No. 14

EXPLANATORY NOTE
ON
THE GEOLOGY AND DEPOSITES
OF
THE UUDAMTAL AREA, MONGOLIA
THE COOPERATIVE MINERAL EXPLORATION
BY
JICA/MMAJ-MGMR, 1990-1993

MARCH, 1994

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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CONTENTS

1. Outline of the Survey

1-1 Survey area and purpose of the survey

The survey area called Uudam Tal Area has a total area of 500,000km^2, 300-400km wide and 1,200km long, demarcated by the meridians passing the two points, ie., long.103° 00′ E-lat.45° 00′ N and long.113° 00′ E-lat.48° 00′ N and by the diagonal lines linking the two points.

Geographically, the area, situated in southeastern Mongolia, is bordered on the north by Russia while on the east and south by China. Topographically, the area consists of the Mongolian Highlands, Dornod Plain and Govi Lowlands. Elevation varies from 560m at Lake Khuh in Dornod District to 2,815m at Gurban Saikhan Mountains in the southwestern tip of the survey area, most parts of which are plateaus of 1,000-1,500m above sea level. In administrative division terms, the area extends over the seven districts(aimag) : Dornod, Sukhbaatar, Hentii, Dornogovi, Dundgovi, Umnugovi and Uvurhangai.

The survey area is located on the Paleozoic orogenic belt between Siberian and Sino-Korean Tablelands. The geology is composed of a small block of the Middle Proterozoic group, the Paleozoic and Mesozoic groups. Igneous activity extends from Proterozoic to Cretaceous, which formed a variety of ore deposits in the area.

The survey was intended to grasp occurrence of ore deposits by clarifying geological conditions of Uudam Tal Area.

1-2 Survey methods, quantities and survey periods

Table 1-1 shows the survey quantities by survey methods conducted during the 3 years in the area. Selection of promising areas was made by the flow chart shown in Table 1-2.

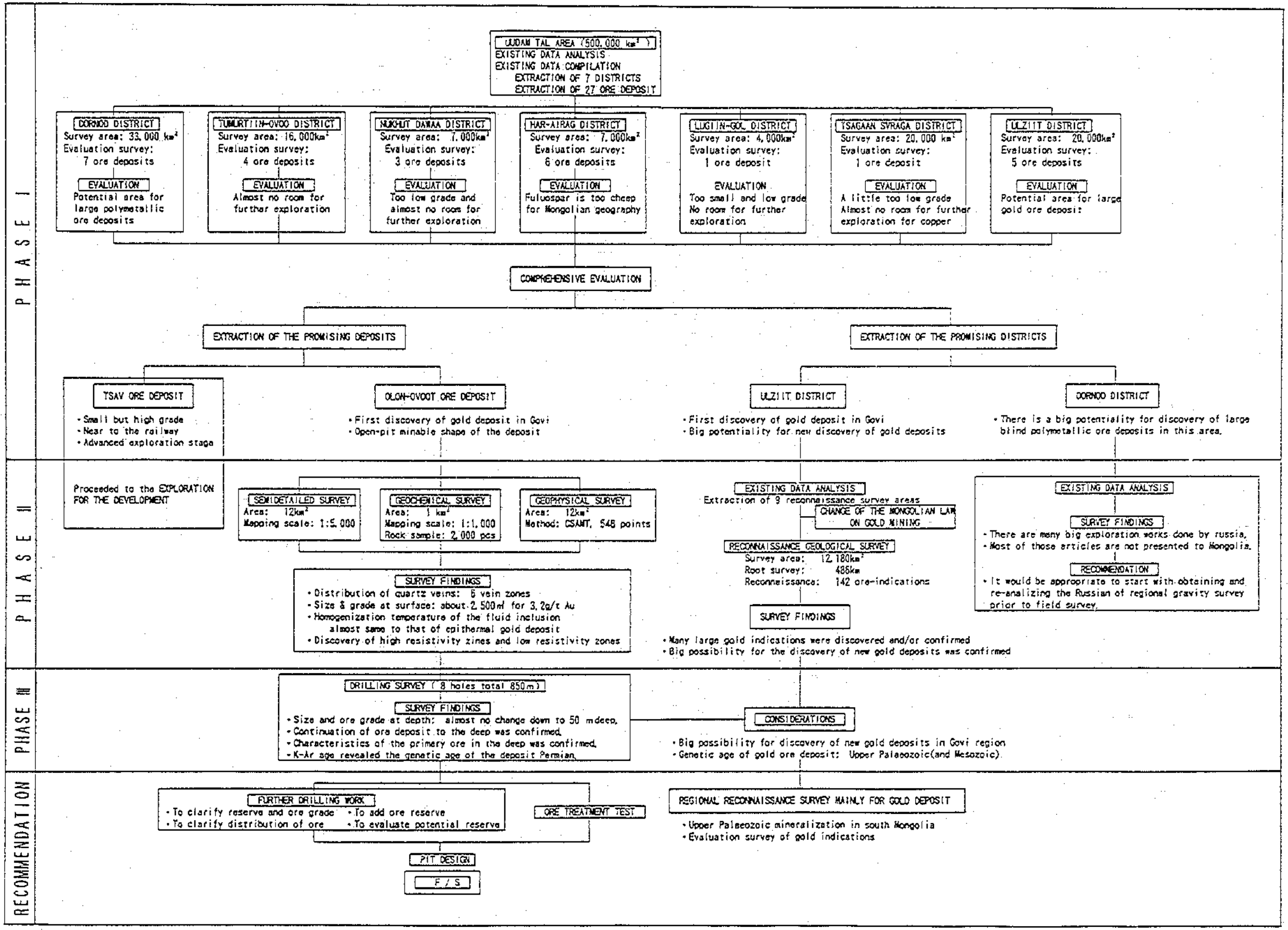
Period of field surveys and analysis for the 3 years are as follows:

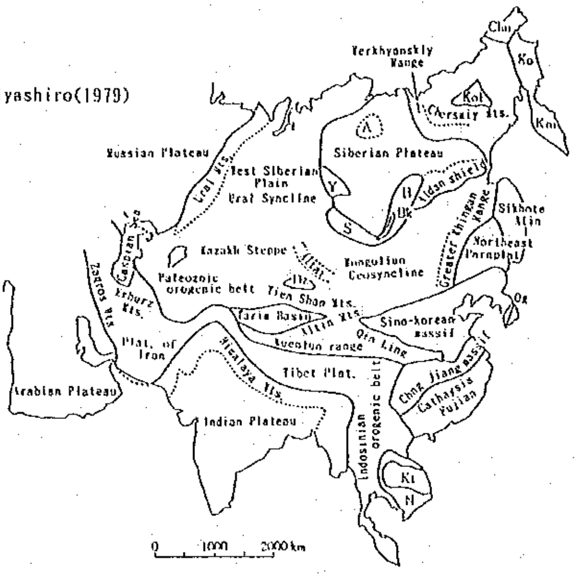
Fiscal year	Field survey	Analysis
1st year	June/18-Oct/8/91	Oct/9/91-Jan/31/92
2nd year	June/14-Sept/23/92	Sept/24/92-Jan/29/93
3rd year	June/28-Oct/7/93	Oct/8/93-Feb/25/94

Table 1-1 Quantity of the Survey Works

	Phase Ⅰ (1991)	Phase Ⅱ (1992)	Phase Ⅲ (1993)	Total
Existing Data				
Compilation (km²)	500,000	—	—	500,000
Analysis (km²)	—	33,000	—	33,000
Satellite Imagery				
Interpretation (km²)	500,000	4,650	—	504,650
Analysis (km²)	200	—	—	200
Geological Survey				
Reconnaissance (km²)	107,000	50,000	—	157,000
Evaluation survey of deposits	27	142	—	169
Semidetailed (km²)	—	12	—	12
Detailed (km²)	—	0.5	—	0.5
Geophysical Survey (km²)	—	12	—	12
TEM method (m.p.)	—	548	—	548
Geochemical Survey (km²)	—	0.5	—	0.5
Drilling Survey				
Drilling hole	—	—	8	8
Total length (m)	—	—	861.70	861.70
Laboratory Tests (Sample, pcs)				
Chemical analysis	385	2,501	201	3,087
Thin section	82	28	10	120
Polished section	52	18	4	74
X-ray diffraction analysis	102	200	20	322
Whole rock chemical analysis	51	58	5	114
Fluid inclusion test	14	95	10	119
Absolute age dating	30	10	3	43
Resistivity measurement	—	56	—	56
Fossil identification	1	—	—	1

Table 1-2 Flow Chart of the Extraction of Promising Areas

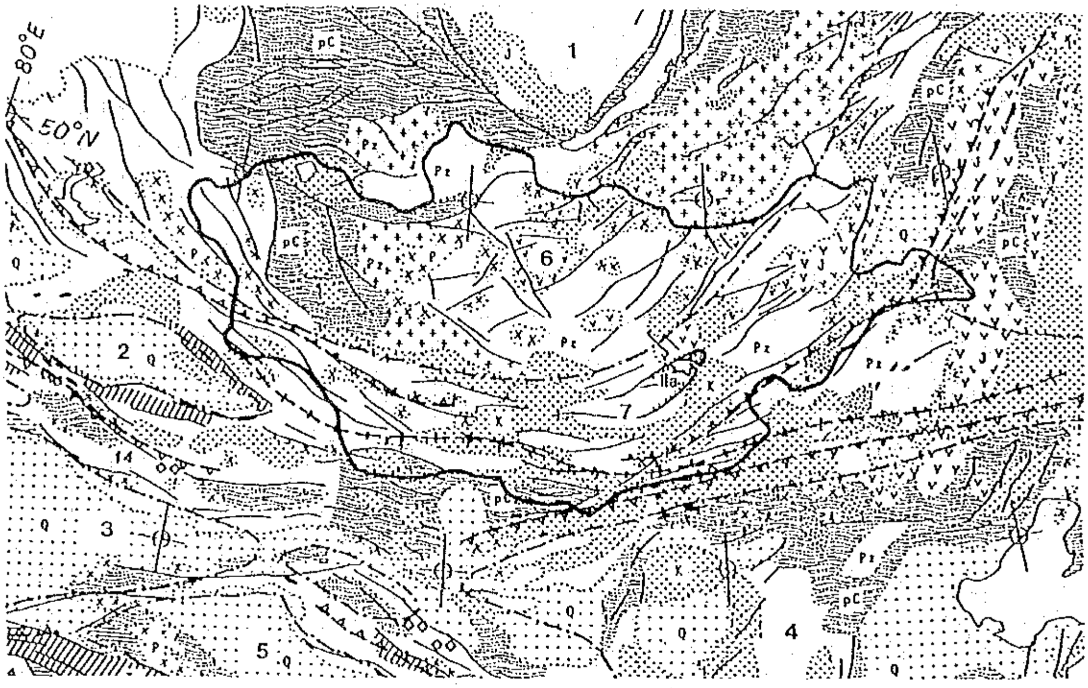




Miyashiro(1979)

LEGEND

A: Anabar Plateau
B: Baikal Mts.
Bk: Lake Baikal
Chu: Chukotskiy Pen.
Dz: Dzungaria Basin
Km: Kamchtka Pen.
Ko: Koryak Mts.
Kol: Kolyma massif
Kt: Kontum massif
H: Hersinian ologenic belt
Og: Ogcheon Geosyncline
S: Sayan Mts.
Y: Yenisei Mts.



LEGEND

Taira and Tashiro(1987)

Sedimentary rocks

- ⁚ Quaternary(Nonmarine)
- ☐ Palaeozoic(Sedimentary and Metamorphic Rocks)
- ▨ Nonmarine Sedimentary Rocks

pC: Precambrian

Pz: Paleozoic

P : Permian

J : Jurassic

K : Cretaceous

Q : Quaternary

Igneous rocks and metamorphic rocks

- ▨ Tertiary igneous rocks (chiefly volcanic rocks)
- VVVV Mesozoic volcanic rocks
- XXX Permo-Mesozoic Granitic Rocks
- +++ Paleozoic Igneous Rocks
- ▨ Precambrian and Early Paleozoic Basement Rocks
- — Ophiolites
- ∞∞ Blue Schists
- IIa Har-Airag Block(middle Proterozoic) gneiss, crystalline schist, marble, gneissose granite

- ⁄ Fault
- ▲ Approximate Location of Ancient subduction zone
- ┼ Approximate Location of suture zone
- ⋯ Approximate boundary of continental blocks

1 Siberian Block

2 Junggar Block

3 Tarim Block

4 Sino-korean Block

5 Tsaidam Block

6 Sajany AFB(Early Paleozoic)

7 Altay-Hinggan AFB(Late Paleozoic)

Fig. 2-1 Geological Setting of the Survey Area

2. Outline of Geology and Ore Deposits

2-1 Outline of the regional geology

Mongolia is located on the orogenic belt once called "Mongolian Geosyncline" lying between the Siberian and Sino-Korean Table Lands.

Geology of the geosyncline is underlain by Precambrian, Paleozoic and Mesozoic in ascending order. These formations underwest orogenic movements of Baikalian(Late Proterozoic), Caledonian(Early Paleozoic) and Hercynian(Late Paleozoic) times.

On the east side of the orogenic belt, there is the Northeast Paratableland(Breya Block), whilst a Precambrian block called "Sino-Korean Massif lines to the south of the belt. The three basins of Jungar (Dzungar), Tarim and Tsaidam located on the west side of the Sino-Korean Massif are all covered with thick(several to 10km) Phanerozoic formations and, in the deep, there lines Precambrian metamorphic basement. Between these basins, mountain ranges composed of rocks deformed and metamorphosed in the Hercynian time, such as Altai, Tenshan and Kunlun, extend east and west.

From these facts, the Mongolian orogenic belt has been considered to be an accretionary zone to the Siberian Tablelands by the subduction of an oceanic plate throughout the Paleozoic era.

2-2 General geology of the survey area

The survey area is situated on the Paleozoic orogenic belt in the south to southeast margins of Siberian Tablelands. The geology is constituted by the Middle to Upper Proterozoic, Paleozoic and Mesozoic groups. The formations in or before the Paleozoic time underwent the orogenic movements of Baikalian, Caledonian and Hercynian ages, into which granitic rocks of various times in or after the Proterozoic intrude. Igneous activity lasted to Mesozoic; volcanic and granitic rock of late Jurassic to Createaceous(Yenshan period) are widely distributed.

The Middle Proterozoic group covered unconformably with Paleozoic and Mesozoic groups out as inlier, in an area 80km(E-W) x 30km(N-S) in southweatern Har-airag district. It consists mainly of gneiss, schist and crystalline limestone, and of gneissose granite intruding into them, which form country rock of the fluorite deposits at crystalline schist presumably of Proterozoic are distributed in the northeast and near Tsav Deposit in the east.

The Paleozoic group is distributed all over Uudam Tal Area, which consists of marine sediments of schist, phyllite, sandstone, siltstone, limestone and chert of Silurian, Devonian, Carboniferous, Permian, ages. These are distributed along the Siberian Tableland, folding intensively and forming an arc; convexly with a southern aspect.

In Govi district, serpentinized ultrabasic rock is scattered along a tectonic line "Main Mongolian Lineament" parallel with the fold axis. Into these sediments, granitic rocks of various ages in or after Paleozoic intrude.

The Mesozoic group is broadly distributed in Govi and Dornod districts, consisting mainly of Jurassic to Cretaceous(Yenshan period) volcanic and granitic rock and Cretaceous continental sediments. Govi and Dornod districts where the Mesozoic group reaches 3,000m in thickness, are known for oil shale and oil production. Many coal filds are also formed there accompanying the inland sediments.

The Cenozoic group mainly of continental sediments is sporadically distributed in the young tectonic basins. It is rather thin and poorly developped in general.

2-3 Outline of the ore deposits

Ore deposits of the survey area are genetically devided into two groupes, namely Late Paleozoic(Hercynian) group and Mesozoic(Yenshanian) group.

Porphyry type copper deposits such as Tsagaan-suvraga(Cu, 315±16Ma～354±18Ma), Harmagtai(Cu), Shuten(Cu,Au?) and the gold ore deposit of Olon-ovoot(Au, 283±14Ma) are genetically related to the Hercynian igneous activities.

With the Mesozoic igneous activities, polymetallic deposits of Dornod District, skarn deposits of Tumurtiin-ovoo District, fluospar deposits of Har-airag District, greisen type tin-tungsten deposits of Nuhut-dawaa District, as well as the rare earths deposits accompanying alkaline rock at Lugiin-gol, Mushgia-hudag, Bayan-khushuu, etc., were formed.

Govi and Dornod districts where the Mesozoic group reaches 3,000m in thickness, are known for oil shale and oil production. Many coal filds are also formed there accompanying the inland sediments.

Thanks to the gentle topography and favorable accesses, the survey area has so far been most closely surveyed and covers most of Mongolia's major known deposits zones.

3. General Remarks of the Survey Results

3-1 Existing data analysis

3-1-1 Existing data compilation

a) Purpose

Past relevant information and data accumulated in Mongolia were collected, sorted out and analysed so that they might serve as basic reference for formulating policies for the subsequent surveys. Main points of the analysis were as follows:

i) Outline of the past and ongoing surveys in the survey area.
ii) Outline of operating mines and mine development projects.
iii) Outline of ore deposits and mineral indications, as well as their occurrence in the survey area.
iv) Problems in survey for mineral resources development in Mongilia.

b) Analytical work

The work was done mainly at the State Geological Center, MPR in Ulaan Baatar (currently, the Information Center of Mongolia) of the reference literature selected and presented by the Mongolian side in line with the purports of analysis. The following items were checked concerning metallic and nonmetallic minerals, and coal resources in the survey area.

i) History of geological survey and minig industry.
ii) Outline of the geology of survey area.
iii) Known ore deposits and mineral indications.
iv) Statistical data of production and external trade of minerals.

c) Results of analysis

The results of analysis, which formed the back bone of the first year's survey, were reflected in the planning field survey and used as the basic reference for descriptions and evaluation of geology, ore deposits and mineral indications.

3-1-2 Existing data analysis

a) Purpose

Previous geophysical survey data on Dornod District were collected, sorted out and analysed to formulate basic ideas for the subsequent surveys. Main points of the analysis were as follows:

i) Outline of the past geophysical survey works in Dornod District.
ii) Outline of the ore deposits and Ore-indications in the survey area.

b) Analytical work

The work was done on the literatures selected and presented by the Mongolian side in line with the purports of analysis.

c) Results of analysis

The work revealed that great amount of geophysical survey works including gravity survey were already done in Dornod District.

As the result, it became clear that many ore deposits and ore indications present in the area. The mineral species cover polymetal, gold, zinc in skarn deposit, tin and tungsten in greisen deposit. Southwestern part of the area is overlain by the younger Mesozoic terrestrial sediments continue to the Choibalsan Basin which accompany with oil field and coal fields.

From above mentioned facts, it is possible to expect blind polymetallic ore deposits in this district.

3-2 Satellite image analysis

3-2-1 Photo-geological interpretaion (PGI)

a) purpose

PGI was intended to study regional geological structure, faults, folds, intrusive rocks, etc. of the entire survey area.

b) Image interpretation

Using the false color images in a 1/500,000 scale, lineament extraction and classification of rock facies were made with photogeological techniques. Interpretation results were compiled with a scale of 1/1,000,000.

c) Lineament analysis findings

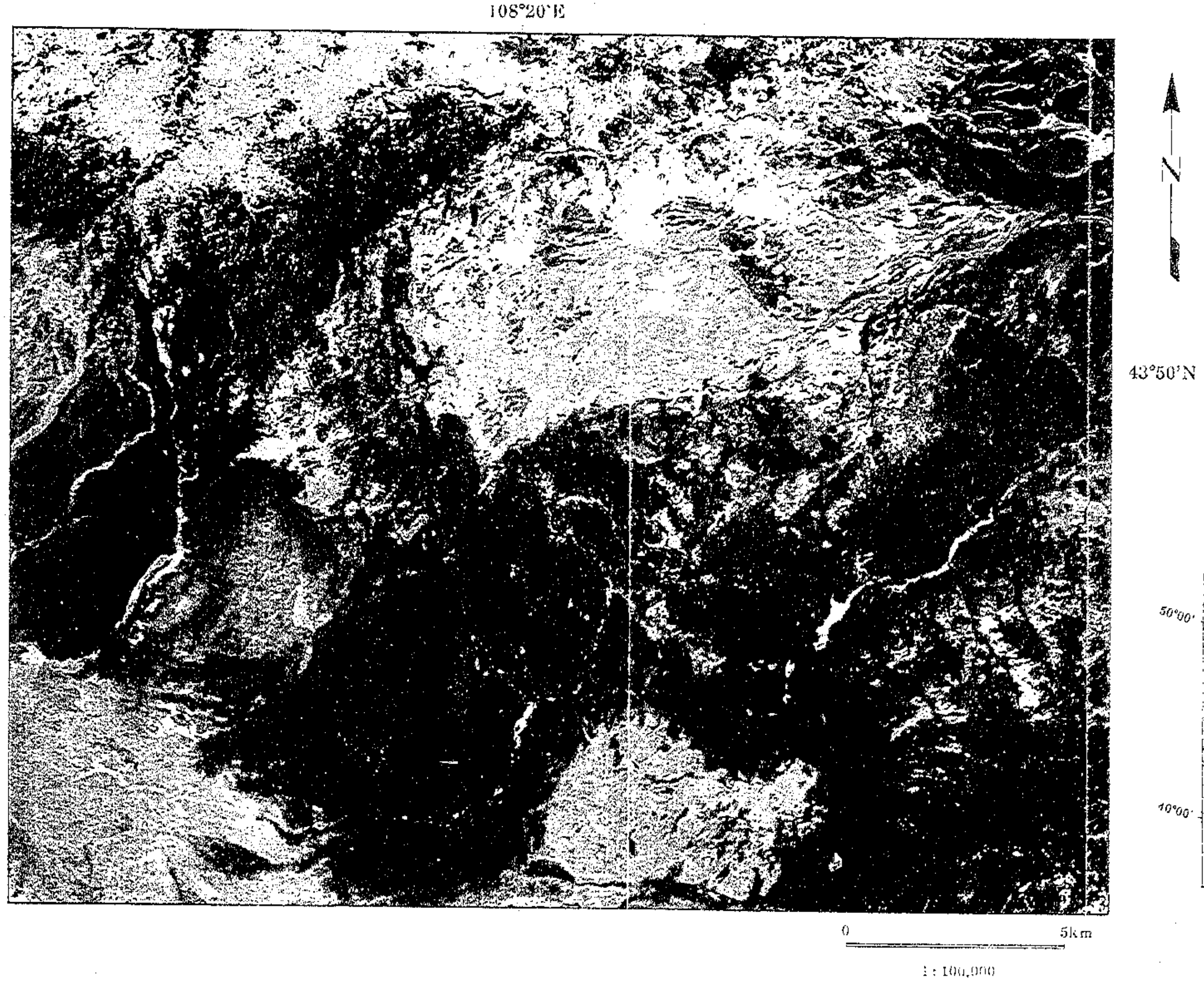
In areas where formations above the upper Cretaceous are distributed, clear lineaments are not recognizable, whilst the lineament density is high in areas where older formations are distributed. In the southwestern part of the survey area, east-west lineaments and faults are conspicuous, but, in the central part, the direction shifts somewhat to NE-SW and, in the northeastern part, NE-SW lineaments are prominent. These directions correspond to the paleozoic orogenic belt of the area.

In Olon-ovoot Area, mineral indications are distributed around ENE-WSW faults and portions of dense lineaments. This suggests that deposition of the ore minerals was controlled by fissures.

d) Findings of geological unit interpretation

The boundary between the upper Cretaceous soft rock and the underlying hard rock is clearly observed on the images, as well as distribution of granitic rock and limestone.

It can be seen from distribution of mineral indications in comparison with geological interpretation map that, in Ulziit District, many mineral indications are distributed in Devonian or Silurian formations. It can be also seen that, in the southeastern part of district, many copper indications are distributed accompanying Carboniferous small-size granitic rocks.



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

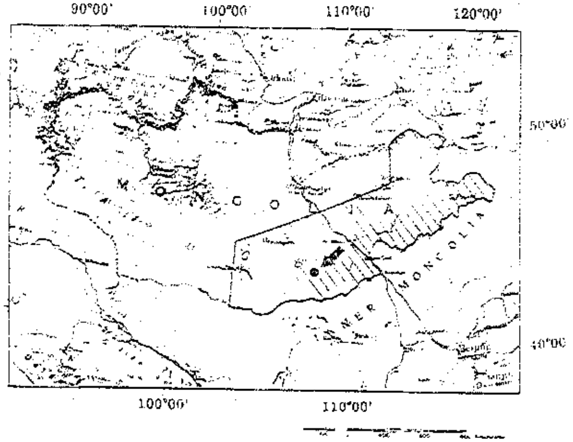


Fig. 3-2-1 Rationing/Principal Component Analysis Image of LANDSAT TM of Tsagaan-svraga Ore Deposit and Adjacent Areas

3-2-2 Extraction of alteration zones

a) Purpose

This work was intended to distinguish alteration zones and lithofacies and to extract details of geological structure such as faults, foldings, beddings, intrusives, etc.

b) Image interpretation

Interpretation of images in a 1/200,000 scale of Ulziit District was done. As the result, it was found to be difficult to extract alteration zones on an image. It was confirmed by surface survey that the difficulty is due to the small size of alteration zones. Information on geological structures and fault displacement were captured on the images with certain clearness.

Fig.3-2-3 and 3-2-4 show the DPCA imags and results of interpretation of the area surrounding Tsagaan-suvraga Deposit. With the processing, distribution of the Devonian nepheline syenite rock bodies, the country rock of deposit, were more clearly observed.

3-2-3 Observation

This area has poor vegetation, which makes it an ideal field for remote sencing. Beddings, faults and intrusions could be clearly extracted from satellite images.

Hydrothermal alteration zones accompanying metallic ore deposits were hard to be extracted on images mainly for the reasons that, concerning porphyry copper, argillized zones have already been eroded, and that other ore deposits in the survey area are not accompanied by large alteration zones.

3-3 Geological Survey

Reconnaissance geological survey was conducted, which formed a part of the first and second yers' survey.

The Reconnaissance geological survey involved field survey of major ore deposits and mineral indications, as well as confirmation of geological units, with the aim to clarify geological conditions in Uudam Tal Area and to grasp occurrence of ore deposits.

The first year's Reconnaissance geological survey was executed on the major deposits and indications in the seven districts selected on the basis of existing data. The survey consisted of preliminary observation by the team leader and survey work by the geological survey team. For the field survey, the GPS was used while trucks and jeeps were used for movement. Topographic maps in a 1/100,000 scale provided by the Mongolian side was utilized. The survey area was divided by type of ore deposits into seven districts, for each of which descriptions and mineral resouces evaluation were made.

The second year's Reconnaissance geological survey was conducted on major gold indications in the nine areas of Ulziit District selected from the first year's existing data compilation. Field survey was carried out in the same way as that of the first year. Survey findings were described by respective district, and evaluation of respective mineral indication was made.

3-3-1 Dornod District

a) Location and access

Donrnod District, situated in the extreme northeast of Mongolia, is an administrative division in the northern Dornod Aimag, having an approximate area of 33,000km^2 . A railroad connecting the Trans-Siberian Railroads and Choibalsan City, the capital of Aimag, run through the central part of district north to south, and its branch line extends east to west from Chingiskhaan to Mardai. Thus, the district has relatively well established infrastructure. From Ulaan Baatar to Choibalsan, domestic flight takes one and half hours, one way.

b) Topography and drainage system

This district with the elevation ranging from 560 to 1,300m above sea level is the lowest area in Mongolia. Most parts of this district are made up of gentle, hilly areas with altitude of 700-900m. The topography may be roughly summarized that, in the central part of district, there are lowlands stretching north to south and both the east and west sides of the lowlands are elevated.

The district has perennial rivers such as the Ulz, Kherlen and Galin, of which the Ulz and Kherlen flow into the Pacific Ocean, while the Galin is an inland river flowing into the Lake Yakh.

c) Climate and Vegetation

Climatic indices vary considerably within the district depending on localities. The average annual temperature falls within a range of +0.3℃ to -1.5℃. The average monthly temperatures vary from 19-21℃ in July to -21∼-23 ℃ in January. Annual precipitation is ±250mm. The district forms a steppe covered with relatively thick vegetation thanks to the moderate precipitation during summertime.

d) Geology

The geology is composed of the proterozoic and paleozoic basement and the overlyng Mesozoic.

The proterozoic and paleozoic groups consist of gneiss, schist and various sedimentary rocks of Silurian and Devonian periods, and Late Paleozoic intrusives. Such formation, forming the basement of this district, is distributed widely on the north side of the Ulz river and east side of the Choibalsan railroads.

The Mesozoic group consists of Cretaceous terrestrial formation intercalating Late Jurassic to Early Cretaceous igneous rocks and lignite beds and is distributed widely in Choibalsan Sedimentary Basin in the southwest of district. Main ore deposits in this district are polymetallic deposits formed by Mesozoic intermediate to acidic igneous activity, Besides, there occur quartz veins and uranium deposits.

e) Ore deposits

Major ore deposits in Dornod District are shown in Table 4-2-1.

f) Observation

With the relatively large polymetallic deposits including Tsav, Ulaan and Mukhar, Dornod District constitutes a metallogenetic province dominated by polymetallic deposits. These deposits were formed by Late Jurassic to Early Cretaceous ingneous activity. The southwestern part of the deposit zone is overlain by younger formations. Therefore, occurrence of blind polymetallic deposits is highly likely in this district.

The district was explored intensively mainly by airborne magnetic suvey, γ-ray survey and geochemical survey. Such exploration, however, might have overlooked blind polymetallic deposits. It is desirable to conduct regional exploration initiated by gravity survey in this district in pursuit of blind polymetallic deposits.

At the stage of the first year's survey, Tsav Deposit was considered to have the highest possibility of development as it has high-grade ores though somewhat small in size and located near the railroad. Feasibility studies of Ulaan and Mukhar Deposits, which should include a review of cutoff grades, are also desirable.

3-3-2 Tumurtiin-ovoo District

a) Location and access

Tumurtiin-ovoo District is located in Suhbaatar Aimag in eastern Mongolia, having an approximate area of 16,000km^2 . Domestic passenger flights are available from Ulaan Baatar to Baruun-urt, the capital of Aimag, which takes some one and half hours, one way. Movement/transportation in the field has to depend on cars running on wheel tracks.

b) Topogrphy and drainage system

The district is made up of hilly zones with elevation of 900-1,100m and is situated in the position where the Govi Lowlands placed bewteen Eastern Mongolian Highlands in the north and Dariganga Basaltic Platform in the south border on Dornod Plain in the east.

The district has no perennial river. Only wadis, in which water flows only at the time of rainfall, form small water systems with parallel or stripe patterns in sedimentary rock zones and in a dendritic pattern in igneous rock zones, which flow into the nearest lowlands to extinguish.

c) Climate and vegetation

Climatic indices vary within the district depending on localities. The average annual temperature is 1 - 5 ℃, while the maximum and minimum teperatures in a year is 40.8℃ and -41.4℃, respectively-ly. The number of frostless days in a year is 120-140.

Annual precipitation ranges from 90-175mm, with an increasing trend toward the north. The district is windy especially in the three months from March to May and also in November, having 30 to 50 sandstorm days per year.

The south of district is desert, while, from the central to northern parts, it changes to semi-desert and to steppe.

d) Geology

The geology of district is composed of Devonian, Permian and Cretaceous, into which Upper Permian to Jurassic igneous rocks intrude. Accompanying the Late Paleozoic to Early Mesozoic acidic igneous activity, high temperature-type deposits such as skarn-type zinc deposits at Tumurtiin-ovoo, Salhit, etc., greisen-type molybdenum deposits at Arin-nuur and tungsten-bearing quartz veines at Salaa were formed.

e) Ore deposits

Major ore deposits in this district are shown in Table 4-2-1.

f) Observation

Skarn-type deposits in the district bear large amounts of magnetite. Therefore, major skarn-type deposits have presumably been captured by the past exploration mainly with magnetic survey.

Tumurtiin-ovoo Deposit, being a metasomatic deposit replacing a Devonian limestone xeno-block, has little potentiality for a further expansion.

Extensive exploration has been conducted of greisen deposits, which have mineralization partially cropping out. Chances seem to be slim for new discovery of a large greisen deposit in this district.

The granite, about 1 km northeast of Tumurtiin-ovoo Deposit, which has been said to be Permian, showed the K-Ar dating of 191±10Ma (Early Jurassic). Its mineralization time may possibly be rejuvenated to Mesozoic.

3-3-3 Nuhut-dawaa District

a) Location and access

Nuhut-dawaa District is located at Erdene-Tsagaan Village in southeastern Suhbaatar Aimag and has an approximate area of 7,000km^2. From Ulaan Baatar to Baruun-urt, the capital of Aimag, it takes some one and half hours by air and, from Baruun-urt to Nuhut-dawaa District, it takes six to seven hours by car running on wheel tracks in the steppe.

b) Topogrphy and drainage system

The district is a hilly area with elevation of 900-1,200m, located in the extreme north of Dariganga Plateau. There is no perennial river in the district. Wadis flow into the nearest lowlands to extinguish, which form small drainage systems with the parallel or stripe patterns in sedimentary rock zones while with a dendritic pattern in igneous rock zones.

c) Climate and vegetation

The average annual temperature is 0-1℃; number of frostless days in a year is 105-115; and, the maximum and minimum temperatures in a year are 39 ℃ and -40.1℃, respectivery. Annual precipitation is 230-270mm. Precipitation is higher in summer and minimal in winter. In the three months from April to June and November, it is especially windy. Number of sandstorm days exceeds 40 days in a year.

The district has steppes somewhat densely coverd with vegetation.

d) Geology

The geology of district is composed of Ordovician sandstone and schist, Triassic to Jurassic biotite granite, etc. Accompanying the Mesozoic igneous activity, numerous greisen-type tungsten-molybdenum deposits, tungten-bearing quartz veins and pegmatite-type beryllium deposits are formed at Tsentr, Yugzer, etc.

The district constitutes a metallogenetic province of rare metal minerals.

e) Ore deposits

Major ore deposits in Nuhut-dawaa District are exhibited in Table 4-2-1.

f) Observation

The greisen-type deposit in this district have been explored intensively and repeatedly with every method. Consequently, some of the deposits have exhausted while major mineral indications including those of low grades have been clarified almost completely by drilling and tunneling surveys. As these greisen deposits have mineralized portions partially cropping out, it is presumed that major deposits have already been known, leaving little chances for new discovery.

3-3-4 Har-airag District

a) Location and access

Har-airag District, approx. 200km east to west and 100km north to south, spreads over the three Aimags: Dundgoivi, Dornogovi and Hentii.

A railroad connecting the Trans-Siberian Railroads and Tianjin, China, which crosses Mongolia(Trans-Russia • Mongolia • China Rail-road) runs through the southwestern part of the district. This rail-road links the district with Ulaan Baatar. Har-airag and Bor-undur Mines, some 45km away, are linked by a branch line of the mentioned railroad. Surface transportation from Ulaan Baatar to this district is an eight to ten hour's journey by a car running on wheel tracks in the steppe.

b) Topogrphy and drainage system

The district lies on Eastern Mongolian Highlands, the highest peak of which is Mt. Sumber, 1,715m alt. and about 45km north of Bor Undur. Topographically, the altitude decreases towards southwest and northeast to form gentle hilly zones with elevation of 1,000 to 1,200m.

The drainage system of this district is divided by a watershed north of Bor-undur into two groups, ie., a group flowing south-wards into Govi Lowlands and the other flowing northwards into the Kherlen River. Owing to little precipitation, the district has no perennial river. Valley patterns are often dendritic, reflecting the fact that igneous rock is dominant in the district.

c) Climate and vegetation

The average annual temperature is -0.5 ∼1 ℃; number of frostless days is 105-115 in a year; and the annual maximum and minimum temperatures are 35.6 ℃ and -38.3℃, respectivery. Annual precipitation is 170-210mm. The Precipitation is higher in summer and lower in winter. During the two months of April and May, it is especially windy; number of sandstorm days is about 24 days in a year.

The district is covered by semi-arid steppe or semi-desert.

d) Geology

The geology is composed of Proterozoic gneiss-crystalline schist, crystalline limestone, Carboniferous rhyolite, Permian granite, granite porphyry, granodiorite porphyry, Jurassic biotite-granite, Cretaceous basalt, quartz porphyry, aplite, aplitic granite, etc. Accompanying the igneous activity, a number of fluorite deposits were formed, which include Bor-undur, Adag, Har-airag, Hongor,etc. The largest of all is Bor-undur with ore reserves exceeding 20 million tons whilst the total fluorite ore reserves of Har-airag district are reported to reach 50 million tons.

e) Ore deposits

Major ore deposits in the district are listed in Table 4-2-1.

f) Observation

Thanks to the best developed transportation facilities in Uudam Tal Area, Har-airag is the district where geological surveys including exploration of ore deposits have been most advanced in the survey area. In the district, many of Mongolia's major fiuorite deposits including Bor-undur concentrate, to form an enormous metallogenetic province of fluorite. However, as long as the current low prices of fluorite prevails in the western markets, and considering the geographical conditions of Mongolia, it would be extremely difficut for fluorite to be positively taken up as an exploration target. It appears also difficult to take up this district for future survey, in view of the fact that the past intensive surveys repeated in this district using every exploration means have resulted in discovery of fluorite deposits only.

3-3-5 Lugiin-gol District

a) Location and access

Lugiin-gol District occupies an area of approx. 70km east to west and 50km north to south, located at the southeastern end of the Mongolian Govi Desert. In terms of administrative division, it belongs to Khatanbulag, located some 240km southwest of Sainshand, the capital city of Aimag.

Ulaan Baatar and Sainshand are linked by railroad and a main road, and it takes about 10 hours by car. From Sainshand to Lugiin-gol District, some 300km away, it is a seven and half hours' jouney by car through desert.

b) Topography and drainage system

The district represents a hilly zone with elevation of 1,040-1,140m, extending in the south side of Govi Lowlands.

Topographically, the district is made up of clastics-filled valleys and monad-nocks with relative height of 100m or so, forming gentle hilly zones.

c) Climate and vegetation

Climatic conditions are very harsh in this district. As precipitation is minimal throughout a year and strong wind blows in spring, the district represents rocky desert with poor vegetation. Temperature fluctuates from 45℃ to -40℃ in a year. From April to July, it is especially windy; number of sandstorm days in a year is around 30.

d) Geology

The geology consists of Upper Permian shale-sandstone and intrusives of Lugiin-gol Alkaline Rock Complex of the Jurassic period. The Lugiin-gol Ore Deposit is a vein-type carbonatite deposit containing mainly light rare earths such as lanthanum and cerium, accompanied by the alkali rock complex (nepheline syenite).

e) Ore deposits

Major ore deposit in this district is listed in Table 4-2-1.

f) Observation

Lugiin-gol Deposit consists of 60 small carbonatite dikes with the average width of 0.3m. The total ore reserves, $C_1 + C_2 =$ 436,000t(TREO=2.86%), are too small in size and too low in grade to be considered as economically valuable mineral resources under the current circumstances.

The K-Ar dating of the nepheline syenite in Lugiin-gol Alkali Rock Complex is 228±11-234±12Ma, which is presumed to be Early to Middle Triassic.

3-3-6 Tsagaan-suvraga District

a) Location and access

Tsagaan-suvraga District is an area, approx. 200km east to west and 100km north to south, spreading over the three Aimags: Dorno-govi, Dundgovi and Umnugovi.

The Tsagaan-suvrage Deposit, the leading deposit of the district, is located amid the unfrequented Govi Desert, some 180 linear km away from the Trans-Russia • Mongolia • China Railroad and 320 linear km from Dalanzadgad.

The district can be reached from Ulaan Baatar either via Dalanzadgad(Umnugovi) or via Sainshand(Dornogovi). From Ulaan Baatar to Dalanzadgad, air flight takes about one hour and twenty-five minutes, and from there to the district, it is a five to thirteen-hour car ride through semi-desert or desert terrain.

b) Topography and drainage system

The district spreads over the extreme south of Mongolian Highlands and Govi Lowlands. Altitude diminishes towards the south. Govi Lowlands are a basin with approximate elevation of 1,000m extending over southern Mongolia from northeast to southwest, in which upheaved block of basement rocks up to 1,500m above sea level are scattered.

Due to minimal precipitation, the district has no perennial river. The drainage system consists of two groups: those flowing southwards from Mongolian Higlands to Govi Lowlands and the others distributed in the upheaved blocks of basment rocks within Govi Lowlands. The former represents a parallel pattern while the latter has a radial pattern, reflecting the general topography. Valleys often form a dendritic pattern in igneous rock zones, a grid pattern in Paleozoic sedimentary rock zones, and a feather-veined pattern in Jurassic to Cretaceous rock zones. These valleys become rivers only temporarily during rainfall in summer and their downstreams extinguish either by evaporation or seeping down into the earth, or flow into salt lakes.

c) Climate and vegetation

The average annual temperature is 3.4℃; number of frostless days in a year is in excess of 150; and the annual maximum and mimum teperatures are 40.8℃ and -41.4℃, respectively. Annual precipitation ranges from 70 to 120mm, with higher precipitation in summer and lower in winter. During the three months from March to May, strong wind rages in the district.

Owing to the extremely dry weather, the district is covered by semi-desert or desert with poor vegetation.

d) Geology

The geology of district consists of Middle to Upper Devonian or lower Carboniferous group, with intrusion of Carboniferous to Early Permian granite and syenite. Accompanying Carboniferous to Early Permian acidic igneous rocks, many porphyry-type copper deposits and indications, including Tsagaan-suvraga, Harmagtai, Ih-shanhai and Shuten, are distributed within an approximate area of 300km east to west and 60km north to south, which forms the country's second largest porphyry copper deposit zone.

e) Ore deposits

Major ore deposits in this district are listed in Table 4-2-1.

f) Observation

Since the late-1960's, surveys were energetically repeated using a variety of exploration techniques, at major deposits in Tsagaan-suvraga District.

With regard to Serven-suhait Orebody, the largest of the Tsagaan-suvraga Deposit(reseves 240 million t; Cu 0.53% - Mo 0.018%), substantial drilling and tunneling surveys were carried out, which revealed, among others, that the orebody is poor with pyrite and has slightly developed secondary enrichment zones. Therefore, this deposit has little room for further exploration. Concernig other deposits in the area, especially of copper, exploration has been conducted relatively well. As all these deposits have certain problems either with ore reserves, grade, characteristics or with infrastructure, it appears difficult for these deposits to come into development for the time being.

On the other hand, it has been known thanks to the past exploration that the mineral indications at Shuten, Harmagtai, In-shanhai, Ovoot-hira, etc. have gold occurrences. Above all, Shuten's alteration zones resemble those of epithermal or hydrothermal gold deposits; accordingly, further survey and re-evaluation of the Shuten indications as a potential gold deposit rather than a copper deposit seem to be necessary.

3-3-7 Ulziit District

a) Location and access

Ulziit District of the first year's survey was an area of about 250km east to west and 80km north to south, spreading over the three Aimags: Dornogovi, Dundgovi and Umnugovi.

Ulziit District of the second year's survey was an area of approx. 250km east to west and 250km north to south, which comprized a part of the Tsagaan-suvraga District of the first year's survey.

Olon-ovoot, which is the base point in the district, is located in sparsely populated Govi, 540km away from Ulaan Baatar and 120km from Dalanzadgad.

From Ulaan Baatar to this district, one can go either straight by car or fly to Dalanzadgad and from there, use a car. In case of using a car all the way, it take some sixteen hours, one way. The flight hours from Ulaan Baatar to Dalazadgad are one hour and twenty-five minutes, and from Dalanzadgad to Olon-ovoot, it is a three-hours journey by car.

b) Topography and drainage system

The district is at the extreme west of Mongolian Highlands, and topographically, it is made up of lowlands of about 1,100m in altitude, where Cretaceous rocks are distributed,and zones of upheaved basement rocks, mainly Paleozoic. The upheaved basment rock zones generally form undulating hills 100-200m higher than the lowlands.

The district has no perennial river due to minimal precipitation. The drainage system represents in many cases a dendritic pattern in igneous rock zones, a grid pattern in paleozoic sedimentary rock zones and a feather-veined pattern in Jurassic to Cretaceous zones. Valleys becom rivers only temporarily at the time of rainfall. Their downstreams evaporate, seep down into the ground or flow into salt lakes.

c) Climate and vegetation

The climate of district falls into the desert type, being dry all through a year. The average annual temperature is 3-4.5℃; number of frostless days is about 130 in a year; and the annual maximum and minimum temperatures are 37.5℃ and -36.5℃, respectively Annual precipitation is from 80 to 120mm; precipitation is higher in summer and lower in winter. During the two months of April and May, it is especially windy; number of sandstorm days is about 40 in a year.

The district has poor vegatation. The northern part is semi-desert while the southern part is rock desert in hilly zones and soil desert in lowlands.

d) Geology

The geology of district is constituted by Upper Proterozoic and Paleozoic such as Upper Silurian, Lower Devonian, Upper Carboniferous and Permian, which have intrusion of and ore overlain by Triassic and unconformably overlain by Jurassic and Cretaceous. There are many gold indications formed by Carboniferous to Early Permian acidic igneous activity, as well as carbonatite deposits and strontium deposits which were formed by Upper Jurassic to Lower Cretaceous acidic igneous activity.

e) Ore deposits

Besides the many gold indications including Olon-ovoot, the district has deposits of many different types such as carbonatite deposits(Mushgia-hudag), strontium deposits(Bayan-khushuu), fluorite deposits, etc. Major deposits are exhibited in Table 4-2-1.

The reconnaissance geological survey of the second year revealed that there exist a number of large gold indicatins in Govi distrct (Table 4-2-1).

f) Observation

Mineral resources survey in Uiziit District has its inception in the discovery of Mushgia-hudag Deposit in the course of geological mapping with a 1/200,000 scale jointly conducted by Mongolia and Russuia from 1974 to 77. Since then, the areas around the deposit have been explored intensively and repeatedly with various techniques. Regarding Mushgia-hudag and Bayan-khushuu Deposits, it can be said that evaluation work has been completed. From the evaluation, these two ore deposits are considered to be unworthy of explotation in view of their ore reserves and grades.

In contrast, Olon-ovoot Deposit, at which the GEOLOGY Company discoversd outcropping gold in 1990, is considered to be of the highest feasibility of development though the area is located in the remote desert with disadvantageous conditions. The Olon-ovoot Ore can easily be processed into the light weight product becaous of the characteristics of ore sutable for heap leaching.

On the other hand, the second year's reconnaissance geological survey revealed that there are numerous, large gold indications in a broad area extending from Ulziit District to Tsagaan-suvraga District (Govi District). At these gold indications, the homogenization temperatures of fluid inclusion are lower than those of Olon-ovoot Deposit, and are accompenied by large, massive silicified rock bodies and various kinds of sinters on the surface, which suggest occurrence of epithermal blind gold deposits.

Gold mineralization in Ulziit District has so far been unknown. In order to acquire certain guidance for exploration of gold resources in Govi District, surveys of Olon-ovoot Deposit should desirably be continued.

3-3-8 Survey findings of the regional geological survey

Within Uudam Tal Area, Tsav Deposit, though somewhat small in size, is considered to be of highest possibility of development because of its favorable ore grade and characteristics, and the infrastructure. For Ulaan and Mukhar Deposits, feasibility studies including a review of cutoff grades will be necessary

Tumurtiin-ovoo Deposit have certain problems in terms of ore reserves and characteristics of ore whilst Tsagaan-suvraga in terms of ore grade and infrastructure.

In view of the social and geographical conditions of the survey area, minerals of high unit prices such as gold can be considered as the most desirable type of minerals. Olon-ovoot Deposit is small in scale but further survey of the deposit will be of great significance not only becaus of the high possibility of its development but becaus it would give invaluable guidance for future gold prospecting in Govi area.

3-3-9 Semi-Detailed Geological Survey

a) Purpose of survey

The survey was intended to investigate geological conditions and nature of mineralization around Olon-ovoot Deposit, thereby defining extension of the deposit and helping analyse geophysical survey findings.

b) Suvey methods

The semi-detailed geological survey was carried out at an area of 3km north to south and 4km east to west surrounding the deposit. The survey area and route are identical to the geophisycal survey lines. The survey was conducted in the east west direction at intervals of 200m along the planned survey line extending magnetic north to south. The total length of the survey route was 63km including the base line survey.

Laboratory tests included microscopic observation, whole rock chemical analysis, absolute dating, ore-analysis, mesurement of homogenization temperatures of fluid inclusion.

The ore analysis was conducted for the two elements, Au and Ag.

Geochemical analysis was made by the ICP method on the seven elements: Au, Ag, Hg, As, Sb, W and Mo.

c) Survey findings

1) Geology

The geology of the semi-detailed survey area is composed of Silurian, Devonian and Jurassic, and intrusive rocks which intrude into Paleozoic group.

The Silurian is composed of crystalline schist derived from marine sediments and is exposed in most part of the area. It consists, in ascending order, of sandstone, alternated beds of siltstone, siltstone medium-to fine-grained sandstone, green schist and mudstone, into which fine-grained diorite, fine-grained granodiorite, basaltic andesite, basalt, trachyte, etc. intrude.

The Devonian is composed of white-colored limestone rich in fossils of crinoids, distributed in the northwestern, southern and northeastern parts of the area. The thickness of the formation exceeds 50m. The formation, folding with an axis east to west, has the structure unconformable to the underlying silurian. It lacks basal conglomerate and is in contract with the Silurian with sharp boundary.

The Jurassic is composed of unaltered lavas of basalt and biotite-rhyorite, exposing itself in the northeastern part of the area. It is located at the margins of upheaved block of Paleozoic formation and distributed on a flat level.

The intrusive rock is composed of medium- to fine-grained diorite, medium- to fine-grained granodiorite, basaltic andesite, bsalt and trachyte. Diorite and medium- to fine-grained granodiorite are distributed in the form of small intrusive rock bodies all over the area, especially in the neighborhood of Olon-ovoot Deposit. Basaltic andesite and basalt in the form of small intrusive rock bodies are conspicuous in the western part of the area.

The structure is divided into two large blocks by a fault running northeast to southwest in the central part of the area(hereafter called "Olon-ovoot Fault" or simply "the fault "). The block east of the fault is characterized by folding structure with an axis of the east-west direction, similar to the regional general structure of the area. In contrast, the block west of the fault shifts its strike to the NW-SE direction near the fault, representing a structural distinction.

Olon-ovoot Deposit is located at the intersection of the NE-SW fault and the Silurian sandstone, where intrusive rocks gather densely.

There are six quartz veins, max. 20m wide and 50-100m long, arranged in an arc form on the west side of the fault. Total extension of the aggregate of quartz veins reaches 1,000m. Besides, silicified and pyritzed alteration zones, max. 200m wide, develops around the deposit, a part of which extends for more than 1km northeastward *along the fault. Similar alteration zones are found on the east side* of the fault and in the northeastern part of the atea. Furthermore, a dominant quartz vein zone was newly found from the northeastern tip over to the western outer side of the survey area.

The homogenization temperatures of the quartz veins' fluid inclusion often exceed 250℃ in the northern and eastern parts of the deposit whilst, at the gold rich parts, the temperatures are lower than 250℃.

Investigation of alteration zones indicated that the wall rock alteration zones of Olon-ovoot Deposit are predominated by chlorite, partially of sericite-chlorite facies and accompanied by plagioclase and some calcite. Only in the close neighborhood of the deposit, the alteration zones are associated with small amount of sericite and, rarely, with kaolinite.

2) Geochemical survey findings

A histogram of the seven elements(Au, Ag, Hg, As, Sb, W. and Mo) was compiled and the thresholds were determined on the basis of which an anomaly distribution map was prepared for the respective elements. Statistical study was made on the analysis figures. Correlations between the elements were also studied. The results are summarized as follows:

Gold :Gold anomalies appeared clearly around the major quartz veins and also on the fault in the southwestern part of the area.

Silver :Siver concentration was low in general, although anomalies were recognized in the center of the deposit, along the fault, in the alteration zones rich in manganese oxide and also in the silicified sandstone zones in the south.

Mercury:An anomaly zones is formed in the east of the central part of the area, in the north-south direction.

Arsenic:Anomaly zones in ring forms were detected over the surroundings of the deposit; and, the silicified sandstone zones in the south also showed high values.

Antimony:An anomaly zone in the north-south direction was detected in the western part of the area, as well as minor anomalies around the deposit.

Tungsten:In the western part, anomaly zone stretching in the north-sourth direction was recognized while one-point anomalies were sporadically observed from the central to the northern part of the area.

Molybdenum:Sporadic anomaly zones were detected in the central and southern parts of the area.

As the result of studies on correlations between each element, no correlation was recognized, except weak statistical correlations between molybdenum and gold. No systematic difference by type of wall rock was observed either,as compared to the geological map.

d) Observation

Mineral indication in the semi-detailed survey area may be classified into the following three types:

i) Quartz veins without wall rock alteration zones.
ii) Quartz veins accompanied by silicified, pyritized alteration zones.
iii) Independent silicified, pyritized alteration zones.

From the fact that the distribution of quartz veins and of silicified, pyritized alteration zones are not always conforming to each other, it is presumed that this area has undergone repeated hydrothermal mineralization, which makes it difficult to interpret the geochemical survey findings.

In case, in geochemical survey, elements other than a target element are used, there should be certain systematic relations between the elements used and the target element. Normally, either positive or negative correlations are expected. However, it does not necessarily seen to be sufficient to explain only by correlation the character of the ring-shaped halos as shown by arsenic anomalies in this survey; probably, a concept of three dimensional models will be required for it.

It is presumably because the subject has since paleozoic time been affected by repeated igneous activity that the six elements used in this geochemical survey did not show correlations with gold.

3-4 Geochemical Survey

3-4-1 Purpose of survey

The survey was conducted for the purpose of clarifying conditions of gold mineralization of quartz veins and wall rock of Olon-ovoot Deposit and investigating extension and continuity of the deposit and approximate grade distribution near the surface.

3-4-2 Survey method

The geochemical survey was carried out at the object area, $0.5km^2$, around Olon-ovoot Deposit.

One hundred and one survey lines were set up in the direction of magnetic north to south at intervals of 10m east to west.

In principle, samples were collected at intervals of 2.5m for quartz veins, 5-10m for alteration zones and 20m or more for the others. The total number of collected samples was 2,261 pieces.

Pitting was done when necessary for collecting autochthonous, unweathered ore samples.

On sample ores and rocks with recognizable mineralization, the gold and silver analysis, microscopic observation of polished sections, measurement of homogenization temperature of fluid inclusion and K-Ar dating were conducted.

The ore analysis was done on the two components, Au and Ag.

3-4-3 Survey findings

Concerning Au and Ag, thresholds were determined by cumulative frequency curves. Anomaly distribution maps were drawn for the respective components. Statistical study was conducted on analized datea while correlation between respective components were studied.

A summary of these studies are as follows:

Gold: Gold concentration is prominent around quartz veins. Gold concentrations of workable level were observed especially on Tsagaan-tolgoi, which has an approximate total ore area of 1,500m^2 at 3.3g/t Au. Quartz veins in other places and some part of alteration zones also have such gold concentrations.

From these findings, it is estimated that the whole deposit has an approximate ore area of 2,500km^2 (3.2g/t Au).

Silver: In general, silver concentration is so that no economic value is expected. The central part of the deposit and alteration zones showed some anomalous figures, but only statistically.

Neither clear correlations between gold and silver nor systematic differences by type of wall rock were recognized by the correlation studies.

In this geochemical survey, the minimum interval between ore sampling points was not less than 2.5m, therefore, narrow quartz veins could not be blocked out.

3-4-4 Considerations

Since gold ore-level concentration of gold are detected at many points on narrow quartz veins both on the east and west sides, a further increase of the ore blocks would be possible by more detailed/minute surveys.

As gold of Olon-ovoot Deposit is generally coarse-grained and, sometimes, wall rock yields gold, it would be necessary to consider/check possible influence of the secondary enrichment in relation to the grades of gold near the suface. For evaluation of the deposit's potential ore reserves, it is necessary to confirm continuity into the deep of quartz veins and Au grades, by core drilling.

The poor silver contents in Olon-ovoot Deposit can interpreted as its intrinsic character in view of the fact that quartz veins of the deposit bear little base metals and no “Ginguro ” (silver black).

3-5 Geophysical Survey

3-5-1 Purpose of survey

The geophysical survey was aimed to estimate extension/continuity of Olon-ovoot Deposit into the deep and to the surroundings, and also to clarify relations between mineralized zones and the geological structure.

3-5-2 Survey methodand survey quantity

The survey was conducted at the object area of 12km^2 (3km magnetic north to south and 4km east to west) around the deposit. For the resistivity survey, the transient electromagnetic measurement(TEM) method was applied. The survey points were located by open traverse method on grid of 100m magnetic north to south and 200m east to west. At the central portion of the deposit, measurements were done not only on the total measurement points were 548.

The transmitter loop dimension were 100m x 100m at most of survey points. For detailed survey of Tsagaan-tolgoi, however, measurement was done in the Turam arrangement using a 100m x 200m rectangular 100p, and in the steep limestone area in the northwestern part of the survey area, the Turam arrangement using a square loop with a 100-m side was applied, respectivery. The transmission current was about 11.0-12.5A for the 100-m square loop and 9A for the 100m x 200m rectangular 100p.

3-5-3 Findings of the survey

The data of all the survey points were converted by imaging processing to the resistivity structure for analysis.

As the result, following anomalous resistivity areas were extracted from the viewpoint of exploration:

i) An area centering around the survey point 1813 at Tsagaan-tolgoi(a vein-like, high-resistivity anomaly)

ii) An area centering around the survey point 2413 along Olon-ovoot Fault(low-resistivity anomaly in the shallow part; high-resistivity anomaly in the deep)

iii) An area centering around the survey lines 32-36 in the northeastern part of the survey area(large scale, low-resistivity anomaly)

3-5-4 Considerations

a) Tsagaan-tolgoi

The quartz vein group at Olon-ovoot Deposit is located between the low-resistivity zone along the fault and the high-resistivity zone parallel with it. This high resistive zone is is presumed to represent sandstone beds. The vein-like, high-resistivity zone, about 70m wide, standing almost upright, which was found right under the survey point 181325(the survey point 25m north of the 1813) by the detailed survey in the Turam arrangement, is believed to capture quartz veins.

b) The low-resistivity anomaly in the shallow portion, and the high-resistivity anomaly in the deep, along Olon-ovoot Fault.

The low-resistivity anomaly zone extends northeastward. At the depth of 20-120m under the surface where the extension reaches, there is a high-resistivity zone over 400 ohm-m with over 400m wide, along the fault. As there is an alteration zone on the surface, this high-resistivity zone is likely to be a silicified zone formed along the fault.

c) Large scale, low-resistivity anomaly in the northeastern part

The area of this low-resistivity anomaly corresponds approximately to the Jurassic volcanic rock area. In this low-resistivity anomaly area, magnetic anomaly was also detected in the course of the survey work. As there are Devonian limestone accompanied by small green copper mineral-bearing hematite skarn, possible occurrence of a skarn-type deposit with magnetite or pirrhotite is inferred.

3-6 Drilling Survey

3-6-1 Purpose of Survey

Core drilling of eight boreholes, totalling 850m, was carried out at Olon-ovoot deposit where gold concentration was detected geochemical survey and also at the geophysical anomaly zone. The drilling survey was aimed at confirming continuity of mineralization into the deep and at checking the geophysical anomaly zone in the south and approx. 2.5km northeast of the deposit. Major purposes of the drilling survey may be summarized as follows:

i) Confirm continuity of the deposit to the deep.
ii) Clarify occurrence and grades of gold and silver to a depth of 50m.
iii) Check the geophysical anomaly zone.
iv) Clarify character of the deposit thereby giving guidance for future gold prospecting in Govi area.

3-6-2 Survey method

The drilling work was executed in the some area to semidetailed geological survey. The survey was concentrated on and around Tsagaan-tolgoi, which is considered to be the center of the deposit in terms of ore reserves and grade. As the deposit was presumed to sharply dip towards the north, the drilling angles were made as gentle as possible so that drill holes may cross quartz veins at the highest possible angles.

3-6-3 Survey findings

The drilling survey revealed the following points:

a) Gold is concentrated at both quartz veins and wall rock.
b) The deposit does not decline in its size and ore grade to a depth of 50m under the surface, accordingly, it will presumably continue further down into the deep.

c) The high magnetic, low-resistivity anomalies detected in the north-eastern part of the deposit derives from the high salinity water held in porous lavas.

3-6-4 Considerations

From these findings, it is inferred:

a) From the above mentioned facts, Olon-ovoot Deposit is considered to reach further to the depth. Tsagaan-tolgoi Ore Body was proved to continue more than 50m down from the outclop by 3 drillings in this survey, and the total prospective ore reserve is assumed to be 369,900 tons(3.2 g/t Au).

It is somewhat difficult to estimate the total potential ore reserve of Olon-ovoot Deposit only by the drilling data of this year, but 700,000 tons of reserve at gold grade of about 3 g/t will be prospected supposing that the deposit is twice as long as the confirmed vertical length at Tsagaan-tolgoi in this survey. And by further exploration of ore-indications and geophysical anomalies around there, the amount will be expected to inclease.

b) that a substantial portion of the ore reserves is amenable to exploitation by open pit, which enhances possibility of the deposit being worked favorably.

4. Considerations and Conclusions

4-1 Considerations

4-1-1 Promising ore deposits

Economic viability of mineral resources is determined by a variety of factors such as i)type of minerals, ii)ore grade, iii)ore reserves, iv)occurrence of a deposit, v)shape of a deposit, vi)climatic conditions, vii) social infrastructure(transportation, communication, etc.), viii)energy cost, ix)labor costs, x)legislation, and forth.

Since Uudam Tal Area is under constraint in the transportation aspect, minerals to be developed must be those which are not bulky, of high grades and of high market prices.

Tsav Deposit, which is of high grade although somewhat small in size, was considered to have the highest feasibility of exploitation. Ulaan and Mukhar, which are of low ore grades but are large in size, are considered to be deposits worthy of feasibility study after a review of the cutoff grades.

Tumurtiin-ovoo is rather small in size and, reportedly, its sphalerite is of high manganese content; therefore, a study on characteristics of the ore would be required.

Tsagaan-suvraga Deposit lacks secondary enrichment zones and is of low grade on the whole; therefore, it is considered difficult to develop the deposit on the assumption of ores being treated by flotation. The deposit is not rich in pyrite and has hard and compact dissemination ores, extraction of copper by leaching method will presumably be difficult, too.

At the Olon-ovoot Deposit, it was ascertained by drilling survey that the primary gold concentration, as well as the size and grade, does not decline to a depth of 50m below the surface. Therefore, the deposit will presumably continue further down to the deep. In addition, a substantial portion of the ore reserves is amenable to exploitation by open pit. Thanks to these factors, the deposit is likely to be operated profitably in spite of its small size.

The mineral indication at Shuten retrieved from the existing literature has been explored in search of copper. However, its alteration zones are composed of massive silified rock accompanied by alunite, which represents the character of a epithermal gold deposit. Since the indication is large in size, Shuten should be reviewed as a target for gold deposit exploration.

The other ore deposits and mineral indications in the survey area appear unlikely to be targets for development in view of the type of minerals, ore grades and deposit sizes.

4-1-2 Promising districts

a) Uiziit District

Olon-ovoot Deposit is of the highest homogenization temperatures of its fluid inclusion in Govi area. Confirmation of the primary gold concentration at this deposit by the survey enhanced the possibility of occurrence of gold deposits formed in the Late Paleozoic time all over Govi area. This has been substantiated by the discovery of numerous gold indications of large scales in a broad area of Ulziit District.

b) Dornod District

In Dornod District, Jurassic to Cretaceous volcanic rocks are widely distributed along the margins of Choibalsan Sedimentary Basin, with which polymetallic deposits such as Tsav, Ulaan and Muhar have been formed.

These deposits were confirmed as the result of regional surveys such as aeromagnetic survey, gravity survey, geochemical survey, etc. which were conducted simultaneously with the regional geological survey in a 1/200,000 scale, as well as the follow-up surveys including γ-ray spectrum survey, trenching, drilling and tunneling, etc. conducted on anomalies extracted by the foregoing regional surveys. The gravity survey was intended for petroleum. Many of these deposits are of non-magnetic substances and presumably fave undergone little erosion in view of their characteristics.

On the other hand, most part of the Choibalsan Sedimentary Basin is covered by the Middle to Upper Cretaceous formations. Therefore, this district is likely to embrace blind deposit zones of a non-magnetic, polymetallic type.

4-2 Conclusions

From the surveys, the following conclusions can be drawn with regard to promising districts and deposits:

4-2-1 Promising ore deposits

a) Olon-ovoot (auriferous quartz veins)

The deposit, although small in size, has possibility of becoming a profitable mine since a substantial portion of its ore reserves is amenable to exploitation by open pit. It is desirable to explore and develop the deposit also from the standpoint that it may result in giving guidance for exploration and evaluation of the large gold indications found in wide zones in Govi area.

b) Tsav Deposit (a vein-type polymetallic deposit)

Although small in size, this deposit has been explored to the most advanced stage, and has ores of highest grades and reasonable infrastructure, Which led to a conclusion that the deposite has the highest possibility of development.

c) Ulaan and Mukhar Deposits (Pipe-type deposits partially skarnized)

These large deposits have been considerably explored and has reasonable infrastructure, but those ore grades are low. There remain tasks such as review of the cutoff grades and study of ore characteristics.

4-2-2 Promising districts

a) Ulziit District

The confirmation of gold concentration of workable grade at Olon-ovoot Deposit and of large gold indications widespread in the surrounding areas which are considered to have undergone lesser erosion than Olon-ovoot, leads to a conclusion that the Upper Paleozoic volcanic rock zones widely distributed in Govi area is worthy of note because of the possibility that the area emplaces blind gold deposits.

b) Dornod District

The substantial exploration conducted in the past at Tsav, Ulaan, etc. indicates that this district has certain interesting ore deposits. From the geological point of view, occurence of blind polymetallic deposits is presumable. Occurrence of gold deposits is also highly possible

Table 4-2-2 Conprehensive Evaluation of the Areas and Deposits in Uudam Tal Area

AREA	MAJOR ORE-DEPOSITS	DESCRIPTION				FACTOR EVALUATION					COMMENT	
		MINERALES	TYPE	RESERVE(M. t)	ORE GRADE(%, Au, Ag:g/t)	MINERALS	RESERVE	ORE GRADE	INFRA STR.	TOTAL EVAL.	DEPOSIT	AREA
DORNOD	TSAV	Pb, Zn, Ag	VEIN	7.68	Pb 6.4, Zn 4.6, Ag 222	◎	○	◎	◎	○	Small but the highest grade	Large potentiality for polymetallic mineralization is expectable in this area. It is recommendable to excute further regional geological survey in this area. Re-evaluation of Ulaan Ore Deposit is also an important subject in the future. Exploration on gold is recommendable too.
	ULAAN	Ag, Pb, Zn	PIPE	93.1	Pb 0.95, Zn 1.9, Ag 49	◎	◎	○?	◎	○?	The largest but low grade	
	MUKHAR	Ag, Pb, Zn	PIPE	25.5	Pb 0.6, Zn 3.4, Ag 113	◎	△?	△?	◎	△?	Large but lowgrade	
	BAYAN UUR	Au, Ag	Qz-V	61.1	Pb+Zn 1.5, Ag 80 g/t.	◎	○?	×	○	○?	Large but lowgrade	
	SALHIT	Pb, Zn, Ag	Qz-V	-	Pb ≤1.6, Zn≤4.1, Ag≤74	◎	?	?	○	?	Further study is required	
	DELGER MUNKH	Ag, Pb, Zn	VEIN	-	Pb 4-6	◎	?	?	○	?	— do. —	
	TSAGAAN CHULUUT HUDUG	Au	PLACER	Au 41 ?	Au0.3g/t?	◎	○?	◎?	○	○?	— do. —	
	MARDAI	U	?	?	?	×	?	?	◎	○?	Restricted by the law.	
	ALTAN TOLGOI	Pb, Zn, Ag	VEIN	-	Pb ~3.1, Zn ~6.6, Ag ~122	◎	?	?	○	?	Further study is required	
	BAITS	Pb, Zn, Ag	VEIN	-	Pb 0.3-15.3, Zn 0.2-12, Ag Max. 1,400g/t	◎	?	?	○	?	— do. —	
	BOLOSTIN	Au, Ag, Sb	VEIN	-	Au 10.5-30, Ag 80-150, Sb 1%, AS 3%	◎	?	○	○	?	— do. —	
TUMURTIIN OVOO	TUMURTIIN-OVOO	Zn, Fe	SKARN	7.57	Zn 11.5	◎	○	○	×	○?	High Mn content in sph?	Little potentiality is remained for new discovery of profitable ore deposit in this area.
	SARHIT	Zn	SKARN	0.92	Zn 6.4	◎	△	×	×	×	Small and scattered	
	SARAA	W	QZ-V	0.17	WO_3, 1.35	◎	×	○	×	×	Small	
	ARIN-NUUR	Mo	GREIZ	24.1	Mo 0.0107	◎	×	×	×	×	Too low grade	
NURUIT-DAVAA	YUGZER	W, Mo, Ba	GREIZ	21.5	WO_3 0.197, Mo 0.056	◎	×	×	×	×	Too low grade	Very few potentiality is remained for new discovery of profitable ore deposit in this area.
	TUB (TSENTR)	Sn, W, Ba	GREIZ	9	Sn 0.078, WO 0.137	◎	×	×	×	×	Too low grade	
	NURUITIN-TSAGA	Ba	PEG	?	?(lenticular ore body,	◎	×	×	×	×	Too small	
	ANTOLGOI				10 ~20 m long)	◎	×	×	×	×	Too small and lowgrade	
	AR-BAYAN	W	GREIZ	0.01	WO_3 < 0.1	◎	×	×	×	×	— do. —	
	UVURBAYAN	W	GREIZ	-	WO_3 0.04-0.1	◎	×	×	×	×	— do. —	
	ORT GROUP	W	GREIZ	-	WO_3 0.01-0.05	◎	×	×	×	×	— do. —	
	TARVAGATAI	Mo, W	GREIZ	-	WO_3 < 0.08, Mo<1	◎	×	×	×	×	— do. —	
	ZURH-OVOO	Mo, Sn	SKARN	-	Mo 0.003, Sn 0.008	◎	×	×	×	×	— do. —	
	BAYAN VAIRAST	W	QZ-V	-	WO_3 1-2	◎	×	×	×	×	Too small and exhausted	
	SAIHAN ULA	W	QZ-V	-	WO_3 0.18-0.5	◎	×	×	×	×	— do. —	
	NURUITIIN	W	QZ-V	-	WO_3 0.04-0.13	◎	×	×	×	×	Too small and lowgrade	
HAR-AIRAG	BOR-UNDUR	CaF_2	VEIN	20.98	CaF_2 39.1%, Qz-Fl type	△	◎	○	◎	△	Fluospar is to cheap in the western world market.	This area is already intensively explored for fluospar. This area should be re-checked for gold in the future.
	ADAG	CaF_2	VEIN	4.0	CaF_2 40 %, Qz-Fl type	△	◎	○	◎	△		
	CHOL-TSAGAAN-DEL	CaF_2	VEIN	1.4	CaF_2 40-53%, Qz-Fl type	△	◎	○	○	△	— do. —	
	HONGOR	CaF_2	VEIN	1.37	CaF_2 29-34%, Qz-Fl, Cal	△	◎	△	○	×	— do. —	
	MAIHANTA	CaF_2	VEIN	3.08	CaF_2 33-36%, Qz-Fl, Cal	△	◎	△	×	×	— do. —	
	TSAGAANTAKHILCH	CaF_2	VEIN	1.82	CaF_2 40.5%, Qz-Fl type	△	◎	○	×	×	— do. —	
LUGIINGOL	LUGIINGOL	REE	CARB-V	0.436	TREO 2.86	○	×	×	×	×	Too small and low grade	No room for exploration
TSAGAAN-SUVRAGA	TSAGAANSUVRAGA	Cu, Mo	PO-Cu	240.0	Cu 0.53, Mo 0.018	◎	◎	×	×	×	Low grade, no 2ndary ore	This area is already well explored for copper. Re-checking survey on gold resources is strongly required. Large potentiality for new discovery of workable gold deposits is expectable in the area.
	DUCHINN-HURAL	Cu	VEIN	-		◎	×	×	×	×	Too small and low grade	
	MARMAGTAI	Cu	PO-Cu	139.6	Cu 0.25	◎	○	×	×	×	Too low grade for Cu	
	III-SHANIAI	Cu	PO-CU	-		◎	×	×	×	×	— do. —	
	NARIN-HUDUK	Cu	PO-CU	0.05	Cu 0.59	◎	×	×	×	×	— do. —	
	OVOOTU-HIRA	Cu	PO-Cu	-		◎	×	×	×	×	— do. —	
	SHUTEN	Cu	PO-Cu	12.6	Cu 0.31	◎	×	×	×	×	Very necessary to check on Au	
	UHAA-HUDAG	Cu	PO-CU	-		◎	×	×	×	×	Too low grade for Cu	
	HUNGUI	Cu	PO-Cu	-		◎	×	×	×	×	Too low grade for Cu	
ULZIIT	MUSHGIA-HUDAG	RE	Carb	398	TREO 1.53 %, O.R. Reduced	○	○	×	×	×	Too low grade	Large potentiality for new discovery of workable gold deposits is expectable in the area.
	BAYAN-KHUSHUU	Sr	Sr, W.	0.7	SrO 40 ~50 %	◎	×	×	×	×	Too low grade?	
	OLON OVOOT	Au	VEIN	0.5 - 2	Au ≈3g/t, Max 340g/t	◎	○	○	○	○	Small but probably workable	
	BAYAN-OVOOT	CaF_2	VEIN	1.0	CaF_2 75 % Qz-Fl type	△	○	○	×	×	Fluospar is too cheap	
	DUGSHIIL	Au	Qz-V	-	Au ≤50 g/t	◎	×	×	○	×	Too small and scattered	
	ONIT	Au	Qz-V	-	Au ≤0.4g/t(13 samples)	◎	×	×	○	×	Further study is required	
	BAYAN-BOR-NURUU	Au	Qz-v	-	Au 1-8 g/t(182 samples)	◎	?	○?	○	○?	Too small and scattered	
	MUNH-TSAGAAN-TOLGOI	Au	Msv-Sil	-	Au ≤0.05, Ag ≤1.3 (9 samples)	◎	?	?	○	○?	Further study is required	
	HETSUU TSAGAAN-TOLGOI	Au	Msv-Sil	-	Au ≤0.05, Ag ≤1.3 (182 samples)	◎	?	?	○	○?	— do. —	
	DERSEN-US-HUDUK	Au	Qz-V	-	Au ≤2g/t, Ag ≤2g/t (190 samples)	◎	?	?	○	○?	— do. —	
	MORIT	Au	Qz-V	-	Au ≤0.7g/t, Ag≤55g/t (35 samples)	◎	?	?	○	○?	— do. —	
	FUTUR-US	Au	Sil-V	-	Au ≤0.05g/t, Ag ≤0.3 g/t (35 samples)	◎	?	?	○	○?	— do. —	
	ULZIIT-OVOO	Au	Qz-V	-	Au ≤0.04g/t, Ag ≤2.9 g/t (9 samples)	◎	?	?	○	○?	— do. —	
	SOLOGOI-BAYAN	Au	Msv-Sil	-	Au ≤0.04g/t, Ag ≤0.8 g/t (4 samples)	◎	?	?	○	○?	— do. —	

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

GEOLOGY AND ORE DEPOSITS OF THE UUDAM TAL AREA, MONGOLIA

THE COOPERATIVE MINERAL EXPLORATION BY JICA/MMAJ-(MGMR). 1991—1993

EXPLANATORY NOTE ON THE GEOLOGY AND DEPOSITES OF THE UUDAM TAL AREA, MONGOLIA

REPORT ON THE MINERAL EXPLORATION IN THE UUDAM TAL AREA MONGOLIA
PREPARED BY JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) AND METAL MINING AGENCY OF JAPAN (MMAJ) IN COOPERATION WITH THE MINISTRY OF GEOLOGY AND MINERAL RESOURCES OF MONGOLIA (MGMR) FEBRUARY, 1994.

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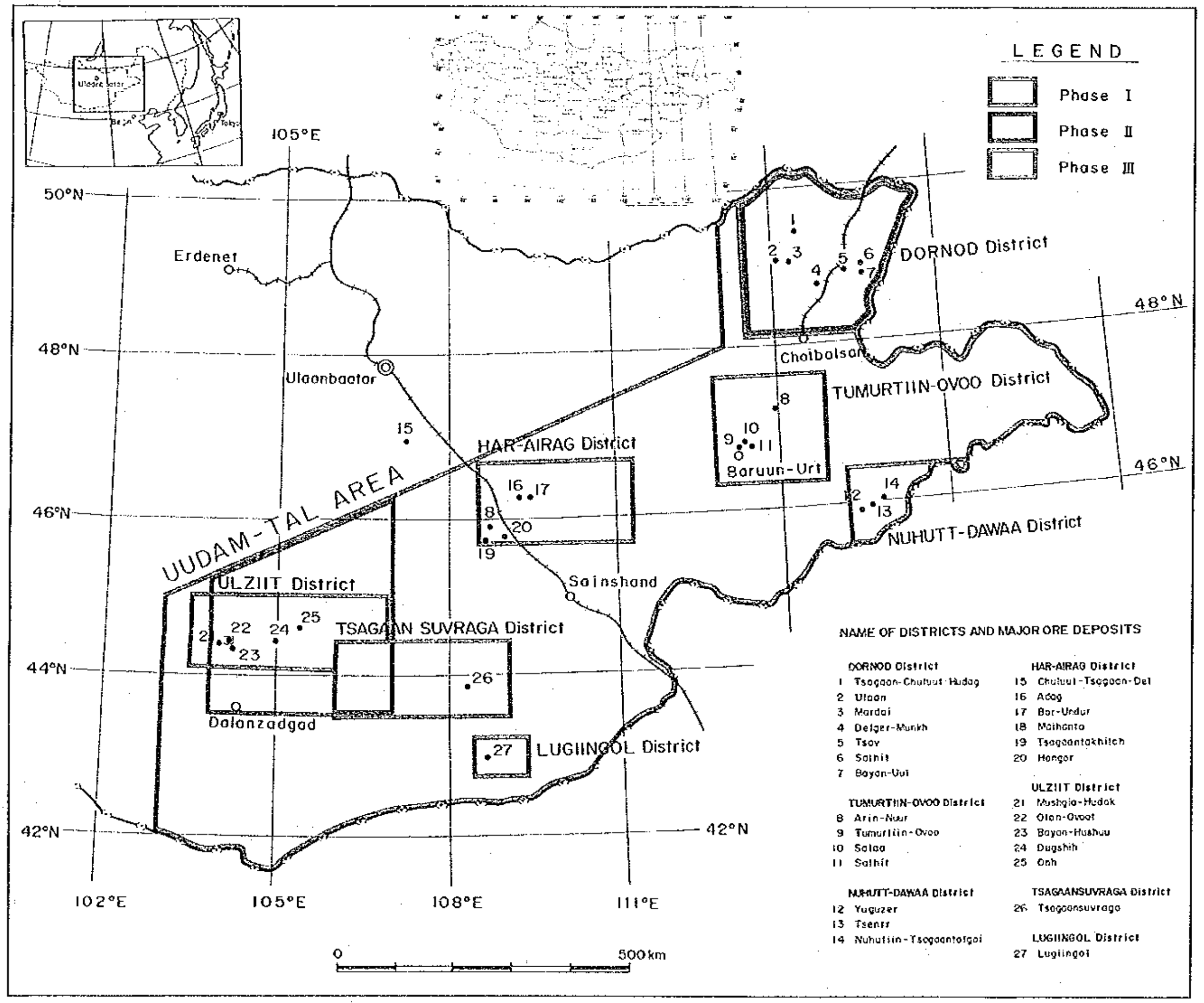
INDEX MAP OF THE SURVEY AREA



NAME OF DISTRICTS AND MAJOR ORE DEPOSITS

DORNOD District
1 Tsagaan-Chuluut-Hudag
2 Ulaan
3 Mardai
4 Delger-Munkh
5 Tsav
6 Salhit
7 Bayan-Uul

TUMURTIIN-OVOO District
8 Arin-Nuur
9 Tumurtiin-Ovoo
10 Salaa
11 Salhit

NUHUTT-DAWAA District
12 Yuguzer
13 Tsenrr
14 Nuhutiin-Tsagaantolgoi

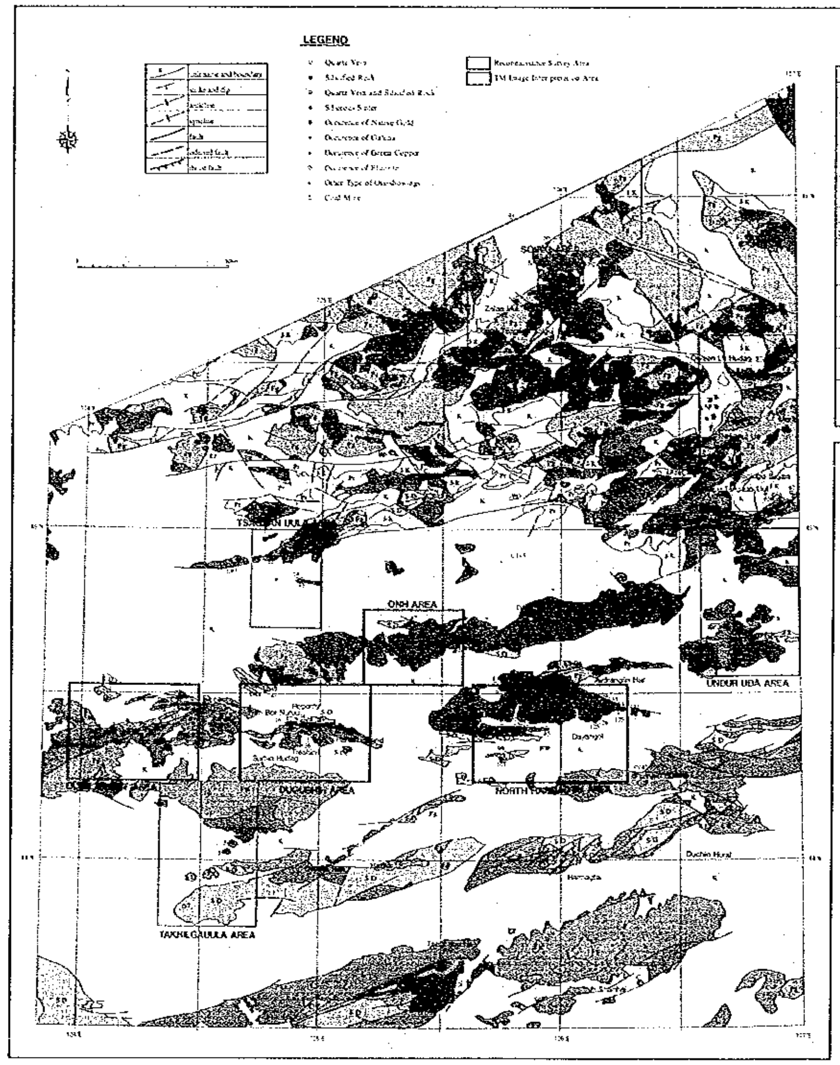
HAR-AIRAG District
15 Chuluut-Tsagaan-Del
16 Adag
17 Bor-Undur
18 Maihanta
19 Tsagaantakhilch
20 Hongor

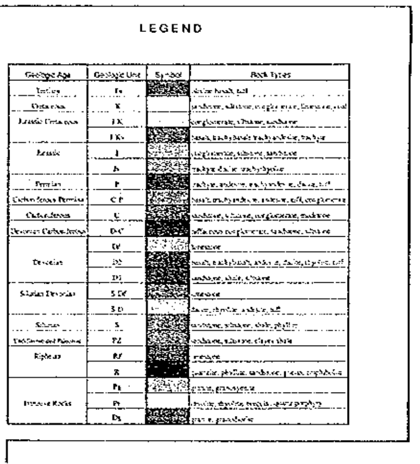
ULZIIT District
21 Mushgia-Hudak
22 Olon-Ovoot
23 Bayan-Hushuu
24 Dugshih
25 Onh

TSAGAANSUVRAGA District
26 Tsagaansuvraga

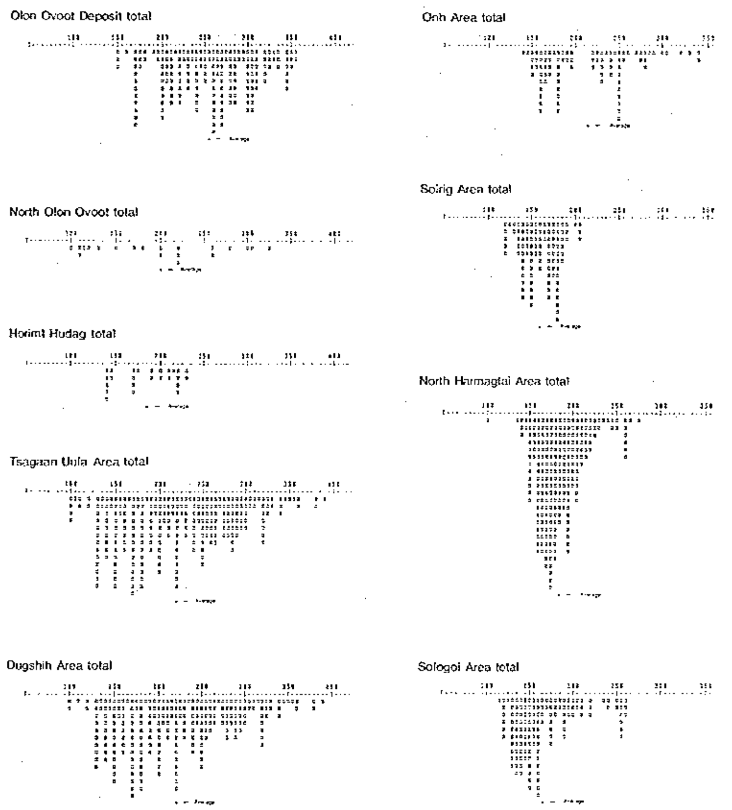
LUGIINGOL District
27 Lugiingol

GEOLOGIC MAP OF THE ULZIIT AREA (PHASE II)

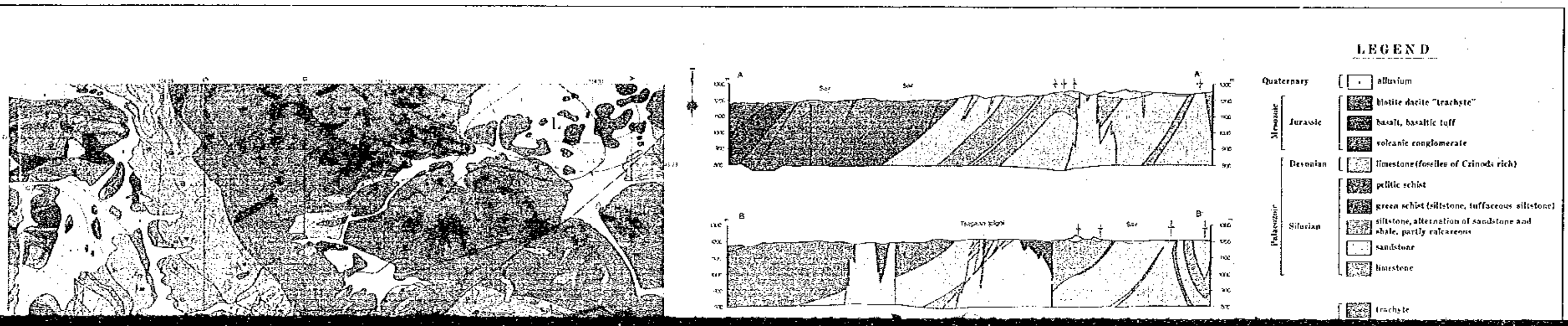




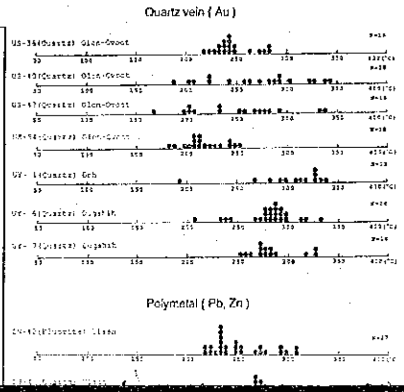
HISTOGRAM OF THE HOMOGENIZATION TEMPERATURE OF FLUID INCLUSIONS IN THE ULZIIT AREA (PHASE II)



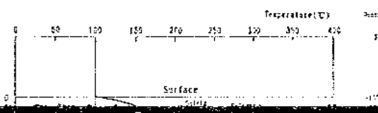
GEOLOGIC MAP OF THE SEMIDETAILED SURVEY AREA (PHASE II)



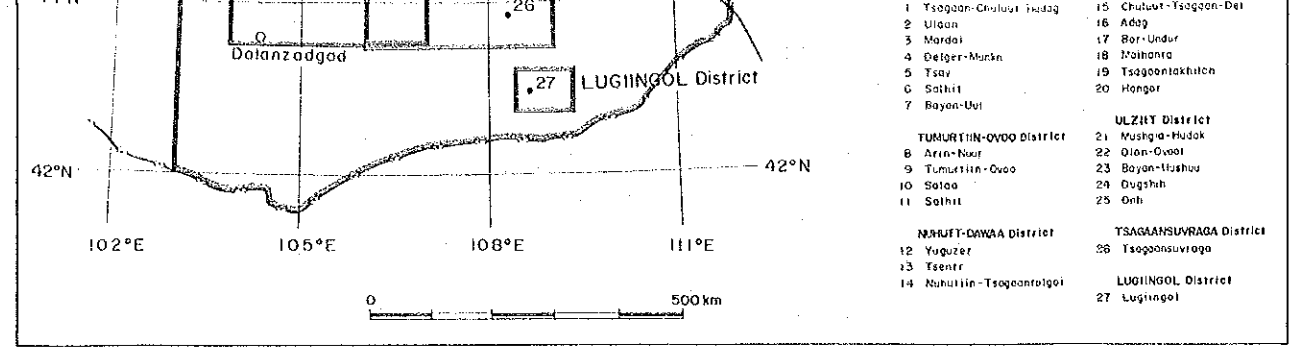
HISTOGRAM OF THE HOMOGENIZATION TEMPERATURE OF FLUID INCLUSIONS IN THE UUDAM TAL AREA (PHASE I)

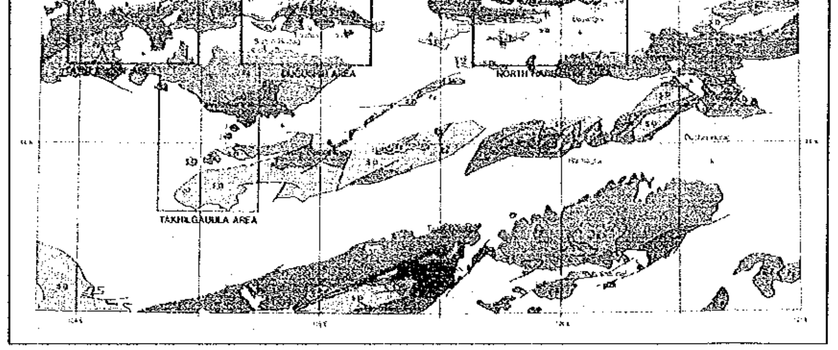


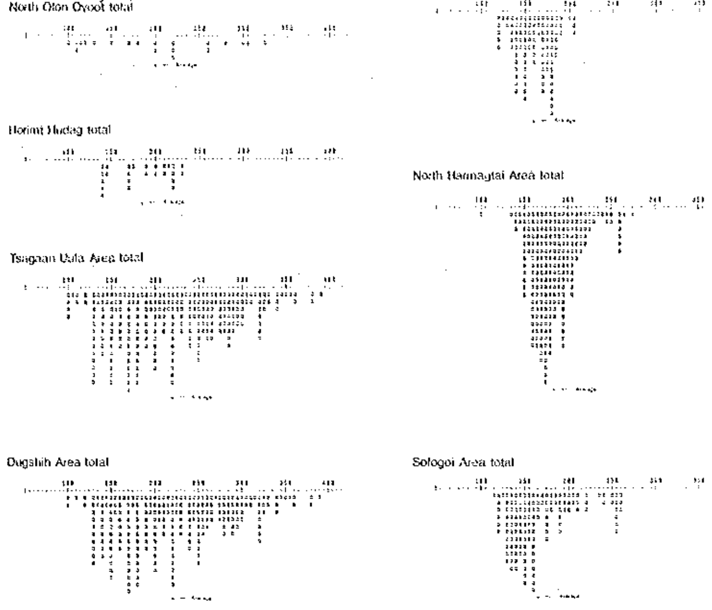
INFERRED DEPTH OF ORE FORMATION IN RELATION TO THE FILLING TEMPERATURES OF FLUID INCLUSIONS IN SELF-SEALING MODEL



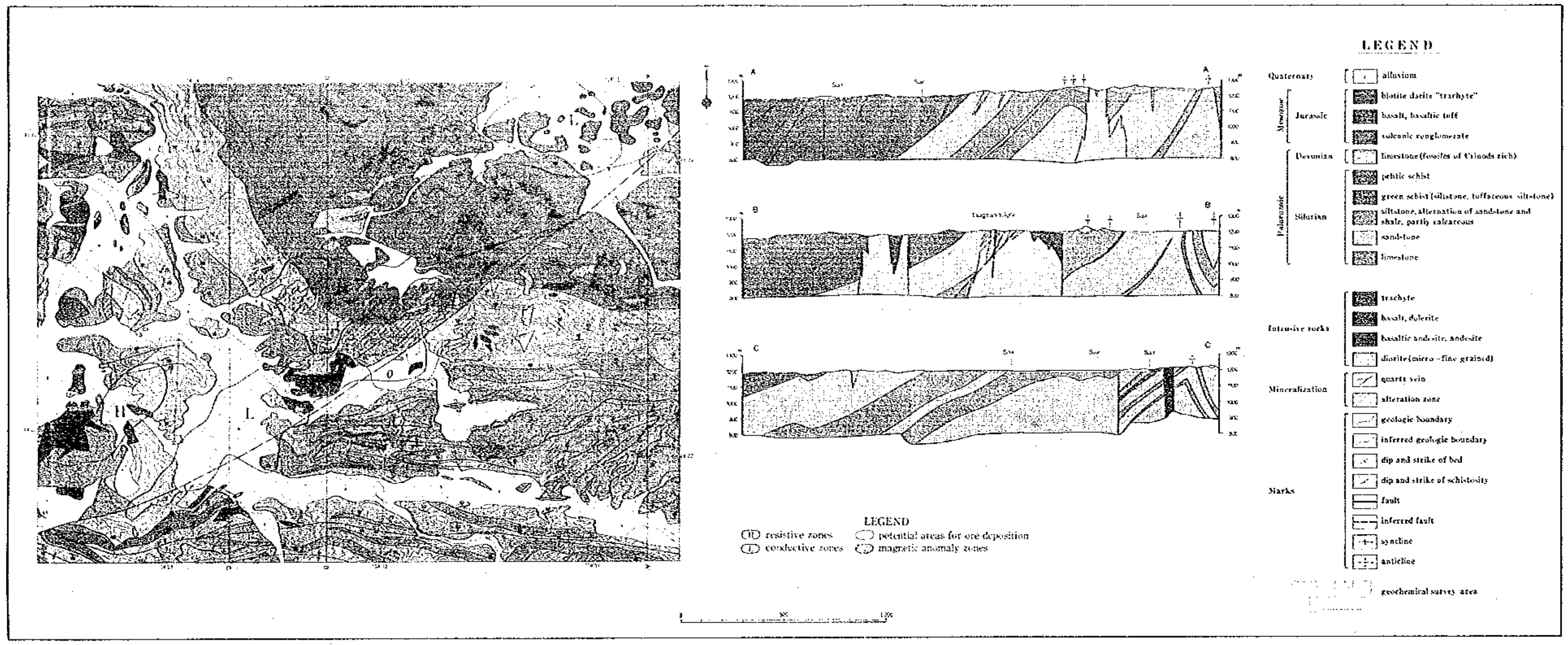
INFERRED EROSION LEVEL OF THE ORE-SHOWINGS IN THE ULZIIT AREA



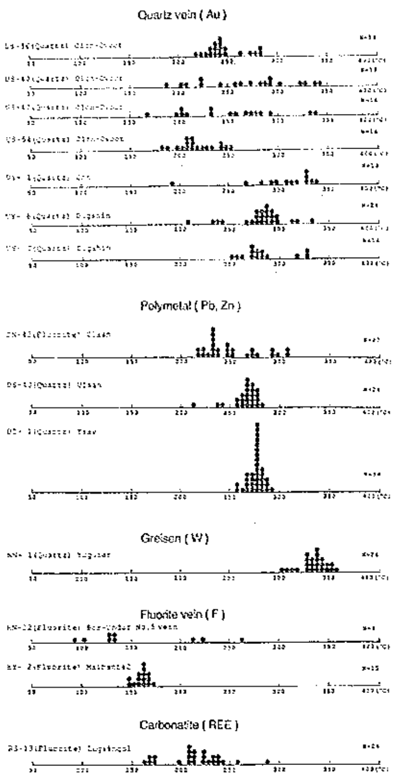




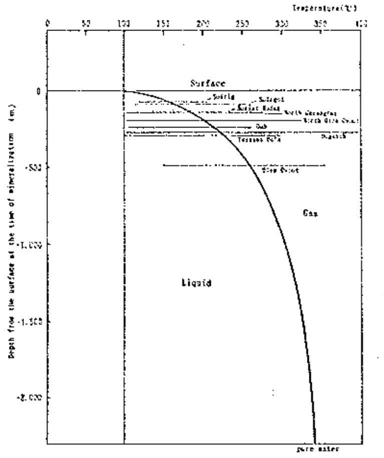
GEOLOGIC MAP OF THE SEMIDETAILED SURVEY AREA (PHASE Ⅱ)



HISTOGRAM OF THE HOMOGENIZATION TEMPERATURE OF FLUID INCLUSIONS IN THE UUDAM TAL AREA (PHASE Ⅰ)

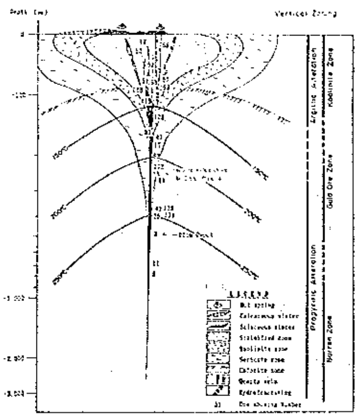


INFERRED DEPTH OF ORE FORMATION IN RELATION TO THE FILLING TEMPERATURES OF FLUID INCLUSIONS IN SELF-SEALING MODEL



Average homogenization temperatures were adopted taking self-sealing effect into consideration.

INFERRED EROSION LEVEL OF THE ORE-SHOWINGS IN THE ULZIIT AREA



RESULTS OF DATING BY K-Ar, Pb-Pb METHOD (PHASE Ⅰ)

No.	SAMPLE No.	LOCALITY	COORDINATES NORTH	COORDINATES EAST	ROCK	MEDIA	RESULT DETERMINED AGE (Ma)	RESULT GEOLOGIC TIME	NOTE
(K-Ar method)									
1	[illegible]	Tsagaan-Chuluut Hud.	[illegible]	[illegible]	Granite porphyry	K-feldspar	154 ± 8	M~L Jur	[illegible]
2	[illegible]	Tsav	[illegible]	[illegible]	Monzodiorite	Hornblende	156 ± 4	M~L Jur	DDH, [illegible]
3	[illegible]	Tsav			Granite porphyry	Whole rock	149 ± 5	L Jur~E Cret	DDH, [illegible]
4	[illegible]	Tsav			Schistose granite	Biotite	161 ± 3	M Jur	DDH, [illegible]
5						Whole rock	160 ± 4	M Jur	
6	[illegible]	Ulaan area	[illegible]	[illegible]	Granite	K-feldspar	191 ± 10	E Jur	SW of Ulaan
7	[illegible]	Lugiingol	[illegible]	[illegible]	Nepheline syenite	Biotite	237 ± 12	L~M Tri	No.6 vein
8	[illegible]	Lugiingol	[illegible]	[illegible]	Syenite	Biotite	239 ± 11	M~L Tri	[illegible]
9						Hornblende	236 ± 12	M~L Tri	
10						K-feldspar	246 ± 12	E Perm~M Tri	
11						Whole rock	239 ± 12	E Perm~E Tri	
12	[illegible]	Lugiingol			Nepheline syenite	Nepheline	234 ± 12	L~E Tri	[illegible]
13						Biotite	239 ± 11	M~E Tri	
14	[illegible]	Tsagaansuvraga	[illegible]	[illegible]	Greisen	Muscovite	354 ± 18	E Dev~L Carb	Ore stock pile
15	[illegible]	Tsagaansuvraga	[illegible]	[illegible]	Quartz monzonite	K-feldspar	315 ± 16	L~E Carb	[illegible]
16	[illegible]	Tsagaansuvraga area	[illegible]	[illegible]	Quartz monzonite	Hornblende	331 ± 17	E Dev~L Carb	10km east from T.S.
17	[illegible]	Salaa	[illegible]	[illegible]	Granite	K-feldspar	161 ± 16	E Jur	[illegible]
18	[illegible]	Tumurtiin-Ovoo area	[illegible]	[illegible]	Granite	K-feldspar	191 ± 10	E Jur	[illegible] from T.O.
19	[illegible]	[illegible]	[illegible]	[illegible]	Alkali granite	Hornblende	280 ± 15	E Carb~L Perm	[illegible]
20	[illegible]	Mushgia-Hudak	[illegible]	[illegible]	Syenite	Nepheline	131 ± 7	E Jur~L Cret	SW of syenite Mt.
21	[illegible]	Olon-Ovoot area	[illegible]	[illegible]	Graphic granite	Albite	318 ± 16	L Ord~E Carb	10km NE from O.O.
22	[illegible]	Olon-Ovoot area	[illegible]	[illegible]	Gabbro	Whole rock	278 ± 14	E Dev~L Perm	[illegible] from O.O.
23	[illegible]	Mushgia-Hudak	[illegible]	[illegible]	Granite	K-feldspar	241 ± 12	E Perm~M Tri	[illegible] from M.H.
24	[illegible]	Olon-Ovoot area	[illegible]	[illegible]	Granodiorite	Biotite	292 ± 14	E Carb~L Perm	[illegible] from O.O.
25	[illegible]	[illegible]	[illegible]	[illegible]	Granite	Whole rock	226 ± 11	M~L Tri	[illegible]
(Pb-Pb method)							**		
26	[illegible]	Tsav	[illegible]	[illegible]	Plymtl vein ore	Galena	121.0	E Cret	No.4 trench
27	[illegible]	Tsav	[illegible]	[illegible]	Plymtl vein ore	Galena	[illegible]	L Cret	Ore stock pile
28	[illegible]	Tsav			Plymtl vein ore	Galena	[illegible]	L Cret	near No.11 shaft
29	[illegible]	Ulaan	[illegible]	[illegible]	Plymtl Bx-pip ore	Galena	[illegible]	M Jur	Ore stock pile
30	[illegible]	Salhit	[illegible]	[illegible]	Car-mgt sh ore	Galena	[illegible]	L Cret	DDH

ABBREVIATIONS T.S.:Tsagaansuvraga, T.O.:Tumurtiin-Ovoo, O.O.:Olon-Ovoot, M.H.:Mushgia-Hudak, E:Early, M:Middle, L:Later
Cret:Cretaceous, Jur:Jurassic, Tri:Triassic, Perm:Permian, Carb:Carboniferous, Ord:Ordovician
DDH:Boring core, Plymtl:Polymetal, Car-mgt sh:Carbonate-magnetite shale, Bx-pip:Breccia pipe
*:Coordinates of core storage yard or ore stock pile.
**:Pb-Pb age were calculated using the formular taken from "Principles of Isotopic Geology" by Gunter Faure, 1977.

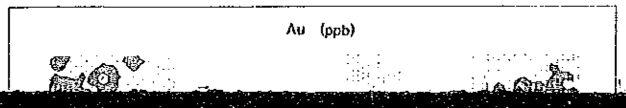
RESULTS OF DATING BY K-Ar METHOD (PHASE Ⅱ)

No.	SAMPLE No.	LOCALITY	COORDINATES NORTH	COORDINATES EAST	ROCK	MEDIA	RESULT DETERMINED AGE (Ma)	RESULT GEOLOGIC TIME	NOTE
1	[illegible]	Geochemical survey area	as collected on the detailed survey grid (refer to PL. [illegible])		Schist	Whole rock	301 ± 15	Upper Carboniferous	
2	[illegible]	[illegible] regional survey area			Muscovite quartz vein	″	287 ± 14	Lower Permian	
3	[illegible]	[illegible] regional survey area	[illegible]	[illegible]	Biotite rhyolite	″	[illegible]	Lower Jurassic	[illegible]
4	[illegible]	[illegible] regional survey area	[illegible]	[illegible]	Sericite schist	″	[illegible]	Lower Permian	
5	[illegible]	[illegible] regional survey area	[illegible]	[illegible]	Andesite	″	[illegible]	Lower Permian	
6	[illegible]	Sologoi regional survey area	[illegible]	[illegible]	Granodiorite	″	[illegible]	Middle Jurassic	
7	[illegible]	Sologoi regional survey area	[illegible]	[illegible]	Andesite	″	[illegible]	Upper Triassic	
8	[illegible]	Sologoi regional survey area	[illegible]	[illegible]	Aplite	″	[illegible]	Lower Jurassic	
9	[illegible]	Sologoi regional survey area	[illegible]	[illegible]	Muscovite granite	″	233 ± 12	Middle Triassic	
10	[illegible]	Hannagtai North regional survey area	[illegible]	[illegible]	Sericite schist	″	[illegible]	Lower Permian	

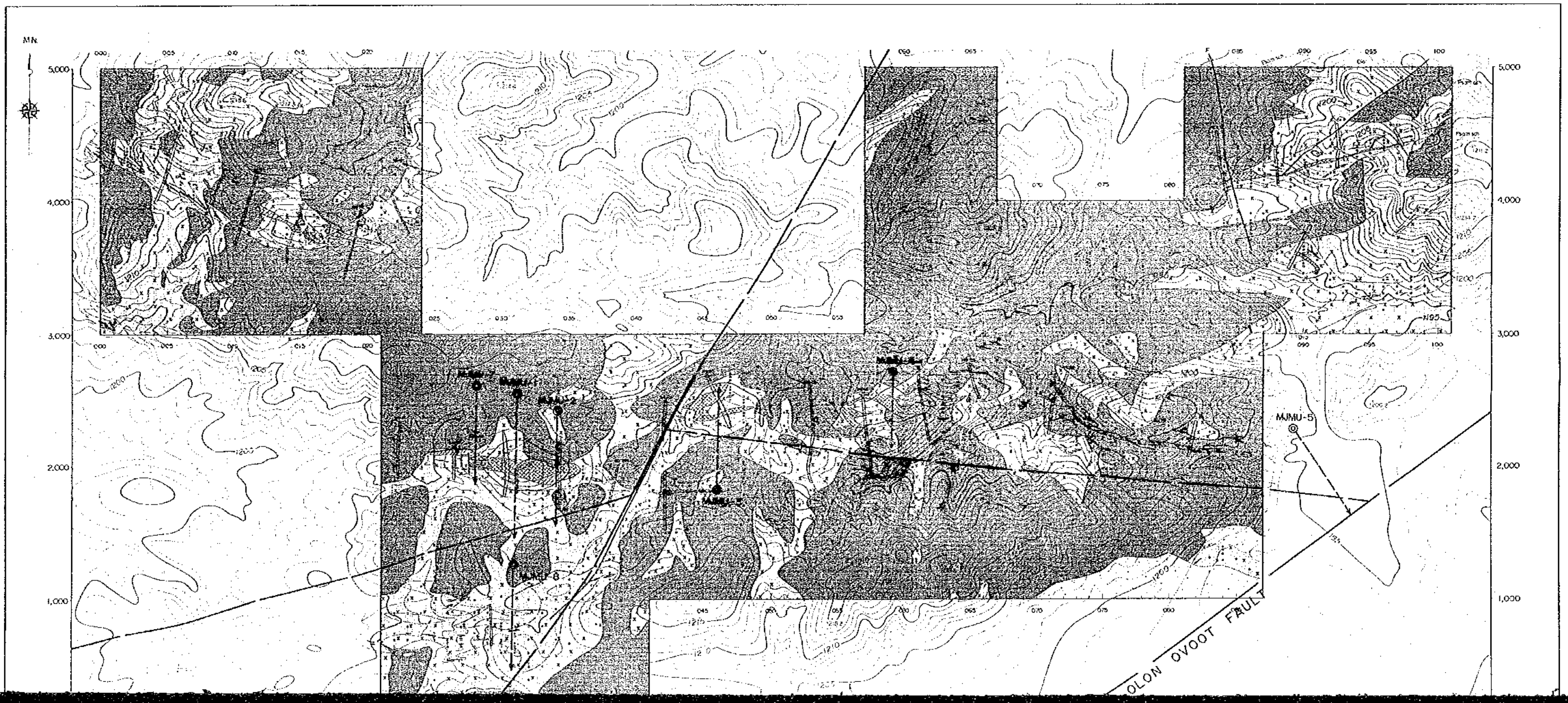
RESULTS OF DATING BY K-Ar METHOD (PHASE Ⅲ)

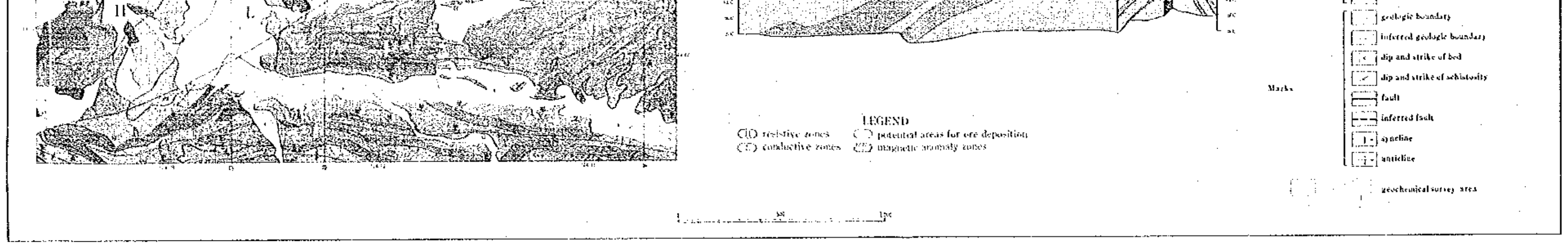
No.	SAMPLE No.	LOCALITY Boring No.	LOCALITY Depth (m)	ROCK NAME	MEDIA	RESULT DETERMINED AGE (Ma)	RESULT GEOLOGIC TIME	NOTE
1	[illegible]	MJMU-1	45.50	White clay	Whole rock	245 ± 12	Lower Triassic	hydrothermal
2	[illegible]	MJMU-7	87.13-89.70	Alt microdio	Whole rock	281 ± 14	Lower Permian	csg-py dissem
3	[illegible]	MJMU-8	26.25-95.50	Gry-grn colored fresh microdio	Whole rock	326 ± 16	Lower Carboniferous	

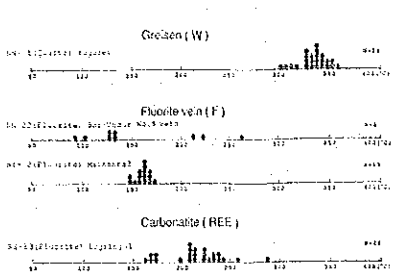
DISTRIBUTION OF GOLD IN THE GEOCHEMICAL SURVEY AREA (PHASE Ⅱ)

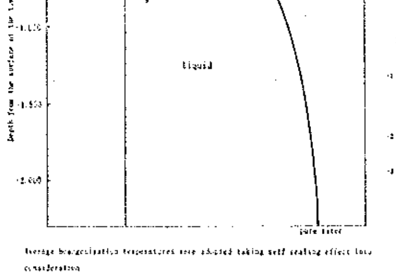


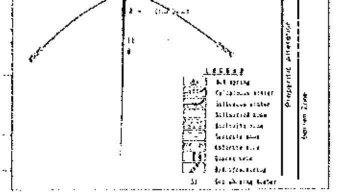
GEOLOGIC MAP OF THE GEOCHEMICAL SURVEY AREA



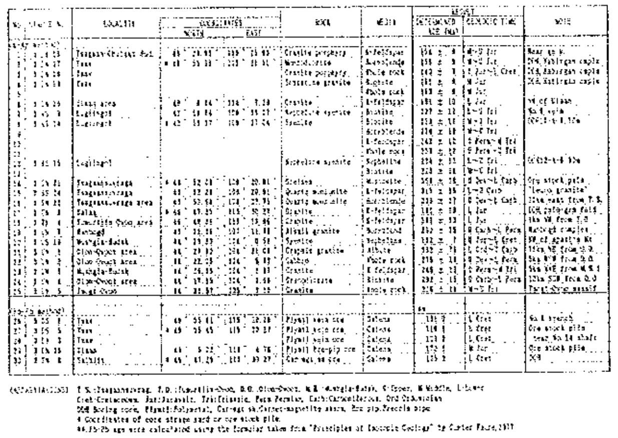




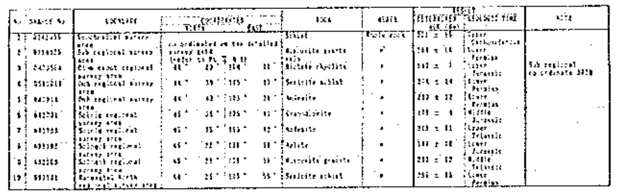




RESULTS OF DATING BY K-Ar, Pb-Pb METHOD (PHASE I)



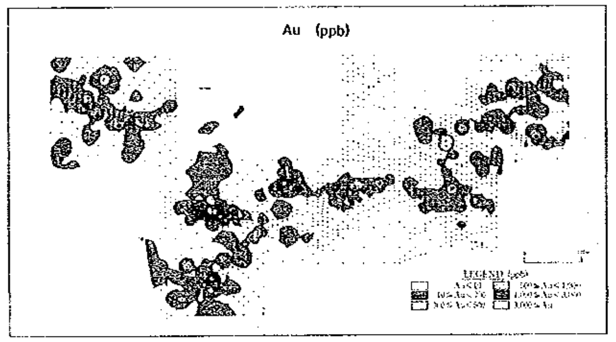
RESULTS OF DATING BY K-Ar METHOD (PHASE II)



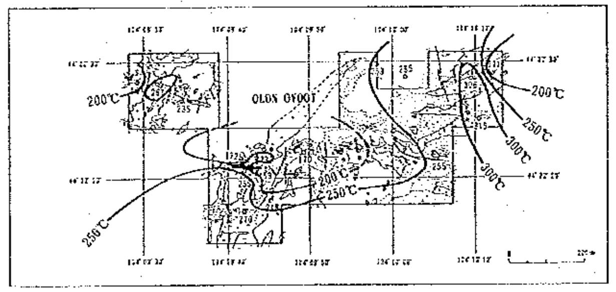
RESULTS OF DATING BY K-Ar METHOD (PHASE III)

No.	SAMPLE No	LOCALITY		ROCK NAME	MEDIA	RESULT		NOTE
		Boring No.	Depth (m)			DETERMINED AGE (Ma)	GEOLOGIC TIME	
1	LXD001	MJMU-1	45.55	White clay	Whole rock	245 ± 12	Lower Triassic	Hydrothermal
2	LXD002	MJMU-7	57.70-59.70	Alt microdio	Whole rock	254 ± 14	Lower Permian	eng-py dissem
3	LXD003	MJMU-8	95.20-96.50	Gry-grn colored fresh microdio	Whole rock	325 ± 15	Lower Carboniferous	

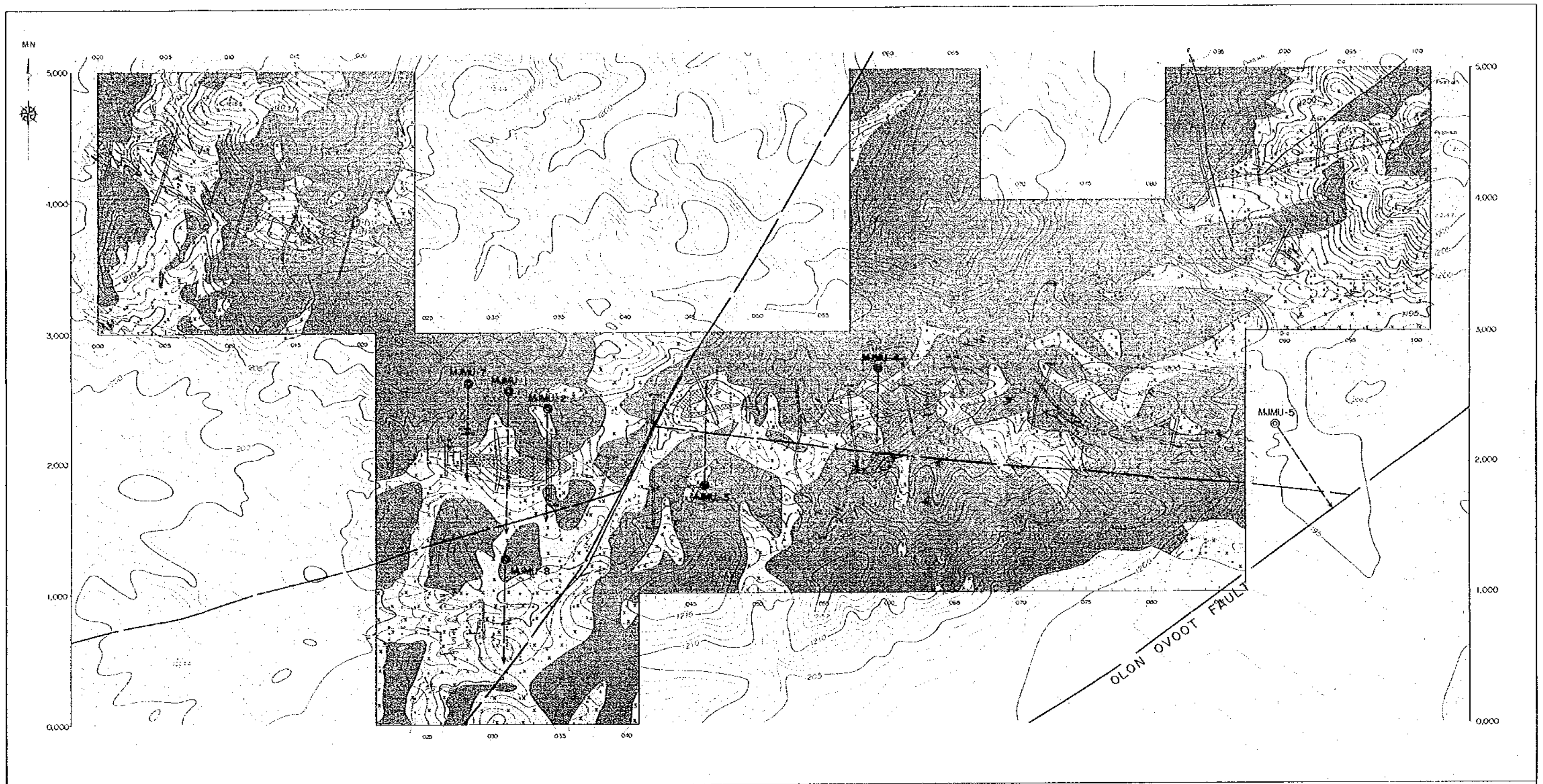
DISTRIBUTION OF GOLD IN THE GEOCHEMICAL SURVEY AREA (PHASE II)

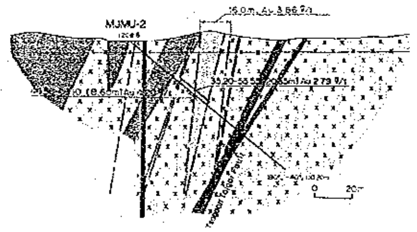


HOMOGENIZATION TEMPERATURE OF THE FLUID INCLUSIONS AT THE SURFACE OF THE OLON OVOOT DEPOSIT

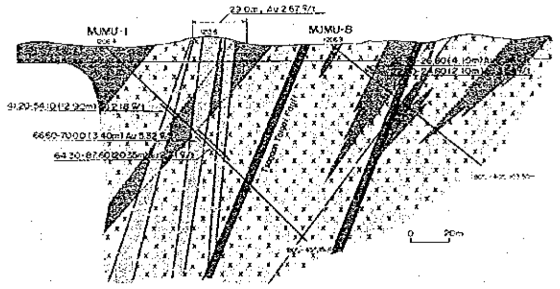


GEOLOGIC MAP OF THE GEOCHEMICAL SURVEY AREA

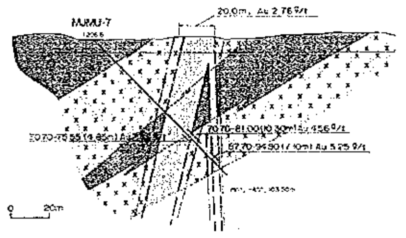




Highest ore grade
MJMU-2 40.50m~42.50m (2.00m) Au 7.81g/t



Highest ore grade
MJMU-1 72.90m~74.30m (1.40m) Au 8.70g/t
MJMU-8 24.60m~24.80m (0.20m) Au 8.92g/t



Highest ore grade
MJMU-7 73.85m~75.55m (1.70m) Au 15.10g/t
92.65m~94.80m (2.15m) Au 8.22g/t

0 50 100m

LEGEND

- quartz vein and veinzone
- quartz stockwork zone
- altered zone (pyritization and silicification)
- lithologic boundary
- dune sand, gravel
- trachyte
- diorite, microdiorite, diorite porphyry
- sandstone, shale, phyllite, tuffaceous schist
- fault
- trench
- borehole
- sampling point

Surveyed by Mitsui Mineral Development Engineering Co., LTD (MINDECO)

JICA