

[Evaluation]

According to the results of the previous survey conducted on the Mongolia side, existence of gold grains was identified in the swamp sand sample from the recent sediments.

### 3.2.10 Erdenet District

#### (1) Outline of the district

Figure II-3-21 shows the geology of Erdenet district, and Figure II-3-22 shows the location of sampling points in the district.

#### (a) Location

Erdenet district is located in the eastern part of the survey area within the scope of E-W 100 km x S-N 80 km centering around 104° east longitude and 49° north latitude. Within the investigated district are situated Erdenet mine which is the most important mine for the mining industry in Mongolia and Erdenet city which is the fourth largest city in Mongolia established as a result of development and operation of Erdenet mine.

#### (b) Topography and vegetation

The district consists of gentle hills that are 1,300 to 2,000 m above the sea level. In the center of the district runs a river with its main stream going in the E-W direction. The ridge and the valley near the center of the district lie in the northwest direction where Erdenet mine is located. As to the vegetation there, low trees and grass grow in the low valley and on the low land and hills, and sparse forests consisting of conifers are seen on a relatively high ridge. The vicinity of Erdenet Mine consists of gentle hill where short grass grows.

#### (c) Infrastructure and access

Because of the existence of Erdenet Mine and Erdenet city, infrastructure may be considered as well developed. Since hospitals and hotels are established in the city of Erdenet, relatively stable power supply is ensured. The streets stretching toward the center and mines are paved. However, even in a big city like Erdenet, gasoline is not sufficiently provided and it is difficult to procure necessary amount of gasoline especially in summer.

Erdenet mine is operated as a joint venture business run by the Mongolian and Russian Governments. In 1999, 22,000,000 tons and 3,000 tons of copper and molybdenum concentrates respectively were produced. It is expected to attain copper concentrate production of 24,000,000 tons by 2004. Purchasers of copper concentrates in recent years are Republic of Russia (approximately 1/4), China (approximately 1/3), Japan, Korea, etc. Copper production using SX-EW for low-grade oxidized ore from Erdenet mine started in January 1997. Cathode copper whose initial production was 3,500 tons/year is expected to become 20,000 tons/year in 2000 and a feasibility study for this aim is now conducted. Currently 7,000 workers are employed, and they will be reduced to 4,200 in number when the existing superannuated facilities are renewed.

Erdenet is 200 km away from Ulaanbaatar in a straight line, and it takes almost a day to reach there by a vehicle. Road to reach there is unpaved but in relatively good conditions as the major

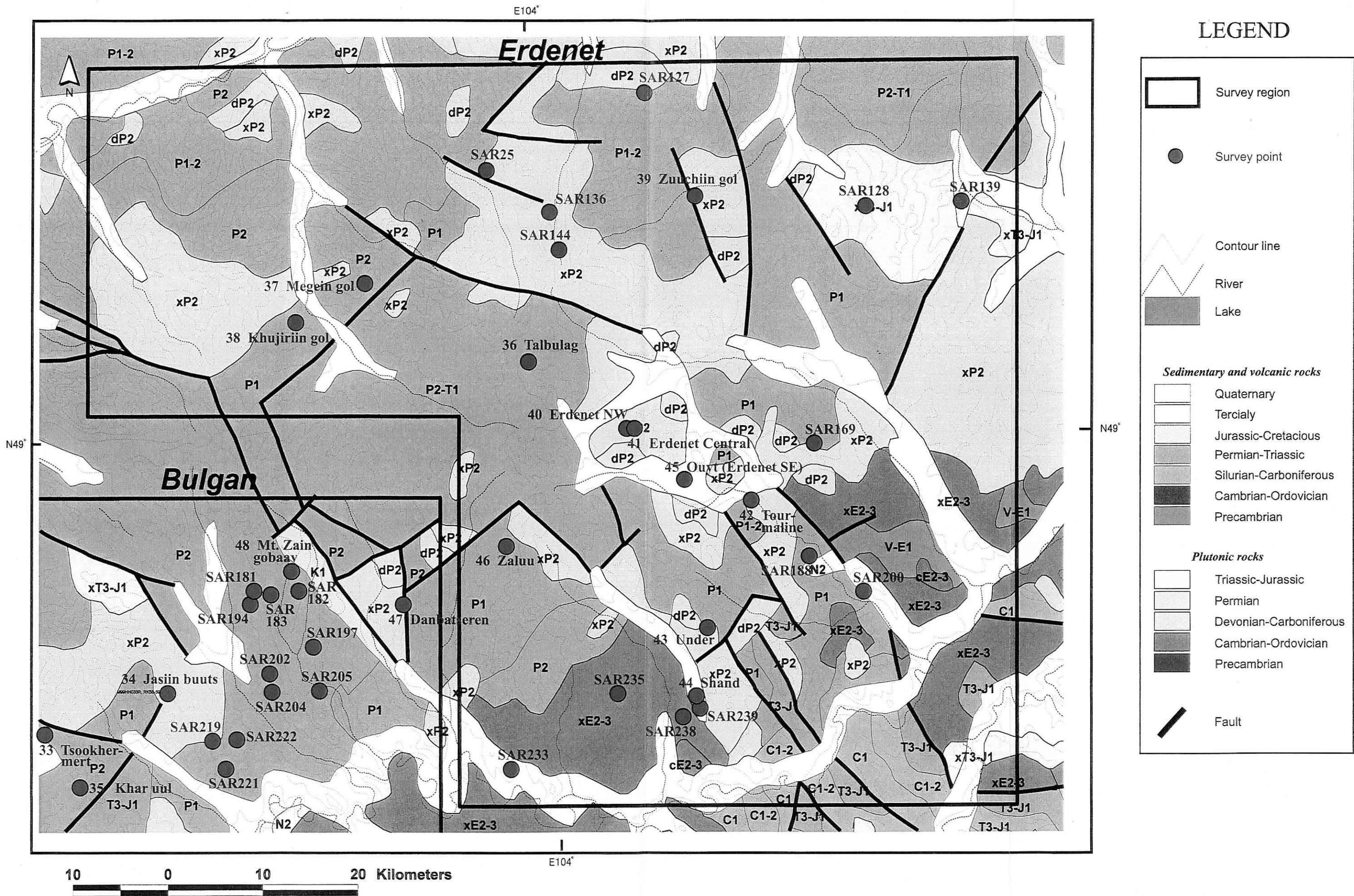


Fig. II-3-21 Geological map of Erdenet region

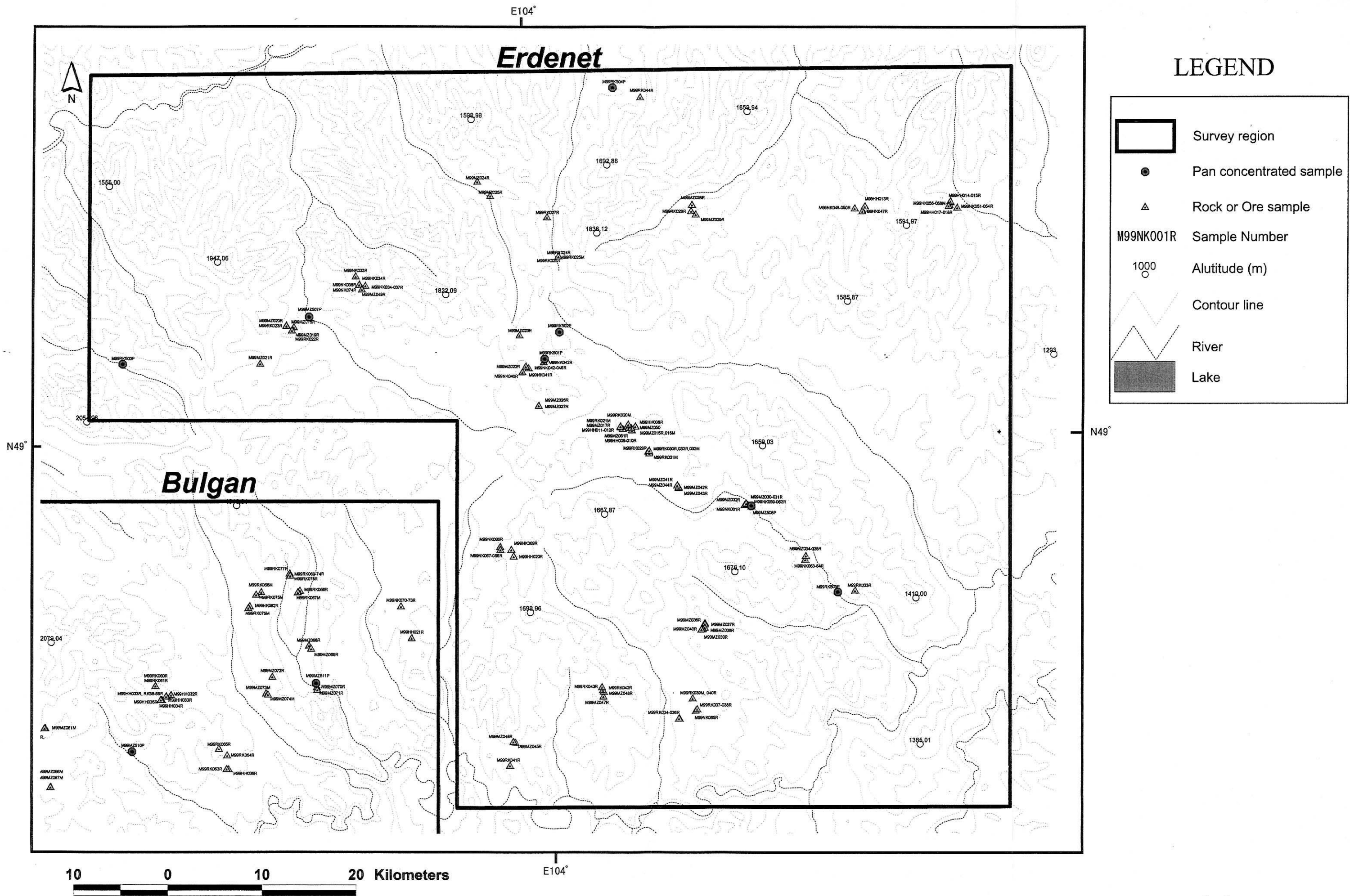


Fig. II-3-22 Sample locations of Erdenet region

highway. Bridges passable by a vehicle are built over the Selenge River. From Erdenet to Ulaanbaatar, a railroad is available which connects to Siberian railroad at Ulaanbaatar. These railroads are used for transportation of copper and molybdenum concentrates to Republic of Russia. In the central to southern parts of the district investigated, slopes are relatively gentle, providing easy and free access. In the northern part of the district, access by a vehicle is limited because of relatively steep slopes and sparse forests well developed on the ridge.

(d) Outline of geology and deposit

The Erdenet district is located between the northern Selenge fault in the E-W direction and the southern Bayangol fault in the E-W direction. Faults in NW-SE to N-S directions are developed in the district.

With regard to geology, sedimentary rocks including trachytic basalt, andesite and tuff as well as sandstone of Permian to Triassic periods are widely distributed. Into these have been intruded granite and granodiorite (Selenge Complex) which is regarded as of Permian to Triassic ages, monzonite, granite, granodiorite, and syenite of late Triassic age. In the southern part of the district under our survey, gabbro and granitic rocks of Cambrian age are distributed.

The host rock of Erdenet deposit is granitic rocks (Selenge Complex) that are regarded as generated in Permian to Triassic ages. Igneous rocks related to mineralization are granodiorite porphyry and diorite porphyry (Erdenet Intrusive rocks) which are regarded as generated in Triassic to Jurassic ages overlapped with igneous activity of the post-Mesozoic. Erdenet deposit is of a dome structure. Its mineralization is under control of a structure in the NW-SE direction, and igneous activity that took place post mineralization was made in the N-S direction. The peripheral mineralized zone including Erdenet mine extends in the NW-SE direction and existence of a total of six known mineralized zones have been grasped in the vicinity including Erdenet deposit. Erdenet deposit roughly consists of 4 ore bodies, out of which only Erdenet Northwest ore body has been so far exploited. It is difficult to exploit other ore bodies in view of their scales and grades. Ore reserves of Erdenet Central ore body almost adjacent to Erdenet Northwest ore body are considered 1/10 as large as Erdenet Northwest ore body based on a trial calculation.

In relation to the district investigated, existence of many copper prospects near acidic intrusive rocks are documented.

(e) Reason for selection

As a result of SAR image analysis, relatively intermittent lineaments in the NW-SE and N-S directions have been extracted. Erdenet deposit is located at the point where these lineaments cross each other. In view of the fact that a lot of known prospects are recorded in relation to the district investigated, the district may be determined as having the highest potential of deposit existence. Further, surveys of Erdenet mine and prospects in the vicinity would enable collection of the data on mineralization, and the data may be utilized as a guideline of survey.

## (2) Survey results

### (a) Talbulag and Tsagaan chuluut (Mineral occurrence No. 36)

#### [Typical latitude and longitude]

Talbulag Prospect: 49° 05' 5.4" north latitude, 103° 59' 00.0" east longitude

Tsagaan chuluut Prospect: 49° 02' 48.6" north latitude, 103° 59' 58.5" east longitude

#### [Topography and vegetation]

The prospect is a low mountain where sparse forests are distributed, and the valley is a steppe where short grass grow.

#### [Access]

It takes approximately 30 minutes by a vehicle from Erdenet city to the vicinity of the prospects, and then about 20 minutes' walk brings you to the prospects. Access is also available by a vehicle to Tsagaan chuluut prospect.

#### [Preceding survey]

Geological, geochemical and geophysical survey as well as drilling (one hole, depth: 300 m) were conducted.

As a result of geophysical survey, IP anomaly found in width of approximately 30 km extending over the prospects in the NW-SE direction was overlapped with negative anomaly of magnetism. This tendency is similar to that of Erdenet Northwest prospect.

Geology consists of Selenge Complex and volcanic rocks of the Mesozoic. Selenge Complex is considered to be distributed in relatively deeper compared with Erdenet Northwest deposit.

Spring water in Talbulag prospect contains high amount of sulfide. As a result of drilling with 800 m grid and 100 m depth, the deeper the prospect was situated, the higher grade was 0.75% Cu was obtained resulting from drilling at 275 m or deeper and within the core length of 15 m in Tsagaan chuluut prospect.

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

In SAR images, the ridge is expressed as a bright part, and the valley and low land, as dark parts. Resistivity is rather low and drainage system is not well developed. Lineament in the NNW-SSE direction is extracted.

#### [Geology and geological structure]

Andesite and dacite were distributed.

#### [Mineral showing and alteration]

In Talbulag prospect, unaltered andesite and dacite were distributed on the ridge. In the valley in the northwestern part of the prospect, silicified zone containing quartz veinlets sectionally, and white silicified rocks were distributed in the valley in the southeastern part.

In Tsagaan chuluut prospect, white silicified rocks and silica sinter were distributed and existence of limonite was identified along crack.

[Laboratory test]

In Talbulag prospect, chemical assay was performed on silicified rocks (M99NK043R, NK045R, NK046R, MZ022R and MZ023R) and the results obtained were <0.005 g/t Au (below the limit of detection), <0.2 - 0.2 g/t Ag, 3 - 50 ppm Cu, 150 - 1,130 ppm Pb and <2 - 70 ppm Zn.

In Tsagaan chuluut prospect, chemical assay was conducted on white silicified rocks and silica sinter (M99MZ026R and MZ027R) and the results were <1 - 1 ppm Cu, 6 - 20 ppm Pb and 2 - 12 ppm Zn. In addition, the powdery X-ray diffraction was conducted on white silicified rock (M99MZ026R). As alteration mineral, quartz - albite - potassium feldspar - andalusite was detected.

[Evaluation]

In Talbulag prospect, volcanic rocks of andesite-dacite were widely distributed covering Selenge Complex. Silicification and hydrothermal alteration such as quartz veinlets were noted in andesite and dacite. In Tsagaan chuluut prospect, white silicified rock and alteration like silic sinter were noted. Since no hydrothermal breccia was found in any of the above, it was considered as alteration caused by gentle acid hydrothermal activity. In Tsagaan chuluut prospect, existence of andalusite was identified in silicified rocks generated in high temperature acid hydrothermal environment. This suggests existence of advanced argillic alteration that is the upper sign of porphyry mineralization.

According to the existing materials, IP anomaly of this prospect was noted in shallower part. Since drilling was conducted for civil engineering purposes, a high possibility of porphyry deposit existence was determined.

(b) Megein gol (Mineral occurrence No. 37)

[Typical latitude and longitude]

49° 10' 03.7" north latitude, 103° 45' 13.5" east longitude

[Topography and vegetation]

The prospect is a mountainous area of almost 300 m in height with conifers and high undergrowth. Because of vegetation, outcrop is scarcely exposed.

[Access]

The prospect is located approximately 25 km to the northeast of Erdenet city. It takes approximately one hour and half by a vehicle to arrive at the foot of the mountain, and then about one hour and half on foot to reach the outcrop of silicified rocks.

[Preceding survey]

In 1981, a geological survey was conducted with a reduced scale of 1:25,000 and existence of secondary quartz zone was confirmed accompanying a small amount of copper in pyroclastic rocks of late Permian age within ranges of 500 m × 1,500 m and 300 m × 1,000 m, and Selenge Complex

was intruded into the secondary quartz zone. The assay results of the ore were 0.0335 - 0.074 % Cu and 0.002 - 0.018 % Mo. Drilling was also conducted for a short distance. Apparently, however, no distinctive copper mineralized zone was captured. Rhyolite porphyry, trachytic rhyolite porphyry, dacite/andesite porphyry are referred to in the existing document, and existence of Erdenet Intrusive rocks may be possible.

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

The prospect is expressed in gray to dark gray tones on SAR image. Resistivity is relatively low, constituting a round ridge. Density of drainage system is low and lineament in the NW-SE direction represented by the river was found.

[Geology and geological structure]

The prospect is located on the northwest extension of Erdenet deposit, and granitic rocks of Selenge Complex and andesitic - dacitic volcanic rocks were distributed. As mentioned above, volcanic rocks are referred to in the existing materials as generated in lower Permian age. However, another view insists that it was generated in late Triassic to early Jurassic ages.

[Mineral showing and alteration]

Strong silicified rocks consisting of acidic intrusive rocks whitened through silicification, and accompanying assembly of small crystalline quartz, were observed. The secondary quartzite as referred to in a document prepared on the Mongolia side is considered to correspond to the above.

[Laboratory test]

As a result of the powdery X-ray diffraction, whitened silicified rocks (M99NK034R) was found to consist of quartz, kaolin and andalusite. The homogenization temperature of fluid inclusion of quartz in silicified rocks (M99NK037R) was indicated as 179.5 °C. Although silicified rocks are generated at a low temperature, existence of andalusite may indicate that the white silicified rock is a part of the lithocap (advanced argillic alteration). No conspicuous anomaly was revealed in the result of chemical assay conducted on M99NK034R, M99NK035R, M99NK036R and M99NK037R.

[Evaluation]

Because of lack of outcrop, it was impossible to grasp detail of geology, mineralization and alteration. However, since andalusite was produced in altered rocks and what is called secondary quartzite in the old USSR as pointed out by Sillitoe (1996) may possibly be the lithocap of porphyry deposit, detailed survey should be conducted in the future.

(c) Khujiriin gol (Mineral occurrence No. 38)

[Typical latitude and longitude]

49° 07' 52.1" north latitude, 103° 38' 52.4" east longitude

[Topography and vegetation]

The prospect is a low mountain where short grass and sparse forests are distributed.

[Access]

It takes approximately one hour and a half by a vehicle to go from Erdenet city to the prospect. Access by a vehicle is also available to the prospect.

[Preceding survey]

High-grade gold and copper are reported as a result of a preceding survey. Geological survey and drilling were conducted in 1985 and 1988 respectively. It is reported that grades of 0.1 - 1 % Cu and 5 - 10 g/t Ag, and that small-scaled altered zone was found on the surface while bonanza exists in a deeper part.

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

In SAR image, the prospect is expressed as a dark part. Resistivity is low and drainage system is not well developed. Lineament of NNW-SSE direction in the northern part was extracted.

[Geology and geological structure]

Granodiorite and syenite of Selenge Complex were distributed. Andesitic - dacitic volcanic rocks were distributed in the southern part of the prospect.

[Mineral showing and alteration]

Existence of quartz vein was identified in granodiorite and syenite. Granodiorite contained a lot of biotite and potassium feldspar under potassic alteration.

[Laboratory test]

Chemical assay was made on granodiorite (M99MZ018R), andesite (M99MZ019R), monzonite (M99MZ020R), diorite (M99MZ021R), granite (M99RK022R) and quartz vein (M99RK023R). The results were: Au and Ag (below the limit of detection), 72 - 113 ppm Cu, 62 ppm Pb and 62 - 460 ppm Zn. As a result of the microscopic observation, diorite (M99MZ021R) was confirmed that quartz and sericite were generated under intensive alteration.

[Evaluation]

Only silicification, potassic alteration and weak geochemical anomaly in copper were identified on the surface. It is reported as results of preceding survey and drilling that high-grade mineralization zone was contained in a deeper underground part. Therefore, evaluation of geophysical survey and drilling results should be examined.

(d) Zuukhiin gol (Mineral occurrence No. 39)

[Typical latitude and longitude]

49° 13' 51.1" north latitude, 104° 14' 05.0" east longitude



[Topography and vegetation]

The prospect is a mountain region with its vegetation consisting of conifer forests and steppe where only short grass is growing.

[Access]

Driving on a paved road in the northeast direction from Erdenet city to Darkhan, then going northward on an unpaved branch road to Hyalganai and further going on another unpaved branch road, takes to the prospect.

[Preceding survey]

Geological survey on a scale of 1:10,000, geochemical and geophysical survey and trenching were conducted in 1967. The copper grade obtained was 0.001 - 0.01 %. Afterwards, a survey was resumed in 1978 and drilling of 20 holes was conducted in a depth of 150 - 450 m on anomaly of 5 - 10% Ip and low magnetism. However, survey activity were completed because of the obtained low grades of 0.006 - 0.2 % Cu and 0.003 % Mo.

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

The prospect is expressed in light gray color on the SAR image. Undulation is low and full of variety. Resistivity is from middle to high. Drainage system is developed also in middle to high degrees in radial distribution.

[Geology and geological structure]

Granodiorite regarded as Selenge Complex was distributed, and andesite - dacite lava were distributed covering the granodiorite. As intrusive rocks, dacite - andesite and dacite porphyry were distributed.

[Mineral showing and alteration]

Dissemination of limonite was noted as dots in silicified intrusive rocks.

Copper oxide observed is considered as local generation. In addition, copper oxide generated by insitu mineralization was sectionally noted.

[Laboratory test]

Assay results of mineralized rocks were 0.025 g/t Au, 14.8 g/t Ag and 8,750 ppm Cu.

[Evaluation]

Mineralization of copper oxide was in a small scale. Since the number of holes and depth of the past drilling were sufficient and yet mineralization of copper was found in low grade, no further survey will be necessary.

(e) Erdenet NW (Mineral occurrence No. 40)

[Typical latitude and longitude]

49° 01' 18.1" north latitude, 104° 07' 44.1" east longitude

[Topography and vegetation]

Operation is now conducted at an open pit surrounded by gentle slopes where short grass grows.

[Access]

It takes approximately 20 minutes to reach the open pit from the nearest Erdenet city.

[Preceding survey]

Geological survey, geophysical (IP, magnetism) prospecting and geochemical survey as well as drilling have been conducted.

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

The prospect is expressed as a dark part on the SAR image. Resistivity is low and no drainage system is developed. No lineament is extracted on the surface in this prospect. From a broad point of view, however, the prospect corresponds to the place where lineaments in the NW-SE and N-S directions are crossed each other.

[Geology and geological structure]

Selenge Complex were distributed, and Erdenet Intrusive rocks and andesite dyke intruded into that.

[Mineral showing and alteration]

On the level of 1,385 m of the open pit, secondary enrichment was observed. Pyrite, chalcopyrite, chalcocite, etc. were disseminated in Erdenet Complex altered to quartz-sericite. According to the classification of Gustafson and Hunt (1975), the quartz vein with sulfide mineral corresponds to B-vein.

On the level of 1,415 m of the open pit, pyrite and chalcopyrite were disseminated in granitic rocks containing large amount of potassium feldspar and biotite under potassic alteration. The oxidized zone remaining on the highest part of the open pit was distinctively limonitized.

[Laboratory test]

As a result of analysis conducted on ore samples (M99HH009R, RK020M and RK021M) from the open pit in which pyrite, chalcopyrite and chalcocite are disseminated and results were <0.005 g/t Au (below the limit of detection), 1 - 5 g/t Ag, 930 - 5,670 ppm Cu, <10 - 110 ppm Mo, 0.01 - 0.02 ppm Pb, and 20 - 600 ppm Zn.

Similarly, analysis of the whole rock, the microscopic observation of thin section, measurement of sulfur and oxygen isotope and EPMA analysis were conducted on the samples (M99HH008R, M99HH009R, M99HH010R, M99HH011R, M99MZ015R, M99MZ016M, M99MZZ017R and

M99MZ050X) extracted in the open pit.

As results of the microscopic observation, biotite tonalite, biotite quartz monzonite and basalt, all of which were intensively altered and as the secondary mineral, quartz-chlorite-sericite was generated.

Also, argillized rock (M99MZ051R) with abundant sericite was extracted from the bottom of the open pit to identify its mineralization age. As the results,  $223 \pm 6$ Ma for biotite conc. and  $202 \pm 4$ Ma for quartz-feldspar conc. were obtained.

#### [Evaluation]

As a result of sericite analysis based on  $^{40}\text{Ar}/^{36}\text{Ar}$  method, the absolute age values of mineralization obtained by us was similar to the result of  $207.4 \pm 2.5$  Ma so far obtained (Melissa A. Lamb and Dennis Cox, 1998).

Based on the results of sulfur and oxygen isotope measurements and analysis of the whole-rock chemical composition, mineralizing of Erdenet NW deposit and peripheral prospects and petrological examination of granitic rocks on mineralization were performed as detailed below.

#### - Oxygen isotope

Oxygen isotope ratio, homogenization temperature and salinity of fluid inclusion were measured on quartz vein (M99MZ016M) of this deposit. Quartz vein is produced in the secondary enrichment of the deposit where chalcopyrite, pyrite, etc. are disseminated (Appendix Table A-20, A-25). Oxygen isotope ratio of quartz (M99MZ016M) was  $+4.3 \text{‰}$  to  $+5.9 \text{‰}$ , and homogenization temperature of fluid inclusion was in a range of  $132 - 172 \text{ }^\circ\text{C}$ . The oxygen isotope ratio of the water in equilibrium with quartz as calculated by applying oxygen isotope separation factor (Matsuhisa et al., 1979) between quartz and water at the average homogenization temperature of  $151.2 \text{ }^\circ\text{C}$  was in a range of  $-11.0 \text{‰}$  to  $-9.4 \text{‰}$  (Appendix Table A-25). Oxygen isotope ratio of magmatic water shows heavy values of  $+6 \text{‰}$  to  $+9 \text{‰}$  (Taylor, 1974). On the other hand, oxygen isotope ratio of meteoric water shows light values in general in a range of  $-15 \text{‰}$  to  $-5 \text{‰}$  obtained in Japan, Korean Peninsula and east-northern part of China (Mizota and Kusakabe, 1994). Oxygen isotope ratio of fluid forming epithermal quartz vein of Tsookher mert prospect to be described below was in a range of  $-10.8 \text{‰}$  to  $-8.0 \text{‰}$ . In view of a low salinity of  $0.16 \text{‰}$ , it is considered as being originated from meteoric water. Taking the data of the deposit also into consideration, the oxygen isotope ratio of meteoric water at the time of mineralization is considered to be around  $-11 \text{‰}$ . In view of the data obtained from M99MZ016M being epithermal originated from meteoric water, low salinity, and that it was the latest hydrothermal process as a porphyry copper deposit, we consider that this does not reflect characteristics seen in the main period of mineralization. However, in view of the fact that hydrothermal activity mainly of meteoric water took place in the latest time of mineralization of porphyritic copper deposit, we know that mineralization occurred in the environment of the depth and pressure to enable circulation of meteoric water.

#### - Sulfur isotope

Sulfur isotope ratio were measured on whole-rock samples of granitic rocks and pyrite after mineral separation. The results are as indicated in Appendix Table A-26. For comparative examination, Appendix Table A-26 also shows the results of measurement conducted on Erdenet SE

deposit and Under prospect.

Observing the effect of mineralization on the whole-rock sample of granitic rocks, we note a distinctive difference between +3.3 ‰ to 7.2 ‰ as sulfur isotope ratio of mineralized rock and -4.8 ‰ to -1.8 ‰ as sulfur isotope ratio of unmineralized rock. On the other hand, with regard to the category of unmineralized rock as Selenge Complex and Erdenet Intrusive rocks, except for the data of +7.2 ‰ for the sample M99HH008R of Selenge Complex, the data of both composite rocks are within a range of +3.3 ‰ to 4.6 ‰ and, therefore, there is no distinctive difference between the two composite rocks. Sulfur isotope ratios of unmineralized rocks correspond to the typical value of granites of magnetite series on granites in Japan as clarified by Sasaki and Ishihara (1979).

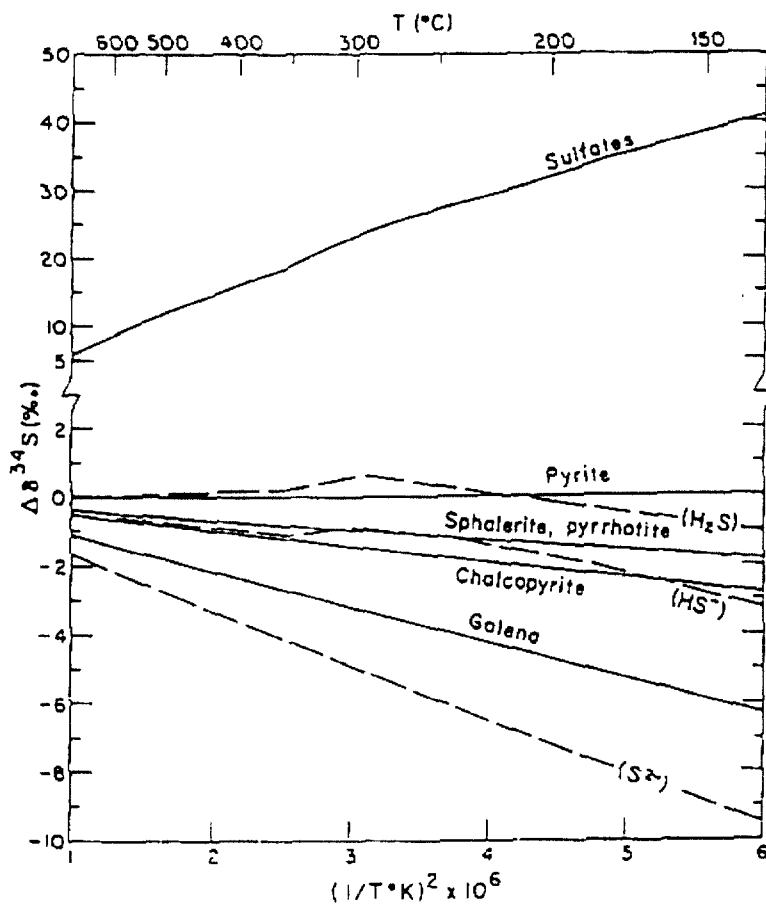
As to difference between mineralized and unmineralized rocks, sulfur isotope ratio of unmineralized rock is considered to indicate all-sulfur isotope ratio of magma. On the other hand, the fact that sulfur isotope ratio of mineralized rock is lower than the above may be as attributable to reduced composition of sulfur isotope under the influence of mineralization even if all-sulfur isotope ratio was the same. Another view may insist that two types of magmatic activities with different all-sulfur isotope ratios were involved. However, since Erdenet NW deposit and Erdenet SE deposit are adjacent to each other both in time and space, it is difficult to consider that two different magmatic activities took place.

With regard to the explanation that although all-sulfur isotope ratio was same, sulfur isotope composition was reduced under the influence of mineralization, since sulfur isotope ratio of pyrite was -0.7 ‰ to -0.5 ‰ and composition of sulfur isotopes of pyrite and H<sub>2</sub>S are almost the same (Appendix A-26), we have to consider that mineralized liquid contained sulfur type whose isotope ratio is lower than that of H<sub>2</sub>S. Based on the details indicated in Figure II-3-23, the different type of sulfur is considered as S<sub>2</sub> instead of SO<sub>4</sub><sup>2-</sup>. This concept is consistent with the fact that existence of anhydrite (gypsum) was not identified in Erdenet NW deposit. This suggests that sulfur did not become SO<sub>4</sub><sup>2-</sup> but remained as S<sup>2-</sup> because mineralization took place in a strong recharging environment.

With regard to sulfur isotope ratio of pyrite as -0.7 ‰ to -0.5 ‰, meteorite of standard substance is 0 ‰ (Canyon Diablo Troilite). If it is concentrated around 0 ‰, the state is considered in general as being originated from magma. Since sulfur isotope ratios are centered around -0.12 ‰ for pyrites from Bingham deposit as a porphyritic copper deposit in the North America (Field, 1966), sulfur from Erdenet NW deposit is also considered as having been originated from magma.

#### - Examination of petrological chemistry on granitic rocks

For examination of petrological chemistry on granite samples, chemical analysis was conducted on its major elements, trace elements and rare earth elements (Appendix Table A-19). Out of the samples analyzed, those determined as fresh or slightly altered through microscopic judgment are as indicated in Table II-3-2. The phrase "weakly altered" as mentioned in the table represents the state where a small amount of chlorite is generated.



Sulfur isotope fractionations among sulfur species and hydrothermal minerals plotted with respect to pyrite. Dashed lines indicate species in solution. Solid lines indicate minerals. (For sources of data see Ohmoto, 1972, and Robinson and Ohmoto, 1973.)

Fig.II-3-23 Sulfur isotope fractionations among sulfur species and hydrothermal minerals (Ryo and Ohmoto, 1974)

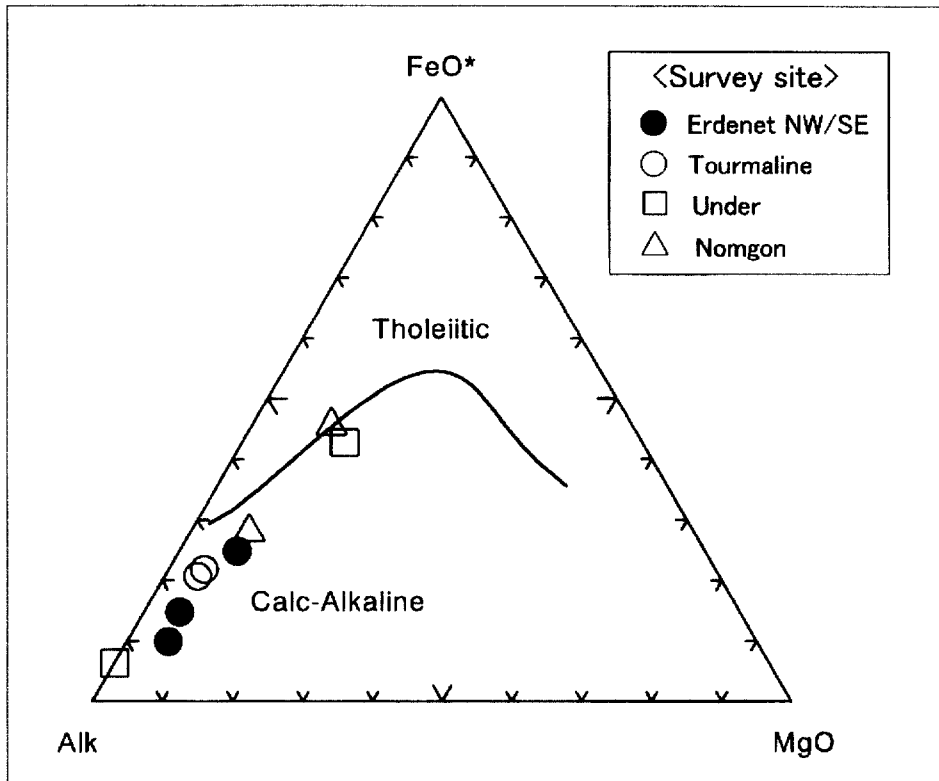
Table II-3-2 List of granitic rocks for examination of petrological chemistry

Sample	District	Rock	Type
M99HH008R	Erdenet NW	Monzonite	Weakly altered
M99MZ043R	Erdenet SE	Granodiorite porphyry	Relatively fresh
M99MZ044R	Erdenet SE	Granodiorite porphyry	Relatively fresh
M99MZ057R	Nomgon	Tonalite porphyry	Fresh
M99MZ059R	Nomgon	Tonalite	Fresh
M99NK059R	Tourmaline	Monzonite porphyry	Weakly altered
M99NK061R	Tourmaline	Granite porphyry	Relatively fresh
M99MZ036R	Under	Granodiorite	Fresh
M99MZ039R	Under	Quartz porphyry	Weakly altered

We conducted analysis of petrological chemistry on the samples shown in Table II-3-2. As indicated in AFM chart (Figure II-3-24), except for a sample of Nomgon prospect plotted on the border between a calc-alkaline series and tholeiitic series, the samples are plotted in area of calc-alkaline series. Figure II-3-25a represents a Qz-Or-Pl chart based on CIPW NORM calculation plotted in the area of monzonitic granite, granodiorite and quartz monzonitic diorite. From these results, the samples are recognized as non-alkaline rocks of calc-alkaline series. Figure II-3-25b indicates the data of Figure II-3-25a as divided into two groups of Selenge Complex and Erdenet Intrusive rocks. Compared with the samples of Selenge Complex, the samples of Erdenet Intrusive rocks (M99MZ039R and M99MZ043R) have a characteristic to be plotted in the area where much quartz is contained. Figure II-3-26 is Rb-(Y+Nb) Chart of Pearce et al. (1984), and all the samples are plotted in the area of volcanic arc granite (VGA). This indicates that they were generated as a result of igneous activity of island arc associated with subduction of plate.

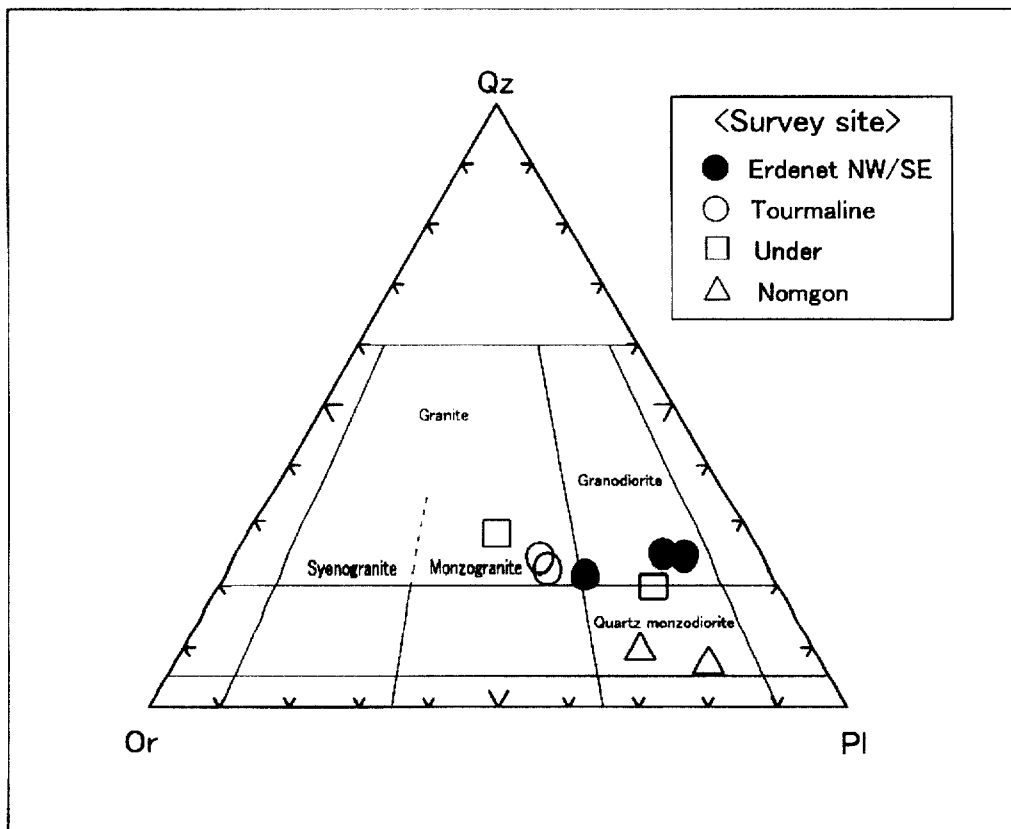
Figure II-3-27 represents the standardized contents pattern of rare earth elements by chondrite. The elements from La to Lu of lanthanoid on the axis of abscissas are arranged from the left in the order of atomic symbols, and Y that shows the action like lanthanoid is arranged at the right end. Elements from La to Sm are classified as light rare earth elements (LREE), and those from Gd to Lu are classified as heavy rare earth elements (HREE). The recommended value for standardization was as established by Boynton (1984).

As indicated in Figure II-3-27, standardized values of the elements of granitic rocks in Erdenet NW and SE deposits (excluding Eu) are lower than granitic rocks in other prospects, and degree of this reduction is especially distinctive in standardized values of HREE. The pattern of granitic rocks in Erdenet NW and SE deposits is in conformity with the pattern of chondrite standardization (Figure II-3-27) and, consequently, large inclination downward to the right of the pattern shows the values lowered as it goes from the left to the right. Concerning Eu, while granitic rocks in other prospects show negative anomaly, the granitic rocks in Erdenet NW/SE deposit show positive anomaly. The



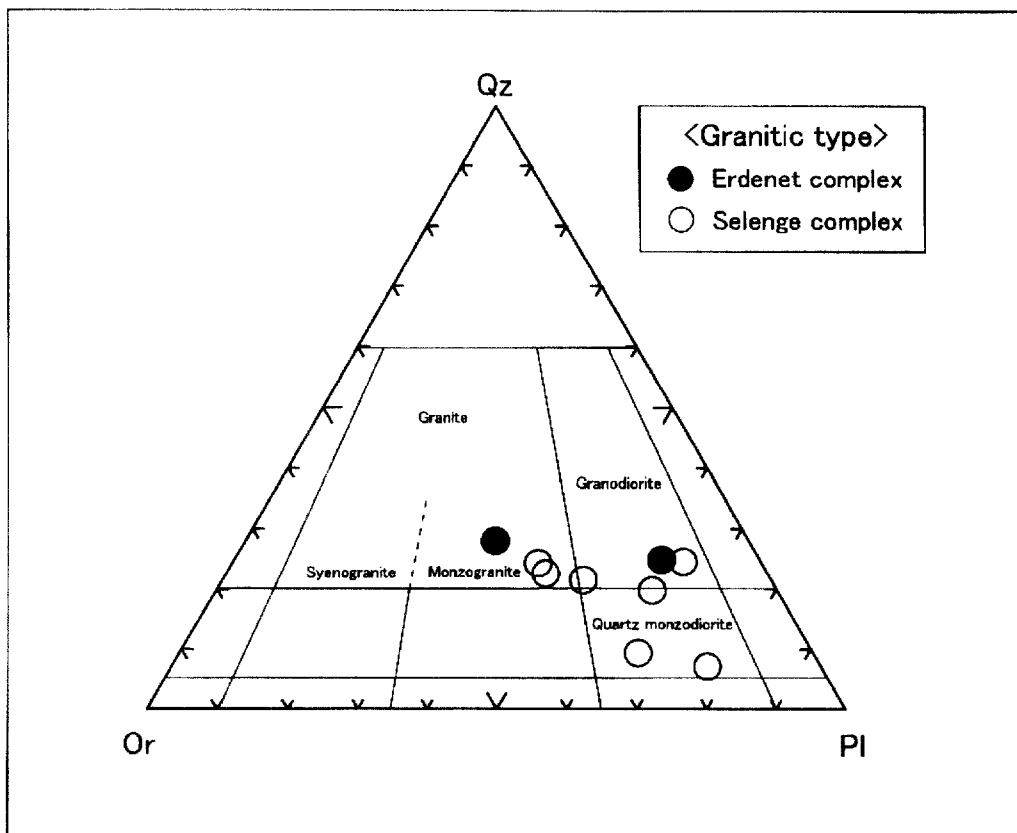
Ternary variation diagram of AFM plot for analyses of granitic rocks. Alk = Na<sub>2</sub>O+K<sub>2</sub>O, FeO\* = Total Fe in FeO.

Fig. II-3-24 AFM diagram



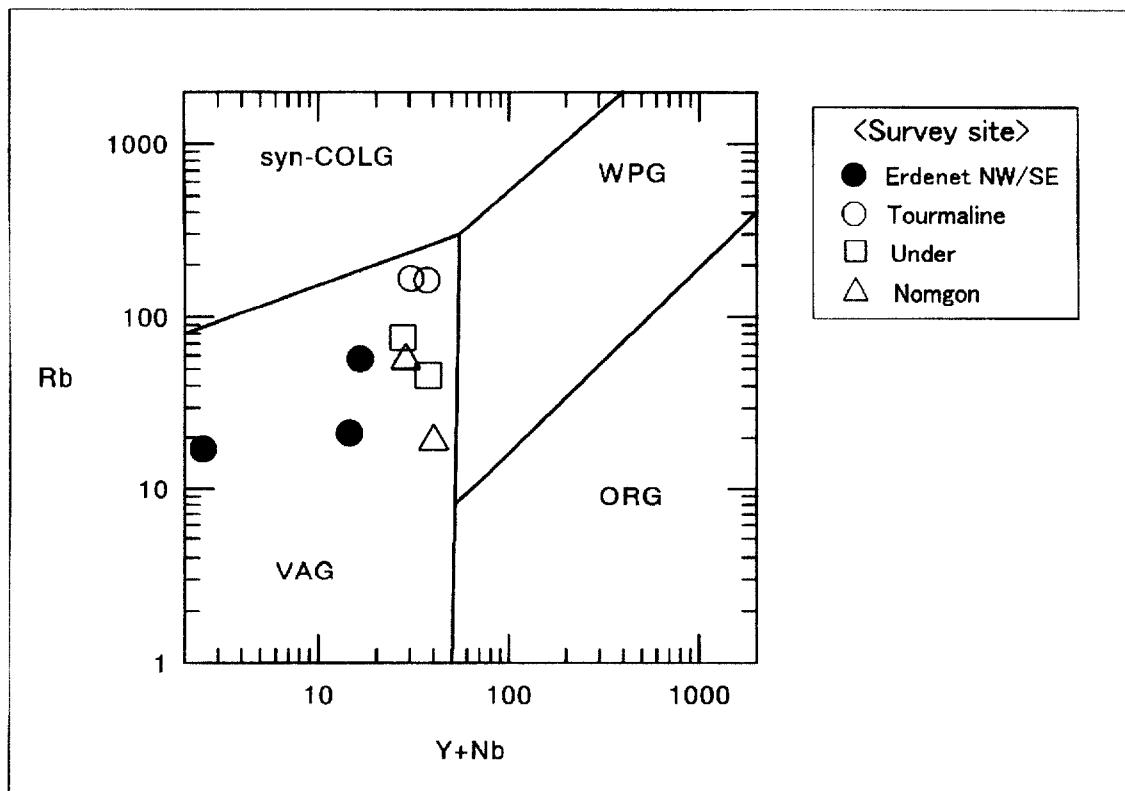
(a) Ternary variation diagram of Qz-Or-Pl CIPW normative compositions for granitic rocks with classification of survey sites.

Fig. II-3-25a Qz-Pl-Or diagram



(b) Ternary variation diagram of Qz-Or-Pl CIPW normative compositions for granitic rocks with classification of granitic types.

Fig. II-3-25b Qz-Pl-Or diagram



Composition of granitic rocks plotted in the Rb v. (Y+Nb) diagram (Pearce et al. 1984). VAG : volcanic arc granites, syn-COLG : syn-collision granites, WPG : within-plate granites, ORG : ocean ridge granites.

Fig. II-3-26 Rb-Y+Nb diagram (Pearce et al., 1984)



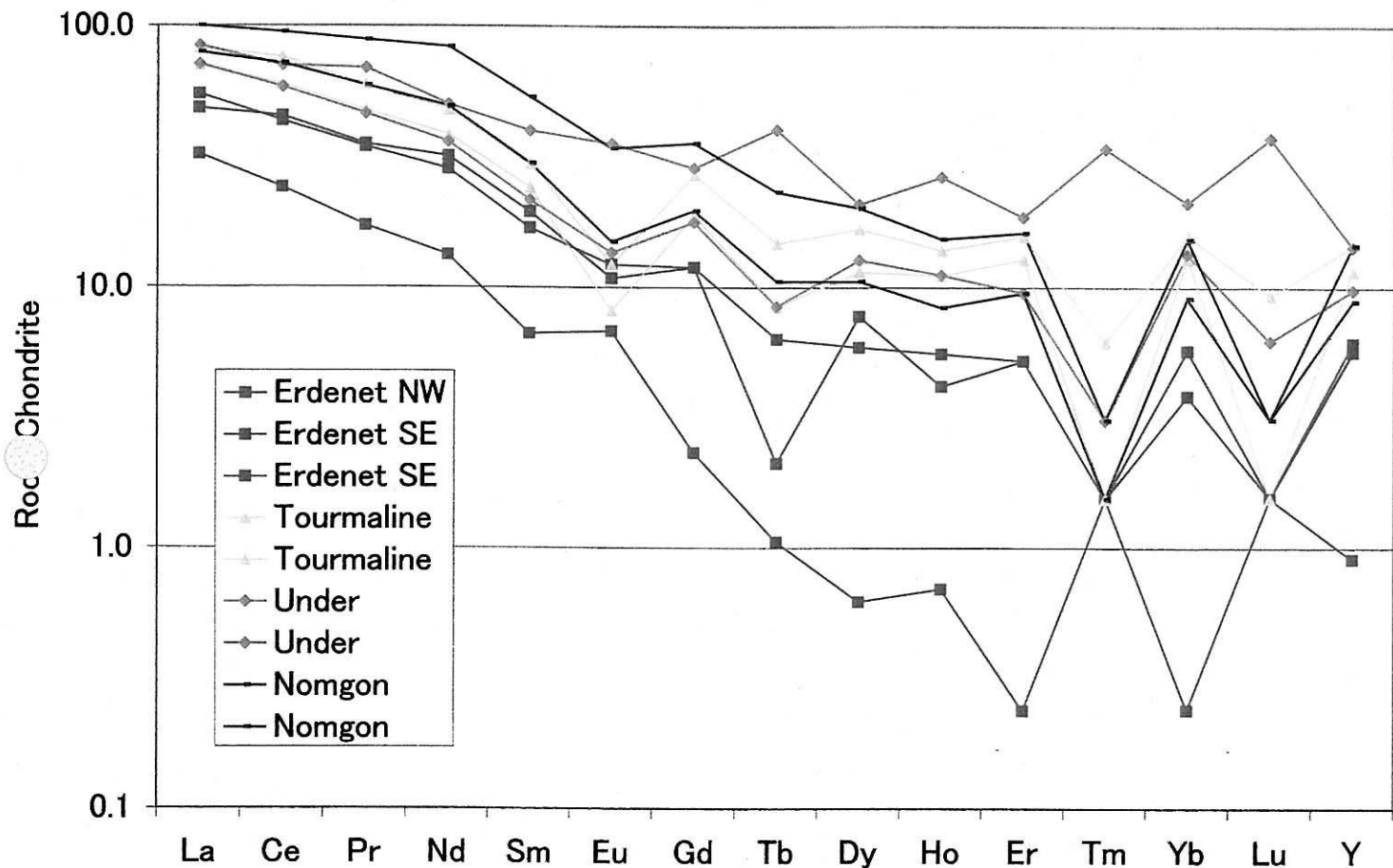
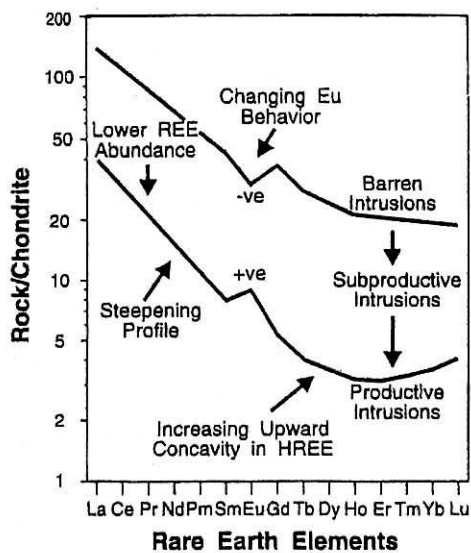
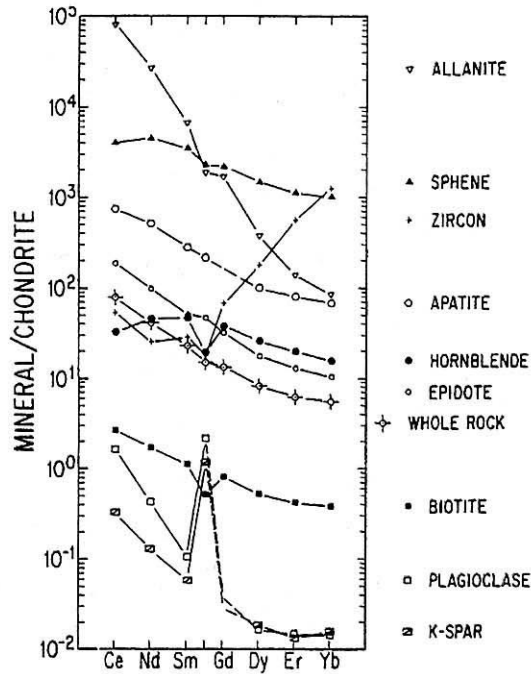


Fig. II-3-27 Chondrite normalized REE profiles of granitic rocks



Generalized REE behavior in Laramide magmatic complexes, Arizona. Early, barren, pyroxene phyric intrusions are represented by the upper curve whereas the lower profile represents productive intrusions. Temporal changes in REE patterns are indicated. Lang and Titley (1998)

Fig. II-3-28 Distribution of REE in granite (Ogasawara, 1989; after Gromet and Silver, 1983)



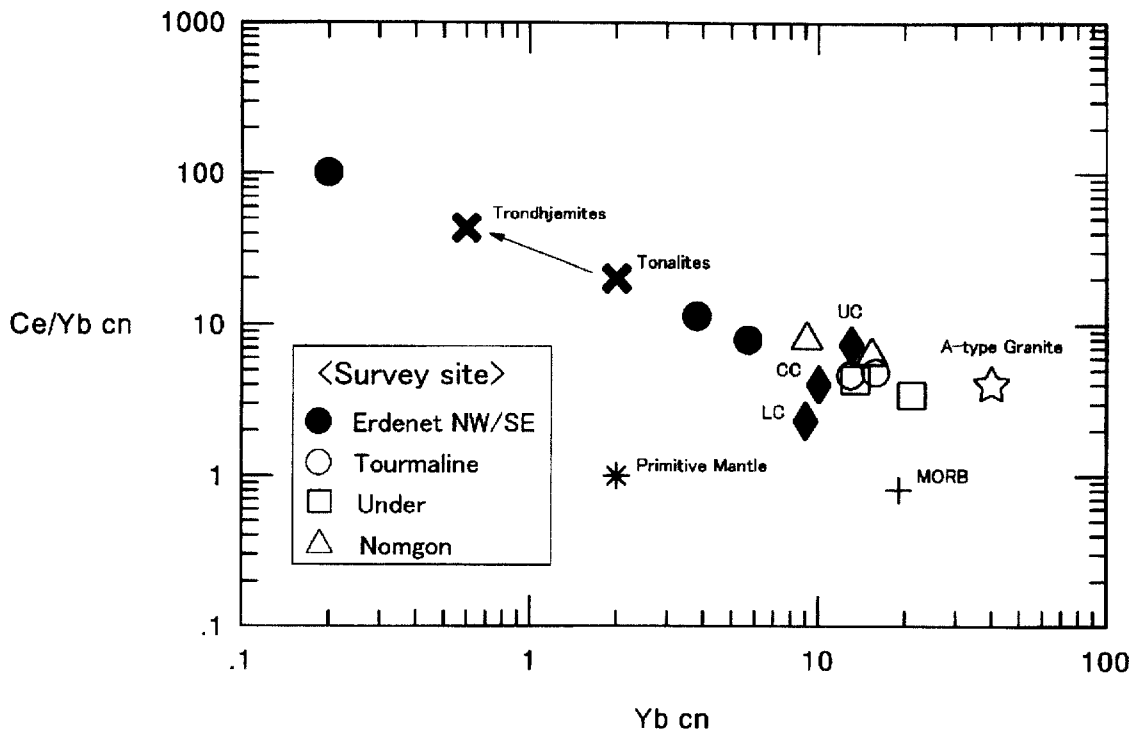
Granodiorite in Peninsular Rang, California (from Gromet and Silver, 1983)

Fig. II-3-29 Chondrite normalized REE patterns of mineral contained in granite (Gromet and Silver, 1983)

pattern as indicated by granitic rocks of Erdenet NW and SE deposits is in consistency with the chondrite standardization pattern of rare earth elements of granitic rocks of porphyritic copper deposit with high mineralization capacity as clarified by Lang and Titley (1998). The pattern peculiar to high mineralization capacity may be considered by referring to chondrite standardization pattern of rare earth elements contained in granites (Figure II-3-28 ). As indicated in Figure II-3-29, rare earth elements of granites are mainly contained in allanite, titanite, zircon and apatite while biotite, plagioclase and potassium feldspar contain only little amounts of rare earth elements. However, since Eu with bivalent is easy to be substituted with site of such as Ca of feldspar, Eu has a characteristic to be selectively contained in plagioclase and potassium feldspar. Therefore, when multiple rocks are generated from melt of magma, the rocks generated early mainly contain allanite, titanite, zircon and apatite, and those generated later contains little of them. If a rock contains a lot of plagioclase and potassium feldspar, it should be defined as a rock generated later. In other words, a rock with advanced differentiation contains little amounts of rare earth elements, indicating positive anomaly in Eu and the pattern of chondrite standardization of rare earth elements inclines downward as it goes to the right.

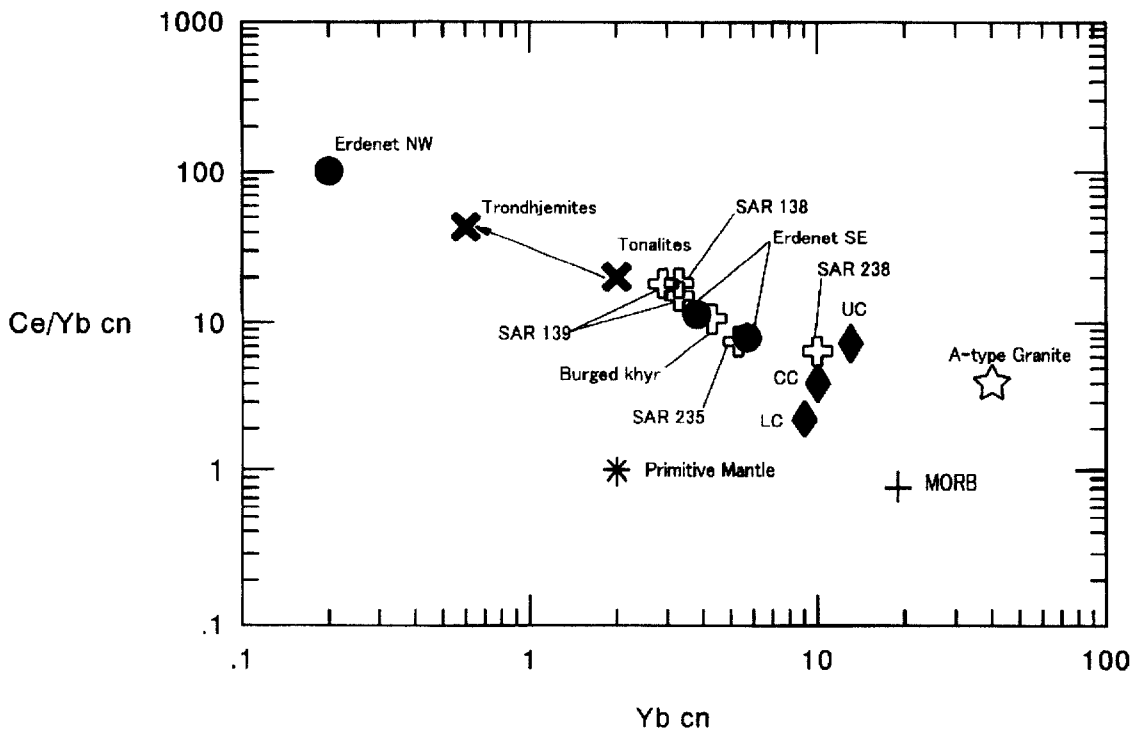
Ce/Yb-Yb chart prepared by Ogasawara (1989) accurately indicates chondrite standardization of rare earth elements of granitic rocks with advanced differentiation because of its high capacity of mineralization (see Figure II-3-30a, b). With Ce and Yb as representatives of LREE and HREE respectively, standardized Ce/Yb values show a distinctive pattern of inclination downward to the right as their values are lowered as it goes to the right. From the standardized value of Yb, we know the degrees of heavy rare earth elements contained, whether concentrated or reduced. Together with the data obtained in Mongolia, Figure II-3-30a shows the values of primitive mantle, MORB, A-type granite, continental crust and tonalite - trondhjemite rock series established by Ogasawara (1989). The fact that standardized Ce/Yb values of primitive mantle and MORB are almost 1 indicates that the standardization pattern is flat. On the other hand, in the case of tonalite-trondhjemite rock series, since standardized Ce/Yb values are high and standardized Yb is low, indicating that the standardized pattern largely inclines downward as it goes to the right. While the data obtained in Mongolia indicate that the values for Tourmaline, Under, Nomgon prospects are similar to those of continental crust, the values for Erdenet NW and SE deposits is in conformity with the trend to connect the continental crust and tonalite - trondhjemite rock series. From this, we understand that while granitic rocks of Tourmaline, Under and Nomgon prospects were generated from the continental crust and undifferentiated, granitic rocks in Erdenet NW/SE deposits were generated from continental crusts but their differentiation as tonalite - trondhjemite rock series has advanced.

As a method of potential evaluation in this district, in the chondrite standardization Ce/Yb-Yb chart we should grasp the granitic rocks plotted in the same area as those of Erdenet NW and SE deposits. Here, samples may not be necessarily fresh, and it would be all right if it is under hydrothermal alteration. The reason is, as indicated in Figure II-3-29, among the ores that mainly contain rare earth elements, titanite, zircon and apatite are stable if they are under hydrothermal alteration. Therefore, we prepared chondrite standardization Ce/Yb-Yb chart on three samples from Erdenet NW and SE deposits (Figure II-3-30b, Table II-3-2) and on altered granite samples shown in Table II-3-3.



(a) Chondrite normalized Ce/Yb - Yb diagram for granitic rocks with classification of survey sites. cn : chondrite normalized, UC : upper continental crust, CC : continental crust, LC : lower continental crust, data except mongolian sites are referred from Ogasawara (1989).

Fig. II-3-30a Ce/Yb-Yb diagram



(b) Chondrite normalized Ce/Yb - Yb diagram for comparison of granitic rocks between Erdenet NW/SE and other sites. Abbreviations are same as Fig. 8.

Fig. II-3-30b Ce/Yb-Yb diagram

Table II-3-3 List of altered granitic rocks for examination of Fig.II-3-30b

SAMPLE	District	Rock	Type
M99MZ054R	Burged khyr	Granitic rock	Limonitic
M99HH013R	SAR138	Monzonite	Strongly altered
M99HH015R	SAR139	Diorite porphyry	Strongly altered
M99HH017R	SAR139	Diorite porphyry	Strongly altered
M99MZ048R	SAR235	Granitic rock	Sil.-sericite
M99RK038R	SAR238	Monzonite	Strongly altered

As indicated in Figure II-3-30b, the granitic rocks plotted in the same area as the granitic rocks of Erdenet NW and SE deposits are SAR138, SAR139, SAR235 and Burged khyr prospects. Since the granitic rocks of these prospects may have the same mineralization capacity as that of granitic rocks of Erdenet NW and SE deposits, they should be noted as objects of future surveys.

(f) Erdenet Central (Mineral occurrence No. 41)

[Typical latitude and longitude]

48° 59' 51.5" north latitude, 104° 09' 27.5" east longitude

[Topography and vegetation]

Gentle hills are extended around the deposit where knee-high grass grows.

[Access]

It takes about 30 minutes to the prospect by driving from Erdenet city. It is accessible by car directly to the prospect.

[Preceding survey]

A detailed preceding survey was being conducted on the prospect and Erdenet NW deposit where mining is in progress. Geological survey, geochemical and geophysical surveys (airborne magnetic and resistivity surveys) and drilling were being conducted.

Erdenet NW deposit and this prospect is considered to be separated with a fault in the N-S direction, relatively uplifted for several hundred meters and deeper geological natures are exposed. Compared with Erdenet Northwest deposit, the prospect is in a smaller scale (ore reserve is one tenth or lower).

Only a small zone surface alteration is reported. The alteration is referred to as potassic alteration. The prospect has a dome structure similar to that of Erdenet Northwest deposit, and Erdenet Intrusive rocks consisting of fine-grained diorite and subvolcanic rocks are intruded into Selenge Complex.

Since denudation progressed more than in Erdenet NW deposit, no secondary copper-enriched

zone was found. With its average grade of 0.4 % Cu and 0.015 % Mo, ore mineral was considered as chalcopyrite and tennantite. The grade of silver was relatively high.

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

In SAR images, the prospect is expressed as a dark part. Resistivity is low and drainage system is not been developed. No lineament is extracted near the prospect. However, from a macroscopic point of view, the prospect is the intersection of lineaments in the N-W and N-S directions.

[Geology and geological structure]

Granitic rocks of Selenge Complex and diorite of Erdenet Intrusive rocks were distributed in the prospect. In addition, trachyte of post - Erdenet Intrusive rocks was identified.

[Mineral showing and alteration]

Intensively silicification and sericitization was recognized in part accompanying tourmaline. Silicified zone did not accompany any copper showing. Copper showing was identified as granite of Selenge Complex under potassic alteration and malachitic stain along cracks in Erdenet Intrusive rocks.

[Laboratory test]

Granite of Selenge Complex whose copper alteration was noted (M99RK029R, RK031M) and diorite of Erdenet Intrusive rock (M99RK032M) were analyzed and the results obtained were <0.005 - 0.01 g/t Au, <0.2 - 0.8 g/t Ag, 4,240 - 5,510 ppm Cu, 2 - 12 ppm Pb, <2 - 94 ppm Zn. The microscopic observation was conducted on M99RK030R and RK032R and generation of quartz, chlorite, epidote and sericite as the secondary mineral was identified.

[Evaluation]

As a result of our field survey, no acidic alteration zone or limonite to suggest existence of sulfide ores was identified. As resulted from preceding surveys, nothing was observed to suggest development of the secondary enrichment zone. Since basic survey was completed in this deposit and reserve of the primary ore was grasped with drilling, exploitation of this prospect will be progressed as a satellite deposit of Erdenet NW deposit.

(g) Tourmaline (Mineral occurrence No. 42)

[Typical latitude and longitude]

48° 56' 33.5" north latitude, 104° 17' 49.5" east longitude

[Topography and vegetation]

The prospect consists of hills and vegetation is scarcely found.

[Access]

The prospect is located at about 20 km to the southeast of Erdenet city. It is accessible to the

vicinity of the prospect about 40 minutes' drive by a vehicle.

[Preceding survey]

In 1985, geological survey with a scale of 1:25,000, trenching, geophysical and geochemical survey (magnetism and IP method) and 6 drill holes (depth: 142 - 270 m) were conducted.

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

In SAR images, the prospect is expressed as a dark gray part. Undulation is gentle with low resistivity. Drainage systems of NW-SE and NE-SW directions were developed.

[Geology and geological structure]

The prospect is located to the southeast of Erdenet NW deposit and on the extension of mineralized zone in the NW-SE direction. Diorite of the 1st period and granodiorite/syenite of the 2nd period of Selenge Complex were distributed, and a lot of andesite dikes in the NW-SE direction were intruded into them (see internal materials of the Mongolian side). As this prospect is named Tourmaline, it has a characteristic of being distinctively tourmalinized. Tourmaline was distributed centering on the area where syenite was distributed. Tourmaline shows in various conditions; some was like network of granitic rocks, and others constitutes a tourmaline-quartz vein or breccia dike.

[Mineral showing and alteration]

No characteristic mineralization or alteration was observed excluding tourmaline referred to above. Pyrite was found disseminated in granitic rocks in the disposed drilling core.

[Laboratory test]

As a result of chemical analysis on a rock sample of M99NK060, no distinctive anomaly was noted. Through microscopic observation, M99NK059 and M99NK061 were both weakly altered containing only a small amount of chlorite.

[Evaluation]

Since detailed surveys have been conducted on this place, no further survey will be necessary.

(h) Under (Mineral occurrence No. 43)

[Typical latitude and longitude]

48° 49' 57.2" north latitude, 104° 13' 19.6" east longitude

[Topography and vegetation]

The prospect is a mountainous zone where short grass and sparse forests grow.

[Access]

The prospect is located at 25 km in a straight line to the southeast of the center of Erdenet city. You should drive 15 km in the southeast direction, and then go southward along the valley. Park your

vehicle on the foot of the mountain of the investigated district, and walk a few hundred meters. Then you will reach the prospect.

[Preceding survey]

As preceding survey, geological survey on a scale of 1:200,000 in 1968, on a scale of 1:100,000, on a scale of 1:50,000 and geophysical survey were conducted.

IP anomaly was captured as a result of electric sounding, and anomaly in low value was captured as a result of magnetic prospecting.

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

The prospect is located in the trends in the NW-SE and N-S directions southward from Selenge River seen as a wide region. Sectionally, the prospect is expressed as a light gray part, separated into several blocks with multiple lineaments in the N-S and NW-SE directions. The prospect is 3 - 4 km to the east of a large fracture in the N-S direction.

[Geology and geological structure]

Andesite of Permian age was distributed in the western part of the investigated area. In the eastern part, granodiorite as intrusive rocks into the above was distributed. In the south of the area where granodiorite are distributed, outcrops and floats of quartz porphyry of late Permian to early Triassic ages were observed. This is assumed as a small-scaled stock, and is altered in part.

[Mineral showing and alteration]

Although most of granodiorite in the eastern part of the investigated district was unaltered, but gossan (quartz, limonite, sericite) was observed partly. Altered part of quartz porphyry was considered as sericitic alteration, and white or reddish acid altered zone (mainly floats) were also distributed. The secondary enrichment zone may exist in the lower part.

[Laboratory test]

As result of whole-rock analysis, granodiorite (M99MZ036R) of Selenge Complex and quartz porphyry of Erdenet Intrusive rocks were considered as calc-alkaline series.

As assay results of rock samples (M99MZ037R and M99MZ038R), no distinctive anomaly was noted.

[Evaluation]

Andesite was intruded into Granodiorite, diorite and syenite of Selenge Complex, which were intruded with quartz porphyry of Erdenet Intrusive rocks. Quartz porphyry was assumed as a small-scaled stock that was sericitized in parts. White or reddish acid altered zone was also distributed. Although no mineral showing was observed on the surface, in view of such geological environment, the secondary enrichment zone of porphyry copper deposit may possibly exist in the deeper part. To grasp the scales of stocks and alteration zone, further survey should be conducted.

(i) Shand (Mineral occurrence No. 44)

[Typical latitude and longitude]

48° 45' 39.5" north latitude, 104° 11' 45.8" east longitude

[Topography and vegetation]

The prospect consists of hills and low mountains. Short grass grows on the hill, and sparse forests are distributed on low mountains.

[Access]

It is accessible by car. From Erdenet city, it is possible to arrive at the prospect by driving approximately for one hour and a half.

[Preceding survey]

In 1967, geological survey on a scale of 1:200,000, as well as geochemical and geophysical surveys were conducted. Afterwards, geological and geochemical survey was repeated on a scale of 1:25,000.

Approximately 60% of the surface was covered with Quaternary sediments, and small amounts of volcanic rocks of Permian to Triassic ages were distributed. Especially in the northern part, sandstone and conglomerate of Triassic to Jurassic ages were distributed. In the central part, Selenge Complex (1st stage: diorite, 2nd stage: granodiorite and trachyte) and granodiorite of Triassic to early Jurassic age were intruded, corresponding to Erdenet Complex. A dominant structure was a fault in the NW-SE direction, and intrusive rocks compared to Erdenet Intrusive rocks were intruded into the intersection of faults.

In the prospect, both geochemical and geophysical anomaly areas were overlapped. On the altered land surface, quartzite, sericite and potassium feldspar were noted. 3-hole drilling was conducted for a drilling depth of 150 to 200 m, and mineral showings were captured which suggests dikes or porphyry type mineralization. The ore body existed in a deeper part. Concerning ore types of Cu and Mo to be mined, it was calculated as P1 ore body (1,000 m × 550 m). Copper reserve was 500,000t and grade was 0.2 % Cu. Molybdenum reserve was 5,000t and grade was 0.001 % Mo.

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

In SAR image, the prospect is expressed as both dark and bright parts. Small-scaled drainage systems are distinctively developed at the intersection of lineaments in the NW-SE and N-S directions.

[Geology and geological structure]

Granite and granodiorite containing abundant amount of biotite in Selenge Complex were distributed, into which small dikes of fine-grained diorite and porphyritic andesite were intruded.

[Mineral showing and alteration]

Granite was under weak potassic alteration. Malachite and azurite were identified along cracks. The land surface where ore body of the deposit was considered to exist was covered with Quaternary



sediments. Therefore, it was impossible to survey.

[Laboratory test]

Granite with mineral showing (M99RK039M) was analyzed. The results were 0.05 g/t Au, 2.2 g/t Ag, 9,490 ppm Cu, 198 ppm Pb and 130 ppm Zn.

[Evaluation]

In this prospect, ore reserves were roughly determined through drilling. Since the land surface was covered with sediments of the Quaternary and no exposure was noted, and the basic survey was completed also in the vicinity of the deposit, no successive survey will be necessary.

(j) Erdenet SE (Oyut) (Mineral occurrence No. 45)

[Typical latitude and longitude]

48° 57' 43.2" north latitude, 104° 11' 52.3" east longitude

[Topography and vegetation]

The prospect consists of hills. Only short grass grows on the steppe.

[Access]

The point near the site is accessible from Erdenet city by driving on unpaved roads.

[Preceding survey]

From 1964 to 1965, geological survey on a scale of 1:10,000, as well as geochemical and geophysical explorations was conducted. In 1970, 9-hole trial drilling and trenching were conducted on high IP and low magnetism anomaly and existence of a deposit was grasped as the result. Trial calculation was conducted based on copper cut-off grade of 0.4% that was same as the copper cut-off grade of Eldenet NW deposit under exploitation at that time. It was determined that the amount of ore reserves was too small. Reevaluation was conducted from 1984 to 1987 based on copper cut-off grade of 0.2 % or 0.3 % together with 32 drill holes of 11,000 m in total. As a result, the ore reserves grasped were 1,000,000 t Cu, with the average copper grade of 0.35%, 15,000 t Mo. From upper to lower, the parts were found to consist of oxidized zone in thickness of 60m, the secondary enrichment zone of chalcocite and azurite in thickness of 5-6m, and the primary mineralized zone of chalcopyrite. No development plan is established on this deposit and the deposit is dormant at present.

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

In SAR images, the prospect is expressed in dark gray tone, flat with little undulation and low resistivity. Drainage system is developed only to a small extent, and existence of the drainage system is not identifiable in SAR images. Lineament like a circular structure was noted.

[Geology and geological structure]

Granodiorite considered as Selenge Complex and an intrusive rock of granodiorite porphyry of

Erdenet Intrusive rocks were distributed. Andesite, syenite, diorite and microdiorite as intrusive rocks post mineralization were distributed.

[Mineral showing and alteration]

Granodiorite porphyry of Erdenet Intrusive rocks was sericited to various extents, and copper oxide was found in some parts along the crack. Leaching noted in other parts was considered as kaoline. In the leached zone, limonite and hematite were identified along the crack. Since the land surface was an oxide-leached zone, no distinctive mineralization was identified. In the core of drilling disposed at the site, the primary ore was observed where chalcopyrite was disseminated in granodiorite. No hydrothermal alteration was recognized in Selenge Complex.

[Laboratory test]

While Selenge Complex (M99MZ044R) indicated +3.3 ‰ as whole-rock sulfur isotope composition, mineralized Erdenet Intrusive rocks (M99MZ041R) showed -4.8 ‰. Interpretation of the measured content and petrologic-chemical characteristics are stated in the section of Erdenet NW. As a result of microscopic observation, M99MZ043R and M99MZ044R were judged as relatively unaltered. However, chemical analysis result revealed the character of high copper content of 385 - 500 ppm.

[Evaluation]

Ore reserves of this deposit were already calculated through sufficient trial drillings. When excavation of Erdenet NW deposit is completed, a development plan will be settled in accordance with the current copper price. Therefore, no survey to find a new deposit will be necessary.

(k) Zалу (Mineral occurrence No. 46)

[Typical latitude and longitude]

48° 54' 50.0" north latitude, 103° 55' 50.3" east longitude

[Topography and vegetation]

In the area where volcanic rocks are distributed, a steep precipice is formed, and in the area where granitic rocks are distributed, a hill is formed. Trees are found to grow on the northern slope and the southern slope is a steppe.

[Access]

The prospect is located 20 km southwest to Erdenet city. It takes an hour to go there by car from the city.

[Preceding survey]

From 1982 to 1983, geological survey on a scale of 1:25,000, as well as geochemical survey and geophysical survey (MT and IP method) were conducted, and slight anomaly of Cu, Pb, Zn, Mo and Au were captured. From point samples, 0.5 - 1 % Cu, 0.01 % Mo and 0.01 % Bi were recorded.

[Features on SAR image] (SAR image unit: “Bulgan”)

In SAR images, the prospect is expressed in dark color. Resistivity is low and drainage system is scarcely developed.

[Geology and geological structure]

Reddish granitic rocks of Selenge Complex and andesitic volcanic rocks of Triassic to Jurassic ages younger than Hanoi Super Group that covered the reddish granitic rocks were distributed. Erdenet Intrusive rocks were in small scales. Fault groups of N-S and NW-SE directions were developed.

[Mineral showing and alteration]

According to Mongolian materials, hydrothermal alteration zone was developed consisting of quartz, sericite and chlorite. However, in our survey of this time, it was impossible to confirm their existence. A quartz-epidote vein in width of several centimeters was found in andesite and monzonite porphyry of Erdenet Intrusive rocks. However no mineralization was observed.

[Laboratory test]

Rock sample (M99KN067R) was unaltered, olivine bearing basalt. The result of dating by K-Ar method using M99KN067R showed  $195 \pm 4$  Ma, which indicated Jurassic age.

[Evaluation]

In view of the facts that no distinctive alteration on the surface was observed on the existence of Erdenet Intrusive rocks and that few anomaly was observed as a result of geochemical survey conducted by the Mongolia side, it is judged that there is little possibility for porphyry deposit in the vicinity of the prospect.

(1) Danbatseren (Mineral occurrence No. 47)

[Typical latitude and longitude]

48° 50′ 06.0″ north latitude, 103° 48′ 13.4″ east longitude

[Topography and vegetation]

The prospect constitutes a gentle hill, and the mountaintop consists of silicified rocks.

[Access]

The prospect is located at 25 km southeast to Erdenet city. It takes approximately an hour and twenty minutes by car from the city.

[Preceding survey]

From 1982 to 1983, geological survey on a scale of 1:25,000 as well as geochemical explorations and geophysical survey (MT and IP method) were conducted. Slight anomaly of Cu, Pb, Zn, Mo and

Au were obtained.

[Features on SAR image] (SAR image unit: “Bulgan”)

The prospect is expressed in dark color in SAR images. With low resistivity, drainage system is hardly developed. Lineament in the NNE-SSW direction exists in the vicinity.

[Geology and geological structure]

The prospect consists of Selenge Complex (1st and 2nd stages) and dacite of Jurassic age. No distribution of Erdenet Intrusive rocks was found. Approximately 50 % of the prospect and its vicinity were covered with alluvium and its outcrops were found in the valley and on the mountaintop.

[Mineral showing and alteration]

The mountaintop at 48° 51′ 39.9″ north latitude and 103° 47′ 16.5″ east longitude consists of silicified dacite. Some of the silicified rocks had many quartz veinlets filling the shattering part, and leached textures were found in other silicified rocks which accompany quartz, tourmaline, hematite and limonite.

[Laboratory test]

Through microscopic observation, rock sample M99NK070R was found almost completely replaced by secondary quartz and no texture of source rock remained. As results of the powdery X-ray diffraction conducted on M99NK072R, sampled from the trench drilled at the col of the mountaintop among silicified rocks, the sample was found to consist of quartz, potassium feldspar, sericite, pyrophyllite, kaoline and andal-site. No conspicuous anomaly was detected as a result of chemical analysis on M99NK070R (dacite) and M99NK071R (quartz - tourmaline - pyrite vein).

[Evaluation]

What had been referred to as “liparite distributed on the mountaintop” was clarified as silicified rocks but its source rock was unknown. In view of the fact that existence of pyrophyllite and andalusite was identified in the trench (stable in acid environment at a relatively high temperature) in addition to neutral alteration mineral, a relatively deep part of lithocap (advanced argillic alteration) of a porphyry deposit may have been observed. Although no distinctive anomaly was captured as a result of geochemical survey conducted on the side of Mongolia, successive survey should be conducted.

(m) SAR127 Point

[Typical latitude and longitude]

49° 20′ 07.1″ north latitude, 104° 09′ 57.3″ east longitude

[Topography and vegetation]

The point constitutes a low mountain with sparse forest of conifers.

[Access]

It takes approximately an hour and half by car to reach the vicinity of the point from Erdenet city and then approximately an hour on foot to the point.

[Preceding survey]

As results of analysis, 0.12 % Cu and 0.003 % Mo were obtained. The alteration zone was reported to have a scale of 500 m × 400 m.

[Features on SAR image] (SAR image unit: “Ingetolgoy”)

In SAR images, the point is expressed as a bright part. It consists of a ridge in the N-S direction. Lineaments in NW-SE to N-S directions are close together. Also in the existing geological map with on a scale of 1:500,000, faults in the NW-SE and NE-SW directions are close together in granitic rocks of Selenge Complex.

[Geology and geological structure]

Granodiorite in coarse and equal-grain were distributed as compared to Selenge Complex.

[Mineral showing and alteration]

No alteration or mineral showing was identified.

[Laboratory test]

The microscopic observation and whole-rock analysis were conducted on sample M99RK044R.

[Evaluation]

No further survey will be necessary since alteration or mineral showing was not found at all.

(n) SAR 136 point

[Typical latitude and longitude]

49° 13′ 32.6″ north latitude, 104° 01′ 23.1″ east longitude

[Topography and vegetation]

The prospect constitutes a low mountain and the valley in the N-S direction is developed to the east of the investigated point. Tall grass grows in the valley and sparse forest of bush grows on the ridge.

[Access]

It takes approximately two hours by driving along the road from Erdenet city northward to reach the vicinity of the investigated point, from where approximately an hour walk is necessary to arrive at the point.

[Preceding survey]

Analysis values as reported were 0.2 % Cu, 0.02 % Mo and 0.01 % Zn. It was also reported that an alteration zone existed in a scale of 4,000 m × 500-1,000 m.

[Features on SAR image] (SAR image unit: “Ingettolgoy”)

In SAR images, the point was expressed as a bright part. Lineaments intersected one another in the area with their high density.

[Geology and geological structure]

Granite in coarse-grain as compared to Selenge Complex were distributed with a small-scaled aplite dike intruded into it.

[Mineral showing and alteration]

No alteration or mineral showing was found.

[Laboratory test]

As assay results of aplite (M99RK027R), Au/Ag (below limits of detection), 108 ppm Cu, 4 ppm Pb and 4 ppm Zn were obtained.

[Evaluation]

Since no alteration or mineral showing was observed, successive survey will not be necessary.

(o) SAR138 point

[Typical latitude and longitude]

49° 13′ 01.4″ north latitude, 104° 29′ 00.9″ east longitude

[Topography and vegetation]

The point constitutes a gentle hill. Granitic rocks are exposed on the mountaintop and a precipice is formed in some part.

[Access]

The point is located at approximately 40 km northeast to Erdenet city. It takes approximately one hour and a half by car to reach the point.

[Preceding survey]

The assay result as report was 0.6 % Cu. It was also reported that an altered zone existed in a scale of 1,500 × 50 - 70 m.

[Features on SAR image] (SAR image unit: “Ingettolgoy”)

In SAR image, the point is expressed in dark to gray color. Resistivity is relatively high with a sharp ridge. An arborescent drainage system is developed. Lineament in the NW-SE direction is

also found. The point is situated at the place where a straight valley in width of several hundred meters extending in the N30° W direction which was extracted as a lineament and a small-scaled, linear valley cross each other at right angles.

[Geology and geological structure]

The point consists of reddish granites in coarse-grain of Selenge Complex.

[Mineral showing and alteration]

Small amount of malachite scattered in granite.

[Laboratory test]

As an assay result of a rock sample (M99NK048M), only 1,560 ppm Cu was obtained.

[Evaluation]

Selenge Complex alone was distributed in the vicinity of this prospect. Only small-scaled mineral showings were observed and analysis values were low. However, since a petrological examination revealed a possibility of its mineralization potential, a survey on the prospect including its vicinity should be examined.

(P) SAR139 point

[Typical latitude and longitude]

49° 13' 07.7" east latitude, 104° 36' 40.1" east longitude

[Topography and vegetation]

The point constitutes a gentle mountain. On the mountaintop, granitic rocks are exposed and a precipice is formed in some part. Although it mostly consists of steppes, forests are formed on some part of the northern slope.

[Access]

The point is located at 40 km to the east-northeast of Erdenet city. It takes approximately two hours and a half by car from the city. The road to reach there by way of SAR138 point is not in a good condition because of debris on the ridge and swamp in the low land.

[Preceding survey]

The assay result as report was 1.1 % Cu. It was also reported that an altered zone existed in a scale of 40 m × 0.5 m.

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

The point is expressed in dark to gray color in SAR images. Resistivity is relatively high, indicating a steep ridge. An arborescent drainage system is developed, and lineament in the NW-SE direction is also noted.

#### [Geology and geological structure]

The point is located at an intersection where a straight valley in width of several hundred meters extending in the N30° W direction which was extracted as a lineament and a small-scaled, linear valley cross each other at right angles. A steep and upright precipice exists in the former clearly suggesting the existence of a fault. The point consists of granitic rocks of Selenge Complex and a basalt dike intruded into it. In particular, the basalt dike was found distinctively, developed.

#### [Mineral showing and alteration]

Quartz - epidote veins were found in the investigated area. At a point of 49° 13' 07.7" of the north latitude and 104° 36' 40.1" of the east longitude, two trenches were excavated for about 50 m in total in the N80° E direction. Altered basalts were in the trenches with matrix on the whole and malachite along the crack.

In the center of trenches, strongly silicification, epidote, malachite and limonite were found in the length of approximately 5 m, presenting a so-called gossan state. Also in the trenches, hydrothermal breccia of an extreme small amount as matrix was found with granodiorite and plagioclase basalt as main constituent crusts.

#### [Laboratory test]

Through microscopic observation, rock samples (M99NK051R, M99NK054R, M99HH015R, M99HH017R and M99HH018R) were found to bear various lithofacies of plutonic and sub-plutonic rocks or gabbro, quartz diorite porphyry, quartz diorite and granodiorite. All the samples altered by hydrothermal fluid, and the primary mineral was replaced with epidote, chlorite, quartz and iron mineral. On the other hand, basalt dikes were fresh in general excluding the part near trenches found with copper mineralization, rock samples M99NK052R was aphyric alkaline basalt, and was not altered. Dating of K-Ar age was conducted on this sample, and as a result it was found to indicate the age of  $282.6 \pm 6$ Ma.

On the other hand, malachite and chalcopyrite were disseminated in basalt found in trenches. Microscopic observation also revealed strong alteration and a lot of chlorite, epidote, oxide iron mineral, biotite and clay mineral were found as the secondary mineral.

#### [Evaluation]

As stated above, the part near trenches at this point was on the mountain foot with little exposure. Although the degrees of mineralized and alteration zones were unknown, trace of hydrothermal process with sediments of metal ores was suggested from the existence of hydrothermal alteration and breccia. From petrological examination, there is a high possibility that granitic rocks distributed in this prospect may have mineralization potential. Therefore, that successive surveys should be conducted in the future taking porphyry copper deposits into consideration.



(q) SAR144 point

[Typical latitude and longitude]

49° 11' 16.8" north latitude, 104° 02' 14.4" east longitude

[Topography and vegetation]

The point constitutes a relatively gentle mountainous district where steppes and conifer forests exist alternately.

[Access]

The point is located at about 20 km to the north of Erdenet city. It takes approximately an hour and a half by car from the city to reach the point.

[Preceding survey]

The assay result as report was 1.179 % Cu. The scale of altered zone was not reported.

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

In SAR image, the point is expressed in gray color. An arborescent drainage system is found. Lineaments in the N10° E and N75° W directions intersect each other near the point.

[Geology and geological structure]

Granite and granodiorite of Selenge Complex were distributed.

[Mineral showing and alteration]

In a cutting beside the road, basalt dikes of several 10 cm - 1m wide were intruded into granite for about 30 m in the NNE-SSW direction. Narrow quartz veins in a width of 2 - 3 cm were developed. Epidotization and silicification were noted in the granite near the quartz vein. Malachite were disseminated and scattered in the cracks of granite and matrix.

[Laboratory test]

As a result of analysis on a rock sample M99RK025M (dissemination of malachite), 2.02 % Cu was obtained.

[Evaluation]

Since slight dissemination of malachite was noted in granite, it will not be worth conducting further survey.

(r) SAR169 point

[Typical latitude and longitude]

48° 59' 45.0" north latitude, 104° 23' 20.0" of the east longitude

[Topography and vegetation]

The point is a low mountain where sparse forests are distributed.

[Access]

It takes about an hour by vehicle to reach the vicinity of the point investigated from Erdenet, and then approximately two hours' walk to the point.

[Preceding survey]

Analysis value of 0.1 % Cu was obtained. However, nothing was referred to concerning the extent of alteration zones.

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

In SAR images, the point investigated is expressed as bright and dark parts. Existence of small-scaled swamps is identified on the images. Lineament in the NW-SE direction was extracted.

[Geology and geological structure]

Some float rocks of granitoid and volcanic rocks were distributed.

[Mineral showing and alteration]

No mineralization and alteration were found.

[Laboratory test]

No sample for laboratory tests was extracted.

[Evaluation]

Although it was impossible to reach the mountaintop of the point because of limited time, floats on the slope were surveyed. The floats existed were granitic and volcanic rocks. However, no alteration or mineral showing was observed. Therefore, it will not be worth conducting further survey.

(s) SAR188 Point

[Typical latitude and longitude]

48° 53' 02.3" north latitude, 104° 22' 54.7" east longitude

[Topography and vegetation]

The point is a gentle mountainous district. Trees scarcely grow in the steppe.

[Access]

The point is located at approximately 30 km to the southeast of Erdenet city. It takes about an hour by car to reach the point from the city.

[Preceding survey]

The assay result as report was 0.06 % Cu. It was also reported that an altered zone existed in a scale of 3 m × 5 m.

[Features on SAR image] (SAR image unit: “Bulgan”)

In SAR images the investigated point is expressed in light gray color with relatively high resistivity. Lineament in the NW-SE direction extends from Erdenet deposit and a small-scaled lineament crossing each other at right angles are developed.

[Geology and geological structure]

The investigated point consists of granitic rocks and basalt dike of Selenge Complex, as well as volcanic rocks of syenitic andesite of Mogod Formation covering the above rocks of Selenge Complex.

[Mineral showing and alteration]

Except for epidotization in the vicinity of basalt dikes in granite, no other alteration was noted.

[Laboratory test]

Microscopic observation of rock sample (M99NK063R) revealed that the rock was adamellite and that parts of hornblende and biotite altered to chlorite and oxide iron ores.

[Evaluation]

Since mineralization or alteration was hardly observed, it will not worth conducting any further survey.

(t) SAR200 Point

[Typical latitude and longitude]

48° 51′ 16.0″ north latitude, 104° 26′ 56.1″ east longitude

[Topography and vegetation]

The point is a mountainous area steeper than a hill, and short grass grows in the steppe.

[Access]

The point is situated at 37 km in a straight line to the southeast of the center of Erdenet city. It takes the point by driving on a road from Erdenet city southeastward, by turning into a side road on the way and riding as far as possible by a vehicle, and then on foot for 3.5 km in a straight line. Because of intensive undulation of the straight course, it is more efficient to detour along a swamp. Walking for an hour and a half is necessary to reach the point.

[Preceding survey]

As the previous survey, Geological survey on a scale of 1:200,000 (Report No. 1813),

Geophysical survey (Report No. 4240) were conducted.

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

As a wide area, the point is located in the trends of the NW-SE and N-S directions southward from Selenge River. Sectionally, response in a bright gray form like a ridge in the NNW-SSE direction was noted. It was in parallel with a swamp extending southeastward from Erdenet city. To the south of the convex, lineaments in the N-S, NE-SW and NNE-SSW directions, in bright gray line which are considered to represent swamps or ridges, are found.

[Geology and geological structure]

The point was relatively steep, with a ridge and valley dominant in the NW-SE direction. Granite and aplite were distributed there.

[Mineral showing and alteration]

Dominant quartz vein were observed in dikes (for example, 20 cm long and 2m wide, strike in the N2° W) or a place of pods for aplitic rocks.

[Laboratory test]

As assay results of aplite (M99RK033R) and pan concentrated stream sediments (M99RK503P), geochemical anomaly was not recognized.

[Evaluation]

Although the point is under control of a large structure line in the NW-SE direction, it accompanied no mineral showing or alteration. Therefore, mineralizing potential there is judged as low.

(u) SAR233 Point

[Typical latitude and longitude]

48° 43' 40.2" north latitude, 103° 56' 33.7" east longitude

[Topography and vegetation]

The point consists of hills and low mountains where short grass mainly grows.

[Access]

The point is approximately 70 km from Erdenet city, and it takes two hours by car to reach there. After passing through Erdenet city, the road in the steppe is unpaved.

[Preceding survey]

Analysis results obtained were 0.75 % Cu and 1.1 % W. Altered zone was reported as having a scale of 20 m × 30 m.

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

In SAR image, the point is expressed as a dark portion in a bright part. Resistivity is low. Since a ridge with good continuity is suddenly cut and concavity or flat land appeared, existence of argillized zone may be expected.

[Geology and geological structure]

Granite and dacite considered as of Palaeozoic era were distributed.

[Mineral showing and alteration]

In the area where dacite was distributed, hydrothermal breccia extended in the E-W direction in the width of approximately 15 m. Silicification was identified in its vicinity. Strongly silicified rocks were identified also in the southwestern part of the district, accompanying a little amount of green material.

[Laboratory test]

Whole-rock analysis was conducted on silicified rock and hydrothermal breccia (M99MZ045R and MZ046R), and results were 0.5 g/t Ag, 2.5 ppm and 5.0 ppm Cu, 5 ppm and 10 ppm Pb and 45 ppm and 50 ppm Zn. Also, chemical assay was conducted on silicified rock (M99RK041R), and the results were Au/Ag (below the limit of detection), 113 ppm Cu, 40 ppm Pb and 10 ppm Zn.

[Evaluation]

The mineral showing suggesting predominant hydrothermal activities of hydrothermal breccia, etc. were identified. However, since no distinctive geochemical anomaly was observed, mineralization potential of the place was considered as low.

(v) SAR235 Point

[Typical latitude and longitude]

48° 46' 17.1" north latitude, 104° 04' 34.6" east longitude

[Topography and vegetation]

The point is a hill where short grass alone grows.

[Access]

After driving southward on an unpaved road in a vehicle and then driving on a branch road, it takes the vicinity of the site.

[Preceding survey]

Although the point was referred to as a prospect in the past, details of such statement is unknown.

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

The point is expressed in gray color in SAR image. Undulation is small and full of variety, and

the degree of resistivity is medium to high. Drainage system is developed also in medium to high degrees, and its distribution is rather in parallel.

[Geology and geological structure]

Granite considered as of the Palaeozoic and andesite dikes were distributed as intrusive rocks. Granitic rocks were mainly granite in coarse-grain in light reddish color sectionally accompanying pegmatitic and aplitic lithofacies. In addition, granodiorite in medium grains were distributed in the western side of the granite. Andesite dike in a width of approximately 10 m was intruded in the N55° E direction.

[Mineral showing and alteration]

Granite and granodiorite were weakly sericitized and chloritized in parts with limonite and a little amount of pyrite being disseminated.

[Laboratory test]

Chemical analysis was conducted on altered rock (M99MZ047, M99MZ048 and M99RK043). The results were 10 ppm Cu or lower.

[Evaluation]

Weak hydrothermal alteration was only sectionally identified and copper content was extremely low. However, in view of the petrological characteristics stated in the section of Erdenet NW deposit, granitic rocks in this point may have some mineralization potential. Therefore, this point should be subject to a basic survey in the future.

(W) SAR238 Point

[Typical latitude and longitude]

48° 44' 30.0" north latitude, 104° 11' 00.0" east longitude

[Topography and vegetation]

The point is a gentle mountainous district forming a steppe. Granite is exposed on the hilltop.

[Access]

The point is located at approximately 30 km to the south of Erdenet city. It takes approximately an hour from the city to reach there by vehicle.

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

In SAR images the point investigated is expressed in dark gray to gray color. Resistivity was medium. The main lineament in the N-S direction and a small arborescent drainage system crossing each other at right angles are conspicuous.

[Geology and geological structure]

The investigated point consists of granite and granodiorite in the 2nd stage of Selenge Complex.

[Mineral showing and alteration]

Quartz - epidote veinlets were rarely recognized in granitic rocks.

[Laboratory test]

No sample for laboratory test was extracted.

[Evaluation]

Since mineralization or alteration was hardly noted, it will be worthless to conduct further explorations.

(x) SAR239 Point

[Typical latitude and longitude]

48° 44' 57.3" north latitude, 104° 12' 29.9" east longitude

[Topography and vegetation]

The point investigated consists of gentle hills where short grass grows. Bush grows in the valley.

[Access]

It takes approximately an hour and half by car from Erdenet city to the vicinity of the point investigated.

[Preceding survey]

Analysis results were 1.0 % Cu and 0.007 % Mo. No statement on the scale of alteration zones exists.

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

In SAR images, the point is expressed as a dark part with low resistivity. Lineaments in the NW and N-S directions cross each other.

[Geology and geological structure]

The point consists of granite and aplite in coarse grains and equal grains corresponding to Selenge Complex.

[Mineral showing and alteration]

No alteration or mineral showing was observed.

[Laboratory test]

The microscopic observation of thin section and modal analysis were conducted on unaltered aplite (M99NK065R).

[Evaluation]

Since no alteration or mineral showing was observed, no further survey will be necessary.

(Y) SAR25 Point

[Typical latitude and longitude]

49° 15′ 46.8″ north latitude, 103° 55′ 23.9″ east longitude

[Topography and vegetation]

The point constitutes a hill and a steppe where short grass grows.

[Access]

The point investigated is located at 25 km in a straight line from the center of Erdenet city. The vicinity of the very point is accessible by a vehicle by going along with the road in NNE direction from Erdenet city.

[Preceding survey]

As past survey, Geological survey on a scale of 1:200,000 (Report No. 1813), geophysical survey (Report No. 4240) were conducted.

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

Seen in a wide range, the point investigated is located in the trends of NW-SE and N-S directions. Precisely, it is located in a zone of bright gray response in a width of 30 km along Selenge River. As a large structure, the point corresponds to the place where a lineament in the NNW-SSE direction (valley) and a lineament in the NWW-SEE direction (valley) meet each other. As smaller structures, several lineaments in the N-S direction are noted in the periphery.

[Geology and geological structure]

Granite of Permian age, coarse-grain having a diameter of 2 mm consist of quartz, potassium feldspar, biotite and hornblendite, was distributed. In the outcrop, xenolith of andesite, extended in the direction of N10° W, was observed. Microgranodiorite was distributed on the hill 2.6 km to the southeast from there.

[Mineral showing and alteration]

The cavities of pulling out pyrite was identified.

[Laboratory test]

Chemical assay was conducted on granite (M99MZ024R) and microdiorite (M99MZ025R). As the results, remarkable geochemical anomaly was not recognized.



### 3.2.11 Bulgan district

#### (1) Outline of the district

Figure II-3-31 shows the geology of Bulgan district, and Figure II-3-32 shows the location of sampling points.

#### (a) Location

The district is in a scope of 40 m<sup>2</sup> including Bulgan city, and is 35 km wide north to south and 45 km long east to west around 103° 30' east longitude and 48° 45' north latitude.

#### (b) Topography and vegetation

The district is 1,500 - 2,000 m above the sea level consisting of hills in the N-S or NW-SE direction. Most of the low land and hills are steppes where short grass is dominant. Forests are developed in some place in higher level above the sea.

#### (c) Infrastructure and access

In the scope of our survey, roads were developed relatively well in Bulgan and its vicinity. Since unsteep places were included, access to the district was rather easy. Bulgan with its population of 13,000 is the second largest city next to Erdenet. Infrastructure including hospitals was well arranged. There was no other city, town or village like Bulgan with respect to the infrastructure.

#### (d) Outline of geology and deposits

In SAR images, the district is located in the trends of the NW-SE and N-S directions of the Selenge River southward. In the trends, the district ranged from a zone where light gray response in a width of 30 km to a zone in its south where dark to dark gray response was dominant. As to lineaments, those in the N-S, NNW-SSE and NW-SE directions are dominant.

In the place where volcanic rocks of Permian age (trachy andesite, trachy basalt, trachy dacite, trachy rhyolite and sedimentary rocks bearing sandstone, conglomerate, etc. in part), granitic rocks of late Permian age (mongonite, syenite, graniorite and granite) and granitic rocks of early to late Jurassic age (granite and granodiorite) were intruded. In the northeast part of the district, volcanic rocks of early to late Jurassic age were widely distributed. However, they were distributed only in a small number of areas.

Volcanic rocks were extended in a trend in the NW-SE direction, and intrusive rocks of late Permian period were also distributed in the NW-SE direction. Dominant faults were in the NNW-SSE and NWW-SEE directions. The river runs in the NW-SE direction.

#### (e) Reason for selection

The district is located at approximately 40 km to the southwest of Erdenet. Its geological structure is similar to that of Erdenet district. The age of its igneous activity was almost the same as that of Erdenet district, and similar volcanic rocks and plutonic rocks were distributed. Because of many known prospects bearing copper, the district was judged as next to Erdenet district in view of its high potential.

E103°30'

# Bulgan

## LEGEND

Survey region

Survey point

Contour line

River

Lake

### Sedimentary and volcanic rocks

- Quaternary
- Tercialy
- Jurassic-Cretaceous
- Permian-Triassic
- Silurian-Carboniferous
- Cambrian-Ordovician
- Precambrian

### Plutonic rocks

- Triassic-Jurassic
- Permian
- Devonian-Carboniferous
- Cambrian-Ordovician
- Precambrian

Fault

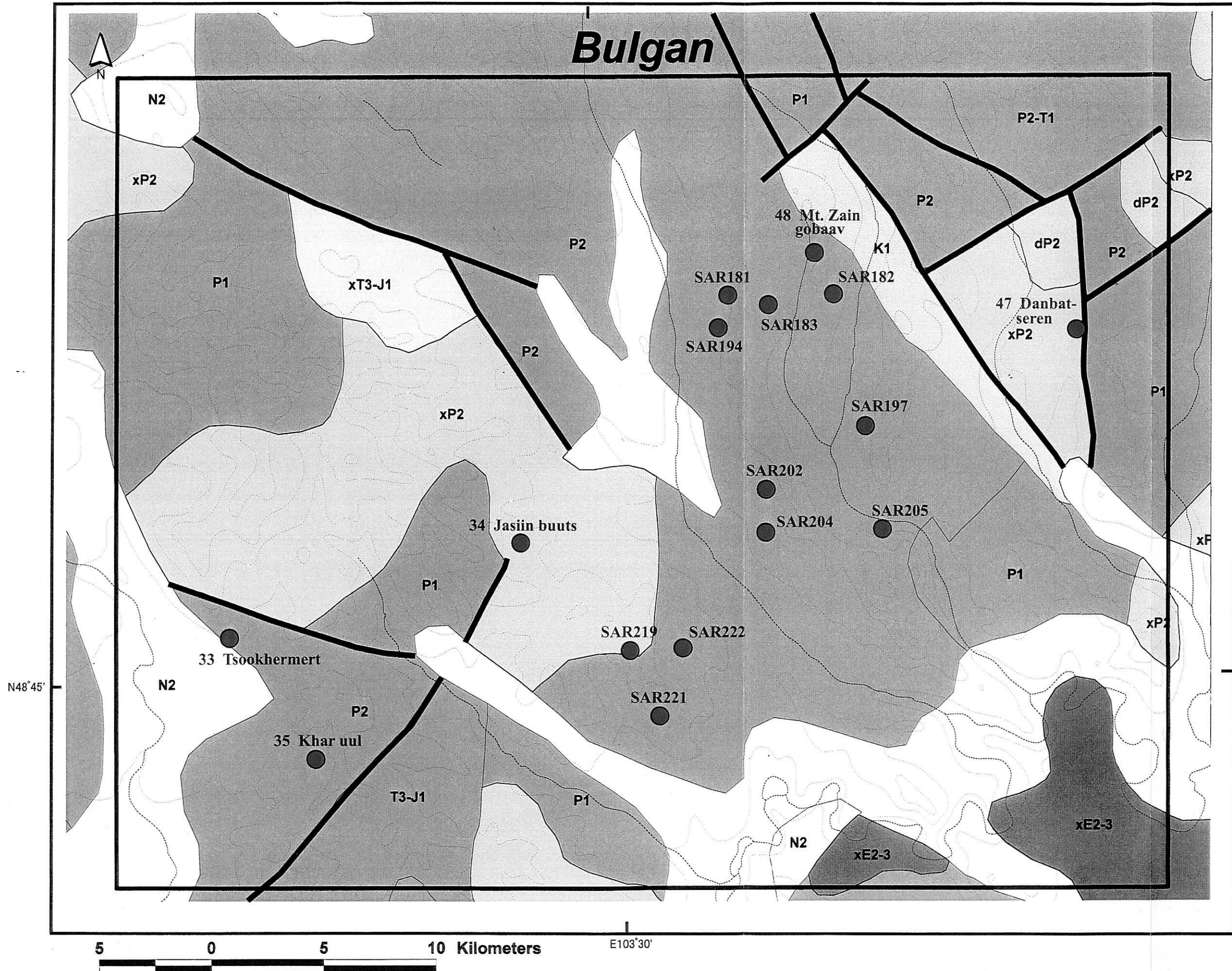


Fig. II-3-31 Geological map of Bulgan region

E103°30'

# Bulgan

1818.81

## LEGEND



Survey region



Pan concentrated sample



Rock or Ore sample

M99NK001R Sample Number

1000

Altitude (m)



Contour line



River



Lake

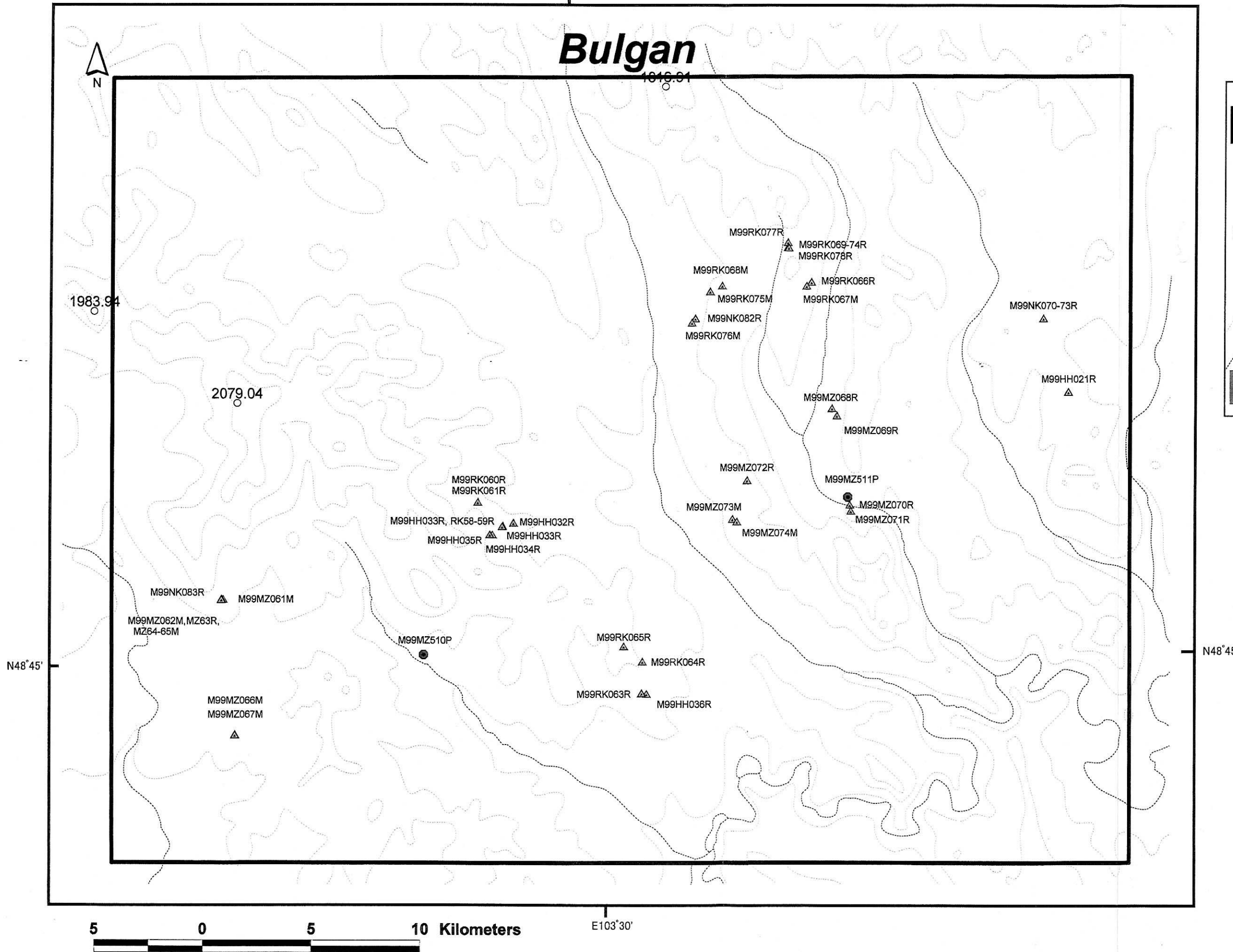


Fig. II-3-32 Sample locations of Bulgan region

## (2) Survey result

### (a) Tsookher mert (Mineral occurrence No. 33)

#### [Typical latitude and longitude]

48° 45' 28.1" north latitude, 103° 16' 00.9" east longitude

#### [Topography and vegetation]

The prospect is a mountainous district, and only short grass grows in the steppe.

#### [Access]

By driving in a vehicle on an unpaved road from Bulgan city westward to Sayhan and then on a branch road, it takes the vicinity of the prospect.

#### [Preceding survey]

In 1986, geological survey on a scale of 1:50,000, trenching, electric sounding, etc. were conducted. Existence of quartz veins with gold and copper showing was identified in granitic rocks of Selenge Complex. Four quartz veins were distributed and their scales were reported to be 100 - 700 m in total length and 0.5 - 2 m in width. Copper ores consist of chalcopyrite, malachite and azurite, and 0.02-0.3 % Cu, 3-10 g/t Au and 20-500 g/t Ag were reported. Khawtsgait and Suuder tolgoin prospects were known, existing to the east of this prospect, and gold grade of the latter was reported as 9.1 g/t.

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

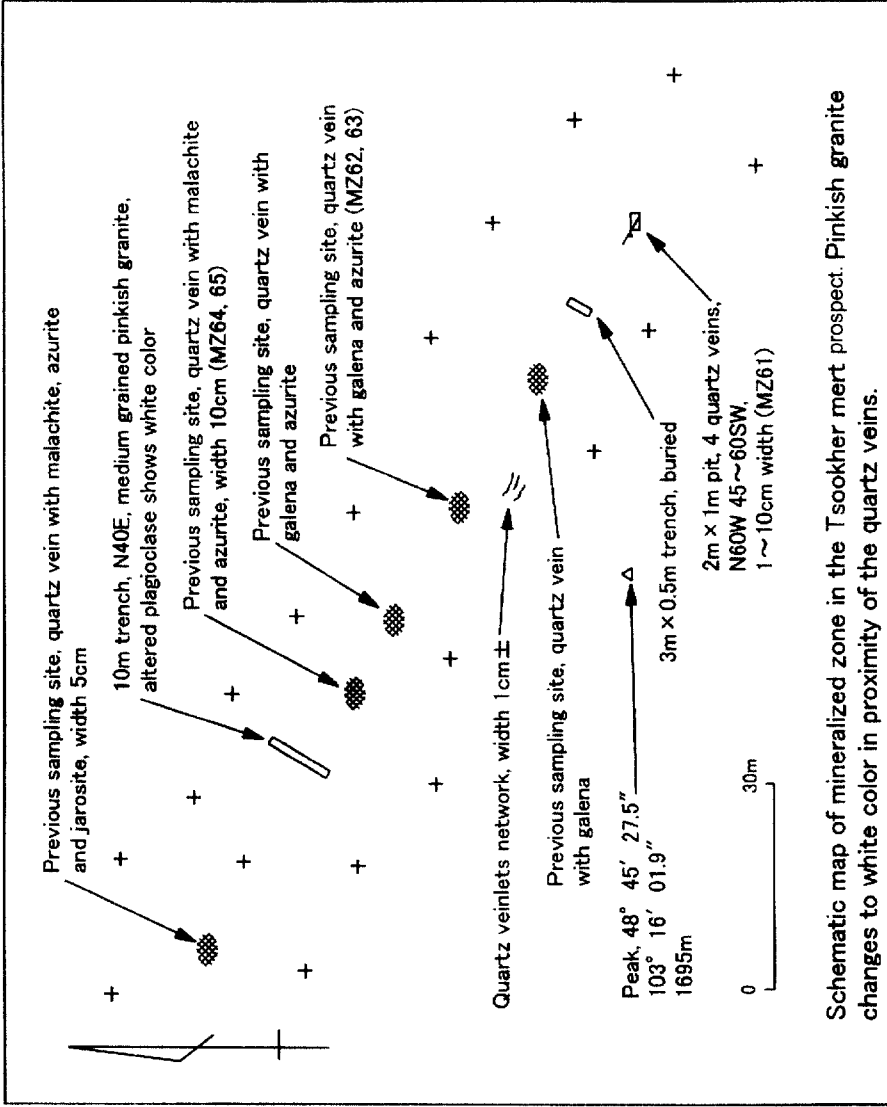
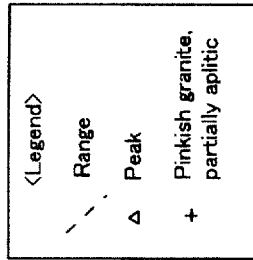
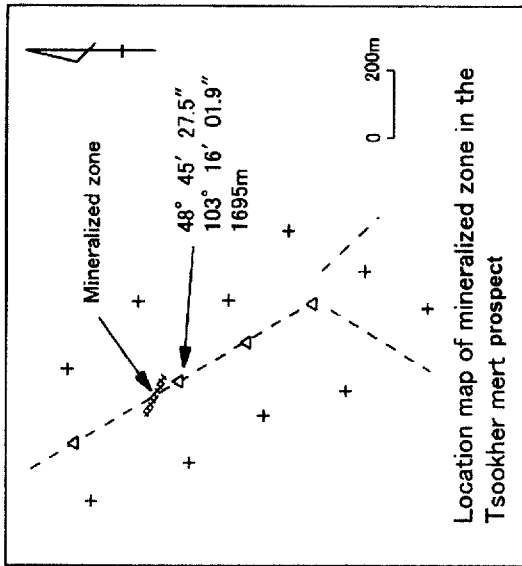
In SAR images, the prospect is expressed in gray to white color. Undulations were small and in variety. Resistivity was from medium to high extent. Drainage systems developed are also from middle to high extents and they are radially distributed.

#### [Geology and geological structure]

Granite in light reddish color in small to medium grains were distributed which were considered as Selenge Complex. Excluding the location of the prospect, unaltered area were widely distributed but with little diversity.

#### [Mineral showing and alteration]

Figure II-3-33 shows the schematic map of this prospect. Existence of quartz dikes was identified in granite. Several quartz veins were observed in widths of 1-10 cm showing structures of N60° W strike and 45° - 60° SW dip and their total length was approximately 120 m. The quartz veins accompanied malachite, azurite, galena, etc. Sericitization was noted the host rock beside the vein.



. Schematic plan of the Tsookher mert prospect (No. 33 occurrence). Au 3 to 10g/t is reported by previous works for quartz veins, but drilling work has not been conducted.

Fig. II-3-33 Schematic plan of the Tsookher mert

[Laboratory test]

Chemical assay was conducted on quartz vein (M99MZ061M - MZ064M), and the results obtained were 0.395 - 6.29 g/t Au, 35.2 - 554 g/t Ag, 89 - 1,940 ppm Cu, 0.37 - 11.9 % Pb and 150 - 396 ppm Zn. As a result of the powdery X-ray diffraction, sericite was detected. On quartz vein (M99MZ065M), oxygen isotope ratio, homogenization temperature and salinity of fluid inclusion were measured (Appendix Table A-25). Oxygen isotope ratio of quartz was +3.0 ‰ to +5.8 ‰ and homogenization temperature of fluid inclusion was 145 °C to 194 °C. Oxygen isotope ratio of water which was in equilibrium with quartz calculated with the oxygen isotope fractionation factor for the average of 169.3 °C (Matsuhisa et al., 1979) was in a range of -10.8 ‰ to -8.0 ‰ (Appendix Table A-25). Oxygen isotope ratio of magmatic water was in heavy values of +6 ‰ to +9 ‰ (Taylor, 1974). On the other hand, oxygen isotope ratio of meteoric water was generally in light values of -15 ‰ to -5 ‰ in Japan, Korean Peninsula and the northeastern part of China (Mizota and Kusakabe, 1994). In view of the light values obtained which suggests that they were originated from meteoric water and low value of 0.16% as salinity, the oxygen isotope ratio of meteoric water at the time of mineralization was considered approximately -11 ‰. Based on these data, it was clearly indicated that mineralization in this prospect was epithermal environment.

[Evaluation]

Although this prospect investigated this time was in a small scale, the analysis values obtained were in notable grades. The prospect is a part of mineral veins reported in preceding surveys. In our survey of this time, however, it was impossible to identify existence of other reported mineral veins owing to time limits. Taking into consideration that trial drilling was not conducted on this product, it will be necessary in the future to systematically grasp features of mineralization of the prospect including that of its vicinity. Based on the data obtained this time, it was clearly indicated that mineralization in this prospect was of epithermal nature. However, in the horizontal zoning of porphyry copper deposit, mineralization of Pb, Zn, Au and Ag may occur in the margin (Jones, 1992). From this viewpoint, it is considered that porphyry copper deposit may possibly exist in the vicinity of this prospect.

(b) Jasiin buuts (Mineral occurrence No. 34)

[Typical latitude and longitude]

48° 47′ 06.5″ north latitude, 103° 26′ 64.2″ east longitude

[Topography and vegetation]

The prospect is a low mountain where sparse forests of conifers are distributed.

[Access]

It takes approximately an hour by car from Bulgan to the periphery of the prospect, and then approximately thirty minutes' walk to reach the prospect.

[Preceding survey]

In 1971, geological survey on a scale 1:200,000 was conducted, and in 1981 geological survey on a scale of 1:50,000, sampling for assay, trenching, drilling (3 holes, lengths of 100.12 m, 100m, and 1103.3 m) and pitting for sampling were conducted.

This prospect belongs to North Mongolia Fault Zone and North Mongolia Metallogenic Belt, and the type of mineralization is regarded as hydrothermal metalomatism. Geology consists of acidic volcanic rocks of Permian age.

The type of alteration was silicification, and alteration zone was in a scale of 200 - 2,000 m long and 40 - 500 m wide extending in the NW-SE direction. It is stated in other records that the scale of alteration zone was 5 km long and 7 - 8 km wide. Geochemical anomaly was in a scale of 500 m × 500 m, and that of 0.005 % Cu and 0.005 % Pb were zonally distributed.

It was reported that Assay results were 0.002 - 0.007 % Cu and 0.0002 % Mo. As alteration minerals, pyrite, limonite and other sulfide mineral were reported.

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

In SAR images, the prospect is expressed in dark to dark gray color, and its texture is relatively smooth. Resistivity is rather high, and drainage systems were not well developed. No lineament is extracted.

[Geology and geological structure]

Andesite, dacite, and dacitic tuff were distributed, and granite and diorite in fine-grain intruded into them.

[Mineral showing and alteration]

Intensive silicification and sericitization were noted showing the state of greisenization. Quarts veins and pyrite dissemination were accompanied.

[Laboratory test]

Chemical assay was conducted on silicified rock sample and quartz vein (M99HH032R, HH033R, HH034R, HH035R, RK058R, RK059R, RK060R, RK061R and RK062R) and the results obtained were Au (Below the limit of detection), 0.2 g/t Ag, max 17 ppm Cu, <2 - 30 ppm Pb and 2 - 70 ppm Zn. In addition, the powdery X-ray diffraction was conducted on whitened rock samples (M99HH032R, HH033R, HH034R, HH035R, RK059R, RK060R and RK061R), and quartz, albite and sericite were detected as alteration mineral.

[Evaluation]

Silicification caused by neutral hydrothermal alteration was extended in a wide range. However, no mineral showing was observed and analysis values were low. Although 3-hole drilling was conducted as a preceding survey, no alteration or mineral showing was found to be remarkable mentioned. Therefore, no successive survey will be necessary.

(c) Khar uul (Mineral occurrence No. 35)

[Typical latitude and longitude]

48° 42' 06.7" north latitude and 103° 16' 21.3" east longitude

[Topography and vegetation]

The prospect constitutes a gentle hill where a steppe is formed.

[Access]

The prospect is located at about 20 km to the southeast of Bulgan city, and it takes about 15 minutes after going into a branch road from the trunk road running from Ulaanbaata to Murun.

[Preceding survey]

Geological survey on a scale of 1:50,000, geochemical survey and magnetic prospecting were conducted in 1986, and mineral showing was discovered in 1988. The mineralized zone was 200 - 300 m wide where chalcopyrite and bornite were observed. Grades obtained resulting from assay on ore samples were 0.2 - 0.5 % Cu, 5 - 10 g/t Ag and 2.15 - 3 g/t Au. No distinctive anomaly was extracted in magnetic prospecting.

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

In SAR images the prospect was expressed in gray to dark gray color. Resistivity is medium indicating a rather sharp ridge.

[Geology and geological structure]

Andesitic and basaltic volcanic rocks in Mogod Formation of Triassic to Jurassic ages were widely distributed, into which small-scaled diorite dikes intruded (according to Mongolian materials).

[Mineral showing and alteration]

In andesitic volcanic rocks, chlorite-quartz veins existed here and there, sometimes accompanying malachite.

[Laboratory test]

Ore samples (M99MZ072M and M99MZ073M) were analyzed and results were recorded as 0.7 % and 2.06 % Cu. Since rock sample (M99NK083R) was under relatively weak alteration, K-Ar age measurement was conducted to decide the age of volcanic activity of Mogod Formation, results was  $205 \pm 4$  Ma.

[Evaluation]

This type of alteration was seen to scatter in volcanic rocks in the entire Bulgan and Bulgan West districts. Since it is considered as one of weak hydrothermal alteration, no further exploration will be necessary.



(d) Mt. Zain gobaav (Mineral occurrence No. 48)

[Typical latitude and longitude]

48° 53' 39.8" north latitude, 103° 37' 44.6" east longitude

[Topography and vegetation]

The prospect is a gentle hill as an outcrop situated along the road between Bulgan and Erdenet cities. Vegetation mostly consists of short grass and conifers growing sparsely.

[Access]

Outcrops are exposed along the roadside between Bulgan and Erdenet cities. Although unpaved, the main road on the way is in a good condition. It takes about 40 minutes by car from Bulgan to the prospect.

[Preceding survey]

No preceding survey was conducted.

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

In SAR images the prospect is expressed as a dark part, and its texture is smooth to some extent. With low resistivity, the drainage system is not developed well and no lineament is extracted from the prospect. However, the prospect is located at an intersection of lineaments in the NW-SE, NNW and NE-SW directions as seen in a large area.

[Geology and geological structure]

Pyroxene andesite was distributed.

[Mineral showing and alteration]

White argillization and silicification were distributed accompanying disseminative pyrite and secondary limonite. No condition of acid leached production was noted. To the south of the road, propylitic alteration caused by chloritization and epidotization as well as quartz veinlets accompanying malachite stain were observed. This propylitic zone gradually changed southward to reddish brown smectite zone, and further changed gradually to unaltered andesite. The alteration zone extended for approximately 300 m in the N50-80° E direction in a width of approximately 30 m. However, extension to the west and north of the investigated point is not clarified since they were covered with soil.

[Laboratory test]

Chemical assay was conducted on silicified and white argillized rocks (M99RK069R, RK070R, RK071M, RK072R, RK073R, RK074 and RK77R), and results were <0.005 g/t Au (Below the limit of detection), 0.2 g/t Ag, 9 - 84 ppm Cu, 2 - 100 ppm Pb and <2 - 42 ppm Zn. Chemical assay was conducted also on silicified and epidotized rock samples accompanying malachite (M99RK78M) and results were <0.005 g/t Au (below the limit of detection), 4.8 g/t Ag, 0.031 % Cu, 6 ppm Pb and 54

ppm Zn.

Powdery X-ray diffraction was conducted on rock samples under whitened alteration (M99RK069R, RK070R, RK071R and RK073R), and alteration minerals of quartz-sericite-kaoline, quartz-pyrophyllite and quartz-montmorillonite were detected.

[Evaluation]

Neutral to acidic hydrothermal activities were noted. Pyrophyllite detected suggested high-temperature and acidic hydrothermal environment. Peripheral condition of outcrops under extreme argillization was basically same as silicification and epidotization of andesite often observed in Bulgan and Bulgan West districts. However, existence of argillized zone may have been attributable to predominant hydrothermal activity.

Only weak copper showing was observed and analysis values were low. However, since hydrothermal feature and copper showing were observed in this alteration as stated above, porphyry mineralization may exist in a deeper part. Since scale of the altered zone was not completely grasped because it was covered with soil, successive survey will be necessary.

(e) SAR181 Point

[Typical latitude and longitude]

48° 52' 39.0" north latitude, 103° 34' 45.5" east longitude

[Topography and vegetation]

The point consists of hills where short grass mainly grows and conifers are rarely observed.

[Access]

It takes approximately 30 minutes to reach the point. It is accessible by car to the point.

[Preceding survey]

0.2 % Cu was obtained as an analysis value. No statement was available concerning scale of the alteration zone. Types of alteration were silicification and epidotization, and existence of malachite and azurite was reported.

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

In SAR images, the point is expressed as a dark gray part. The area is an intersection of lineaments in NNW-SSE and NNE-SSW directions, and development of fissure may be expected.

[Geology and geological structure]

Slightly porphyritic andesite was distributed.

[Mineral showing and alteration]

Weak and small-scaled silicification, epidotization and limonitization (hematite) accompanying malachite were observed.

[Laboratory test]

Chemical assay was conducted on M99RK075M, the results were Au (below the limit of detection), 7.8 g/t Ag, 0.133 % Cu, 14 ppm Pb and 28 ppm Zn.

[Evaluation]

Sectional silicification, epidotization and limonitization were observed accompanying copper showing. Since these alterations were small-scaled, no successive survey will be necessary.

(f) SAR182 Point

[Typical latitude and longitude]

48° 52' 47.1" north latitude, 103° 38' 34.4" east longitude

[Topography and vegetation]

The point is a gentle mountainous area where trees grow in parts.

[Access]

The point is located at about 10 km to the north of Bulgan city. It takes approximately 30 minutes to reach there by vehicle.

[Preceding survey]

As an analysis value, 0.46 % Cu was obtained. Alteration was considered as silicification and epidotization. Existence of copper oxides such as malachite and azurite was reported. No statement was available concerning scale of altered and mineralized zone.

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

The point is expressed in dark gray color in SAR image with low resistivity and little undulation. Lineament in the N-S direction is dominant.

[Geology and geological structure]

Geology of the point consists of basaltic andesite, trachytic andesite lava bearing potassium feldspar and pyroclastic rocks bearing hornblende.

[Mineral showing and alteration]

Foaming trachytic andesite lava was distributed on the mountaintop, whose cavities were filled with quartz. Quartz-epidote like veins and irregular silicification and epidotization were observed, and malachite was disseminated in each of them.

[Laboratory test]

Chemical assay was conducted on rock sample (M99RK067M), and 1.9 % Cu was obtained as the result.

[Evaluation]

Quartz and epidote vein accompanying malachite were observed in the entire district. Since they were considered as small-scaled hydrothermal activities, further exploration will be worthless.

(g) SAR183 point

[Typical latitude and longitude]

48° 52' 47.1" north latitude, 103° 38' 34.4" east longitude

[Topography and vegetation]

The point consists of hills where short grass mainly grows, and conifers are rarely observed.

[Access]

The point is located at about 10 km to the north of Bulgan city. It takes approximately 30 minutes to reach there by vehicle.

[Preceding survey]

As assay results, 0.46 % Cu was obtained. No statement was available concerning scale of alteration zones. Types of alteration were silicification and epidotization.

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

The point is expressed in dark gray color in SAR image. The point corresponds to the intersection of the lineaments in the NW-SE and NE-SW directions. The area indicating gentle topography is a place where hydrothermal activities are caused by development of fissure. Therefore, existence of a formed alteration zone may be expected.

[Geology and geological structure]

Porphyritic andesite was distributed.

[Mineral showing and alteration]

Silicification and epidotization were observed along the cracks of unaltered andesite, and quartz-epidote veins in the maximum width of approximately 20 cm were noted. Quartz-epidote veins accompanied malachite stains.

[Laboratory test]

Chemical assay was conducted on samples of quartz-epidote veins (M99RK066R and RK067R), and the results were <0.005 g/t Au (below the limit of detection), 8.4 g/t Ag, 0.191 % Cu, 62 ppm Pb and 20 ppm Zn.

[Evaluation]

Through this survey, alteration and copper mineralization were observed only along the cracks,

and andesite as the host rock was unaltered. Although hydrothermal activities accompanying mineralization took place, it was not predominant, therefore, no successive survey will be necessary.

(h) SAR 194 Point

[Typical latitude and longitude]

48° 52' 00.0" north latitude, 103° 34' 10.0" east longitude

[Topography and vegetation]

The point is a gentle hills where steppes are formed.

[Access]

The point is located about 10 km to the north of Bulgan, and it takes approximately 30 minutes by car to reach there.

[Preceding survey]

Silicification and epidotization were reported, and the content of 0.46 % Cu was obtained as assay results. No statement was available concerning scale of altered or mineralized zone.

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

The point was expressed in dark gray color with low resistivity and little undulations in SAR image. Lineament in the N-S direction was distinctive.

[Geology and geological structure]

The investigated point consists of andesite lava and pyroclastic rocks.

[Mineral showing and alteration]

Only quartz-epidote veins accompanying malachite were rarely distributed.

[Laboratory test]

As a result of chemical assay on rock sample (M99NK082), quartz-epidote veins accompanying malachite contained 2.57 % Cu.

[Evaluation]

Quartz-epidote veins accompanying malachite was seen in the whole investigated area. Since they were considered as results of small-scaled hydrothermal activities, further exploration will be worthless.

(i) SAR197 Point

[Typical latitude and longitude]

48° 49' 40.5" north latitude, 103° 39' 01.9" east longitude

[Topography and vegetation]

The point is a hill where short grass grows.

[Access]

The point is located at 7 km in a straight line northeastward from the center of Bulgan city. It is accessible by car to several hundred meters away from the very point.

[Preceding survey]

Geological survey on a scale of 1:200,000 (Report No. 2035) and 1:50,000 (Report No. 3538) and geochemical survey (Report No. 3988).

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

As seen in a wide area, the survey point is located in trends in the NW-SE and N-S directions at the Selenge River southward. Sectionally, the point was located on the slope southwest to a ridge-like response in the NW-SE direction that is expressed in light gray to gray color. Small-scaled response in light gray color was developed in the point, and it is possible to read the topography in detail. Responses were in the N-S and NE directions, and the responses in the NE-SW direction were considered to represent a ridge and a swamp crossing it in the NW-SE direction at right angles.

[Geology and geological structure]

Andesite of Permian age was distributed.

[Mineral showing and alteration]

Quartz veins and veinlets existed the investigated point. The quartz veins showed the strike of N20° E and the dip of vertical. Epidote veins and gossan were observed on an outcrop.

[Laboratory test]

As assay results of quartz vein (M99MZ068R) and andesite (M99MZ069R), no remarkable geochemical anomaly was obtained.

[Evaluation]

From the state of alteration, the point was interpreted as the margin of a weak hydrothermal alteration zone. Although quartz veinlets were found, there was weak alteration with the content of 2.5 ppb Au. Therefore, potential in its vicinity is evaluated low.

(j) SAR202 Point

[Typical latitude and longitude]

48° 47′ 56.1″ north latitude, 103° 35′ 54.2″ east longitude

[Topography and vegetation]

The point constitutes a hill, and only short grass grows on the steppe.

[Access]

The site is accessible by vehicle using an unpaved road from Bulgan city to the survey point.

[Preceding survey]

Although the point was referred to in the past as a prospect, details are unknown at present.

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

The point is in gray to light gray color in SAR images, with medium undulations and low to medium resistivity. Existence of lineament in the NNW-SSE direction is observed in the vicinity. Drainage system develops to a medium extent are distributed more or less in parallel.

[Geology and geological structure]

Andesite that considered as of Permian age was widely distributed. Andesite was in the state of massive lava and gray color.

[Mineral showing and alteration]

Although andesite was almost unaltered, it was in green color in part owing to epidotization accompanying quartz veinlets in a width of about 1 cm. The quartz veinlets in the N-S direction were vertical in its structure. A trace of its exploration remained as a trench of about 20 m.

[Laboratory test]

Chemical assay was conducted on altered rock sample (M99MZ072R) bearing quartz veinlets, and the result corresponded to epidotization with a high content of 8.17 % CaO. Sr content of 1,460 ppm was also high. However, in view of 32 ppm Cu and Au/Ag (below the limits of detection), no notable values were obtained.

[Evaluation]

In view of a small-scaled altered zone accompanying only quartz veinlets, the point cannot be subject to further survey.

(k) SAR204 Point

[Typical latitude and longitude]

48° 46' 59.6" north latitude, 103° 35' 18.4" east longitude

[Topography and vegetation]

The survey point consists of a hill where short grass grows.

[Access]

The point is located at 3 km in a straight line from the center of Bulgan city eastward. It is accessible by car to the investigated point.

[Preceding survey]

Geological survey on a scale of 1:200,000 (Report No. 2035) and 1:50,000 (Report No. 3538), geophysical prospecting (Report No. 3988) were conducted.

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

As in a wide area, the point is located in the trends in the NW-SE and N-S directions at the Selenge River southward. This point is situated at approximately 5 km to the northwest of the above SAR 197 Point. Also sectionally, the point is on the slope southwest to the response like a ridge expressed in a light gray to gray color in the NW-SE direction. In particular, the point expressed in dark gray to dark color was dominant. From physiographical point of view, this point may be interpreted as lower land with fewer undulations compared with SAR 197 point.

[Geology and geological structure]

Andesite of Permian age were distributed. Some outcrops were too distinctively altered to know its host rock.

[Mineral showing and alteration]

Greenish alteration was dominant attributable to chlorite and epidote. Malachite was observed in part, with quartz veins and network, and white argillized zone added. Rough structural direction of quartz vein was a strike in the N50° W. The extent of the mineralized zone was 150 m x 20 m.

[Laboratory test]

Chemical assay of quartz vein hosted andesite with malachite (M99MZ073M - MZ074M) were conducted, and the results were 7,060 ppm Cu (MZ073M) and 20,600 ppm Cu (MZ074M).

[Evaluation]

Existence of quartz veinlets and epidotization were confirmed. Malachite was accompanied along the crack of quartz veinlets dikes and andesite. The mineralized zone was in the direction of N50 - 60° W, about 150 m in the total length and about 20 cm in the maximum width. The structure of the quartz veinlets was consistent with the direction of the mineralized zone, but narrow quartz dike in the N15-30° E direction was accompanied. Dip of any quartz veinlets was almost vertical. Since scale of the mineralized zone was relatively large and Cu grade was 2% at the maximum, potential of the point was evaluated high. First of all, a detailed mapping should be conducted.

(I) SAR205 Point

[Typical latitude and longitude]

48° 47' 05.0" north latitude, 103° 39' 45.8" east longitude



[Topography and vegetation]

The point was a mountainous area where grass grows in the steppes and sparse forests of conifers are noted. The sparse forests are dominant on the slope of the mountain.

[Access]

The investigated point is accessible from Bulgan city by vehicle using an unpaved road.

[Preceding survey]

Although the point was referred to in the past as a prospect, details are unknown at present.

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

The point is expressed in gray to white color in SAR image. Undulations are minute and full of variety. Resistivity is medium to high degree. Drainage systems are developed also in medium to high degrees and distributed in parallel more or less.

[Geology and geological structure]

Andesite of Permian age was widely distributed.

[Mineral showing and alteration]

Andesite was almost unaltered, but it was green in part owing to silicification and epidotization accompanied with quartz veinlets.

[Laboratory test]

As a result of chemical assay on altered rock samples (M99MZ070R and MZ071R) bearing quartz veinlets, CaO was in high content of 5.82 - 10.9 % corresponding to epidotization, and strontium also revealed high content of 2,790 - 3,250 ppm. However, in view of 3 - 12 ppm Cu and Au/Ag (below the limits of detection), no notable values were obtained.

Pan concentrated stream sediments (M99MZ511) was extracted from a nearby river. However, no notable content were obtained since Cu was 36 ppm, Pb was 18 ppm and Zn was 83 ppm.

[Evaluation]

Since only quartz veinlet were accompanied by a small-scaled alteration zone and no notable contents were obtained as results of chemical assay, the point cannot be subject to further survey.

(m) SAR219 Point

[Typical latitude and longitude]

48° 43' 57.0" north latitude, 103° 31' 03.1" east longitude

[Topography and vegetation]

The investigated point consists of gentle hills and low mountains with short grass growing on

most of them and conifers sparsely growing on the ridge.

[Access]

It takes about an hour to reach the point by vehicle to the vicinity of the point from Bulgan and on foot to the very point investigated.

[Preceding survey]

As an assay content, 0.007 % Cu was obtained. No statement was available concerning scale of alteration zones. Diorite and granite were found intruded into the alteration zone, and existence of oxide copper like sinter and chalcopyrite were identified.

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

Since the point is expressed in dark gray color in SAR images, its texture is smooth and the slope is gentle, existence of argillized zone may be expected.

[Geology and geological structure]

Andesite considered as of the middle Mesozoic was distributed.

[Mineral showing and alteration]

Whitened alteration and silicification were observed.

[Laboratory test]

Chemical assay was conducted on silicified and whitened sample (M99RK065R), and the results obtained were Au/Ag (Below the limits of detection), 5 ppm Cu, 16 ppm Pb and 26 ppm Zn. Moreover, as a result of powdery X-ray diffraction, existence of quartz-albite-sericite was identified as alteration mineral.

[Evaluation]

Neutral hydrothermal alteration was noted sectionally. However, since no mineral showing was observed and analysis values were low, it will not be necessary to conduct any successive survey.

(n) SAR221 Point

[Typical latitude and longitude]

48° 42' 46.5" north latitude, 103° 31' 39.2" east longitude

[Topography and vegetation]

The point consists of gentle hills and low mountains with short grass growing on most of them and conifers sparsely growing on the ridge.

[Access]

It takes about an hour from Bulgan to the investigated point. It is accessible by vehicle to its

vicinity, and on foot to the very point investigated.

[Preceding survey]

As an analysis content, 0.5 % Cu was obtained. Scale of alteration zone was referred to as 0.5-2 m × 0.2-0.4m.

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

In SAR images, the point is expressed in dark gray color, as a gentle slope with smooth texture. Consequently, existence of argillized zone may be expected.

[Geology and geological structure]

Andesite considered as of the middle Mesozoic was distributed.

[Mineral showing and alteration]

Whitened and silicified alterations were observed. Quarts and epidote veins accompanying hematite was observed.

[Laboratory test]

Chemical analysis was conducted on quarts vein (M99HH036R) and silicified rock (M99RK063R), and the results were <0.005 g/t Au and <0.2 g/t Ag (below the limits of detection), 52 ppm Cu, 32 ppm Pb and 44 ppm Zn.

[Evaluation]

Sectional silicification and quarts veins were noted in andesite. However, since no mineral showing was observed and analysis values were low, no successive survey will be necessary.

(o) SAR222 Point

[Typical latitude and longitude]

48° 43' 33.3" north latitude, 103° 31' 43.8" east longitude

[Topography and vegetation]

The investigated point consists of gentle hills and low mountains with short grasses growing on most of them and conifer sparsely growing on the ridge.

[Access]

It takes approximately an hour from Bulgan to the site. It is accessible by vehicle to its vicinity, and then on foot to the very point investigated.

[Preceding survey]

As analysis content, 0.6 % Cu and 0.02 % Zn were obtained. Alteration zone was referred to as in a small scale.