silicified rock	original rock ?	silicification	Bb1	77													
18	M99MZ026R	Erdenet	Tsagaan chuluut	silicified rock	white	---	Bb1	80	31		6	6							1		
19	M99MZ027R	Erdenet	Tsagaan chuluut	silica sinter?	white	---	Bb1	77													
51	M00MZ167	Erdenet West	Tsagaan chuluut West	Altered rock	Light grey	Silicification	Bb1	81	41					3							
56	M00TM154	Erdenet West	Tsagaan chuluut West	Tuff breccia	White-grey	Modelate silicification, white argillization	Bb1	80	34					3							
4	M00MZ184	Erdenet West	Talbulag	Altered rock	Light grey	Silicification	Bb2	88	64		1						5	6			
33	M00TM143	Erdenet West	Tsagaan chuluut East	Altered rock	White	Intense silicification, limonitization	Bb2	84	58								1	15			
47	M00NK153	Erdenet West	Tsagaan chuluut North	tuff breccia	pale pinkish	silicification, argillization	Bb2	85	38								2	15			
50	M00NK142	Erdenet West	Tsagaan chuluut South	Rhyolite	white, banded	silicification, argilization(alunite?)	Bb2	86	61									8			
20	M00HH181	Erdenet West	Tsagaan chuluut East	silicified rock	Outcrop (brown~gray)	silicification	Bb2	85	59								2	10			
25	M00IH141	Erdenet West	Tsagaan chuluut East	Altered rock	highly silicified altered rock	limonitization, silicification, unknown alteration	Bb2	83	37									21			
49	M00NK141	Erdenet West	Tsagaan chuluut South	Rhyolite	white, banded	silicification, argilization	Bb2	80	44									14			
23	M00HH184	Erdenet West	Tsagaan chuluut East	silicified rock	Float (whitish gray; partly reddish)	silicification	Bb2	80													
48	M00NK140	Erdenet West	Tsagaan chuluut South	Andesite?	white, patially leached	silicification, argillization	Bb2	83	39					3			3				
27	M00MZ164	Erdenet West	Tsagaan chuluut East	Altered rock	Light grey	Silicification	Bb2	84	60								15				
35	M00TM146	Erdenet West	Tsagaan chuluut East	Altered rock	White-brown	Intense silicification, pyritization (limonite)	Bb2	91	69								12	8			
53	M00TM150	Erdenet West	Tsagaan chuluut West	Altered rock	White	Silicification, white argillization, limonittization	Bb2	85	59									16			
54	M00TM152	Erdenet West	Tsagaan chuluut West	Trachite porphyry?	K-feldsper rich	Weak silicification, argillization, limonitization	Bb2	82													
21	M00HH182	Erdenet West	Tsagaan chuluut East	silicified rock	Float (whitish gray)	silicification	Bb2	82													
22	M00HH183	Erdenet West	Tsagaan chuluut East	silicified rock	Float (brown~whitish gray)	silicification	Bb2	82													
24	M00HH185	Erdenet West	Tsagaan chuluut East	silicified rock	Float (light gray; brownish band)	silicification	Bb2	86													
52	M00TM149	Erdenet West	Tsagaan chuluut West	Altered rock	White	Intense silicification, limonittization, weak argillization?	Bb2	84	57					1			4	8			
26	M00IH142	Erdenet West	Tsagaan chuluut East	Silicified rock	limonitized, highly silicified rock	limonitization, silicification, unknown alteration	Bb3	84													
30	M00NK137	Erdenet West	Tsagaan chuluut East	silciified rock	oolitic quartz	silicification	Bb3	79	35			4		1							
28	M00MZ165	Erdenet West	Tsagaan chuluut East	Altered rock	Light grey		Bb3	81	44									16			
29	M00NK135	Erdenet West	Tsagaan chuluut East	Andesite?		strongly silicified	Bb3	79	46								1	19			
31	M00NK138	Erdenet West	Tsagaan chuluut East	Andesite?		argillization	Bb3	68	17		23	3		2							
55	M00TM153	Erdenet West	Tsagaan chuluut West	Altered rock	White	Silicification, argillization, limonite along cruck	Bb3	72	41					1			17				
34	M00TM145	Erdenet West	Tsagaan chuluut East	Altered rock	Brown	Silicification, intense limonitization (gossan)	Bb3	93													
8	M99NK045R	Erdenet	Talbulag	silicified rock	original rock ?	silicification	C	98													
38	M00HH195	Erdenet West	Tsagaan chuluut North	silicified rock	Outcrop (brown~gray)	silicification (souce rock: dacitic tuff?)	C	98													
12	M00MZ168	Erdenet West	Talbulag South	Altered rock	Yellowish light grey	Silicification	C	96	64								1	2			
13	M00MZ169	Erdenet West	Talbulag South	Altered rock	Yellowish light grey	Silicification	C	93	63								4				
40	M00NK146	Erdenet West	Tsagaan chuluut North	?	dark greyish	silcification, limonitization	C	85	47		1										
41	M00NK147	Erdenet West	Tsagaan chuluut North	?	greyish, fine grained	silicification	C	99													
46	M00NK152	Erdenet West	Tsagaan chuluut North	tuff breccia	pale pinkish	silicification, argillization	C	97	83												
5	M99MZ022R	Erdenet	Talbulag	dacite	gray	---	D	65	32		12	7		4							
32	M00NK139	Erdenet West	Tsagaan chuluut East	Trachy andesite	dark greyish, k-feld,Hb phenocryst	epidote	D	65	17		30	3		2							1
39	M00NK144	Erdenet West	Tsagaan chuluut North	Trachy andesite	phenocryst: plagioclase, k-feldsper	less	D	62	6		27	5		3							

2000). Meanwhile, the existence of altered rock, which includes andalusite, in white argillized and silicified rock indicates the effect of acid to neutral pH and higher temperature hydrothermal solution at deep depth. Although the three-dimensional distribution form of the white argillized and silicified rock is not identified, we estimate that lateral flow once occurred in this mineral occurrence from the facts that strongly silicified rock is distributed in areas with a high altitude and that weakly altered volcanic rock is found beneath the silicified rock in the northern area of Erdenet city. One specimen of silicified rock indicated 0.1 ppm of Au content. Also as stated earlier, the information that copper mineralization was detected 15 meter length at 275 meters from surface is extremely important. These facts seemingly indicate the existence of porphyry-type copper deposit, including lithocap, under the white argillized and silicified rock. Accordingly, we hope to conduct a detailed survey targeting for a high sulfidation type gold deposit at shallow and a porphyry-type copper deposit at deep.

(2-6) Under (Mineral occurrence No.20)

[Representative latitude and longitude]

48° 50' 32.3" north latitude, 104° 12' 51.9" east longitude

[Topography and vegetation]

Hills with an altitude of 1500 meters are formed. Short grasses are dominated and forests are spotted in a part.

[Access]

This mineral occurrence is located 25 km from the center of Erdenet city in the southwestern direction. The distance to the survey point is 32 kilometers. It will take about 75 minutes by vehicle to reach the place.

[Preceding survey]

In the past, geological survey in 1:200,000, 1:10,000, and 1:50,000 scales, and geophysical explorations (IP method and magnetic exploration) were conducted. However, no mineral occurrence with high Cu grade on surface has been identified so far. The first year filed survey indicated the possibility of a secondary enriched zone of porphyry-type copper deposit below the surface. Thus, another survey to check the dimensions of the stocks and the alteration zone was recommended.

[Features on SAR image] (SAR image unit: "Bulgan")

This mineral occurrence is located in the NW-SE and N-S trends in southern area from Seleng River seeing from broad viewpoint. In other words, this district is located in the light gray response area in the NW-SE trends (which is subdivided into several blocks due to multiple lineaments of the N-S and NW-SE trends). The mineral occurrence is found 3 to 4 kilometers away in the eastern direction from a large rupture in the N-S system.

[Geology and geological structure]

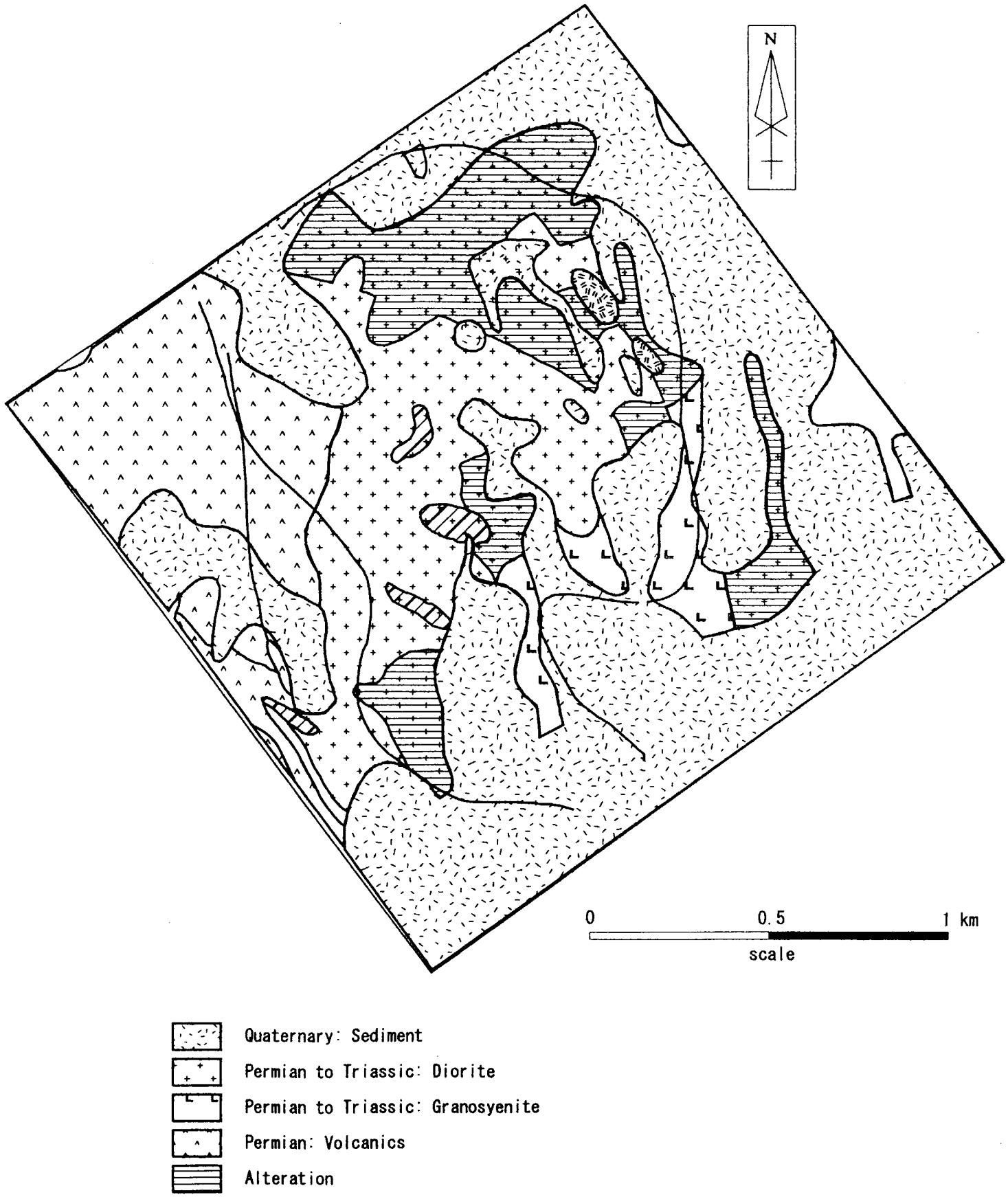


Fig. II-3-16 Geological map of the Under

According to an existing data as shown in Figure II-3-16, the western part of the survey area is occupied with andesite lava and pyroclastic rock in the Permian, to which Selenge complex (granodiorite/granitic syenite) intruded in the eastern part of the survey area. Quartz porphyry, Erdenet intrusive rocks, inject into the southern part of grnodiorite distribution area. This is estimated a small scale stock, part of which has been altered.

[Mineral showing and alteration]

Most of the granodiorite in the eastern part of the survey area is not altered though part of which is altered to argillite (quartz-sericite-limonite). Quartz porphyry is suffered sericic alteration. The andesite in the northern and northeastern areas is suffered propylitization, and quartz vein was found at two outcrops. Granosyenite that intruded in the andesite with propylitization is not altered.

[Laboratory test]

As the result of microscopic observation, M00HH180 (alteration rock) was identified as thermally metamorphosed sandstone; M00TM136 (tuff-breccia) was identified as tuff; M00TM141 (granite float rocks) was identified as hornblende and biotite granitie. The result of X-ray diffraction of the alteration rocks (M00TM140, M00TM142) identified quartz and sericite. Fluid inclusion homogenization temperatures of the quartz vein (M00TM138) indicated 151.2± 16.1℃. The result of geochemical analysis indicated that M00TM136, M00TM137, M00TM138, M00TM139, M00TM140, and M00TM142 had no noteworthy anomalous value.

[Evaluation]

The Phase-I survey indicated the possibility of a secondary enriched zone of porphyry-type copper deposit underground. Although we identified a float rocks in the stock of quartz porphyry which is estimated to have relation with mineralization in the northeastern part of this area, the distributed area seems to be narrow. No alteration zone was identified expect for float rocks. Since the result of our geochemical analysis of the quartz vein and alteration rock indicated no anomalous values, the possibility of existence ore deposits having economical value is considered to be low.

(2-7) Danbatseren (Mineral occurrence No. 27)

[Representative latitude and longitude]

48° 51' 39.3" north latitude, 103° 47' 30.2" east longitude (peak of silicified rock ledge)

[Topography and vegetation]

The entire survey area has gradual hills, and mountaintops have ledges consisting of silicified rock on steep landform. Grasses of less than 10 cm tall cover this area, and no tall trees are seen.

[Access]

This mineral occurrence is located 25 km from Erdenet city in the southwestern direction. It will take about 80 minutes by vehicle to reach this point.

[Preceding survey]

In 1982 to 1983, a geological survey in 1:25,000 scale was conducted. At the same time, a geochemical exploration and geophysical exploration (MT method and IP method electric exploration) were conducted. The result of the geochemical exploration indicated weak anomaly of Cu, Pb, Zn, Mo, and Au while the geophysical exploration (IP method) detected high resistivity anomaly and high FE anomaly area.

[Features on SAR image] (SAR image unit: "Bulgan")

This area in the SAR image indicates dark tone. The resistivity is very low and almost no drainage system is developed. A nearby NNE-SSW trending lineament is observed.

[Geology and geological structure]

According to an existing data (geological map in 1:25,000 scale issued in 1985), this mineral occurrence area consists of granite, granodiorite, and diorite of the Selenge complex, and rhyolite (intrusive rock) in the Jurassic. About a half of the surroundings of the mineral occurrence is covered with the alluvium, and outcrops are observed only at valleys and summits. The document also describes an N-S trending fault and a N-S to NE-SW trending dykes and quartz veins. The Phase-II survey covered the area shown in Figure II-3-17. The identified lithofacies are almost equal to those in the existing document. High resistivity and high EF anomalous areas are almost equal to the distribution of silicified rock.

[Mineral showing and alteration]

The summit area at 48° 51' 39.3" north latitude and 103° 47' 30.2" east longitude consists of silicified rock. Some silicified rocks have many quartz veinlets that fill in shattered portion, or leaching texture. or sugary feature, while others include tourmaline or hematite or limonite. According to the existing data, the original rocks of the silicified rock are granite to granodiorite and rhyolite of the Selenge complex, extending some 500 meters in the east-west direction and some 300 meters in the north-south direction. However, the original rock is unidentified because of strong silicification. AS shown in Figure II-3-18, there is a trench of about 60 meters in total length at the col near summit. White argillized rock was identified in the trench. Laboratory test detected quartz-potassic feldspar-sericite-pyrophyllite-kaoline-andalusite. Granite (M00NK112) is distributed in the surroundings of the silicified rock.

[Laboratory test]

According to the result of microscopic observation, granitic rock (M00NK112) represents medium-grained and idiomorphic-inequigranular texture and consists of plagioclase, quartz, potassic feldspar, common amphibole, biotite, iron oxide, sphene, allanite and apatite. The degree of alteration is weak and small quantities of chlorite, sericite, epidote and quartz were

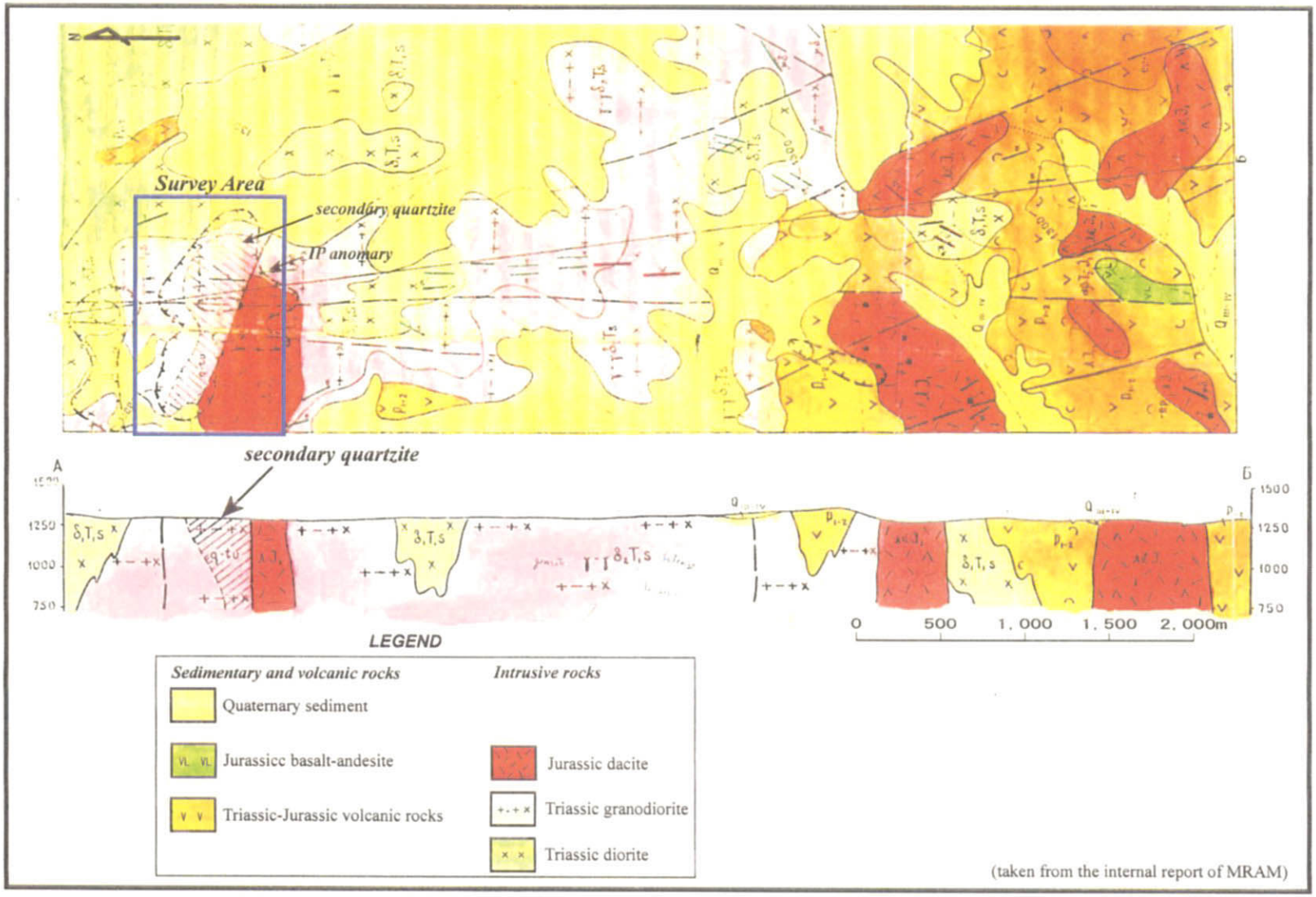


Fig. II-3-17 Geological map of the Danbatseren

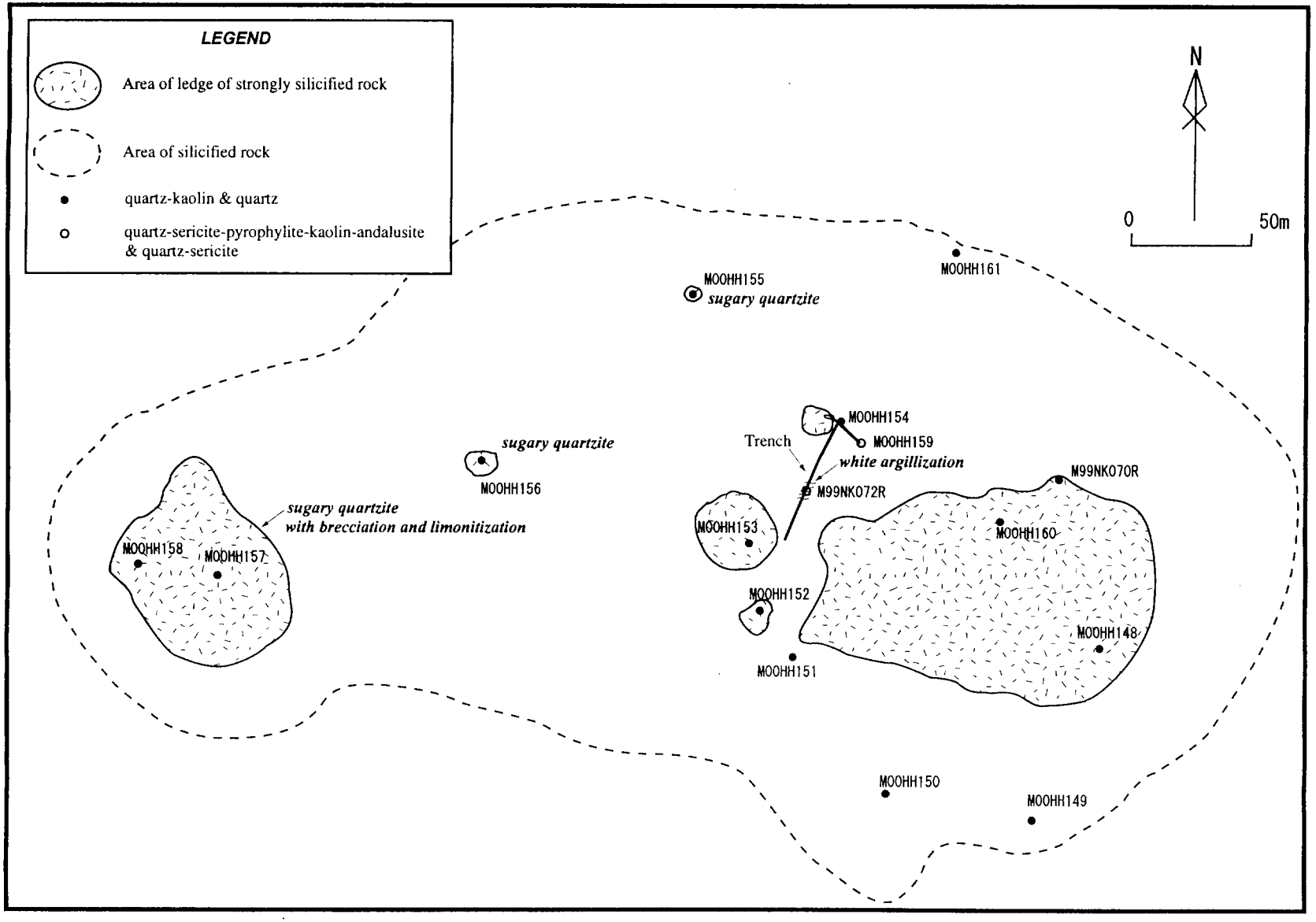


Fig. II-3-18 Route map of the Danbatseren

observed. Silicified rock (M99NK070R) has almost been replaced by quartz, and no texture of the original rock remains. X-ray diffraction of a white argillized rock (M99NK072R) extracted in a trench driven in the col at the summit sandwiched by silicified rock detected quartz-potassiic feldspar-sericite-pyrophillite-kaoline-andalusite. The silicified rocks (M00HH148, M00HH149, M00HH150, M00HH152, M00HH153, M00HH156, M00HH157, M00HH160) almost consist of quartz. M00HH159 alone consists of quartz-sericite kaoline.

Also, although chemical analysis indicated no particular anomalous values of metal elements, silicified rocks (M99NK070R, M00HH148-158, M00HH160-161) showed a remarkable reduction of Al (average of 14 specimens: 0.36%Al), indicating strong leaching and addition of silica.

[Evaluation]

In white argillized rock in a trench driven in the central zone of silicified rock, pyrophyllite and andalusite, which are stable in a relatively high temperature acid environment, were observed besides sericite. Although we cannot confirm whether the mineral occurrence has been formed due to a series of the same hydrothermal solution with steep gradient of temperature, which formed silicified rock and white argillization or due to different hydrothermal solution, this feature is inferred that indicating a relatively deep zone of lithocap or a deeper high-temperature solution ascended to this level. This sugary quartzite is similar to the quartzite in Mogoin gol 2. Although a geochemical exploration conducted by the Mongolian side didn't show any remarkable anomaly, in the surroundings and the deeper zone of the silicified rock porphyry type copper deposits and high sulfidation type gold deposit are expected. Thus, further detailed survey is recommended.

(2-8) Tsookher mert (Mineral occurrence No. 42)

[Representative latitude and longitude]

48° 45' 28.8" north latitude, 103° 16' 0.3" east longitude (point where a specimen (M00IH132) was collected, indicating 285.4g/t Au)

[Topography and vegetation]

Although this mineral occurrence has relatively many ups and downs of mountains, the surrounding areas are covered with flatland. For vegetation, low grasses alone grow on this area.

[Access]

We will get this mineral occurrence on the unpaved main road from Bulgan city, which goes to Sayhan located to west, and branch road.

[Preceding survey]

In 1986, geological survey in 1:50,000 scale, trench, and an electric exploration were conducted. Gold and copper bearing quartz veins were identified in granites of the Selenge complex. The quartz veins are distributed in several areas. So far, ore grads of 0.02 to 0.3% Cu,

3 to 10 g/t Au, and 20 to 500 g/t Ag were reported.

[Features on SAR image] (SAR image unit: "Jargalant")

This image shows gray to white color tone. The area has many small ups and downs, and lineaments are observed in the NW-SE and NE-SW directions (Figure II-3-19). Rock resistivity is medium to high. Medium and high drainage systems develop in radial shape. The bedding surface is unreadable.

[Geology and geological structure]

Fine to medium-grained granite, inferred to be the Selenge complex, and light-brown dacite intrusive rock are distributed in this area. These rocks are host rocks of gold bearing quartz vein. Granite is fresh and has little change in lithofacies, except for the neighbors of gold bearing quartz veins. Also, andesite lava, estimated to have been formed in the Permian, is distributed in the western and southern parts of the Khar uul copper occurrence. (Figure II-3-20)

[Mineral showing and alteration]

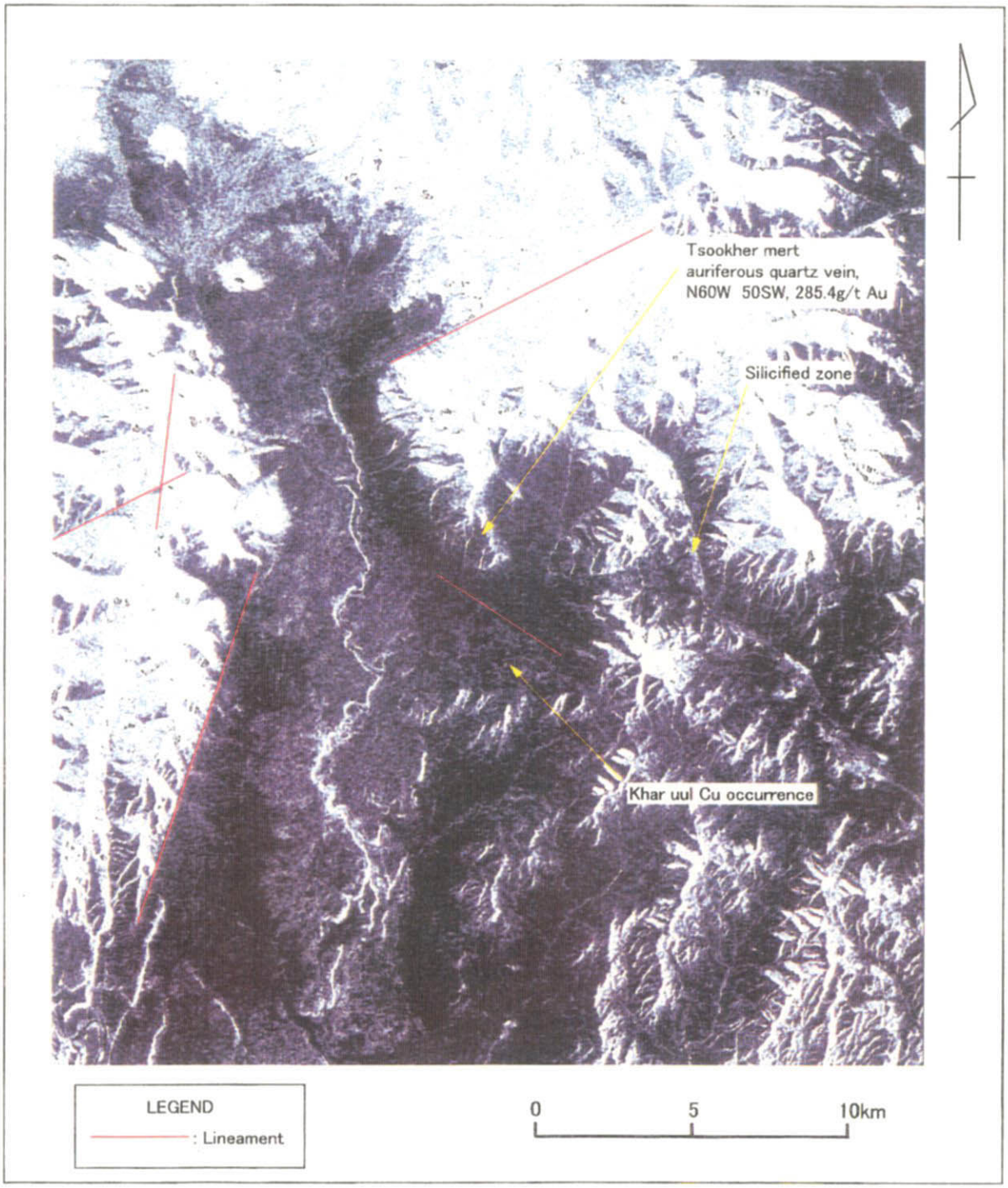
The distribution of quartz veins, whose host rock is granite and dacitic intrusive rock, was identified at three locations. One of them, namely quartz vein (M00IH132) indicated in Figure II-3-20 was identified in the Phase-I survey. As sketched in the Phase-I report, four quartz veins with a width of 0.01 to 0.1 meter extend about 180 meters with strike of N60° W and dip of 50° SW . The quartz veins contain malachite, azurite, and galena. The host rock has sericitic alteration adjacent to quartz veins.

Two quartz veins identified by the survey of Phase-II are located about 1 km in the northwestern direction from the quartz vein identified in the Phase-I survey. One of the two is a quartz vein at the M00MZ143 point (Figure II-3-20). The quartz vein has 2 meters in width and 13 meters in length with strike of N50° E and dip of 90° . The host rock of the quartz vein is dacite in lens form. The vein is characterized as having mainly white quartz, including amethyst, and no sulfide mineral is included. The host rock, dacite, is suffered silicification. The other of the two quartz veins is network consisting of thin quartz veilets at the M00MZ144 point (Figure II-3-20). This network with width of 0.2 to 1.0 cm hosted in granite represent strike of N80° W and dip of 80° S. In addition, the distribution of granites affected by weak thermal metamorphism was identified at a point about 6.5 km in the eastern direction from the quartz veins (Figure II-3-20).

[Laboratory test]

Of the quartz veins shown in Figure II-3-20, the largest quartz vein with strike of N60° W and dip of 50° SW is named quartz vein A; the lens-like quartz vein with strike of N50° E and dip of 90° is named quartz vein B; and veinlets network with strike of N80° W and dip of 80° S is called quartz veinlets C.

Concerning quartz vein A, M99MZ062 indicated 6.29 g/t Au, 554 g/t Ag, and 2.59% Pb in the Phase-I survey. M99MZ065 indicated an average temperature of 169.3℃ from fluid



SAR image of the Tsookher mert mineral occurrence. NW trend lineament is extracted in south of the Tsookher mert auriferous quartz vein of N60W 50SW.

Fig. II-3-19 SAR image of the Tsookher mert

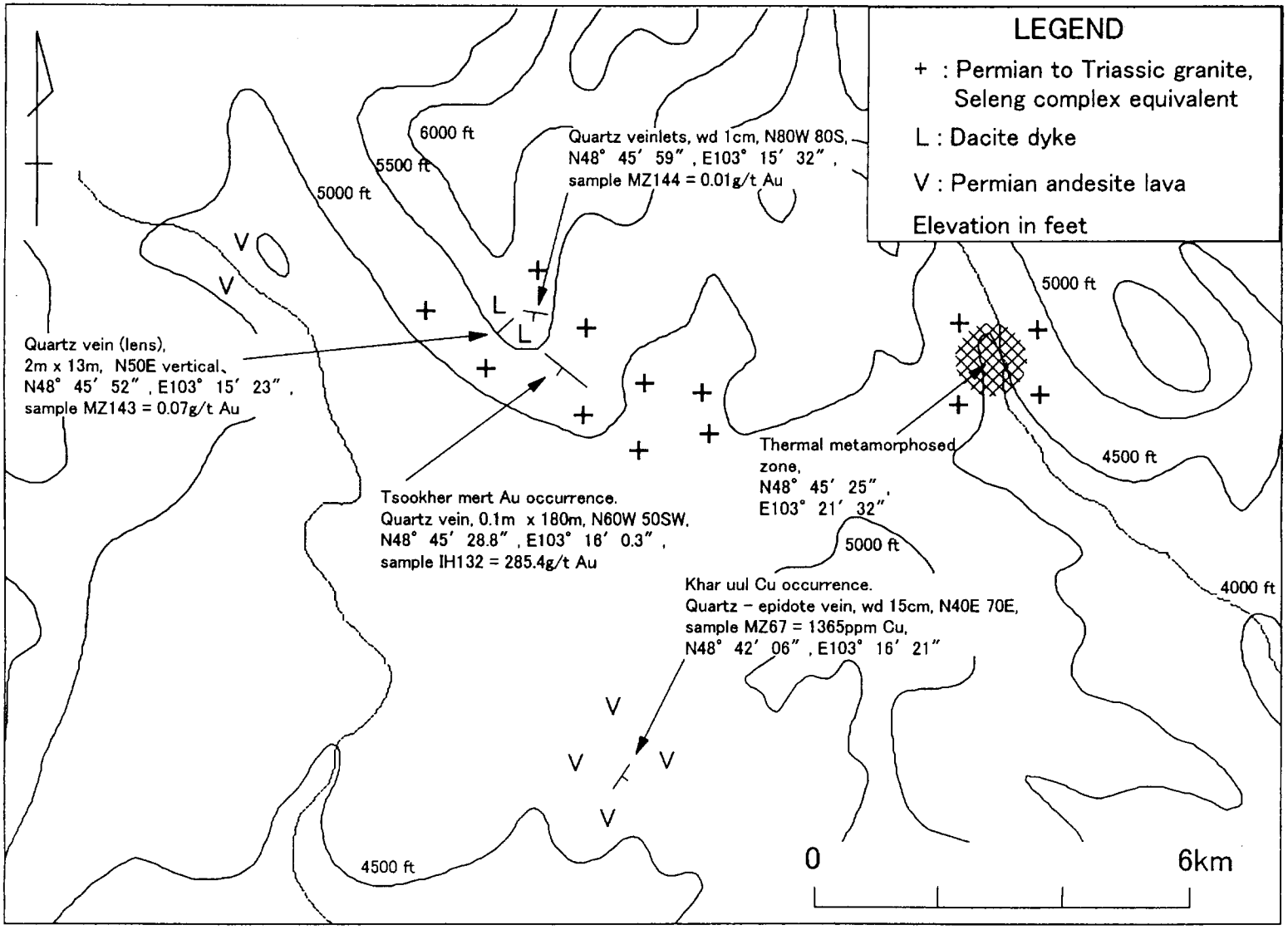


Fig. II-3-20 Schematic plan of the Tsookher mert

inclusion homogenization temperature. The hydrothermal solution that formed this specimen is calculated as - 10.8‰ to - 8.08‰ oxygen isotope ratio, and the specimen is epithermal gold deposit formed by hydrothermal solution from the meteoric water source. In addition, X-ray diffraction of granitic rocks (M00MZ63) collected close to quartz vein identified sericite. Chemical analysis of quartz veinlets (M00IH132) which were concentrated in a width of 30 cm running strike of N60°. W and dip of 70° SW recorded 285.4 g/t Au, 950 g/t Ag, 624 ppm Cu, 8.99% Pb, and 0.101% Zn. Also, microcsopic observation of a polished thin section of M00IH131 indicated pyrite.

Concerning quartz vein B, M00MZ143 recorded 0.07 g/t Au, while quartz vein C has an analytical value of 0.01 g/t Au, a low grade.

The granites collected in the eastern area (M00MZ145, M00TM115, M00TM116), affected by weak thermal metamorphism were identified as granitic porphyry and dacite. Although re-crystallization by thermal metamorphism is observed, hydrothermal alteration is weak. X-ray diffraction indicated an extremely small quantity of chlorite, calcite, and kaoline.

[Evaluation]

Specimen M00IH132, which was taken from a channel with a width of 30 cm where quartz veinlets are concentrated, indicated 285.4 g/t Au and 950 g/t Ag. Although these quartz veinlets has about 180 meters in length, the vein width is narrow 0.01 to 0.1 cm and is estimated as gold grade is changeable. However, we think that a survey for checking the possibility of parallel veins and the condition of the deeper extension is necessary. This quartz vein runs in the NW-SE direction. In the southern area, a lineament running in the NW-SE direction is identified on a satellite image (Figure II-3-19). Since the area is flat, no outcrop is observed. Thus, conducting geochemical exploration for soil is needed. In this case, because Au and Ag show a good correlation with Hg, As, and Sb, geochemical exploration by using Hg, As, and Sb as path finder elements are thought to be useful to for delineation of the promising sites.

(2-9) Burged khyr (Mineral occurrence No. 45)

[Representative Latitude and Longitude]

48° 52′ 04.2″ North latitude, 102 ° 49′ 41.4″ east longitude, 1,700m above sea level (Site of boring extending 118m shown in Figure II-3-21)

[Topography and vegetation]

This area is a gently sloping area covered with only short grass.

[Access]

One can arrive at the area by car from the city of Bulgan by an unpaved road.

[Preceding Survey]

In 1986, geological survey in a scale of 1:50,000 were conducted including a trenching, an electrical exploration, a magnetic mineral occurrence, etc. No sign of mineral showing was

recognized from the surface, but the alteration of the potassic feldspar, kaoline, etc was recognized. In this survey, an anomalous sign was detected by the geophysical exploration, and, for this reason, drilling (2 holes, 118 m in length and 200 m in length) were conducted to find the sign of copper ore in the underground. From the results of these drillings, the amount of the ore deposit was estimated to be 163,000 tons, while the grade of the copper ore was estimated to be 0.36%. Since then, exploration in this area has been quitted. But the possession of the mining right by any third party other than the Mineral Resource Authority of Mongolia is not permitted.

However, the review of the original data of the existing data has revealed that the average copper grade was 0.05% at a maximum, indicating the possibility of error in transcribing the original figure that might be 0.036%.

[Features on SAR image] (SAR image units "Jargalant")

The SAR image presented a dark grayish tone. The undulation is flat and the resistance is low. A lineament in N-S direction was recognized in the vicinity (of the surveyed area). The drainage system shows a radial distribution, but its development is weak.

[Geology and geological structure]

There are distributions of granites of Selenge complex belonging to the Permian to the Triassic, and the distribution of the conglomerate of the Saikhan-owoogiin formation, which is considered belonging to the Jurassic in the northern area. Of granites, mainly the medium-grained granite through syenite are distributed, while the felsite and coarse-grained monzonite are distributed in the eastern part of the area. Syenite presents a lithofacies characterized by predominant pink potassic feldspar content.

[Mineral showing alteration]

In the Phase-I survey, the existences of the trenches and the remains of drill holes were confirmed, and, in parallel the alterations of surrounding granites and conglomerate for silicification and argillization alteration were confirmed to produce sericite by X-ray diffraction.

In the Phase-2 survey, the result of the Phase-I survey was re-confirmed, and then it was confirmed that a small-scale altered zone affected by the hydrothermal solution existed in the area where granite was distributed in the eastern and western part (Fig. II-3-21).

In the altered zone of the eastern part of the area, the strongly silicificated rocks and pale grayish argillizated rocks were confirmed from the outcrop and the remains of the pits. Although these alterations accompanied with limonite, limonite accompanying the strongly silicificated rock is characterized by presenting reddish color.

In the altered zone of the western part of the area, the alteration into pale grayish clay and a gossans zone were confirmed from the outcrop and the remains of the trenches. The clay zone formed by the alteration also accompanying network type quartz vein.

Further, it was re-confirmed that, in the central northern part of the surveyed area, granites and conglomerate had been subjected to hydrothermal alteration, and so the time of the

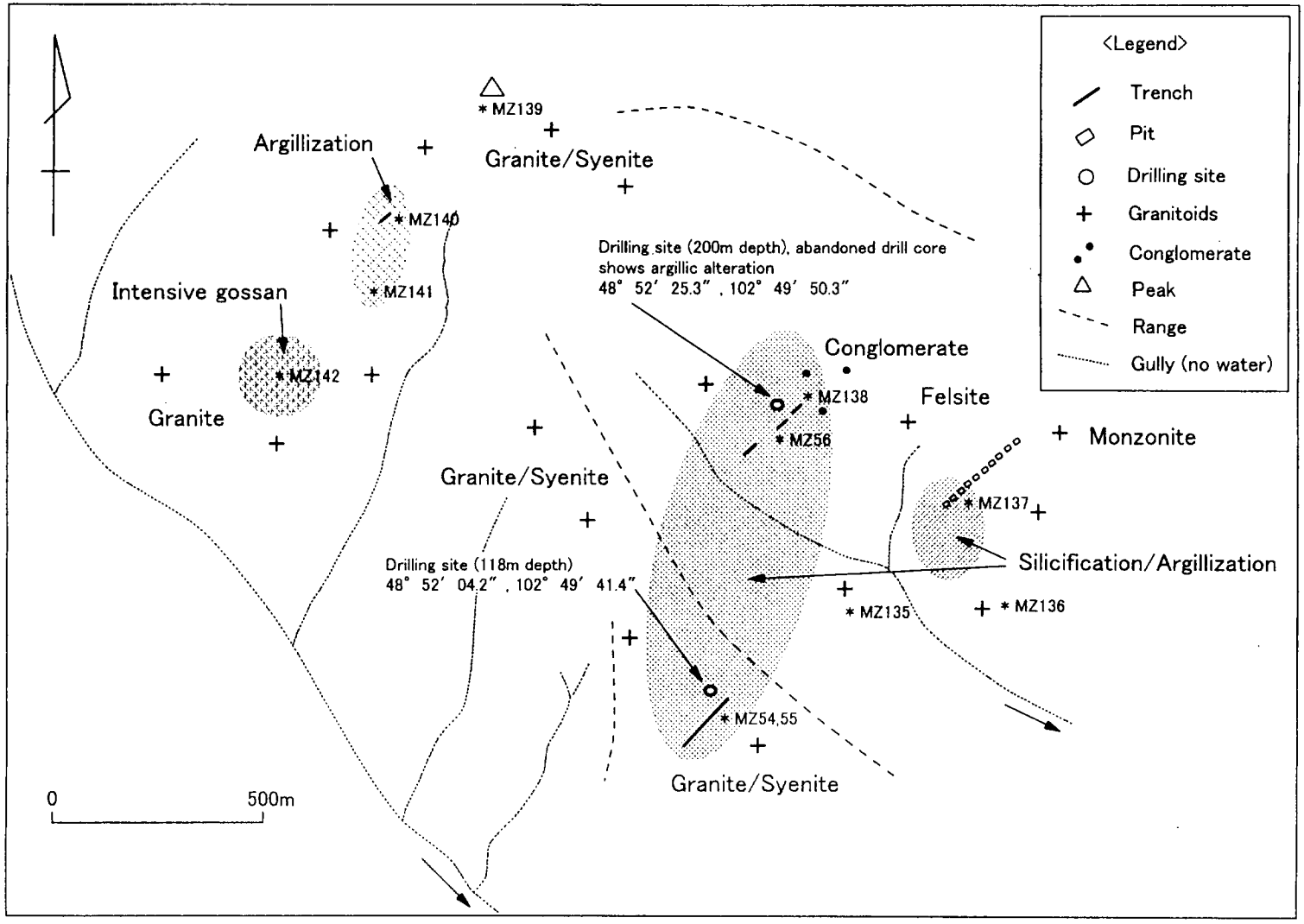


Fig. II-3-21 Schematic plan of the Burged khyr

hydrothermal activity considered to have occurred after formation of conglomerate layer in the Jurassic.

[Laboratory test]

The result of the microscopic observation indicates that M00HH143 is granodiorite, while M00MZ136 is tonalite. Of the 8 samples subjected to X-ray diffraction, sericite was identified with 6 samples and the kaoline was identified with 5 samples, all of which were confirmed to have been subjected to the hydrothermal alteration. The results of the chemical analyses of granites subjected to the hydrothermal alteration indicate that copper content, together with result of the Phase-I survey, is within the range of 5ppm to 52ppm.

[Evaluation]

According to the re-confirmed results of the pas drilling, the highest grade was 0.05% for Cu, and, according to the result of the present survey, copper content in the surface alteration zone was within the range of 5ppm-52ppm. From these results, copper content of the surface and that of underground were estimated to be around 0.05% at a maximum. Therefore, the possibility of existing deposits having economical value is considered to be low. Further, the drilling of the hydrothermally altered zones in the eastern and western parts of this mineral occurrence were not conducted, but since the surface altered zone is small in scale, the possibility of existing large-scale ore deposits are considered to be low.

(2-10) Undrakh (Mineral occurrence No. 49)

[Representative latitude and longitude]

48° 42′ 03.3″ north latitude, 102 ° 45′ 44.6″ east longitude. (A gently rising topography with exposure of aplite type fine-grained granite with which the mineralization for copper was observed.) In the Phase-I survey, float rocks in the trenches, the alteration of outcrop and mineral showing in the vicinity of this rise of the land were examined, while, in the Phase-II survey, a route map (Figure II-3-23) was prepared in order to accurately determine the distribution of outcrop of granites and the range of mineral showing.

[Topography and vegetation]

The area is within a wide and densely grass-grown plain 50% of vegetation rate including some gentle rises. The mineral occurrence is covered with the sediment of Quaternary, although there are only a few outcrops.

[Access]

The survey point is located about 50 km west of the city of Bulgan, and it takes by 4-wheel-driven car about half a day to get there. All the roads to the survey point are unpaved but convenient to get there. Since the mineral occurrence and the surrounding area are within grass-grown plane, cars can use for traveling.

[Preceding Surveys]

The mineral occurrence was found at the time of the geological survey of a 1:500,000 scale map in 1986, followed by a trenching survey (176.6 m^3), a magnetic mineral occurrence and an IP electric exploration. Further, in order to measure the thickness of the sediment covering the surface, drilling (5 holes, 1 line, total length: 100m, depth of each hole: 1.5m-28m) was conducted. The existing data are a geological map in a scale of 1:10,000 and cross section of drill holes.

According to the list of mineral occurrences prepared based on the result of the Phase-I survey and the information obtained from the counterpart, the type of mineralization is a hydrothermal metasomatic deposit, and the alteration zone is 300m x 150m in scale. Also, the presences of the potassic feldspar and tourmaline as the altered minerals, and the malachite, chalcocite, bornite, azurite and turquoise were reported.

According to the point samples, the grades were 5,000-7,000ppm Cu, 3-700ppm Mo, 5-10g/t Ag and 15ppm Pb.

[Features on SAR image] (SAR image unit " Jargalant")

The mineral occurrence and its surrounding area being a densely grass-gown area, the mineral occurrence appears as a dark area in the SAR image and as a smooth fine-grained area. Further, the resistances of the distributed geologic bodies are low, and the development of the drainage system was not observed. Lineament was not sampled.

[Geology and geological structure]

According to the existing data and geological map in a scale of 1:10,000 (Figure II-3-22), the geology of the area near the mineral occurrence comprises diorite of the Lower Paleozoic and leucocratic granites with grains ranging from fine grain to medium grain, which are comparable to the Selenge complex of the Upper Permian to the Lower Jurassic. However, the major portion of the wide distribution of diorite shown on the geological map was found to be the sediment of the Quaternary mainly comprising fine grains of diorite, and no outcrop of diorite was observed. Therefore, the distribution range of granite, which was considered to intrude into diorite, could not be surveyed in detail.

In the vicinity of the surveyed area, there were observed the distributions of leucocratic fine-grained aplitic granite and biotite granite with grains ranging from medium grain to coarse grain, and these granite were covered with sediment of Quaternary. Since aplitic granite is fine-grained and does not accompany with any significant amount of mafic mineral, it was considered to be an intrusive rock.

The dikes were observed at a site about 500m in the south of the surveyed area: about 1 m wide, of syenitic porphyry and dacitic andesite trending in NNE-SSW to NE-SE direction.

[Mineral showing and alteration]

Four trenches and one pit line, where leucocratic fine-grained aplitic granite was exposed,

were observed in the vicinity of the gentle rise. There are two kinds of equigranular biotite granite in the trench (Trench 2), i.e., one mainly comprising potassic feldspar and one mainly comprising biotite, both of them were affected by the potassic alteration.

Aplitic granite and biotite granite are partially altered for silicification and accompany with quartz veins and quartz veinlets having conspicuous expansion and shrinkage and partially presenting pod-like appearance. An aplitic granite and quartz vein have spot-like chalcopyrite and malachite. Quartz vein has vugs, which are thought to be solved sulfide. Further, there was observed permeation of malachite into the cracks of the aplitic granite and biotite granite, and limonite was observed throughout these granites.

The mineral showing was specially conspicuous in the trench (Trench 1) excavated in the north of aplitic granite outcrop, and chalcopyrite, malachite and azurite were found widely in aplitic granite and the quartz vein, which were altered for silicification and limonization. Further, white argillic alteration was observed on the side of the trench. The spot-like formation of malachite was also observed in outcrop of coarse-grained and equigranular biotite granite located about 70m away in the northeastern direction from aplitic granite outcrop.

Together with the distribution of granites, the expansion of the alteration zone, in which the presences of potassic alteration and quartz vein were observed, was measured up to the range of 300m x 100m, but the expansion of the alteration and mineralization zones could not be measured definitely, since the surveyed area was covered with Quaternary sediments.

[Laboratory test]

According to the result of the laboratory test conducted in the Phase-I survey, quartz vein (M99RK054R) included 0.215g/tAu, 33.8g/tAg, $>$ 10,000ppmCu, while biotite granite (M99RK057M) accompanying the sign of copper oxide included $<$0.005g/t Au, 0.8g/t Ag and 465ppm Cu. Further, according to the result of microscopic observation of biotite granite, the chlorite and sericite were formed as the secondary minerals.

In the Phase-2 survey, quartz vein (M00NK103) accompanying malachite originating in aplitic granite, aplitic granite (M00NK104) accompanying malachite, quartz vein (M00NK105, M00NK109) not accompanying malachite, unaltered granite (M00NK106), aplitic granite (M00NK110) and aplitic granite altered for white argillization weak silicification (M00TM113) were subjected to geochemical analysis and the highest values of copper 5,300ppm Cu, was obtained from the aplitic granite accompanying malachite sampled from the trench (Trench 1).

In the Phase-I survey, a geochemically anomalous value, i.e., 0.215ppm Au, was obtained from the sample of quartz vein, but in the Phase-II survey, any geochemically anomalous analyses other than those obtained in the Phase-I survey were not obtained; for instance, the highest analysis was 0.045g/t Au that is obtained from quartz vein (M00NK105), not accompanying malachite, sampled from the trench (Trench 1).

The aplitic granite (M00TM113) with white argillic alteration, and weak silicification was

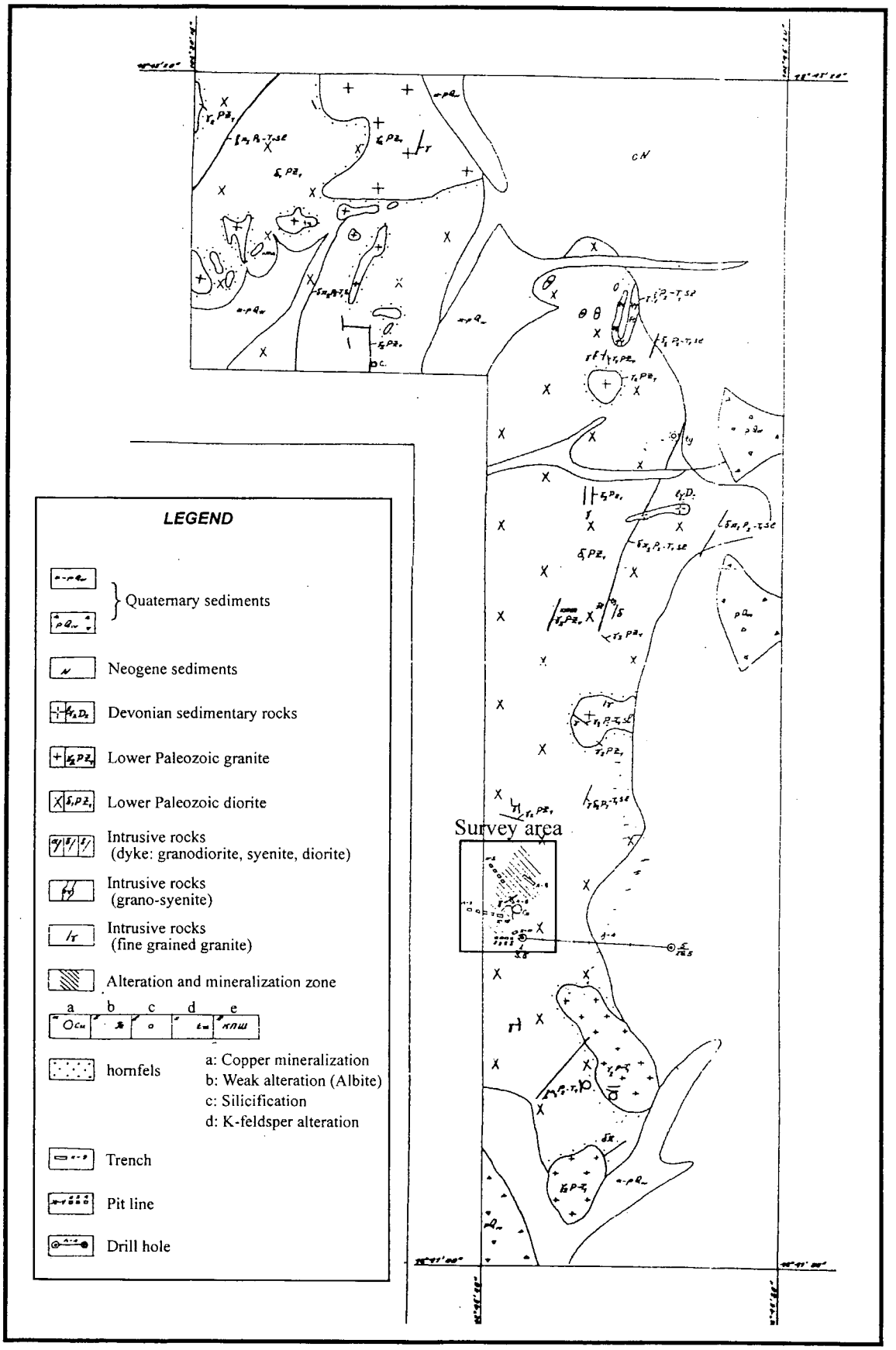


Fig. II-3-22 Geological map of the Undrakh

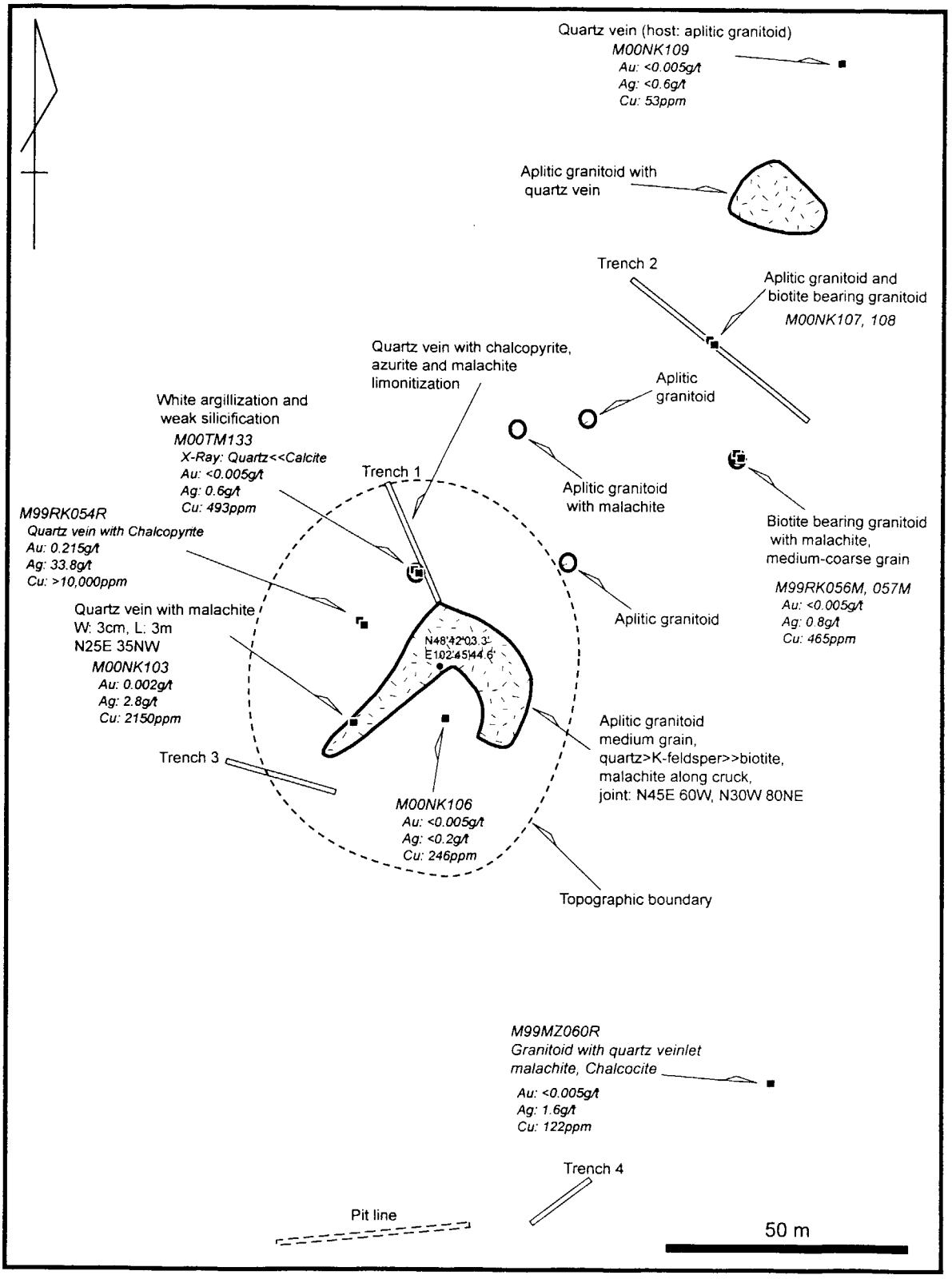


Fig. II-3-23 Route map of the Undrakh

subjected to the X-ray diffraction to find that only quartz-albite-calcite was identified, but clay mineral was not detected.

[Evaluation]

Judging from the condition of alteration, there have occurred porphyry type mineralization and also from that copper content of 0.183% at a maximum was confirmed in sample taken from the trench, the presence of porphyry type copper deposit can be expected in this mineral occurrence. Further, from that the evidence of the elution of sulfide was confirmed on the surface, secondary enrichment of copper can be expected. However, the surface of the ground is widely covered with sediment of the Quaternary, the range of the mineralized zone in horizontal and vertical directions could not be confirmed. In the future, it is desired to evaluate this mineral occurrence by grasping the size and grade of the ore with methods of the geophysical exploration, drilling and the like.

(2-11) Bulgan NW (Mineral occurrence No. 50)

[Representative latitude and longitude]

49°00′ to 49°20′ north latitude, 102°20′ to 103°20′ east longitude

[Topography and vegetation]

The Bulgan NW consists of hills and mountains 1,000 to 2,000 m above sea level. Tall conifers grow on the northern slope of the mountainous district while there are not so many tall trees and low grass grows on the southern slope.

[Access]

The Bulgan NW corresponds to the whole district 60 km to the northwest of Bulgan City, the seat of the provincial government of Bulgan. This point is relatively easily accessible along the main road. The roads are severely limited in quantity off the main road and they are too bad for cars to pass.

[Preceding survey]

Geological survey with a scale of 1:200,000 map was conducted in the entire area of this district in 1974. Geochemical samples seem to have been analyzed together with geological survey, but the details are unknown.

[Features on SAR image] (SAR image unit "Hatag")

This mineral occurrence looks white to grayish white on the SAR image. It has a high resistivity and a well-developed dendritic drainage system. On the north of the survey area, it has a developed E-W trending lineament represented by Selenge River. The N-S trending drainage system that meets this at right angles is developed. Near 49°07'30" north latitude and 102° 06'42" east longitudes, a huge annular structure having a diameter of about 15 km is developed in the volcanic rock distribution area of the Lower to Middle Permian.

[Geology and geological structure]

According to the existing data (document No. 2043, geological map in 1:200,000 scale), andesitic volcanic rocks of the Middle Permian, granites, which intrudes the volcanic rocks, equivalent to the Selenge Complex of the Middle Permian to the Lower Triassic, and the Quaternary alkali basalt are distributed in the whole area of the district. Three bodies of granite equivalent to the Selenge complex have been discovered in the district, and hornfels is developed in the volcanic rocks, which lie next to this. Also, many parallel faults of the E-W trending are developed. In the Phase-II survey, basalt, trachyte andesite, andesite, and homogeneous pyroclastic rock have been discovered as volcanic rocks. Granites equivalent to the Selenge Complex such as coarse-grained biotite granite and diorite have been found.

[Mineral showing and alteration]

According to the survey so far conducted by Mongolia, no mineral occurrences have been known in the survey target area. In the Phase-II survey, a 15 cm wide quartz vein was found in sedimentary rock. In addition, silicificated rock that originated from volcanic rock (M00HH141, M00HH142, M00MZ133) and silicificated rock with pyrite (M00MZ134) was discovered. According to the existing documents, an anomaly zone of >8 ppm Cu and >6 ppm As was extracted. The details such as the number of analyzed samples are not known.

[Laboratory test]

The chemical analysis of the M00HH141, M00HH142, M00MZ133, and M00MZ134 above showed no noteworthy anomalous value. The chemical analysis of ten panning samples collected from the main drainage system revealed no noteworthy anomalous value.

[Evaluation]

This district lies to the west of the Erdenet mine and a mineral showing has not been known so far within this district. Since granites equivalent to the Selenge Complex exist and volcanic rocks of the same period are widely distributed, a check survey was conducted for porphyry-type copper and molybdenum deposit. Although the existence of silicificated rock accompanied with pyrite was confirmed in the field survey, no remarkable alteration zone pointing to the mineralization was discovered, and the panning sample analysis showed no geochemical anomaly. Judging from the findings above, the possibility of the existence of deposits having economic value is considered to be low.

3.2.3. Zaamar district

(1) Outline of survey results

The geology consists of sedimentary rocks from the Upper Proterozoic to the Lower Paleozoic and granites of the Middle Paleozoic, which intrudes sedimentary rocks. NW-SE and

N-S trending lineaments have been extracted. For alteration and mineral showing, a quartz vein was found in granites dated to the Middle Paleozoic and scorn was recognized in sedimentary rocks. A weak gold mineralization was discovered in quartz vein of the granites.

3.2.4 Zaamar West district

(1) Outline of survey result

The geology consists of limestone of the Proterozoic, granites of the Lower Paleozoic, and volcanic rocks from the Upper Paleozoic to the Middle Mesozoic. NW-SE trending lineaments have been extracted. For alteration, silicification and epidotization were found in tuff near the distribution area of the granites, but no mineral showing was recognized.

3.2.5 Bulgan SW district

(1) Outline of survey district

(1-1) Location

The Bulgan SW district lies to the southeast of the survey area and is within the range of 25 km north and south and 50 km east and west around 102°50' east longitude and 48°15' north latitude. It is situated about 100 km to the southwest of Bulgan city, the seat of the Bulgan aimag. There are two towns in this district: Mogot and Ulziyt.

(1-2) Topography and vegetation

The topography consists of rolling hills on the whole. The height above sea level of this area ranges between 800 m and 2,000 m. The greater part of the survey district is 1,500 m to 2,000 m above sea level. The 100-meter-wide Korhon River, which flows into the Selenge River, runs through the survey district toward north. The ridges and Rivers show the N-S system on the whole. Short grass grows in this survey district and conifers can be rarely seen on the ridges.

(1-3) Infrastructure and access

The survey district has small towns such as Mogot and Ulziyt. Although these towns have a power supply, they do not have facilities such as a hospital and the general infrastructure is poor. The means of transportation is either vehicles or domestic animals such as horses or cows. It takes almost a day to get to the nearest city from Bulgan by car. The roads have not been paved even in the middle of the towns. Off the towns, an unpaved road runs through the steppe

and a part of the road is in bad condition. Since the Rivers in the survey district do not have bridges, there is no other choice but to find a shallow place and tow a car by a tractor or a truck in order to cross the Rivers.

(1-4) Features on SAR image

On SAR image, the survey district where the topography of the rolling hills is reflected is represented as a dark color. Lineaments of the N-S and NNW-SSE tends are concentrated.

(1-5) Outline of geology and deposit

Sandstone and conglomerate of the Carboniferous are distributed in the northwestern part of the survey district. Sandstone, conglomerate of the Triassic and andesite, basalt, trachyte basalt, and acidic tuff of the Triassic to the Jurassic can be found in the entire area of the survey district. Sedimentary rocks of the Carboniferous abut on sedimentary rocks and volcanic rocks of the Triassic to the Jurassic along a fault. Intrusion of granite of the Triassic to the Jurassic can be found in the narrow area in the northwestern part of the survey district.

(1-6) Reasons for selection

In Phase-I survey, a proof of a dominant hydrothermal activity such as hydrothermal breccia was obtained in an old pit of the Oyuut khonkhor mineral occurrence where turquoise was mined and in a trench where a preceding survey was conducted. In addition, the existence of silicification accompanied with kaolin suggested a possibility of shallow level argillization. For this reason, Oyuut khonkhor was selected a follow-up mineral occurrence in order to determine the size and detailed characteristics of the alteration zone.

(1-7) Survey content

A survey on the alteration and mineral showing near the trench of the mineral occurrence was conducted in the Oyuut khonkhor mineral occurrence.

(2) Survey results

(2-1) Oyuut khonkhor (Mineral occurrence No. 58)

[Representative latitude and longitude]

48°10′ 24.4″ north latitude, 102°56′ 10.8″ east longitude (pit where Chinese mined turquoise)

[Topography and vegetation]

The topography consists of gentle slope areas and hills where short grass grows and has a

gentle inclination from west to east.

[Access]

This mineral occurrence is situated 70 km to the southwest of Bulgan city. It takes about two hours to get to the site by a 4-wheel drive car from Mogod or Ulzit, the nearest towns. The roads to the site are all unpaved. Since the neighborhood of the trench and open pit in the mineral occurrence has a gentle slope and is free from obstacles, it is possible to move by vehicle.

[Preceding survey]

It was reported that Chinese had mined this mineral occurrence for turquoise before the 1921 revolution. A preceding survey, which was composed of geological surveys with the scale of 1:200000 and 1:50000, geophysical explorations, trench (723.1 m^3), and drillings (seven drill holes, total length reached to 1041.3 m), was conducted in 1977 and from 1984 through 1987. The analysis of samples collected from out crop and drill cores revealed maximum 0.01% Cu, 4.4 g/t Au, and 0.2 g/t Ag. Since the copper grade was low, the exploration was terminated. However, as a result of the 1997 scientific study, an analysis value of 8.8 g/t Au was obtained from brecciated rhyolite.

The description of the drill hole log collected in Phase-2 survey is summarized below.

Drill hole No. 15 had length of 170 m and inclination of 90°. The core was analyzed for Cu, Mo, Pb, Zn, and Sn.

Talus deposit occupies from the mouth of the drill hole to 6 m. Volcanic rock such as porphyritic andesite – rhyolite is dominant to 60 m, and syenite – syenite porphyry is dominant from that point to 172 m, which is the bottom of the drill hole.

For alteration and mineral showing, copper oxide is found in talus. In the part lower than the talus, this mineral occurrence is characterized by silicification, quartz vein – veinlet, and pyritie dissemination. There is a description that chalcopyrite is disseminated 70 – 80 m, 129 – 134 m, 140 – 162 m, and 165 – 170 m. The analytical value is about 50 ppm Cu at any length. No noteworthy analysis value has been obtained for other elements. The core analysis was conducted at every core length of 2 m.

Drill hole No. 14 had length of 300 m and inclination of 90°. The core was analyzed for Cu, Mo, Pb, Zn, Sn, and Ag.

The geology consists of talus from mouth to 9 m. Porphyritic syenite from 87 m to 114 m, the geology consists of andesite – rhyolitic volcanic rock. In particular, effusive rocks are dominant from 9 m to 200 m.

As for alteration and mineral showing, silicification, quartz vein – veinlet, and pyritic dissemination have been described to the bottom of the drill hole. Different from drill hole No. 14, chalcopyrite has not been described. The analysis value of copper is maximum 700 ppm, which is at a geochemical anomaly level. For other elements, no noteworthy results have been

obtained.

[Features on SAR image] (SAR image unit "Jargalant")

Since this mineral occurrence has a gentle slope where short grass grows, it looks dark gray on SAR image and its surface is smooth. The resistivity of the distributed geologic body is low, and the erosion is advanced. No drainage system is found in the mineral occurrence.

[Geology and geological structure]

According to the existing data (geological map in 1:10000 scale), volcanic rocks such as trachyte, andesite, dacite, and rhyolite of the Mogod formation considered to belong to the Triassic – Jurassic are distributed near this mineral occurrence. Granitic dykes such as syenite and granodiorite intrudes the above volcanic rocks. Surface around the mineral occurrence is covered with sediment of the Quaternary. Continuous NE and NW trending fault that is cut by the NE trending fault are remarkable beside the mineral occurrence (Figure II-3-24).

[Mineral showing and alteration]

White to gray silicificated rock is distributed in the trench near the turquoise gob in the southeastern part of the mineral occurrence. Toward the highlands on the west side, silicificated rock shifts to gradually weakly silicificated rock substituted by opaline silica and smectite argillization. Then, it turns to unaltered andesite through the propylitic alteration. In addition, hydrothermal breccia (the original rock is granodiorite porphyry and porphyritic trachytite andesite) is scattered in the northwestern to the northern part of the mineral occurrence. As mentioned before, an analysis value of 8.8 g/t Au has been obtained. In the trench in the northwestern part of the mineral occurrence, opaline quartz coats the surface and cracks of the silicificated rock. Judging from the findings, it is assumed that the low-temperature hydrothermal activities are repeated.

Smectite and sericite were detected from white to gray silicified rock distributed near the trench in the southeastern to southern part of the survey district and the trench in the northwestern part through X-ray diffraction, which suggests alteration caused by neutral pH hydrothermal activity. Sericite was detected ubiquitously from hydrothermal breccia and silicified rock in the northwestern to northern part of the survey district. A combination of sericite - kaolin (silicified rock: M00HH167) or sericite - alunite (hydrothermally brecciated syenite: M00NK113) was found, which suggests concurrence of neutral pH alteration with subordinate acidic alteration. An alteration zone proved to have a size of 1 km x 1 km. It was confirmed that the alteration shows the condition of the center of the hydrothermal activities toward the east of the mineral occurrence.

Although copper oxide was discovered in the pit of the turquoise gob and the distribution of new hydrothermal breccia was confirmed besides the hydrothermal breccia from which an analysis value of 8.8 g/t Au was obtained through the preceding survey, a remarkable gold mineralization has not been discovered.

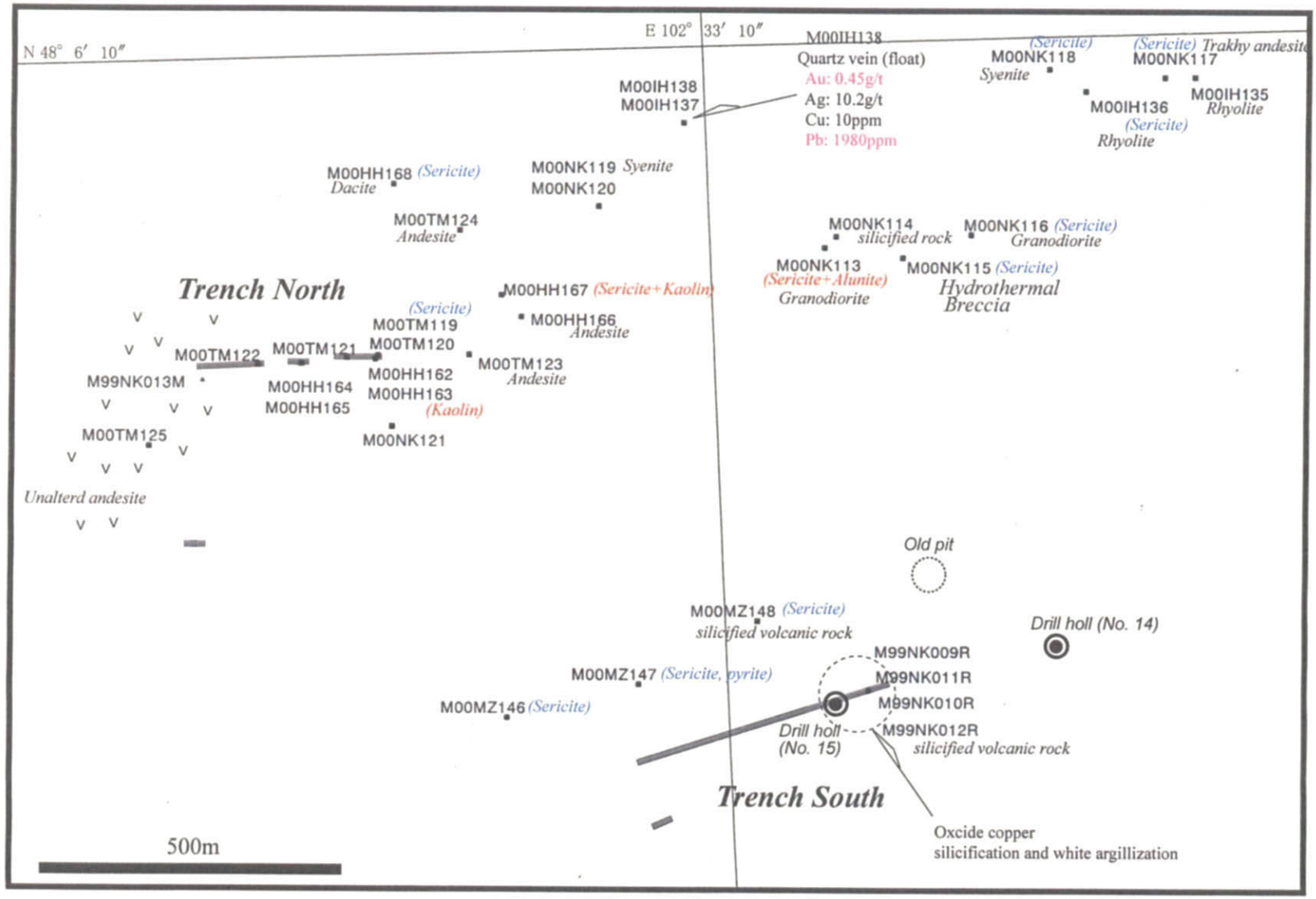


Fig. II-3-24 Route map of the Oyuut khonkhor

[Laboratory test]

As a result of the chemical analysis of silicified rock and quartz veins (M99NK009R – 013R, M00NK114 – 121, M00IH137 – 138, M00HH162 – 167, M00MZ146 – 148, and M00TM119 – 125), 0.45 g/t Au and 10.2 g/t and Ag were obtained from quartz vein float (M00IH138) collected from the northern part of the mineral occurrence and 0.135 g/t Au, 7.8 g/t Ag, 790 ppm and Cu were obtained from gossan float (M00IH137).

[Evaluation]

White silicification and argillization (sericite) was discovered on surface and an extension of neutral pH hydrothermal activities was confirmed within a range of 1 km x 1 km. Silicified rock and hydrothermal breccia from the northwestern part to the northern part of the mineral occurrence are accompanied with kaolin and alunite as well as sericite. These rocks may have been formed by acidification of neutral pH hydrothermal solution. However, since activities of granites and mineral showing of copper are found, the rocks may have been formed in advanced argillic alteration at the upper part of a porphyry-system. The discovery of the Erdenet deposit was triggered by the existence of turquoise. Since it is recorded that this mineral occurrence was mined for turquoise, the existence of a copper deposit is expected.

Drilling and other studies have been conducted around the turquoise gob in the eastern part of the mineral occurrence. Exploration in the northern part to northeastern part of the mineral occurrence where hydrothermal breccia and quartz veins with a high grade of gold exist is desired.

Incidentally, a Mongolian private company obtained a mining concession of this mineral occurrence in 1999 and started exploration such as trenching since 2000.

3.2.6 Tavt District

(1) Outline of the district

(1-1) Location

The Tavt area is located in the north of the surveyed area at 49 ° 55′ - 50° 15′ north latitude and 102° 05′ - 103 ° 00′ east longitude, covering the area ranging about 60 km from east to west and about 60 km from north to south (area: about 3,600 km^2). The center of this area is away about 150 km in a straight line in northwest from Erdenet city.

(1-2) Topography and vegetation

The Eg River, a branch of the Selenge River, flows through this area. In the east of the Ereen mineral occurrence, located substantially the center of this area, the Uuall River and the

Ereen River joins to flow southward to join the Eg River. There are mountains with peaks about 1,500m above sea level continue in the center to western part of this area. The town of Teshig and the Margal Lake in the southeastern part of this area are near the gently sloping hills.

There are thin coniferous forests on the relatively low mountains in this area, while the valleys and hills are covered with dense grasses with trees growing sporadically.

(1-3) Infrastructure and access

The town of Teshig is located in this area, and the electricity supply is available within the town. This town is so small that the services of the infrastructure including the facilities such as the general hospitals are not available. In the mining camp of the M & Diamond Corporation located near the Ereen mineral occurrence, the electricity generated by the generator is available. There are many Rivers in this area, especially the Rivers in the western part of this district do not have any bridges or roads, and so the travel by vehicles is difficult.

(1-4) Features on SAR image

The SAR image and analysis of the lineament of the area concerned are shown in the figure. The low mountains lying from the central part to the southern and northern parts of the area are covered with the coniferous forests appear as bright area in the SAR image. This area presents a relatively steep topography and its geologic resistance is relatively high. The Eg River and the Uuall River in the surveyed area were sampled as the NW-SE and N-S trending lineaments having good continuity.

(1-5) Outline of geology and mineral deposit

According to the geological map in scale of 1:200,000 of this area comprises the ophiolite of the Vendian to the Lower Cambrian, the limestone, chert of the Lower Cambrian to the Middle Cambrian and sandstone, conglomerate, basalt, acidic tuff, etc. of the Permian, which are intruded widely by the granites such as the diorite, granitic diorite, granite, etc. of the Devonian, the Middle Ordovician and the Upper Permian (see Figure II-3-25.). In this area, the NW-SE and NEE-SWW trending faults were observed in the area of granites distributed, while the NE-SW trending faults was observed along the boundary of the sedimentary rocks and the granites in the northwestern part of this area.

The list of the mineral occurrences contains the records of 19 known mineral occurrences for gold/copper or copper within this surveyed area and in the neighboring areas, the records of alteration zone mainly accompanying quartz vein and silification/pyritization, and the records of the skarn type mineral occurrences. The grades of the gold ores in the existing mineral occurrence are relatively high, of which the highest grade is 1,284g/t for Au (Nariinii mineral occurrence).

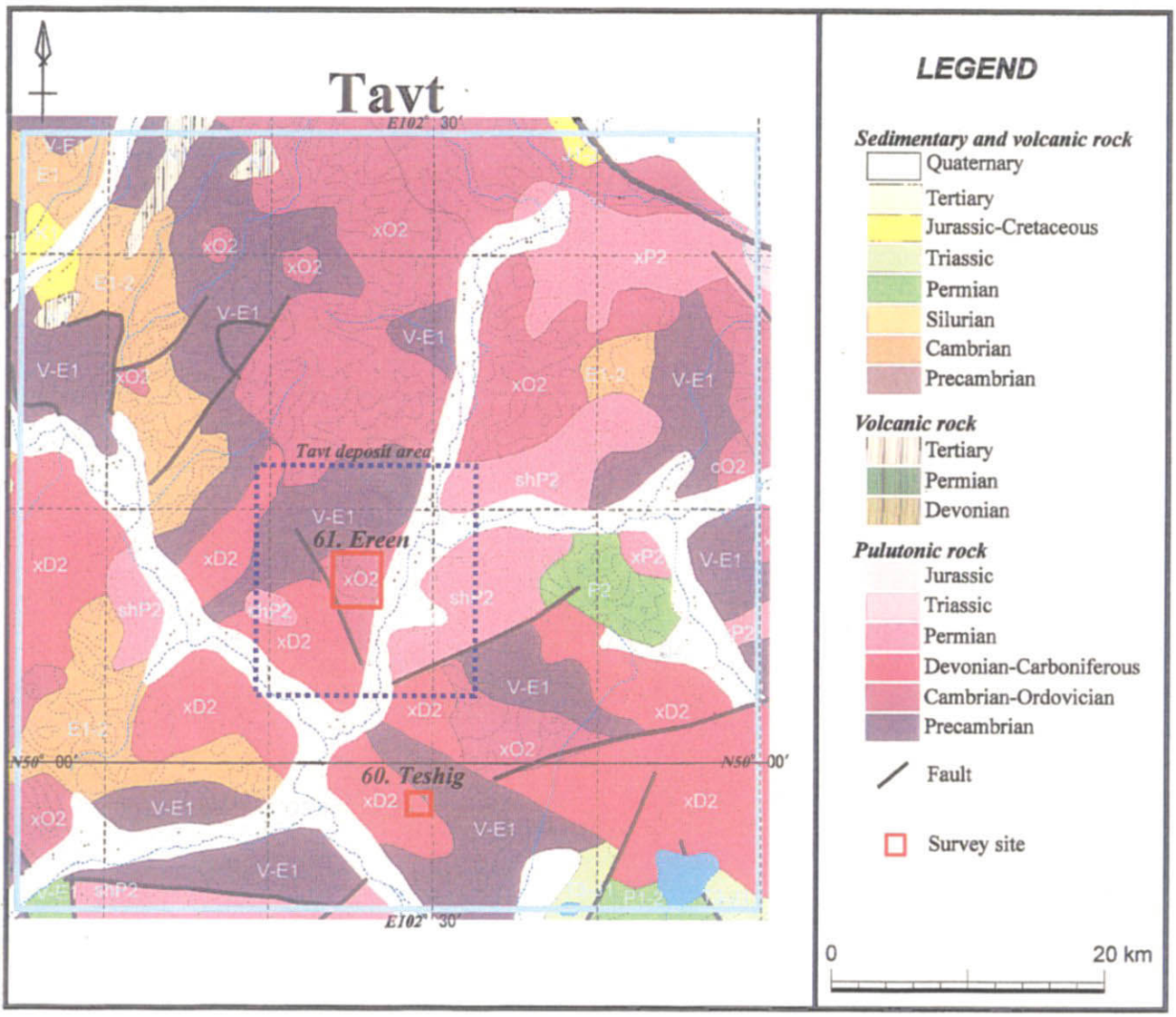


Fig. II-3-25 Geological map of the Tavt district

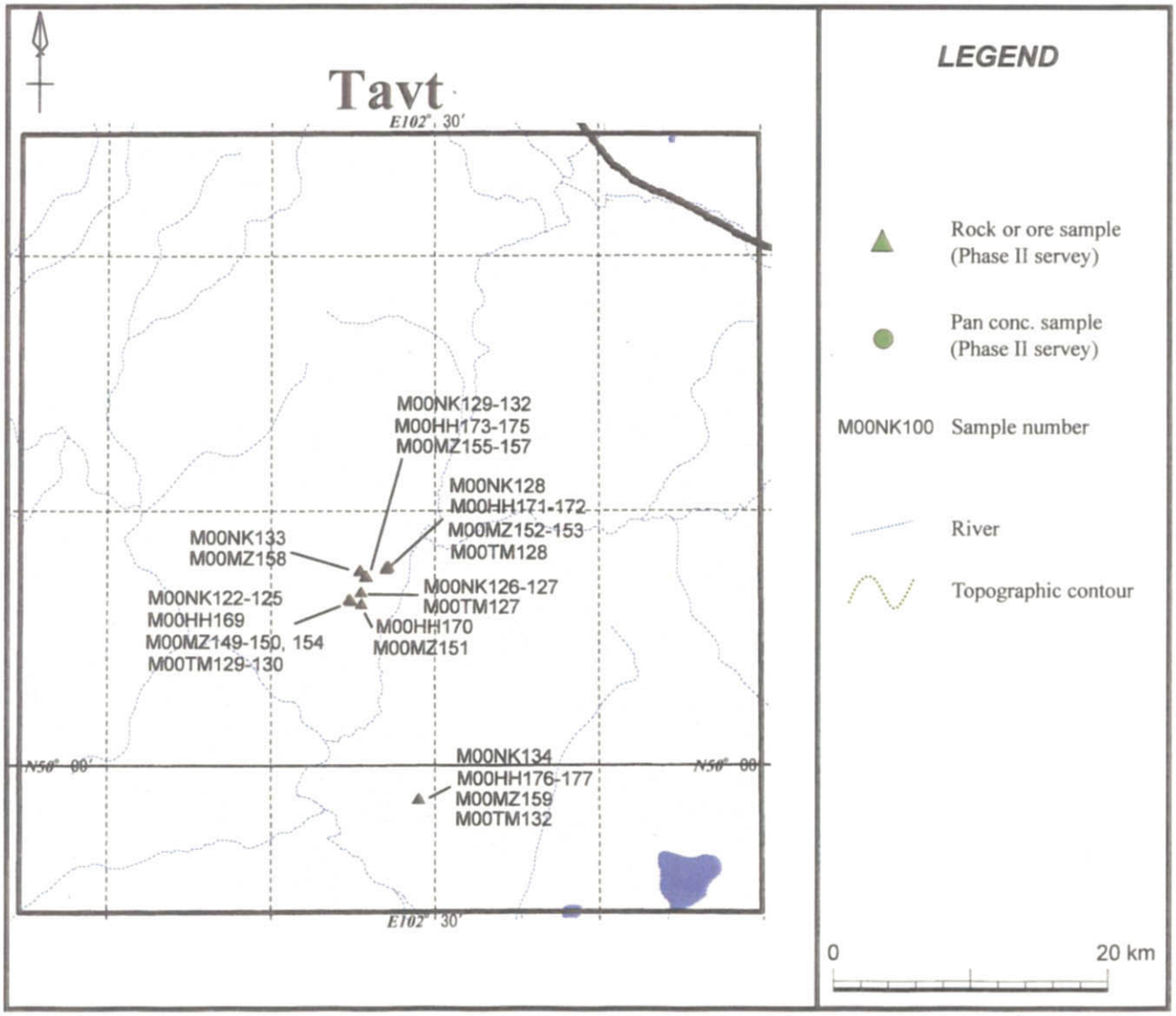


Fig. II-3-26 Sample locations of the Tavt district

(1-6) Reason for selection

In the surveyed area, there is a gold occurrence called Tavt, wherein the mineral occurrence operation is currently in progress. Further, there are records of many gold and copper occurrences, which are considered to be vein type deposits formed by the hydrothermal solution accompanying granite igneous activity, judging from the geologic conditions and the recorded conditions of the alteration. Further, according to the results of the past surveys, the presence of high-grade gold ore was reported as to each of the mineral occurrences, and this is the reason for that these mineral occurrences have been selected for the survey.

(1-7) Survey content

In this area, the characteristics of alteration and mineral showing were surveyed in the Ereen mineral occurrence (Tavt deposit) and Teshig-1 mineral occurrence, where the mineral occurrence by the M & Diamond Corporation is currently in progress. Figure II-3-26 shows sampling location within this area.

(2) Survey results

(2-1) Teshig (Mineral occurrence No. 60)

[Representative latitude and longitude]

49° 59′ 00″ north latitude, 102 ° 29′ 00″ east longitude

[Topography and vegetation]

This mineral occurrence situated on the southern slope of the mountain mass lying 1,800m above sea level. The mountain mass is covered mainly with larch forests, although this area is covered with relatively sparse larch forests and high bushes and grasses (with vegetation covering about 70% of the area concerned).

[Access]

This mineral occurrence is located at 150 km to the northeast of Erdenet city. The shortest route to this mineral occurrence is crossing the Selenge River by a bridge located near Hyalgant, by which it takes about a day to reach M & Diamond Corp.'s mineral occurrence camp and about 2 hours to reach this mineral occurrence by returning by way of Teshig towards the direction of the Erdenet city.

[Preceding survey]

According to a chief Geologist of M & Diamond Corp., which is currently engaging in the mineral occurrence project, Teshig is Au mineral occurence accompanying skarn, and gold reserve is estimated to be about 4 tons.

[Features on SAR image](SAR image unit "Zakamenks")

In the vicinity of the surveyed area, lineaments are detected in NW-SE and NE-SW directions, but no other lineaments are identified within a 5-km radius.

[Geology and geological structure]

According to the existing data (Document No. 2982, Geological map of 1:200,000 scale), there are the distributions of sedimentary rocks, which is the oldest around the area, formed from the Vendian to Cambrian-system, the plutonic rock formed during the early to middle Devonian, intruding into the former rocks (Figure 11-3-25) in the surveyed area.

[Mineral showing and alteration]

In appearance, the sedimentary rocks are distributed above the plutonic rocks, and several trenches, 100m-200m long, are dug ranging from the mid-slopes to the ranges of the mountain mass in E-W direction of the sedimentary rock distribution area. In the trenches, there observed the skarn, which are composed of epidote mainly, occurring substantially along the bedding of sedimentary rock, accompanying some locally irregularly formed magnetite.

According to the Chief Geologist of M & Diamond Corp., the Au grade of epidote-magnetite ore skarn is 10-30g/t, and geological resource of gold around the surveyed area is estimated to amount to about 4 tons.

[Laboratory test]

The two samples of the skarn (sample of magnetite skarnM00HH177 and sample of skarn M00TM132) taken from the trenches were analyzed, and the analyses data of the Au, Ag and Cu are as follows:

M00HH177 0.050g/t Au, 0.6g/t Ag, 0.155% Cu

M00MZ159 0.060g/t Au, 1.0g/t Ag, 0.559% Cu

M00TM132 0.125g/t Au, 1.4g/t Ag, 0.125% Cu

[Evaluation]

From the result of the survey, it cannot be concluded generally that the magnetite always accompanies with the Au and Ag, but at least it can be concluded that the analyzed skarn accompanies with Au, Ag and Cu. Concerning the adequacy of the gold reserve which is estimated as being 4 tons in terms of the amount of the geological resource of gold made by M & Diamond Corp., it is hard to evaluate the adequacy, because all of the analytical data of the trenches and the data on which the calculations have been made are not available, therefore it is desired to conduct more detailed survey of this area.

(2-2) Ereen (Mineral occurrence No. 61)

[Representative latitude and longitude]

50 ° 07′ 27.1″ north latitude, 102 ° 25′ 45.1″ east longitude. (location of the trench where the survey was conducted for No. 3 ore body in the Tavt deposits group).

[Topography and vegetation]

In the neighboring area of this mineral occurrence, there are relatively low continuous mountains whose peaks range at 1,500m-1, 700m above sea level, and the east side of this mineral occurrence runs a branch of Selenge River flowing down towards the south. Further, the branch of the River joins another branch flowing down southeast in the south of this mineral occurrence area. The top of the mountains is covered with sparse forests and the valley is a steps where short grass.

[Access]

This mineral occurrence is located at 150 km to the northwest of Erdenet city. The shortest route to this mineral occurrence is crossing the Selenge River by a bridge near Hyalgant, by which the mining camp of M & Diamond Corp. can be reached in about a day. There lies a River, about 30m wide and flowing down to south, near the mineral occurrence, and crossing this River by a vehicle is not possible when the water level of this River rises. The nearest town is Teshig.

[Preceding survey]

This mineral occurrence is registered by the name of Ereen on the mineral occurrence list, but it is generally known by the name of Tavt. In 1995, mining company, M & Diamond Corp. in Mongolia (at that time the joint-venture company with a Russian diamond mining company) acquired the local mining right in Tavt district and started the exploration. In 1997, the company acquired the secondary mining right for the area of 2,000 km^2 lying northeast of the Selenge River. The Ereen deposit is gold bearing quartz vein deposit accompanies with copper controlled by fracture in the northwest direction and developed in granites formed in the Cambrian and the Ordovician, and by now 10 ore bodies (including 100 mineral veins) have been detected within the area of about 10 square kilometers, of which No. 1, No. 2 and No. 3 ore bodies are considered to be mineral occurrence. Main vein is No. 3 ore body, comprise 6 ore bodies in total including No. 3a, No. 3b, No. 3c, extending about 3 km, about 3 m width at a maximum and varying largely throughout its overall length. The average Au grade is 6.3g/t Au, although being dispersed largely. According to the result of a grid drilling (drilling length:60m-80m) covering the area of 20m x 40m conducted by a Canadian drilling company, the average of the ore grade was 4.3g/t Au (1- 1,150g/t Au), totaling 6 tons in Au and 3 tons in Cu according to the result of reserve calculation.

Further, the gold grade of the No. 1 ore body is 3g/t Au on the average and 70g/t Au at a maximum; the No. 1b ore body is 1.8 km long, has the gold ore grade of 1-60g/t Au, while the No. 2 has gold ore grade of 1-33g/t Au.

At present, the gold deposit in Ereen is estimated to be 8 tons. High-grade ore is collected from the surface soil. After it is confirmed that the estimated gold production is over 2.5 tons or more, the application for the license for the mining operation by using dressing plant, which is under construction, is scheduled to be submitted.

[Features on SAR image](SAR image unit "Zakamenks")

The neighboring mountains of this mineral occurrence are dotted with sparse forests consisting of conifers and others, which will appear as bright area on the display screen of the SAR images.

This area has a steeper topography as compared with the plains in the center to the south of surveyed area, and the geologic body thereof can be said showing a high resistance. In the neighboring area there lies a drainage systems flowing south and southeast, which were sampled as N-S and NW trending lineament respectively.

[Geology and geological structure]

According to the existing data (Geological, maps of 1:200,000 scale and 1:1,000,000 scale), this area comprises granite of the Cambrian to the Ordovician, sedimentary rocks of the Middle Permian to Lower Triassic and granite of the Permian to the Triassic. In the neighboring area of this mineral occurrence, there are developed NW and N-S to NNE trending faults. The host rock of the ore deposit is granite (Figure II-3-27).

Concerning the age of granite, the age of the fine-grained diorite (M00TM129) intrusion into granite around No.1 ore body was measured by the bulk K-Ar method and determined to be 247 ± 12Ma, which corresponds to the Upper Permian. However, the result of the age determination of the sample is treated as a reference, since its age may be determined to be younger than the actual age due to the reason that the sample includes chlorite, epitode, sericite and quartz formed due to the hydrothermal alteration. Concerning the No. 42 ore body, slightly altered granodiorite (M00TM128) is subjected to the age determination by the bulk K-Ar method and is analyzed to be 330 ± 16Ma, which corresponds to the Middle Carboniferous.

[Mineral showing and alteration]

The field surveys were conducted for the No. 1, 2, 3 and 42 ore bodies. The type of ore deposit are classified as auriferous vein type deposit, and their host rocks are mainly gabbro, diorite, granodiorite and granite which age are regarded as the Lower Paleozoic, and occur in the boundaries with the intrusion rocks. Each ore body is controlled by NW trending fracture zone. The host rock along the vein is hardly affected by the alteration and the boundary thereof has become vague due to crushing happened after the formation of the Au bearing quartz veins. The alteration occurred at the boundary of the vein resulted in the formation of the muscovite and potassic feldspar, and a greisen-like formation was also observed. The result of X-ray diffraction indicates that sericite was detected from diorite (M00NK122, 123) accompanying the copper oxide and silicification. Small-scale dyke and barren quartz veins were observed indicating that magmatism and the hydrothermal activity occurred plural times. The ages of the alteration and mineralization of the No. 1 ore body were determined by K-Ar method by muscovite (M00TM130) separated from the quartz vein (formed by the hydrothermal activity occurred after the mineralization and shows no mineralization) cutting into the fine diorite

intruded into granitic host rock in the No. 1 ore body. As a result, 276 ± 14Ma was obtained, which corresponds to the Lower Permian.

The average grade of gold is highest in the gossan-like ore, which accompanies with chalcopyrite (limonization being conspicuous), while grade of gold is uneven in the ore of the quartz vein whose sign of limonization is relatively poor. The style of gold in the gossan like ore is not clarified yet, although the gold is visible in some cases.

[Laboratory test]

Quartz vein (M00NK124) accompanying the copper oxide in the No. 1 ore body was found to contain 54.14g/t Au and 2.4% Cu; the quartz vein (M00MZ151) accompanying limonite in No. 1b ore body contains 2.01g/t Au and 0.659% Cu; the quartz vein (M00TM127) in the No. 2 ore body contains 11.23g/t Au and 1.94% Cu; the quartz vein (M00TM155) accompanying limonite in the No. 3 ore body contains 5.52g/t Au and 0.021% Cu; the quartzite (M00HH172) accompanying the copper oxide in the No. 42 ore body contains 0.23g/t Au and 0.26% Cu. All the analyzed samples were taken at spots respectively.

According to the results of the measurement of the fluid inclusion homogenization temperature and the salinity of fluid inclusions, in the case of No. 1 ore body, 103-163 ℃ for the fluid inclusion homogenization temperature, 124.1℃ on the average, and 1.88% for the salinity of fluid inclusions; in the case of the No. 1b ore body, 98-158 ℃, 124.4 ℃ on the average and 5.24%; in the case of the No. 3 ore body, 198-273 ℃, 240 ℃ on the average and 0.25% were observed; the hydrothermal solution, in terms of the temperature, is classified into the epithermal.

Further, the oxygen isotope ratio (refer to the data given at the end of the this volume) of the hydrothermal solution in equilibrium with the quartz was calculated as being - 2.8-2.6 0 / 00 on the basis of the oxygen isotope fractionation coefficient (Matsushisa et al., 1979) between the quartz and the water by using the oxygen isotope ratio of the quartz vein and the temperature of the hydrothermal solution estimated from the fluid inclusion homogenization temperature. This calculated value is between that of the meteoric water and that of the magmatic water, suggesting the involvement of the meteoric water in the formation of the mineralizing hydrothermal solution.

[Evaluation]

The surveyed ore deposit was found to be gold and copper bearing quartz vein type deposit, formed by the hydrothermal solution in the NW trending fissure following intrusion of the granite and the like corresponding to the Permian. This ore deposit being of relatively low grade for a vein type and having a relatively large variation, the development thereof will depend on the mining method, ore dressing method and ore reserve. The potentiality of gold deposit in this area is thought to be high because there are some mineral occurrences containing high gold content besides the Ereen mineral occurrences. From now on, the development of the Tavt ore

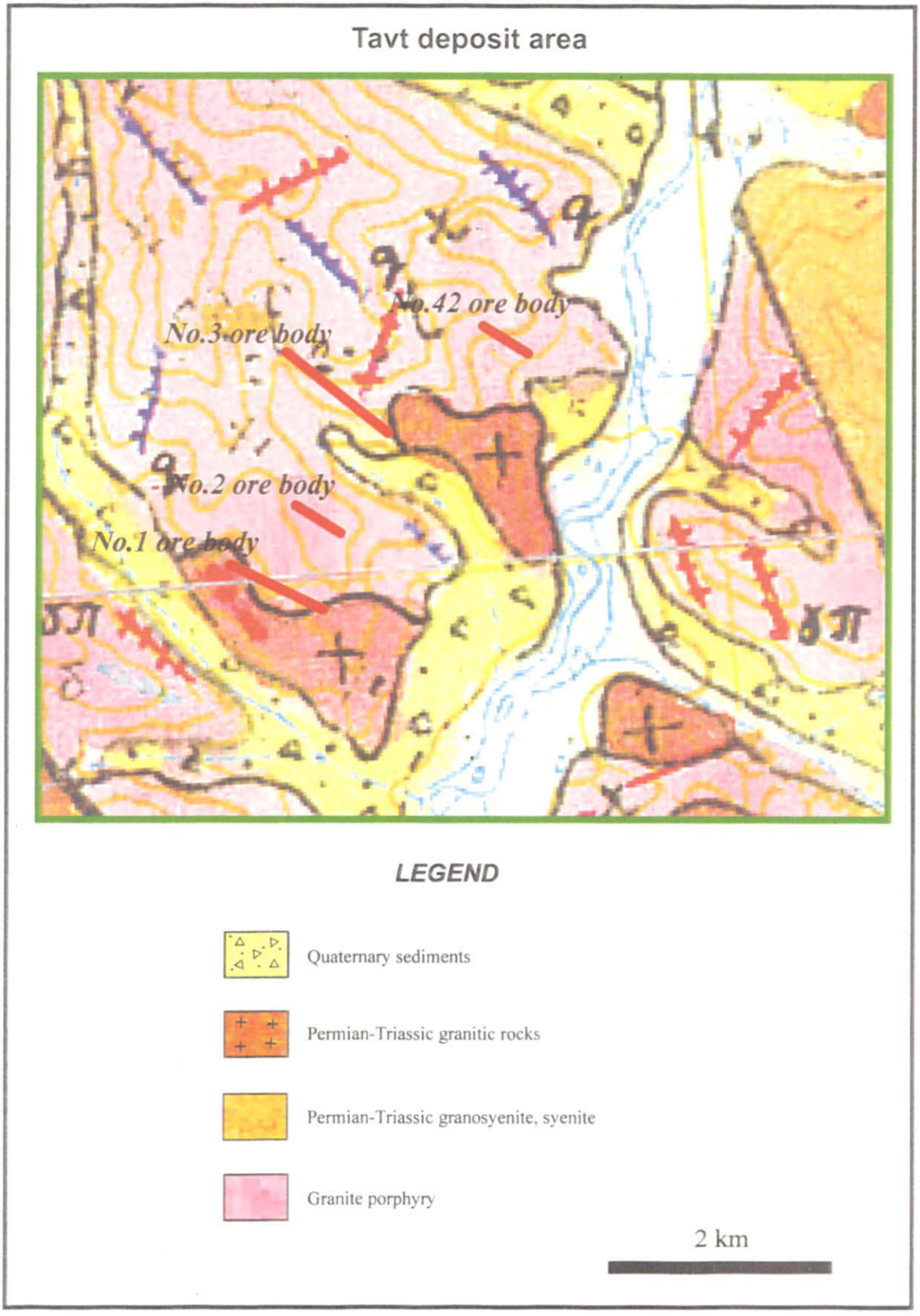


Fig. II-3-27 Geological map of the Ereen