

Chapter 5 Conclusion and recommendation

5-1 Conclusion

A number of mineral occurrences of copper and gold have been known in the geologic province of Terektinsky Uplift. Central Zalturbulak and Akmola were selected for the 3rd Year's exploration areas, looking for porphyry style mineralization, in accordance with the results of the surface prospecting, the geophysical prospecting using an IP method, the rock geochemical prospecting by shallow drilling and the investigation of geological structure by deep drilling in the 1st and 2nd Years' Investigations.

The 3rd Year's Investigation comprises mainly drilling operations for the selected two exploration areas. In West Aktau of the Central Zalturbulak exploration area, two inclined holes(at 70° inclination, to the depth of 250m) were put down, targeting superimposing Cu and Au geochemical anomalies(Cu>300ppm, Au>100ppb) located in the peripheral zone of an IP anomaly. In West Zalturbulak, the other prospect of the Central Zalturbulak, one vertical hole was drilled to the depth of 350 m, targeting superimposing Cu and Mo geochemical anomalies. In Akmola, four vertical holes(3 to the depth of 350 m, 1 to the depth of 288 m) were drilled, targeting Mo, Cu and Au geochemical anomalies. In addition, supplemental surface prospecting was also carried out for both exploration areas in order to collect samples for age dating and other purposes.

(1) Zalturbulak

1) Au-Cu Mineralization Related to Diorite Porphyry

This mineralization occurs in an Ordovician volcano-sedimentary rock distributing area in West Aktau and is characterized by concentrations of gold and copper. It is centered in the northern half of the main diorite body elongating in the N-S direction and extends northeastward along an assumed major fault. A typical occurrence comprises abundant pyrite in dissemination or in veinlets associated with quartz networks carrying disseminated chalcopyrite. The sequence of alteration-mineralization is interpreted as follows;

Stage-1: Regional propylitic alteration has taken place in the initial stage of hydrothermal activity accompanied by intrusion of the diorite porphyry.

Stage-2: The mineralization of Au-Cu type has been introduced in association with pyrite-quartz networks, which is considered to be the main mineralization stage. Characteristic ore minerals are pyrite, chalcopyrite, pyrrhotite and magnetite

accompanying minor electrum, molybdenite, cubanite and gersdorffite. The temperature of the hydrothermal solution in this stage is estimated at 300° C or higher judging from occurrences of some temperature indicative minerals. The outstanding Cu values are recorded at 1308 and 934 ppm for two drill core samples of 3m sections of MJTA-4. The highest Au value is recorded at 470 ppm for the same core sample that indicates the copper value of 1308 ppm.

Stage-3: Quartz-tourmaline alteration has been locally formed, accompanying Au and very weak Cu mineralization.

Stage-4: At the waning stage of hydrothermal activity, Au mineralization has been locally brought about in association with carbonitization. The records to date indicate Au concentrations in the order of several hundreds parts per billion.

The quartz-sericite alteration zone with distinct Cu and Au geochemical anomalies is outlined from the center (near MJTA-1) of the diorite porphyry body northward, while the alteration is generally weak southward without indicating any distinct geochemical anomalies either in copper or gold. The Au and Cu concentrations, though only to geochemical levels, in association with the quartz-sericite alteration are also intersected by MJTA-4 to the north of MJTA-1. The modes of occurrence of the mineralization and the alteration are similar to those associated with known porphyry style ore deposits. This type of mineralization-alteration has not been identified in the geologic province of Terktinsky Uplift, and attracts exploration geologists' attention. However, the data obtained to date has failed to suggest possible mineralization of any economic significance. In addition, the mineralization is confined in the area where Ordovician Series distributes. Therefore, the potential area is limited to the North Zalturbulak fault located some 400 m northeast of MJTA-4.

2) Cu-Mo Mineralization Related to Granite

A branch of hornblende-biotite granite (hereinafter called 'granite') stems out of its main body in the northwestern part of Zalturbulak and extends south southeastward. A geochemical concentration of copper and molybdenum was outlined in association with the branch of granite by the 2nd year's rock geochemical prospecting. Mineralization of copper, molybdenum and gold is intersected by the hole, MJTA-5, drilled in the center of the geochemical concentration. Similar mineralization is also observed in association with the granite in the hole, MJTA-3, drilled in West Aktau.

The mineralized zone is characterized by development of abundant quartz-pyrite networks and/or pyrite-chalcopyrite dissemination. A series of the different types of

mineralization has taken place in advancing order of Mo dissemination, Mo-Cu-Au quartz networks and Au-Ag-Cu-Pb-Zn quartz veins in West Zalturbulak, while the main mineralization stage of Mo-Cu- Au quartz networks has been followed by the Cu-Au type associated with chlorite-quartz veins in West Aktau. Several 10m-sections between 120 and 240 m of MJTA-3 indicate Cu contents of 500 ppm or higher. Comparing MJTA-3 and-5, Cu and Au values are generally higher in the former, and Mo values are higher in the latter. The mineralization in West Zalturbulak has been formed within a batholithic granodiorite-granite complex, while that in West Aktau, in the periphery of the complex, superimposing the preceding Au-Cu mineralization of late Devonian.

Fracture development is very poor in granitoids distributing in the general area. Intensity and extent of the porphyry style mineralization are primarily dependent on density of fractures and extent of their development. There will be, therefore, a little possibility for the mineralization of this category with any economic significance in size and grade in West Zalturbulak and West Aktau.

(2) Akmola

A number of quartz porphyry/dacite porphyry stocks, with sizes of about 500 m long and 200 m wide, intrude rhyolitic pyroclastics of Early Devonian and medium grained granite in the exploration area of Akmola. In association with the quartz porphyry/ dacite porphyry stocks, quartz-sericite and argillic alteration is extensively developed for an area of some 2300 m long in the east-west and 1600 m wide in the north-south, surrounded by propylitic alteration. An oxide zone is formed to the depth of 20 to 40m from the surface. Outcrops, where the mineralization is expected, are prominently stained with hematite forming networks, veinlets, speckles and dissemination, and are often shattered or brecciated.

Mineralization with an average grade of 0.045 % Mo is intersected for the 38.0 m section between 210 and 248 m of MJTA-9. The host rocks, comprising medium grained granite, are subjected to extremely intense silicification with dense development of quartz networks. The section above 210 m of MJTA-9 to the surface also contains 3 to 4 % of sulfides. The ore minerals consist of mainly pyrite, subordinate molybdenite and very minor chalcopyrite. Molybdenite occurs as fine euhedral crystals with the maximum size of 50 microns and is concentrated upto 2 to 3 volume % as observed under micro- scope. Mo values above and below the mineralized section are also significantly elevated to several tens ppm for appreciable intervals.

This mineralization is, judging from its close association with porphyritic intrusions and intense quartz sericite/argillic alteration, interpreted to be of a porphyry style.

Although the degree of Mo concentration is considered sub-economic at this stage, the drill holes to date are too scarce in number and too widely spaced to verify its economic significance.

(3) Mineral Potential for the Geologic Province of Terektinsky Uplift

The Au-Cu mineralization in West Aktau of Zalturbulak is accompanied by diorite porphyry intruding volcano-sedimentary complex of an island-arc type in Ordovician. There will be, however, a little possibility for this type of mineralization with any economic significance to be located in the Geologic Province of Terektinsky Uplift, because the distribution of Ordovician Series is very limited.

The Mo mineralization in Akmola is considered to have been formed in association with intrusions of quartz porphyry/dacite porphyry under a terrestrial environment in early Devonian. The northwestern part of Terektinsky Uplift includes some areas indicating similar geological environments as in Akmola; they are the eastern part of the Western Karamendin mineralization zone and the S3 mineralization zone where NE-SW trending fracture systems are well developed in terrain comprising relatively old formations. An area in the southeastern part, where terrestrial volcanics of early Devonian are extensively distributed, may be of some interest as well.

The porphyry style mineralization ordinarily accompanies extensive areas of distinctively zoned alteration. Accordingly, it is not too difficult to locate its indicators by surface prospecting. However, the 3 Year exploration has revealed no outstanding indication of mineralization of this type other than the above two exploration areas. It may be, therefore, concluded that the potential for the porphyry style mineralization in Terektinsky Uplift is low. Notwithstanding, a vast area is covered by steppe and may conceal ore deposits without any signature on the surface. Exploration for such vast steppe cover area will require considerably regional approaches including airborne geophysics.

5-2 Recommendation

The follow-up exploration is recommended for Akmola and Zalturbulak as follows;

1) Akmola

Drilling exploration with appropriate hole intervals in order to narrow the target of the Mo mineralization intersected by MJTA-9 and to assess its economic significance. A geophysical IP work may be effective to lay out a drilling pattern.

2) Zalturbulak

Drilling exploration to verify detailed characteristics, at depth, of the Au-Cu mineralization associated with the diorite porphyry body in West Aktau. Expectation for mineralization with economic significance may be low.