No. 14

REPORT
ON
THE MINERAL EXPLORATION
IN
THE ALTAN-TAL AREA, MONGOLIA

(PHASE Ⅱ)

MARCH 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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PREFACE

The Government of Japan, in response to the request of the Government of Mongolia, decided to conduct a mineral exploration in the Altan Tal area, Mongolia and entrusted the survey work to the Japan International Cooperation Agency (JICA). JICA, considering the importance of technical nature of the survey work, in turn, sought the cooperation of the Metal Mining Agency of Japan (MMAJ) to accomplish the work.

MMAJ concluded the scope of work (S/W) with Ministry of Energy, Geology, and Mining after discussion on the survey.

The survey work in the survey area will be carried out within a period of two years commencing from 1994.

Metal Mining Agency of Japan dispatched the survey mission consisting of four members for the second phase work to Mongolia from July 17, 1995 to Sepember 19, 1995.

The survey work in Mongolia was carried out successfully with cooperation of the Mongolian Government authorities and MONGEO Co., Ltd.

This report is mainly summarized based on the result of the second phase survey work carried out in 1995, adding partly the result of the first phase survey work carried out in 1994, and also forms the final consolidated report which will be submitted to the Government of Mongolia after completion of the survey work.

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

March, 1996

Kimio Fujita

Kimio Fujita
President
Japan International Cooperation Agency

清滝昌三郎

Shozaburo Kiyotaki
President
Metal Mining Agency of Japan

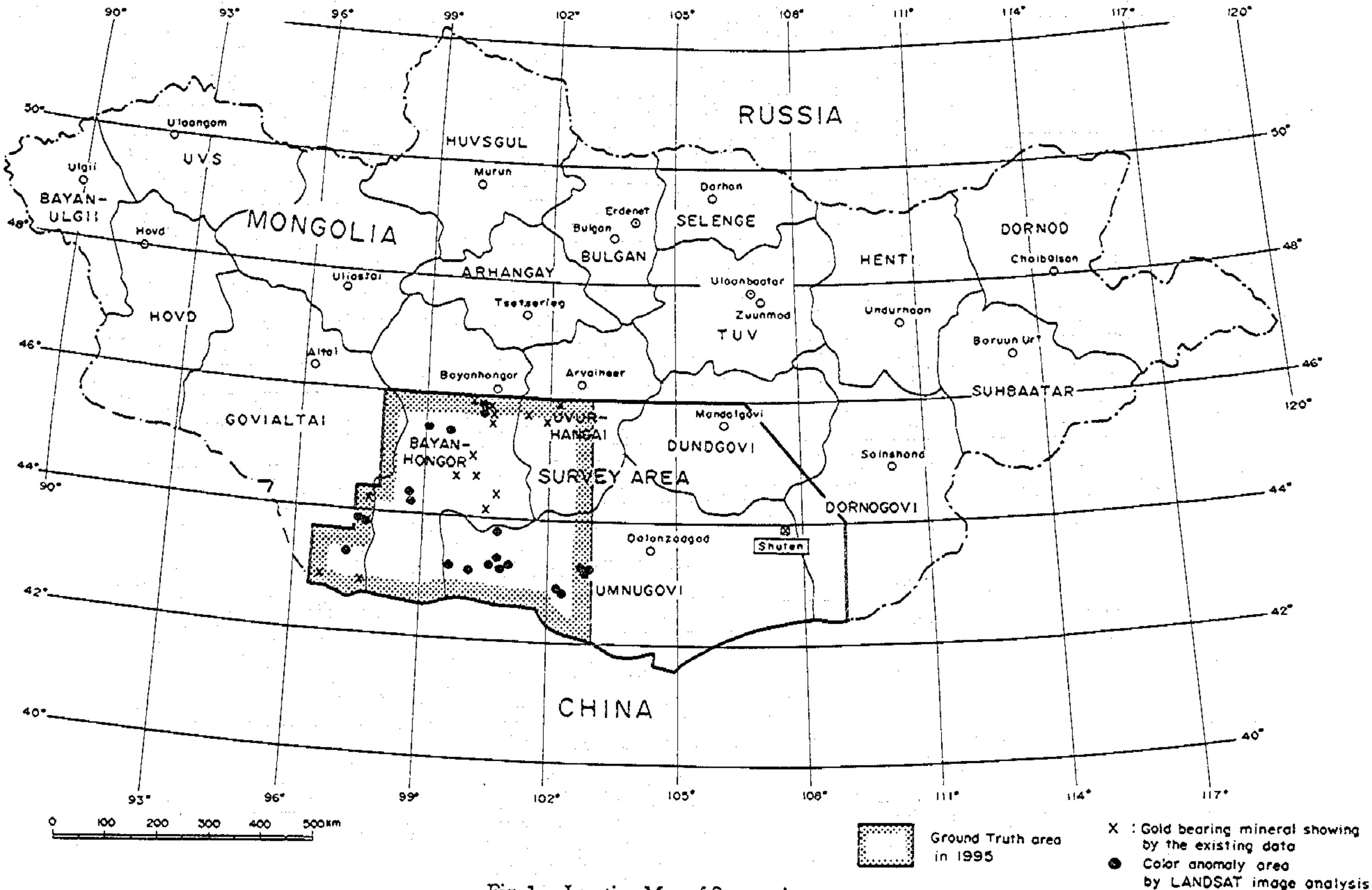

Fig. 1 Location Map of Survey Area

SUMMARY

SUMMARY

The result of the second phase survey conducted in the Altan Tal Area from July, 1995 to February, 1996, adding partly the results of the first phase survey (especially the results of satellite image analysis) in 1994, is described in this report.

The main objective of the survey is to find out a gold bearing ore deposit or mineral showing in the survey area, through synthetical analysis the results obtained from collection, compilation, analysis and evaluation of the existing data arround concerned area and groundtruth, and to pursue technology transfer to the Mongolian counterpart personnel in the course of the survey.

The region to be surveyed is called "Altan Tal area" of about 345,000km^2 occupies more than a half of southern Mongolia, through the groundtruth of the second phase survey was carried out for the western half of the Altan Tal area (hereinafter referred to as the "west Altan Tal area"), lying west side of Long. 103° E.

The Altan Tal area lies between the Siberian Plateau in the north and the Sino–Korean block in the south, and is included in the Ural–Mongolian Palaeozoic fold belt in terms of its geological structure, but it is divided into two blocks by the "Ih–bogd deep fracture" running in approximately east–west direction and dividing Mongolia into the northern part and the southern part. One is the northern megablock, lying on the north side of the deep fracture and is consisted geologically of the Baikalian and the early Caledonian fold belts, and other is the southern megablock, lying on the south side of the main geotectonic line and is constituated of the late Caledonian, the Variscan, and the Kimmeridgian fold belts.

The west Altan Tal area to be covered for the groundtruth targets is within the area where the magmatism was repeated during the Palaeozoic and the Mesozoic, especially during the Palaeozoic period. In this area, there are many distributions of gold deposits, placer gold deposits and its showings, which accompany the quartz vein relating to the granitic igneous activity during the Devonian to Carboniferous period and the Permian to Triassic period, partially including the locality, in which prophyry type copper mineralization occurrs.

The results of analysis of the existing data to be collected and the groundtruth conducted during the Second phase survey are summarized as follows.

1. Collection, Compilation and Analysis of the Existing Data

(1) Shuten mineralized area

The Shuten area is located in the Govi Khin Gai tectonic zone and consists of the Shuten volcano–intrusive acidic complex of the early Carboniferous to early Permian period in a circular structure with a diameter of 6 to 7 km, and was affected mainly with hydrothermal and

metasomatic alterations caused by fluids and volcanic gases of post-orogenic activities. and alterations such as silicification, argillization, propylitization, feldspatization and metasomatic quartz-tourmaline are recognized.

In this area, gold mineralization concerning metasomatic altered rock and quartz veins and having a posibility of the relation to alunitized rock, and copper mineralization relating to the intrusion of porphyritic rocks are recognized. besides the elements of zinc, lead, nickel,cobalt, silver and other elements are found. However, the mineralization of such elements is not so strong.

The results of general mineral resources survey carried out arround the Shuten area in 1982 could be summarized as follows:

① Synthetical survey works such as geological survey, geochemical survey, geophysical prospecting and other works including trenching and drilling, had already been conducted.

② The geological survey covered geological mapping, a study on genesis of porphyry copper type mineralization and alteration phase etc.

③ The geochemical survey by rocks and heavy minerals were conducted restrictively at most promising areas cosisting of the alteration zones of potassic feldspar and sericite.

④ Slightly mineralized zones of gold and copper were observed in this area, but it is believed to not expansive and small scale.

⑤ The above mentioned surveys led to selecting the most promising 15 areas, where check drilling were conducted. The results of spectrophotometric analysis of 13 drilling core samples picked up from these areas indicated the gold content was below the detection limit of value wholly, and no presence of gold occurrences in the underground were confirmed by drilling.

Based on the above mentioned judgment on the strength, scale, characteristics etc. of gold mineralization in the Shuten area, it could be said the area has no high potentiality of gold occurrences.

(2) Gold Deposits and Gold Showings in the west Altan Tal area

In the west Altan Tal area, the two main metallogenic provinces are found. They are (a) the north Mongolian metallogenic province belonging to the northern megablock of Mongolia, and (b) the south Mongolian metallogenic province belonging to the southern megablock of Mongolia.

The north Mongolian metallogenic province consists of two metallogenic zones such as the Bayanhongor and the Khungui-Baidrag, while the south Mongolian metallogenic province includes three metallogenic zones of the Bayanlig-Bayangovi, the Edrengiin Nuruu and the Tomortiin Nuruu.

At this time, 24 main gold deposits and gold showings are known in the west Altan Tal area, and the following 5 except alluvial placer gold and conglomerate types are important, such as: the Saran Uul porphyry copper type mineralized area belonging to the Khungui-Baidrag metallogenic zone, the Xhan Uul quartz vein network type mineralized area belonging to the Bayanhongor metallogenic zone, the Bayangovi-1 quartz vein network type mineralized area belonging to the Bayanglig-Bayangovi metallogenic zone, and both of the Hatan Suudal and Tallin Meltes quartz vein type mineralized areas belonging to the Tomortiin Nuruu metallogenic zone.

2. Groundtruth

(1) Existing Gold Deposits and Gold Showings

Concerning the existing gold showings in the west Altan Tal area, most of them come within the category of gold bearing quartz vein. However, these veins are considered to be small and narrow in general. The result of the groundtruth covering the 15 areas picked out as the survey targets indicates that the scales and grades of gold showings are generally small and lower than those stated in the existing data, so that the facts obtained through the surveys are not so promising as expected in the beginning before survey.

Of the 15 existing gold deposits and gold showings, 14 are gold bearing quartz vein type. The survey result shows that a 43.5 g/t of gold content was highest, which was obtained from a quartz vein in the Hatan Suudal gold deposit (MS−572) in Govialtai Aimag located near the southwestern border of the area, followed only by a 1.41 g/t of gold content, which was obtained from a quartz vein in the Bayangovi−1 gold showing (MS−592) near Bayangovi in Bayanhongor Aimag. Generally speaking, the gold value of the concerned area was low.

The general tendency of gold deposits and gold showings in the west Altan Tal area showed that gold was limited in quartz veins and did not extend into the surrounding altered country rocks. This fact indicates that actual gold content are generally lower than the records in the existing data, which is against the initial expectation. It cannot be denied the possibility of finding gold mineralized zones with a some 10g/t of gold content and reaching tens of thousands tons of ore resrves, just as found in Hatan Suudal, however it seems finding of a large scale gold mineralized zone of this type is difficult.

(2) Satellite Image Anomaly

Regarding the color anomaly zones obtained by satellite images analysis during the First phase survey, it was detected 19 zones indicating of the presence of mineralized areas out of 21 observed zones, and was confirmed superficial indications of the gold mineralization in 4 zones out of these 19 zones.

That is to say, concerning 21 image anomaly zones, where these were made surveys, the 19 areas had hydrothermal alteration zones of mainly silicification and argillization though their strength are different by the area.

Of the 19 areas, only 1 area falls under the category of gold bearing porphyry copper type (IA−68), whose country rock consists of brecciated dioritic rock and the surrounding silicified rocks. On 10 samples taken from the brecciated dioritic rock, a highest gold content of 0.38 g/t, or 0.17 g/t of average gold content and a highest copper content of 0.12% were obtained.

Remarkable epithermal silicification and argillization was confirmed in relatively broad areas of the 18 other areas, where intermediate to acidic volcanic rocks are major constituents of the country rocks. Of the 18 areas, the indication of a gold mineralization was observed on the surface of 3 areas such as IA−52, IA−65 and IA−51.

IA−52 has a highest gold content of 1.44 g/t in argillized dacitic rock. IA−65 had a highest gold content of 1.07 g/t in a network quartz vein of silicified volcanic rocks, while IA−51 had a highest gold content of 0.102 g/t in a silicified zone of volcanic rocks. All of such low gold content were obtained clearly in silicified and argillized zones in broadly spread intermediate to acidic volcanic rocks.

The interpretation of satellite images provided effective data to achieve the initial objective of selecting altered and mineralized zones from unexplored areas and tracing such large scale epithermal gold occurreces unexplored so far. Namely, a very noteworthy indication to select future exploration targets is found.

From now on, it should be consider to conduct the follow-up surveys covering a wide area indicative of the presence of hydrothermal altered and mineralized zones containing the gold is necessary in order to more definitely detect the localities of such gold bearing mineralized zones and it is also necessary to make further effort for the discovery of new gold deposits in this type.

3. Recommendation to the future exploration

As the recommendation to the future exploration for mineral resources, especially for the gold bearing ore deposits, it would like to make the following reommndations, based on the results during the First and the Second phase surveys.

(1) For the principal areas, in IA-68 area (promising area: what is called "Bayanhongor-South") indicating the showing of the presence of the gold bearing porphyry copper type mineralization, and the surrounding both gold metallogenic zones such as Bayanhongor and Khungui-Baidrag (refer to Fig.10: the northwestern part of those metallogenic zones are out of the area to be surveyed) where are including above mentioned IA-68 area, the systematic geological survey acommpanying trenching, geochemical survey, physical survey, drilling etc. should be conducted for discovering new gold deposits.

(2) For the IA-52 and IA-51 areas (promising area: as it called "Noyon-East") situated in the east of Noyon in Umnugovi Aimag and IA-65 area (promising area: what you call "Gurbantes-West") situated in the west of Gurubantes in same Aimag, where both areas were detected through the satellite image analysis and confirmed the presence of hydrothermal alteration and gold mineralization by groundtruth, the systematic geological survey accompanying trenching, geochemical survey etc. should be conducted in order to definitely detect the localities of the gold mineralization.

(3) In the central to northern part of the Altan Tal area, where covers the Bayanlig-Bayangovi metallogenic zone besides above mentioned two metallogenic zones, there are many distribution of placer gold deposits and its showings. Therefore, the information concerning those placer gold deposits and its showings should be collected in details so that it will be able to pick up some promising areas and to conduct the on-site check survey for them.

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PART I THE GENERAL

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CHAPTER 1 INTRODUCTION

1.1 The background and objective of the survey

The Mongolia has recently opened the door of the economy to western countries and is now pursuing a policy which promotes the introduction of funds and technology fromthese countries. The Mongolia government has approached Japanese government positively and private companies are also taking a strong interest in development of the mineral resources in Mongolia. Technological cooperation with Japan, in the field of mining, was desired and a written request for survey to develop rare earth element deposit in the Mushgia−Hudak area was submitted in October, 1989. The first project finding mission was dispatched at the request of the Mongolian government and the possibility of cooperative survey for copper, lead, zinc and rare earth minerals was confirmed.

A second project finding mission was dispatched in March of 1991, following three additional requests for assistance from Mongolia in February of 1991. The purpose of this mission was to investigate the feasibility of the surveys which had previously been proposed and to discuss specific survey items with Mongolian counterparts. As a result, the survey mission and the State Geological Center of Mongolian People's Republic agreed upon the commencement of the survey in the Uudam−Tal area and a Scope of Work (S/W) dated March 16th, 1991 was signed. The survey in the Uudam−Tal area had been conducted from 1991 to 1993 according to this Scope of Work.

Furthermore, the Scope of Work on the survey in the Altan Tal area adjacent to the west of the Uudal Tam area was signed on the 29th of July, 1994, and the survey scheduled to conduct in 1994 and 1995 was commenced in September of 1994. The Second phase field survey in Mongolia had been carried out from 17th of July to 19th of September in 1995.

The main objective of the survey is to find gold occurrence or deposit in the survey area described below, through analyzing synthetically the results obtained from collection, compilation, analysis, and evaluation of the existing data and groundtruth, adding partly the results of the First phase survey, and to pursue technology transfer to the Mongolian counterpart personnel in the course of the survey.

1.2 Conclusion and Recommendation of the First phase Survey

1.2.1 Conclusion of the First phase Survey

(1) Collection and analysis of the existing data

As the result of the collection, compilation, and analysis of the existing data on geological survey, geochemical exploration, geophysical exploration, drilling, and so on for ore deposit and ore showing of gold, silver, copper, lead, and zinc in the survey area, 10 areas, namely Tsagaan Ovoo, Ulziit−Gurvansaihan, Olon Ovoot, Narangin Hudak−Tsagaansubraga, Ih Shanhai, Harmagtai, Bayanhongor, Bayan Govi, Bogd, Mt. Nemegt, where many gold showings which contain gold swarm, have been selected.

Out of these 10 areas, Tsagaan Ovoo, Ulziit−Gurvansaihan, Olon Ovoot, Narangin Hudak−Tsagaansubraga, Ih Shanhai, and Harmagtai areas are situated in the ground truth survey area to the east of long. 103° E and other four areas are situated in the western half part to the west of long.103° E.

(2) Interpretation of satellite image

Thirty–three scenes of the Landsat TM images covering the whole survey area have been interpreted and the alteration zones and lineament in the satellite images have been selected.

The selected alteration zones which show same color in the analyzed satellite images as that of the Shuten area or Ih Shanhai area have numbered 96 areas in the whole survey area and 47 areas in the eastern half area investigated by the ground truth survey.

The Alteration zones selected seem to have a tendency to swarm in some areas such as the Mandalgovi–Saihan Ovoo area in the northern part of the ground truth survey area, Shuten–Ih Shanhai area in the east, and Hanbogd–Nomgon area in the south and are arraged in a east–northeast to east and west direction.

It was difficult to detect the known porphyry copper type ore showings such as Serven–Suhait, Harmagtai, and Narim Hudak in the satellite images, because they are not accompanied by strongly argillized and highly silicified zones. It was also difficult to detect vein type gold ore deposits such as Olon Ovoot deposit because of narrow alteration zone.

In the eastern half part of the survey area to the east of long.103° E, two linear structures, namely northeast to east–northeast and west–northwest directions, are predominant and extend for a long distance.

The curved to circular structures in the satellite images are clearly observed in the Shuten area, an area to the southeast of Shuten, the Hanbogd area, and an area tothe south–southeast of Luus.

The lineament of the east and west direction is dominant in the Nos. 43 and 44 areas, the east–northeast direction in the Shuten and Ih–Shanhai areas, and the east and west direction in the Nos. 23, 24, and 25 areas.

As the result of the ground truth survey for the selected alteration zones, it is concluded to be possible to select the ore showings accompanied by the silicified and argillized zones covering an area of more than 300 meters in diameter. Therefore, it seems to be useful to survey the selected alteration zone as a clue to search for epithermal gold deposit.

(3) Groundtruth

Forty–five areas out of 47 areas selected from the analyzed satellite images of the eastern half part of the survey area to the east of long. 103° E were investigated in the field. In 24 areas out of these 45 areas, neither silicification nor argillization was observed. In these areas accompanied by no argillization and silicification, although a little amount of clay minerals were sometimes found, some rock bodies which have special structure or brown surface stained by oxidized iron minerals might be selected by analyzed satellite images. No. 5 (Shuten), Nos. 10' and 11', Nos. 23~25, No. 31, and Nos. 43~45 areas out of the remaining 21 areas are considered to be ore showings of epithermal type gold deposits related to the volcanic activity in late Carboniferous to early Permian, judging from the fact that host rocks of these areas have been subjected to intensive silicification and argillization, mineral assemblages of hydrothermal alteration zones consist mainly of quartz, alunite, and kaolinite, host rocks are andesitic volconic and pyroclastic rocks of late Carboniferous to early Permian, silicified breccias which seem to be hydrothermal explosion breccias are found everywhere in the silicified zones, and the silicified zones are rich in arsenic, antimony, and mercury. In particular, gold-bearing quartz vein containing 4.16 to 9.78 g/t of gold, 1.1 to 2.0 meters wide and 350 meters long, and large-scale silicified zone, 1.0 to 3.5 kilometers wide and about 7.0 kilometers long, are found in the Shuten mineralized zone. Therefore, It is expected that quartz veins and/or networks containing gold may be present around and below the silicified zone in the Shuten mineralized zone.

(4) General commentary

The ground truth survey for 45 hydrothermal alteration zones which are situated in the eastern half part of the survey area to the east of long. 103° E, out of 96 alteration zone selected from the whole survey area by the satellite image analysis, and 2 known silicified zone which were not detected on the analyzed satellite image was carried out. As a result, hydrotheral alteration zones were observed at 21 localities. Fifteen localities out of these 21 localities are newly found alteration zones by the satellite image analysis. Out of 23 localities where hydrothermal alteration zones were found, Shuten mineralized zone which seems to be of epithermal type gold deposit, 10 silicified zones, namely No. 10, No. 11, No. 23, No. 24, No. 25, No. 31, No. 43, No. 44, No. 45, and the area adjacent to the northeast of Shuten, which may be epithermal type gold ore showing, and 3 weak hydrothermal alteration zones (No. 34, No. 35, and No. 37) is thought to be surveyed further in detail. In spite of the vast survey area covering 345,000 km², hydrothermal alteration zones were effectively found. This fact indicates that the satellite image analysis is useful for search of epithermal type gold deposit.

1.2.2 Recommendation to the Second phase Survey

(1) In the western half part of the survey area to the west of long. 103° E, the ground truth survey for the alteration zones selected in the analyzed satellite images and known hopeful gold showings in the areas, where gold showings swarm, which have been selected from the analysis of the existing data is recommended to be conducted to find hopeful area of gold, because no ground truth survey was carried out in 1994.

(2) In the eastern half part of the survey area to the east of long.103° E, is recommended to be conducted.

① Shuten mineralized zone area

(a) Detailed geological survey and sampling for laboratory works

(b) Geochemical prospecting by means of soil and rock samples

② Area adjacent to the northeast of Shuten, Nos. 10' & 11', Nos. 23~25, No. 31, Nos. 43~45, Nos. 34 & 35, No. 37 area

Semi-detailed geological survey and sampling for laboratory works

1.3 Outline of the Second phase Survey

1.3.1 Survey Area (refer to Fig.1 & Fig.10)

The region to be surveyed is called "Altan Tal area" of about 345,000km² defined by Long. 96° 30′ E, Lat. 43° 40′ N, Long. 97° 30′ E, Lat. 44° 20′ N, Long. 98° E, Lat. 46° N, the line connecting the intersection of Lat. 46° N and Long. 106° E, and with the intersection of Lat. 44° N and Long. 109° E, and surrounded by the boundary of Mongolia and China. However, the ground truth to be carried out during this fiscal year (second phase survey) will approximately cover the western half of the Altan Tal area ("west Altan Tal area"), lying west side of Long. 103° E.

1.3.2 Contents of the Survey

(1) Collection, compilation and analysis of existing data

This work will be intended to evaluate the potentiality of gold occurrences within Shuten mineralized area, and to pick out some promising areas of gold occurrences in the west Altan Tal area, lying in the west side of Long. 103° E, by collection, compilation, analysis and evaluation of existing data that the Mongolian autholities concerned have and include the results on geological survey, geochemical survey, geophysical prospecting and drilling for the mineral deposit and mineral showing to be bearing a gold especially.

(2) Groundtruth

The target of the groundtruth will be the west Altan Tal area, lying west of Long.103° E, and the following works will be carried out.

① Geological survey will be conducted for the promising mineral deposits which have been picked out by analysis the existing data during the First phase and Second phase survey, in order to check and take some samples at the mineralized and altered zone to be described in existing data, and

② The field investigation for clarifying the conditions of geology, geological structure, mineralization, hydrothermal alteration will be conducted for the color anomaly zone picked up by interpretation of the Landsat TM images in the First phase survey, showing anomalous indications seemingly of the hydrothermal mineralized alteration and presenting the color tone similar to those of the Shuten and Ihshanhai mineralized areas, and also for taking samples of rock, ore, quartz vein, hydrothermally altered rocks etc.

The samples to be taken by groundtruth will under go to the following laboratory tests:

(a) Chemical analysis of samples to be taken at and around the mineralized zone and hydrothermally altered zone.
(9 elements such as: Au, Ag, Cu, Pb, Zn, As, Sb, Hg, and Te)

(b) X-ray diffraction examination of samples to be taken at the hydrothermally altered zone.

(c) Microscopic observation of thin section from host rocks to be taken at and around mineralized zone and hydrothermally altered zone.

(d) Microscopic observation of polished section made from ore sample to be taken at and around mineralized zone.

(3) Synthetic analysis

The results of analysis of the existing data, interpretation of the Landsat TM images (to be conducted in First phase survey) and the groundtruth will synthetically be discussed and analyzed to pick up the promising areas to be especially occurred gold bearing ore deposits, and this will be followed by the preparation of the most appropriate and effective prospecting programme in future.

1.3.3 Participant member list of the survey

(1) Members particpating in planning and negociation

a) Japanese member;

Kenji NAKAMURA	Metal Mining Agency of Japan, Tokyo
Nobuyasu NISHIKAWA	Metal Mining Agency of Japan, Tokyo
Yoshiaki IGARASHI	Metal Mining Agency of Japan, Tokyo

Yuichi SASAKI	Metal Mining Agency of Japan, Tokyo
Kazuko MATSUMOTO	Japan International Cooperation Agency,

b) Mongolian members

Oidovyn CHULUUN	General Director, Department of Geology, Ministry of Energy, Geology and Mining
Dashiin BAT-ERDENE	Executive Director, Department of Geology, Ministry of Energy, Geology and Mining
Tsegmidyn RENCHINDORJ	General Director, MONGEO Co., Ltd.

(2) Members partipating in the survey in Mongolia

a) Japanese members

Naoto AIZAWA	Leader, Collection and analysis of existing data, Groundtruth, Overseas Mineral Resources Development Co., Ltd. (OMRD)
Masakazu KAWAI	Collection and analysis of existing data, Groundtruth, OMRD
Shigehisa FUJIWARA	Collection and analysis of existing data, Groundtruth, OMRD
Toshiaki SUZAKI	Collection and analysis of existing data, Groundtruth, OMRD

b) Mongolian members

Oidovyn CHULUUN	General Director, Department of Geology, Ministry of Energy, Geology and Mining
Dashiin BAT-ERDENE	Executive Director, Department of Geology, Ministry of Energy, Geology and Mining
Tsegmidyn RENCHINDORJ	General Director, MONGEO Co., Ltd.
Dorjsuren GANSUKH	Leader of Mongolian counterparts, Chief geologist, MONGEO Co., Ltd.
S. GANBATAR	Mongolian counterparts, Chief geologist, GURBAN GOL Co., Ltd.
Sharav ZOLJARGAL	Mongolian counterparts, Geochemist, Institute of Geology and Mineral Resources, Ministry of Energy, Geology and Mining
Sh. ENKHEBAATAR	Mongolian counterparts, Chief geologist, DARHAN Geol. Co., Ltd.

(3) Synthetic analysis (in Japan)

Naoto AIZAWA	Leader, Collection and analysis of existing data, Groundtruth, Overseas Mineral Resources Development Co., Ltd. (OMRD)
Masakazu KAWAI	Collection and analysis of existing data, Groundtruth, OMRD

Shigehisa FUJIWARA	Collection and analysis of existing data, Groundtruth, OMRD
Toshiaki SUZAKI	Collection and analysis of existing data, Groundtruth, OMRD

1.3.4 Period of the survey

(1) Collection and analysis of existing data
July 17, 1995 ~ August 1, 1995

(2) Groundtruth
August 2, 1995 ~ September 19, 1995

(3) Synthetic analysis
September 20, 1995 ~ February 2, 1996

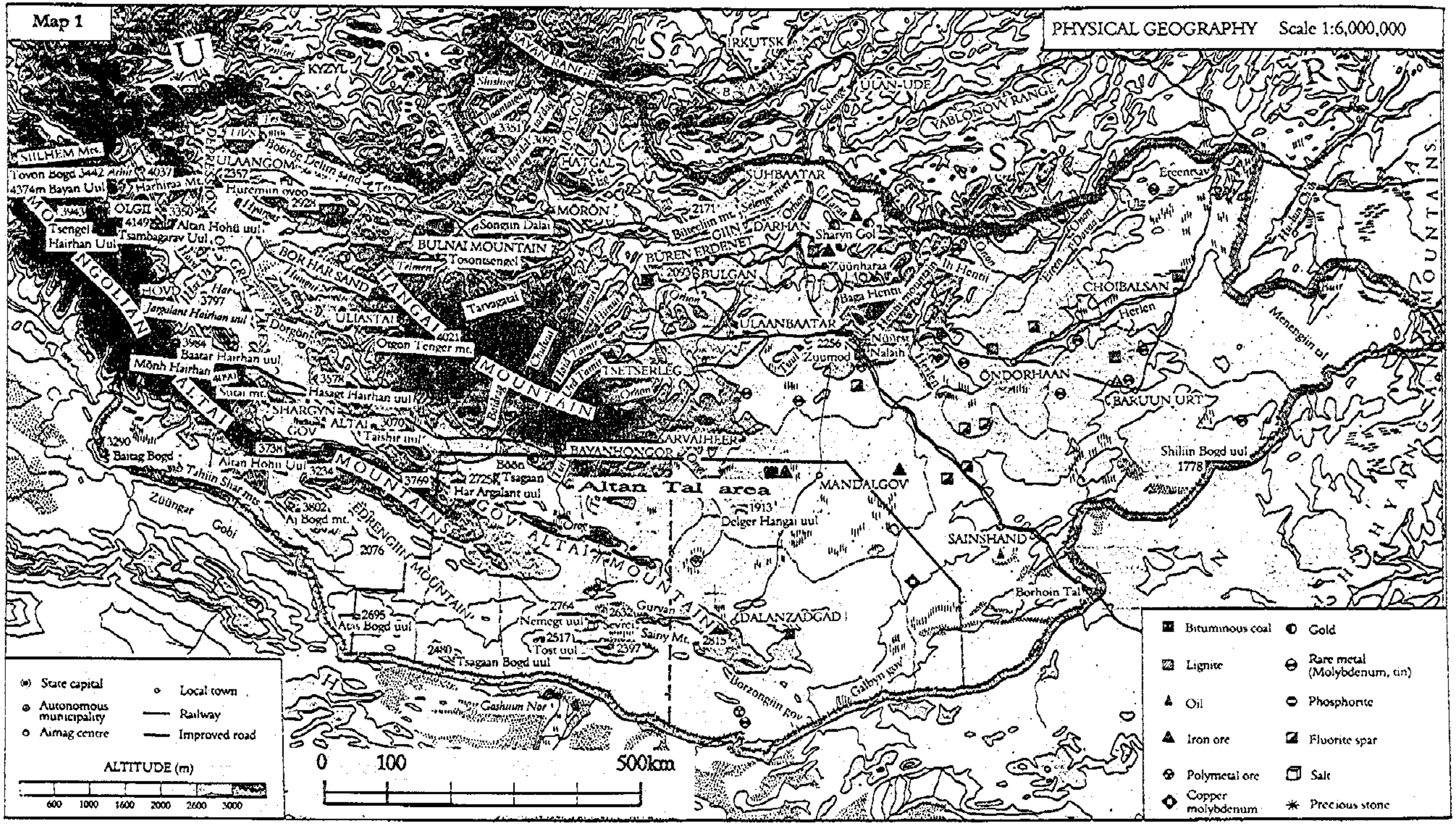


Fig. 2 Physical Geography in Mongolia

CHAPTER 2 GEOGRAPHY OF THE WEST ALTAN TAL AREA

2.1 Location and Accessibility (Refer to Fig.1 & Fig. 2)

The area to be surveyed is an area of about 345,000k㎡ situated in central south of Mongolia, administratively covering 6 prefectures (Aimag). Namely, from the east Dornogovi, Dundgovi, Umnugovi, Uvurhangay, Bayankhongor and Govialtai, only Umnugovi being wholly included in the area, while others are included in the area only by their southern peripheral territories. The groundtruth in this Second phsae survey was conducted covering the west Altan Tal area, that is, the area covering 4 prefectures, namely, Uvurhangay, Bayankhongor, Govialtai and Umnuogovi.

The most common access from Tokyo to Ulaanbaatar is the air route covering Narita--Beijing--Ulaanbaatar. There are a plural number of air lines serving daily between Nariata and Beijing taking about 4 hours on the average. Beijing and Ulaanbaatar are connected with the jet liners of China International Airlines and Mongolian Airlines providing 5 flights a week (except Thursday and Sunday), each flight taking about 2 hours.

There is no domestic direct flight service connecting Ulaanbaatar and the area to be surveyed during this the Second phase survey, but there are flight services by propeller planes of Mongolian Airlines between Bayanhongor, the capital of nearby prefecture, and Dalanzadgad, the capital of Umnugovi prefecture, taking about 1 hour and 40 min. for each flight.

Ulaanbaatar and Bayanhongor are connected with a main highway running almost from east to west covering about 680km on a wide grassland, 1,000m to 1,500m above sea level, of which about 70% is paved, the remainder being left as unpaved bad road. Thus, the travel by surface using a compact vehicle such as Landcruiser takes about 15 hours or overnight run.

2.2 Topography and Drainage

2.2.1 Topography

Mongol is situated in the northern part of the Central Asia Highlands lying between Russia and China. A vast grassland 1,000m to 3,000m above the sea level, 1,580m on the average, covers about 80% of its territory. Ulaanbaatar, the capital of Mongolia, lies 1,351m above the sea level. In general, however, its northern and western territories are occupied by mountains, whereas the plateau including small hills covers the remainder, though there are some barren lands and deserts in its southern part.

Principal mountain ranges are Mongolian Altai mountain range and Hangai mountain range in the west and Hentei mountain range in the central northern part. The Mongolian Altai mountain range runs from northwest to southeast covering the distance of about 1,500km, gradually decreasing its height towards southeast until joining the Govi Altai mountain range which disappears at its southeastern end into the Govi desert. The Mongolian Altai mountain range embraces Mt.Huiten, 4,374m lying along the boundaries of Mongolia, Russia and China and many other high peaks exceeding 4,000m rise one after another. The Hentei mountain range, generally lower than aforesaid two mountain ranges, embraces Mt.Hairhan, 2,800m, its main peak located northeast of Ulaanbator and other peaks rising to the heights of 2,000m or more.

Topographically, the area to be surveyed can roughly be divided into the southeastern peripheral part of Hangai inter-mountain area expanding towards the south of Bayanhongor situated in the northern part of the area, Govi Altai inter--mountain area transversally extending though the central part of the area from east to west, highlands running from east to west near the boundary of China lying in the southern part of the area, embracing Mt.Nemegt, 2,768m, Mt.Sevrei, 2,632m, Mt.Tost, 2,517m, Mt.Tsagaan Bogd, 2,480m, Mt.Atas Bogd, 2,695m and others, narrow lowland belt in the plateau extending between the southeastern peripheral part of Hangai intermountain area in the northern part of the area and the Govi Altai intermountain area, and narrow Govi Lowland belt intermittently extending between the Govi Altai intermountain area in southern part of the area and the southern plateau belt.

The southeastern peripheral part of the Hangai intermountain area comprises a hill area having heights of 1,600m to 2,600m. The Govi Altai mountain range is divided into some mountain masses such as Mt.Terguun Bogd, 3,957m, the highest peak of all within the area to be surveyed, Mt.Dzuun Bogd, 3,367m, Mt.Dzaran Bogd, 2,757m, Mt.Noyon Uul, 2,602m, Mt.Bayan Tsagaan, 3,452m.

The northern lowland belt in the plateau consists of relativelygrassy plains of 1,000m to 1,500m high above the seal level, whereas the Govi lowland in the south is a structurally formed lowland including the barren lands and deserts with scattered upheaved land masses of 1,000m to 1,200m high and sand dunes.

2.2.2 Drainage

There are some 1,200 rivers within the territory of Mongolia, and total length of these rivers amounts about 70,000km. The drainage system can be divided into the drainage system into the Arctic Ocean, the drainage system into the Pacific Ocean and inland drainage system.
The drainage system into the Arctic Ocean comprises many large rivers such as the River Selenge which is fed by many tributaries rising from all over the Hangai mountain range and Darhadin mountain range situated near the boundary of Russia in the north of the former and running into Russia across the border from northern part of Suhbaatar, a boader city of Russia and pours into the Lake Baikal, River Orhon rising from the eastern part of the Hangai mountain range and joining River Selenge at Suhbaatar, River Tuul rising from the Hentei mountain range and joining the River Orhon near Erdenet Mine after traversing Ulanbaatar and others.

The drainage system pouring into the Pacific Ocean comprises the River Onon rising from the eastern part of Huntei mountain range and flowing into the northern Russian territory, River Herlen rising from the eastern end of Hentei mountain range and flowing into Chinese territory in the east via Choybalsan, River Uuldza flowing north-eastward between River Onon and River Herlen and so on, all of which later join River Amur (River Heilongjiang in Chinese).

The inland drainage system comprises River Hovd rising from the Mongolian Altai mountain range and pouring into Lake Har Us situated between Mongolian Altai mountain range and Hangai mountain range, River Tesin rising from the northwestern part of Hangai mountain range and flowing westward and pouring into Lake Urs, River Dzavhan rising from the southwestern part of Hangai mountain range and flowing northwest to pour into Lake Hyargas, River Baidrag rising from the southern part of Hangai mountain range and flowing south to pour into Lake Boon Tsagaan, River Ongiin rising from the eastern part of Hangai mountain range and flowing south to pour into an unnamed lake situated in the Mongolian Plateau, and so on.

These rivers mainly derive from the precipitations and and melted snow in the mountains.

Thus, the levels of these rivers rise in the summertime which is also the rainy season and snowmelting season, while the levels of the rivers fall markedly in the wintertime during which not only the precipitations are scarce but also the riverheads are frozen.

There are more than 4,000 lakes within the territory of Mongolia, including Lake Hovsgol, the largest of all and having the total areaof 3,350k㎡, and other large lakes such as Lake Haar, Lake Buir, etc., all of which are freshwater lakes. Many of these lakes, however, are situated in the lowlands lying between Mongolian Altai mountain range and Hangai mountain range except the Lake Hovsgol located in the north of Hangai mountain range and Lake Buir at the eastern end of the eastern Mongolian Plain.

There are no large rivers within the area to be surveyed; however, there are small drainage systems flowing southward and pouring into the inland lakes within the narrow lowland belt in the plain extending from west northwest to east southeast between the southeastern peripheral part of Hangai inter-mountain area in the north of the area to be surveyed and Govi Altai inter-mountain area.

More specifically, as the representative rivers of this type there are aforementioned River Baydrag and River Ongiin. Besides, River Tuin pouring into Lake Orog, River Taatsyn pouring into Lake Taatsyn Tsagaan also come within this category. In the case of the Govi lowland belts lying intermittently extending from east to west between Govi Altai intermountain area in the south of the area to be surveyed and the southern plateau belt, there is no major drainage system capable of providing constant flow of water, since the water systems in this area eventually disappear, in the form of wadi into Govi lowlands or nearby sunken places.

2.3 Climate and Vegetation

2.3.1 Climate (Refer to Tables 1 & 2)

The climate of Mongolia is a continental climate characterized by large temperature fluctuation, low humidity and low precipitation. The annual average of the temperatures observed throughout the territoryof Mongolia is − 2.9℃. By locality, the annual average of the temperatures within the area situated at the middle of the latitudes within the territory of Mongolia is on the level of 0℃, the same being − 5℃ within the area situated in the north of this middle latitude, and the same being about 5℃ in the area in the south of the middle latitude. For instance, the annual average of the temperatures in Bayankhongor situated at the northern periphery of the area to be surveyed, the latitude of which is close to Lat. 46° N, is − 0.7℃, the average of highest temperatures in July being 15.9℃ and the average of lowest temperatures in January being − 18.4℃. In Dalanzadgad situated in Govi Lowland in the vicinity of Lat. 44° N in the area to be surveyed during the First phsae survey is 3.9℃, the average of highest temperatures in July being 21.2℃ and the average of the lowest temperatures in January being − 15.4℃. in Ulaanbaator located in the north of the area to be surveyed, the annual average of temperatures is − 2.9℃, the average of the highest temperatures in July being 17.0℃ and the average of the lowest temperatures in January being − 26.1℃. The highest temperature ever recorded was 42℃ observed in Sainshand in the south of the area to be surveyed, while the lowest temperature ever registered was − 56℃ in Ubus Basin.

The precipitation in Mongolia varies depending on the season, altitude and locality. For instance, in Hangai mountain range and Hangai grassland belt in the north, the precipitation is relatively large amounting as much as 400mm annually, but the precipitation in the Govi Lowlands and western part of the area is 100mm or so annually in many localities. The climate in the area to be surveyed ranges from the climate typical in the steppe in highaltitude areas to the climate typical in the desert as is observed in Govi Lowlands, and the annual average of the temperatures in this area is, as mentioned previously, − 0.7℃ in Bayanhongor in the vicinity of the northern periphery of the area to be surveyed and 3.9℃ in Dalanzadgad in the east, the annual fluctuation of the temperature being so large as about 80℃ in most instances as exemplified in the case of the temperature fluctuation ranging from the highest temperatures of 45℃ to 47℃ in Govi Lowlands to the lowest temperature of − 35℃ registered in Bayanhongor.

The annual precipitation within the area to be surveyed is 100mmto 250mm in general, the largest of all being 216.3mm in Bayanhongor, while the smallest of all being 100mm or less in Govi Lowlands, indicating that the precipitation in this area tends to increase towards the north and decrease towards the south. The precipitation seasonally fluctuates largely. For instance, the precipitation concentrates in the summertime ranging from May to September, of which the precipitation concentrates most in July. During the wintertime, which is the dry season, the monthly precipitation is as small as several mm or less. In the area to be surveyed, it is windy all the year round. In Govi area, it is specially windy in three months from March to May and in the month of November, including the 40 to 50 windy days causing the sandstorm. Also, in Govi area, the hot wind at temperature of 40℃ or more blows, makingthe climate conditions in this area severe to the inhabitants.

2.3.2 Vegetation

The vegetation in the area to be surveyed is largely limited due to the balance between the precipitation and evaporation. The northern part, where the precipitation is relatively large and the temperature is relatively low (low evaporation accordingly), comprises the steppe covered with relatively tall and thick−grown grasses, while the Govi area, characterized by smaller precipitation and higher temperature, comprises barren lands and deserts due to the extremely dry climate. In the areas between the above two extreme cases, constitute steppes or semideserts covered with short and rough−grown grasses, in which extremely smallnumber of the woody plants grows, though the woody plants can be seen growing only around the oasises and wadi.

Table 1 Mean Monthly and Annual Temperature (°C) in Mongolia

Meteorological station	Mean Monthly												Annual average
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Altai	-18.9	-17.0	-8.9	-0.5	6.9	12.6	14.0	12.7	6.3	-1.8	-10.8	-16.9	-1.8
Arvaiheer	-15.5	-13.9	-6.6	1.4	8.5	14.2	15.4	14.0	8.4	1.2	-8.2	-14.1	0.4
Baruun Urt	-21.5	-18.6	-8.5	2.9	11.2	17.4	19.9	17.9	11.2	1.3	-10.1	-18.9	0.4
Bayanhongor	-18.4	-16.8	-7.9	1.0	9.3	15.0	15.9	14.4	7.9	-0.8	-10.8	-17.4	-0.7
Bulgan	-21.3	-19.2	-9.5	0.8	8.6	14.7	16.3	14.4	7.5	-1.3	-11.4	-19.2	-1.6
Choibalsan	-21.3	-18.8	-9.1	2.4	11.1	18.0	20.6	18.2	10.7	1.8	-10.5	-18.9	0.4
Dalanzadgad	-15.4	-12.2	-3.2	6.1	13.6	19.4	21.2	19.5	13.2	4.8	-5.8	-14.0	3.9
Hovd	-25.4	-20.8	-7.3	3.8	11.5	17.5	18.9	16.9	10.4	1.3	-10.1	-20.3	0.3
Mandalgov'	-18.0	-15.3	-7.0	2.7	10.6	16.9	18.8	17.2	10.3	1.8	-8.3	-16.8	1.1
Mörön	-23.8	-19.7	-8.3	1.5	9.1	15.7	16.9	14.7	7.8	-1.2	-12.3	-21.5	-1.8
Ölgii	-17.8	-15.2	-6.4	1.9	8.9	14.8	14.5	14.6	8.3	-0.1	-9.1	-16.3	-0.2
Öndörhaan	-23.2	-20.2	-9.5	2.3	10.4	16.8	18.8	16.8	9.7	0.6	-12.2	-21.1	-0.9
Sainshand	-18.4	-14.8	-4.7	5.9	14.0	20.6	23.2	21.1	13.8	4.3	-7.5	-16.5	3.4
Sühbaatar	-23.3	-19.6	-8.0	3.3	10.5	17.2	19.1	16.6	9.8	0.5	-10.0	-19.9	-0.3
Tsetserleg	-15.6	-14.1	-6.9	1.1	8.1	13.3	14.7	13.1	7.4	0.2	-8.4	-14.1	0.1
Ulaanbaatar	-26.1	-21.7	-10.8	0.5	8.3	14.9	17.0	15.0	7.6	-1.7	-13.7	-24.0	-2.9
Ulaangom	-33.0	-30.2	-19.0	-0.2	11.1	17.7	19.2	16.9	10.0	0.1	-11.3	-26.8	-3.8
Uliastai	-23.1	-21.2	-11.3	0.3	7.9	14.1	15.4	13.7	7.1	-1.4	-13.9	-21.6	-2.8
Zuunmod	-20.5	-18.4	-9.9	0.1	7.9	13.8	15.4	13.7	7.4	-0.7	-11.1	-18.9	-1.8

Note: Mongolia's climate is sharply continental. Throughout the year, there are 250 sunny and 9-23 cloudy days. The duration of the period with a mean daily temperature higher than 0°C lasts about 170-190 days, increasing to the south and south-east up to 200-215 days.

Table 2 Mean Monthly Precipitation (mm) in Mongolia

Meteorological station	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total yearly
Altai	1.2	1.8	6.7	9.9	14.1	28.9	44.4	42.2	14.8	7.6	3.3	2.0	176.9
Arvaiheer	0.9	1.8	4.2	8.8	17.1	40.6	91.7	61.9	17.9	4.8	2.8	1.7	254.2
Baruun Urt	2.2	1.7	3.3	7.0	13.7	31.1	57.0	42.1	23.2	5.8	2.7	1.9	191.2
Bayanhongor	1.9	3.2	4.5	9.3	15.2	33.8	66.4	54.5	16.4	7.1	2.6	1.5	216.3
Bulgan	1.4	2.1	3.9	9.4	24.5	57.1	101.0	77.9	30.2	11.4	3.6	1.8	324.3
Choibalsan	1.9	2.4	3.0	6.7	14.8	40.8	75.7	59.4	27.1	8.2	3.3	2.7	246.0
Dalanzadgad	1.1	1.5	2.8	5.6	11.2	23.9	33.5	34.6	12.4	2.9	1.9	1.1	132.5
Hovd	1.6	1.2	1.7	5.4	13.1	17.7	34.5	27.6	9.6	3.2	1.5	2.1	119.0
Mandalgov'	0.7	1.4	2.0	3.3	10.2	33.0	46.5	45.6	14.1	3.8	1.8	1.4	163.8
Mörön	1.5	0.9	2.1	6.4	13.8	46.2	70.1	60.6	22.3	6.2	2.5	1.9	234.5
Ölgii	0.8	0.6	1.2	4.3	10.9	23.5	33.8	15.4	12.2	2.2	0.9	1.3	107.1
Öndörhaan	1.8	2.6	4.7	7.4	15.8	47.0	73.3	58.9	29.5	7.3	3.7	2.2	254.2
Sainshand	0.7	1.4	1.3	4.2	10.4	19.6	34.9	27.0	9.8	4.3	1.5	1.0	116.1
Tsetserleg	2.5	3.7	5.9	17.4	32.5	68.5	90.9	76.0	27.7	11.2	6.0	2.3	344.0
Ulaanbaatar	1.5	1.9	2.2	7.2	15.3	48.8	72.6	47.8	24.4	6.0	3.7	1.6	233.0
Ulaangom	2.2	2.1	3.5	4.2	7.1	23.2	36.0	27.2	14.0	4.5	7.7	3.6	135.3
Uliastai	2.6	2.6	5.6	9.6	15.0	33.8	65.2	42.1	21.9	8.0	4.9	5.7	217.0
Zuunmod	1.4	2.1	3.8	8.9	14.4	49.8	83.8	64.8	29.6	6.0	3.6	2.6	270.8

Note: Precipitation is extremely irregular according to different seasons of the year. During the coldest months (Octover-March) just 8-10 per cent of the total annual precipitation falls and 67-78 per cent during the three summer months (June-August). The lowest precipitation is in January and the highest in July.

CHAPTER 3 INFORMATION OF GEOLOGY AND MINING ACTIVITIES

3.1 Regional geotectonic Setting

The geological formations ranges in age from Precambrian to Quaternary and include sedimentary, igneous, and metamorphic rocks andunconsolidated material. The formations are dominated by products of different magmatic activities, in particular granitic rocks and volcanic rocks.

Structurally, Mongolia basically comes under the Ural–Mongolia Paleozoic fold belt, and only a portion of Mongolia belongs to the Mediterranean–Central Asiatic branch of Tethis. The principal structural elements are traced in the form of smooth arcs curving southward and joining along major lineaments and regional faults.

Mountainous regions are usually ditributed by Precambrian and Paleozoic complexes, characterized by significant metamorphism. In distinction from it, in intermontane and on a considerable part of the Gobi, Mesozoic and Cenozoic deposits cover the faulted basements.

3.1.1 Stratigraphy

The Archeozoic and Paleozoic complexes of Mongolia are composed of various gneisses, crystalline shales, amphibolites, marble, quartzite, granite–gneisses and enderbite, as well as ultrabasite and anorthosite, with an isotopic age of 2,650 ± 30 million yeares.

In the Riphean, with varying compositions, greenschist complexes are predominant. Although distribution of the upper Riphean is restricted, the upper Riphean is characteristic of weak metamorphosed subaerial volcanic or volcanic–molasse strata.

Extensive areas in different regions of Mongolia are covered by Vendian–Lower Cambrian marines, basically consist of sedimentary volcanogenic or terrigenous carbonated complexes. The age of these complexes are determined by the micro–phytolith, archaeocyte and trilobites found in the rocks.

The Paleozoic in Mongolia is represented practically everywhere by marine poly–phaseal complexes with remains of different marine fauna and subaerial flora. Prominence among the Paleozoic are the Middle–Upper Cambrian terrigenous; Middle Ordovician, Lower and Upper Silurian, and Lower Devonian volcanogenic carbonated terrigenous; Middle–Upper Devonian and Lower Carboniferous terrigenous; Middle–Upper Carboniferous volcanogenic, and Lower–Upper Permian sedimentary volcanogenic or terrigenous complexes. In the majority of instances, these complexes were virtually unaffected by the processes of regional metamorphism.

Lower Trias, also of marine origin, include the Ammonites.

Continental loose deposits usually contain a residue of fossils of plant and different kinds of subaerial fauna of the period betwee the Middle Trias and Anthropozoic throughout Mongolia.

Volcanogenic deposits are in eastern Mongolia, whereas in western and south–western Mongolia the volcanogeic deposits are almost to tally absent.

Sandy–clay predominant sediments of Late Cretaceous to Paleogene widespread on the vast Gobi as well as in the depression of the Great Lakes and the Valley of Lakes.

In the Neogene and Anthropogene of the Mongolian plateau, significant basalts have developed along with sandy drift. The majority of large outcrops of the basalts display many extinct volcanoes, whereas the rocks themselves include hypogene rocks and minerals.

3.1.2 Intrusive rocks

Intrusive rocks occupy abut one fifth of the territory of Mongolia. The composition of these rocks, changing from ultrabasic to acidic, is extremely diverse.

Ultrabasites and gabbro are found more often in the Precambrian and Paleozoic ophiolite and less frequently form stratified intrusions.

The massive alkaline intrusions in the Devonian and Permian conditioned the formation of the North Mongolian, West Mongolian and South Mongolian alkaline rock belts.

The Mesozoic granitoid magmatism was basically confined within the territory of eastern and southern Mongolia.

3.1.3 Tectonic Zones

In tectonic terms, the territory of Mongolia is divided into northern and southern megablocks by the "Ih-Bogd deep fracture" is the main Mongolian Lineament.

The northern megablock covers most of the northern part of the country, from the Mongolian Altai in the west to the basin of the lower flows of Ulz and Herlen rivers in the east. The northern megablock is characterized by a mozaic block and consists of the central Mongolian Precambrian massif and the Caledonian nappe structures surrounding the massif.

The central Mogolian massif is distinctive for its richness in various granites of different ages. The massif is formed of Upper Precambrian metamorphic rocks and frequently displaying numerous granite-gneiss cupolas of different sizes.

The Caledonian folded frameworks of the central Mongolian massif include the Lower Caledonian and Upper Caledonian nappe structures.

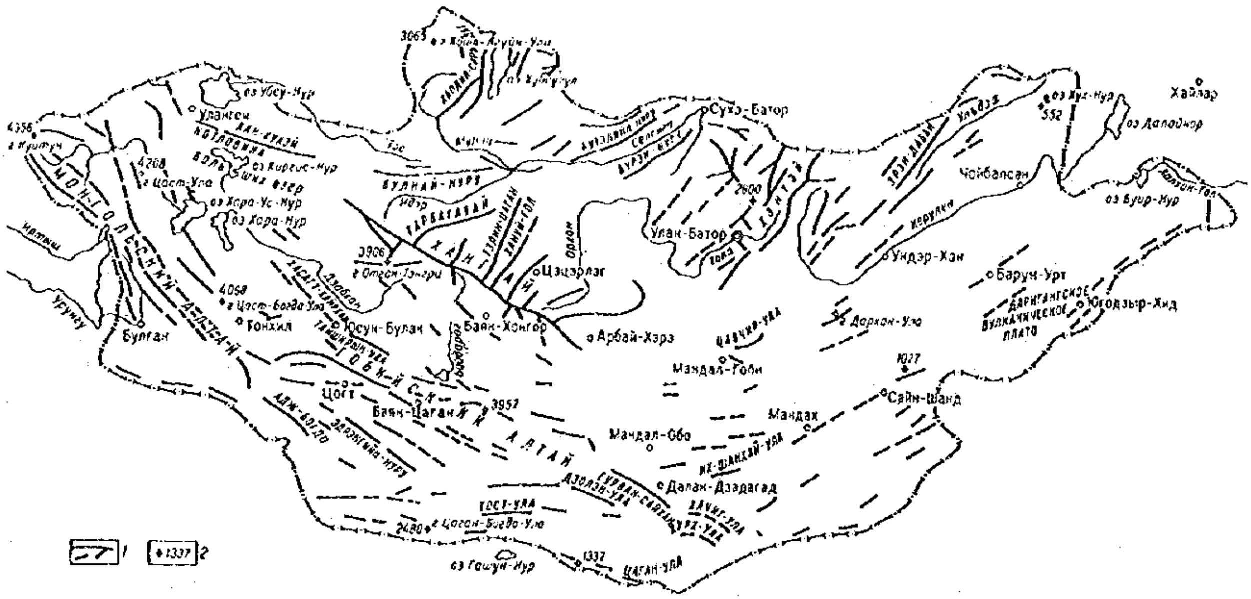
The early cledonids, the Lake, Jidan and Herlen folded zones, border directly on the central Mongolian massif from different sides. The largest lake zone directly supersedes the central Mongolian massif to the west, spanning the depression of the Great Lakes, the Valley of Lakes and the faces of the neighbouring Hangai, Mongolian Altai nd Govaltai mountain ranges. Ophiolite rocks are accompanied by the Vendian-Lower Cambrian volcanogenic and sedimentary-volcanogenic complexes. The Lake, Jidan and Herlen zones of early caledonites abound in intrusions of basites and granitoides. The contemporary structure of all three zones is typical nappe.

Late caledonids are developed only within the westernmost part of the Caledonian folded fringes of the central Mongolian massif, where they are represented by the Mongolian Altai folded zoes.

As a whole, the northern megablock is a Caledonian folded system with a median massif in the centre, and intrudes the south-eastern end of the Variscan structures of the Mongol-Okhotsk folded belt on the outskirts of the massif.

The southern megablock stretches out in the form of an extensive sublongitudinal arc through the entire territory of south Mongolia, from the Baruunhuurai basin in the west to the Buir Nuur lake region and Halhyn Gol river in the east. A distinguished character of this megablock is the linearity of the structurally substantive complexes, as well as diverse types of the broadly developed Paleozoic marine complexes.

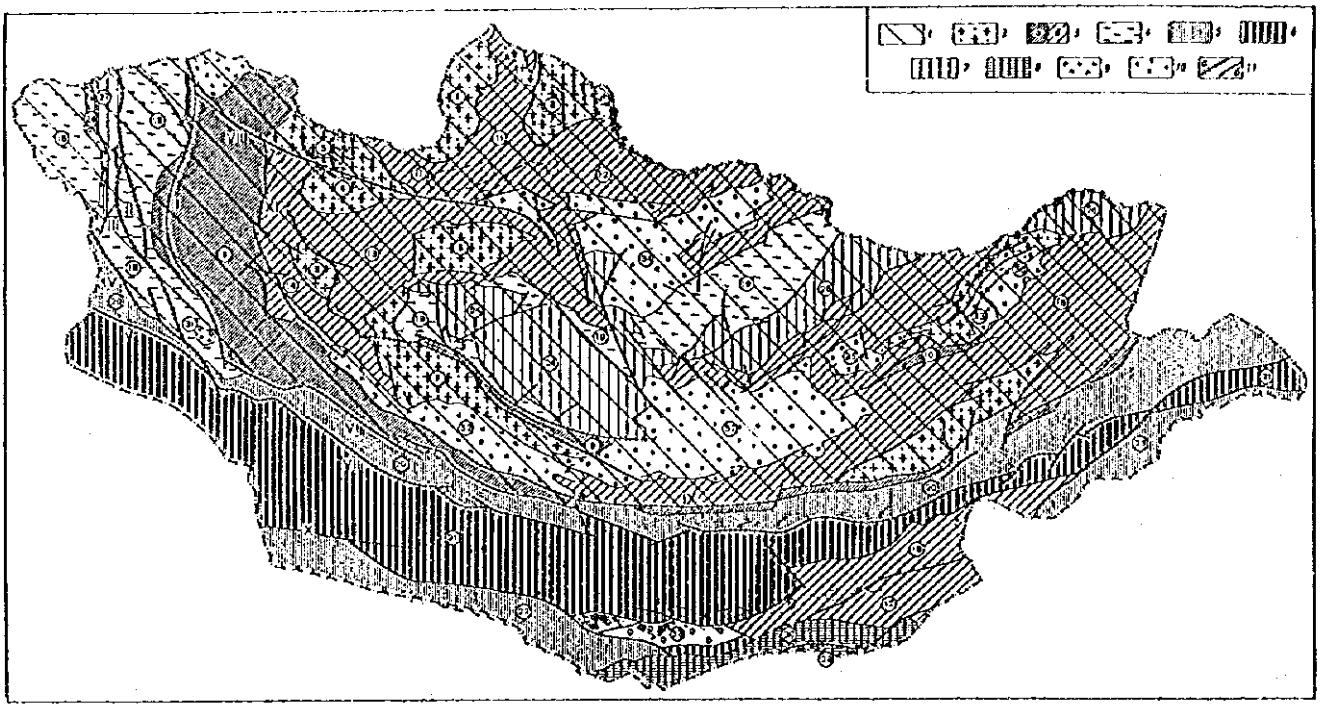
Structurally, the southern megablock is divided into two folded systems that developed at different ages: the Northern part of South-Mongolian is Variscan and the Northern part of Inner Mongolian is Upper Kimmerdgian.



EXPLANATION
Towns, villages:
Capital: Ulaanbaatar(Ulan Bator; Улан-Батол).
Arbay-Khere(Арбай-Хэрэ), Barun-Urt(Барун-Урт), Bayan-Khongol(Баян-Хонгор), Bayan-Tsagan (Баян-Цаган), Bulgan(Булган), Dalan-Dzadagad(Далан-Дзадагад), Mandal-Gobi(Мандал-Гоби), Mandal Obo (Мандал-Обо), Mandakh(Мандах), Sayn-Shand(Сайн-Шанд), Sukhe-Bator(Сухэ-Батол), Tonkhil(Тонхил), Ulangom(Улангом), Undel-Khan(Ундэл-Хан), Tsetserleg(Цэцэрлэг), Tsogt(Цогт), Choybalsan(Чойбалсан), Khaylar(Хайлар), Yugodzyr-Khid(Югодзыр-Хид)
Mountains:
Darkhan-Urt(г. Дархан-Урт), Kuitun(г. Куитун), Otgon-Tengri(г. Отгон-Тэнгри), Tsagan-Bogdo-Ula (г. Цаган-Богдо-Ула), Tsast-Bogdo-Ula(г. Цаст-Богдо-Ула), Tsact-Ula(г.Цаст-Ула), Khoit-Aguyn-Ula (г. Хоит-Агуйн- Ула).
Mountain ranges
Adzh-Bogdo(Адж-Богдо), Bolshikh(Больши Озер), Bulnay-Nuru(Булнай- Нуру), Buren-Nuru(Бурэн- Нуру), Buteliyn-Nuru(Бутэлийн-Нуру), Gobi Altay(Гобийский Алтай), Gurvan-Saykhan(Гурбан-Сайхан), Darigang (Дарриганское) volcanic plateau, Dzolen-Ula(Дзолэн-Ула), Ikh-Shankhay-Ula(Их-Шанхай-Улб), Kotlovina (Котловина), Mongolian Altay(Монгольский Алтай), Taishkryn-Ula(Таишкрын-Ула), Tarbagatay(Тарбагатай), Telin-Tsagan(Тэлин-Цаган), Tsavchir-Ula(Цабчир-Ула), Tsagan-Ula(Цаган-Ула), Khangay(Хангай), Khan-Khukhey(Хан-ХуХэй), Khanuy-gol(Хануй-гол), Khapdil-Saldag(Харгил-Сальдаг), Khacagt-Khayrkhan (Хасагт-Хайрхан), Khachig-Ula(Хачиг-Ула), Khentey(Хэнтэй), Khupkh-Ula(Хурх-Ула), Edlengiyn-Nuru (Эдлэнгийн-Нуру), Eren-Daban(Эрэн-Дабан).
Streams:
Baydarag(Байдараг), Dzabkhan(Дзабхан), Kerulen(Керулен), Iptysh(Иртыш), Mupen(Мурэн), Orkhon(Орхон), Selenga(Селенга), Tes(Тес), Tola(Тола), Khalkhin-Gol(Халхин-Гол), Uldza(Ульдза), Urungu(Урунгу)
Lakes:
Buir-Nur(оз. Буир-Нур), Gashun-Nur(оз. Гашун-Нур), Dalaynop(оз. Далайнол), Khara-Nur(оз. Хорд-Нур), Khara-Us-Nur(оз. Хорд-Ус-Нур), Khirgis-Nur(оз. Хиргис-Нур), Khukh-Nur(оз. ХуХ-Нур), Khubsygul(оз. Хубсугул).

1 - Ridges 2 - Elevation point
Drainage: Streams Lakes

Fig. 3 Physical Feature of Mongolia



EXPLANATION

1 - Caledonian geosynclinal structure and complex: 2 - Proterozoic,
3 - Upper Proterozoic - Cambrian (a - I type zones, b - II type zones),
4 - Lower Paleozoic (II type zones);
5 - 7- Middle Paleozoic Hercynian geosynclinal structure and complexes:
5, 6 - I type zones (5 - inner part, 6 - outer part),
7 - II type zones; 8 - Upper Paleozoic geosynclinal structure and complex;
9, 10 - Orogenic structure and complex: 9 - Middle Paleozoic, 10 - Upper Paleozoic;
11 - Fractures (a - deep fracture, b - others).

Geotectonic units of Mongolia:

(1) Delger-Muren, (2) Urigol, (3) Khankhukhei, (4) North Sangin,
(5) South Sangin, (6) Tarrbagatai, (7) Baydarik; Zones and subzones: (8) Lake,
(9) Bayan Khongor, (10) Kyerulen, (11) Khubsugul, (12) Dzhidin, (13) Ider,
(14) Dzabkhan, (15) Central Mongol, (16) Ulan Ul, (17) Toto-Shan,
(18) Mongolian Altai, (19) Khangai- Khentei; (20) South Mongolian outer zone:
a) Bayanleg subzones, b)Sukhe Bator subzones, c) Ueitsin subzones;
(21) South Mongolia inner zone; (22) Gobi Tyan-Shanya; (23) Nukut-Daban;
(24) Khangai syncline; (25) Khentei syncline; (26) Agin synclinal;
(27) Dyelyun-Yustyd depression axial zone; (28) Dyelyun-Yustyd depression outer zone;
(29)Solonkyer; (30) Dalan Ul-Lugin Gol; (31) Khulmunur basin; (32) Delger basin;
(33) Salkhit syncline; (34) Orkhon-Syelengin depression; (35) Tsenkhir Gol syncline;
(36) Ulddein basin; (37) North Gobi basin, (38) Noyansomon basin.

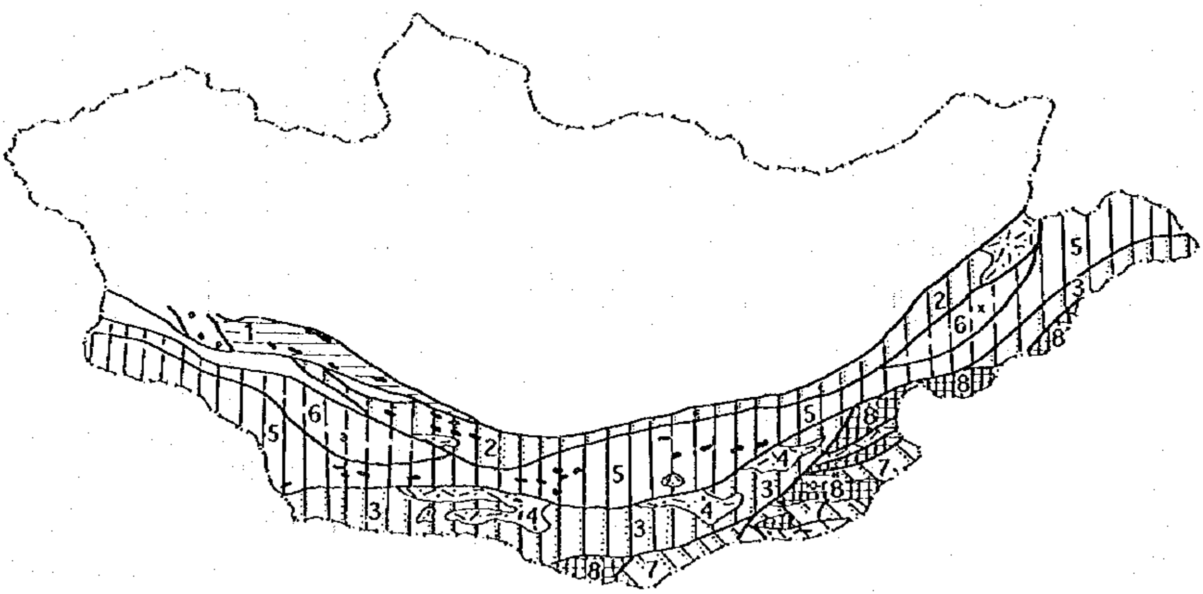
Fractures:

I - Tsaganshibetin, II - Kobdin, III - Tolbonur, IV - Tyrgen Gol, V -Bulgan,
VI - Ikhe Bogd, VII - Za Altai, VIII - Khankhukhei; IX - Undurshilin;
X - Gobi Tyan Shan, XI - Dzabkhn.

Fig. 4 Geotectonic Framework of Mongolia

1 - Mongol-Baikalian (МОНГОЛО - ЗАБАЙКАЛЬСКАЯ), 2 - North-Mongolian (СЕВЕРО - МОНГОЛЬСКАЯ),
3 - Central-Mongolian (ЦЕНТРАЛЬНО - МОНГОЛЬСКАЯ), 4 - Mongol-Altay (МОНГОЛЬСКО - АЛТАЙСКАЯ),
5 - South-Mongolian (ЮЖНО - МОНГОЛЬСКАЯ), 6 - South-Gobi (ЮЖНО - ГОБИЙСКАЯ)
7 - Inner-Mongolian (ВНУТРЕНИЕ - МОНГОЛЬСКАЯ).

Fig. 5 Fold System of Mongolia



1 - Caledonian fold system, 2 - South-Altaic fold zone, 3 - Gobi Tyani-Shani fold system,
4 - Late Kimmerian assemblages, 5 - Gobian fold zone, 6 - Edrengein fold zone,
7 - Late Kimmerian fold system, 8 - Precambrian blocks (South Gobian),
Ophiolites, Fractures, Geological boundaries

Fig. 6 Variscan Fold System of Southern Mongolia

An independent structural stage on the territory of Mongolia is formed by Mesozoic and Cenozoic stratified structures, which are largely concentrated in the southern megablock and less developed within the northern megablock. Numerous superimposed depressions of sedimentary−volcanogenic complexes of the Middle Triassic to the Lower Cretaceous, are found in the lower layer of this stage.

3.2 Outline of Gold deposits in Mongolia

In Mongolia, the disturbances of the Caledoinian Orogeny and the Variscan Orogeny contributed mainly to the formation of economical worthy gold ore drposits. And most of these gold deposits belong to gold bearing quartz vein type, and some belong to the gold bearing ore deposits of Skarn type and polymetallic type.

More specifically, such gold bearing ore deposits are classified into the following three main categories:

① Gold bearing Skarn ore deposit

② Gold bearing ore vein, lode, sheeted vein, saddle reef vein formed in the fault, fissure, discontinued bedding plane, sheared bedding, drag fold, fracture zone, anticlinal crestfault zone in the sedimentary rock, and the plat−like and irregular metasomatic alteration zone developed in the neighborhood of fault and fissure formed in the bed.

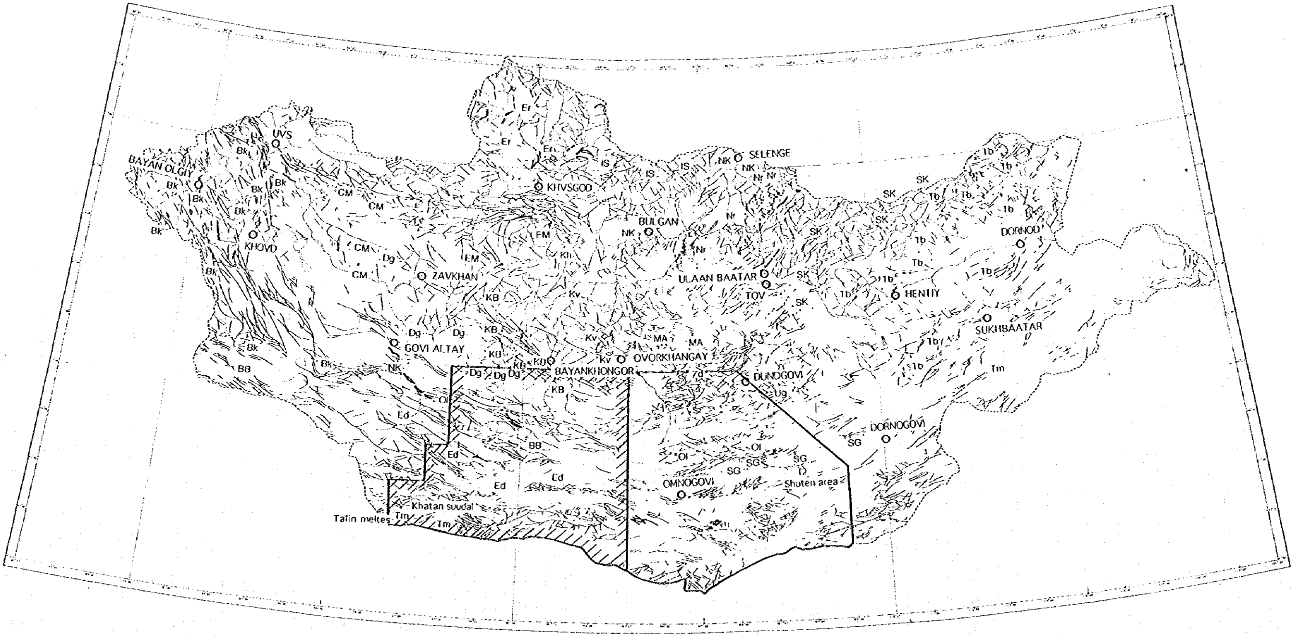
③ Placer gold deposits such as Eluvial, Deluvial, Proluvial and Alluvial placer.

The two main geotectonic units are found in Mongolia. They are (a) the Baikalian to early Caledonian fold belt, to be accompanied by the north Mongolian metallogenic province, in the northern megablock of Mongolia, and (b) the late Caledonian to Variscan fold belt, to be accompanied by the south Mongolian metallogenic province, in the southern megablock of Mongolia.

These two megablock are devided north and south of Mongolia by Ih−Bogd deep fracture that is the main geotectonic line in Mongolia.

The north Mongolian metallogenic province is developed in the northern paft of Mongolia and consists of 17 metallogenic zones, while the south Mongolian metallogenic province is occupied in the southern part of Mongolia and includes 3 metallogenic zones.

The distribution of main gold deposits and gold shoings each metallogenic zone is shown in Fig. 7, and the number and the type of main gold deposits and gold shoings each metallogenic zone is shown in table 3.



EXPLANATION

Deep fractures		Fractures	
Placer workings			
Gold deposits		Gold showings	
Altan Tal Area		West Altan Tal Area	

North Mongolian metallogenic provinces

Bk: Bayankhongor metallogenic zone
Ck: Central Khangay metallogenic zone
CM: Central Mongolian metallogenic zone
Dg: Dundgovi metallogenic zone
EM: East Mongolian metallogenic zone
Er: Erdenedalay metallogenic zone
IS: Ider-Selengi metallogenic zone
KB: Khunguy-Baydrag metallogenic zone
Kh: Khangay metallogenic zone
Kv: Khovsgol metallogenic zone
MA: Mongol Altay metallogenic zone
NK: North Khentiy metallogenic zone
Nr: Nuur metallogenic zone
SK: South Khentiy metallogenic zone
Tb: Tarbagatay metallogenic zone
Ug: Urgamal metallogenic zone
Zd: Zhidi metallogenic zone

South Mongolian metallogenic province

BB: Bayanleg-Bayangobi metallogenic zone
Bt: Baytag metallogenic zone
Ed: Edreng Mountain metallogenic zone
Ol: Olziyt metallogenic zone
SG: South Govi metallogenic zone
Tm: Tomorte Mountains metallogenic zone

Fig. 7 Gold Metallogenic Province and Gold Localities in Mongolia
Data source: Dezhidmaa and Byamba, ed., (1992)

Table 3-(1) Characteristics of the Auriferous Metallogenic Province in Mongolia

Number of Mines	Deposits	Selected	Total showings	Quartz vein system*1 (single vein)	Skarn	Placer (Alluvial/ Others*2)	Others*3
North Mongolian metallogenic provinces							
Total 28	95	439	566	206(120)	13	309(243;66)	38
Mongol Altay metallogenic zone (MA)							
0	6	45	51	27(15)	3	17(16; 1)	4
Nuur metallogenic zone (Nr)							
0	1	4	5	3(1)	1	0	1
Urgamal metallogenic zone (Ug)							
0	0	12	12	7(4)	3	0	2
Khunguy-Baydrag metallogenic zone (KB)							
0	1	11	12	3(1)	2	3(2; 1)	4
Tarbagatay metallogenic zone (Tb)							
0	0	3	3	0	0	2(2; 0)	1
Khovsgol metallogenic zone (Kv)							
0	1	2	3	1(1)	0	2(2; 0)	0
Zhidi metallogenic zone (Zd)							
0	1	3	8	5(4)	1	2(1; 1)	0
Bayankhongor metallogenic zone (Bk)							
4	15	35	54	14(3)	1	36(19;17)	3
Central Khangay metallogenic zone (Ck)							
0	0	1	1	1(1)	0	0	0
Khangay metallogenic zone (Kh)							
1	1	8	10	4(1)	0	5(3; 2)	1
Central Mongolian metallogenic zone (CM)							
0	0	4	4	1(1)	0	3(0; 3)	0
Ider-Selengi metallogenic zone (IS)							
0	0	5	5	3(1)	1	0	1
North Khenti metallogenic zone (NK)							
23	62	186	271	78(60)	0	182(160; 22)	11
South Khenti metallogenic zone (SK)							
0	3	25	28	7(1)	0	20(15; 5)	1
East Mongolian metallogenic zone (EM)							
0	4	85	89	42(24)	1	37(23; 14)	9
Dundgovi metallogenic zone (Dg)							
0	0	4	4	4(0)	0	0	0
Erdenedalay metallogenic zone (Er)							
0	0	6	6	6(2)	0	0	0

*1 vein, lenticular, stockwork, layered
*2 deluvial, proluvial
*3 mineralization zone, fissure zone, brecciated zone; alteration zone, metasomatite zone, beresite zone

Table 3-(2) Characteristics of the Auriferous Metallogenic Province in Mongolia

Number of Mines	Deposits	Selected	Total showings	Type and number of deposits: Quartz vein system*1 (single vein)	Skarn		Placer (Alluvial/ Others*2)	Others*3
South Mongolian metallogenic provinces								
Total 0	2	43	45	31(11)	1		11(10; 1)	2
Baytag metallogenic zone (Bt)								
0	1	3	4	4(0)	0	0	0	0
Tomorte Mountains metallogenic zone (Tm)								
0	0	2	2	2(0)	0	0	0	0
Edreng Mountain metallogenic zone (Ed)								
0	0	15	15	4(1)	0	0	11(10; 1)	0
Bayanleg-Bayangobi metallogenic zone (BB)								
0	0	6	6	4(2)	1	0	0	1
South Govi metallogenic zone (SG)								
0	0	8	8	8(5)	0	0	0	0
Olziyt metallogenic zone (Ol)								
0	1	9	10	9(3)	0	0	0	1

*1 vein, lenticular, stockwork, layered
*2 deluvial, proluvial
*3 mineralization zone, fissure zone, brecciated zone; alteration zone, metasomatite zone, beresite zone

3.3 Previous works and present mining activities in the west Altan Tal area

3.3.1 Previous works

The surveys for the mineral resources in the west Altan Tal and its adjacent area were conducted hastily and extensively by the former U.S.S.R. and the member countries of the COMECON after 1964.

During some 10 years, since then to the middle of 1970's, most of the ore mineralization zone of porphyry copper type including one in Tsagaansuvraga, the rare earth deposits in Lugiin Gol and other areas, and gold deposits and gold showings such as Ulziit area including Olon Ovoot were discovered, though these areas belongs to the east side of Long. 103° E where ground truth was conducted during the First phase survey.

The gold deposits and gold showings distributed in the west Altan Tal area lying west side of Long. 103° E seem to have been discovered during the above-mentioned periods except those in two areas, namely, Hatan Suudal and Taliin Meltes area lying in the southwestern periphery of the area, though we have no way of confirming this at present because of unavailability of reliable data. Also, at present, we are not able to know the process led to the discovery of the above-mentioned two of gold occurrences in Hatan Suudal and Taliin Meltes areas, since any reliable data to clarify this process is not available. However, judging from the legend that these areas were unlawfully exploited by the Chinese in the past, the gold discovery of these areas may date back to some time during the Ch'ing dynasty of China or more.

Since then, the follow-up survey of the respective ore deposits and ore showings have been conducted. However, due to the later rapid decline of the economies of the socialist states, the prospecting activities of the states have been reduced or discontinued or abandoned. Even under the present circumstances, however, the prospecting activities by the Mongolians are continued in some of those prospective areas.

The international geologic survey team organized by the member nations of COMECON was considerably large in scale and systematic. In the initial stage of its general survey, the survey team conducted aerial magnetic prospecting, and the geologic survey maps in a scale of 1:500,000 covering wide areas were compileded in parallel.

This was followed by the geological surveys covering wide areas systematically accompaying the geochemial survey and the analysis of aerial photographs based on the geological survey maps in scale of 1:200,000. Based on the results of these surveys, further detailed geological surveys were conducted employing the gammaray spectrometry, IP method, Pit exploitation method, trenching method, boring method, shaft exploitation method and spending 2 to 3 year period for single survey project. However, the airborne magnetic survey covering the Altan Tan area conducted relatively lately, that is, between 1987 and 1990. For instance, the airborne magnetic survey covering the northern central part of the area was conducted after completing the survey based on the map in scale of 1:200,000, and this survey procedure was reversed from that of the previous survey in the case of this airborne magnetic survey.

The contents of the previous surveys covering the west Altan Tal area which we are able to know are summarized in chronological order in the following and is shown in table 4, and seventeen investigation have been implemented (these are illustrated in the report of First phase survey).

Table 4　Abstracts of Previous Surveys in the West Altan Tal Area

Area to be surveyed (name of Aimag)	survey scale	Surveyed area(km²)	Period of survey	Data No. (Year of completion)
(1) Geological survey				
① Southern part of Uvurhangai–Eastern central part of Bayanhongar	1:500,000	28,440	Unknown	91, 92 1,024 (1940)
② Southern part of Bayanhongor–northwestern part of Umnugovi	1:1,000,000	13,430	Unknown	1,753 1,754 (1966)
③ Eastern central part of Bayanhongor	1:500,000	3,100	Unknown	1,895 (1968)
④ Southern part of Uvurhangai–Eastern central part of Bayanhongor	1:500,000	18,900	Unknown	1,977 (1972)
⑤ Southern peripheral part of Uvurhangai–Southern central part of Bayanhongor	1:500,000	11,900	Unknown	2,017 (1972)
⑥ Southern central part of Bayanhongor	1:500,000	26,400	Unknown	2,079 (1973)
⑦ Southern part of Uvurhangai	1:500,000	12,640	Unknown	2,007 (1974)
⑧ Southern peripheral part of Uvurhangai–Northern peripheral part of Umnugovi	1:500,000	4,740	Unknown	2,017 (1974)
⑨ Central part of Uvurhangai	1:500,000	1,580	Unknown	2,574 (1976)
⑩ Central part of Umnugovi	1:500,000	2,370	Unknown	3,361 (1980)
⑪ Central part of Umnugovi	1:500,000	8,840	Unknown	3,431 (1982)
⑫ Southern central part of Uvurhangai–Northern central part of Umnugovi regional geological survey by Gurugbansaichan survey team	1:200,000	25,280	1982–1984	3,912 (1986)

⑬ Western central peripheral part of Bayanhongor–Eastern central peripheral part of Govi Altai (regional geological survey of southeastern part of Mongolian Altai mountain range)	1:200,000	12,640	1983–1986	4,186 (1987)
⑭ Central part of Bayanhongor–Southeastern part of Uvurhangai (regional geological survey of Bayanhogor area)	1:200,000	56,880	1984–1987	4,276 (1988)
⑮ Western central peripheral part of Uvurhangai	1:50,000	1,500	Unknown	4,544 (1991)
(2) Airborne magnetic survey				
⑯ Eastern central part of Bayanhongor–Southwestern part of Uvurhangai–Northeastern part of Umnugovi (Airborne magnetic survey covering Uvurhangai and Bayanhongor)	1:200,000	72,680	1987–1988	4,354 (1990)
⑰ Eastern central part of Govi Altai–Southwestern part of Bayanhongor–Western part of Umnugovi–Southern peripheral part of Uvurhangai (Airborne magnetic survey covering southern Govi and Bayanhongor)	1/200M	94,000	1989–1990	4,547 (1991)

3.3.2 Present Mining Activities

As discussed previously in article 3.3.1, in the northern central part of the west Altan Tal area, the surveys for the deposits of mineral resources have been conducted to considerable extents, and the occurrences of many ore deposits and prospective ore deposits, mainly those of gold ore and nonferrous metal, have been reported. However, the present mining activities in this area are not so active, and there are no prospective mines currently under development or expected to be developed in the near future.

The records of the surveys for mineral resources and development of mines date back to the record of the commencement of gold mining in 11th to 12th century. According to these records, the exploitations of the gold ore by gold miners were started early part of 1800's in Za-altai and Southern Hangai. In the early part of 1900's, the Russian-Mongolian joint stock company "Mongolor" was founded, and the gathering of gold dust in the northern part of Hentei hills was started.

Since then, the placer gold exploitation in Mongolia has become one of major mining activities by the middle of 1970's. By now after 1970's, Erdenet Mine producing copper and molybdenum and the mines producing fluorite, the deposit of which is considered to be one of the largest in the world, and the coal for export have become to play major roles for the Mongolian national economy. However, at present, the government of Mongolia is placing its major emphases on the probing and development of gold ore deposits and energy resources such as the coal, oil, uranium, etc. which are capable of most contributing to its national finance. Thus, the probing of a largescale copper ore mine such as that of Erdenet copper mine has a lower priority than other development projects, mainly due to the reason that the development of such largescale mine takes longer period of time.

Under such circumstances, surveys of Bayanhongor gold Area, belonging to the both of the Bayanhonor and Khungui-Baidrag metallogenic zones and lying extending northeast from the northern part of the area us and Mt. Nemegt placer gold area belonging to the Edrengiin Nuruu metallogenic zone and lying the central part of the area are currently conducted by Bayanhongor Geology Company and Umnuogovi Geology Company, which were founded as private companies by privatizing local geological survey bureau of the former Geology and Mineral Products Ministry. Besides the surveys conducted by these companies, survey of the aforementioned Bayankhongor Au Area by the joint survey team organized will also be conducted from FY 1995 through the cooperation of Japanese specialists and the Institute of Geological and Mineral Resources in Mongolia based on the technical cooperation as one of JICA's technical cooperation programs.

CHAPTER 4 GENERAL COMMENT ON THE SURVEY RESULT

4.1 Collection and Analysis of the Existing Data

The existing data, to be owned by the Mongolian government, such as those of the geological survey, geochemical survey, physical prospecting, drilling etc. relating to the "Shuten mineralized area" lying in the east of Long. 103° E and in where the groundtruth was already carried out during the First phase survey (1994), and the gold deposits and gold showings containing comparatively large amounts of gold in the west Altan Tal area lying in the west of Long. 103° E, were collected, compiled and analyzed.

As a result, concerning about the Shuten mineralized area the contents of survey had been carried out previously is clarified and the potentiality of the gold occurrences is evaluated, and the distribution and localities of main gold deposits and gold showings in the west Altan Tal area are compiled and the promising ones of them are picked out, and the target areas to be condcuted for the groundtruth in the Second phase survey are selected, as described in the following.

4.1.1 Shuten mineralized area

It had been conducted a two year intensive general mineral resource survey in the Shuten mineralized area area about 255k㎡ in 1981 through 1982. In particular, in 1982 exploration was carried in cooperation with the 30th International Geological Survey Team, which led to conducting a general and comprehensive mineral resource survey, including geological survey, geochemical survey, geophysical prospecting, trenching, and drilling.

In other words, it may say that the survey of the stage for the evaluation of ore potentiality has almost completed before the intensified survey and study of mineral deposit.

The main objective of the comprehensive mineral resource survey was to prospect the mineral resources, especially, copper, molybdenum, other polymetallic minerals, gold silver and other precious metals occurred in the Shuten volcano-intrusive complex situated along geological structure.

The Shuten area is located in the Govi Khin Gai tectonic zone and consists of the Shuten volcano-intrusive acidic complex of the early Carboniferous to early Permian period in a circular structure with a diameter of 6 to 7km.

The Shuten complex (Mandah intrusive rocks) found in the half of the southeastern area of the circular structure and the volcanic rocks (Ducinobin formation and Ihshanhai formation) found in the northwestern side and its eastern side are considered as an volcano-intrusive complex body derived from the related same magma. The main igneous activities are considered to be classified into 3 stages.

The Shuten volcano-intrusive complex was affected mainly with hydrothermal and metasomatic alterations caused by fluids and volcanic gases of post-orogenic activities. and wide range of alterations such assilicification, argillization, propylitization, feldspatization and meta-somatic quartz-tourmaline are recognized.

In this area, gold mineralization concerning metasomatic altered rock and quartz veins and having a posibility of the relation to alunitized rock and copper mineralization relating to the intrusion of porphyritic rocks are recognized. besides the elements of zinc, lead, nickel, cobalt, silver and other atomic elements are found. However, the mineralization of such elements is not so strong.

According to the results of heavy mineral analysis, chemical analysis, and spectrophotometric analysis of some 7,000 geochemical rock samples and some 1,000 heavy mineral samples, native granular gold containing scheelite, molybdenum lead (Wulfenite, PbMo04) and malachite are found in some of the heavy mineral samples taken from the Bayan Khushuu area, and other gold occurrences are known in several spots. However, the results of spectrophotometric analysis for gold content of 13 core samples collected from promising 2 drilling holes are below the detection limit of value.

In addition, the result of a chemical analysis during the First phase survey of Altan Tal area reported that 9.78 g/t of gold content (vein width: 1.10m) and 4.16 g/t of gold content (vein width: 2.20m) were found in 2 spots in a quarts vein which accompanies iron, pyrite, chalcopyrite and marcasite in the southwestern Shuten volcano-intrusive complex, thopugh no other reports have so far indicated that a promising gold mineralization is found in the whole Shuten mineralized area.

Concerning copper, a weak mineralization was found in some metasomatic altered rock samples taken from drilling core. And spectro-photometric analysis of some geochemical samples showed a geochemical anomaly zone with 0.03 to 0.05% of copper content (background is 0.01 to 0.02% of copper).

Concerning other minerlizations, a geochemical anomalies of zinc 0.01 to 0.03%, lead 0.001 to 0.01%, nickel of 0.01% (background 0.005 to 0.009%), cobalt of 0.003 to 0.005% and silver of 0.001 to 0.0001% were reported. These vlues are, however, not so noteworthy.

The results of general mineral resources survey in the Shuten mineralized area mentioned above can be summarized as follows:

① Synthetical works such as geological survey, geochemical survey, geophysical prospecting and other works including trenching and drilling, had already been conducted.

② The geological survey covered geological mapping, a study on genesis of porphyry copper type mineralization and alteration phase etc. and reached to indepth content.

③ The geochemical survey by rocks and heavy minerals were conducted restrictively at most promising areas, namely at alteration zones of potassic feldspar and sericite.

④ Slightly mineralized zones of gold and copper were observed in this area, but it is believed to not expansive and small scale.

⑤ The above mentioned surveys and explorations led to selecting most promising 15 areas, where check drilling were conducted. The results of spectrophotometric analysis of 13 drilling core samples picked up from these areas indicated the gold content was in the trace (below the detection limit of value) wholly, and no presence of gold occurrences in the underground were confirmed by drilling.

Based on the above mentioned judgment on the strength, scale, characteristics etc. of gold mineralization in the Shuten area, it could be said the area has no high potentiality of gold occurrences.

4.1.2 Gold deposits and gold showings in west Altan Tal area

In the west Altan Tal area, the two main geotectonic units are found. They are (a) the Baikalian to early Caledonian fold belt in the northern megablock of Mongolia, accompanied by the north Mongolian metallogenic province, and (b) the late Caledonian to Variscan fold belt in the southern megablock of Mongolia, accompanied by the south Mongolian metallogenic province. These two megablock are devided into north and south of Mongolia by Ih-Bogd deep fracture that is the main geotectonic line in Mongolia.

The north Mongolian metallogenic province consists of two metallogenic zones such as the Bayanhongor and the Khungui-Baidrag, while the south Mongolian metallogenic province consists of three metallogenic zones, namely, the Bayanlig-Bayangovi, the Edrengiin Nuruu and the Tomortiin Nuruu.

At this time, 24 main gold deposits and gold showings are known in west Altan Tal area.

In breakdown by ore types, overwhelming 13 alluvial placer goldtype are found, and followed by 7 quartz vein type, 2 quartz vein network type, 1 gold bearing porphyry copper type, and 1 conglomerate type (refer to table 7-(1) & 7-(2)).

In breakdown by metallogenic zone, 3 in the Bayanhongor metallogenic zone and 3 in Khungui-Baidrag metallogenic zone, 6 in total are found in the north Mongolian metallogenic province. On the other hand, 12 in Edrengiin Nuruu metallogenic zone, 4 in Bayanglig-Bayangovi metallogenic zone, and 2 Tomortiin Nuruu metallogenic zone, 18 in total arefound in the south Mongolia metallogenic province.

Of these 24 gold deposits and gold showings, relatively promising 9 areas except placer and conglomerate types of glod were picked up and additional 6 other gold deposits and gold showings already selected in accordance with the analysis of existing data of the First phase survey, 15 areas in total thus were selected and conducted for the groundtruth of the Second phsae survey.

The main areas to be conducted for groundtruth are the Saran Uul porphyry copper type mineralized area belonging to the Khungui-Baidrag metallogenic zone, the Xhan Uul quartz vein network type belonging to the Bayanhongor metallogenic zone, the Bayangovi-1 quartz vein network type mineralized area belonging to the Bayanglig-Bayangovi metallogenic zone, both of the Hatan Suudal and Tallin Meltes quartz vein type mineralized area belonging to the Tomortiin Nuruu metallogenic zone.

4.2 Groundtruth

As mentioned earlier, the existing 15 gold deposits and gold showings seemingly promising, located westAltan Tal area lying west of Long. 103° E were picked up as a result of collection and analysis of existing data executed for the First and this Second phase surveys.

At the same time, 21 areas belonging to rank A and B were selected from 49 anomalies in the west Altan Tal area which are parts of 96 anomalies selected based on satellite image analysis in the whole Altan Tal area during the First phase survey.

In total, 36 areas were selected and carried out for groundtruth during the Second phase survey.

4.2.1 Existing gold deposits and gold showings

Of the 15 the existing gold deposits and gold showings, 14 are gold bearing quartz vein type. The survey result shows that a 43.5 g/t of gold content was highest, which was obtained from a quartz vein in the Hatan Suudal gold deposit (MS-572) in Govialtai Aimag located near the southwestern border of the area, followed only by a 1.41 g/t of gold content, which was obtained from a quartz vein in the Bayangovi-1 gold showing (MS-592) near Bayangovi in

Bayanhongor Aimag. Generally speaking, the gold value of the concerned area was low. The 43.5 g/t of gold content was obtained from a tip sample of a quartz vein where it could be observe native granular gold with the naked eyes in the Hatan Suudal. Though the results of crossing-channel sampling from a quartz vein with a width of 5 to 20 cm and from the 1 to 1.5 cm wide entire mineralized zone including the surrounding country rock showed a 1.59 g/t of gold content was highest.

Of the 15 existing gold deposits and gold showings, 1 area which are not gold bearing quarts vein type is the Saran Uul gold showing (MS-78) at the south of Bayanhongor in bayanhongor Aimag, and indicates porphyry copper type mineralization in granite as the country rock. A highest 0.55 g/t of gold content was obtained from a quartz vein and a highest 0.14 g/t of gold content was obtained from altered granitic rocks.

Although several quartz stringers are found having gold content higher than 40 g/t, the general tendency of these gold deposits andgold showings showed that gold was limited in quartz veins and did not extend into the surrounding altered country rocks. this fact indicates that actual gold content are generally lower than the records in the existing data, which is against the initial expectation. it cannot be denied the possibility of finding gold mineralized zones with a some 10 g/t of gold content and reaching tens of thousands tons of ore resrves, just as found in Hatan Suudal, however it seems finding of a large scale gold mineralized zone of this type is difficult.

The Altan Tal project, however, was conducted mainly except placer gold, and so had not obtained any detailed information as far as the placer gold was concerned. Thus, it is believed that the prospecting of the placer gold is left as the subject of the future study.

4.2.2 Satellite image anomaly

Regarding the color anomaly zones, obtained by satellite images analysis during the First phase survey, it was detected 19 zones indicative of the presence of mineralized areas out of 21 observed zones, and was confirmed superficial indications of the gold mineralization in 4 zones out of those 19 zones.

That is to say, concerning 21 anomaly zones by satellite images, where we made surveys, 2 areas (IA-66, IA-69) seemingly had almost no alteration zones as silicification and argillization. The remaining 19 areas had hydrothermal alteration zones of mainly silicification and argillization though their strength are different by the area.

Of the 19 areas, 1 area falls under the category of gold bearing porphyry copper type (IA-68), whose country rock consists of brecciated dioritic rock and the surrounding silicified rocks. On 10 samplestaken from the brecciated dioritic rock, a highest gold content of 0.38 g/t, or 0.17 g/t of average gold content and a highest copper content of 0.12% were obtained.

Remarkable epithermal silicification and argillization was confirmed in relatively broad areas of the 18 remaining areas, where intermediate to acidic volcanic rocks are major constituents of the country rocks. Of the 18 areas, the indication of a gold mineralization was observed on the ground surface of 3 areas such as IA-52, IA-65 and IA-51. IA-52 has a highest gold content of 1.44 g/t and 8.8 g/t of silver content in the argillized dacitic rock. IA-65 had a highest gold content of 1.07 g/t in a networck quartz vein of silicified volcanic rocks, while IA-51 had a highest gold content of 0.102 g/t in a silicified zone of volcanic rocks. All of such low gold and silver content were obtained in silicified and argillized zones in broadly spread intermediate to acidic volcanic rocks.

These findings were not obtained at all during the First phase survey. In other words, the interpretation of satellite images provided effective data to achieve the initial objective of selecting altered and mineralized zones from unexplored areas and tracing such large scale epithermal gold occutrreces unexplored so far. Namely, a very noteworthy sign to select future exploration targets is found.

In picking out the anomaly zones as the objects of the Second phase survey, it had been used most of experiences in First phase survey. As a result, it were able to detect 90% or more of hydrothermal alteration zones from among the intermediate to acidic volcanic rocks, and it was reconfirmed that the analysis of the satellite images was an extremely useful means for detecting the altered and mineralized areas efficiently and in a short period of time, especially in the initial stage of survey covering an extremely wide area.

4.3 Geological structure and gold mineralization in the survey area

4.3.1 Geological structure and metallogenic province

In the Altan Tal area, the two main geotectonic units are found. They are (a) the Baikalian to early Caledonian fold belt in the northern megablock of Mongolia, accompanied by the north Mongolian metallogenic province, and (b) the late Caledonian to Variscan fold belt inthe southern megablock of Mongolia, accompanied by the south Mongolian metallogenic province. These two megablock are devided into north and south of Mongolia by Ih−Bogd deep fracture that is the main geotectonic line in Mongolia and running with a direction of apporoximately west−east in the northern part of the area..

The north Mongolian metallogenic province consists of two metallogenic zones such as the Bayanhongor and the Khungui−Baidrag while the south Mongolian metallogenic province consists of three metallogenic zones, namely, the Bayanlig−Bayangovi, the Edrengiin Nuruu and the Tomortiin Nuruu (refer to Fig. 9 & Fig. 10).

4.3.2 Characteristics of mineralization

In Mongolia, the disturbances of the Caledoinian Orogeny and the Variscan Orogeny contributed mainly to the formation of economical worthy gold ore drposits. And most of these gold deposits belong to gold bearing quartz vein type, and some belong to the gold bearing ore deposits of Skarn type and polymetallic type.

More specifically, such gold bearing ore deposits are classified into the following three main categories:

① Gold bearing Skarn ore deposit

② Gold bearing ore vein, lode, sheeted vein, saddle reef vein formed in the fault, fissure, discontinued bedding plane, sheared bedding, drag fold, fracture zone, anticlinal crestfault zone in the sedimentary rock, and the plat−like and irregular metasomatic alteration zone developed in the neighborhood of fault and fissure formed in the bed.

③ Placer gold deposits such as Eluvial, Deluvial, Proluvial and Alluvial placer.

In the Altan Tal aera, most of the gold ore deposits and gold showings belong to the gold bearing quartz vein and the network quartz vein in category ② above, and Eluvial placer and Alluvial placer in ③. Thus, reports on finding the Skarn type of gold deposit or gold bearing polymetallic type have hardly made.

4.4 The gold potential in the west Altan Tal area

In the case of discussion the potentialy on gold deposit in Mongol, especially, that of hygogene gold deposits, it should consider the following 3 basic view--points: (1) source of gold of the deposit, (2) Passage of the ore sollution (containing conductive structure and permeable rock through which the gold reached to the precipitating place), and (3) location of original place occurred the deposit or existence of trap (containing structure and country rock which are appropriate to metasomation or/and dissemination).

Concerning the latter two factors, both of the northern Mongolian metallogenic province and the southern Mongolian metallogenic province have the structure formed in the orogenic movements in the early Caledonian age and late Caledonian to Variscan age. These factors normally have a scale enough to trap the vast volume of constituents provided to the ore deposit. Most of the metallogenic zones in Mongol have suitable rocks enough to cause constitutive traps and metasomation in mineralization of gold deposits. Thus, it is logical to say that the potentiality of the gold occurrences is attributable to the source of gold and accompanying elements.

It may be said that most of the main gold deposits throughout Mongol are formed closely related to Proterozoic igneous activities. In particular, superior metallogenic zones such as the Bayanhongor, Hangai, Central Mongolia, North Henti, South Henti, and many others are located in the greenstone belts to be generated by Proterozonic altered basic volcanic rocks (refer to Fig. 60 & Fig. 61). The greenstone zone is distributed in the northern Mongolian metallogenic province, north of the Ih--Bogd deep fracture crossing over almost east to west at northern rim of the Altan Tal area.

The northern Mongolian metallogenic province, especially, South Henti metallogenic zone has many placer gold deposits succeeded form gold deposits in the Precambrian era. Some of these are being operated. Meanwhile, in the southern Mongolian metallogenic province, occupying for most of the west Altan Tal area, the igneous activities in the Palaeozonic age are predominant. Therefore, the gold mineralization related to the igneous activity in the southern Mongolian metallogenic province seems to be relatively weak compared with gold mineralization developed in the Proterozoic era in the northern Mongolian metallogenic province.

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

5.1.1 Shuten Mineralized Area

Regarding the Shuten mineralized area, as discussed in the previous chapter, the survey has been conducted not only as to a variety of aspects but also to a considerably farreaching extent. However, slightly mineralized zones of gold and copper were observed by geological survey, geochemical survey, drillings etc. in this area, thuogh it is believed to not expansive and small scale. On the other hand, the results of analysis on the core samples taken from check drillings were conducted at most promising areas, namely at alteration zones of potassic feldspar and sericite, indicated the gold content was in the trace (below the detection limit of value) wholly, and no presence of gold occurrences in the underground were confirmed by drilling.

Based on the above mentioned judgment on the strength, scale, characteristics etc. of gold mineralization in the Shuten area, it could be said the area has no high potentiality of gold occurrences, and is not appropriate as a target area to prospect a gold deposit in future. It is considered that there is the possibility that the clayish mineral resources such as the alunite, which were mentioned in the comprehensive report of general mineral resources survey of 1982.

5.1.2 Existing Gold Deposits and Gold Showings

Concerning the existing gold showings in the west Altan Tal area, lying west of Long. 103° E, most of them come within the category of gold bearing quartz vein. However, these veins are considered to be small and narrow in general. The result of the groundtruth covering the 15 areas picked out as the survey targets indicates that the scales and grades of gold showings are generally small and lower than those stated in the existing data, so that the facts obtained through the surveys are not so promising as expected in the beginning before survey.

Hatan Suudal area is an area where the survey was conducted most systematically of all other surveys and better result was obtained,but it would not be consider that this area deserves further prospecting as one of major targets in future judging from its property of mineralized zone, scales and locational advantages and consider that the priority of prospecting should be given to the neighboring areas of Bayanhongor because of their locational advantages and greater distribution of existing gold bearing ore showings.

Besides, there are many localities of placer gold showings in the above mentioned areas. The Altan Tal project, however, was conducted mainly except placer gold, and so had not obtained any detailed information as far as the placer gold was concerned. Thus, it is believed that the prospecting of the placer gold is left as the subject of the future study.

5.1.3 Satellite image anomaly

Regarding the color anomaly zones, obtained by satellite images analysis during the First phase survey, it was detected 19 zones indicative of the presence of mineralized areas out of 21 observed zones, and was confirmed superficial indications of the gold mineralization in 4 zones out of those 19 zones.

In picking out the anomaly zones as the objects of the Secondphsae survey, it had been used most of experiences in First phase survey. As a result, it were able to detect 90% or more of hydrothermal alteration zones from among the intermediate to acidic volcanic rocks, and it was reconfirmed that the analysis of the satellite images was an extremely useful means for detecting the altered and mineralized areas efficiently and in a short period of time, especially in the initial stage of survey covering an extremely wide area.

From now on, it should be consider to conduct the follow-up surveys covering a wide area indicative of the presence of hydrothermal altered and mineralized zones containing the gold is necessary in order to more definitely detect the localities of such gold bearing mineralized zones and it is also necessary to make further effort for the discovery of new gold deposits in this type.

5.1.4 Synthetic Commentary

Groundtruth of the First phase survey in the east Altan Tal area, lying east side of Long. 103° E, was conducted mainly at the areas whose were interpreted as anomaly zones by satellite images thoroughly at 45 areas selected out of 47 anomaly zones. However, existing ore deposit and ore showings were exempted from groundtruth programme except the Shuten and the Ihshanghai mineralized areas where were type localities of color index for the satellite image interpretation.

In the shuten mineralized area, gold content of 4.16 g/t and 9.78 g/t were acquired at two spots of quartz vein through the groundtruth conducted in the First phase survey. However, no other promising zones indicating possible gold mineralization were hardly found in the rest of the anomaly area interpreted by satellite images.

Based on the above results, two main target were set for the Second phase survey in 1995: that is (a) to collect and analyze in detail existing data for the Shuten mineralized area to confirm the potentiality of gold occurrences, and (b) to conduct groundtruth at existing promising gold deposits and gold showings and areas whose were interpreted as anomaly by satellite images in the west Altan Tal area, lying west of Long. 103° E.

The results of survey of this Second phase survey are summarized as follows:

(1) The Shuten area is not a promising target to prospect as a gold bearing mineralized area. it is able to conclude that continued explorations in the Shuten area will show only a small possibility of finding a promising gold deposit. it may say rather that the Shuten area has a high potential of alunite and other clay mineral resources, as it was already stated in the 1982 on the Report of General Mineral Survey.

(2) Concerning existing gold deposits and gold showings, future exploration may lead to findings of new gold bearing mineralized area like Hatan Suudal, where a some 10 g/t of gold content was found and has an estimated amount of tens of thousands tons of ore reserve. For the time being, however, the main exploration target should be focused on the surrounding areas of Bayanhongor, because these areas have many gold deposits and gold showings, besides relatively good site conditions.

(3) It have realized that satellite image analysis was a very effective means at work procedure in the initial stage to pick up the altered and mineralized zones efficiently within a short period of very broad areas. A follow-up survey to which was found a clue should be carried to identify epithermal gold mineralization and to clarify its existing conditions for altered and mineralized zones spreading into wide areas. This will probably lead to findings of new gold deposits of this type in the Altan Tal area.

5.2 Recommendation to the future exploration

As the recommendation to the future exploration for mineral resources, especially for the gold bearing ore deposits, it would like to make the following proposals, based on the results during the First phase and the Second phase surveys.

(1) For the principal areas, in IA–68 area (promising area: what is called "Bayanhongor–South") indicating the showing of the presence of the gold bearing porphyry copper type mineralization, and the surrounding both gold metallogenic zones such as Bayanhongor and Khungui–Baidrag (refer to Fig. 10: the northwestern part of these metallogenic zones is out of the area to be surveyed) where are including above mentioned IA–68 area, the systematic geological survey acommpanying trenching, geochemical survey, physical survey, drilling etc. should be conducted for discovering new gold deposits.

(2) For the IA–52 and IA–51 areas (promising area: as it called "Noyon–East") situated in the east of Noyon in Umnugovi Aimag and IA–65 area (promising area: what you call "Gurbantes–West") situated in the west of Gurubantes in same Aimag, in where both areas are detected through the satellite image analysis and confirmed the presence of wide range of hydrothermal alteration and gold mineralization by groundtruth, the systematic geological survey accompanying trenching, geochemical survey etc. should be conducted in order to definitely detect the localities of the gold mineralization.

(3) In the central to northern part of the Altan Tal area, where covers the Bayanlig–Bayangovi metallogenic zone besides above mentioned two metallogenic zones, there are many distribution of placer gold deposits and placer gold showings. Therefore, the information concerning those placer gold deposits and its showings should be collected in details so that it will be able to pick up some promising areas and to conduct the onsite check survey for them.

PART II DETAILS

PART II DETAILS

CHAPTER 1 COLLECTION AND ANALYSIS OF THE EXISTING DATA

1.1 Purpose of Analysis

The principal Purpose was to collect as much geological information as possible to provide the geological background needed to assess the nature and potential of the the gold deposits in the Shuten area and in the western Altan Tal area, including Taliin meltes–Hatan Suudal district.

Many mineral localities have been reported from the Altan Tal area including gold, copper, polymetal, silver, molybdenum, tungsten, iron, fluorite, building materials and coal.

Most of the previous information on the gold showings consists of brief on–the–spot descriptions without benefit of laboratory assays. Therefore, it seemed desirable to conduct a study of wider scope so as to obtain more complete information on the nature, content, extent, and potential of the gold deposit in the west Altan Tal area.

1.2 List of the Existing Data to be collected

The published previous works assembled for this report are as follows:

(1) Dezhidmaa, G., and Byamba, Zh., ed., 1992, Metallic mineral resources map of Mongolia (16 sheets): Ministry of Geology, Energy and Mineral Resources, scale 1:1,000,000 (in Mongolian).

(2) Gold resources map of Mongolia (part of the Altantal area:8 sheets): scale 1:1,000,000 (in Mongolian); Ministry of Geology, Energy and Mineral Resources.

(3) Mineral resources map of Mongolia (part of the Altantal area: 10 sheets): scale 1:1,000,000 (in Mongolian); Ministry of Geology, Energy and Mineral Resources, Report No. 4496.

(4) Khovan, M., Gregush, Ya, Delgertsogt, B., Xhovanova, M., 1983, Prospecting and mapping work in the Shuten volcanic–plutonic structures and Alagbayan horst, South Govi: International Geological Expedition, Field party No. 30 in 1982 (in Russian); Ministry of Geology, Energy and Mineral Resources, Report No. 3615.

(5) Khovan, M., Gregush, Ya., Moravek, R., Lukash, F., 1984, Revsional prospecting work, in the vocano–plutonic structures of the Ikhe Shankhai, Kharmagtay and Shuten areas, South Govi: International Geological Expedition, Field party No. 35, 1983 (in Russian); Ministry of Geology, Energy and Mineral Resources, Report No. 3695.

(6) Togtokh, D., Gurtsoo, S., Lkhundev, Sh., Bomboroo, G., Tooruul, P., Burentogs, Zh., Baatar, Ts., Tomerchodor, Ch., Bilegsaykhan, Ts., Minzhin, Ch., and Bat Olziy., S. 1986, Group geologic maps at a scale of 1:200,000 by the Gurvansaykhan party No11 in 1982–1984, (include geochemical (heavy concentrates) prospecting map, and mineral resources map for 10 quadrangle areas): total 20 sheets (in russian); Ministry of Geology, Energy and Mineral Resources, Report No. 3912.

(7) Zabotkin, L.V., Mosiondz, K.A., Dobrov, G.M., Bochkov, S.V., Nikitin, L.V., Vertlib, V.I., Klichkov, A.A., Basmahov, V.M., Murashov, V.M., Tsedenbal, Ch., Eenzhin, G., and Davadorzh D. 1988, Maps in the report of the results of geological survey at a scale of 1:200,000 in the Bayankhongor region in 1984–1987, (include geological map, geochemical (heavy concentrates) prospecting map, and mineral resources map for 9 quadrangle areas): total 27 sheets (in russian);

Ministry of Geology, Energy and Mineral Resources, Report No. 4276.
(8) Group geological maps at a scale of 1:200,000 in the southeastern part of the Mongol Altay mountains by the Govi Altay Soviet–Mongolin party No. 8 in 1983–1986: 11 quadrangle sheets, Moscow, 1987 (in russian); Ministry of Geology, Energy and Mineral Resources, Report No.4186.
(9) Bayandorzh, B., Vishnevskaya, N. P., and Khuderbat, N. 1990, Attached maps in the report on results of aeromagnetic mappings at a scale of 1:200,000 on the area of Ubyrkhaangayckoy and Bayankhongor in 1987–1988, 20 sheets (in Mongolian); Ministry of Geology, Energy and Mineral Resources, Report No. 4354.
(10) Bayandorzh, B., and Dashzeveg, Ts. 1991, Attached maps in the report on results of aeromagnetic mappings at a scale of 1:200,000 on the area of South Govi and Bayan Khongor in 1989–1990, 29 sheets (in Mongolian); Ministry of Geology, Energy and Mineral Resources, Report No.4547.

1.3 Results of analysis

1.3.1 Geology of the Altan Tal and its adjacent area

(1) Stratigraphy

(a) Proterozoic Era

Proterozoic rocks: The oldest known rocks in the area are the metamorphic rocks of Proterozoic age. A sequence of Proterozoic rocks extend along the Bayankhongor deep fracture in the southern part of Khangay range and consist of volcanic greenstone, biotite schist, quartz–biotite schist, limestone biotite–muscovite chlorite schist, sandstone, gravelstone and gneiss. Ripheian rocks in the southern part of the area and the Lugiyn river consist of biotite–amphibole–plagioclase gneiss, quartz–chlorite schist, quartz–muscovite schist, quartz– biotite shale, quartzite, marble, metasediments and volcnic greenstone.

Vendian – Cambrian rocks extend along the Bayankhogor deep fracture consist of calcareous sandstone siltstone, limestone and volcanic greenstone (andesite, basalt and its tuff). Vendian – Cambrian rocks of the Bayanhongor Belt in the Baidrag and Ulziit river consist of limestone, shale, greywacke, conglomerate, basalt, basalt tuff, plagioclase porphyrite and andesite. Middle Ripheian – Vendian rocks in the Lugiin river consist of quartzite, limestone, calcareous shale, sandstone, gravelstone, siltstone, and acidic volcanic rocks.

(b) Paleozoic Era

Paleozoic rocks: Early paleozoic rocks in the southern part of Khangay range and the western part of the Baidrag river consist of green schist and quartz–feldspathic terrigenous sandstone. Early Silurian rocks extend along the Ih–Bogd deep fracture consist of mainly volcanic greenstone (basalt) and terrigenous deposits (sandstone and shale). Early Silurian rocks in the Southern Govi belt and the Lugiin Gol belt consist of siliceous shale, siltstone, conglomerate, gravelstone and limestone. In the Tyan Shan range, the unit consists of coarse–grained sandstone, shale and volcanic rocks. Late Silurian rocks in the northern part of the area consist of metasomatically altered shale, albitite, dacite, acidic tuff breccia. In the eastern part of the area, the unit consists of siltstone, sandstone, basic volcanic rocks and limestone.

Devonian rocks extend to the northeastern part of the Ulziit river consist of sandstone, siltstone, argillite and volcanic rocks with jasper red. Devonian rocks developed in the southeastern part of the area consist of shale, sandstone, and phyllitic rhyolite porphyry. Early to late Devonian rocks in the northern part of the South Mongolia fold belt consist of tuffaceous sandstone, tuffaceous siltstone, siliceous tuff and arkose sandstone; felsite, felsite porphyry, felsitic tufflava and tuff breccia. The upper unit of sandy limestone bed yield brachiopod and crinoid of middle to late Devonian age. Undivided Devonian unit form Ikh khongorzhin and Baryyn tskhiot ranges, and consists of andesite, andesite–dacite porphyry, tuff and sandstone.

Carboniferous rocks is widely distributed over the central part and western part of the South Govi Fold Belt. The Saynshand Khdg Formation in the southeastern part of the area consists of andesite, andesite–dacite porphyrite, tuff, tuffaceous sandstone, siltstone and conglomerate. The Tsagan Suvarg Formation is distributed over the central and eastern part of the South Govi Fold Belt, and consists of conglomerate, calcareous sandstone, siltstone and organic chalk. The Zhirmen Uul Formation extends from the Lugiin Gol Fold Belt to the Ikh Khongorzhingiyn range, and consists of arkose sandstone, siliceous sandstone and conglomerate. Middle to late Carboniferous Dusinovoogiyn Formation in the northern part of the South Govi Fold Belt consists of andesite, trachyandesite, andesite–dacite porphyrite, rhyorite, trachy–rhyorite porphyry, siliceous tuff, tuffaceous siltstone and tuffaceous sandstone.

Permian rocks is widely distributed over the Central Mongolia and Inner Mongolia Fold Belt. Early Permian rocks in the Tuyn Gol basi consist of sandstone, siltstone, conglomerate, coal bearing shale, acidic and basic volcanic rocks and tuffaceous sandstone. Early Permian rocks form two formations in the eastern part of the area: the Argalant Formation consists mainly of rhyorite, trachyrhyorite, rhyorite–dacite porphyry, andesite, andesite–basalt porphyry, siltstone, sandstone and tuffaceous sandstone; and the Bayrimovoogiyn Formation consists mainly of sandstone, siltstone, andesite, andesite–dacite porphyrites, chalkstone and limestone. The Lugiin Gol Formation is early to middle Permian in age and mainly consists of sandstone, shale, conglomerate and chalkstone, one bed of which contains brachiopods and bryozoans.

(c) Mesozoic Era

Mesozoic rocks: Jurassic rocks are spreaded in the Central Mongolia and South Govi Fold Belt, and consist of continental deposits. Early to middle Jurassic rocks extend along the Ih–Bogd and Gurvan Saykhan deep fractures, and consist of trachy andesite and alkali basalt. Middle to late Jurassic rocks in the eastern and southern part of the South Govi Fold Belt consist of acidic volcanic rocks, andesite–basalt and basalt. Middle to late Jurassic rocks in the eastern part of the Govi Tyan Shan range consist of sandstone, siltstone and shale. Late Jurassic to early Cretaceous Tsagaan Tsav Formation is spreaded on the valleys of the Central Mongolian and South Govi Fold Belt, and consist of terrigenous sandstone, tuff, conglomerate, calcareous tuff and volcanic rocks.

Cretaceous rocks form three outcrop belts: Ih Nuruud, Khooloy and Zuun Bayangiyn in the northern and eastern part of the area. The Zuun Bsyangiyn Formation consists of clay shale, sandstone, siltstone and conglomerate. Early Cretaceous undivided unit consist of conglomerate, siltstone clay and gravelstone. The Saynshand formation consists of clay, sandstone and gravelstone. The Bayanshireet Formation consists of sandstone gravelstone and clay. The Baruungoot Formation consists of siltstone, argillite, clay sandstone, conglomerate, basalt and inter-bedded coal seams.

Late Cretaceous to Paleogene deposits rest on the Cretaceous formations of intermontane valleys. The deposits consist of sandy clay, shingle, gravel and rubbles.

Paleogene deposits are spreaded on the intermontane valleys of the southern part of the area, Ih Nuuruud, Buuntsagaan, Tuin Gol, Taatsyn Gol and Argalant. The deposits consist of mudstone, sandy clay, sand, sandy conglomerate and shingle.

(d) Cenozoic Era

Cenozoic deposit: Neogene deposits are spreaded on intermontane valeys and local valleys in the southern part of the area. The deposits consist of sand, shingle, conglomerate, sandstone, clay siltstone chalkstone and gravelstone. Conglomerate bed exposed near the Noyon yield amynodon and rhynoceros.

Quaternary deposits consist of alluvial sand, gravel, and boulders in the streambeds; alluvial terraces above the streambeds; scree, talus and landslide debris on the slopes; and upland alluvium, including boulder fields in the high basins and upper reaches of the main creeks. Lower unit of the Quaternary deposits consist mainly of basalt.

Cenozoic volcanic rocks in the eastern and southern Gobi consist of basalt, andesite-basalt, diabase, plagio granite and tuff.

(2) Intrusive Rocks

Intrusive rocks in the Altan Tal area are multi-period and multi - phase, formed within a wide time interval: from late Proterozoic to early Cretaceous. 11 main intrusive periods can be distinguished: late Proterozoic, Riphean, Vendian-Cambrian, Cambrian, early Paleozoic, early to middle Paleozoic, Devonian, Carboniferous, early Permian, Permian to Triassic, and late Jurassic to early Cretaceous. The emplacement of intrusions is in close connection with the Mongolia-Baikal, Central Mongolia, South Mongolia, South Govi, and Inner Mongol Orogeny. The intrusive rocks exhabit a wide range of composition. The composition of the intrusive rocks ranges from basic to acidic, and alkaline: gabbro, gabbro diorite, diabase porphyrite, diorite, diorite porphyrite, granodiorite, granite, alaskite granite and alkalic rocks.

Late Proterozoic intrusive rocks are located along the Ulziyt and Taats river with two phases of emplacement. The early Ulziit Complex along the Ulziit and Taats river, Central Govi-Altay form a massif and consits of gabbro-gneiss-granite (plagiogranite). The gabbro is fine to medium-grained and gneissic. A pronounced contact aureole by the gabbro are present. A zone of hornfels has formed in sandstone and siltstone. The late granite forming severa small massifs located in near of the Ulziit Formation. The Riphean granitic rocks are present in the South Govi and Inner Mongolia Fold belt. The rocks consist mainly of light gray, fine to medium-grained gneiss and in some places, biotite granite, two mica granite, and granite gneiss. the Vendian granitic rocks of the Toto Shan range consits mainly of medium to coarse-grained, porphyritic, biotite-hornblende granite, potassium feldspar granodiorite and granosyenite. These rocks intrude middle Riphean to Vendian rocks.

The Vendian to Cambrian plutonic rocks are located along the Bayanhongor deep fracture. The rocks consist of serpentinite, dunite and pyroxenite. The Cambrian plutonic rocks of the Ih and Baga Bogd ranges consist of serpentinite and layered intrusion of gabbro. This association forms the Ih-Bogd ultrabasic rock belt. The gabbro is dark green, medium to coarsegrained, and form small stocks. The serpentinite is dark to light green and oily in color, and located in the recrystallized chalk stone, in places along the contact of aegirine gabbro. The age of the rocks is undetermined.

The early Paleozoic intrusive rocks in the Central and South Mongolia Fold Belt consist of granodiorite, granite, plagiogranite, tonalite, gneissose granite and granodiorite gneiss. The Tugreg granitic body forms small stock and consist of diorite, quartz diorite and granodiorite. The Tugreg rocks intrude the middle to late Proterozoic and early Cambrian rocks and are overlain by the late Carboniferous rocks. Early to middle Paleozoic granitic rocks of Ikh and Baga Bogd ranges consist of alkali granite, alkali granite porphyry and in places biotite granite. Devonian granitic rocks are limited only in the Central Mongolia Fold Belt and in the southern part of the area. The Devonian complex consists of granite, granosyenite, quartz syenite, adamellite, granodiorite and alkali granite. The Carboniferous complex of the northwestern, central and southeastern part of the Altan Tal area consit of granodiorite, tonalite, granite, quartz diorite and plagiogranite. The complex consists of early, middle and late phases. Early Carboniferous rocks of northern, central eastern and southern part of the Altan Tal area consist of granite, diorite and quartz diorite. Late Carboniferous intrusive rocks form a batholith, and are located along the geological structure. Garnet–epidote and garnet–magnetite skarn rocks have been formed near the contact of cabonate rock and the intrusive rock. The Carboniferous intrusive rocks consist of gabbro, gabbro diorite, and hornblende–biotite granodiorite. The gabbro and gabbro diorite are dark gray, medium–grained. The contact between the gabbro and gabbro diorite is gradual. The late phase of the late Carboniferous is consists mainly of gabbroic rocks. The middle to early Carboniferous intrusive rocks consists of three phases: the first granitic rock phase, the second granodiorite phase, and the third diorite dyke phase. Both the granodiorite and the diorite dykes form large body. The late Permian granitic rocks along the Ikh Bogd deep fracture and near the Toto Shan range consist of light pink and pink coloured, medium to coarse–grained, biotite–granite, biotite–hornblende granite adamellite and minor porphyry. This granitic rocks form small stocks and dykes. In the southeastern part of the fracture, the rocks form Khanbogd massif and are fractured. The late Permian intrusive rocks form an elongate, northeast–trending belt and located along the Ikh Bogd tectonic deep fracture. The rocks consist of granite, granosyenite and alkali granite.

The Permian to Triassic intrusive complex in the Central Mongolia Fold Belt consist of two phases: the first phase consists of peridotite and gabbro; the second phase consists of alkali granite and normal granite. These granitic rocks are spatialy connected with the deep fractures. Late Jurassic to early Cretaceous intrusive complex in the southern part of the area consist of dolerite–basalt dykes and microgranite. The complex intrudes the early JurassicTsagaan Shan rocks.

(3) Tectonics

Two main geotectonic units can be distinguished in the Altan Tal area: (a) the North Megablock, north of the Ih–Bogd deep fracture, and (b) the South Megablock, south of the deep fracture. The North Megablock includes Baikalian and late Caledonian fold system while the South Megablock includes early Caledonian and Hercynian (Variscan) fold system.

Six structural belts are subdivided in the Altan Tal area: the Bayanhongol Belt, the Baidrag Belt, and the Ih–Bogd Belt are defined in the North Megablock, while the Bayanlig Belt, the

Zhinst belt and the South Altay (Za-altay) Belt are determined in the South Megablock.

Late Proterozoic to early Paleozoic geoanticlinal complex are widespreaded in the North Megablock. The middle to late paleozoic tectonic activization occured in the area and formed irregular block structure.

Middle to late Paleozoic geocynclinal complex are widespreaded in the South Megablock. The complex form linear block structure. The complex is characterized by the presence of volcanic greenstone, spilite-diabase and quartz-keratophyre in the upper and middle to upper part of the Carboniferous; and rhyolite-andesite and rhyolite activity in the later stage of geosyncline.

The Baidrag Belt in the northern part of the Altan Tal area ranges in length 400 km and in width 100-150km. The belt lies along the south border of the Ih-Bogd ophiolite zone. And the belt is separated by the Bayan Khongor deep fracture from the Khangai Khentiy belt. In many places, the unit is overlain by the Mesozoic to Cenozoic rocks. Linear faults in the Baydrag belt extend in a northwesterly direction. In the North Megablock, main three tectonic units can be distinguished from the north to the south of the area: 1) Bayanhongor deep fracture zone, 2) Proterozoic salient, and 3) Ih-Bogd ophiolite zone. The Bayanhongor zone is characterized by the presence of early Carboniferous and Devonian rocks. Both the northern and southern border of the Bayanhongor zone are the Bayanhongor deep fracture, which seprates the adjacent structure. Some bodies of gabbro and granitic rocks are ditributed in the Bayanhongor zone. The Baidrag belt forms the Proterozoic salient. The belt consist mainly of Precambrian metamorphic rocks, diorite, granodiorite, and granite. The Ih-Bogd ophiolite zone in the northern part of the Govi Altay range occupies south of the Baydrag belt. The Ih-Bogd deep fracture separates the Caledonian rocks of the Central Mongolia Fold system from the Hercynian rocks of the Southern Mongolia Fold System. The Ih-Bogd zone consists of volcanic greenstone, terrigenous and carbonate rocks, gabbro and ultrabasic rocks.

The northern Mongolia fold system is defined in the ranges of Mongol and Govi Altay, South Altay, Govi Tyan Shan, Toto Shan and Govi Khingan. (Fig.00). In the South Megablock, main four tectonic units can be distinguished from the north to the south of the area: 1) Govi Altay zone, 2) Edreng subzone, 3) South Altay subzone and 4) Govi Tyan Shan zone. Govi Altay zone is subdivided into two subzones: Bayangovi and Bayanzagi. These subzones consist of limestone, serpentinite and gabbroic rocks. Bayanleg and Zhinst subzones are defined in the north of the Ih-Bogd deep fracture. The northern border of the Bayanlig subzone is the Ih-Bogd deep fracture and the southern part of the subzone borders the Zhinst subzone. The Bayanlig subzone consists of serpentinite, carbonate rocks, sandstone, siltstone, basalt, andesite and rhyolite. The zhinst subzone is characterized by the late Ordovician to early Permian complex. The subzones of Zhinst, Bayanleg and South Altay are emplaced by the late Permian granite and alaskite. The South Altay zone in the ranges of Edreng, Zuulen, Gurvan Saikhan border Bayanlig and Zhinst belts. The South Altay subzone characterized by the early devonian to late Carboniferous rocks.

The rocks consist of greywacke, siliceous rocks, andesite-dacite-rhyolite (marine and continental), and molasse. The South Altay zone is widespreaded diverse intrusive rocks.

Inner Mongolian Fold System is defined in the southeastern part of the Altan Tal area. The Carboniferous to Permian rocks in the Lugiin river consist of carbonate rocks, volcanic rocks and terrigenous rocks. The volcanic rocks is slightly metamorphosed greenstone. Early Permian rocks is emplaced by the granodiorite and gmosyenite in the Lugiin river.

(4) Faults

The faults in the Altan Tal area include deep fractures, normal faults, reverse faults and strike slip faults and cracks of Mesozoic, Mesozoic to Cenozoic and Quaternary in age. The boundary of the Ih-Bogd and Bayanhongor ophiolite zones are the deep fractures. Early to middle Riphean and late Riphean intrusive rocks, Devonian serpentinite, early to middle Cambrian plagiogranite, and Vendian to Cambrian volcanic rocks are seen in the fracture zones. Metamorphic rocks of green schit facies and also netasomatic alteration facies are developed in the fracture zones.

1.3.2 Shuten mineralized area

(1) Introduction

Cooperative geological and mineral investigations covering an area of about 255 km^2 were conducted in 1982 by the government of Mongolia and the Party No. 30 of the International Geological Expedition in the Shuten mineral showings, Umnugovi aimak. This chapter is based upon the results of the integrated exploration works (geological, geochemical, geophysical, trenching and drilling).

(2) Location and accessibility

The Shuten area is in the Umn Ugovi aimak. Dalan Dzadagad, the aimak center, about 540 airline-km or about 750 road-km by south of Ulaanbaatar, is about 270 km west from the approximate center of the area. And Sain Shand, Dornogovi aimak, is about 250 km east of the area.

The prospect is between Lat. 43° 53′ 00″ -44° 00′ 30″ N and Long. 107° 34′ 30″ -107° 48′ 00″ E (refer to Fig. 8).

Scheduled air service connects Ulanbaatar with Dalan Dzadagad, during the tourist season. Paved roads extend for short distances near Ulaanbaatar. Improved roads include the Ulaanbaatar - Dalan Dzadagad and Sain Shand.

Closed drainage depression, rolling plain and hillocks, with few mountain ridges and hills are characteristic of the region including the area. Mt. Shuten-khan-bogd uul (1,288.70m) is in the northwestern part of the area.

(3) Purpose of mineral investigations

The primary aim of the exploration work was to investigate the mineral resources, particularly for copper, molybdenum, polymetallic ore and sparse precious metals of the Shuten volcano-plutonic structure.

The fieldwork executed in 1982 are shown on Table 5.

Table 5 Fieldwork executed in 1982

① Geologic mapping,	scale 1: 50,000,	21 km^2
② Geologic mapping,	scale 1: 10,000,	16.3 km^2
③ Geological excurtion,		1,200 km
④ Lithogeochemical sampling		6,181 samples
⑤ Heavy mineral concentrate sampling		202 samples
⑥ Core drilling		1,974 m, Max. depth 284 m

⑦ Trenching 3,000 m^3

⑧ Prospecting shaft 150 m

(4) Geological setting (refer to Fig. 8)

The Shuten volcano-plutonic complex, showing ring structure, is on the Govi-Khingay structural zone. The geologic formations of the Shuten area of Figure 1 range in age from Carboniferous to Quaternary and include sedimentary, igneous, and metamorphic rocks and unconsolidated material.

The rock units of late Carboniferous and early Permian age, and early Carboniferous age (Ducinobin Formation and Ikheshankhay Formation) are mainly volcanic. Mesozoic and Cenozoic units are mainly clastic (undivided). The metamorphic rocks are schist in xenolithes of Ducinobin Formation, and granitized and migmatized rocks. The dominant structural feature in the area is the ring (diameter: 6-7 km) structure.

A semicircular granitic body occupied the southeastern half of the Shute ring structure (7km in diameter) are flanked by the volcanic rocks of Ducinobin formation and Ikheshankhay formation on both northwestern and eastern sides. The rocks of the Shuten granitic rocks (Mandakh Intrusive rocks) associated with volcanic rocks (Ducinobin and Ikheshankhay formations) are regarded as a comagmatic volcano-plutonic formation. Three main phases of igneous activities are included in the Shuten granitoides. The first phase is represented by hybrid hornblende diorite, rare plagiogranite and monzonite. The second phase is mainly denoted by porphyritic, coarse-grained granodiorite, granite, rare syenodiorite and monzonite. The third is characterized by medium- to coarse-grained, biotite-hornblende granite, biotite granite (rare), and sometimes granodiorite.

Granosyenite, granosyenite porphyry, aplite and quartz-tourmaline breccia are present in the area as small bodies.

The Shuten granitoids exhabit a wide range of composition and textural variations. The complex was formed in the Carboniferous/Permian period, ranging in age from 249 ± 16 m.y. to 329 ± 9 m.y.

Postorogenic intrusive rocks include dikes and hydrothermal veins. The former consists of syenogranite-porphyry, granite porphyry, syenodiorite porphyry; plagiogranite porphyry; aplite and pegmatite; granodiorite porphyry, dacite porphyry, liparite, felsite porphyry; and microdiorite porphyrite, diorite porphyrite, diabase. And the latter thought to be associated with a phase of considerable hydrothermal activity, which produced quartz veins and stocks; quartz-tourmaline veins and stocks; and carbonate veins. Metasomatite formations, associated with a phase of metasomatic alteration activity, include silicification, secondary monoquartzose quartzite, and quartz tourmaline metasomatite.

(5) Alteration

The type, degree and the lateral and vertical extent of alteration, developed in the Shuten volcano-intrusive complex depends on numerous interracting factors both geological and chemical. The Shuten volcano-intrusive complex is mainly hydrothermally and metasomatically altered by both solutions, and volcanic gases and hot solutions.

Several types of hydrothermal and metasomatic alteration, silicification, argillic alteration (solfataric-fumarolic stage), propylitization, feldspathization, and quartz-tourmaline metasomatic alteration, are defined in the Shuten volcano-plutonic area.

(a) Silicification and argillic alteration

Silicification and argillic alteration developed mainly in acidic and intermediate volcanic and volcano-sedimentary rocks of Dusinobin formation, and is chracterized kaolinite-alunite-quartz facies.

Two petrogenic processes can be differentiated – silicification facies produced as a result of subvolcanic (1-2km in depth, 200-400℃) processes and argillic alteration facies developed as a result of subsurface solfataric-fumarolic (acidic, 200-50℃) hydrothermal-metasomatic alteration processes.

Alteration zones and facies of the silicification and argillic alteration are shown in Table 6.

Table 6 Alteration Zones and Facies of the silicification and Argillization

Alteration zones	Facies	Paragenesis	Accessory minerals
Silicification	Mono-quartz	Qtz	Aln+Ser+And+Crn+Lm+Hm
	Quartz-tourmaline	Qtz+Trm	Cc+Mt+Hm-oxide
	Quartz-andalusite	Qtz+And+Ser	Py+Hm+Li
	Quartz-diaspore	Qtz+Dsp+Pyr+Py	And
	Quartz-alunite	Qtz+Aln	Ser+Py+Gp+Li+Ja
	Quartz-pyrophyllite	Qtz+Pyr	
	Quartz-sericite	Qtz+Ser	Aln+And+Hm+Li+Py
	Quartz-kaolinite	Qtz+Ka	Ser+Li
Argillization	Sericite(rock)	HSer+Py	Qtz+Cc+Chl+F

Abbreviations: Alunite-Aln, Andalusite-And, Calcite-Cc, Chlorite-Chl, Corundum-Crn, Diaspore-Dsp, Flourite-Fl, Gypsum-Gp, Hematite-Hm, Hydrosericite-HSer, Jarosite-Ja, Kaolinite-Ka, Limonite-Li, Magnetite-Mt, Muscovite-Mst, Pyrite-Py, Pyrophyllite-Pyr, Quartz-Qtz, Sericite-Ser, Tourmaline-Trm.

(b) Propylitization

The pricipal secondary minerals developed are chlorite, epidote, calcite, sericite pyrite, albitized feldspar and magnetite. The propylitization is mainly developed in the outlying part of the silicified zone.

(c) Feldspathization

Feldspathization consists of the development of secondary potassium feldspar in porphyritic granodiorite, syenite and diorite. Metasomatism: Plagioclase, by replacement of K-feldspar phenocryst and groundmass of porphyritic rocks are developed. Feldspathized rocks are consist of tourmaline, biotite, chlorite, epidote, andalusite, magnetite and apatite. Paragenesis: Plagioclase, K-feldspar, quartz, sericite, biotite and calcite are determined in the metasomaticaly altered rocks.

(d) Tourmaline-chlorite metasomatic alteration

This type of metasomatic alteration zone shows vague zonal arrangement from the center to the outward zone, and paragenesis of quartz–tourmaline, tourmaline–sericite and tourmaline–chlorite.

(6) Mineralization

(a) Gold showing

In the Shuten area, gold mineralization is associated with metasomatites, possible alunitization and quartz veins (refer to Fig. 8).

In the Shuten area, as a consequence of the integrated exploration, about 1,000 heavy mineral concentrate samples and about 7,000 geochemical rock samples were taken. Chemical and spectrometric analyses of about total 8,000 samples show as follows:

Gold along with scheelite, wulfenite (PbMoO4), and malachite are in the heavy mineral concentrate smples from Bayan Khushuu district. Gold, pyrite, chalcopyrite, and marcasite are found in a quartz vein of the southwestern part of the Shuten volcno–plutonic structure. Analysis of two samples taken from the quartz vein shows 9.78 g/t Au (1.10 m thick) and 4.16g/t Au (2.00 m thick) respectively.

(b) Copper and molybdenum mineralization

Copper mineralization is associated with the intrsion of porphyritic rocks, and represented by weak minerlization in metasomatically altered rocks sampled from the boreholes(ShN–3, and ShN–4; 100m in depth).

Geochemical anomalies of Cu and Mo are delineated in the Shuten area. Spectrographic analyses of the geochemicl samples show 0.03–0.05% Cu (background 0.01–0.02% Cu), 0.0005–0.003% Mo.

(c) Other mineralization

Geochemical anomalies of Zn, Pb, Ni, Co and Ag are delineated in the Shuten area. Spectrographic analyses of the geochemicl samples show 0.01–0.03% Zn, 0.001–0.01% Pb, 0.01%Ni (background 0.005–0.009% Ni), 0.003–0.005% Co, and 0.0001–0.001% Ag.

(7) General comentary

In the Shuten area, integrated geological, geochemical and geophysical exploration included trenching, and diamond drilling for mineral resourses. The geological investigation involve geological mapping of the area and a metallogenic study of the porphyry copper mineralization, including alteration facies.

The geochemical exploration (rock geochemistry and heavy mineral survey) was mainly confined to the most promising area, associated with potssic silicate alteration and sericitic zone.

As a consequence of this integrated exploration, the most promising 15 areas in the Shuten volcano–plutonic structure were selectd for checking by diamond drilling. These drillings (1,974m, in total depth) to a maximum depth of 284 m, revealed no significant gold mineralization (spectrographic analyses of 13 core samples show all trace Au).

The project identified some mineralization and investigated gold along with cu occurrences, but they are either less promissing or smaller in size.

The magnitude, extent and character of the gold mineralization in the Shuten area are discouraged in further exploration.

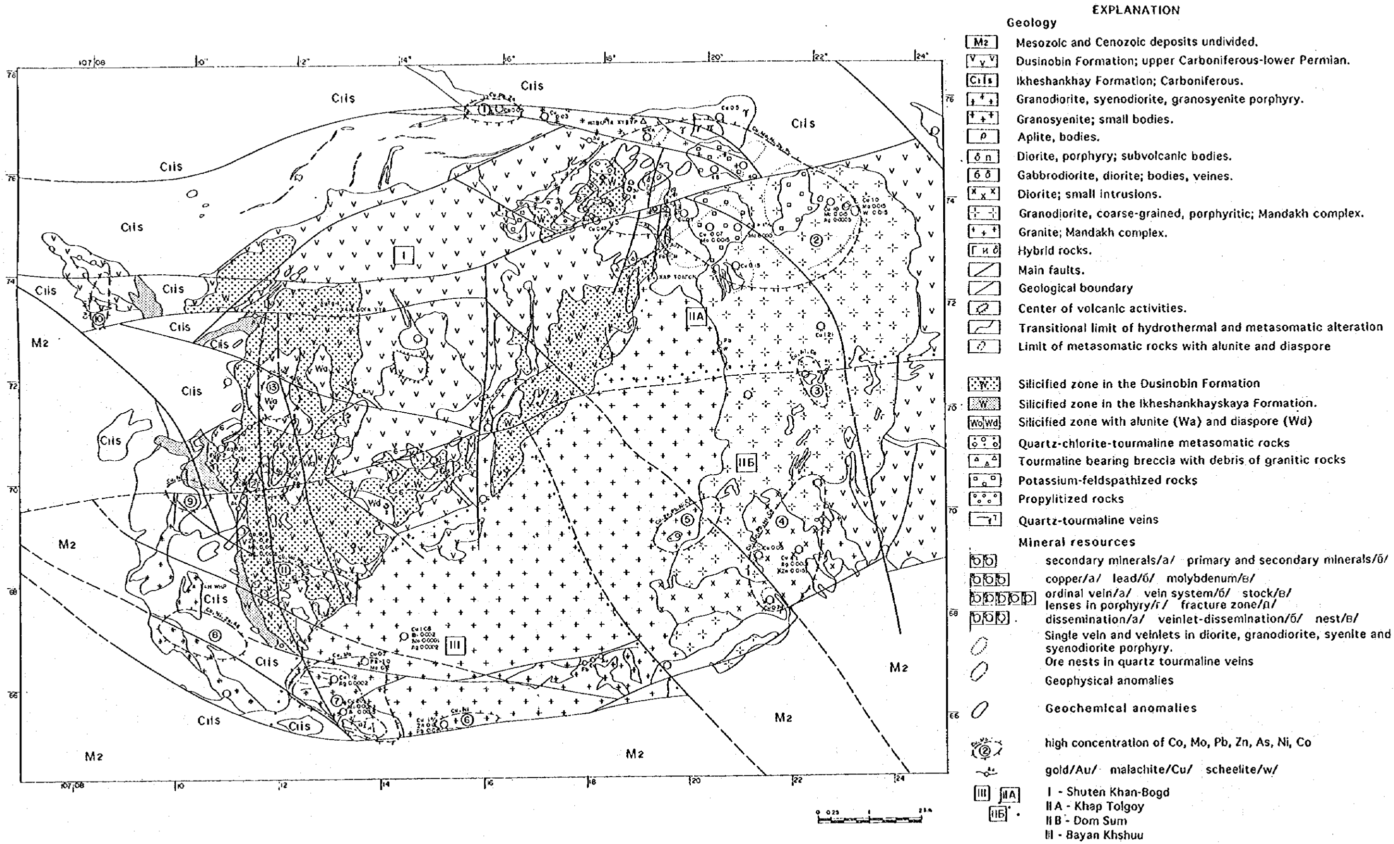


Fig. 8 Mineral Resources in the Shuten Area

1.3.3 Gold Deposits and Gold Showings in the west Altan Tal area

In the west Altan Tal area, the two main geotectonic units are found. They are (a) the Baikalian to early Caledonian fold belt in the northern megablock of Mongolia, accompanied by the north Mongolian metallogenic province, and (b) the late Caledonian to Variscan fold belt in the southern megablock of Mongolia, accompanied by the south Mongolian metallogenic province. These two megablock are devided north and south by Ih–Bogd deep fracture that is the main geotectonic line in Mongolia. A small portion of the former zone is found developed in the northern rim of the west Altan Tal area while most parts of the area is covered with the latter zone.

The north Mongolian metallogenic province consists of two metallogenic zones, namely, the Bayanhongor and the Khungui–Baidrag metallogeniczones, while the south Mongolian metallogenic province consists of three metallogenic zones, namely, the Bayanlig–Bayangovi, the Edrengiin Nuruu and the Tomortiin Nuruu metallogenic zones (refer to Fig. 9).

At this time, 24 main gold deposits and gold showings are known in west Altan Tal area.

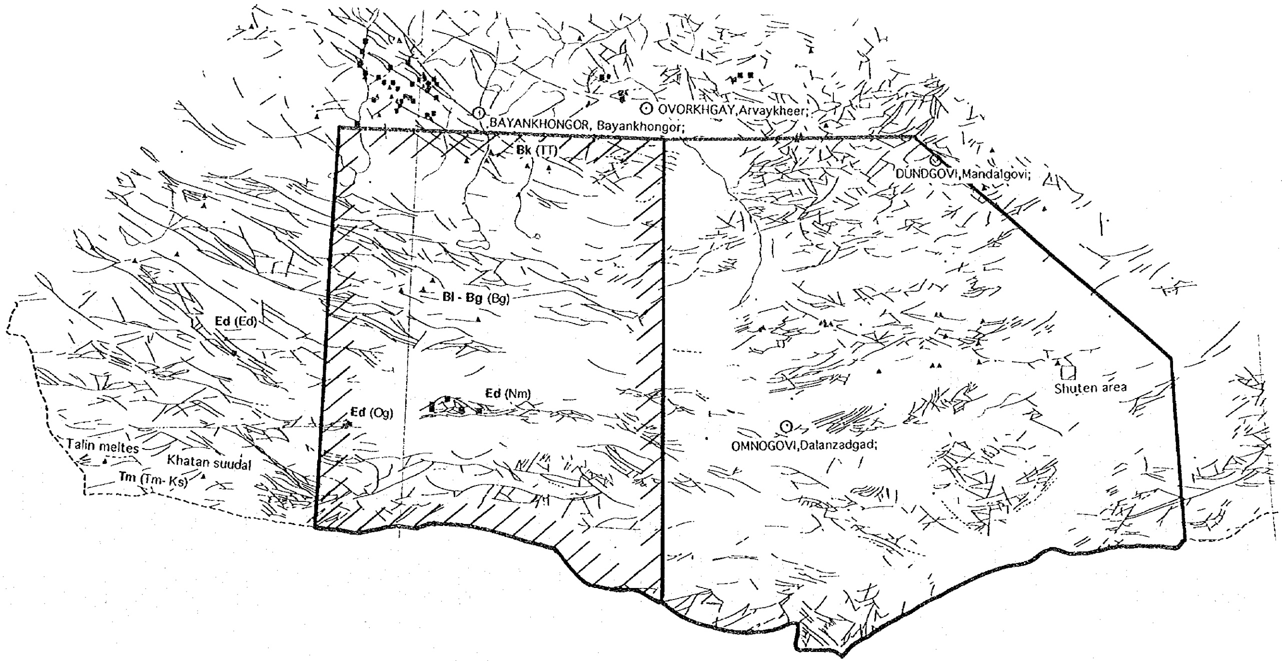
In breakdown by ore types, overwhelming 13 alluvial placer gold type are found, and followed by 7 quartz vein type, 2 quartz vein netwok type, 1 gold bearing porphyry copper type, and 1 conglomerate type.

In breakdown by metallogenic zone, 3 in the Bayanhongor metallogenic zone and 3 in Khungui–Baidrag metallogenic zone, 6 in total are found in the north Mongolian metallogenic province. On the other hand, 12 in Edrengiin Nuruu metallogenic zone, 4 in Bayanglig–Bayangovi metallogenic zone, and 2 Tomorte metallogenic zone, 18 in total are found in the south Mongolia metallogenic province.

Of these 24 main gold deposits and gold showings, relatively promising 9 areas except alluvial placer gold and conglomerate types, were selected and additional 6 others which had already been selected in accordance with the analysis of existing data in the first phase survey, 15 areas in total thus were picked out for groundtruth in the second phase survey.

The main targets to conduct the ground truth include the Saran Uul porphyry copper type mineralized area belonging to Khungui–Baidrag metallogenic zone, the Xhan Uul quartz vein network type in the Bayanhongor metallogenic zone, the Bayangovi–1 quartz vein netwok type mineralized area belonging to in the Bayanglig–Bayanggovi metallogenic zone, both of the Hatan Suudal and Tallin Meltes quartz vein type mineralized area belonging to in the Tomortiin Nuruu metallogenic zone etc..
zone.

Abstract of 24 main gold deposits and gold showings in the west Altan Tal area are shown in Table 7–(1) & 7–(2).



EXPLANATION

Deep fractures	Fractures
Placer workings	
Gold deposits	Gold showings
Altan Tal Area	West Altan Tal Area

North Mongolian Metallogenic Provinces

KB: **Khunguy - Baydrag zone**
(sr): Saran uul district

Bk: **Bayankhongor zone**
(TT): Tuyn - Taats gol district

South Mongolian Metallogenic Province

Tm: **Tomorteyn mountains metallogenic zone**
(Tm- Ks): Talyn meltes - Khatan suudal district

Ed: **Edreng mountains metallogenic zone**
(Og): Ongon uul district
(Ed): Edreng mountains district
(Nm): Nemegt district

Bl - Bg: Bayanleg - Bayangovi metallogenic zone
(Bg): Bayangovi district

Fig. 9 Gold Metallogenic Province and Gold Localities in the West Altan Tal Area

Table 7-(1) Gold Localities in the West Altan Tal Area

No.	Name	Coordinates	Type of deposits	Mineral resources	Content	Reserves
			North Mongolian Metallogenic Province			
Khunguy - Baydrag zone (KB)						
Saran uul district (sr)						
78	Saran uul deposit	100° 36'00"	stockwork	Cu	Au 1.5-2.5 g/t,	
		45° 46'00"		(Ag, Mo, Au)	Ag 3-11.2 g/t, Mo 0.03%, Cu 1.24 %	
79	Khar nuden khurem showing	100° 50'00"	conglomerate	Au	Au 50-602	
		45° 46'00"			mg/cubic m	
80	Taats gol showing	101° 14'30"	placer- alluvial	Au	Au 30-260	Au 660 kg - P3
		45° 28'30"			mg/cubic m	
Bayankhongor zone (Bk)						
Tuyn - Taats gol district (TT)						
144	Khan uul showing	101° 36'00"	mineralization	Au	Au 0.8-6.2 g/t	Au 16875 kg
		45° 43'00"	zone			- P3
145	Tuyn gol showing	100° 53'00"	quartz vein	Au	Au 2 g/t	
		45° 51'00"				
146	Taats gol - 2 showing	101° 21'00"	quartz vein,	Au (w)	Au 2g/t;	
		45° 44'00"	vein system		W 0.3-1%	
			South Mongolian Metallogenic Province			
Tomorteyn mountains metallogenic zone (Tm)						
Talyn meltes - Khatan suudal district (Tm- Ks)						
571	Talyn meltes mountains showing	96° 34'00"	quartz veins	Au (Ag)	Au 3-30 g/t;	
		42° 59'00"	- lenticular		Ag 6.1-100 g/t	
572	Khatan suudal showing	97° 43'00"	quartz vein zone	Au (Ag)	Au 11.7-12.6 g/t;	
		42° 54'00"	- lenticular		Ag 6-8 g/t, Au 156.8 g/t; Ag 167-172 g/t	
Edreng mountains metallogenic zone (Ed)						
Ongon uul district (Og)						
573	Ongon ulaan showing	99° 19'10"	placer - alluvial	Au	Au 450	
		43° 30'00"			mg/cubic m	
574	Ongon ulaan-1 showing	99° 17'02"	placer - alluvial	Au	Au 100	
		43° 29'18"			mg/cubic m	

Table 7--(2) Gold Localities in the West Altan Tal Area

No.	Name	Coordinates	Type of deposits	Mineral resources	Content	Reserves
Edreng mountains district (Ed)						
575	Khadat gun well showing	97° 52'00" 44° 08'00"	quartz veins	Au	Au 0.1-20 g/t	
576	Khoshuut showing	97° 58'30" 44° 01'15"	placer - alluvial	Au	Au 300 mg/cubic m	
577	Khur uul showing	97° 59'00" 44° 01'00"	placer - alluvial	Au	Au 300 mg/cubic m	
578	Khar uul showing	97° 59'45" 44° 00'00"	placer - alluvial	Au	Au 300 mg/cubic m	
Nemegt district (Nm)						
579	Toromkhon showing	100° 18'21" 43° 41'12"	placer - alluvial	Au	Au 173-220 mg/cubic m	Au 3.9 kg - P1
580	Zostyn river (middle reaches) showing	100° 20'00" 43° 40'54"	placer - alluvial	Au	Au 430 mg/cubic m	Au 20 kg - P1
581	Khyren bosg river showing	100° 29'19" 43° 45'16"	placer - delluvial	Au	Au 125-336 mg/cubic m	Au 1.5 kg - P1
582	Alag shand river showing	100° 19'30" 43° 39'25"	placer - alluvial	Au	Au 13-426.6 mg/cubic m	
583	Tamgat showing	100° 39'30" 43° 39'00"	placer - alluvial	Au	Au 1-499, Au 535-1795 mg/cubic m	
584	Devteer showing	100° 52'00" 43° 39'00"	placer - alluvial	Au	Au 100 mg/cubic m	
Bayanleg - Bayangovi metallogenic zone (Bl - Bg)						
Bayangovi district						
590	XXXIV-128-B-1 showing	99° 53'05" 44° 38'30"	quartz vein	Au (Ag)	Au 0.25-8 g/t; Ag 6 g/t; Cu 0.03 %; Bi 0.003 %	
591	Khokh tolgoy showing	100° 47'40" 44° 24'30"	quartz veins	Au (Ag)	Au 0.005-1 g/t; Ag 30 g/t; Cu 0.1-5 %; Pb 1.5 %; Zn 0.5%	
592	Bayangovi-1 showing	100° 16'00" 44° 44'00"	quartz vein, alteration zone, stockwork	Au	Au 0.1-0.2 g/t; Ag 1-4 g/t; Au 0.1-1.5 g/t	Au 2500-3000 kg - P3
593	Oortsog showing	100° 10'00" 44° 39'00"	stockwork	Au	Au 1.5-15 g/t	Au 660kg - P2

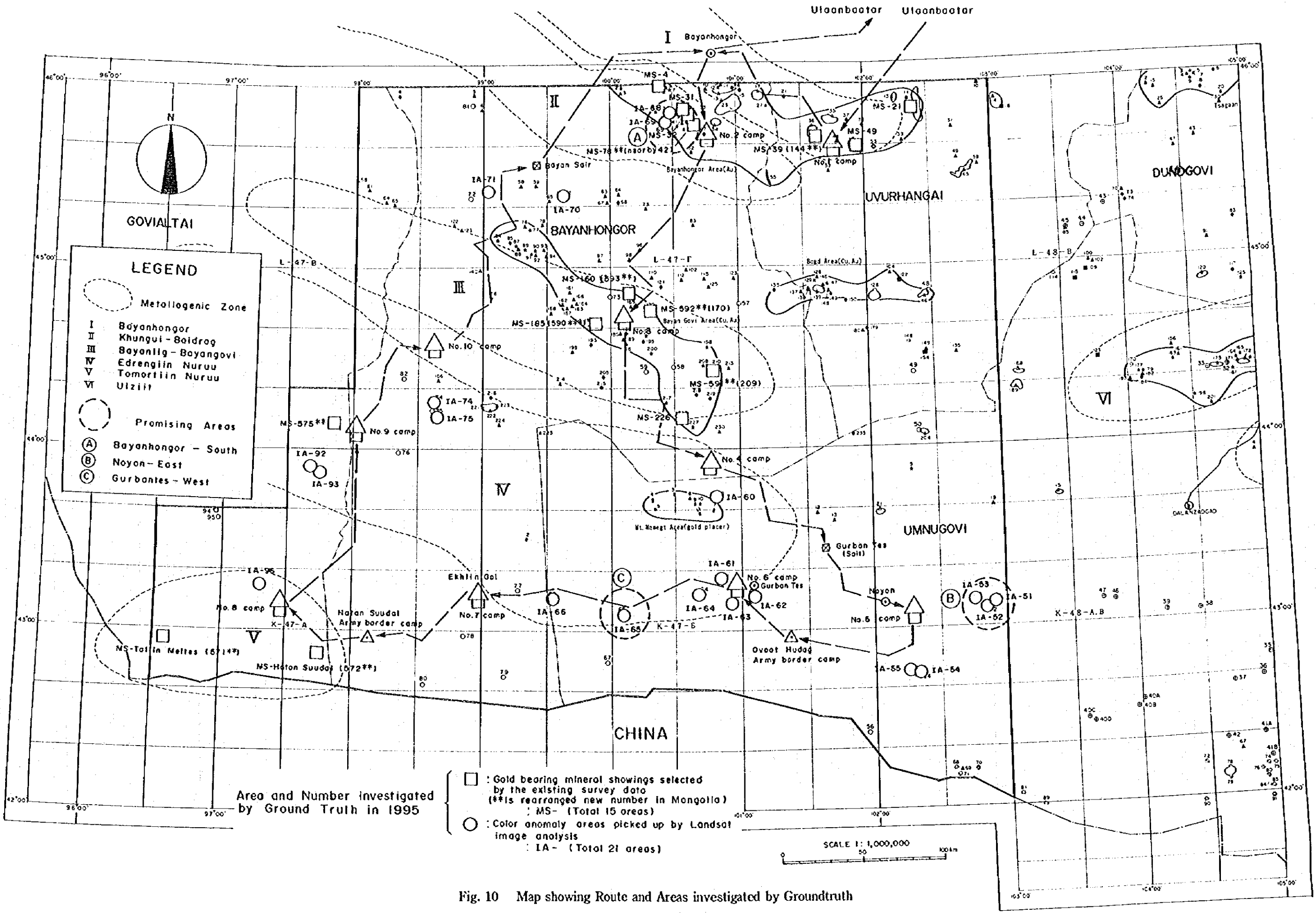


Fig. 10 Map showing Route and Areas investigated by Groundtruth