CHAPTER 1 GENERALITIES

(1) Background

In accordance with the Scope of Work signed on 18th May 2001 between the Government of the Mongolia and the Government of Japan, a mineral exploration project of three years duration began from 2001 in the Western Erdenet area.

Location of the project area is shown in Fig.1. The survey areas are indicated in Fig.2.

The Western Erdenet area is located in the northern central part of Mongolia at 300 km west from the capital of Ulaanbaatar. The survey area consists of area 1 and area 2 delimited by the coordinates 49° 20′ N, 48° 40′ N, 104° 27′ E and 102° 38′ E. The total area of the project area is 5,500 km^2.

Fig. 3 shows as a flow chart all the main mineral exploration works conducted during the three years duration of the project.

(2) Objectives

The purpose of this survey is to find new ore deposits in Mongolia by clarifying the geology and mineral potential of the Western Erdenet area. The purpose of the project also includes the transfer of technical knowledge to our Mongolian counterpart.

Activities such as compilation of existing data, geological survey and airborne geophysical survey were carried out during Phase I. Regarding the compilation of previous data, data related to previous geological, geochemical, geophysical and drilling surveys and others owned by the Mongolian counterpart organization, were compiled and analyzed in order to select promising areas. The selection of seven promising areas took also into consideration the previous geological survey performed by MMAJ from 1999 to 2000 that investigated the mineralization and constructed a mineralization model. Geological survey together with the airborne survey was conducted in order to clarify the geology, geological structure, igneous activity and mineralization in the seven promising areas.

In Phase II, a geological mapping was carried out in the Erdenet SE area, the Under/ Shand area and the Mogoin gol area, resulting in the construction of a mineralization model. Geophysical survey by using the IP method was also carried out in the Under/ Shand and the Mogoin gol areas to clarify the resistivity and IP anomaly related to the mineralization. The information obtained from the geological and geophysical data focused in the selection of the best sites for drilling.

In Phase III, the following works were conducted:

Geological survey in the following 6 areas in order to reassess mineral potentials: Khujiriin gol,

Khujiriin gol north, Mogoin gol central, Zuukhiin gol, Danbatseren east and Tsagaan chuluut west,
Geophysical surveys (Time Domain IP electric survey) in order to delineate the resistivity structures and IP anomalies related to the mineralization in 5 areas located in Western Erdenet areas: Khujiriin gol, Khujiriin gol north, Zuukhiin gol, Danbatseren and Tsagaan Chuluut west,
Integrated interpretation of the geological and geophysical surveys results to select areas suitables to confirm mineral potential by carrying out the drilling survey in this phase,
Drilling survey was conducted in the areas where the geological and geophysical survey gave promising results for the existence of mineral potential in the north silicified zone (Shar Chuluut Mountain) of the Mogoin gol area and the western Erdenet area.

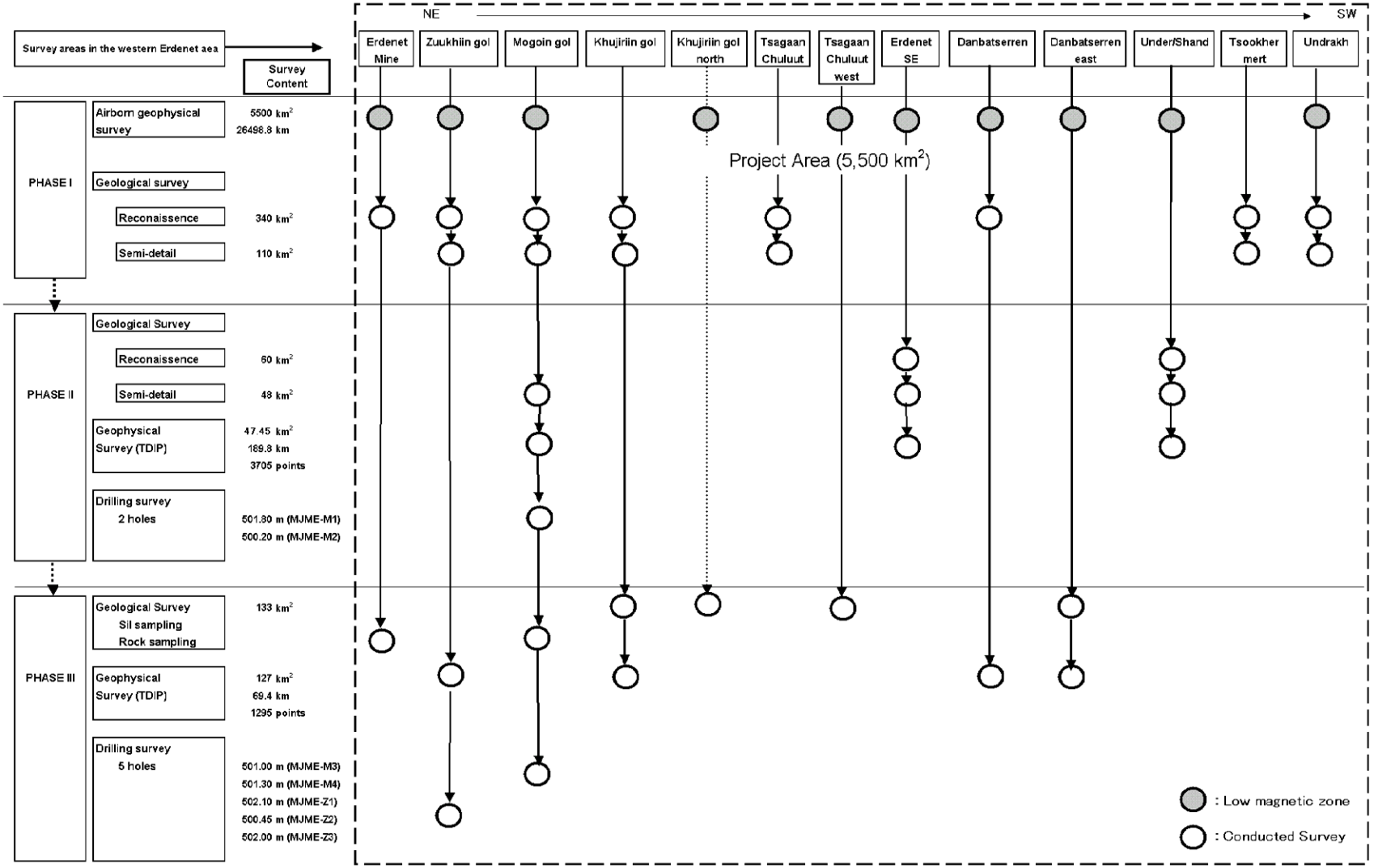


Fig. 3 Work Flow of the Project Area

(3) General Overview of the Project Area

Geography of the Survey Area

The western Erdenet area is located in the Bulgan District and Erdenet city of the northern-central part of Mongolia. The total area of the project area is 5,500 km^2. Mobilization by vehicles to the project area takes approximately 10 hours for 340 km from Capital Ulaanbaatar to the Erdenet city.

The topography is generally gentle hillside and flat grassland with the elevation of 1,000m to 2,000mASL. However, the land is covered by plain and forest. Outcrops of rocks are very few. Main rivers in the area are the Okhon River running northeast in the southern part and the Selenge River running east in the northern part.

The weather consists of a typical continental climate. This area presents few rainfalls and a dry weather. As shown in Table 1, the temperature presents a great difference between summer and winter, as well as between day and night. In winter, minimum temperature is under –40 ℃. Snow damage has been a seriously issue in recent years. The period when the main survey was carried out is the best season for the survey as it becomes pleasant from summer to autumn.

Table 1 Mean monthly Temperature and Precipitation of Bulgan and Ulaanbaatar in Mongolia

Province center	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov
Temperature (℃)											
Bulgan	-21.3	-19.2	-9.5	0.8	8.6	14.7	16.3	14.4	7.5	-1.3	-11.4
Ulaanbaatar	-26.1	-21.7	-10.8	0.5	8.3	14.9	17.0	15.0	7.6	-1.7	-13.7
Precipitation (mm)											
Bulgan	1.4	2.1	3.9	9.4	24.5	57.1	10.1	77.9	30.2	11.4	3.6
Ulaanbaatar	1.5	1.9	2.2	7.2	15.3	48.8	72.6	47.8	24.4	6.0	3.7

General Geology and Ore Deposits in Mongolia

Geographically, Mongolia is a country located between Russia to the north and China to the south. Geologically, Mongolia is located in the eastern edge of orogenic belt (Central Asia Folded belt) between Angara craton (Siberian Block) to the northern side and the Northern China craton to the southern side. The mobile belt of about 2,000km existing from Mongolia to Far East Russia is called the Mongol - Okhotsk Fold Belt or the Ural - Mongol Fold belt. According to several studies, the geological framework of Mongolia is formed by Cordilleran type orogeny or Collision type orogeny (Maruyama et al., 1997). The Cordilleran type orogeny forms accretionary prism – magmatic arc accompanied with subduction surrounding Siberian craton and North-China craton in the Paleo Asia Ocean or Mongolian Seaway. The Collision type orogeny was formed by the approach of two cratons. Recently it is vastly recognized that island arcs and micro-continentals existed in Altaids and that the Mongolian geological formation consists of the assembly of accretionary prism and magmatic arc; however, the stratigraphic correlations between geologic divisions have not been analyzed yet.

Various mineralization types exist in Mongolia. They are due not only to magmatic activity accompanied by a subduction process in the Tuva-Mongol island arc with continental crust existing from early Proterozoic, but also to magmatic activity accompanied by the collision process of Angara craton and North-China craton. The porphyry type copper-molybdenum deposits and the gold deposits related to the plutonic rocks are considered to have considerable economic significance.

General Geology and Mineralization in the Project Area.

The project area is located in the western Tuva-Mongol Unit on the south of the Vitim Structure, which is a large structural line trending east to west. The geology in the area corresponds to magmatic island arc formed by accretion on subduction system from Vendian of Proterozoic to late Permian.

The general geological maps in the project area are shown in the Fig 4(1) and 4(2) were made. The generalized stratigraphic columnar section in the project area is shown Fig. 5.

In the eastern project area, trachybasalt, trachyandesite, tuff and sandstone from Permian to Triassic are widely exposed. The Selenge complex from Permian to Triassic consisting of granite, granodiorite, gabbros, etc., and the Triassic granitic rocks of monzonite, granite, granodiorite and syenite, intrude in the above Permian to Triassic sedimentary rocks. The Triassic to Jurassic volcanic rocks cover them. Finally, the Quaternary alluvial deposits are distributed along streams.

Especially, plutonic rocks are widely distributed in the western part and eastern part of the project area, and consist of calc-alkaline rocks to alkaline rocks of Permian to Jurassic ages. Permian plutonic rocks consist mainly of granite, granodiorite and diorite and rarely of gabbro, syenitic granite to granodiorite porphyry. Plutonic rocks in the Erdenet Mine area are divided in Selenge

complex and Erdenet complex. The Erdenet complex consists of granite porphyry and granodiorite porphyry and accompany with mineralization and alteration. The Selenge complex is host rock of porphyry copper-molybdenum ore deposits. The Erdenet complex is igneous rock related to the formation of the porphyry copper-molybdenum ore deposits.

Granite of Paleozoic and syenitic rhyolite, syenitic dacite, comendite, basalt, pyroclastic rocks and sandstone of Permian are distributed around the western area of Bulgan city in the southwestern part of the project area,. The Jurassic molasse faces of conglomerate, sandstone and mudstone cover unconformable them.

The project area is geologically located in the western Tuva-Mongol Unit on the south of the Vitim Structure, which is a large structural line trending east to west. The geology of the area corresponds to magmatic island arc formed by accretion on subduction system from Vendian of Proterozoic to late Permian.

The structure of plutonic rocks arrangements, the basin structure, dyke arrangement structure, fault structures and ring structure can be confirmed in the project area.

Plutonic rocks arrangements: Permian to Triassic plutonic rocks are arranged along a NW-SE direction around the Erdenet mine area and the Mogoin gol area. On the other hand, the distributions and the arrangements elongate to NS direction in the northeastern part of the area.

Basin structure: Late Triassic to early Jurassic Volcanic rocks is distributed in a circular area from the Erdenet mine area to the Mogoin gol/Khujiriin gol area. This distribution shows the basin structure with diameters around 40 km in the EW direction and 30 km in NS direction.

Small body structure: Liparite dyke and stocks are developed surrounding the basin structure including the distribution of the Triassic to Jurassic volcanic rocks. The direction of dykes in the southwestern part of the project area is probably controlled by the existence of deep faults in the area.

Faults structure: Typical faults can be recognized in the existing geological map of the project area. NW-SE faults system is developed in the western part of the area, while NE-SW faults are developed in the northeastern part. The Erdenet mine exists in the junction of the NW-SE faults and NE-SW faults.

Ring structure: A big scale ring structure was detected in the southern part of the area after compiling the geological maps in the project area.

Plutonic rocks arrangements, small body structures and fault structure trending NW-SE direction and fault structure trending NE-SW direction are found developed in the whole project area. The Erdenet ore deposits are located in the southwestern end of the basin structure at the crossing point between the structures.

General Mineralization in the Project Area

General Mineralization

Mineral deposits and occurrences in the project area are indicated in the mineral location map (G. Dejidmaa etc, 2001) shown in Fig. 6. The following three types of mineralization can be recognized in the project area as:

(1) Porphyry Cu-Mo deposits and mineralization zones hosted in porphyry and granitic rocks,
(2) Copper mineralization related to basalt dykes and
(3) Gold vein type and stockwork type related to granitic rocks.

① Porphyry Cu-Mo deposits hosted in the porphyry and granitic rocks

Typical ore deposit distributed in the area is the Erdenet ore deposit composed of the Erdenet NW deposit, the Erdenet Central deposit, the Erdenet Intermediate deposit and the Erdenet SE deposit. In the southeastern part of these deposits, there exist the Shand mineral showing, the Tourmaline mineral showing, the SAR188 mineral showing and the SAR200 mineral showing.

Other mineralizations showings such as the ones at Zuukhiin gol, Mogoin gol, Khujiriin gol, Tsagaan Chuluut, Danbatseren, and Undrakh are known to be of the same type mineralizations. In the western part of Bulgan city, there are several showings as well.

② Copper mineralization related to basalt dykes

This type of mineralization is distributed around the Bulgan city.

③ Gold vein type and stockwork type related to granitic rocks

This type of mineralization is located in the Tsookher mert gold mineral showing.

Summary of Formation of the Erdenet mine

The Erdenet copper deposits in the project area are the biggest porphyry copper-molybdenum deposit in eastern Asia. The mineralized zones in the area with six known ore bodies, including the Erdenet mine, show elongated NW-SE trends extending approximately 20km.

The geology of Erdenet Mine area is shown in Fig. 7 and the total magnetic intensity shown in Fig. 8. The mineralization features are as follows:

Regional background: The Erdenet ore deposits are reported to form in relation with the Permian to Triassic collision process (240 Ma) of the Siberian Block and the Mongol-Northern China block in the Eurasia by Watanabe (1998, 1999). The Selenge complex (290 to 240 Ma) represents deeper lithofacies of the igneous activities in the volcanic arcs that were formed in the northern, central and southern part of Mongol before the collision. At the latest stage of the igneous activity, the Erdenet complex (granodioritic porphyry; 250 to 245 Ma, 250 to 220 Ma and 205 to 195

Ma: Berzina et al., 1999) and the alkali rock (180 Ma) intruded and the Erdenet ore deposits were formed (190 to 210 Ma).

Geology: The Erdenet ore deposits exist in the junction of the granitic rocks arrangements, the dyke and the fault systems in NW-SE direction and the fault systems in NE-SW direction, and also in the southern edge of the Basin structure, late Triassic to early Jurassic deposit. Permian volcanic rocks, the Selenge complex intrusion in the Permian intrusion and the Erdenet complex intrusion in the Selenge complex distributed around the Erdenet mine. In and around the Erdenet mine, the host rock of the porphyry Cu-Mo mineralization is the Selenge Complex, and the igneous rock related to the Erdenet ore deposit, the porphyry cupper-molybdenum deposit, is the Erdenet Complex composed of granite porphyry and granodiorite porphyry. The Erdenet Complex is composed of granite-porphyry, diorite porphyry and granodiorite porphyry.

Geological structure: In the project area, the geological structure consists of granitic rocks arrangements, dyke and the fault systems in NW-SE direction and fault systems in NE-SW direction, as shown in Fig. 3. The Erdenet mine exists in the southern edge of the basin structure and also in the junction of these main faults.

Alterations: The alteration assemblages present strong silicification-greisen zone, quartz-sericite zone, sericite-chlorite zone and calcite-epidote-chlorite zone from the center to outward, accompanied with other spotty alterations (Naito and Sudo, 1999). Acid alteration, called as the advanced argillic alteration (the Tsagaan Chuluut area) and sericite alteration (the Mogoin gol area), are recognized related to the formation of porphyry Cu-Mo deposits in the project area.

Mineralizations: Oxide and leached zone is situated on the surface, but the secondary enrichment zone composed of chalcocite, bornite, covelite and oxide copper are found beneath the oxide and leached zone. Primary ores composed of chalcopyrite, bornite, pyrite and molybdenite are located beneath the secondary enrichment zone.

Results of the airborne geophysical survey: The Erdenet mine is located in the northern part of the lowest small magnetic zone in a lower magnetic anomaly trending NW-SE direction. Porphyry forming the Erdenet complex is located in the lowest small magnetic anomaly and thus it is recognized that the porphyry is related to the generation of porphyry copper-molybdenum deposits. High potassium content results are caused by the Erdenet deposits and coincide with the rocks in the open pit and its surrounding waste dumps that reflect the alteration rocks bearing potassium.

The genesis model of the Erdenet ore deposits in early Jurassic age is shown in Fig. 9.

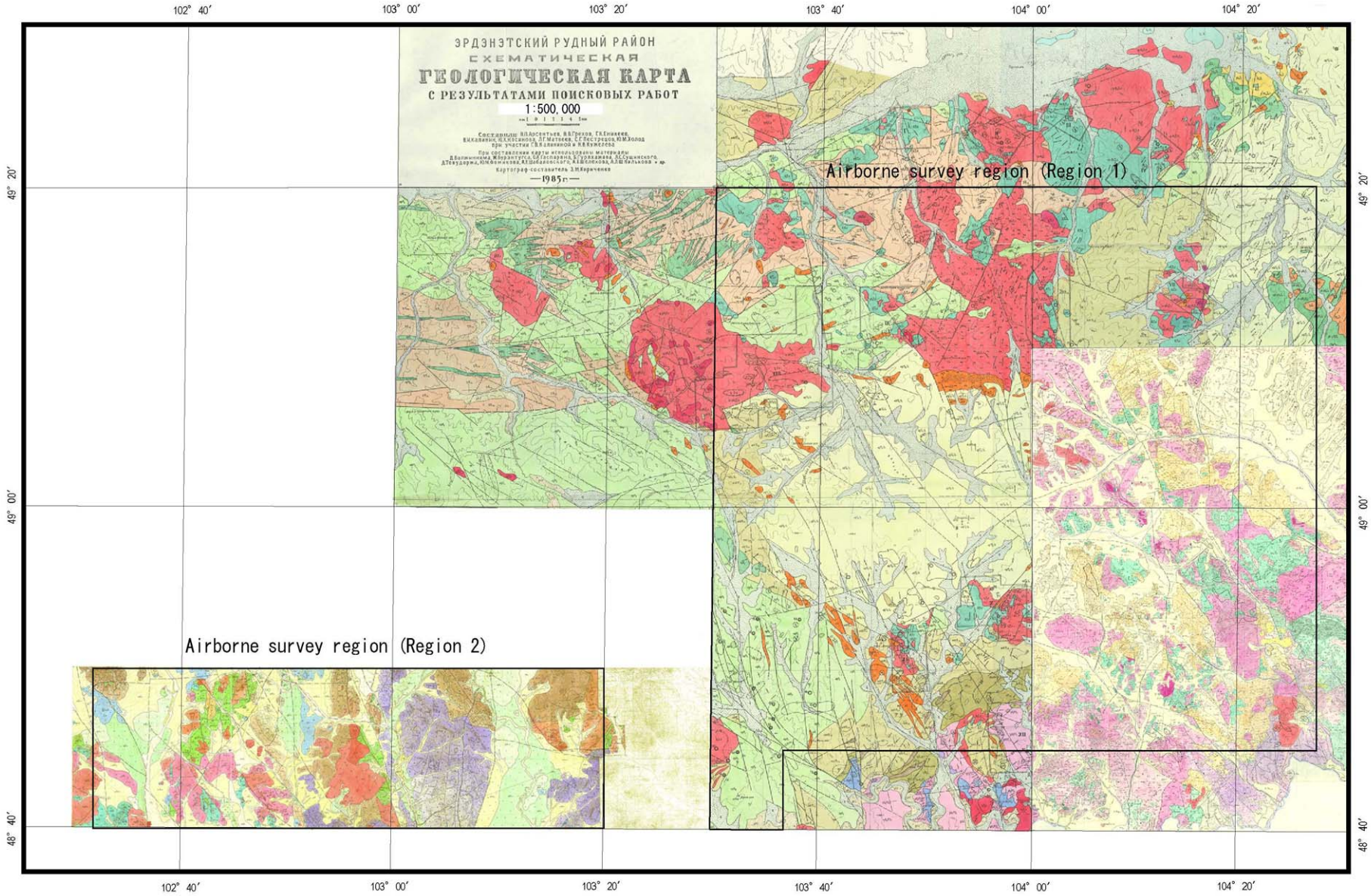


Fig. 4(1) Work Flow of the Project Area

L E G E N D

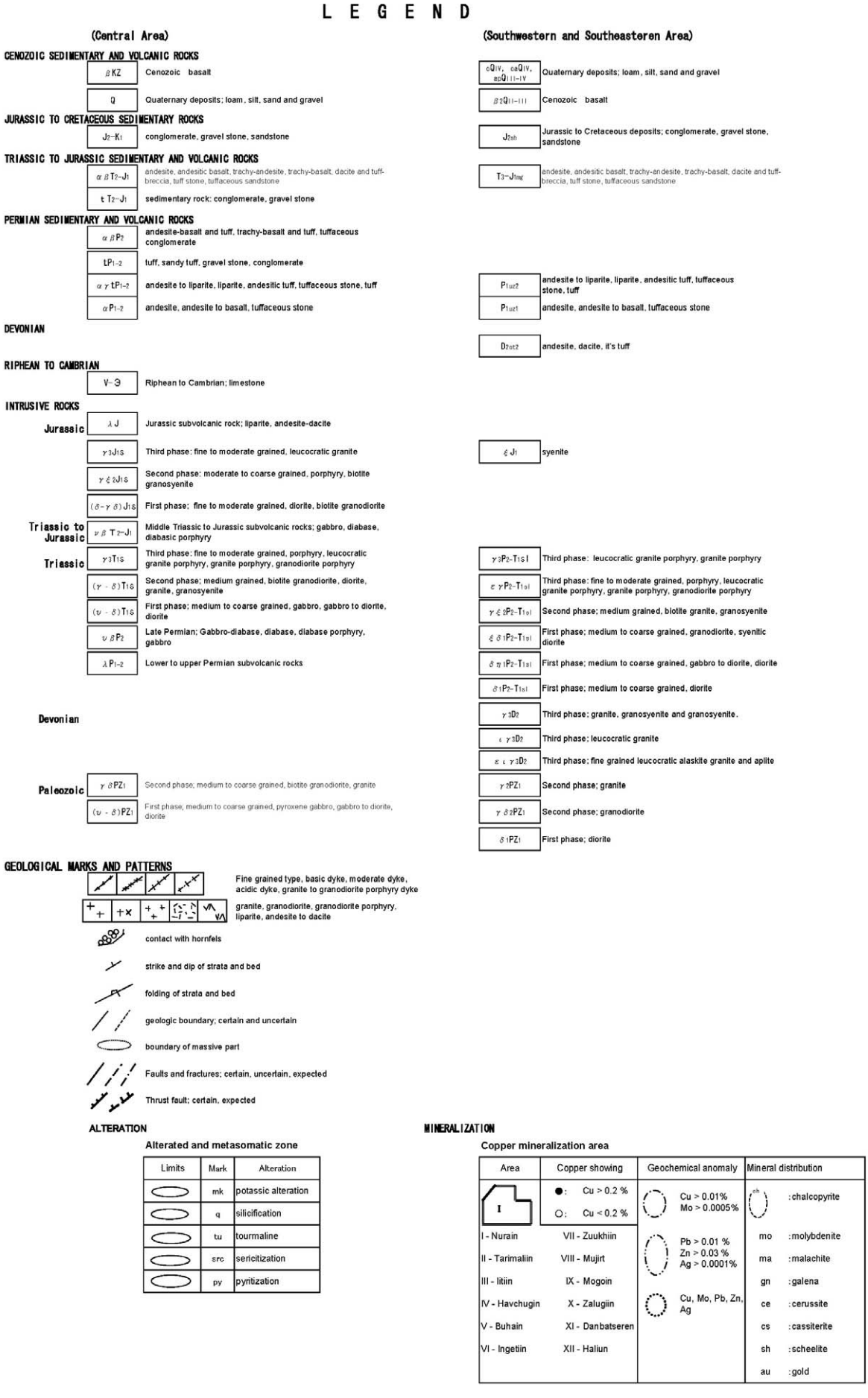


Fig.4(2) Legend of existing geological map in the project area in Mongolia

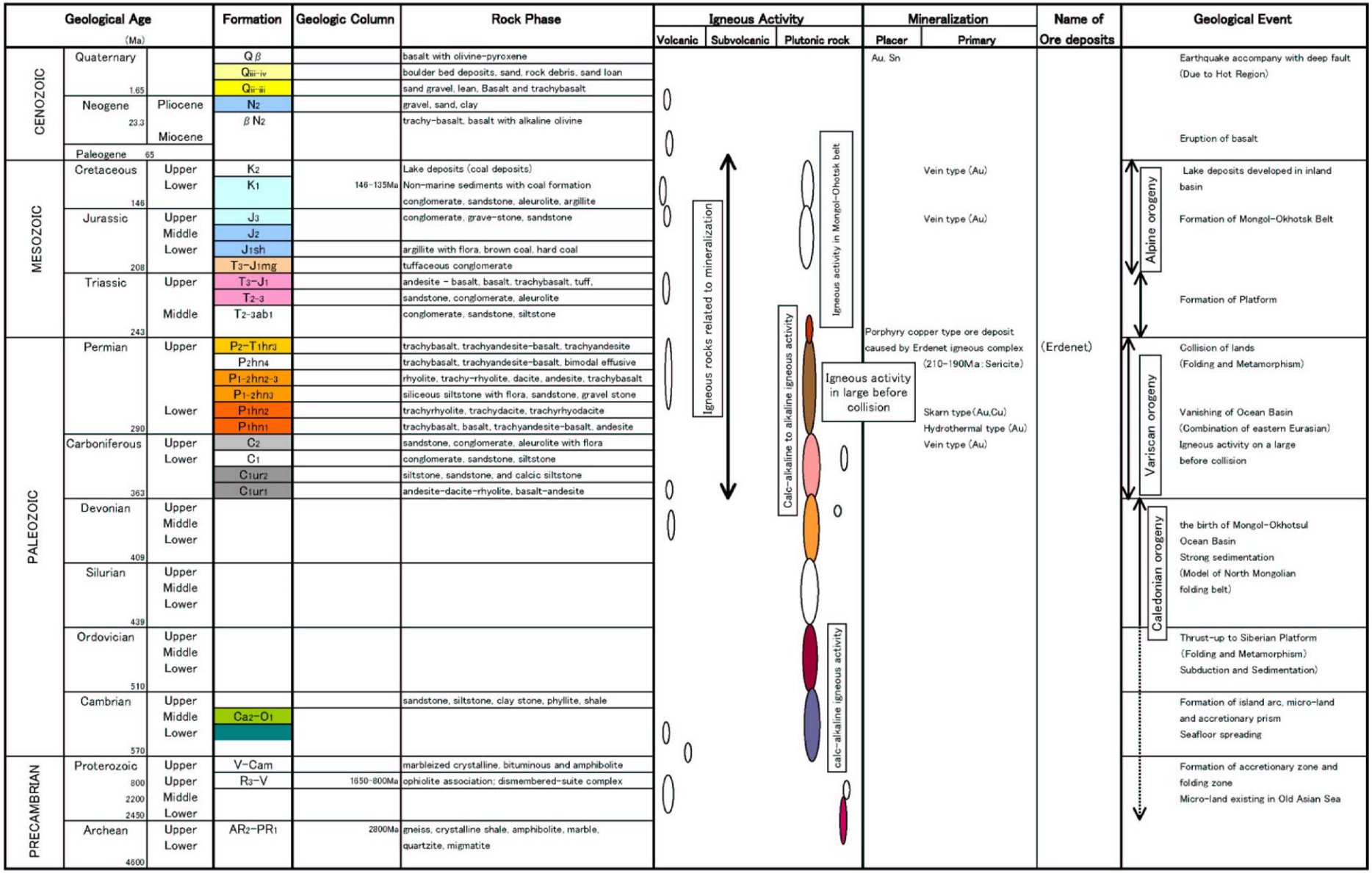
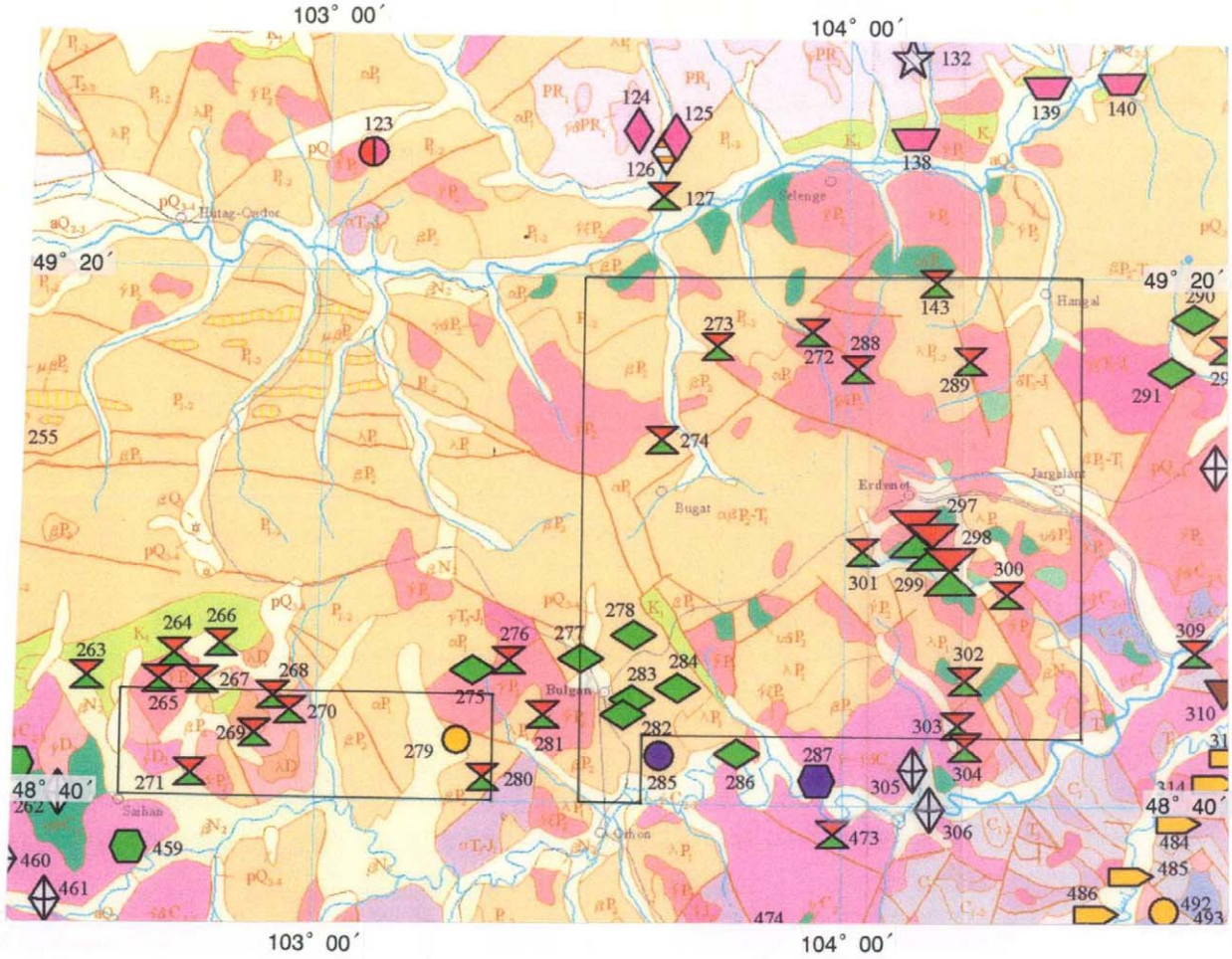


Fig.5 Generalized stratigraphic columnar section in the project area, Mongolia



L E G E N D

: Porphyry Cu-Mo (Ag, Re) deposit

: Porphyry Cu-Mo (Ag, Re) occurrence

: Basaltic Cu Occurrence

: Granitoid related Au occurrence

: Placer Au occurrence

Fig.6 Generalized mineral location map in Western Erdenet area

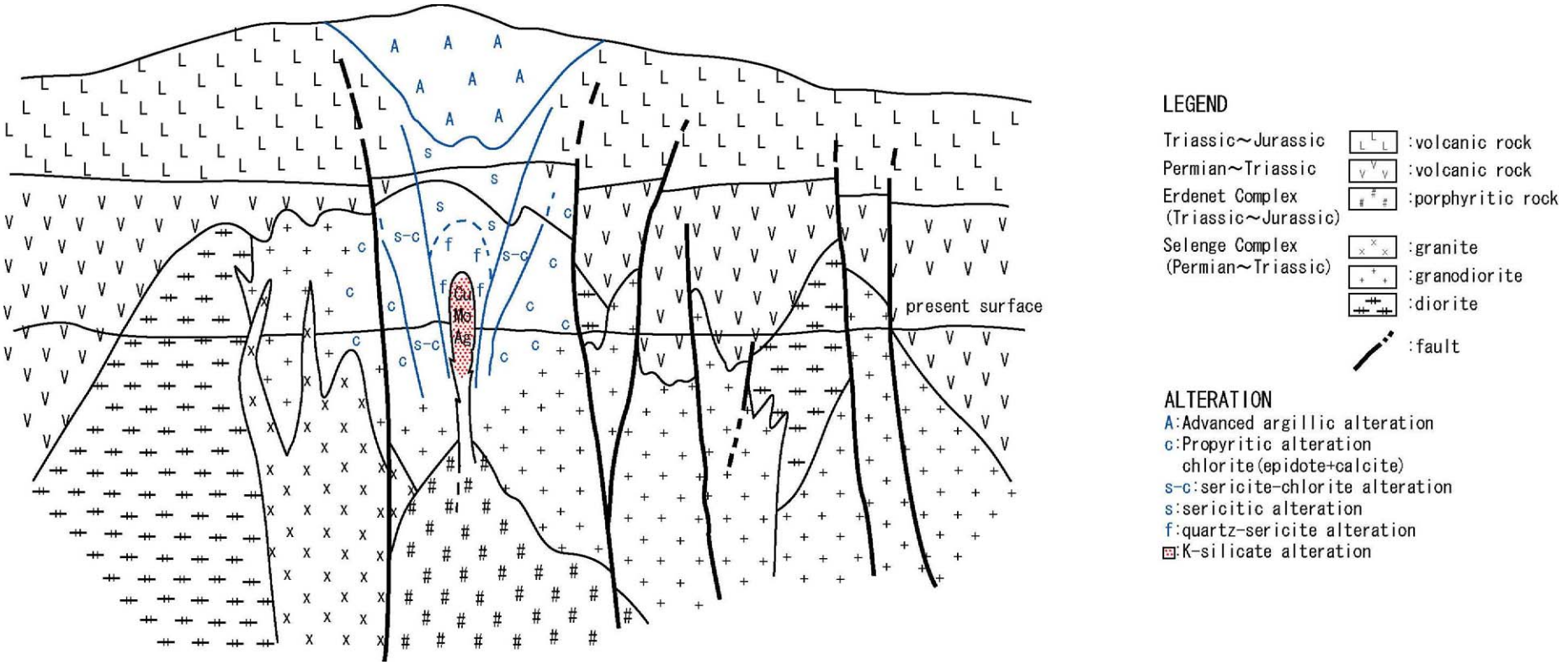


Fig.7　Genesis model of Erdenet ore deposit in early Jurassic

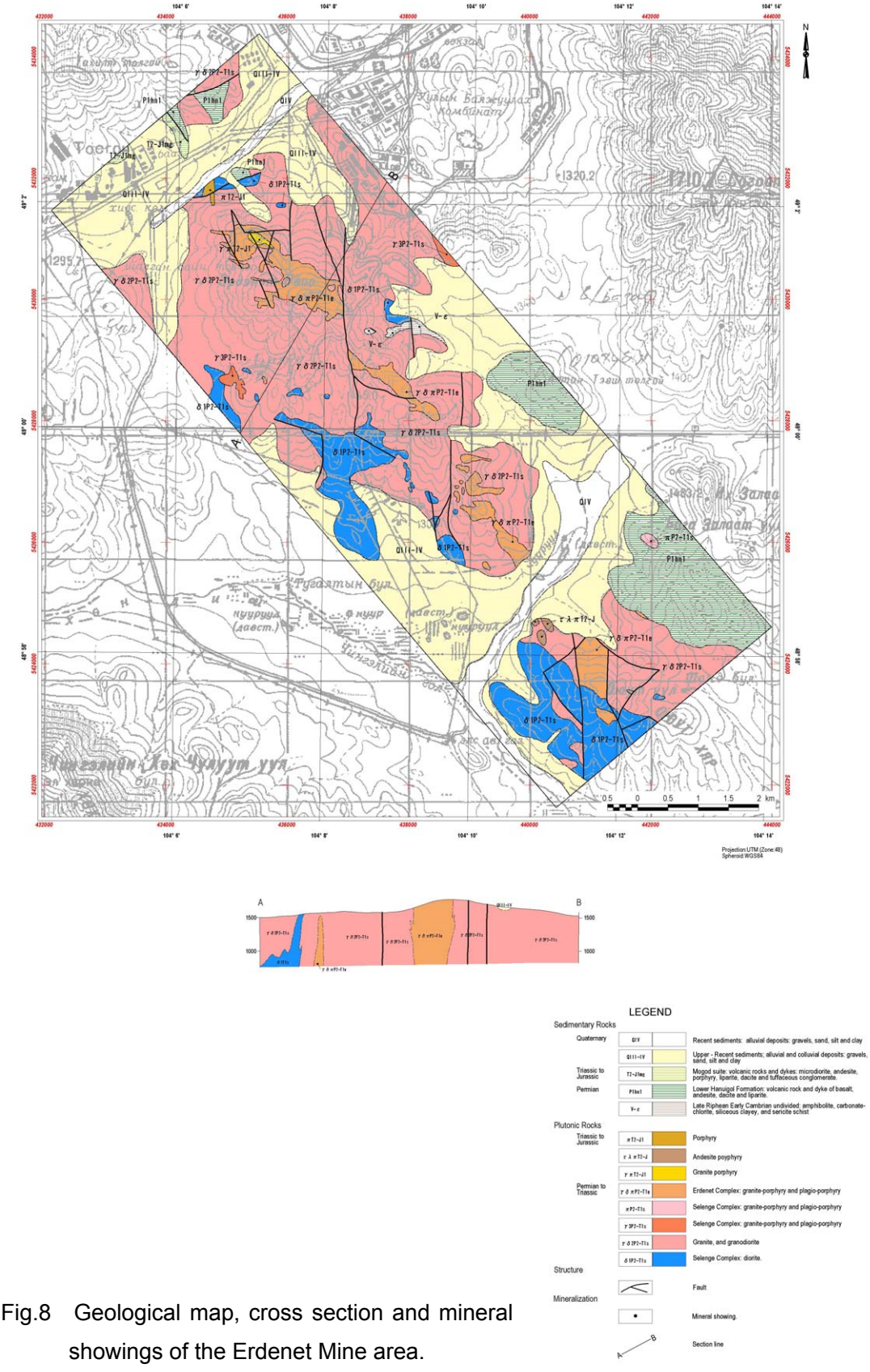


Fig.8 Geological map, cross section and mineral showings of the Erdenet Mine area.

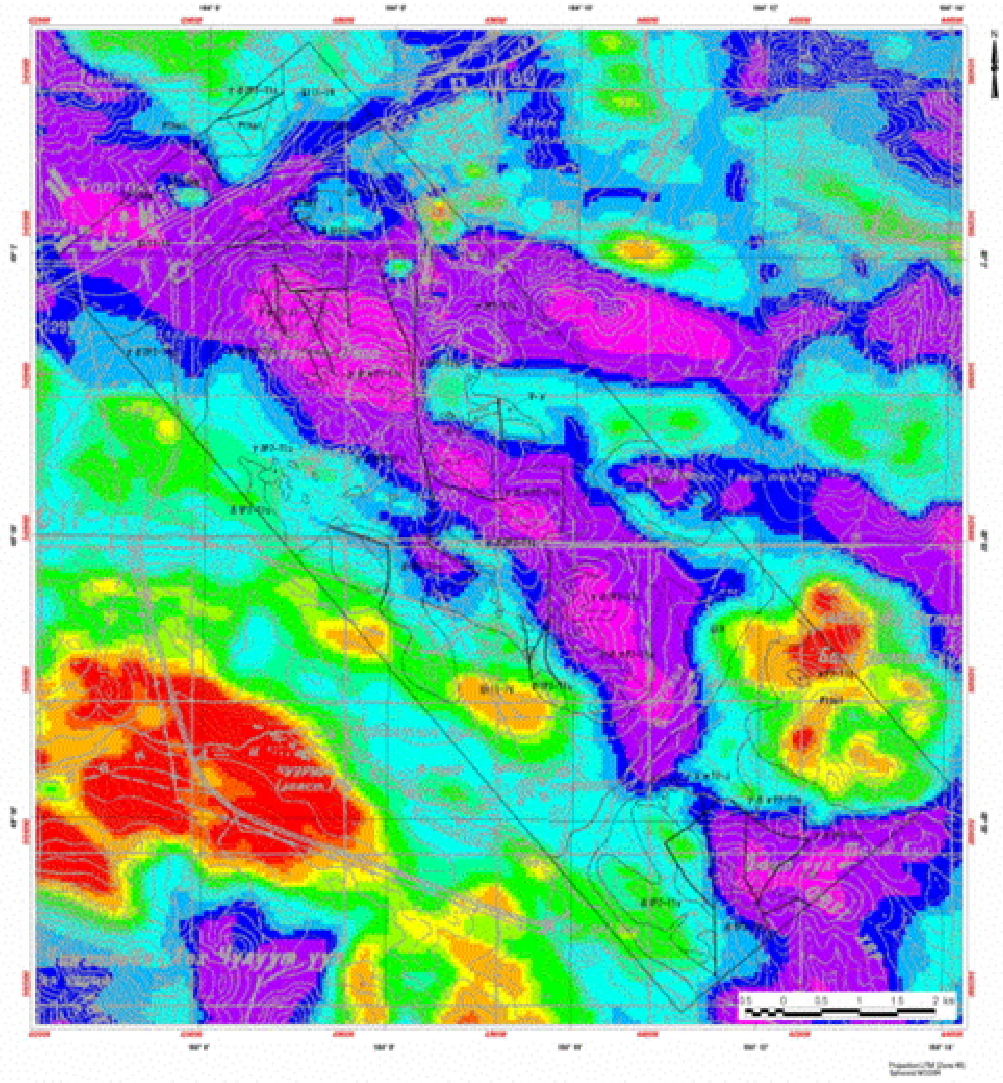


Fig.9 Total magnetic intensity of air borne survey in the Erdenet Mine area.

Outline of the Mining History

The biggest porphyry copper-molybdenum deposit in eastern Asia exists is the Erdenet copper deposit. From north to south direction, this deposit is composed of the Erdenet NW ore deposit (mined as an open pit), the Erdenet Central deposit, the Erdenet Intermediate deposit and the Erdenet SE (Oyut) deposit. The Erdenet Central deposit, the Erdenet Intermediate deposit and the Erdenet SE (Oyut) deposit have already finished exploration studies including feasibility.

In 1941 the Erdenet deposits were firstly reported when the area was geological mapped by a USSR team. During 1964 and 1969, an intensive exploration program was conducted by a cooperative program between the Czech-Slovakia and Mongolian Governments. Ore reserves were calculated in 512,000,000 tons including 4,300,000 tons of copper.

In 1972 it was decided that the Erdenet mine be developed in cooperation with the Soviet Republic. In 1978 the Erdenet mine started operations with a production of about 4,000,000 tons per year. In 1983, the production increased to 16,000,000 tons per year and in 1989, 20,000,000 tons per year were produced. Up to 1990 the copper concentrate of 30 % to 32 %Cu produced 350,000 tons.

In 1995 the extracted ores were amounted to 20,900,000 tons grading 0.73 %Cu and 0.02%Mo which were equivalent to 152,570 tons of copper metal and 4,180 tons of molybdenum metal. Cu concentrate produced was 346,300 tons Cu (Cu grade in Cu Conc. is about 40%) and 3,900 tons Mo.

Erdenet Mining Corporation operated the Erdenet Mine under joint management between Mongolia and Russia. In 2000 production summary of the Erdenet mine was as follows:

- Ore grade: Cut-off grade: Cu 0.25%
- Oxide ore: more than 0.70%.
- Oxide ores are processed by SX-EW, joint venture project with USA.
- Heap leaching: production rate of 5 to 4 tons copper per day.
- Ores mined: 24,000,000 tons/year at 0.69%Cu, 0.02 %Mo
  Including secondary enrichment ore of 40 % and primary ore of 60 %.
- Annual production: 40,000,000 tons/year
- Production of concentrate: 400,000 tons per year at 30%Cu, 1%Mo
  Contained 120,000 tons Cu metal, 2,000 tons Mo metal, 8,000 tons Ag metal.
- Ore reserve in 1999: 1,400,000,000 tons at 0.25%Cu COG
  (7,000,000 tons Cu, 200,000 tons Mo)
- Mine Life: 35 years
- Secondary enrichment zone: surface (1,600mASL) to 400m in depth.
- Oxide ore: surface to 100 to 300m in depth,
- Primary ore zone: Some drill holes of 1000m in depth confirmed primary sulfides at a deeper zone

- Current mining level: 1,325mASL (8 levels).

Based on exploration studies including feasibility study around the mine, ore reserves in the Erdenet Central deposit and the Erdenet Southeast (Oyut) deposit were estimated in 1,250,000 tons (0.43%Cu, 0.018 %Mo) and 41,890,000 tons (0.40%Cu, 0.007%Mo) respectively.

The tenement of the Erdenet mine is limited to the vicinity of the Erdenet NW only, which is currently mined and do not include other deposits such as the Central deposits and others.