

the Tsagaan Chuluut Mountain and that sulfide minerals as copper minerals and pyrite could not be confirmed in the area. The alteration zoning composed of quartz-alunite-(pyrophyllite) -(kaolinite) type and quartz-alunite-sericite-(kaolinite) type is distributed in the area and the sericite-chlorite-(smectite) alteration is controlled by fault system.

The previous existing data indicated that the quartz-(jarosite)-(kaolinite) alteration zone in the white argillized and silicified zone is located in the southeastern extension of the magnetic anomaly and IP anomaly of the Erdenet NW ore deposits.

## **(6) Discussion**

According to the results of the geological survey, the Permian to Triassic granodiorite of Selenge complex is distributed in the southern part of the Tsagaan Chuluut mountain and Triassic to Jurassic volcanic rocks cover the granodiorite.

The white argillized and silicified zone in and around the Tsagaan Chuluut mountain is the alteration mineral assemblage of quartz-(jarosite)-(kaolinite) type and quartz-alunite-(pyrophyllite)-(kaolinite) type. The alteration zone belonged to the advanced argillic alteration zone of the porphyry copper type alteration system. The expected porphyry copper mineralization is inferred to be in the deeper part from the ground surface.

The previous geophysical survey results indicated that the white argillized and silicified zone is located in the magnetic anomaly as well as in the IP anomaly.

It is considered the possibility that the porphyry type copper and molybdenum mineralization exists in the deeper part from the ground surface.

## **2-4-4 The Erdenet Mine area**

### **(1) Generality**

As shown in Fig. 2, the Erdenet Mine is located 260km northwest from Capital Ulaanbaatar and at approximate elevation of 1,200m to 1,600m above sea level. The topography shows steep to gentle mountain as shown in Fig. II-2-28. The vegetation in the area is composed of tall grass in the hill and low grass along the streams.

In this area, there exists the Erdenet NW, Erdenet Central, Erdenet Intermediate and Erdenet SE (Oyut) ore deposits. The Erdenet NW ore deposits were developed by open pit methods. The ore reserves of Erdenet Central, Erdenet Intermediate and Erdenet SE (Oyut) ore deposits have been already calculated.

In 1941, geologists of Soviet Republics who reported about Erdenet ore deposits surveyed the area. In 1964 to 1969, the exploration survey including geological, geophysical, geochemical and drilling surveys were conducted by the cooperation work between the Czech-Slovakia and Mongolia Governments. Ore reserves were calculated in 512,000,000 tons including copper metals of 4,300,000

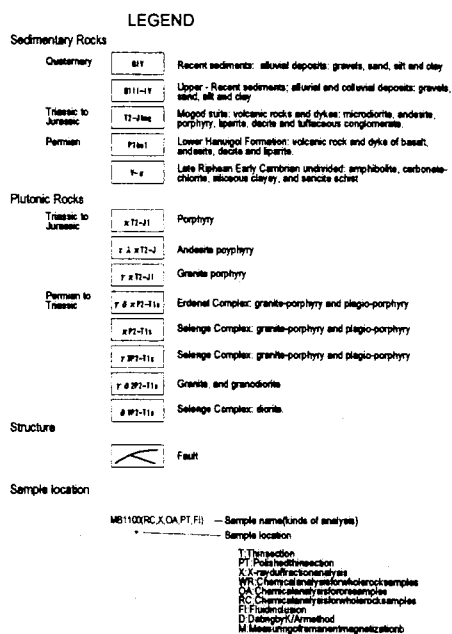
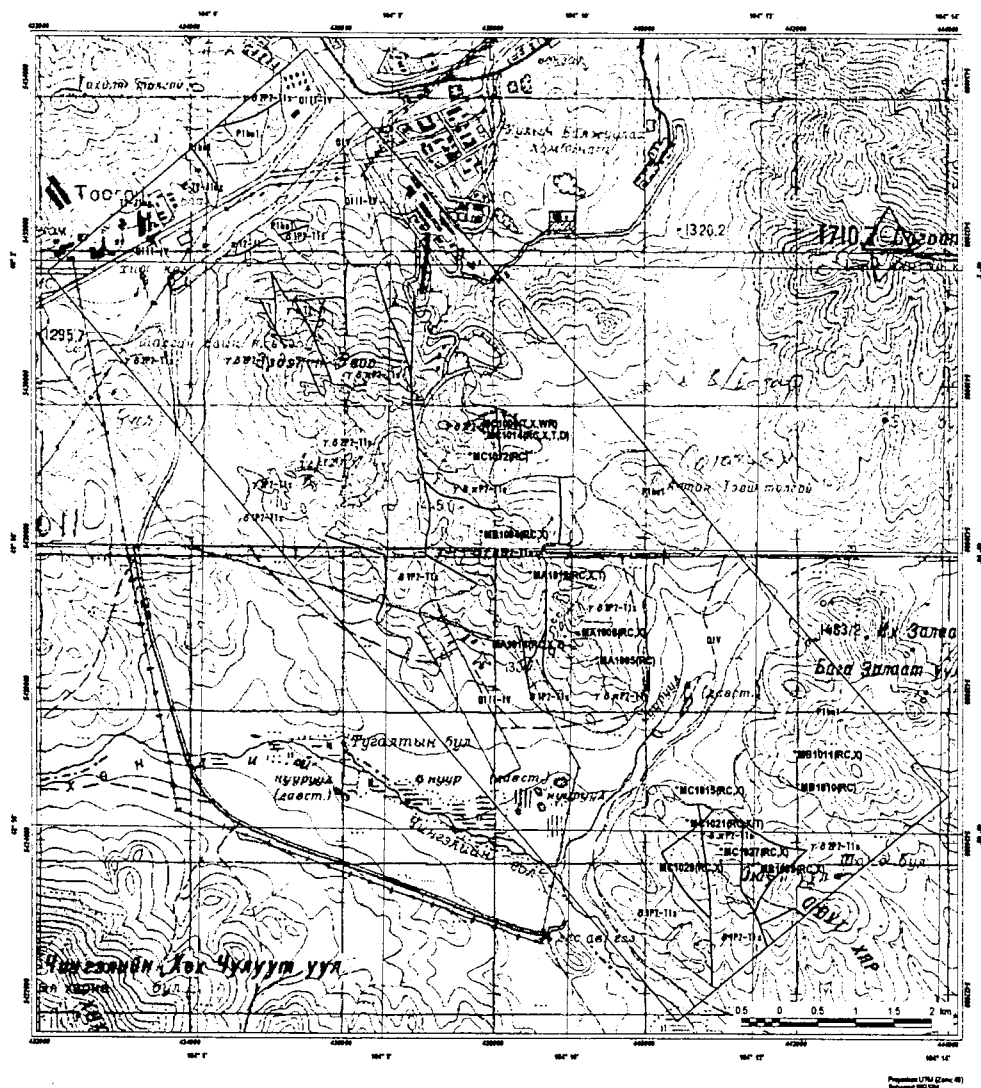


Fig. II-2-28 Survey location and sample locations map of the Erdenet Mine area

tons.

At present, Erdenet Mine is under operation by Erdenet Mining Corporation through a joint management between Mongolia and Russia.

## **(2) Geology**

The geology of the area is shown in Fig. II-2-29. Stratigraphy, Geological structure and mineralization are as follows:

### **(i) Stratigraphy**

The area presents Pre-Cambrian, Permian volcanic rocks, Triassic to Jurassic volcanic rocks, Permian granites, Permian to Triassic porphyries, Triassic to Jurassic porphyry, dykes and Quaternary deposits.

Pre-Cambrian consisting of crystalline rock and amphibolite is distributed in central east part of the area.

The Permian called as Hijii Formation (P1hn1) in the area is composed of first suite consisting of trachybasalt, trachybasalt, basalt, trachyandesite-basalt, andesite-basalt, andesite, tuff, sandstone, gravel stone, conglomerate. The formation is distributed in the northern and eastern parts of the area.

Triassic to Jurassic volcanic rocks is called as Mogod Suite (T2-J1mg) and consists of andesite – basalt, basalt, trachybasalt, tuff and tuffaceous conglomerate. The stocks consist of liparite porphyry, syenitic diorite porphyry. The suite is distributed in the north edge of the area.

Permian granites called as Selenge complex is composed of granite to diorite ( $\delta$  1P2-T1s), granodiorite ( $\delta$   $\gamma$  2P2-T1s) and granite porphyry ( $\pi$  1P2-T1s). The diorite ( $\delta$  1P2-T1s) is distributed in the western part of the area. The granodiorite ( $\delta$   $\gamma$  2P2-T1s) is widely distributed in the area.

Permian to Triassic porphyries called as Erdenet complex is mainly composed of granite porphyry to granodiorite porphyry ( $\delta$   $\gamma$   $\pi$  P2-T1e). The porphyry is distributed in central zone of the area. The dating by K/Ar method indicates that the age of the porphyry is 181 Ma and corresponds to early Jurassic geologic age.

Triassic to Jurassic porphyry rocks consists of granite porphyry ( $\gamma$   $\pi$  T2-J1), liparite ( $\tau$   $\lambda$   $\pi$  T2-J1) and porphyry ( $\pi$  T2-J1). The granite porphyry ( $\gamma$   $\pi$  T2-J1) is distributed in the southern part of the area, while the liparite ( $\tau$   $\lambda$   $\pi$  T2-J1) is distributed in the northern part of the area and the porphyry ( $\pi$  T2-J1) is distributed in northern part of the area.

Dykes consist of syenite porphyry, diorite porphyry, andesite and basalt.

Quaternary deposits are composed of boulder, single, loan and clay.

### **(ii) Geological structure**

Fault structures are developed in the area along the main direction NS and along other directions such as NW-SE, NE-SW and EW. The fault located in the east of Erdenet NW ore deposits is called

as North-South Fault.

### **(3) Mineralization**

The Erdenet NW ore deposit, the Erdenet Central ore deposit, the Erdenet Intermediate ore deposit and the Erdenet SE ore deposit are distributed in the area. At the present time, the Erdenet NW ore deposit has been operated by open-pit. The alteration distribution map is shown in Fig. II-2-30. The results of the rock geochemistry are shown in Fig. II-2-31 and Fig. II-2-32.

#### **(a) Erdenet NW ore deposit**

The state of the ore deposits is as follows:

Annual crude ore is 24,000,000 t (Cu: 0.69%, Mo: 0.02%). A breakdown of the crude ore shows that secondary enriched ore is 40% and primary ore is 60%. Annual mined ore is 40,000,000 t. Annual concentrate production is 400,000 t (Cu: 30%, Mo: 1%). Metal production is 120,000 t metal Cu, 2,000 t metal Mo, 8,000 t metal Ag.

Ore reserves in 1999 is 1,400,000,000 t (Cu: 7,000,000 t, Mo: 200,000 t), operation is feasible for 35 more years.

400 m from the surface exists a secondary enriched sulphide. 100m to 300m from surface exists the oxidized zone. The existence of primary ore was confirmed by some 1,000 m drilling holes. At present, the open-pit have been mined up to 1.325 m in sea level and 8 levels.

#### **(b) Erdenet Central ore deposit**

The ore deposit is located in southeastern part of the Erdenet mine as shown Fig. II-2-33. North-South faults divide the ore deposit into Erdenet NW ore deposit in west and Erdenet Central ore deposit in east.

The feasibility study of the Erdenet Central has already been finished and the ore reserve is calculated to be 1,250,000 t (Cu: 0.43 %, Mo: 0.018 %).

The alteration mineral assemblage of the Erdenet Central ore deposit is sericite-chlorite-(smectite) type and chlorite type. The results of the rock geochemistry indicate that the analytical vales are Cu 608 ppm, Pb 58 ppm, Zn 55 ppm, Au 32 ppb, Ag 7.7 ppm and Mo 101 ppm.

#### **(c) Erdenet Intermediate ore deposit**

The ore deposit is located in southeastern part of the Erdenet central ore deposit as shown Fig. II-2-33.

The alteration mineral assemblage of the Erdenet Central ore deposit is sericite-chlorite-(smectite) type. The results of the rock geochemistry indicate that the analytical vales are Cu 67.777 to 185 ppm, Pb 126 to 638 ppm, Zn 71 to 689 ppm, Au 2 to 10 ppb, Ag 1.1 to 10.1 ppm and Mo 3 to 188 ppm.

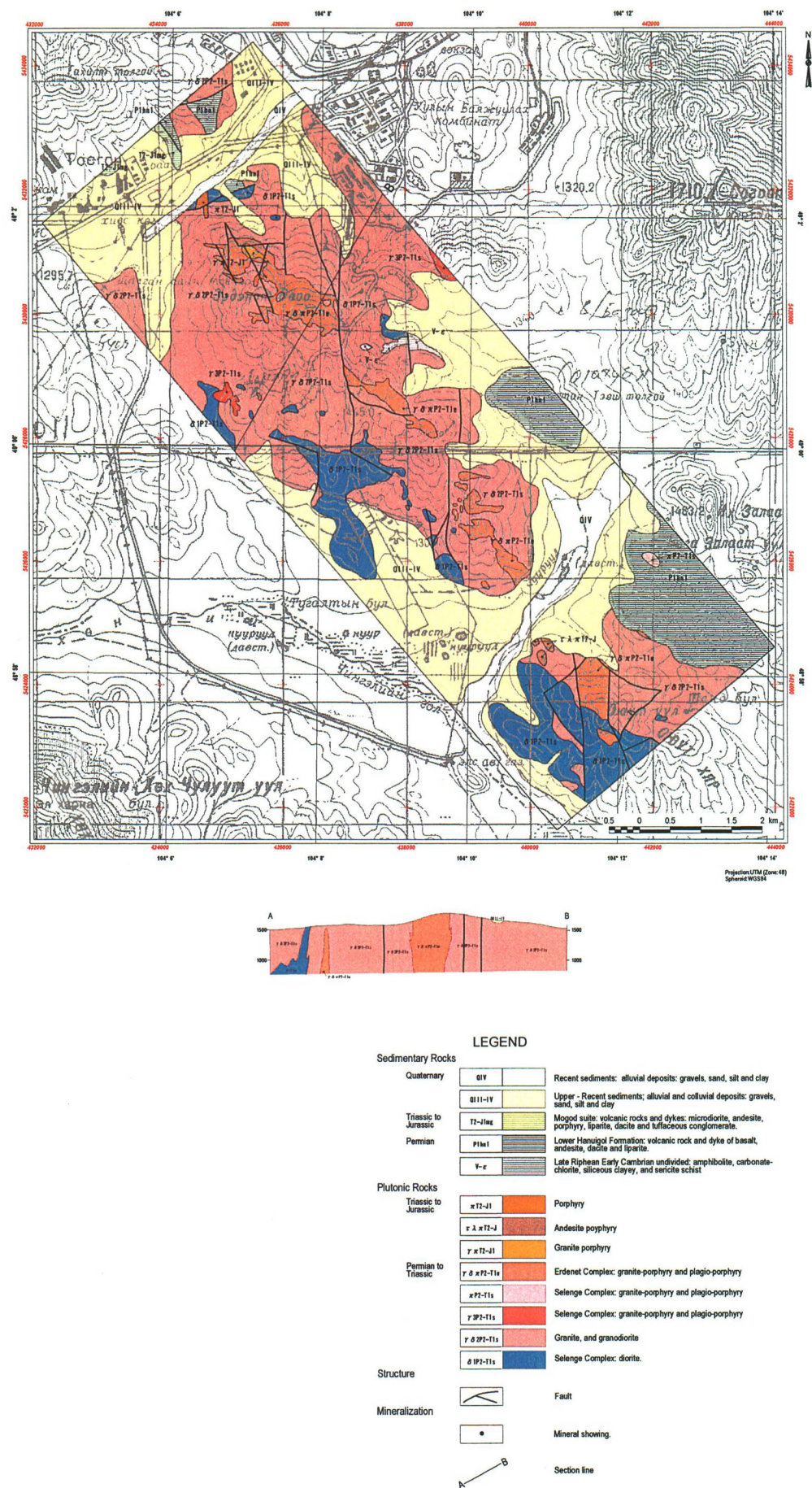


Fig. II-2-29 Geological map, cross section and mineral showings of the Erdenet Mine area

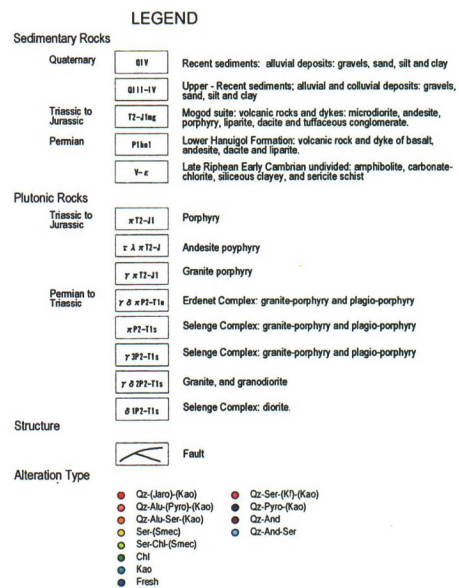
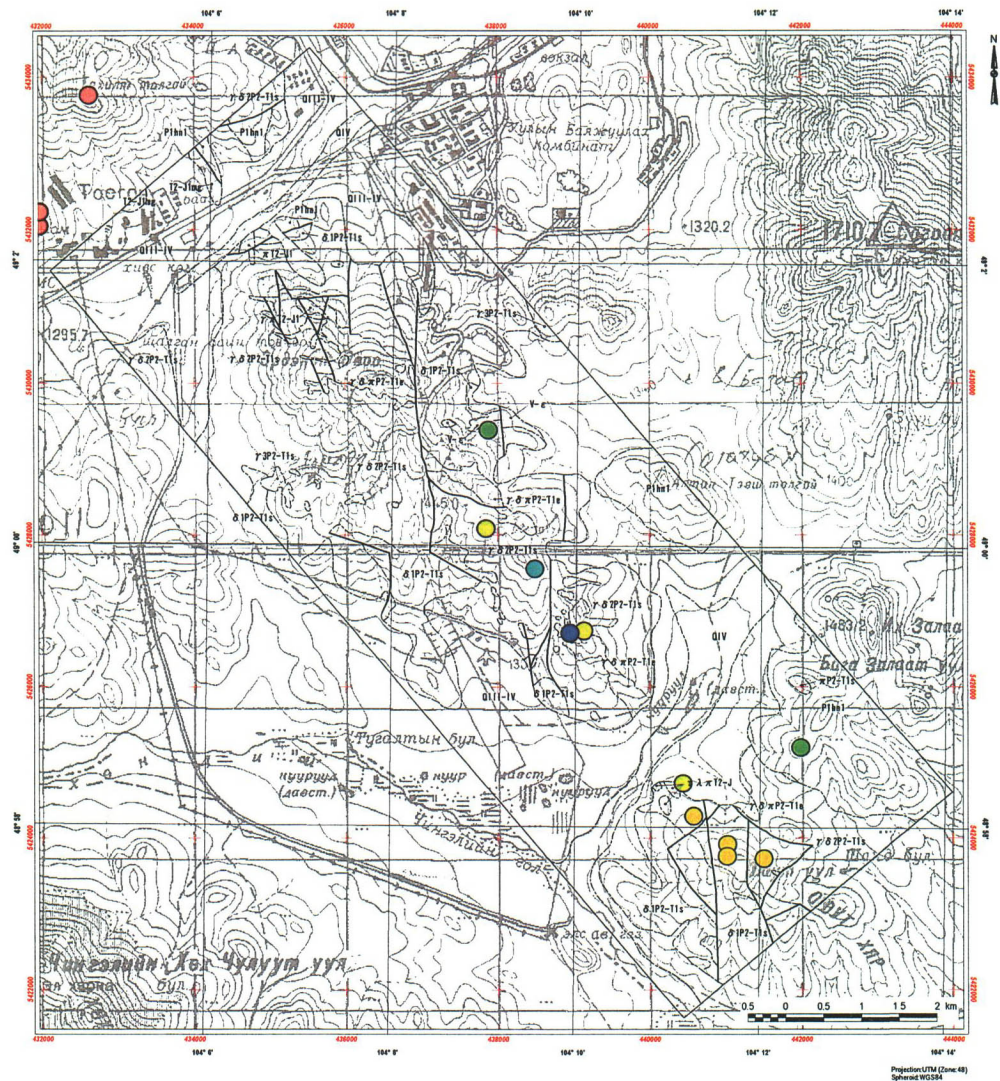


Fig. II-2-30 Distribution map of alteration mineral assemblages in the Erdenet Mine area

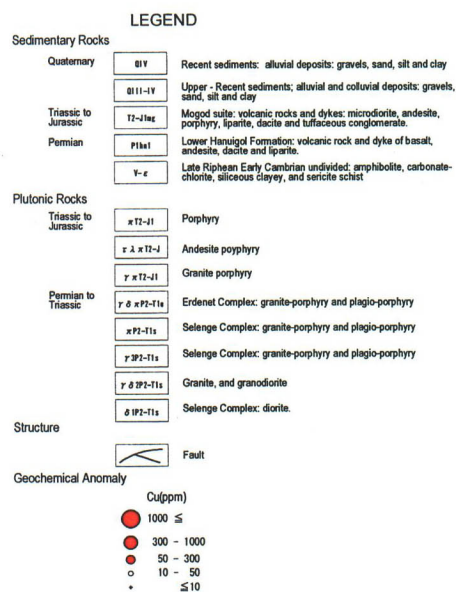
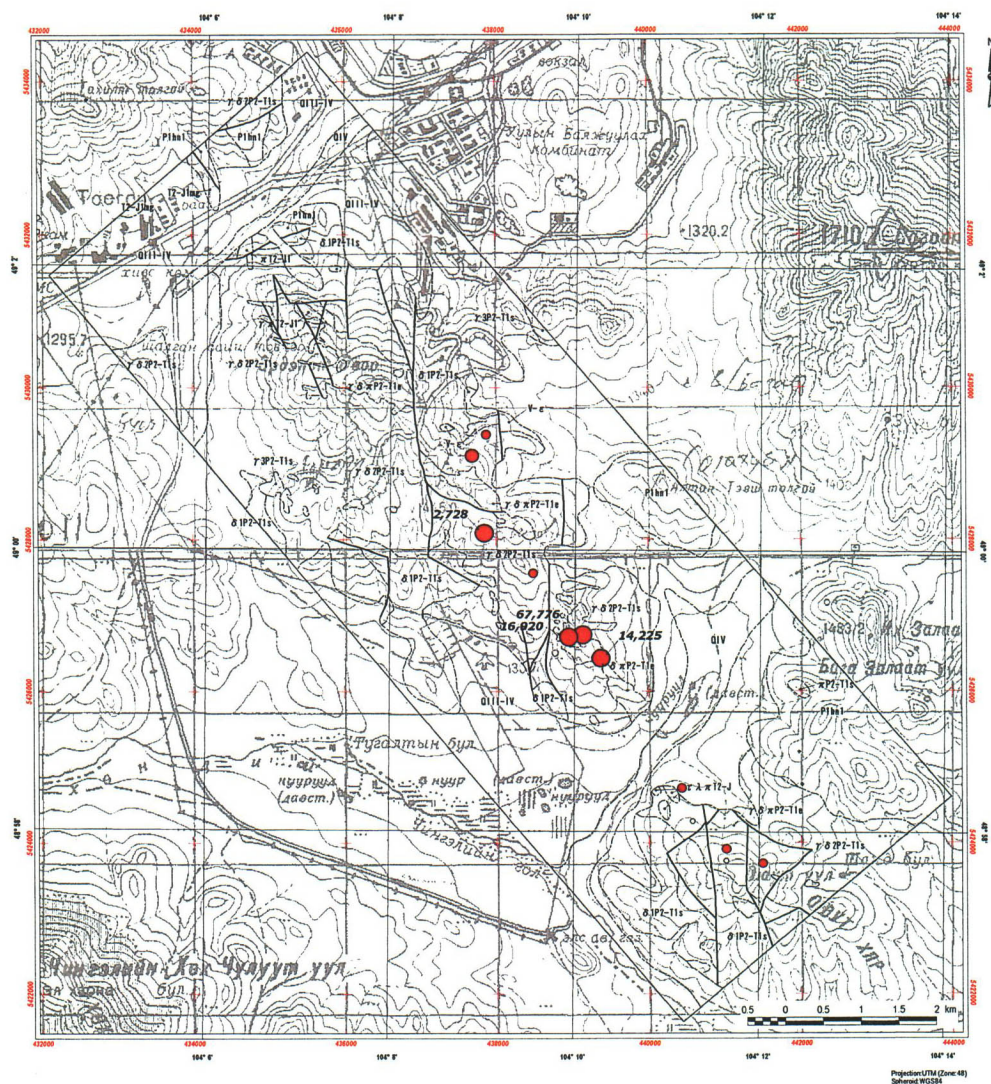


Fig. II-2-31 Distribution map of Cu anomaly in the Erdenet Mine area

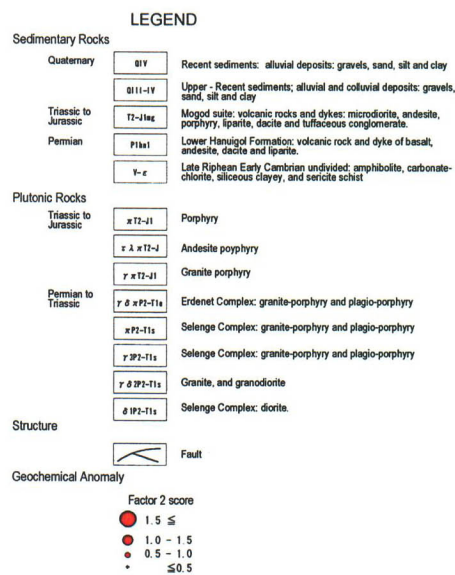
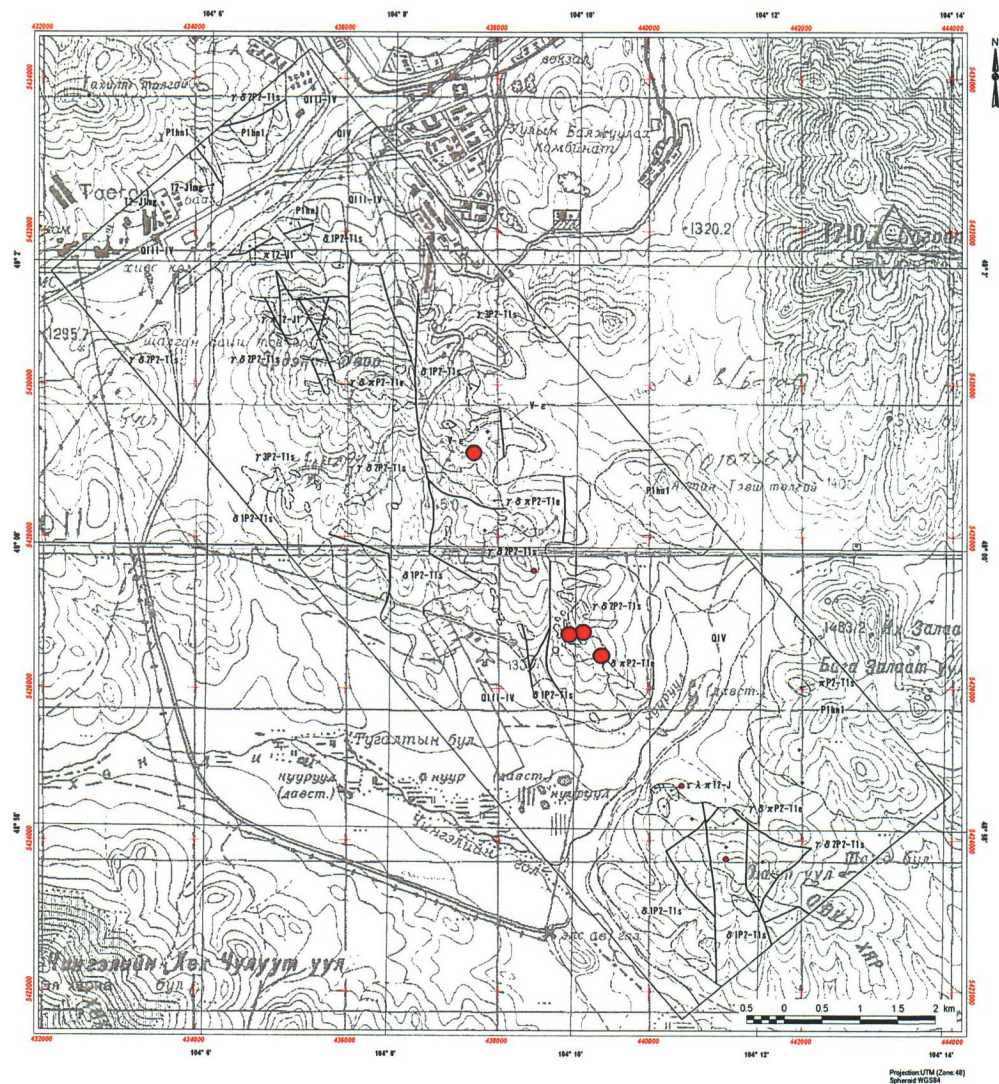


Fig. II-2-32 Distribution map of factor 2 scores in the Erdenet Mine area

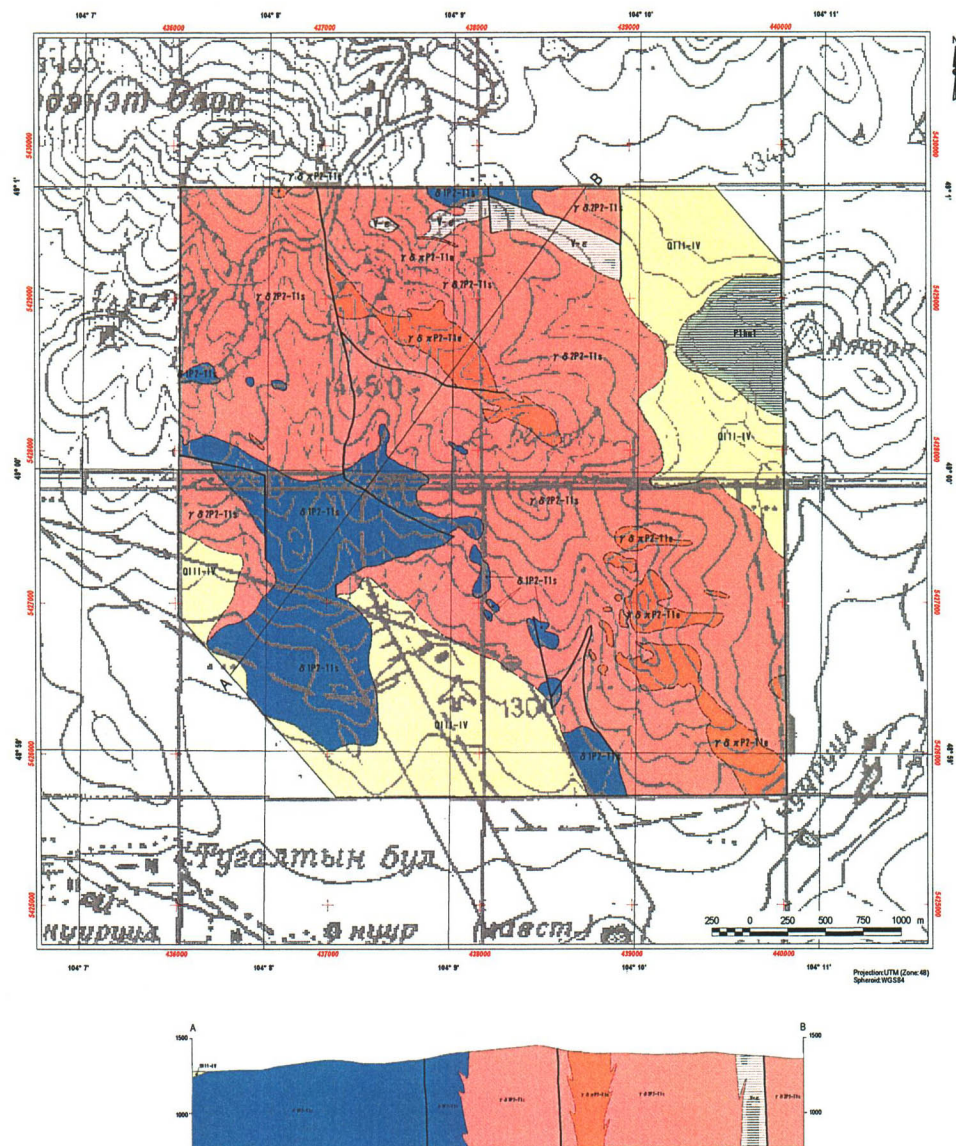


Fig. II-2-33 Geological map, cross section and mineral showings of the Erdenet Central and Intermediate area

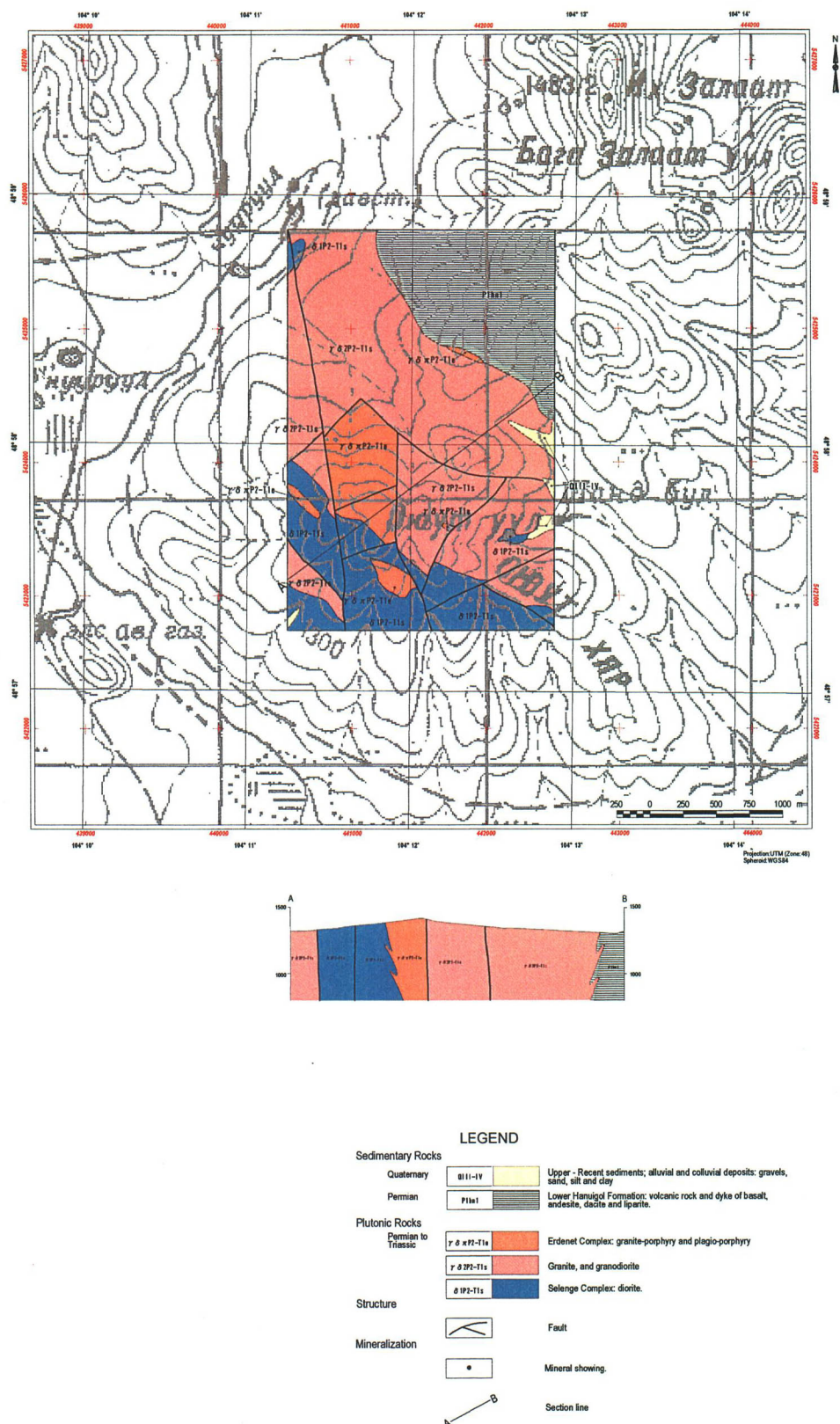


Fig. II-2-34 Geological map, cross section and mineral showings of the Erdenet Southeast area

#### **(d) Erdenet SE (Oyut) ore deposit**

The ore deposit is located in southeastern part of the Erdenet mine area as shown Fig. II-2-34.

The feasibility study of the Erdenet SE ore deposit has already been done with a confirmed ore reserve of 41,890,000 t (Cu: 0.40 %, Mo: 0.007 %).

The alteration mineral assemblage of the Erdenet Central ore deposit is sericite-(smectite) type, sericite-chlorite-(smectite) type and chlorite type. The results of the rock geochemistry indicate that the analytical values are Cu 9 to 169 ppm, Pb 42 to 142 ppm, Zn 13 to 110 ppm, Ag 0.7 to 2.3 ppm and Mo 1 to 9 ppm.

#### **(4) Previous geophysical survey**

The previous geophysical survey carried out in the Erdenet Mine area shows the following characteristic in the geophysical magnetic and IP surveys. Refer to Appendix 16.

- i) Erdenet NW ore deposit located in lowest magnetic zone forms an elliptical shape along EW direction. Other mineralized zones of Erdenet Central, Erdenet Intermediate and Erdenet SE (Oyut) are located in the lowest magnetic zone along the EW direction.
- ii) The Erdenet NW ore deposit shows a high chargeability zone of elliptical shape trending EW direction.
- iii) Erdenet Central and Erdenet SE (Oyut) mineralized zones are located in a small high chargeability zone
- iii) The Erdenet NW ore deposit is located in a relatively lower resistivity zone of elliptical shape. Erdenet Central and Erdenet SE (Oyut) mineralized zones are located in relatively lower resistivity zones along clear NW-SE direction.

#### **(5) Summary**

In the Erdenet mine area, the Erdenet NW ore deposit, the Erdenet Central ore deposit, the Erdenet Intermediate ore deposit and the Erdenet SE ore deposit are distributed. The feasibility study of the three ore deposits have already been carried out and at present, the Erdenet NW ore deposit has only been operated by open-pit methods.

In Erdenet NW ore deposit, the ore reserves in 1999 was 1,400,000,000 t (Cu: 7,000,000 t, Mo: 200,000 t), operation is possible for 35 years. 400 m from the surface is inferred a secondary enriched sulphide. 100m to 300m from surface is assumed the oxidized zone. The existence of primary ore was confirmed by some 1,000 m drilling holes. At present, the open-pit have been mined up to 1.325 m in sea level and 8 levels.

In the Erdenet Central ore deposit, the ore reserve is confirmed to be 1,250,000 t (Cu: 0.43 %, Mo: 0.018 %). The results of the rock geochemistry indicate that the analytical values are Cu 608 ppm, Pb 58 ppm, Zn 55 ppm, Au 32 ppb, Ag 7.7 ppm and Mo 101 ppm.

In the Erdenet Intermediate ore deposit, the analytical values are Cu 67.7 to 185 ppm, Pb 126 to