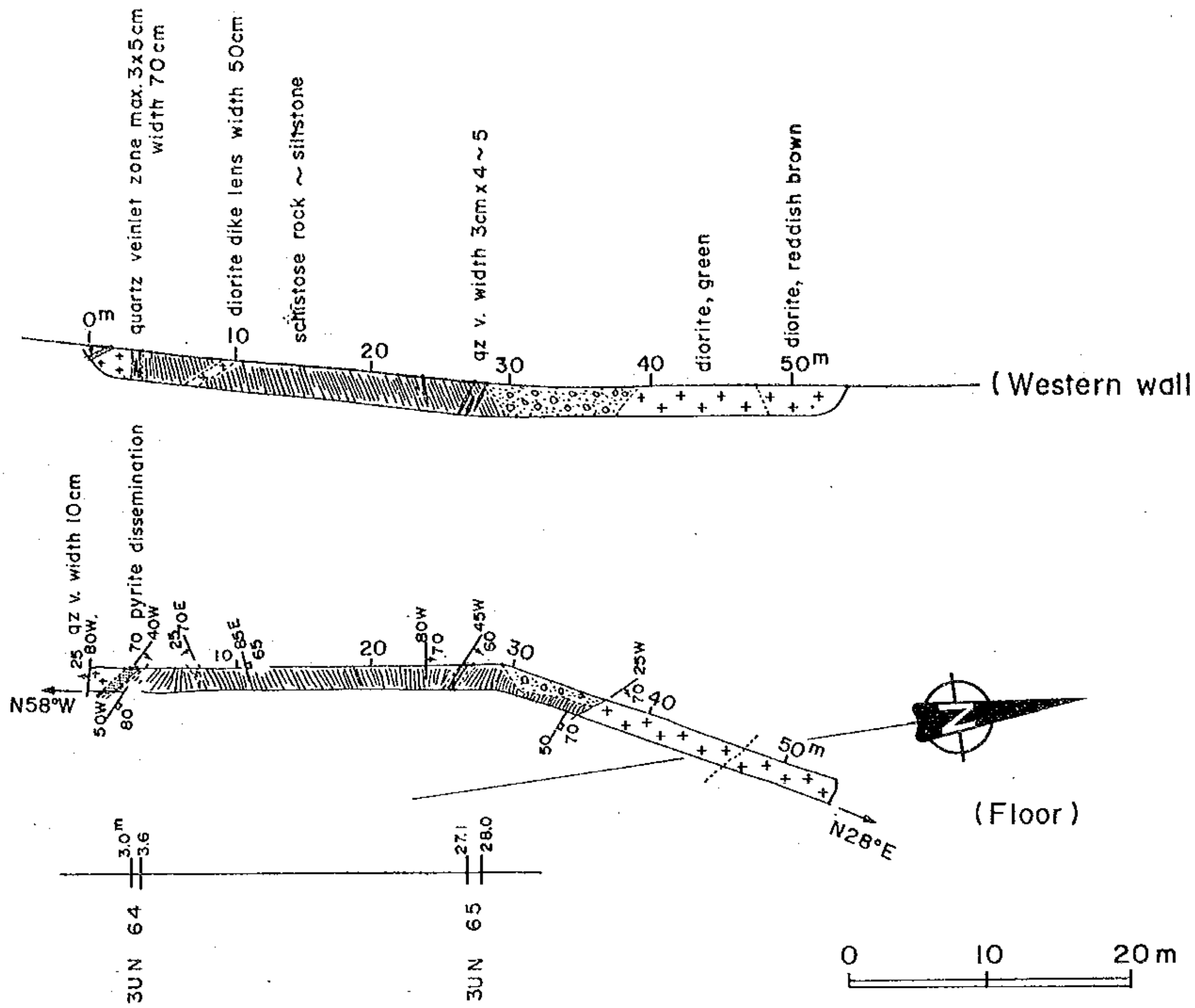
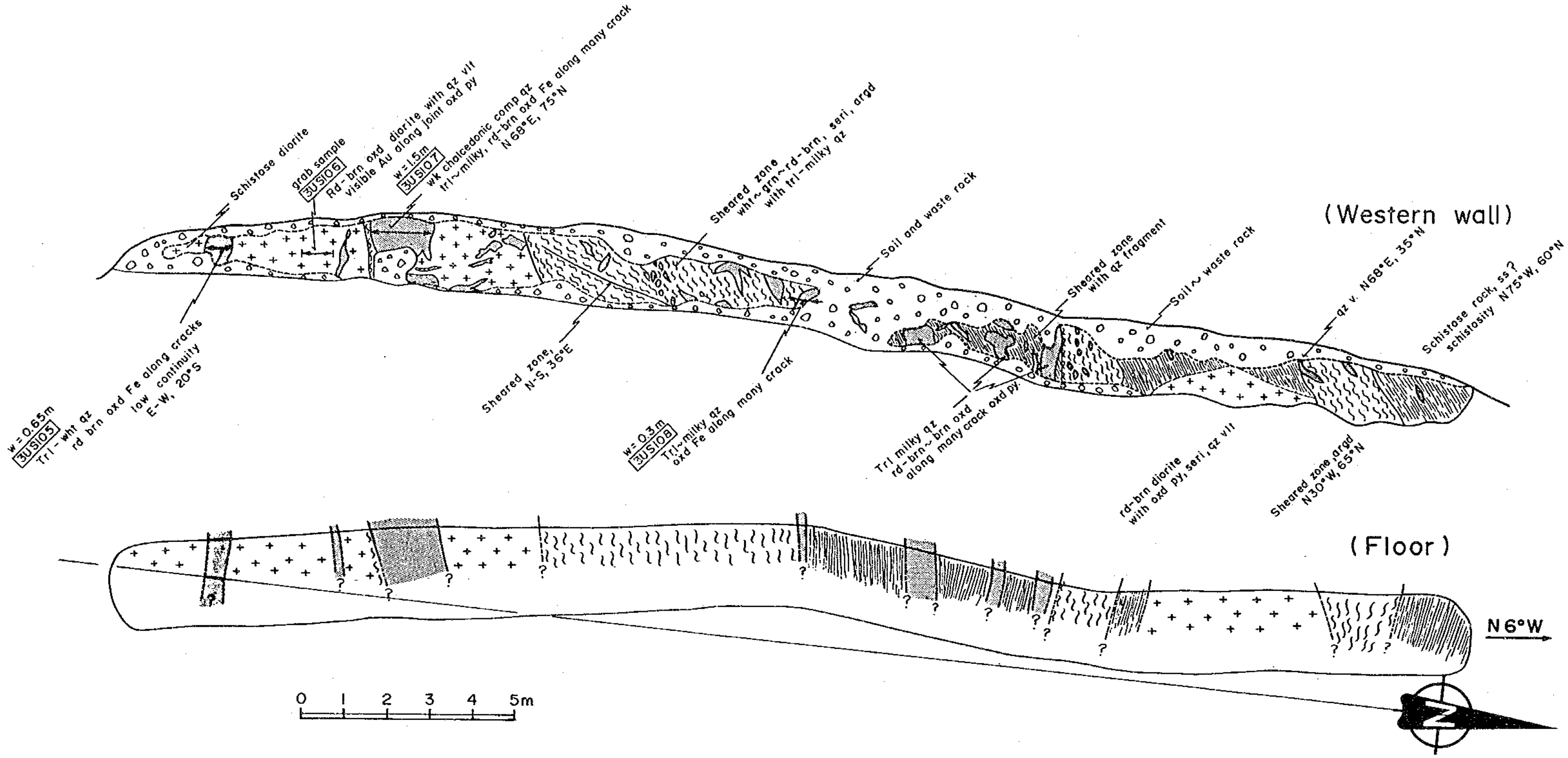


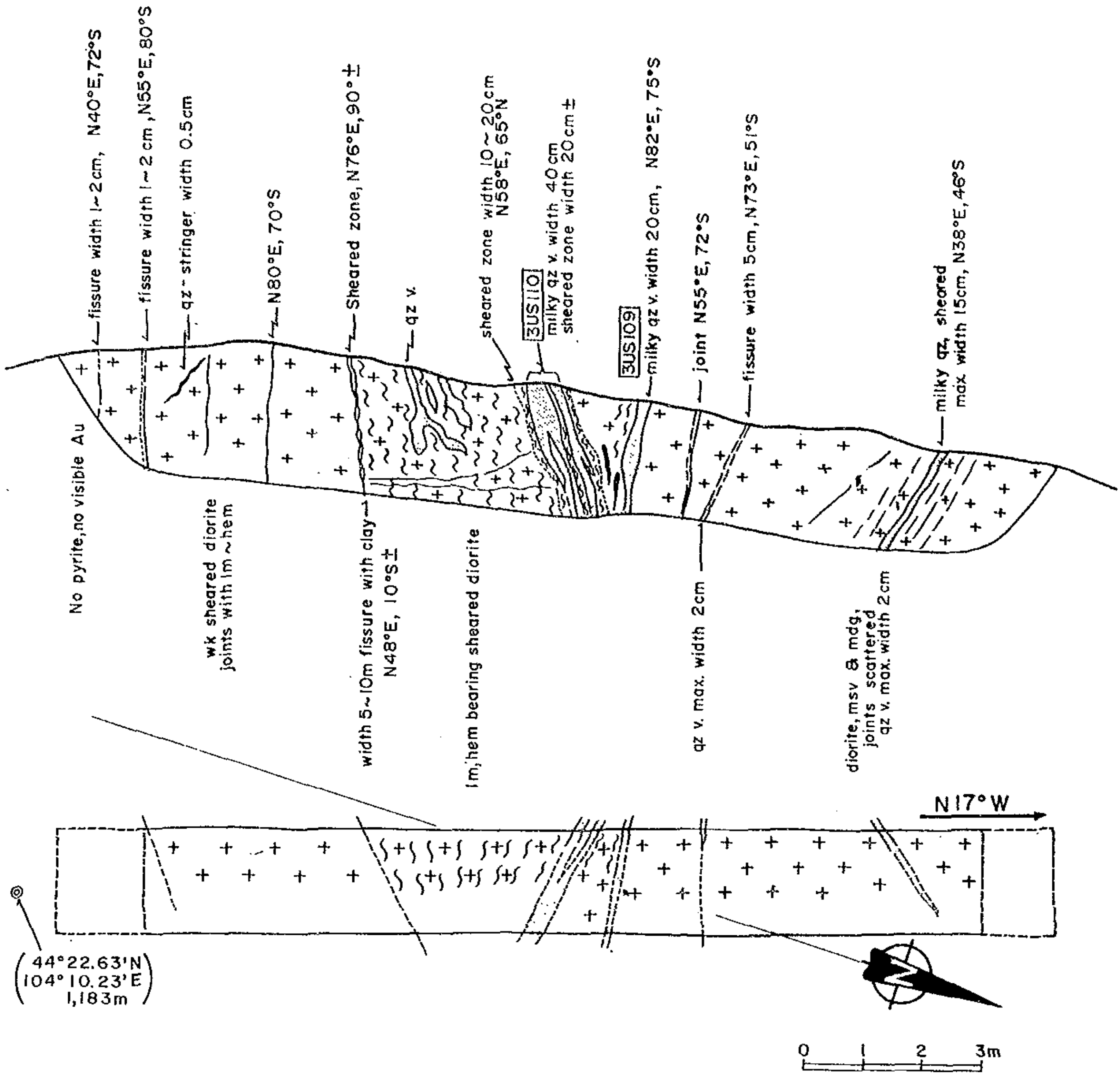
Sample No.	width m	Au g/t	Ag g/t	Note
3UN 64	0.6	< 0.07	< 0.5	qz v.
3UN 65	0.9	< 0.07	< 0.5	qz v.

Fig. II-1-37 Assay of trench No. 62, Olon-Ovoot



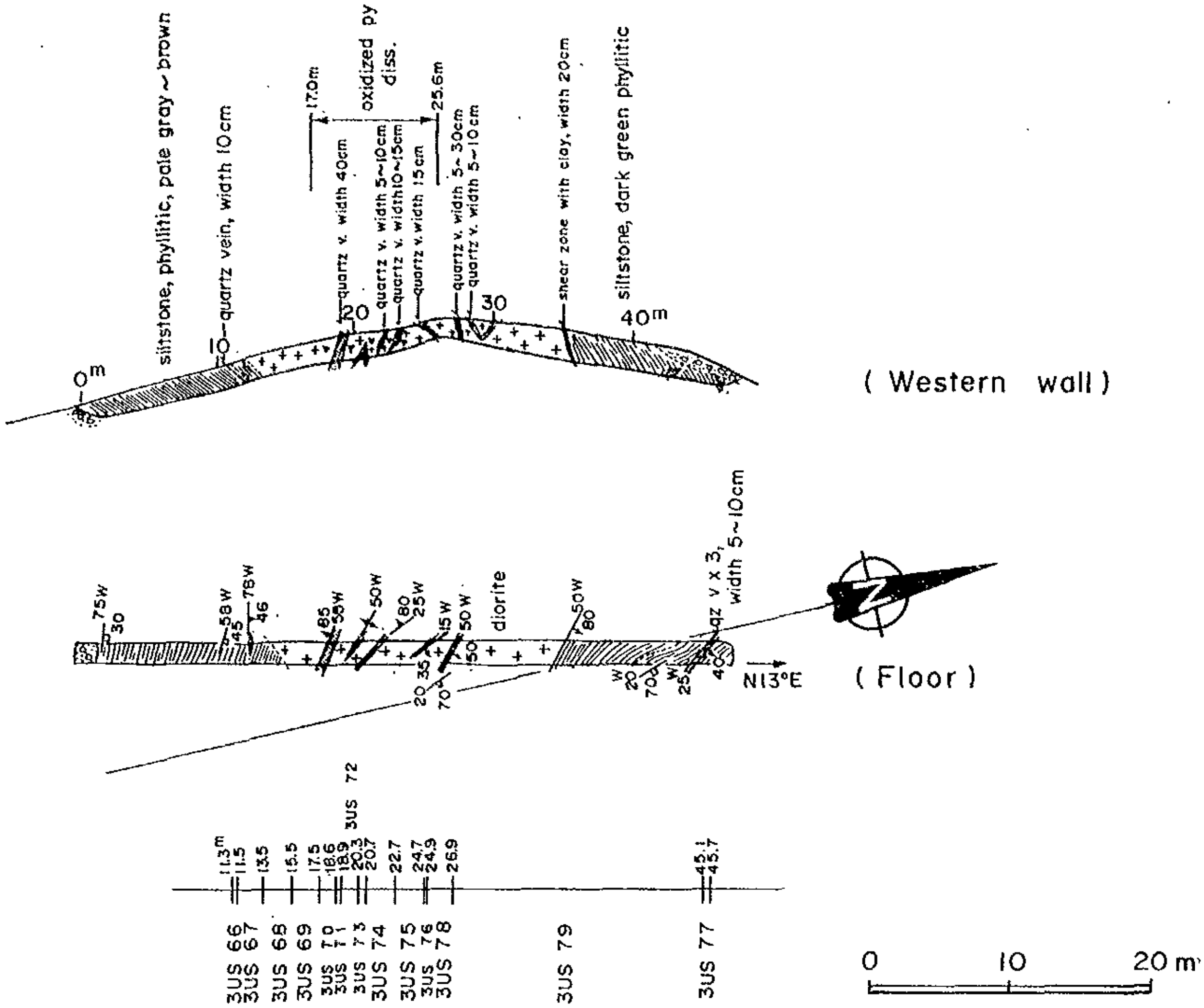
Sample No.	width m	Au g/t	Ag g/t	Note
3US 105	0.65	<0.07	<0.5	qz v
3US 106	grab	2.53	<0.5	diorite
3US 107	1.50	0.14	<0.5	qz v.
3US 108	0.30	<0.07	<0.5	qz v.

Fig. II-1-38 Assay of trench No. 64, Olon-Ovoot



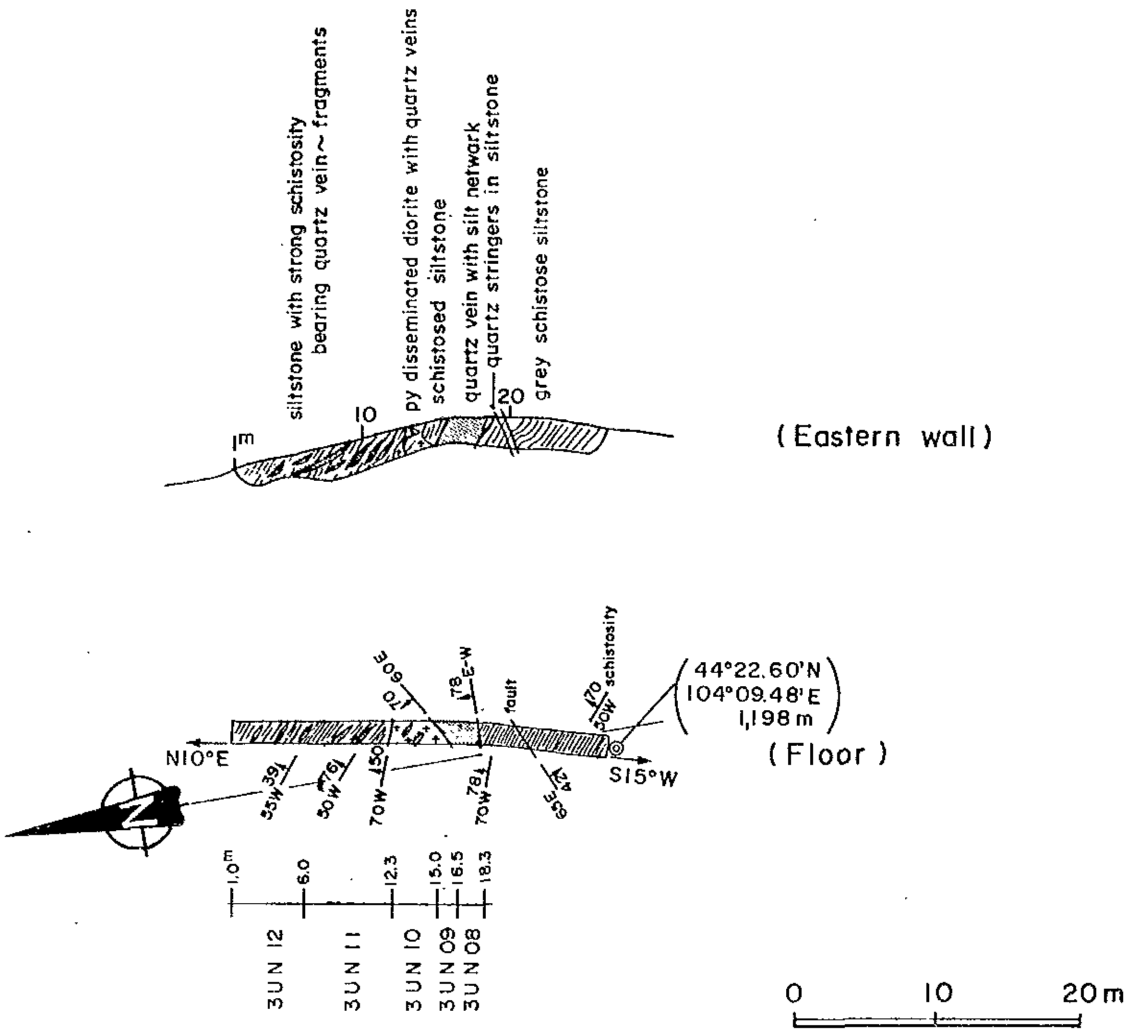
Sample No.	width m	Au g/t	Ag g/t	Note
3US110	0.4	0.21	<0.5	qz v.
3US109	0.2	1.30	<0.5	qz v.

Fig. Ⅱ-1-39 Assay of trench No. 65, Olon-Ovoot



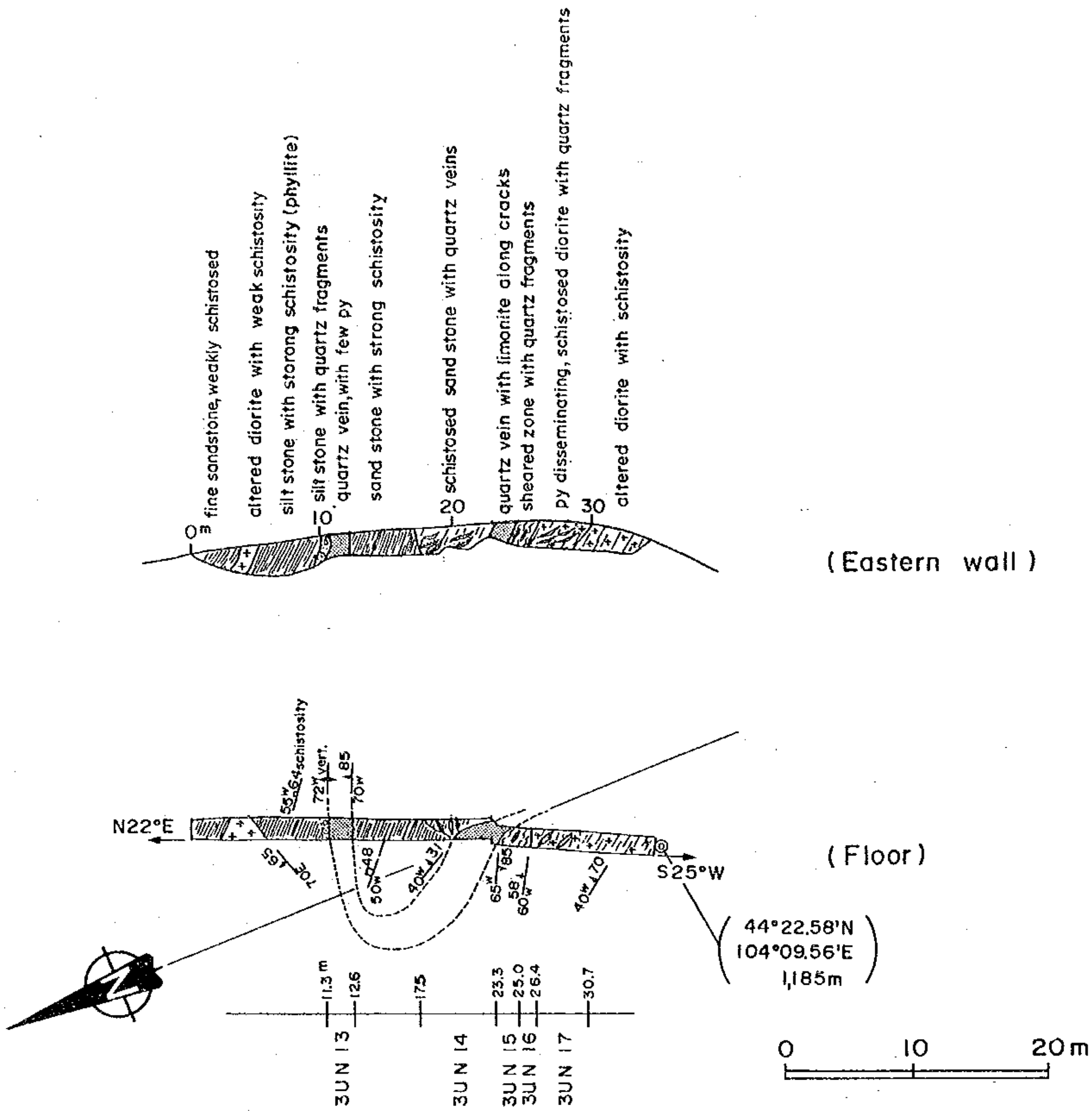
Sample No	width m	Au g/t	Ag g/t	Note
3US 66	0.2	0.14	<0.5	qz v.
3US 67	2.0	<0.07	<0.5	siltstone
3US 68	2.0	<0.07	<0.5	diorite
3US 69	2.0	0.21	<0.5	
3US 70	1.1	0.75	<0.5	
3US 71	0.3	0.21	<0.5	qz v.
3US 72	1.4	2.60	<0.5	diorite
3US 73	0.4	5.21	<0.5	qz v.
3US 74	2.0	1.44	<0.5	diorite
3US 75	2.0	0.68	<0.5	
3US 76	0.2	0.14	<0.5	qz v.
3US 78	2.0	4.11	<0.5	diorite
3US 79	18.2(grab)	0.21	<0.5	siltstone
3US 77	0.6	<0.07	<0.5	siltstone + qz v.
3US 80	chip	19.30	<0.5	qz v. near by 3US 74

Fig. II-1-40 Assay of trench No. 67, Olon-Ovoot



Sample No.	width m	Au g/t	Ag g/t	Note
3UN 12	5.0	1.78	< 0.5	siltstone + qz v.
3UN 11	6.3	0.14	< 0.5	〃
3UN 10	2.7	1.64	< 0.5	diorite + qz v.
3UN 09	1.5	<0.07	< 0.5	qz v.
3UN 08	1.8	1.92	< 0.5	qz v.

Fig. II-1-41 Assay of trench No. 68, Olon-Ovoot



Sample No.	width m	Au g/t	Ag g/t	Note
3UN 13	1.3	0.48	< 0.5	qz v.
3UN 14	5.8	< 0.07	< 0.5	ss + qz v.
3UN 15	1.7	< 0.07	< 0.5	qz v.
3UN 16	1.4	< 0.07	< 0.5	ss + qz v.
3UN 17	4.3	0.27	< 0.5	diorite + qz v.

Fig. II-1-42 Assay of trench No. 69, Olon-Ovoot

1-7-4 Bayan-Ovoot ore showing ★

1. Location and transportation

Location: Longitude 104°26'25" East, Latitude 44°21'58" North. Elevation 1,285m above sea level. In administrative division terms, the deposit is located in the Mandal-Ovoo Sum in the Umnugovi Aimag.

It is about 100km from Daranzadgad city to the deposit, about 3 and a half hour drive by car through the semi-desert and desert area.

2. Topography

The vicinity area of Bayan-Ovoot ore showings is a gentle hilly zone (elevation, about 1,250m~1,320m). The maximum elevation around this area is the nameless hill (1,324.0m), about 1.5km southwest of the deposit.

3. Climate

Same as Mushigia-Hudak deposit.

4. Geology and deposit

(1) Mineralization

The deposit contains fluorite. Quartz-fluorite type.

(2) Type of deposit

Vein type

(3) Ore reserves and grades

Probable reserve: 1,000,000t, CaF_2 75%

(4) Size of deposit

Length: 2,500m, width 0.5~12m, depth more than 100m.

(5) Structure of deposit

Strike:N30°E, N70°E etc.

(6) Country rock

Silurian sandstone and shale intruded by granite.

(7) Structural control

The deposit occurs in the boundary between sandstone, shale and granite.

(8) Related igneous rocks

Granite of early Permian

(9) Alteration

Not obvious.

5. Water supply

There are wells about 9km west of the deposit.

6. Hydrology

Not obvious.

7. Discovery and history

1976: The USSR discovered the ore showings by a geological survey (1/200,000).

1981-84: The USSR conducted boring (20 holes), and pitting and trenching.

8. Mining operation

None.

1-7-5 Dugsih deposit★ ore showing (Fig. II-1-43)

1. Location and transportation

Location: Longitude 104°55'48" East, Latitude 44°24'29" North. Elevation 1,284m above sea level. In administrative division terms, the deposit is located in the Tsogt-Ovoo Sum in the Umnugovi Aimag of the Govi desert.

It is about 100km from Daranzadgad city to the deposit, about 3 and a half hours by car through the semi-desert and desert area.

2. Topography

The district is a very gentle hilly zone (elevation, about 1,200m~1,270m). The maximum elevation around this area is a nameless hill (1,271.3m), about 3km north west of the deposit.

3. Climate

Same as Mushigia-Hudak deposit.

4. Geology and deposit

(1) Mineralization

The deposit contains gold. The ore consists of milky-white auriferous quartz vein, and does not contain much sulfide.

(2) Type of deposit

Auriferous quartz vein

(3) Ore reserves and grades

Not obvious.

(4) Size of deposit

Length 30~50m × Max. width 1m as a single vein.

(5) Structure of deposit

Strike: N70°E, Dip: 70°~90°N~S

(6) Country rock

Upper Silurian~Lower Devonian schist, rhyolite, and gabbro.

(7) Structural control

Not obvious

(8) Related igneous rocks

Not obvious

(9) Alteration

Sericitization, pyritization

5. Water supply

There are wells about 1.5km southeast of the deposit.

6. Hydrology

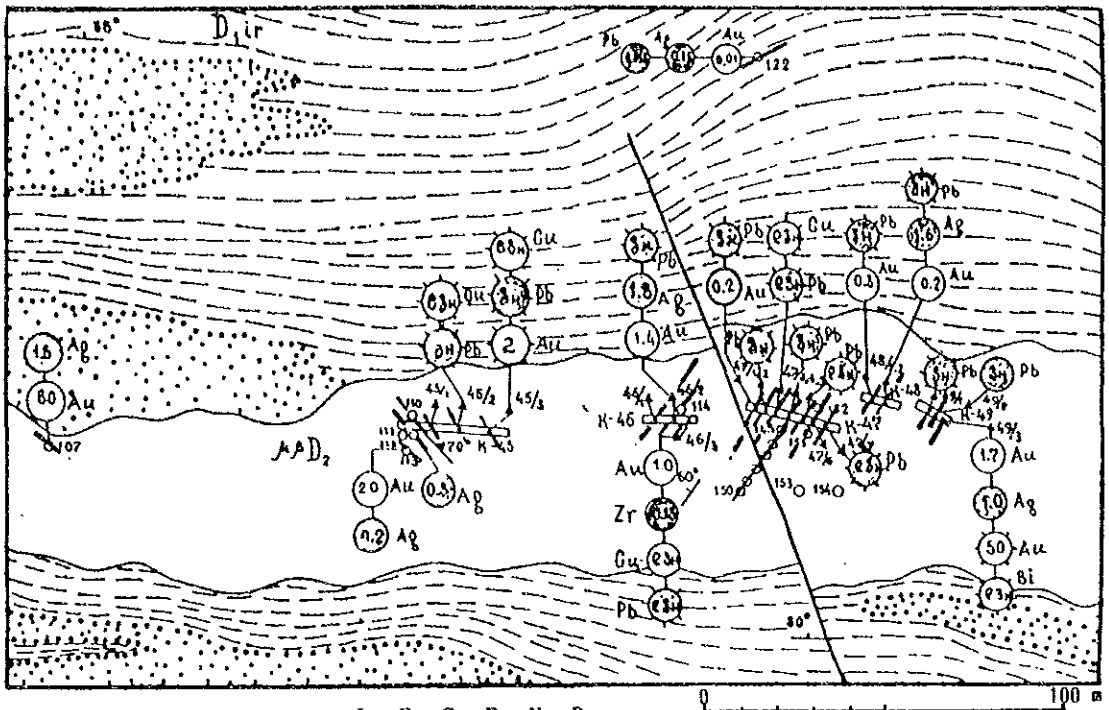
Not obvious.

7. Discovery and history

1979-82: The USSR discovered and described the quartz vein when conducting a geological survey at a scale of 1:200,000.

8. Mining operation

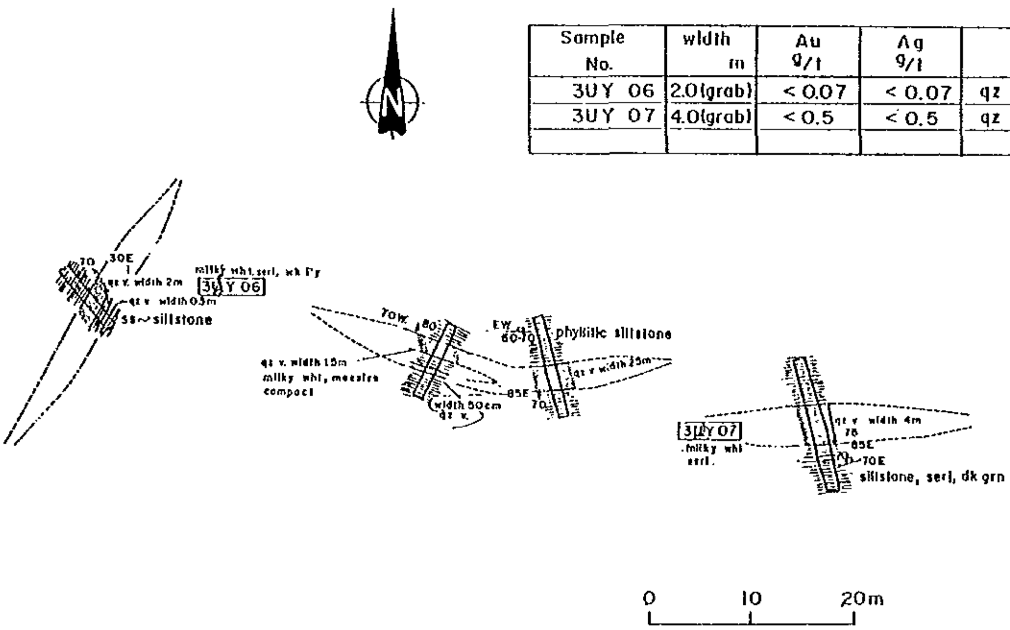
None.



L E G E N D

D_1ir	Lower Devonian system lower part of Irtinbayanhural formation sandstone, siltstone, claystone
$\mu\beta D_2$	Middle Devonian subvolcanic products diabase, gabbro-diabase
	Quartz vein (tourmalin, calcite, hematite bearing)
	Glassy tuff, siltstone, claystone
	Sandstone (fine-grained to medium-grained)
	Granite of various age, medium grained
	Granitic rocks, medium grained
	Fault
	Strike and dip a): country rock, b): quartz vein
	Trench and its number
	Sampling point
	Assay gold and silver in g/t, other elements in %
Au	gold (number means gold content)
Pb	lead
Cu	copper
Bi	bismuth

Sample No.	width m	Au g/t	Ag g/t	Note
3UY 06	2.0(grab)	< 0.07	< 0.07	qz v.
3UY 07	4.0(grab)	< 0.5	< 0.5	qz v.



0 10 20m

Fig. II-1-43 Geology and assay of quartz vein of Dugshih

1-7-6 Onh ore showing ★

1. Location and transportation

Location : Longitude 105°22'29" East, Latitude 44°36'12" North. Elevation 1,284m above sea level. In administrative division terms, the deposit is located in the Tsogt-Ovoo Sum in the Umnugovi Aimag of the Govi desert.

It is about 130km from Daranzadgad city to the deposit, about 3 and a half hours by car through the semi-desert and desert area.

2. Topography

Onh area consists of a very gentle hilly zone (elevation, about 1,240m~1,300m). The maximum elevation around this area is the nameless hill (1,302.6m), about 4km southwest of the deposit.

3. Climate

Same as Mushigia-Hudak deposit.

4. Geology and deposit

(1) Mineralization

The ore of this deposit contains gold. The ore consists of milky-white quartz vein, and does not contain much sulfide.

(2) Type of deposit

Auriferous quartz vein

(3) Ore reserves and grades

Ore reserves are not obvious. According to the existing data, the grades of the outcrop are as follows: Au 0.1~0.4g/t, Ag 0.2~0.8 g/t. The survey results of this project showed the same results. (Fig II -1-44).

(4) Size of deposit

Single vein: 50~150m(length)×1m (Max. width). The size of the mineralized zone: 2,500m(length)×600m.

(5) Structure of deposit

Strike: N70°E, Dip 70°~90°.

(6) Country rock

Upper Silurian~Lower Devonian schist, rhyolite, and gabbro.

(7) Structural control

Not obvious.

(8) Related igneous rocks

Not obvious.

(9) Alteration

Sericitization, pyritization

5. Water supply

There are wells about 5km north of the deposit.

6. Hydrology

Not obvious.

7. Discovery and history

1979-82: The USSR discovered and described the quartz vein when conducting a geological survey at a scale of 1:200,000.

1983: Five trenches were conducted. (N20°W direction)

8. Mining operation

None.

1-7-7 Bayan-Bor-Nuruu ore showing ★

1. Location and transportation

Location: Longitude 104°53'06" East, Latitude 44°24'25" North, Elevation 1,275m above sea level. In administrative division terms, the deposit is located in the Tsogt-Ovoo Sum in the Umnugovi Aimag, of the Gobi desert.

It is about 100km from Daranzadgad city to the deposit, about 3 and a half hours by car through the semi-desert and desert area.

2. Topography

The elevation of Bayan-Bor-Nuruu area is 1,210m~1,300m, and mountanous. The maximum elevation around this area is a nameless hill (1,301.2m), about 0.5km west of the deposit.

3. Climate

Same as Mushigia-Hudak deposit.

4. Geology and deposit

(1) Mineralization

The deposit contains gold. It occurs as milky-white quartz vein, and does not contain much sulfide.

(2) Type of deposit

Auriferous quartz vein

(3) Ore reserves and grades

Not obvious. Five among 182 samples from the outcrops show 1~6 g/t of gold.

(4) Size of deposit

About 100 quartz veins (length 5~100m, width 0.1~1.4m, Max. 1.5m) are in the *vicinity of 360m×60m* area.

(5) Structure of deposit

Strike: E-W

(6) Country rock

Silurian sandstone and shale

(7) Structural control

Not obvious. Genetic relation with a regional big fault is suspected.

(8) Related igneous rocks

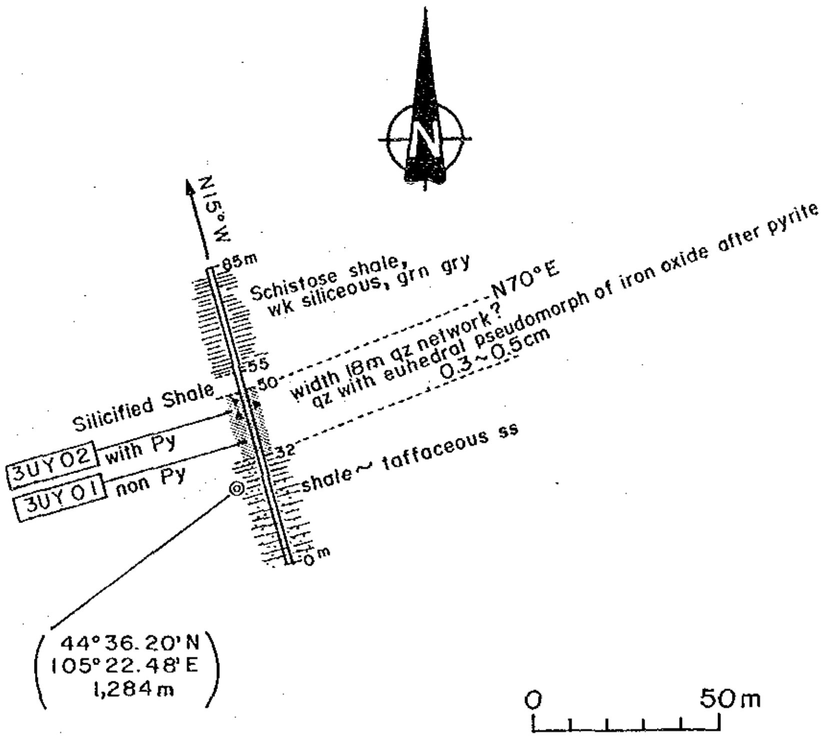
Sericitization, pyritization

5. Water suppy

There are wells about 5km west of the deposit.

6. Hydrology

Not obvious.



Sample No.	width m	Au g/t	Ag g/t	Note
3UY 02	grab	< 0.07	< 0.5	qz v.
3UY 01	grab	< 0.07	< 0.5	qz v.

Fig. II-1-44 Assay of quartz vein, Onh.

7. Discovery and history

1979-82: The USSR discovered and described the quartz vein when conducting a geological survey at a scale of 1:200,000.

8. Mining operation

None.

1-7-8 Other ore showings

Many ore showings such as quartz veins and hydrothermal alteration zones, are known which mainly consist of silicification, and argillization are known. These ore showings were discovered mainly by geological surveys (1/200,000) from 1974 to 1978. Outline of the main ore showings among them are shown based on the existing data. (Appendix 2)

Chapter 2 Analysis of Satellite Image

2-1 Photogeological interpretation of the satellite imagery

1. Purpose

The purpose of this work is to understand the large-scale geological structure of all the survey area. In particular, to learn of the faults, folds, intrusive rocks etc. and their geographical relationships with known deposits and mineral indications, as well as to divide area into those covered by clastics and those exposed.

2. Data used

Table II-2-1 indicates the data used for interpretation and its specifications. As the table shows, 43 scenes of data were obtained in the form of film this year. Two scenes were received at Chinese station, 39 scenes at the station in USA, and 2 scenes at the Japanese station. Fig. II-2-1 shows the location of each satellite image. On the whole, the amount of data was limited, therefore it was impossible to select favorable data in terms of quality, season, and satellite.

3. Data processing

From the data of the 43 scenes, the 17 MSS data and the 2 TM data are linear-stretched and edge enhanced false color positive films. The assignment of the colors is as follows. MSS : Band 4 (blue), 5 (green), 7 (red). TM : Band 2 (blue), 3 (green), 4 (red). As for the remaining 26 scenes, color positive films were prepared by analog synthesis after obtaining the monochrome films of MSS band 4,5 and 7, as it was impossible to obtain color films.

4. Image interpretation

Geological interpretation of the images was conducted in order to extract the lineaments and classify the rock facies using false color images in a scale of 1/500,000.

PL. II-2-1 and PL. II-2-2 shows the interpretation results which were compiled on a scale of 1/1,000,000.

(1) The results of the lineament analysis.

Clear lineaments have not been recognized in the district of the Upper Cretaceous and younger units, however, in the older units than Upper Cretaceous, lineaments are rather visible. At the Govi desert area, in the southwestern part of the survey area, the lineaments and faults with E-W trend are dominant. However, in the central part of the survey area, the direction changes slightly to NE-SW, and at the northeastern part, the lineaments with NE-SW trend are dominant. These directions correspond to the large-scale structure of this district, where there was a collision between the Siberian plate (northern part) and the micro-continents such as Tarim and Sino-Korean.

In the Siberian plate, northwestern part of the survey area, NNE-SSW and WNW-ESE trends of lineaments, which are diagonal to the above-mentioned major structures, are dominant. It is assumed that these have features of strike-slip fault related to the maximum stress.

At the Ulziit district, in the western part of the survey area, the major mineral indications are distributed along the ENE-WSW strike faults or the lineaments, and that indicates that mineralizations are controlled by fissures.

(2) The results of the geological interpretation

The geological units were classified based on the differences in color and surface texture on the image, and interpreted referring to the geological map (1/1,500,000) published by the former USSR Science Academy Geological Research Institute. As for unit names, the same unit names in the geological map were used.

The accuracy of the interpretation was greatly influenced by the quality of the data and vegetation. In particular, at the Dornod district, in the northeastern part of this area or southeastern part of the Donord district, the accuracy was not as good as the previous geological map, because of the vegetation. However, at the Govi district where the Tsagaansuvraga and Ulziit districts are included, the distribution of rock facies were interpreted with great accuracy. In particular, the boundary between soft rocks in upper Cretaceous and hard rocks in the lower units than it, the distribution of granite and limestone are recognized clearly on the image.

When the distribution of the known mineral indications is overlapped with the geological interpretation map, it is found that at the Ulziit district, many mineral indications, such as Olon Ovoot, are distributed in Devonian and Silurian. As well, at the southeastern part of Ulziit district, a lot of copper mineralizations are distributed in the small-scale granite. And between both mineral indication groups, ultrabasic rocks, which intruded in the Palaeozoic era are scattered in the E-W direction. It is considered that the distribution of the ultrabasic rocks indicates the location of a large-scale fracture which corresponds to the above-mentioned past plate movement. And it is assumed that the kinds of ores are different at the area south of the fracture and the area north of it.

2-2 Delineation of alteration zoning.

1 Purpose

The purpose of this work is to identify the geological structures such as faults, folds, beddings, and intrusive rocks and so on, as well as to discern the alteration in each rock facies.

2. Data used

Table II -2-2 indicates the data used on this occasion and its specifications. As the table shows, 7 scenes of TM data were obtained in the form of CCT. Of these, 4 scenes were received at the Chinese station, and 3 at the station in USA. The location of image data is shown in Fig. II-2-2.

3. Data processing

Allocation of colors is as follows. Band 2 (blue), 3 (green), 4 (red) and Band 4 (blue), 5 (green), 7 (red). The linear stretched and edge enhanced falsecolor images were prepared. And, spectrum analysis of reflecting light was conducted on the rock samples from the site and spectrum features of each rock types were obtained. Based upon these results, image processing was conducted by choosing the effective band combination for the rock classification. The scale of image was 1:200,000, which is considered suitable for interpretation, considering TM spatial resolution 30m.

4. Image interpretation

As for the Ulziit district, which is known for its abundant distribution of gold showings, photogeological interpretation was conducted using the image (scale 1/200,000). As a result, the information about geological structures and fault movement were interpreted clearly. PL. II -2-3 indicates the results of the interpretation. As for this district, there are geological maps whose scale is 1:200,000 and the one whose scale is 1:50,000 are preparing. However, as these maps have not been published yet, this interpretation map is considered as the useful basic material for next year's survey of this area.

As the results of the geological survey indicate the scale of alteration zones which are accompanied with the known deposits and mineral indications is relatively small, it was difficult to identify the alteration zone clearly on the image.

Comparing the two kinds of band combinations prepared, the combination of Band 4, 5, and 7 is considered to be suitable for the interpretation of the geological unit.

2-3 Measurement of the reflectance spectra of the rocks

1. Purpose

In order to evaluate the technique to extract the alteration zone by means of the reflectance spectra of rocks, and to select the effective bands for the method of processing of the data gained by satellite, measurement of the reflectance spectra of the rocks were carried out on the 105 pieces of rock samples which were collected from the Serven-Suhait deposit (porphyry type, copper and molybdenum deposit) at the Tsagaansuvraga district in order to carry out experiments to extract the alteration minerals using the results of the above-mentioned measurements.

2. Measurement

① Apparatus for measurement

The measurement was carried out by means of an IRIS Ⅲ type spectroradiometer which is manufactured by GER Co. .This IRIS Ⅲ is able to measure wavelengths in the range of 0.4 to 2.5 μm. The RDS halogen lamp was used for the light source and the $BaSO_4$ white plate for the reference plate.

② Method of measurement

To attain definite conditions of measurement, the distance between the light source and the test sample was kept at 107 cm, between the test sample and the lens of the spectroradiometer at 23 cm, and between the light source and the flat plate where the test samples were placed, at 95 cm, in every case of measurement, respectively. All measurement processes were controlled by personal computer, and were carried out automatically from the beginning of measurement, to the reading of the data and to data filing. It took about 8 minutes to measure a piece of sample. The reflectance charts became available by means of special software for data processing on the IBM-XT personal computer.

③ Selection of sample for measurement

Rock samples were crushed. But the grain size was not uniform as it consisted of various sizes of grain ranging from sand to pebble. As the data obtained by former investigations stated that the grain size of samples may not be very effective on the pattern of peaks of spectrum absorption, the samples for measurement were not screened too closely. However, the samples used for measurement were arranged in order of grain size.

3. Results of measurement

① Extraction of alteration minerals

Among the measured samples, 16 pieces were identified by X-ray diffraction analysis and alterated clay minerals such as chlorite, sericite, montmorillonite were mainly found. Extraction and classification of alterated minerals were carried out by using the results of the reflectance spectrum analysis which were applied to all samples. Alterated minerals were extracted by referring the particular absorption patterns of each group compared with the reflectance spectra of known alterated minerals. Most of the samples suggested the existence of clay minerals and their absorption peaks appeared at around 1.4, 1.9 and 2.2 μm which are particularly indicated areas of clay minerals. The absorption caused by chlorite (2.32μm) was recognized and the X-ray analyses also showed similar results, in almost all of the samples.

The other alteration minerals except chlorite, were classified into the following 4 groups based on the pattern of absorption peaks which mainly appear at the wavelength zones of 1.4, 1.9, 2.2μm and relative intensities:

- Sericite group

  It had an obvious absorption peak near 2.2μm. The shape is comparatively sharp and the intensity is equivalent to an absorption of 1.9 μm. (Fig. II -2-3 (1))

- Montmorillonite/sericite group

  Montmorillonite had such a strong absorption at around 1.9μm, which conceal the co-exisitng sericite. Or it may appear as a shoulder on the long wavelength side of the absorption peak of montmorillonite. At the wavelength of 2.2μm, the absorption peak became a shape like a shoulder or doublet because of the accumulation of absorption peaks of both minerals. By using the above mentioned two characteristics, it was distinguished from the sericite group. (Fig. II -2-3 (2)).

- Montmorillonite-Kaolinite Group

  When the absorption intensity at 1.9μm is stronger than that of 2.2μm, it was distinguished as montmorillonite and when the doulet absorption was at 1.4 and 2.2 μm, it was distinguished as kaolinite. Both minerals are classified in the same group (Fig. II -2-3 (3), (4)).

- A group without any absorption

  The samples which did not have any obvious absorption peak at each of the 3 wavelength zones.

② Discrimination of alteration zone of Serven-Suhait

Based on the above mentioned results of areal reflectance spectram measurements of rock samples, the areal distribution (Fig. II -2-4) of each group is considered and concluded as follows:

a) Sericite group and montmorillonite/sericite group are in the granite syenite zone. The distribution of both groups do not have much regularity to conform to some branch zones, however, there is a trend to increase the sericite group from the fringe to the central part of the deposit which suggests that there is a little stronger alteration to sericite.

b) Most of montmorillonite- kaolinite group used to be on the fringe and not in the central part of the deposits.

It is considered that the above-mentioned features of distribution at this area may reflect the alteration zones of porphyry type ore deposit.

4. 5/7 and 4/3 images

In the case of extraction works of the alteration zone by means of data from Landsat TM, a ratio image is used, with a denominator of Band 7 showing the absorption of various altered minerals, and a numerator of Band 5 with high and stable reflection and without an obvious absorption feature (Fig II -2-5). According to this figure, in the vicinity of the Tsagaansuvraga deposits, there is a dominant red color which suggests the presence of the alteration zone in comparison with the surrounding area.

On the other hand, the 4/3 image is generally used for the extraction of vegetation (Fig. II -2-6). This 4/3 image consists of the numerator of Band 4 showing the high value on vivid plants and the denominator of Band 3 without showing a significant change. In order to draw this figure, an enhancement was applied because of the generally low ratio value. The reason why there is generally a lot of red colored portion is because of the result of linear stretch treatment.

Since these areas have very poor vegetation, there is some possibility that even the areas showing red color may not have vegetation. The red color showing inside of rivers and streams seem to imply vegetation. As the alteration including iron minerals shows wide absorption at Band 4, the blue colored portion on Fig. II -2-6 may imply the possibility that the area has iron oxide minerals such as hematite, limonite and so on.

5. DPCA image

DPCA is the abbreviation of Directed Principal Component Analysis. This is a method developed in order to make the descrimination of the alteration zone more effective. 5/7 image is useful as the image showing alteration zone, but it also tends to show high ratio clues for vegetation. In order to remove this effect of vegetation, it is better to identify the pixel of high corelation in the plane conformed by the 2 axes of 5/7 and 4/3. As vegetation has high value of both 5/7 and 4/3, the distribution is along the correlated axes. On the other hand, in case of rocks, the value of 4/3 does not change considerably and shows up along the 5/7 axis. In the case that there is a lot of vegetation, the component relating to 5/7 and 4/3 normally tends to appear as the principal component (PC 1) in the case of this area, PC 1 represents the alteration of rocks because of less vegetation, and the indications of vegetation appear on the principal component which is normal to PC 1.

Fig. II -2-7 and 8 show the DPCA image and the photo interpreted result.

The reddish colored portion in these figure may be considered as the place with a relatively strong alteration, and the yellowish and greenish portion may be the place rich in vegetation. As a result, the Tsagaansuvraga deposit and the surrounding area are recognized as high alteration and less vegetation.

Additionally, the distribution of nephline syenite from the Carboniferous period, the country rock of the mineral deposit, which was not able to be delineated by the 5/7 image, and the distribution of sand which appears on the bottom left corner of the image becomes quite obvious with the difference in color.

2-4 Comments

There is little information concerning the geology of the Mongolian People's Republic, therefore the remote sensing data is highly anticipated. This particular analysis on these kind of areas over a wide-area is important. The first thing to be carried out on the desert-area like this is to understand the distribution of clastic and naked rock. In this sense, satellite images were effective, as it enable us to identify wide areas on a larger scale.

Concerning the vegetation, which often causes problems when analyzing the satellite images, the Dornod district, where the vegetation is thick, was difficult to decipher, while the Gobi claim, where there is little vegetation, was clearly deciphered. The Tsagaansuvraga and Ulziit districts are suitable for remote sensing.

Useful geological factors to help identify are intrusive rocks such as bedding, faults, alkaline rock etc. However, generally rock facies were difficult to identify. In particular, it was difficult to discern as to whether the hydrothermal alteration zone exists by only using the images. The two reasons for this are as follows.

① At most porphyry-copper deposits and mineral indication areas, the argillized alteration-zone has already slipped down.

② In the surveyed area including cabonatite, vein-type polymetallic deposit, and pipe-type and/or network polymetallic deposit etc., many deposits are not accompanied by the large-scale alteration zone. According to the results of measuring spectral reflection feature, the absorbing peak of clay minerals was confirmed. Therefore, it is considered that by using the data whose spectral analyzing ability is superior, the hydrothermal alteration will be identified.

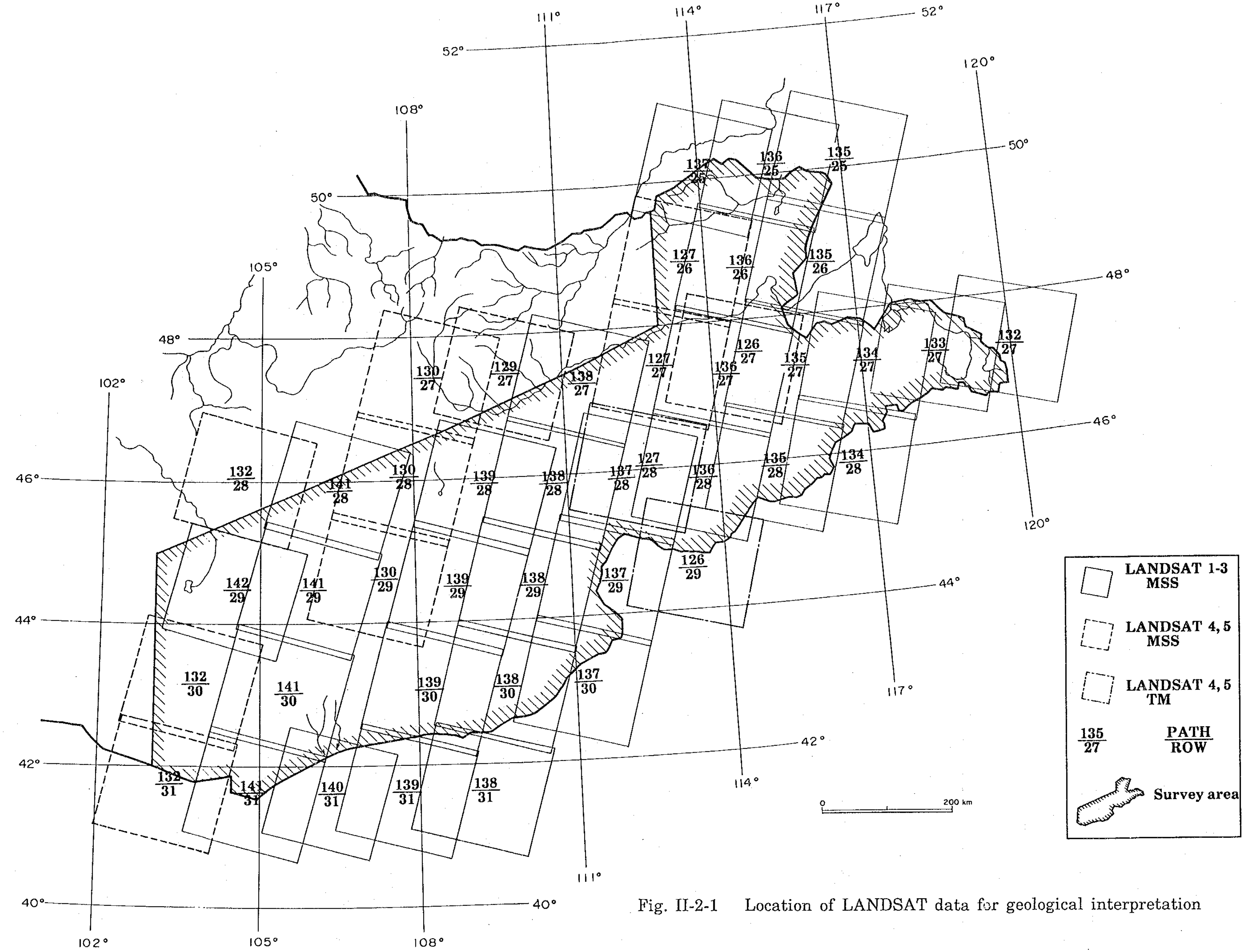


Fig. II-2-1 Location of LANDSAT data for geological interpretation

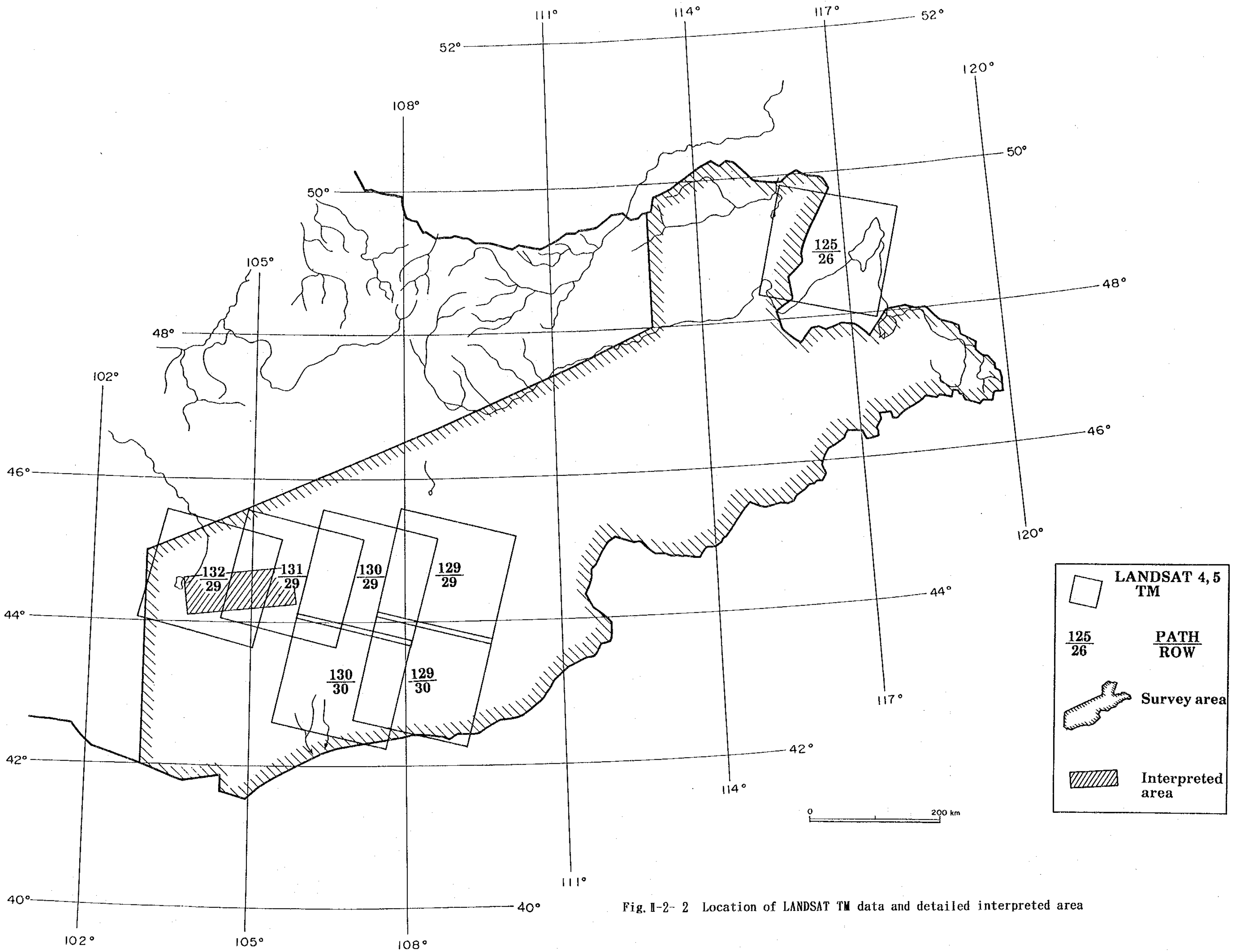
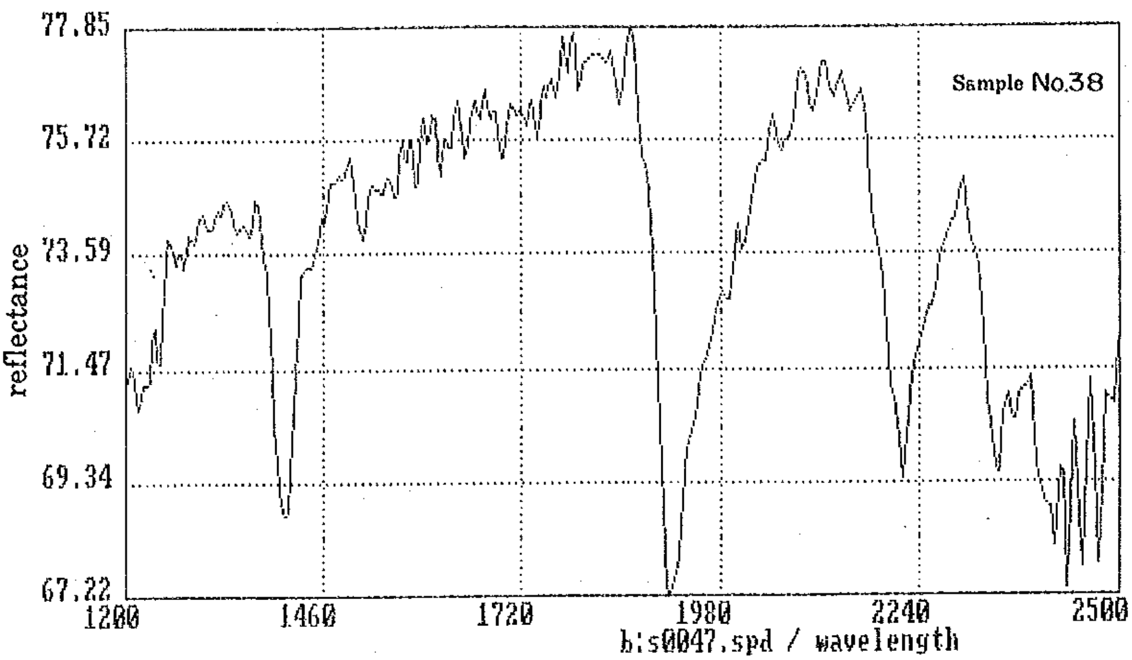
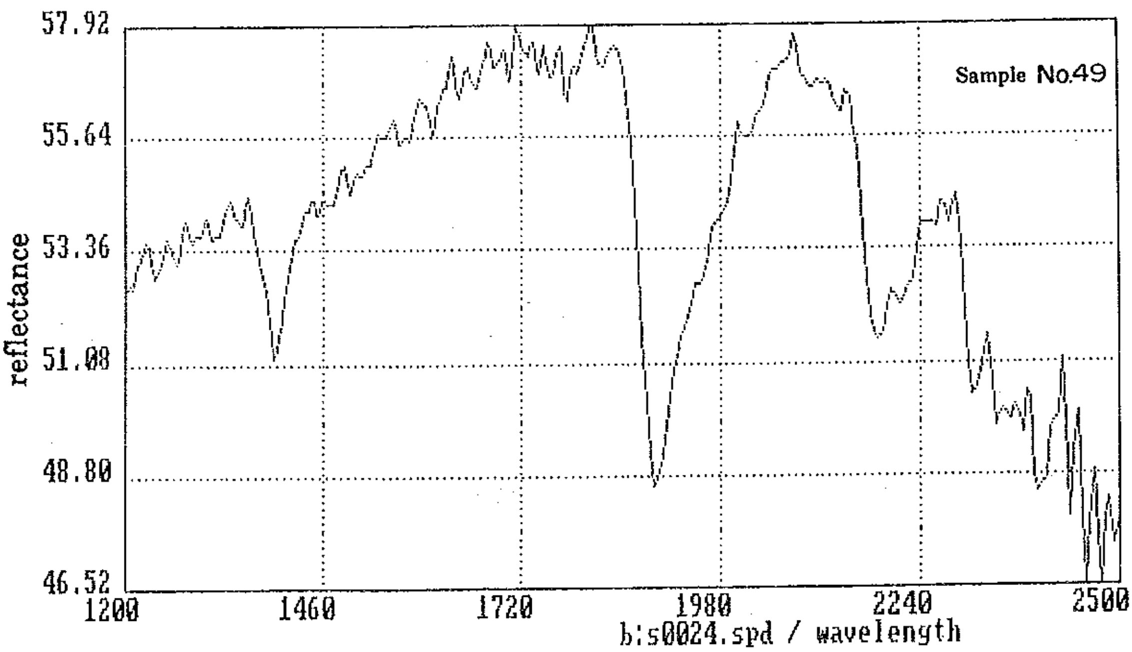


Fig. II-2- 2 Location of LANDSAT TM data and detailed interpreted area

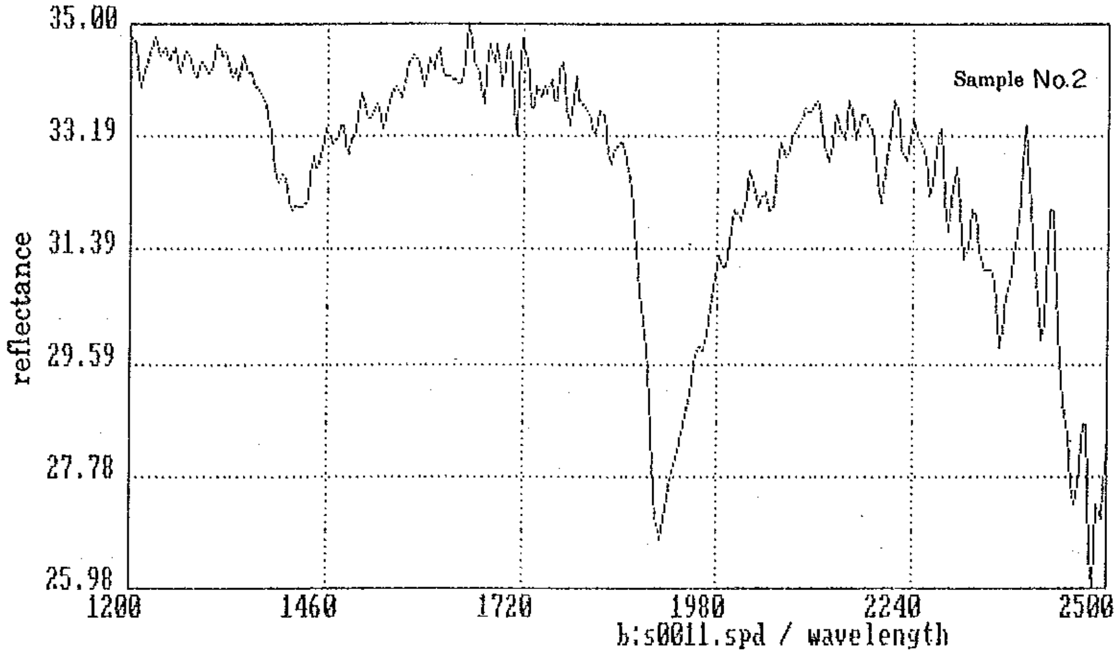


(1) Sericite

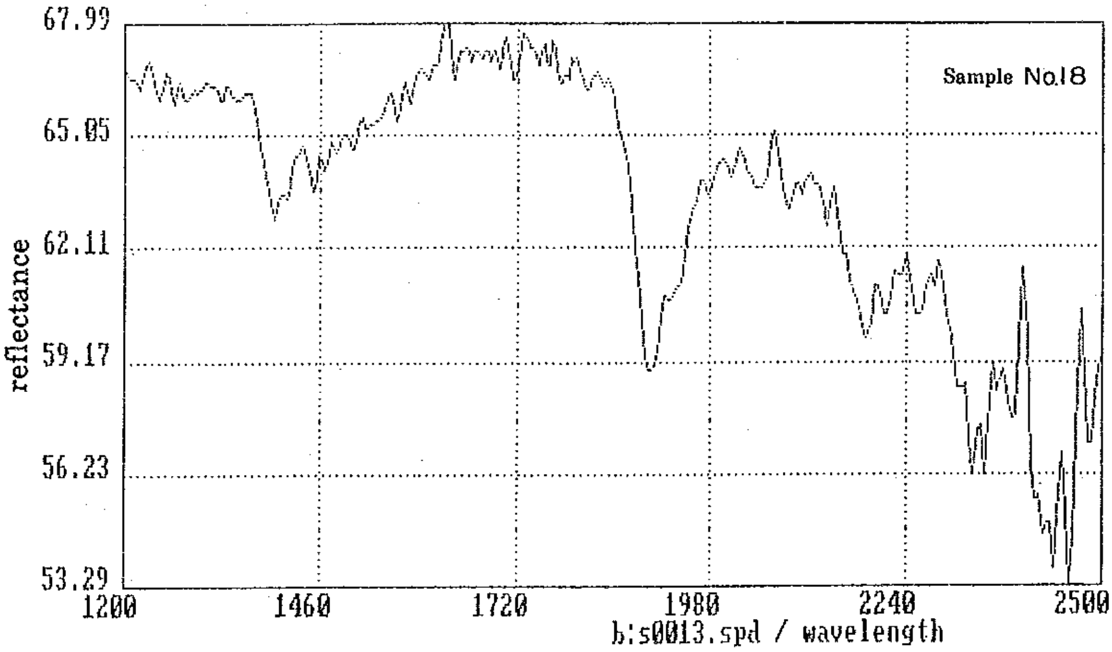


(2) Montmorillonite/Sericite

Fig. II-2-3 Spectral reflectance of rock samples



(3) Montmorillonite



(4) Kaolinite

Fig. II-2-3 Spectral reflectance of rock samples

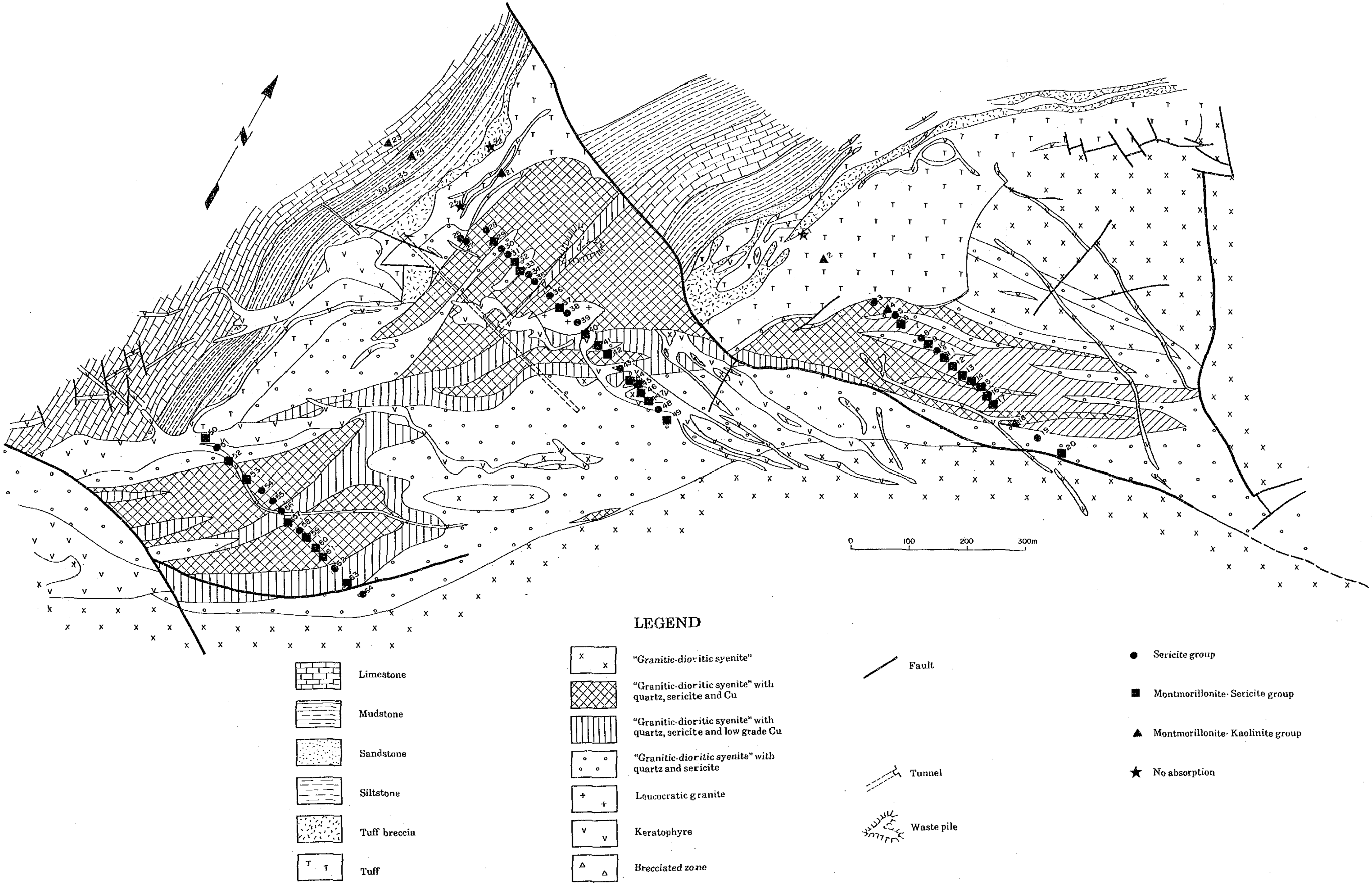


Fig. II-2-4 Distribution map of clay minerals extracted by reflectance spectra

Data acquisition: Sep. 6, 1988
China
Path : 129
Row : 30

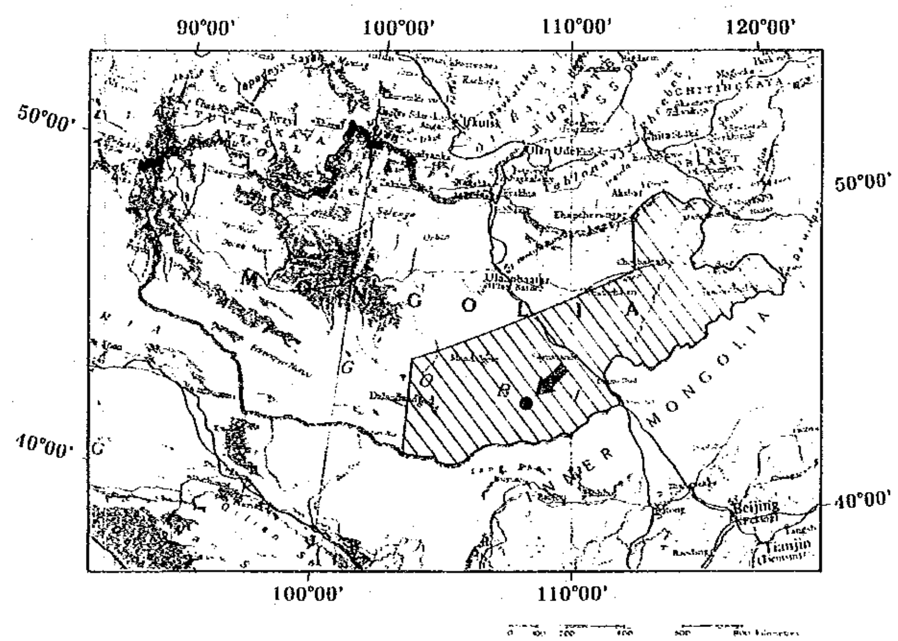
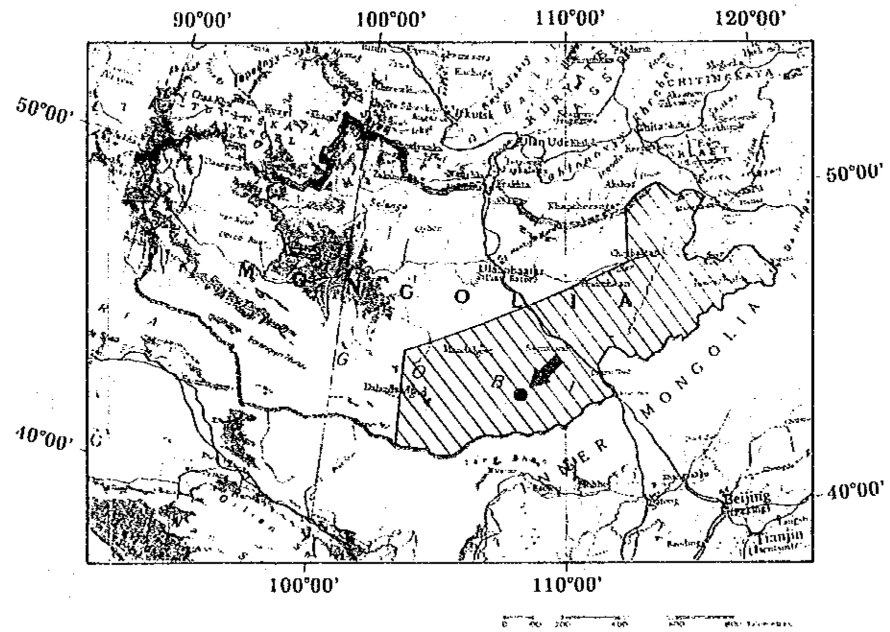


Fig. II-2-5 Pseudo color image of 5/7

108°20'E

43°50'N

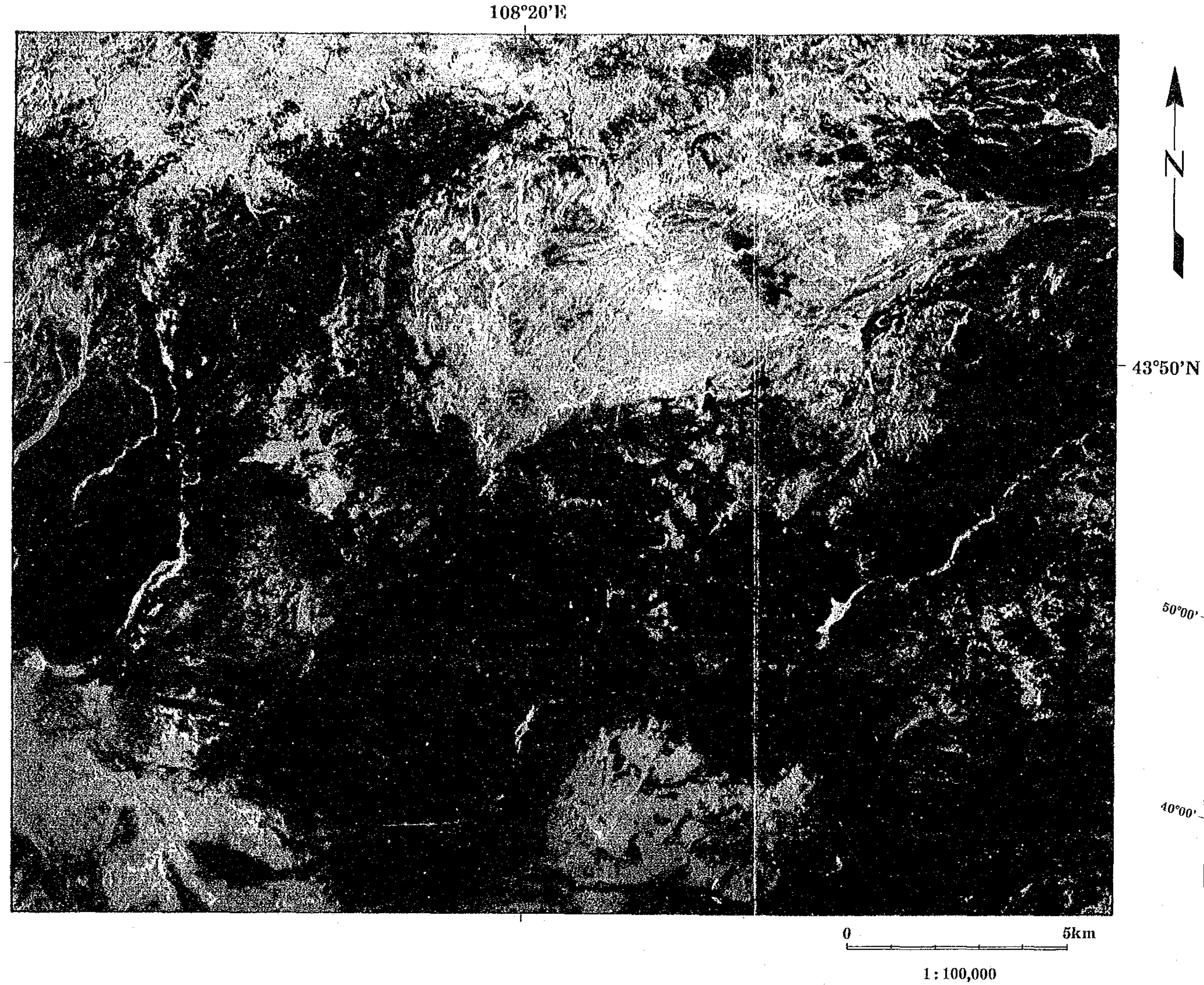
Data acquisition: Sep. 6, 1988
China
Path : 129
Row : 30



0 5km

1 : 100,000

Fig. II-2-6 Pseudo color image of 4/3



This image was produced by principal component analysis from LANDSAT TM 5/7 and 4/3 ratio. The first principal component is displayed as red and the second as green.

Data acquisition: Sep. 6, 1988
China
Path : 129
Row : 30

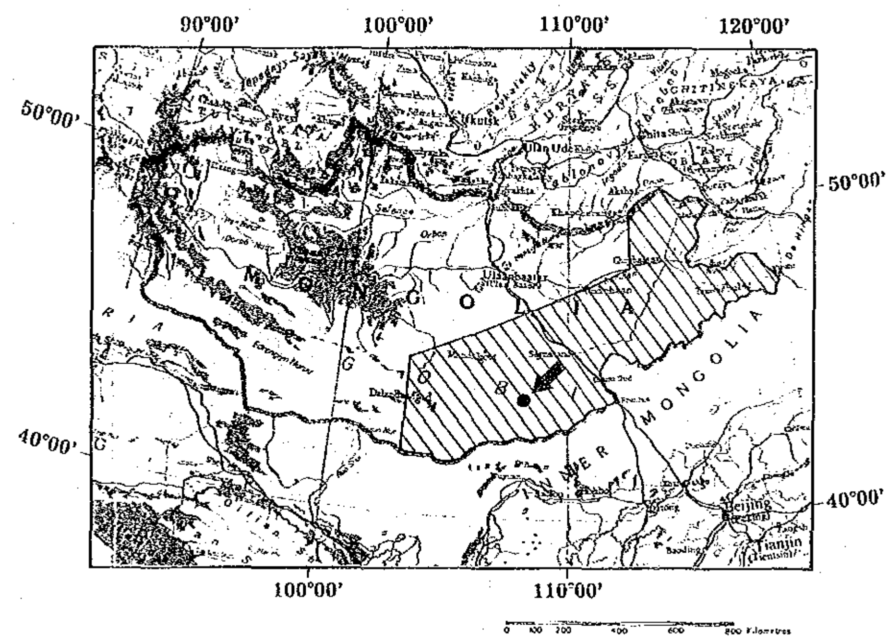


Fig. II-2-7 Rationing / Principal component analysis image of LANDSAT TM of Tsagaan-Suvrag ore deposit and adjacent area

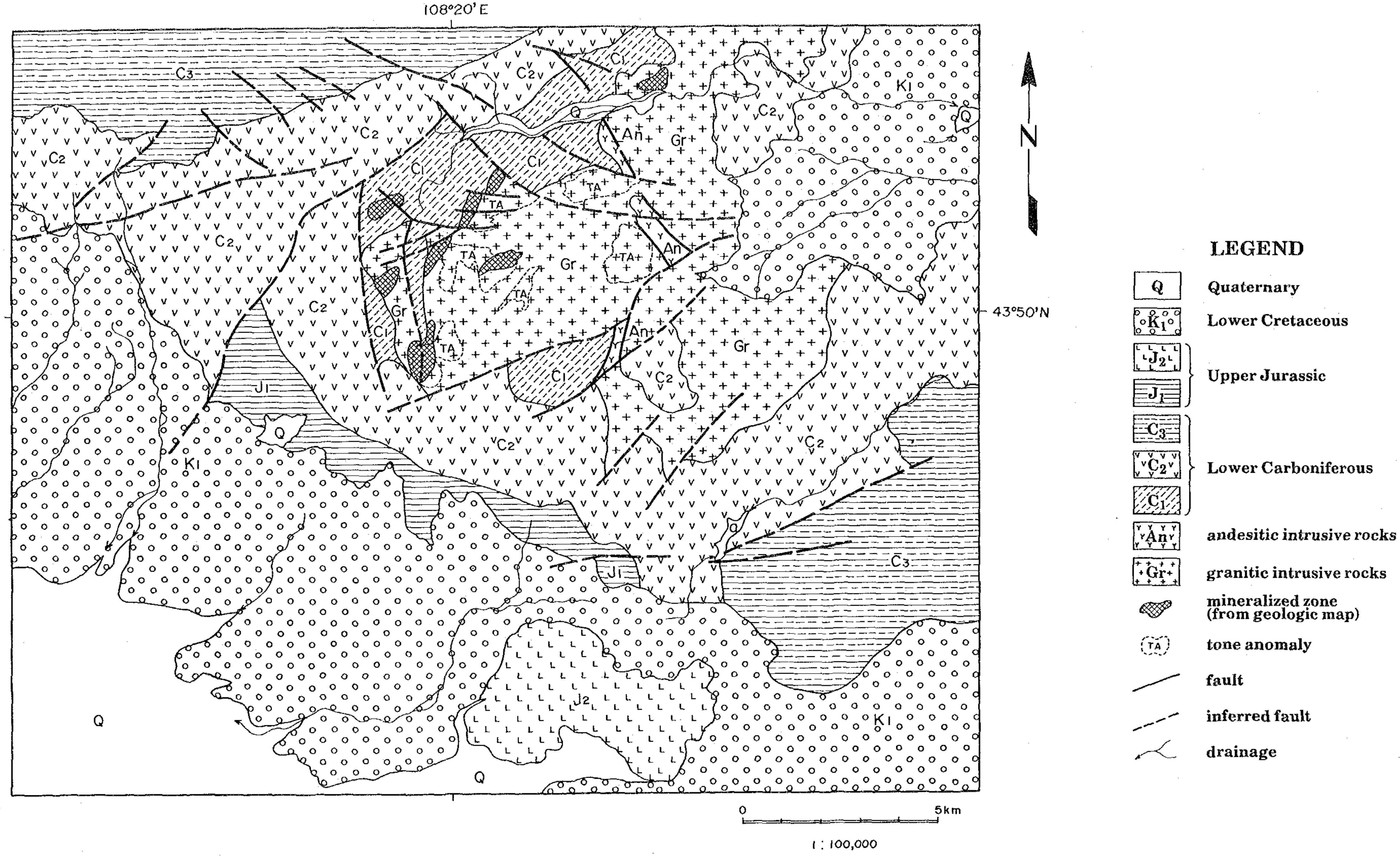


Fig. II-2- 8 LANDSAT TM image interpretation of Tsagaansuvraga ore deposit and adjacent area

Table II-2-1 LANDSAT data for geological interpretation

	Sensor	Data Form	Satellite	Path	Row	Date	Distributor
1	MSS	1/1,000,000 color film	L4	126	27	Oct.17,1990	EOSAT
2	TM	1/1,000,000 color film	L5	126	29	Oct.25,1990	China
3	MSS	1/1,000,000 color film	L4	127	26	Oct.08,1990	EOSAT
4	MSS	1/1,000,000 color film	L4	127	27	Oct.08,1990	EOSAT
5	TM	1/1,000,000 color film	L5	127	28	Apr.07,1990	China
6	MSS	1/1,000,000 color film	L4	129	27	Oct.22,1990	EOSAT
7	MSS	1/1,000,000 color film	L5	130	27	Mar.30,1991	EOSAT
8	MSS	1/1,000,000 color film	L5	130	28	Sept.03,1990	EOSAT
9	MSS	1/1,000,000 color film	L5	130	29	Sept.03,1990	EOSAT
10	MSS	1/1,000,000 color film	L5	132	28	Sept.01,1990	EOSAT
11	MSS	1/1,000,000 color film	L5	132	30	Sept.01,1990	EOSAT
12	MSS	1/1,000,000 color film	L5	132	31	Sept.01,1990	EOSAT
13	MSS	1/1,000,000 color film	L3	132	27	Jul.20,1981	NASDA
14	MSS	1/1,000,000 color film	L2	133	27	Aug.01,1979	NASDA
15	MSS	1/1,000,000 monochrome film	L2	134	27	May 07,1975	EOSAT
16	MSS	1/1,000,000 monochrome film	L2	134	28	May 25,1975	EOSAT
17	MSS	1/1,000,000 monochrome film	L2	135	25	Apr.20,1975	EOSAT
18	MSS	1/1,000,000 monochrome film	L3	135	26	May 08,1975	EOSAT
19	MSS	1/1,000,000 color film	L2	135	27	May 12,1981	EOSAT
20	MSS	1/1,000,000 color film	L2	135	28	May 12,1981	EOSAT
21	MSS	1/1,000,000 monochrome film	L2	136	25	Aug.01,1976	EOSAT
22	MSS	1/1,000,000 monochrome film	L2	136	26	May 09,1975	EOSAT
23	MSS	1/1,000,000 monochrome film	L1	136	27	Nov.06,1973	EOSAT
24	MSS	1/1,000,000 monochrome film	L1	136	28	Nov.06,1973	EOSAT
25	MSS	1/1,000,000 monochrome film	L2	137	25	Sept.02,1977	EOSAT
26	MSS	1/1,000,000 monochrome film	L1	137	28	Dec.13,1973	EOSAT
27	MSS	1/1,000,000 monochrome film	L1	137	29	Dec.13,1973	EOSAT
28	MSS	1/1,000,000 monochrome film	L1	137	30	Dec.13,1973	EOSAT
29	MSS	1/1,000,000 monochrome film	L2	138	27	May 11,1975	EOSAT
30	MSS	1/1,000,000 monochrome film	L1	138	28	Nov.26,1973	EOSAT
31	MSS	1/1,000,000 monochrome film	L1	138	29	Dec.14,1973	EOSAT
32	MSS	1/1,000,000 monochrome film	L1	138	30	Dec.14,1973	EOSAT
33	MSS	1/1,000,000 monochrome film	L1	138	31	Dec.14,1973	EOSAT
34	MSS	1/1,000,000 monochrome film	L1	139	28	Dec.15,1973	EOSAT
35	MSS	1/1,000,000 monochrome film	L1	139	29	Dec.15,1973	EOSAT
36	MSS	1/1,000,000 monochrome film	L1	139	30	Dec.15,1973	EOSAT
37	MSS	1/1,000,000 color film	L3	139	31	Sept.21,1979	EOSAT
38	MSS	1/1,000,000 monochrome film	L1	140	31	Dec.03,1972	EOSAT
39	MSS	1/1,000,000 monochrome film	L1	141	28	Jan.04,1974	EOSAT
40	MSS	1/1,000,000 monochrome film	L1	141	29	Jan.04,1974	EOSAT
41	MSS	1/1,000,000 monochrome film	L1	141	30	Feb.14,1973	EOSAT
42	MSS	1/1,000,000 monochrome film	L1	141	31	Jan.09,1973	EOSAT
43	MSS	1/1,000,000 monochrome film	L1	142	29	Jun.03,1973	EOSAT

Table II - 2 - 2 LANDSAT data for delineation of alteration zones

	Sensor	Data Form	Satellite	Path	Row	Date	Distributor
1	TM	CCT	L4	125	26	Jun.20,1987	China
2	TM	CCT	L4	129	29	Sept.20,1987	China
3	TM	CCT	L4	129	30	Sept.06,1988	China
4	TM	CCT	L5	130	29	Sept.03,1990	EOSAT
5	TM	CCT	L4	130	30	Dec.18,1988	China
6	TM	CCT	L5	131	29	Apr.19,1990	EOSAT
7	TM	CCT	L5	132	29	Sept.17,1990	EOSAT

Part Ⅲ COMMENTS

Chapter 1 Geological Structure and Features of Mineralization

1-1 Geological structure

The survey area is located in a fold belt, formerly called Mongolian geosyncline in the south-southeastern margin of Siberian block. The sediments of the "geosyncline" of the Precambrian to Paleozoic have undergone orogenic movements in Baikalian (latest Proterozoic), Caledonian (early Paleozoic) and Hercynian (late Paleozoic). The rocks consist of gneiss, schist, phyllite, crystalline limestone, sandstone, shale, siltstone, limestone and volcanic rocks such as basalt, andesite, rhyolite, which folding intensively and forming an arc convexly with a southern aspect, are distributed outside the Siberian block. These sediments were intruded granite of various ages since Proteorozoic. In the survey area, the igneous activity lasted to Mesozoic, and the volcanic and granitic rocks of Jurassic to Cretaceous Period (Yenshan period) are widely distributed. In the Gobi area, serpentinized ultrabasic rocks supposed to be ophiolite are sporadically distributed along a major tectonic line paralled to the fold axis. In the Gobi district, there are some inland sedimentary basins of the Mesozoic (mostly Cretaceous Period), and many coalfields are formed.

From the viewpoint that these sediments become younger toward south with the core of the Siberian block, Mongolian fold belt is considered to be an accretionary zone to the Siberian plate by the subduction of oceanic plate (Fig. I-3-1). This way of thinking seems to be fascinating for explaining the variety of ore types distributed in the survey area. However, in order to actually accept it, general interpretation including the treatment of the Middle Proterozoic rocks exposed in the area of 80km E-W×30km N-S in the Har-Airag district is necessary, and it will be left as a future subject.

1-2 Features of mineralization

In the survey area, various metallogenic provinces with different geological environments are distributed, such as polymetallic deposit zone mainly consisting of silver, lead and zinc, accompanied by hydrothermal gold veins (Dornod district), greisen type deposit zone mainly consisting of tungsten and molybdenum (Nufut-Dawaa district), skarn type zinc deposit zone with magnetite and garnet (Tumurtiin-Ovoo district), fluorite deposit zone (Har-Airag district), carbonatite type rare-earth deposit zone accompanied by alkaline rocks (Lugiingol district), porphyry copper deposit zone (Tsagaansuvraga district), polymetallic zone consisting of carbonatite type rare-earth deposit zone accompanied by alkaline rocks, fluorite deposit, mesothermal quartz vein type and porphyry type gold deposits (Ulziit district).

As a result of this year's survey, at least it was found and confirmed that the polymetallic deposit in the Dornod district was formed since Jurassic to Cretaceous Period, the skarn deposit in the Tumurtiin-Ovoo district was formed since Jurassic Period, the carbonatite deposit in the Lugiingol district was formed in Triassic Period and porphyry copper deposit in the Tsagaansuvraga district was formed in Carboniferous Period. Also it was confirmed that in the Ulziit district, there were igneous activities during a long range from Devonian to Cretaceous Period. These facts mentioned above, by specifying the periods of various kinds of mineralization, show the possibility of inspecting or constructing the history of structural development of this area from the study of mineral deposit, and attracts attention as a future subject.

1-3 Structural control of mineralization

Each mineralization of the seven districts mentioned above found in the survey area forms a striking metallogenic provinces, and their distribution are localized. To clarify the reason, it is necessary to clarify the age of mineralization of each district and the nature of magma of related igneous rocks, and to study based on the history of structural development in this area.

As a result of the surveys up to the present, the following factors to control the mineralized zones of the deposits in the survey area are recognized:

1. Factors accompanied by specific igneous rocks

   a) Mushgia-Hudak (RE), Lugiingol(RE) deposit : accompanied by alkaline rocks. They are fromed in different ages; Mushgia-Hudak in Jurassic Period, Lugiingol in Triassic Period.

   b) Tsagaansuvraga (Cu) deposit: accompanied by quartz monzonite (K-Ar age; 339±17Ma) of Carboniferous Period

   c) Yugzer, Tsentr deposits: accompanied by biotite granite of latest Triassic to Jurassic Period.

2. Factors controlled by passage of ore-forming fluid.

   a) Bayan-Uul, Tsav deposits: deposits are formed in fractures (strike; N-S~NW-SE).

   b) Ulaan, Muhar deposits: deposits are formed in breccia pipes.

3. Factors controlled by country rocks appropriate for mineralization

   a) Tumurtiin-Ovoo, Salhit deposits: skarn deposits are formed in the Paleozoic limestone strata.

   b) Greisen deposits in the Nuhut-Dawaa district: deposits are formed in the granite with a clear boundary to the Paleozoic strata.

As for structural control of mineralization in each district, as every deposit in the survey area belongs to epigenetic or similar type deposit, it is considered to be possible to locate accurately the mineralized zone by clarifying ① related igneous rocks, ② fractures possible to be passages for ore-forming fluid, ③ country rocks appropriate for mineralization, and ④ alteration of country rocks and the homogenization temperature of fluid inclusions. These are the future subjects to be surveyed and solved in each deposit.

Chapter 2 Potentials of the Existence of Ore Deposits

2-1 Dornod district

The geology of this district is composed of granite and volcanic rocks from Jurassic to CretaceousPeriod, accompanied by abundant polymetallic deposits (argentiferous lead-zinc deposits), such as Tsav, Ulaan, Muhar.

Concerning this district, various survey work such as geological survey at a scale of 1:200,000, airborne magnetic survey, geochemical exploration were carried out mostly by the Soviet Union since 1971, and the deposits mentioned above were confirmed as a result of such follow up survey as γ-ray spectra survey, trenching, diamond drilling, tunnelling conducted for the anomalies extracted from those surveys.

On the other hand, these deposits are non magnetic bodies except the skarnized zone of the Ulaan. Muhar is a blind deposit, and Tsav and Ulaan are supposed to be also the blind deposits which are not eroded so much. Therefore, a large potentiality for non magnetic polymetallic blind deposits is expected, and these type doposits have been possibly overlooked by the surveys up to the present.

2-2 Tumurtiin-Ovoo district

The geology of Tumurtiin-Ovoo district is composed of Devonian, Permian and Cretaceous Systems and Permian to Jurassic granites intruding into Paleozoic, and with the acidic igneous activities from late Palaeozoic to early Mesozoic, high temperature-type deposits were formed, such as the skarn type zinc deposits of Tumurtiin-Ovoo, Salhiit, etc., greisen type molibdenum deposit of Arin-Nuur, tungsten-quartz vein of Slaa.

All these deposits are exposed on the surface or shallow seated. Since COMECON countries usually conducted airborne magnetic survey in their early period, magnetic anomaly suggesting the presence of magnetite-type skarn deposits were almost extracted. In addition, as the skarn deposits are localized to the contact zone between igneous rocks and limestone or dolomitic sedimentary rocks, it is easy to limit the target. Therefore, there is a little possibility of remaining of large scale deposits undiscovered here, except known deposits. As for the largest Tumurtiin-Ovoo deposit, the xenoblock of Palaeozoic rocks which contains deposits are small and limited, little space is remained for exploration around. Other deposits such as Salhiit are generally of low grade and have weak mineralization.

2-3 Nuhut-Dawaa district

The geology of Nuhut-Dawaa district is composed of Ordovician sandstone, schist and biotite granite which intruded in Trissaic to Jurassic Period. With these acidic igneous activities, greisen type tungsten-molybdenum-beryllium deposits such as Tsentr, Yuguzer and many other greisen type tungsten-molybdenum deposits, tungsten-bearing quartz veins, or pegmatite type beryllim deposits were formed, and form metallogenic province of a rare metal.

Basically the deposits in this district are considered to be exposed on the surface. In this district during a long time since 1942 up to the early 1980's, exploration activities were energetically conducted applying the methods of geochemical exploration, airborne magnetic survey, gravity survey, radioactivity survey, IP method, trenching, drilling, tunnelling etc. As a result, even low grade, small scale mineral showings with poor continuity were surveyed in detail. Accordingly there is a little possibility of new large scale and high grade deposits to be discovered in this district in the future.

2-4 Har-Airag district

The geology of Har-Airag district is composed of various kinds of gneisses, schists, crystalline limestone of Proterozoic Era, rhyolite of Carboniferous Period, granite, granite pophyry, granodiorite porphyry of Permian Period, basalt, quartz porphry, aplite, aplitic granite of Cretaceous Period, etc., and in these rocks many fluorite deposits are formed such as Bor-Undur, Adag, Har-Airag, Hongor, Hajyuu-Ulaan. The largest deposit is Bor-Undur which has the ore reserves of more than 20 million tons, and the total amount of ore reserve in the Har-Airag district is reported to be 50 million tons.

In this district, by COMECON countries' energetic survey works up to the present, the survey for mineralized outcrops was at least completed, and a large number of ore showings were found out. The fluorite resources of this district are considered to be possibly more abundant, but concerning main ore showings detailed surveys have already been conducted, and the discovery of larg- scale deposits can scarcely be expected.

2-5 Lugiingol district

The geology of Lugiingol district is composed of shale, sandstone of Devonian Period and Lugiingol alkaline complex of Triassic Period intruding into them. The deposit is a vein type carbonatite deposit mainly with the light rare earth metals as lanthanum, cerium, etc. accompanied with alkaline complex.

Concerning the Lugiingol carbonatite deposit, details have become clear by the survey works up to the present. It is small scale, low grade and has less possibility to be developed.

2-6 Tsagaansuvraga district

The geology of the Tsagaansuvraga district is composed of Middle to Upper Devonian and Lower Carboniferous Series and quartz monzonite of Carboniferous intruded into them. Accompanied with acidic igneous rocks of Carboniferous to Early Permian Epoch, in the area of about 300km E-W×about 60km N-S, many porphyry type deposits and ore showings such as Tsagaansuvraga, Nalinhuduk, Harmagtai, Ih-Shanhai, Duchin-Hural and others are distributed, and the district forms a porphyry copper belt which is the second largest ore in Mongolia.

Concerning the Serven-Suhait deposit (with the ore reserves of 240 million tons, Cu 0.53% and Mo 0.018%), a main deposit in this district, quite intensive exploration works has been carried out by diamond drilling and tunnel. As a result the whole image of the deposit has become obvious, including its low grade nature, with poor pyrite and poor secondary enrichment. Very few room is remained for exploring this deposit.

As for the other ore showings distributed in this district, there are showings of gold-bearing copper ore such as Harmagtai, Ovootu-Hira,etc., though low grade as a copper deposit. For these ore showings, checking and evaluation are necessary, as well as the survey for alteration zones.

2-7 Ulziit district

The geology of the Ulziit district is composed of Upper Silurian to Lower Devonian schist and granite, granite-diorite of Late Carboniferous to Permian Period, syenite-syenite porphyry, rhyolite and gabbro, etc. of Cretaceous Period.

Various deposits, such as Mushgia-Hudak (REE), Bayan-Hoshoo (Sr), Bayan-Ovoot (fluorite), Olon-Ovoot (Au), and many gold ore showings including Dugsih, Onh, Bayan-Bor-Nuruu are formed. Among these, the Olon-Ovoot gold deposit and many gold ore showings such as Dugsih, Onh, Bayan-Bor-Nuruu,were discovered by the geological surveys at a scale of

1:200,000 conducted from 1979 to 1982 by the Soviet Union, but have been left without any follow-up surveys up to the present.

By this year's survey, Olon-Ovoot deposit was confirmed to be mesothermal auriferous quartz vein. On the other hand, porphyry type ore showings in the Tsagaansuvraga district, such as Harmagtai, Ih- shanhai, Ovootu-Hira, partly contain gold. From the fact that copper ore showings are found in the adjacent district of Ulziit, it is possible that these two are continued, and there exist porphyry type gold deposits. There is also a possibility of presence of hot spring type or epithermal gold deposits, and overlapping of different types of gold deposits is expected.

Chapter 3 Proposed Surveys

There are two forms of survey works in Mongolian People's Republic: one is the work exceeding the results of past surveys, the other is the work supplementing the incomplete parts of past surveys.

3-1 Past surveys

The survey works which have been carried out in the survey area up to the present, have been conducted by various international geological survey teams with the cooperation of COMECON countries, led by the Soviet Union, since mid. 1940's. The methods of those surveys have a series of the following stages:

① Geological survey at a scale of 1:500,000

② Geological survey at a scale of 1:200,000: the area to be surveyed is several ten thousands square km

- Geological survey: in addition to a photo-geological survey as the main method, geological survey and sampling for geochemical exploration, airborne magnetic exploration and systematic geochemical exploration are jointly used. Usually most of the deposits and ore showings are detected at this stage of surveys.
- Geochemical exploration: along traverse lines with an interval of several hundreds meters, the samples are collected regularly or randomly, and multicomponent semi-quantitative analysis by means of emission spectrograph analysis and mineralogical analysis are conducted.
- Airborne magnetic survey: airborne magnetic map at a scale of 1:500,000 is made.

③ Geological survey at a scale of 1:100,000: in addition to a photo-geological survey as a main method, geological survey and systematic geochemical exploration survey are jointly used, but this survey are applied but not often.

④ Geological survey at a scale of 1:50,000: the area to be surveyed is several thousands square km. It follows geological survey at a scale of 1:200,000 or 1:100,000. At the same time surveys by γ-ray spectrum method, IP method, etc. are often applied together.

⑤ Geological survey at a scale of 1:10,000: conducted around specific ore showings. The area to be surveyed is less than several hundreds square km. During this stage, many trenching works and some of diamond drilling works are started.

⑥ Geological survey at a scale of 1:2,000: a map of ore deposit based on trenching, etc.

The characteristic feature is that at the early stage of the survey works, generally, airborne magnetic survey and a huge number of geochemical exploration are jointly used. Trenching and pitting are the most popular exploration methods, and energetic surveys are conducted including diamond drillings. Therefore it can be considered that in Mongolia at the stage of completing the geological survey at a scale of 1:200,000, the survey of searching ore deposits and ore showings with magnetic anomalies and outcrops seems to be almost completed.

In Mongolian People's Republic, some mines such as the Erdenet mine (copper), the Bor-Undur mine (fluorite) have already been developed by these surveys, and there exist some deposits which have not yet developed but have been explored to the latter stage. The exploration of non magnetic blind deposit is a subject of future survey.

3-2 Survey exceeding the results of past surveys

The survey works following and exceeding the results of past surveys are to develop ore deposits which seem to have brighter prospects in the future among the past surveys taken up as promising and explored to the latter stage. The deposits to be surveyed are Tsav, Ulaan, Tumurtiin-Ovoo, etc. As for the development of the polymetallic deposits of Tsav, Ulaan, etc. in the Dornod district, it seems to be the best plan to transfer technology at first through the survey and development of the Tsav deposit which has a higher grades and a reasonable scale of deposit, and then to start the survey of other deposits. As for the Tumurtiin-Ovoo deposit, Mongolia decided to develop it by itself and started to strip the overburden, but it seems necessary to support Mongolia in a mineralogical study with a perspective of refining process in the future. On the other hand, the Tsagaansuvraga deposit has poor secondary enrichment and lacks in high grade parts, it is judged not to be developed under the present market conditions.

3-3 Survey supplementing the past survey works

The examples of surveys supplementing the imperfect parts of past surveys are an exploration of blind polymetallic deposits in the Dornod area, an evaluation survey of gold showings in the Ulziit district and a structural analysis survey by remote sensing analysis and gravity survey in Tsgaansuvraga and Ulziit districts.

As the blind polymetallic deposits in the Dornod area is non magnetic polymetallic deposits in volcanic rocks areas, structural surveys by gravity survey and other basic surveys seem to be effective (Fig.I-5-1, I-5-2).

The location and the outline have already become clear concerning many gold ore showings in the Ulziit district. Concerning the Olon-Ovoot deposit, in the future, it is necessary to make the vein map and assay map, and to confirm the extension of veins towards horizontal and vertical directions and their structure by geophysical exploration . It is also necessary to conduct a series of surveys consisting of ore analysis, vein mapping, alteration zone survey, measurement of homogenization temperature of fluid inclusions, mineralogical study, etc., and at the same time to evaluate the possibility of finding of deposits in each ore showings. In the Ulziit district, igneous activities occurred repeatedly from Devonian to Cretaceous, then different types of gold deposits might have been overlapped. Therefore, it is also an important task to decide the mineralization ages of main deposits.

From the Tsagaansuvraga to Ulziit districts the geological structure is complicated, and different types of mineralization are overlapped, such as porphyry copper, rare earth, fluorite, gold. Therefore it is desirable to conduct geological survey as a part of the satellite imagery analysis in order to classify and arrange the alteration zone in the survey area in connection with geological structure.

Furthermore, it will be very useful to clarify the location of tectonic lines covered by the detritus by means of regional gravity survey and satellite imagery analysis in order to focus the place of ore formation.

Part Ⅳ CONCLUSION AND RECOMMENDATIONS

Chapter 1 Conclusion

Based on this year's results, each district was evaluated from the viewpoint of the possibility of future development of the known deposits (Table IV-1-1).

As a result, the following districts can be considered to be promising among the districts in the Uudam Tal area:

1. Dornod district: vein type polymetallic deposit in Tsav, stockwork skarn deposit in Ulaan

2. Tumurtiin-Ovoo district: Tumurtiin-Ovoo zinc deposit

3. Ulziit district: Olon-Ovoot gold deposit and ore showings around the deposit.

Among them Tsav deposit is excellent in type of ore, ore reserves, grades and infrastructure (close to railway), and has the best possibility for development. Tumurtiin-Ovoo is also worthy of studying its development from its ore reserves and grades.

As for the deposits with the advanced stage of exploration, it is desirable to conduct higher stage exploration. More specifically, it is advisable to make a technology transfer at first through development work of Tsav deposit which has a higher grades and a reasonable size, and then to start development work on the other deposits.

Then, each district was evaluated from the viewpoint of the possibility of finding new deposits in future. As a result, the following promising districts were selected:

1. Dornod district: most of the polymetallic deposits in the Dornod district are considered to be blind deposits. It is also possible that the whole area can be a zone of blind polymetallic deposit as the area is widely covered with volcanic rocks of Jurassic to Cretaceous Period.

2. Ulziit district-Tsagaansuvraga district: It is known that in the area from Ulziit district to the western part of Tsagaansuvraga district, a number of gold - silver showings are distributed. It is assumed from the records and this survey result that there are several types of gold mineralization, such as mesothermal gold deposits and porphyry type deposits.

Table Ⅳ-1-1 Feasibility evaluation of major ore deposits in Uudam-Tal Area

AREA	ORE DEPOSIT	DESCRIPTION				EVALUATION					NOTE
		MINERALES	TYPE	RESERVE(M. t)	ORE GRADE(%, Au, Ag:g/t)	MINERALS	RESERVE	ORE GRADE	INFRA STR.	TOTAL EVAL.	
	TSAV	Pb, Zn, Ag	VEIN	7.68	Pb 6.4, Zn 4.6, Ag 222	◎	○	◎	◎	◎	Large potentiality is ex-
	ULAAN	Ag, Pb, Zn	PIPE	83.1	Pb 0.95, Zn 1.9, Ag 49	◎	◎	○?	◎	○?	pected for polymetallic
	MUXHOR	Ag, Pb, Zn	PIPE	25.5	pb 0.6, Zn 3.4, Ag 113	◎	△?	△?	◎	△?	mineralization in this area
	BAYAN-UUR	Au, Ag	Qz-V	61.1	Pb Zn 1.5, Ag 80 g/t.	◎	○?	×	○	○?	
DORNOD	SALHIIT	Pb, Zn, Ag	Qz-V	-	Ag 15g/t at out crop	◎	?	?	○	?	Further study is required
	DELGER-MUNH	Ag, Pb, Zn	?	-	Pb 4-6	◎	?	?	○	?	Further study is required
	TSAGAAN-CHULUUT HUDUX	Au	PLACER	Au 4t ?	Au0.3g/t?	◎	○?	◎?	○	○?	Restricted by law of MPR.
	MARDAI	U	?	?	?	×	?	?	◎	○?	Restricted by law of MPR.
	TUMURTIIN-OBOO	Zn, Fe	SKARN	7.57	Zn 11.5	◎	○	○	×	○?	Little potentiality is re-
TUMURTIIN-OVOO	SARHIT	Zn	SKARN	0.92	Zn 6.4	◎	△	×	×	×	mained for new discovery of
	SARAA	W	QZ-V	0.17	WO 1.35	◎	×	○	×	×	ore as an area.
	ARIN-NUUR	Mo	GREIZ	24.1	Mo 0.0107	◎	×	×	×	×	
	YUGZER	W, Mo, Be	GREIZ	21.5	WO 0.197, Mo 0.056	◎	×	×	×	×	Very few potentiality is
	TUB (TSENTR)	Sn, W, Be	GREIZ	9	Sn 0.078, WO 0.137	◎	×	×	×	×	remained for new discovery
	MUNUTTIN-TSAGA-ANTOLGOI	Be	PEG	?	?(lenticular ore body, 10 ~20 m long)	◎	×	×	×	×	of profitable ore deposit
						◎	×	×	×	×	in this area.
NUHUTT-DAWAA	AR-BAYAN	W	GREIZ	0.01	WO < 0.1	◎	×	×	×	×	
	UVURBAYAN	W	GREIZ	-	WO 0.04-0.1	◎	×	×	×	×	
	ORT GROUP	W	GREIZ	-	WO 0.01-0.06	◎	×	×	×	×	
	TARVAGATAI	Mo, W	GREIZ	-	WO < 0.08, Mo<1	◎	×	×	×	×	
	DZURH-OVOO	Mo, Sn	SKARN	-	Mo 0.003, Sn 0.008	◎	×	×	×	×	
	BAYAN-HAIRAST	W	QZ-V	-	WO 1-2	◎	×	×	×	×	
	SAIHAN-ULA	W	QZ-V	-	WO 0.18-0.5	◎	×	×	×	×	
	NUHUTTIIN	W	QZ-V	-	WO 0.04-0.13	◎	×	×	×	×	
	BOR-UNDUR	CaF_2	VEIN	20.98	CaF_2 39.1%, Qz-Fl type	△	◎	○	◎	△	Fluorite is to cheap in the
	AGAG	CaF_2	VEIN	4.0	CaF_2 40 %, Qz-Fl type	△	◎	○	◎	△	western world market.
HAR-AIRAG	CHOL-TSAGAAN-DEL	CaF_2	VEIN	1.4	CaF_2 40-53%. Qz-Fl type	△	◎	○	○	△	
	HONGOR	CaF_2	VEIN	1.37	CaF_2 29~34%, Qz-Fl, Cal	△	◎	△	○	×	
	BAIHANTA	CaF_2	VEIN	3.08	CaF_2 33~36%, Qz-Fl, Cal	△	◎	△	×	×	
	TSAGANTAKHILCH	CaF_2	VEIN	1.82	CaF_2 40.5%, Qz-Fl type	△	◎	○	×	×	
LUGIINGOL	LUGIINGOL	RE	CARB-V	0.436	TREO 2.86	◎	×	×	×	×	No secondary enrichment
	TSAGAANSUVRAGA	Cu, Mo	PO-Cu	240.0	Cu 0.53, Mo 0.018	◎	◎	×	×	×	No secondary enrichment
	DUCHINN-HURAL	Cu	VEIN	-		◎	×	×	×	×	in this region.
	HARMAGTAI	Cu	PO-Cu	139.6	Cu 0.25	◎	○	×	×	×	
TSAGAAN-SUVRAGA	IH-SHANHAI	Cu	PO-CU	-		◎	×	×	×	×	
	NARIN-HUDUK	Cu	PO-CU	0.05	Cu 0.58	◎	×	×	×	×	
	OVOOTU-HIRA	Cu	PO-Cu	-		◎	×	×	×	×	
	SHUTEN	Cu	PO-Cu	12.6	Cu 0.31	◎	×	×	×	×	
	UHAA-HUDAG	Cu	PO-CU	-		◎	×	×	×	×	
	HUNGUT	Cu	PO-Cu	-		◎	×	×	×	×	
	MUSHGIA-HUDAK	RE	Carb	398	TREO 1.53 %, O.R. Reduced	◎	○	×	×	×	No secondary enrichment
	BAYAN-HOSHOO	Sr	St.W.	0.7	SrO 40 ~50 %	◎	×	×	×	×	
ULZIIT	OLON-OVOOT	Au	VEIN	?	Au ≤32.8g/t, Max 340g/t	◎	○?	○?	○	○?	Large potentiality for new
	BAYAN-OVOOT	CaF_2	VEIN	1.0	CaF_2 75 % Qz-Fl type	△	○	○	×	×	discovery of workable gold
	DUGSHIH	Au	Qz-V	?	Au ≤50 g/t	◎	?	?	○	○?	ore deposits is expectable
	ONH	Au	Qz-V	?	Au ≤0.4g/t(13 samples)	◎	?	?	○	?	in this area.
	BAYAN-BOR-NURUU	Au	Qz-v	?	Au 1-6 g/t(182 samples)	◎	?	○?	○	○?	

Note;
◎ good, ○ passable, △ with difficulty, × bad

Chapter 2 Recommendations for the Second Year's Survey

1. It was found that, in Mongolia, there are enormous data concerning the surveys conducted in the past. In order to carry out the survey more smoothly and effectively in this country, it is necessary to collect further information concerning the past surveys and the geology of the survey area, and based on them, to consider the way of development work according to the survey stage, geological conditions and the features of deposits in each district.

2. As for the Uudam Tal area's survey, it is desirable to conduct the following surveys aiming the early development of profitable mines.

①: Promoting the surveys of Olon- Ovoot gold deposits

The method is

a) to prepare basic maps such as vein maps, assay maps on the surface of Olon-Ovoot deposit, and at the same time to confirm the horizontal and vertical extension and the structure of veins by geophysical exploration method.

②: Survey to evaluate a number of gold ore showings distributed in the area of about 300 km E-W×about 60 km N-S from the Ulziit district to the Tsagaansuvraga.

a) to conduct, on the known ore showings, a series of surveys of ore analysis, vein mapping, alteration zone survey, the homogenization temperature measurement of fluid inclusion, mineralogical study, etc. and to evaluate the possibility of finding of gold ore deposits.

b) to assume the tectonic line by satellite image analysis and gravity survey, and then to extract the promising area.

c) to determine the mineralization age of the deposits, as igneous activities in this area occur repeatedly from Devonian to Cretaceous Period and there is a possibility of overlapping gold mineralization.

d) to conduct remote sensing analysis including geological survey in order to correlate with results of photo-geological interpretation and extraction of alteration zones by satellite image analysis.

③: On the other hand, in the Dornod district, there is a possibility of existence of blind polymetallic deposits in the area covered widely with volcanic rocks of Jurassic to Cretaceous Period, so regional gravity survey should be conducted.

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APPENDICES

Appendix 1

Results of Laboratory Works

Appendix 1-1 Table of Laboratory Works

Testing items	Quantity Specified	Dornot	Tumurtiin -Ovoo	Nuhut-Dawaa	Har-Airag	Lugiin -gol	Tsagaan-suvraga	Ulziit	Performance Total
1. Thin sections	80	26	14	4	3	8	7	20	82
2. Polished sections	50	19	16	1	0	1	11	4	52
3. Whole rock chemical analysis	50	17	5	2	2	7	6	12	51
4. Ore analysis	370	82	45	12	29	7	90	120	385
1) Polymetallic vein and skarn (Cu, Pb, Zn, Ag, Au, Mo, W)	(100)	62	32	10	0	0	0	0	104
2) Porphyry copper(Cu, Mo, Ag, Au)	(100)	0	13	0	0	0	90	0	103
3) Auriferous quartz vein (Au, Ag)	(90)	18	0	0	0	0	0	74	92
4) Carbonatite and Apatite rock (TREO, Sr, Ba, P, Y)	(30)	0	0	0	0	7	0	26	33
5) Fluorite ore(CaF_2, SiO_2, $CaCO_3$, Fe_2O_3,)	(30)	0	0	2	29	0	0	0	31
6) Strontium ore ($SrSO_4$, $BaSO_4$, $CaSO_4$, Fe_2O_3,)	(20)	2	0	0	0	0	0	20	22
5. X-ray diffraction	100	25	12	5	9	6	19	26	102
6. Dating	30	10	3	0	0	7	3	7	30
1) K-Ar Method(whole rock)	(5)	2	0	0	0	1	0	2	5
2) K-Ar Method(mineral)	(20)	4	2	0	0	6	3	5	20
3) Pb-Pb Method(mineral)	(5)	4	1	0	0	0	0	0	5
7. Fluid inclusion test	10	3	0	1	2	1	0	7	14
8. Fossil identification	1	0	0	0	0	0	1	0	1

ABBREVIATIONS FOR SAMPLE LIST

act : actinolite
alk : alkaline
alt : altenated
and : andesite
apt ; apatite
argd : argillizated
az : azurite
ba : barite
ba : barite
bas : basalt
bg : bearing
bn : bornite
brc : brecciated
brn : brown
bt : biotite
cal : calcite
cala : calamine
calc : calcareous
carb : carbonate
cbt : carbonatite
ccp : chalcopyrite
cel : celestite
cer : cerussite
chl : chlorite
cly : clay
comp : compact
cpx : clinopyroxine
cpx : clinopyroxene
crdm : corundum
csg : coase grained
cup : cuprite
cv : covelline
da : dacite
dio : diorite
dress plt ; dressing plant
drsy ; drusy
effsv ; effusive
ep ; epidote
f ; fault
feld ; feldspor
fl ; fluorite
flowstrc : flow structure
fng : fine grained
gar : garnet
gb : gabbro
gd : granodiorite
gn : galene
gp : granitc porphyry
gr : granite
grn : green
grnCu : green Copper
grsn : greisen
gry : grey
gyp : gypsum
hb : hornblende
hem : hematite
hf : hornfels
kaol : kaolinite
lampro : lamprophyre
liev : lievrite
lm : limonite
lptf : lapilli tuff
ls : limestone
ltl : little
mal : malachite
mart : martite
mcs : marcacite
mdg : medium grained
mgt : magnetite
mo : molybdenite
monz : monzonite
ms : mudstone
msv : massive
mus : muscovite
neph : nepheline
ntwk : net work
ol : olivine
opx : orthopyroxine
oxd : oxide
pari : parisite
part : partialy
peg : pegmatite
phl : phlogopite
po : porphyry
po : pyrrhotite
po-Cu : porphyry copper
por : porphyrite
prop : propylite
prs : porous
purp : purple
py : pyrite
qp : quartz porphyry
qz : quartz
rh : rhyolite
scnd : secondary
sed : sedimentary rock
ser : serisite
sil : silicified
siltst : siltstone
sk : skarn
skzed : skarnized
sp : sphalerite
specl : specularite
ss : sandstone
stg : strong
stkwk : stock work
sy : syenite
synchi : synchisite
tf : tuff
trch : trachyte
trl : translucent
trp : transparent
v : vein
vlt : veinlet
vtrc : vitric
wd tf : welded tuff
wf : wolframite
wht : white
wk : weak
wthd : weathered
xln : crystalline

Appendix 1-2 (1) Sample List (1)

	SAMPLE No.	LOCALITY	ROCK NAME	WTDP (ASTL)	ORE (FPGPCS / LMVCBR)	XF (DI)	REMARKS
1	3 DN 1	Tsav	granodiorite, mdg, mt				No. 4trench
2	3 DN 2	Tsav	granodiorite	X		X	No. 4trench
3	3 DN 3	Tsav	clay, gry-wht, alt			X	No. 4trench
4	3 DN 4	Tsav	Pb-Zn ore		X		No. 14shaft pile
5	3 DN 5	Tsav	Pb-Zn ore		X		No. 14shaft pile
6	3 DN 6	Tsav	Pb-Zn ore		X		No. 14shaft pile
7	3 DN 7	Tsav	Pb-Zn ore		X		No. 14shaft pile
8	3 DN 8	Tsav	Pb-Zn ore		X		No. 14shaft pile
9	3 DN 9	Tsav	granite, csg, py				No. 14shaft pile, dike
10	3 DN 10	Tsav	qz, ccp, gn	X	X		No. 14shaft pile
11	3 DN 11	Tsav	qz, Mn-cbt, py, gn		X	X	No. 14shaft pile
12	3 DN 12	Tsav	granodiorite, csg, mt				No. 14shaft pile
13	3 DN 13	Tsav	Pb-Zn ore, Mn-cbnt	X	X	X	No. 15shaft pile
14	3 DN 14	Tsav	Pb-Zn ore, Mn-cbnt		X		No. 15shaft pile
15	3 DN 15	Tsav	Pb-Zn ore, Mn-cbnt, Ag	X	X		No. 15shaft pile
16	3 DN 16	Tsav	Pb-Zn ore, calamine		X	X	No. 15shaft pile
17	3 DN 17	Tsav	monzodiorite	XXK			DDH, Habirgan cmplx
18	3 DN 18	Tsav	granite porphyry	XXK			DDH, Habirgan cmplx
19	3 DN 19	Tsav	granite, schistose	XXK			DDH, Habirgan cmplx
20	3 DN 20	Tsav	alkali basalt	XX			DDH
21	3 DN 21	Tsav	nepheline basalt	XX			DDH
22	3 DN 22	Bayan-Uul	granite, schistose	XX			
23	3 DN 23	Tsav area	rhyolite				dike
24	3 DN 24	Tsav area	andesite				
25	3 DN 25	Tsav area	quartz orphyry, csg				
26	3 DN 26	Delger-Munh	15cm, qzv		X		
27	3 DN 27	Delger-Munh	1.2m, Pb ore, qzv-ntwk	X	X	X	
28	3 DN 28	Delger-Munh	sandstone				
29	3 DN 29	Mardai	welded tuff	X		XX	
30	3 DN 30	Mardai	lapilli tuff, alt, chl			XX	
31	3 DN 31	Mardai	welded tuff	X		X	
32	3 DN 32	Ulaan area	rhyolite	XX			S of Ulaan
33	3 DN 33	Ulaan area	rhyorite, flow-strc				S of Ulaan
34	3 DN 34	Ulaan area	rhyolite				S of Ulaan
35	3 DN 35	Ulaan area	dacite				NW of Ulaan
36	3 DN 36	Ulaan area	granite, sytic				NW of Ulaan
37	3 DN 37	Tsagaan-Chuluut Hud.	granite	XX			
38	3 DN 38	Ulaan area	granite	XXK			NW of Ulaan
39	3 DN 39	Ulaan	rhyolite, carb-fl	XGX	X		waste pile
40	3 DN 40	Ulaan	skarn, ep, sp	X	X		waste pile
41	3 DN 41	Ulaan	skarn, ep-act	X X			waste pile
42	3 DN 42	Ulaan	skarn, ep py, qzv, fl			X	
43	3 DN 42	Ulaan	rhyolite with qz v	X X			waste pile
44	3 DS 1	Tsav	galena rich ore	G	X		No. 4trench
45	3 DS 2	Tsav	oxd, gn, mal, cerussite	X	X	X	No. 4trench
46	3 DS 3	Tsav	oxd, gn, sp, qz		X		No. 4trench
47	3 DS 4	Tsav	qz, gn, ccp, py, grnCu	X	X		No. 4trench
48	3 DS 5	Tsav	galena rich ore, ccp	GX	X		No. 14shaft pile
49	3 DS 6	Tsav	1m v, oxd, MnO2, Ag		X	X	No. 8trench
50	3 DS 7	Tsav	andesite, wht alt			X	No. 8trench
51	3 DS 8	Tsav	oxd, Pb, Zn ore		X		No. 1trench
52	3 DS 9	Tsav	qzv10cm, oxd, Pb, Zn		X		No. 1trench
53	3 DS 10	Tsav	carbonate-opaq-qz v	X X	X	X	No. 15shaft tunnel
54	3 DS 11	Salhiit	qz, csg		X		
55	3 DS 12	Salhiit	meta-tonalite	XX			

Appendix 1-2 (2) Sample List (2)

	SAMPLE No.	LOCALITY	ROCK NAME	W	T	D	P	ORE						X	F	REMARKS
				A	S	T	L	FL	PM	GV	PC	CB	SR	D	I	
56	3 DS 13	Delger-Munh	ntwk10cm, wht carb						X					X		
57	3 DS 14	Delger-Munh	sil bre-zone 30cm						X							
58	3 DS 15	Ulaan	bre, sp, py, fl, qz						X							
59	3 DS 16	Ulaan	rhyolite	X	X											
60	3 DS 17	Ulaan	skarn, gar-act-bt-ep		X		X		X							proptic
61	3 DS 18	Ulaan	bre, gn, act, ep, sp, py													fl
62	3 DS 19	Ulaan	bre qz, sp, py, fl													
63	3 DS 20	Ulaan	galena, act, py, sp						X							stock pile
64	3 DS 21	Ulaan	galena, act, py, sp						X							stock pile
65	3 DS 22	Ulaan	py, qz, sp						X							stock pile
66	3 DS 23	Ulaan	py, qz, sp						X							stock pile
67	3 DS 24	Ulaan	galena, act, py, sp, qz						X							stock pile
68	3 DS 25	Ulaan	skarn ep-act						X							stock pile
69	3 DS 26	Ulaan	skarn ep-act, py						X							stock pile
70	3 DS 27	Ulaan	galena, act, py, sp, qz						X							stock pile
71	3 DS 28	Ulaan	galena, act, py, sp, qz						X							stock pile
72	3 DS 29	Ulaan	skarn ep-act, py						X					X		stock pile
73	3 DS 30	Ulaan	qz, epidote						X							
74	3 DS 31	Ulaan	rhyolite, sp, py						X							
75	3 DS 32	Ulaan	rhyolite, sil, sp, py						X							
76	3 DS 33	Ulaan	rhyolite, sil, sp, py						X					X		
77	3 DS 34	Ulaan	rh, bre, sp, py, act						X							
78	3 DS 35	Ulaan	strong oxd ore						X							
79	3 DS 36	Ulaan	oxd, act, ep, py, qz						X					X		
80	3 DS 37	Ulaan	hematite rich ore						X							
81	3 DS 38	Ulaan	oxd, bre, Mn						X							
82	3 DS 39	Ulaan	oxd, hem						X							
83	3 DS 40	Ulaan	1.5m qz, pegmatite												X	
84	3 DS 41	Ulaan	galena rich ore						X							
85	3 DS 42	Ulaan	qz, drusy						X							
86	3 DS 43	Tsagaan-Chuluut Hud.	qz, stkwk, oxd				X			X						
87	3 DS 44	Tsagaan-Chuluut Hud.	qz, stkwk, oxd, porous				X			X						
88	3 DS 45	Tsagaan-Chuluut Hud.	qz, stkwk, oxd				X			X						
89	3 DS 46	Tsagaan-Chuluut Hud.	qz, ser, py				X			X				X		
90	3 DS 47	Tsagaan-Chuluut Hud.	qz brecciated, mica							X				X		
91	3 DS 48	Tsagaan-Chuluut Hud.	qz, oxd, porous							X						
92	3 DS 49	Tsagaan-Chuluut Hud.	qz, oxd, porous							X						
93	3 DS 50	Tsagaan-Chuluut Hud.	qz, oxd, porous							X						
94	3 DS 51	Tsagaan-Chuluut Hud.	qz in peg, oxd, po							X						
95	3 DS 52	Tsagaan-Chuluut Hud.	qz brecciated, ntwk							X						
96	3 DS 53	Tsagaan-Chuluut Hud.	qz, ntwk							X						
97	3 DS 54	Tsagaan-Chuluut Hud.	qz, ntwk							X						
98	3 DS 55	Tsagaan-Chuluut Hud.	qzvlt							X						
99	3 DS 56	Tsagaan-Chuluut Hud.	qzv, 5m							X						
100	3 DS 57	Tsagaan-Chuluut Hud.	qzv, 50cm							X						
101	3 DS 58	Tsagaan-Chuluut Hud.	qzv 2.5m, py, mal, az							X				X		
102	3 DY 1	Tsav	Pb-Zn ore		X		X		X					X		No.4trench
103	3 DY 2	Tsav	Pb-Zn ore						X							No.14shaft pile
104	3 DY 3	Tsav	Pb-Zn ore			G	X		X							No.14shaft pile
105	3 DY 4	Tsav	granite, schistose	X	X											No.15shaft pile
106	3 DY 5	Salhiit	qzv						X					X		
107	3 DY 6	Salhiit	qzv, oxd						X							
108	3 DY 7	Bayan-Uul	qzv, oxd						X					X		
109	3 DY 8	Bayan-Uul	qzv, oxd						X					X		
110	3 DY 9	Bayan-Uul	qzv, oxd						X					X		

Appendix 1-2 (3) Sample List (3)

	SAMPLE No.	LOCALITY	ROCK NAME	WTDP				ORE						XF		REMARKS
								F	P	G	P	C	S			
				A	S	T	L	I	M	V	C	B	R	D	I	
111	3 DY 10	Bayan-Uul	qzv, oxd						X							
112	3 DY 11	Bayan-Uul	qzv, oxd						X							
113	3 DY 12	Bayan-Uul	qzv, oxd						X							
114	3 DY 13	Bayan-Uul	meta-dolerite	X	X											
115	3 DY 14	Ulaan area	rhyolite, spherulite													
116	3 DY 15	Tsagaan-Chuluut Hud.	monzodiorite	X	X					X						
117	3 DY 16	Tsagaan-Chuluut Hud.	granite porphyry	X	X	K										
118	3 DY 17	Tsagaan-Chuluut Hud.	monzodiorite	X	X											
119	3 DY 18	Tsagaan-Chuluut Hud.	welded tuff													
120	3 DY 19	Tsagaan-Chuluut Hud.	meta-granite po	X	X											
121	3 DY 20	Tsagaan-Chuluut Hud.	qzv							X						
122	3 DZ 1	Tsav	skarn, sp fl, qzv, fl												X	
123	3 HA 1	Bor-Undur No. 5	quartz orphyry, sil											X		tunnel
124	3 HN 1	Hatsungin-alshan	calcareous sinter													
125	3 HN 2	Tsagaantakhilch	qzv, fl													
126	3 HN 3	Tsagaantakhilch	qzv, fl													
127	3 HN 4	Tsagaantakhilch	qzv, fl													
128	3 HN 5	Maihanta 2	fl, zebra ore													
129	3 HN 6	Maihanta 2	Marble, banded													
130	3 HN 7	Tsagaantakhilch	granite, gneissose													DDH
131	3 HN 8	Tsagaantakhilch	granite, fng~mdg													
132	3 HN 9	Hongor 3	limestone, part sil													
133	3 HN 10	Hongor 3	qzv, fl													
134	3 HN 11	Hongor 3	rhyolite, a ltl of qz													
135	3 HN 12	Bor-Undur No. 2	quartz orphyry													waste pile
136	3 HN 13	Bor-Undur No. 3	quartz orphyry, fl					X						X		
137	3 HN 14	Bor-Undur No. 3	basalt													
138	3 HN 15	Bor-Undur No. 2	qzv, fl					X								waste pile
139	3 HN 16	Bor-Undur No. 11	meta-dacite	X	X											
140	3 HN 17	Bor-Undur No. 11	fl ore					X								
141	3 HN 18	Bor-Undur No. 11	clay in 3HN17											X		
142	3 HN 19	Adag No. 1	granite, aplitic													
143	3 HN 20	Adag No. 1	white alt in 3HN19											X		
144	3 HN 21	Adag No. 1	granophyre	X	X											
145	3 HN 22	Bor-Undur No. 5	qz-fl v		X			X						X	X	tunnel
146	3 HN 23	Bor-Undur No. 5	quartz orphyry, sil													tunnel
147	3 HN 24	Bor-Undur No. 5	fl ore					X								tunnel
148	3 HN 25	Bor-Undur No. 5	fl ore					X								tunnel
149	3 HN 26	Bor-Undur dress plt	flotation head ore					X								φ16-20mm
150	3 HN 27	Bor-Undur dress plt	fl-conc					X								final product
151	3 HN 28	S of choir Mt.	granite, csg, potic													
152	3 HS 2	Bor-Undur No. 3	fl ore					X								
153	3 HS 3	Bor-Undur No. 2	fl ore					X								
154	3 HS 4	Bor-Undur No. 13	fl ore					X								
155	3 HS 5	Bor-Undur No. 13	fl ore					X								
156	3 HS 6	Adag No. 3	fl ore					X						X		
157	3 HS 7	Adag No. 3	fl ore					X								
158	3 HS 8	Bor-Undur No. 5	clay, fl					X						X		tunnel
159	3 HS 9	Bor-Undur No. 5	fl ore					X								tunnel
160	3 HS 10	Bor-Undur No. 5	fl ore					X								tunnel
161	3 HS 11	Bor-Undur No. 5	fl ore					X								tunnel
162	3 HS 12	Bor-Undur No. 5	fl ore					X								tunnel
163	3 HY 1	Tsagaantakhilch	fng qzv, comp fl					X								
164	3 HY 2	Maihanta 2	fng qzv, csg fl					X							X	
165	3 HY 3	Bor-Undur No. 13	fng fl					X								

Appendix 1-2 (4) Sample List (4)

	SAMPLE No.	LOCALITY	ROCK NAME	WTDP				ORE						XF		REMARKS
								F	P	G	P	C	S			
				A	S	T	L	L	M	V	C	B	R	D	I	
166	3 HY 4	Adag	rhyolite, wk sil, fl					X								
167	3 HY 5	Bor-Undur No. 5	qzv, fl					X						X		tunnel
168	3 HY 6	Chol-Tsagaan-Del	white clay											X		
169	3 HY 7	Chol-Tsagaan-Del	qzv, fl					X								
170	3 HY 8	Chol-Tsagaan-Del	qzv, fl					X								
171	3 HY 9	Chol-Tsagaan-Del	qz ntwk, fl					X								
172	3 HY 10	Chol-Tsagaan-Del	qzv, fl					X								
173	3 HY 11	Chol-Tsagaan-Del	fl ore, fng gravel					X								tailing
174	3 NN 1	Yuguzer	qzv w8cmm min, Mo W												X	
175	3 NS 1	Yuguzer	greisen, fl		X				X					X		
176	3 NS 2	Yuguzer	greisen, mica, mo				X		X							
177	3 NS 3	Yuguzer	greisen	X	X				X							
178	3 NS 4	Yuguzer	greisen		X				X							
179	3 NS 5	Yuguzer	fl v					X								
180	3 NS 6	Yuguzer	oxide ore						X					X		
181	3 NS 7	Yuguzer	qzv, ccp, py, gn, mo						X							
182	3 NS 8	Yuguzer	qzv, wf, mo						X							
183	3 NS 9	Yuguzer	qzv, mo, weathered						X							
184	3 NS 10	Tsentr	qz, wf						X							
185	3 NS 11	Tsentr	secondary carb, on qp											X		
186	3 NS 12	Tsentr	granite, greisenized	X	X											
187	3 NS 13	Nuhutiin-Tsagaantolg.	beryl											X		Be assey
188	3 NS 14	Nuhutiin-Tsagaantolg.	qz, wf						X					X		
189	3 NS 15	Nuhutiin-Tsagaantolg.	fl ore					X								
190	3 RS 1	Lugiingol	carbonatite, synchi									X		X		
191	3 RS 2	Lugiingol	hornfels, corundum	X	X							X				
192	3 RS 3	Lugiingol	carbonatite	X	X							X		X		
193	3 RS 4	Lugiingol	syenite	X	X											alkali gabbro
194	3 RS 5	Lugiingol	syenite													
195	3 RS 6	Lugiingol	syenite	X	X											
196	3 RS 7	Lugiingol	lamprophyre		X											
197	3 RS 8	Lugiingol	cbt, shynchi, pari									X		X		
198	3 RS 9	Lugiingol	nepheline syenite, fl	X	X	X										
199	3 RS 10	Lugiingol	cbt, shynchi, pari, gn									X		X		wdth 8cm
200	3 RS 11	Lugiingol	carbonatite, pseu py									X		X		
201	3 RS 12	Lugiingol	carbonatite, specul?				X									
202	3 RS 13	Lugiingol	shynchi, fl									X		X	X	
203	3 RS 14	Lugiingol	syenite	X	X	X										DDH10-A-8, 10m
204	3 RS 15	Lugiingol	nepheline syenite	X	X	X										DDH12-A-6, 90m
205	3 SN 1	Tsagaansuvraga	tuff													DDH
206	3 SN 2	Tsagaansuvraga	meta-dacite		X						X			X		survey line 12
207	3 SN 3	Tsagaansuvraga	qz monzonite, grn-Cu								X			X		survey line 12
208	3 SN 4	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
209	3 SN 5	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
210	3 SN 6	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
211	3 SN 7	Tsagaansuvraga	syenite, dike								X			X		survey line 12
212	3 SN 8	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
213	3 SN 9	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
214	3 SN 10	Tsagaansuvraga	quartz monzonite	X	X						X			X		survey line 12
215	3 SN 11	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
216	3 SN 12	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
217	3 SN 13	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
218	3 SN 14	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
219	3 SN 15	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
220	3 SN 16	Tsagaansuvraga	qz monzonite, grn-Cu								X			X		survey line 12

Appendix 1-2 (5) Sample List (5)

	SAMPLE No.	LOCALITY	ROCK NAME	WT A	DP S	T	L	ORE FP L	M	G V	P C	C B	S R	XF D	I	REMARKS
221	3 SN 17	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
222	3 SN 18	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
223	3 SN 19	Tsagaansuvraga	qz monzonite, grn-Cu								X			X		survey line 12
224	3 SN 20	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 12
225	3 SN 21	Tsagaansuvraga	greisen	X	X	K					X			X		
226	3 SN 22	Tsagaansuvraga area	quartz monzonite	X	X	K										10km east from T.S.
227	3 SS 1	Tsagaansuvraga	qz monzonite, grn-Cu													
228	3 SS 2	Tsagaansuvraga	qz monzonite, grn-Cu													
229	3 SS 3	Tsagaansuvraga	qz monzonite, grn-Cu													
230	3 SS 4	Tsagaansuvraga	qz monzonite, grn-Cu													
231	3 SS 5	Tsagaansuvraga	qz monzonite, ccp, cv													stock pile
232	3 SS 6	Tsagaansuvraga	qz monz, mo, grn-Cu													stock pile
233	3 SS 7	Tsagaansuvraga	keratophyre	X	X						X					
234	3 SS 8	Tsagaansuvraga	acid-effsv or wdtf								X					
235	3 SS 9	Tsagaansuvraga	qz monzonite, ccp													DDH-core
236	3 SS 10	Tsagaansuvraga	calc-siltst, fossil								X					survey line 20
237	3 SS 11	Tsagaansuvraga	tuff breccia								X			X		survey line 20
238	3 SS 12	Tsagaansuvraga	qz monzonite, grn-Cu								X			X		survey line 20
239	3 SS 13	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
240	3 SS 14	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
241	3 SS 15	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
242	3 SS 16	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
243	3 SS 17	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
244	3 SS 18	Tsagaansuvraga	qz monzonite, grn-Cu								X			X		survey line 20
245	3 SS 19	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
246	3 SS 20	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
247	3 SS 21	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
248	3 SS 22	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
249	3 SS 23	Tsagaansuvraga	leuco granite, grn-Cu								X					survey line 20
250	3 SS 24	Tsagaansuvraga	quartz monzonite, Cu	X	X	K					X			X		survey line 20
251	3 SS 25	Tsagaansuvraga	leuco granite, grn-Cu								X					survey line 20
252	3 SS 26	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
253	3 SS 27	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
254	3 SS 28	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
255	3 SS 29	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
256	3 SS 30	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
257	3 SS 31	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
258	3 SS 32	Tsagaansuvraga	qz monzonite, grn-Cu								X			X		survey line 20
259	3 SS 33	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 20
260	3 SS 34	Tsagaansuvraga	keratophyre	X	X						X					survey line 20
261	3 SS 35	Tsagaansuvraga	granodiorite								X			X		survey line 20
262	3 SS 36	Tsagaansuvraga	qz monzonite, grn-Cu								X			X		survey line 32
263	3 SS 37	Tsagaansuvraga	granodiorite, grn-Cu								X					survey line 32
264	3 SS 38	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 32
265	3 SS 39	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 32
266	3 SS 40	Tsagaansuvraga	qz monzonite, grn-Cu								X			X		survey line 32
267	3 SS 41	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 32
268	3 SS 42	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 32
269	3 SS 43	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 32
270	3 SS 44	Tsagaansuvraga	qz monzonite, grn-Cu								X			X		survey line 32
271	3 SS 45	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 32
272	3 SS 46	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 32
273	3 SS 47	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 32
274	3 SS 48	Tsagaansuvraga	qz monzonite, grn-Cu								X			X		survey line 32
275	3 SS 49	Tsagaansuvraga	qz monzonite, grn-Cu								X					survey line 32

Appendix 1-2 (6) Sample List (6)

	SAMPLE No.	LOCALITY	ROCK NAME	WTDP ASTLI	ORE FPG MV	ORE PCS CBRD	XF DI	REMARKS
276	3 SS 50	Tsagaansuvraga	qz monzonite, grn-Cu			X		survey line 32
277	3 SY 1	Tsagaansuvraga	qzv, mal, cc, ccp	X		X	X	stock pile
278	3 SY 2	Tsagaansuvraga	mal, cup					stock pile
279	3 SY 3	Tsagaansuvraga	ccp, bn, mo	X		X		stock pile, Composit
280	3 SY 4	Tsagaansuvraga	py, ccp, bn, mal, mo			X		stock pile, Composit
281	3 SY 5	Tsagaansuvraga	py, ccp, bn, mal	X		X		stock pile, Composit
282	3 SY 6	Tsagaansuvraga	po, py, ccp, bn, mal			X		stock pile, Composit
283	3 SY 7	Tsagaansuvraga	py, ccp, mo, mal			X		stock pile, Composit
284	3 SY 8	Tsagaansuvraga	qzv, ccp, mo, bn, py	X		X		stock pile
285	3 SY 9	Tsagaansuvraga	qzv, ccp, mo, bn, py					stock pile
286	3 SY 10	Tsagaansuvraga	qz-ser v, ccp, bn					stock pile
287	3 SY 11	Tsagaansuvraga	qzv, ccp, bn, mal					stock pile
288	3 SY 12	Tsagaansuvraga	qz-ser v, ccp	X		X		stock pile
289	3 SY 13	Tsagaansuvraga	mal, ccp, bn, mo			X		stock pile, Composit
290	3 SY 14	Tsagaansuvraga	qz-ser v, ccp, bn, mal	X		X		stock pile
291	3 SY 15	Tsagaansuvraga	qzv, ccp, bn, mal	X		X	X	stock pile
292	3 SY 16	Tsagaansuvraga	mal, ccp, bn, cv, mo			X		stock pile, Composit
293	3 SY 17	Tsagaansuvraga	mal, ccp			X		stock pile, Composit
294	3 SY 18	Tsagaansuvraga	qz-ser v, mal, ccp, py					stock pile
295	3 SY 19	Tsagaansuvraga	ccp, py					stock pile
296	3 SY 20	Tsagaansuvraga	ccp, bn, mal, mo	X		X		stock pile, Composit
297	3 SY 21	Tsagaansuvraga	ccp, bn, mo, fl			X		stock pile, Composit
298	3 SY 22	Tsagaansuvraga	ccp, bn, mo, fl	X		X		stock pile, Composit
299	3 SY 23	Tsagaansuvraga	qz-ser v, mal, ccp, mo					stock pile
300	3 SY 24	Tsagaansuvraga	qzv, ccp, mal, bn	X		X		stock pile
301	3 SY 25	Tsagaansuvraga	ccp, mal, bn			X		stock pile, Composit
302	3 SY 26	Tsagaansuvraga	mal, ccp, bn, mo			X		stock pile, Composit
303	3 SY 27	Tsagaansuvraga	ccp, cv, mal			X		stock pile, Composit
304	3 SY 28	Tsagaansuvraga	ccp, cv, bn			X		stock pile, Composit
305	3 SY 29	Tsagaansuvraga	ccp, bn, mo			X		stock pile, Composit
306	3 SY 30	Tsagaansuvraga	ccp, bn, mal, mo			X		stock pile, Composit
307	3 SY 31	Tsagaansuvraga	ccp, mo, mal			X		stock pile, Composit
308	3 SY 32	Tsagaansuvraga	ccp, cv, mal, mo	X		X		stock pile, Composit
309	3 SY 33	Tsagaansuvraga	ccp, bn, mal			X		stock pile, Composit
310	3 SY 34	Tsagaansuvraga	ccp, mal			X		stock pile, Composit
311	3 TN 1	Tumurtiin-Ovoo	skarn, gar, mgt, sp	X X	X		X	
312	3 TN 2	Salaa	granite, mdg-csg, bio					pale-grn feld
313	3 TN 3	Salaa	granite	XXK				pale-grn feld, DDH
314	3 TN 4	Salhiit core strage	skarn, gar	X X	X		X	
315	3 TN 5	Salhiit core strage	skarn, gar, sp		X			DDH
316	3 TN 6	Salhiit core strage	skarn, gar, mgt		X			
317	3 TN 7	Salhiit core strage	cortlandite	X	X		X	
318	3 TN 8	Salhiit core strage	limestone/skarn, gn	G				DDH
319	3 TS 1	Arin-Nuur	oxd ore, grnCu, mus			X	X	
320	3 TS 2	Arin-Nuur	granite	X X		X		
321	3 TS 3	Arin-Nuur	granite, potic, mus, mo			X		
322	3 TS 4	Arin-Nuur	qzv, py, mo, mus,			X		
323	3 TS 5	Arin-Nuur	qz, mus, mo, py			X		
324	3 TS 6	Arin-Nuur	Mo ore			X		stock pile
325	3 TS 7	Arin-Nuur	granite	X X		X	X	
326	3 TS 8	Arin-Nuur	Mo ore			X		stock pile
327	3 TS 9	Arin-Nuur	Mo ore			X		stock pile
328	3 TS 10	Arin-Nuur	Mo ore			X		stock pile
329	3 TS 11	Arin-Nuur	Mo ore			X		stock pile
330	3 TS 12	Arin-Nuur	Mo ore			X		stock pile