CHAPTER 3 SHYRALDZHYN AREA

3-1 Purpose and methods of survey

A detailed geological survey was conducted over an area of 12 square kilometers in Shyraldzhyn gold deposit extracted as a favorable prospective area from the compilation and analysis of the previous data on geology and mineral deposit of the phase I survey. The purpose of the survey is confirm the dimension of surface exposure of veins (width and elongation), the grade of ore and the dimension of alteration of country rocks.

A topographic map on a scale of 1/10,000 belonged to Goscomgeology is enlarged to a scale of 1/5,000 and is used as a base map for the survey. The survey was carried out using a surveying transit compass and/or clinocompasses, GPS and measuring tapes with a scale of 1/5,000. Geological observations are recorded on the field map. A closed measuring line was drawn around the main orebody vein, combined with making the relative position of each outcrop accurate. Camp for the survey was set up at the middle reaches of Kumyshtag river. Horse riding was used to go to the survey area.

Transporting road was constructed for the drilling survey in the Shyraldzhyn area from the northwestern side through Beisheke village and Manka-Blak river. Clearing previous road was completed on 14.22 km, and new road construction was completed on 10.11 km by bulldozers. Cutting works were drilled by compressed air drifters and exploded by ANFO. Base camp was set up at the uppermost reaches of Manka-Blak river. Location map of transporting road is shown in Fig.II-3-1.

3-2 Geology

This survey area is covered with the Sarydzhonskaya and Chatkaragaiskaya group and is intruded by Kumyshtag granite. They are overlain by Quaternary sediment. The Chatkaragaiskaya group is exposed in a small field in the southeast part of the area. The geological map and profile of this area are shown in Fig.II-3-2 and Fig.II-3-3, respectively.

3-3 Result of survey

3-3-1 Geological survey

Kumyshtag granite in Shyraldzhyn area is divided into medium-grained pink granite (γ Sdm), fine-grained pink granite (γ Sdf) and white granite porphyry (γ Sdp) by naked eyes. Medium-grained pink granite is the prominent rock facies

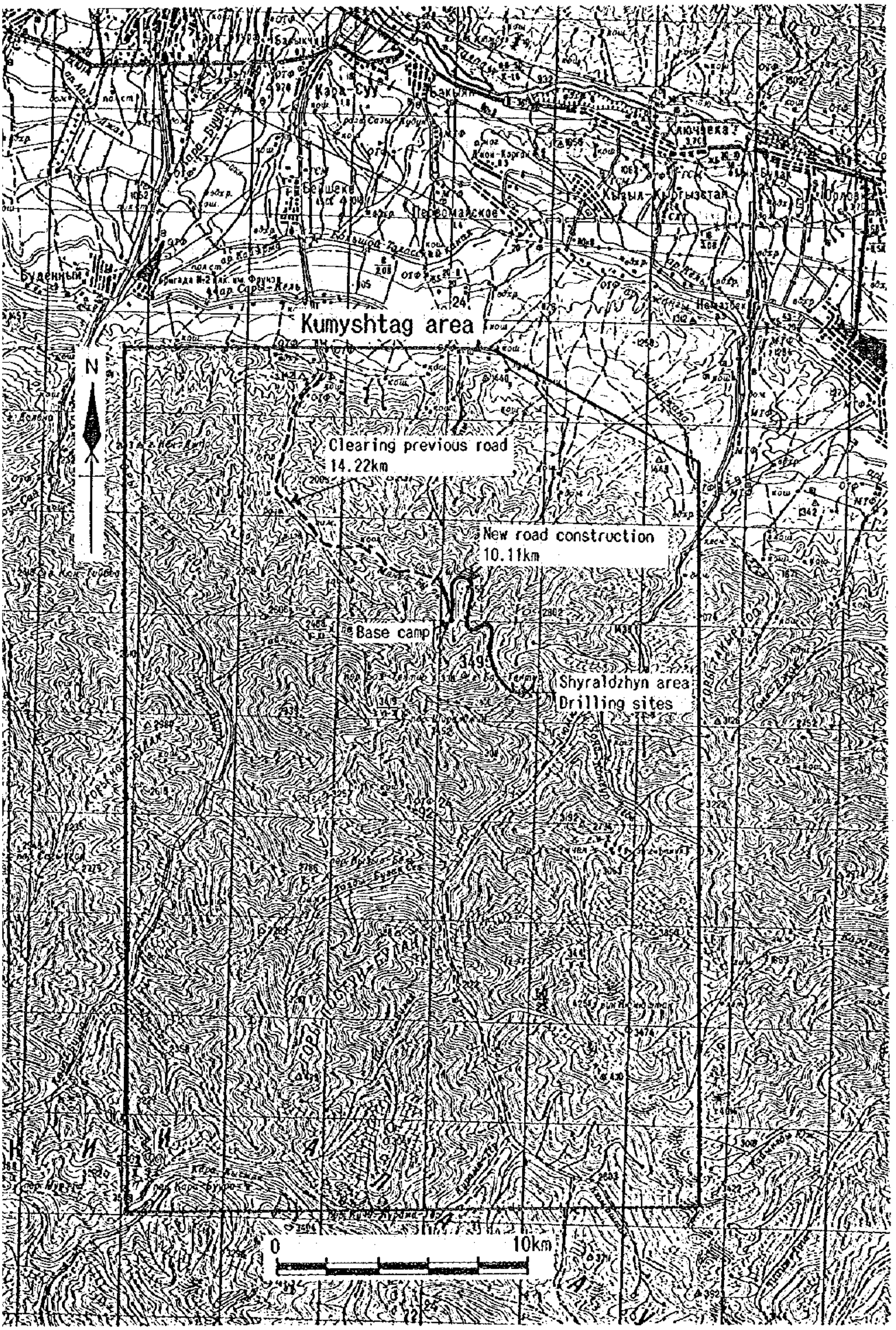


Fig.II-3-1 Location Map of Transporting Road for Drilling Sites in the Shyraldzhyn Area

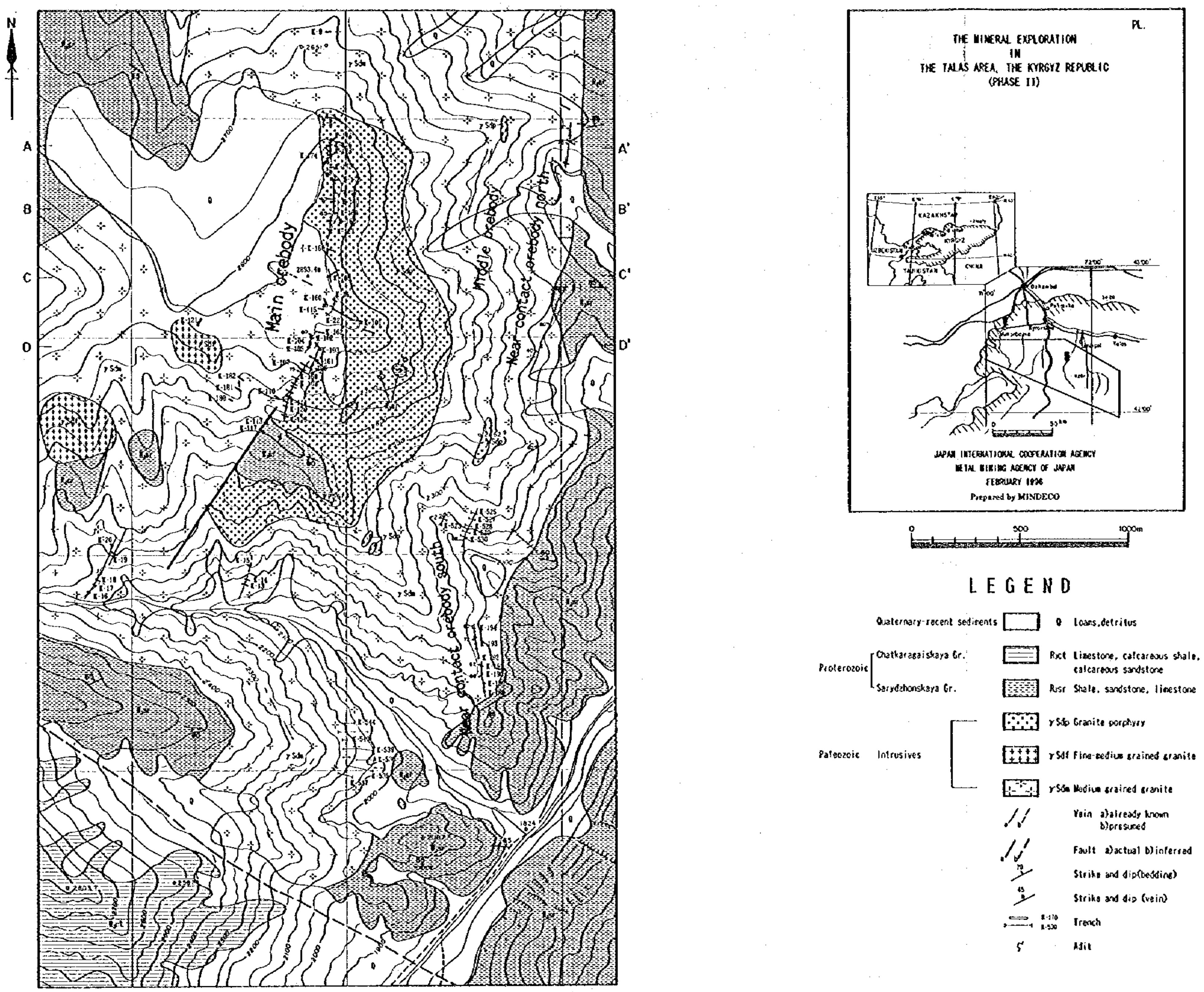
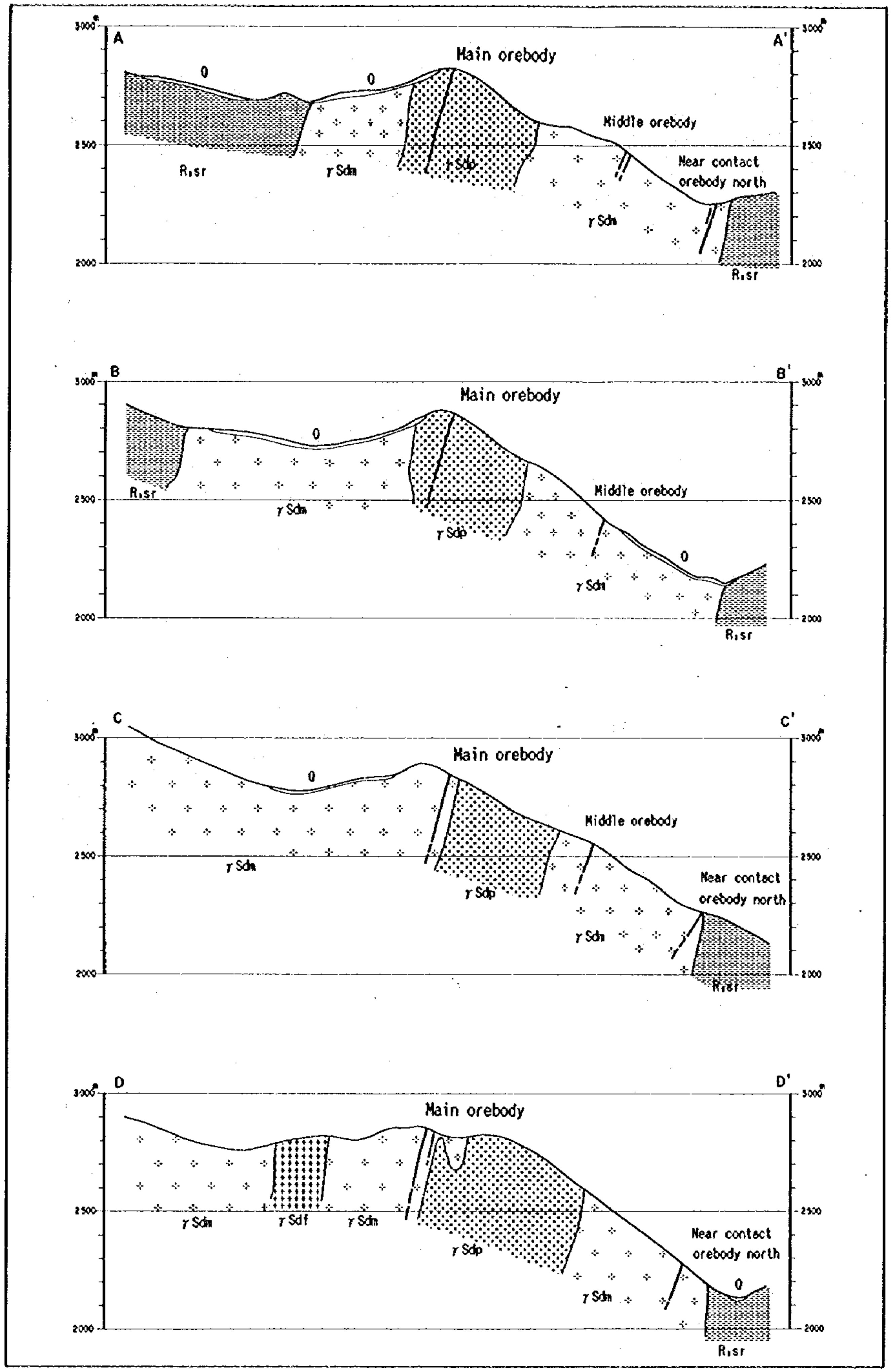
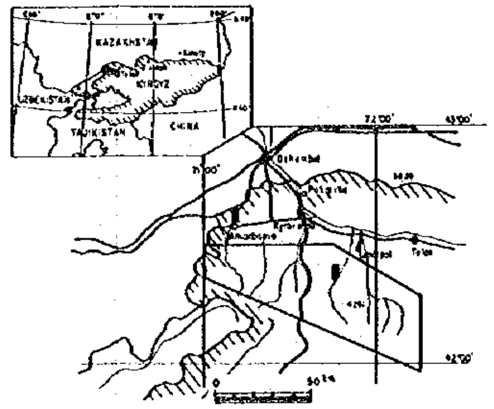


Fig. II-3-2 Geological Map of the Shyraldzhyn Area



PL.

THE MINERAL EXPLORATION
IN
THE TALAS AREA, THE KYRGYZ REPUBLIC
(PHASE II)



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FEBRUARY 1996
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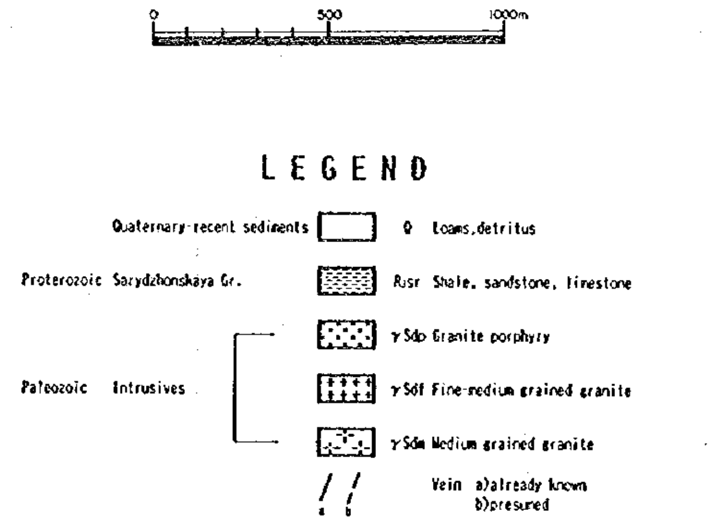

Fig. II-3-3 Geological Profile of the Shyraldzhyn Area

and is exposed broadly in this area. Under the microscope (Apx-2; 5KS41), it shows hypidiomorphic-grained and poikilitic texture and is composed mainly of microcline, quartz, plagioclase and biotite, with subordinate amounts of tourmaline, apatite and zircon. Fine-grained granite is exposed in a small field with about 300 m×300 m and about 200 m×200 m. Under the microscope (Apx-2; 5KS40), it shows hypidiomorphic-grained and poikilitic texture and consists mainly of microcline, quartz and plagioclase, with subordinate amounts of apatite and zircon. White granite porphyry is exposed in the central area forming crescent-shaped with 500 m in east and west and 1,000 m in south and north. It is strongly subjected to white alteration. Under the microscope (Apx-2; 5KS42), it shows porphyric, glomeroporphyric and hypidiomorphic-grained texture and phenocrysts are of microcline, quartz and plagioclase, with sphene, zircon, apatite and biotite.

The Sarydzhonskaya group composed of hornfels and silicified shale occurs in the eastern and southern part and covers partly granite. The relation between the granite and the Sarydzhonskaya group in the eastern area was described to be in fault contact in the phase I report. Existence of shear zone or formation of mylonite that prove existence of a fault, are not observed in this survey. Sandstone and shale near the granite are changed to hornfels. They proves to be subjected to contact metamorphism. Therefore, this report assumes that the Sarydzhonskaya group is intruded by the granite. But, possibility that fault would be formed by intrusion can not negate, because boundary between the granite and the sedimentary rock represents linear structure of the direction of south and north.

3-3-2 Mineralization

Shyraldzhyn gold deposit is situated in Kumyshtag granite in the area, and consists of manganous siderite vein and quartz vein. Outcrop of vein in this deposit is shown in PL. 12. So far total four veins composed of main orebody, middle orebody, near contact orebody north and near contact orebody south, have been found by the investigation of Goscomgeology.

The main orebody is exposed about 100 m to the east of the highest peak with altitude of 2,893 m. The width of main vein ranges from 0.6 to 3.7 m with extension of 1,400 m along strike of vein. It strikes N10°E and dips 35°to 48°W at the outcrops on the ridge. On the slope of mountain, it dips 75°W.

The near contact orebody north is located at 1,000m to the east of main orebody. It occurs in granite near boundary of the Sarydzhonskaya group and partly occurs in hornfels of the Sarydzhonskaya group. The vein crops out 200 m and 400 m in length and ranges from 0.4 to 0.8 m in width. It strike N5°E to N20°E and dips 40° to 80°W.

The near contact orebody south is located about 1 km to the south of near contact orebody north. It separates into two outcrops of 200 m and 300 m in length. The vein ranges from 0.3 to 0.75 m in width. It strikes N5°E to N20°E and dips 50° to 82°W.

Sketches of trench at the main orebody are presented in Fig.II-3-4, and a sketch of an adit at the near contact orebody north is presented in Fig.II-3-5. Manganous siderite vein and quartz vein occur in pale greenish white colored greisen. Occasionally the vein borders greisen with white clay zone ranging from 0.1 to 0.3 m in width at both sides of hanging and foot wall, respectively. Greisen grade into non-altered granite through weak greisen altered granite.

The ore from manganous siderite and quartz veins have assayed. The result of assay are given in Apx-6. Assay of the main vein showing the most prominent mineralization ranges from 1.0 to 19.6 g/t of gold, from 1 to 6.6 g/t of silver, from 0.28 to 2.6 % of copper. Assay of the near contact orebody south ranges from 1.8 to 28.4 g/t of gold, from 1 to 3.6 g/t of silver, from 0.18 to 3.4 % of copper. Assay of the near contact orebody north ranges from 0.6 to 9.7 g/t of gold, from 0.3 to 3.2 g/t of silver, from 0.06 to 2.6 % of copper. A lot of arsenic assay are less than 0.1 %, though highest assay is 0.42 % in arsenic. Therefore this deposit has a sign of predominant gold mineralization.

Under the microscope (Apx-4), ore is composed mainly of goethite, pyrolusite and cryptomelane, as accessories psilomelane, chalcophanite, pyrite, chalcopyrite, malachite and azurite. Gold occurs in quartz, chalcopyrite, sometimes in goethite mass. Gold forms small crystals of isometric, sometimes elongated, drop-shaped. Size of gold crystal ranges from 0.003 to 0.015 mm.

Apx-8 is presented homogenization temperature of fluid inclusion in quartz from quartz, manganous siderite vein in this deposit. Size of fluid inclusion is extremely small and less than 20 μ m. Only inclusions inferred to be primary inclusion on the basis of occurrence, were selected to measure temperature, though many pseudo-secondary inclusions were observed. As host crystal were collected four specimens of quartz from the main vein and two specimens from the near contact orebody south. Measured homogenization temperature of six specimens ranges from 310°C to 120°C, and centers ranging from 210°C to 130°C. Average homogenization temperature of each specimen centers ranging from 180°C to 150°C in the main vein, centers ranging from 220°C to 180°C in the near contact south

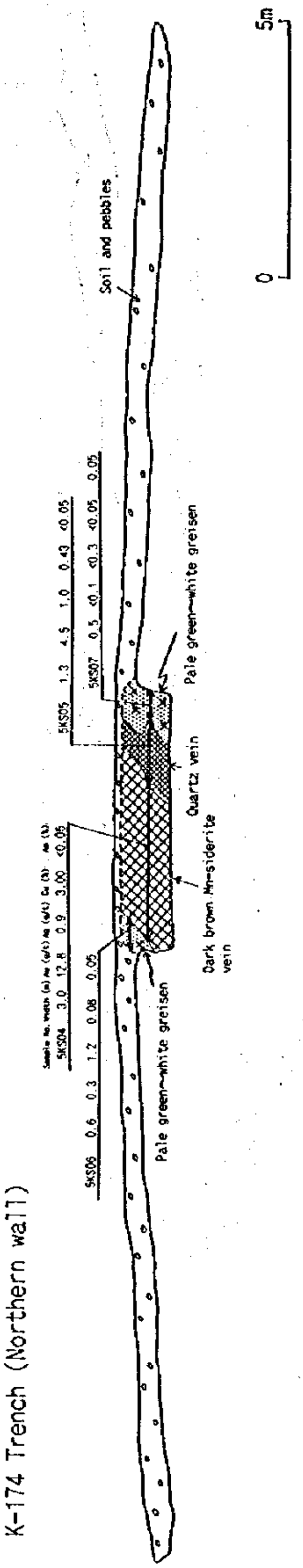

Fig. II-3-4 Geological Sketches of the Trenches in the Shyraldzhyn Deposit (1)

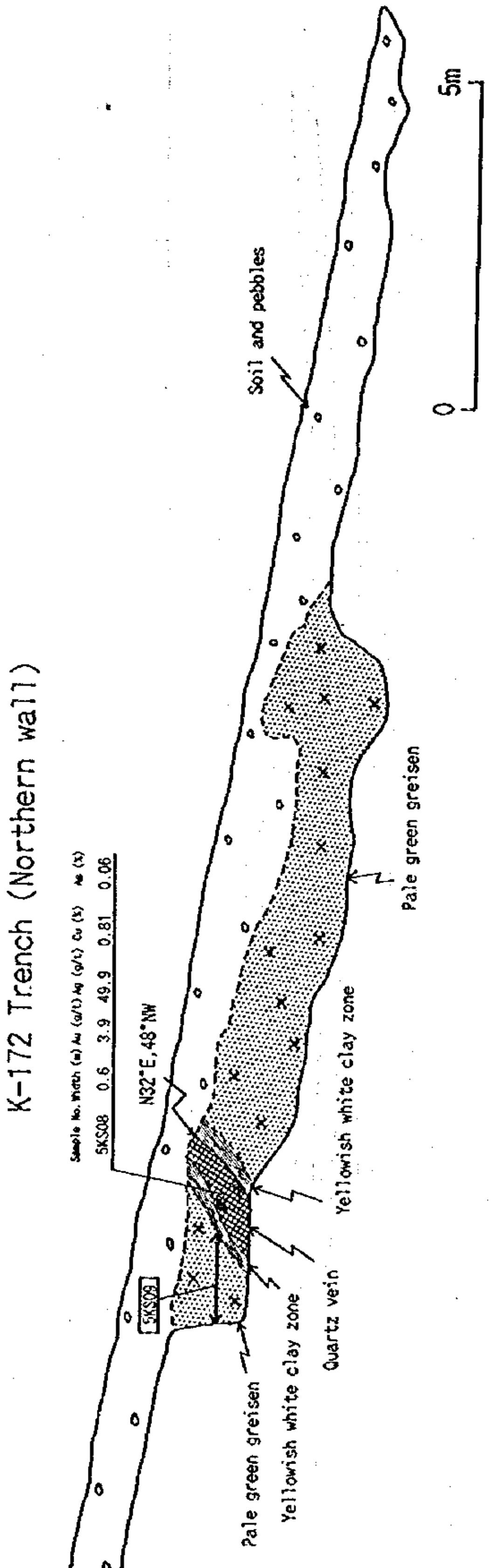

Fig. II-3-4 Geological Sketches of the Trenches in the Shyraldzhyn Deposit (2)

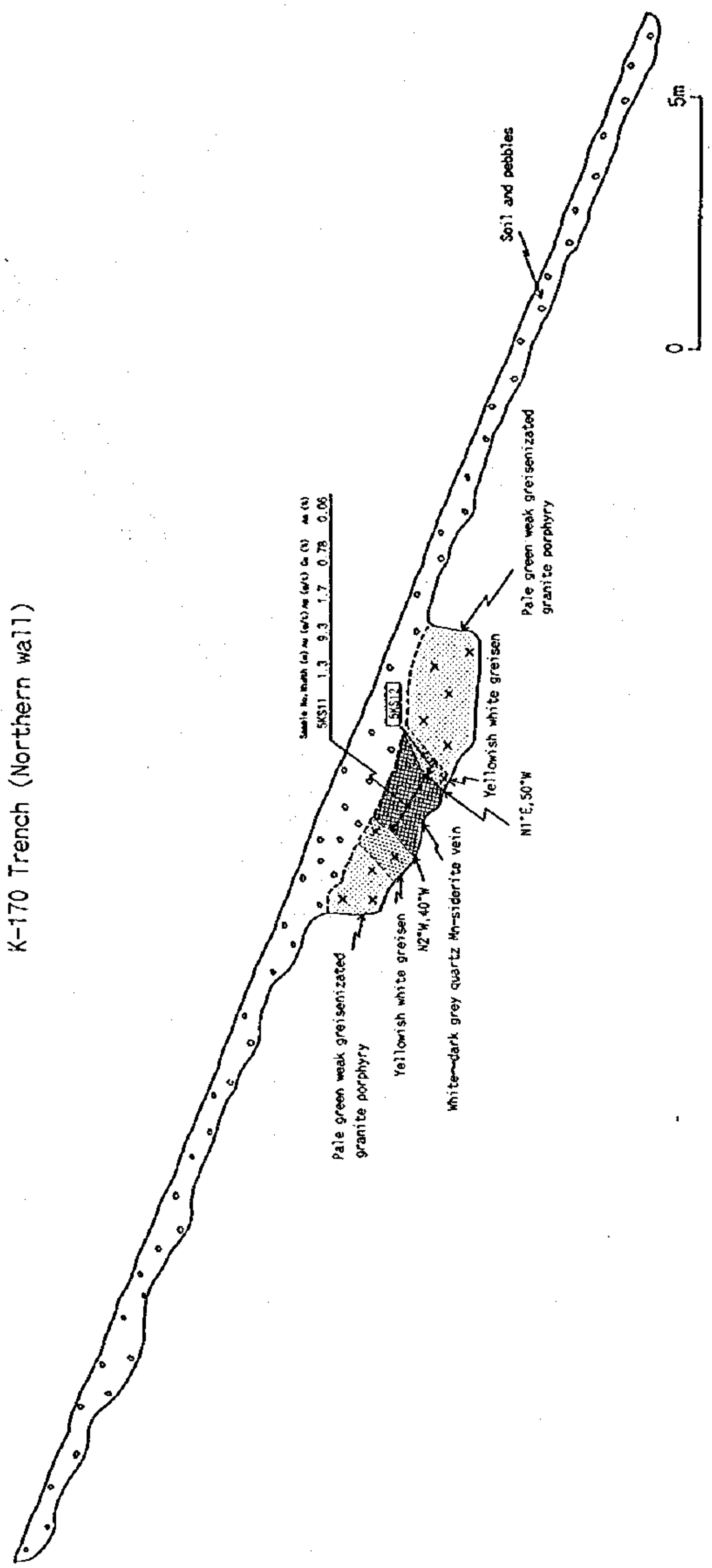

Fig. II-3-4　Geological Sketches of the Trenches in the Shyraldzhyn Deposit (3)

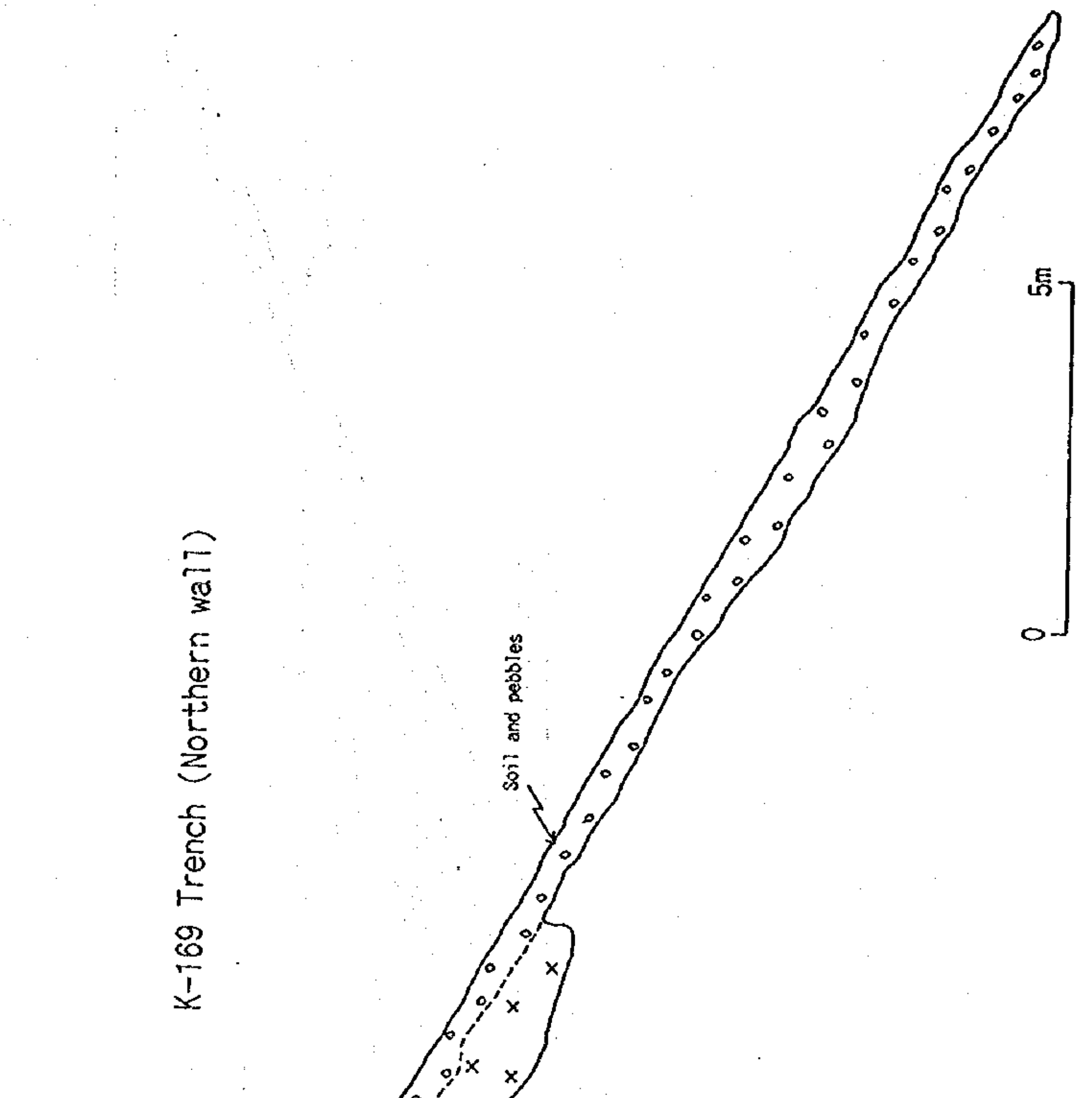

Fig. II-3-4 Geological Sketches of the Trenches in the Shyraldzhyn Deposit (4)

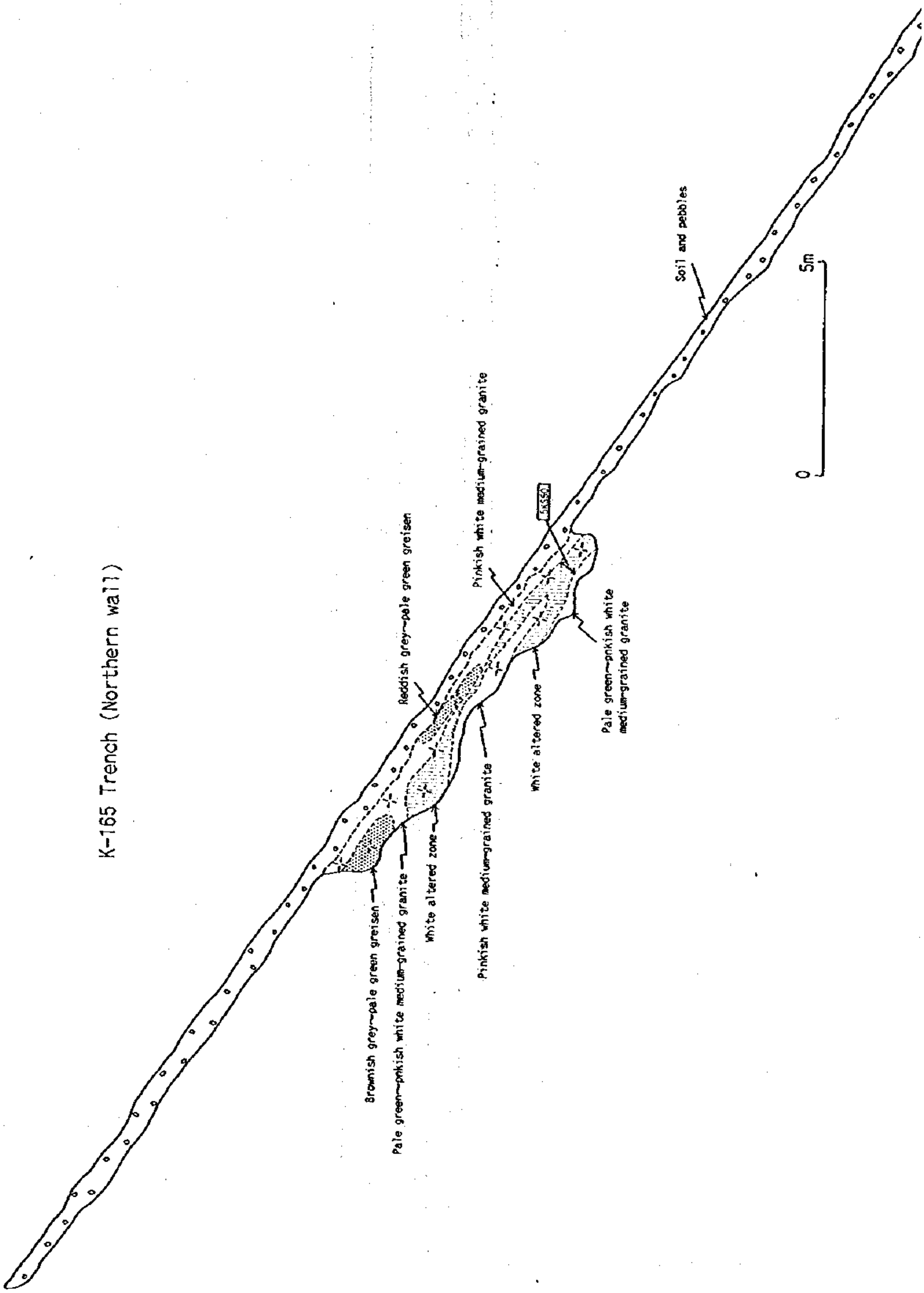

Fig. II-3-4 Geological Sketches of the Trenches in the Shyraldzhyn Deposit (5)

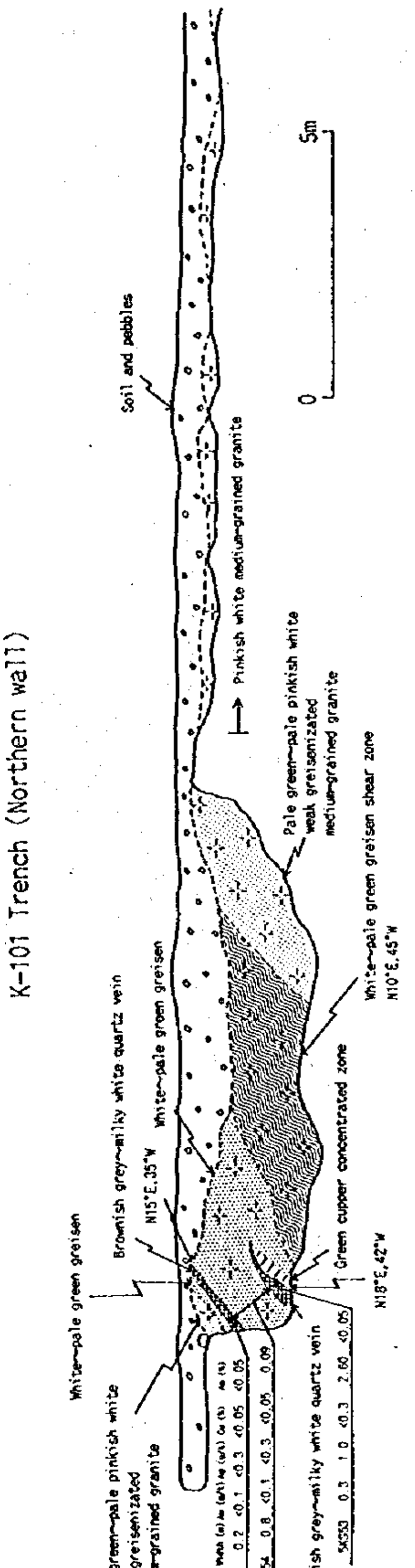

Fig. II-3-4 Geological Sketches of the Trenches in the Shyraldzhyn Deposit (6)

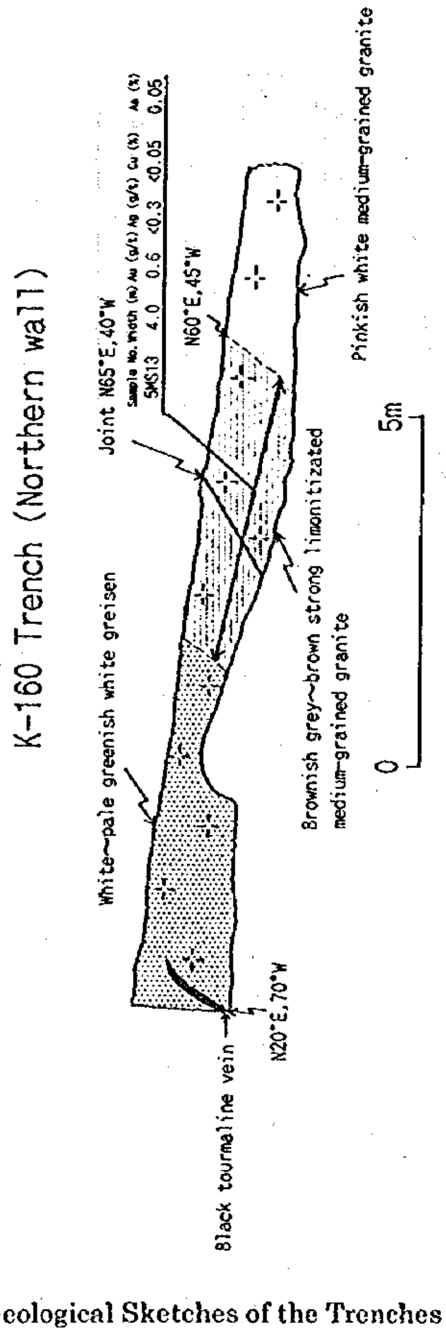

Fig. II-3-4 Geological Sketches of the Trenches in the Shyraldzhyn Deposit (7)

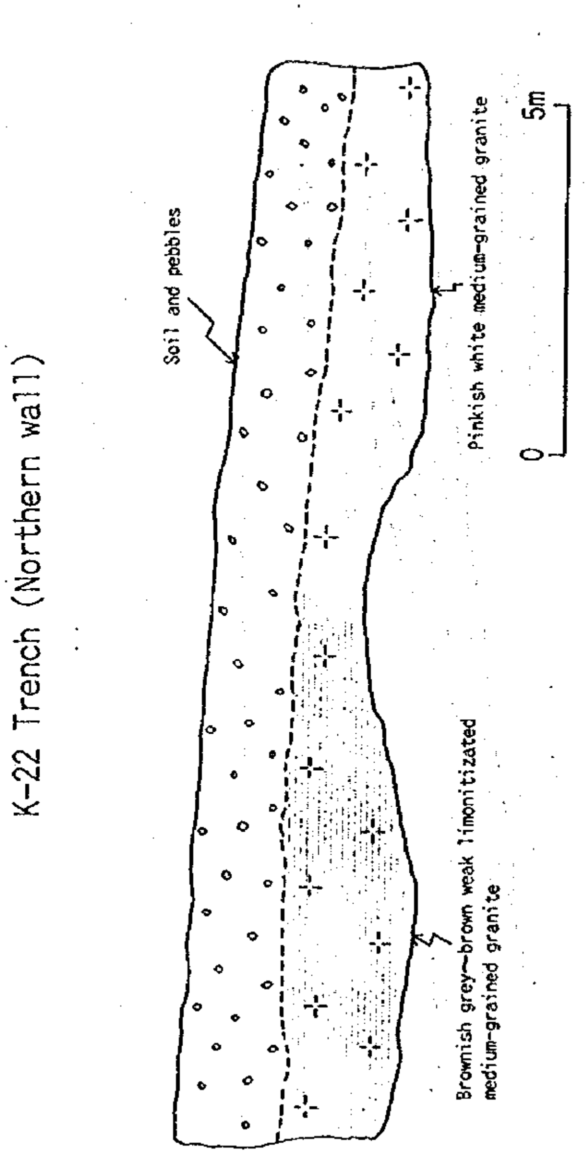

Fig.II-3-4 Geological Sketches of the Trenches in the Shyraldzhyn Deposit (8)

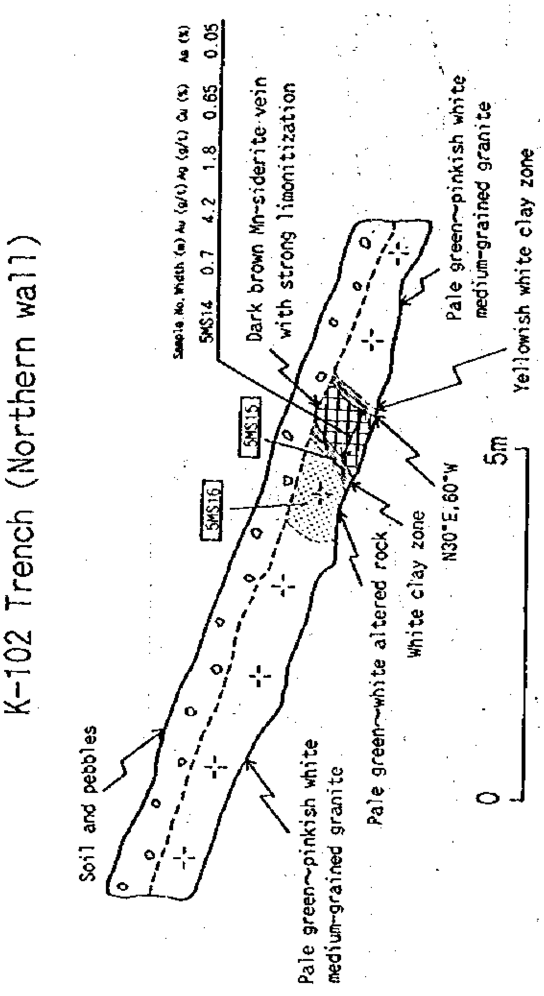

Fig. II-3-4 Geological Sketches of the Trenches in the Shyraldzhyn Deposit (9)

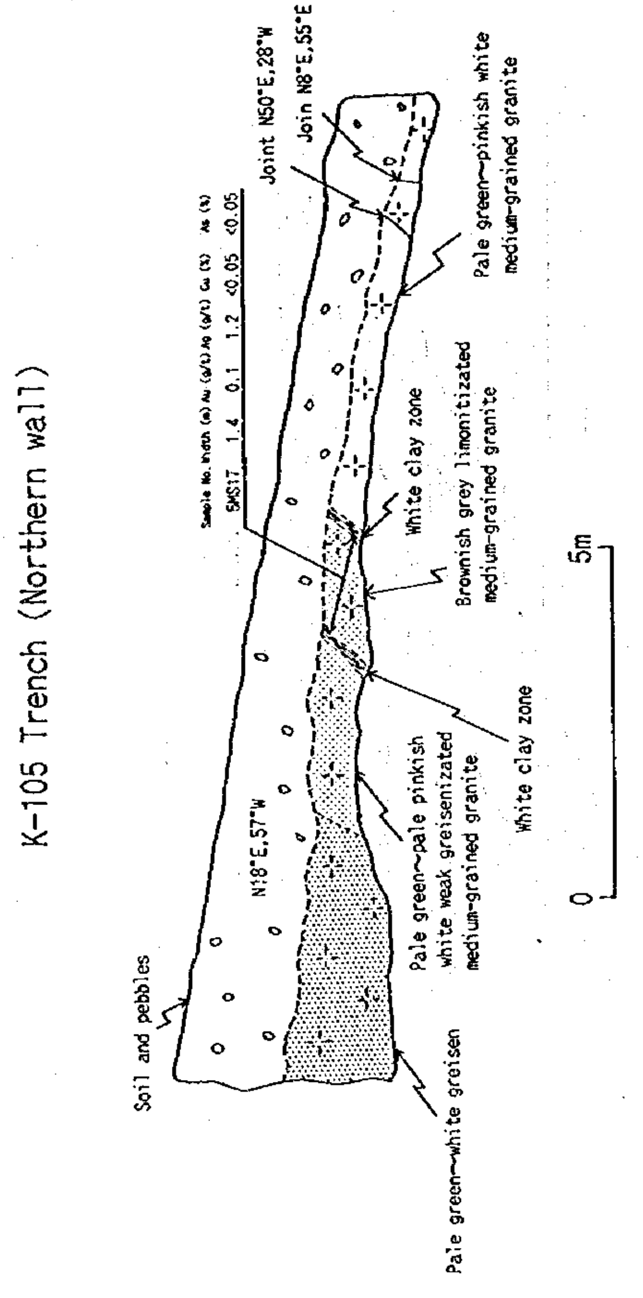

Fig. II-3-4 Geological Sketches of the Trenches in the Shyraldzhyn Deposit (10)

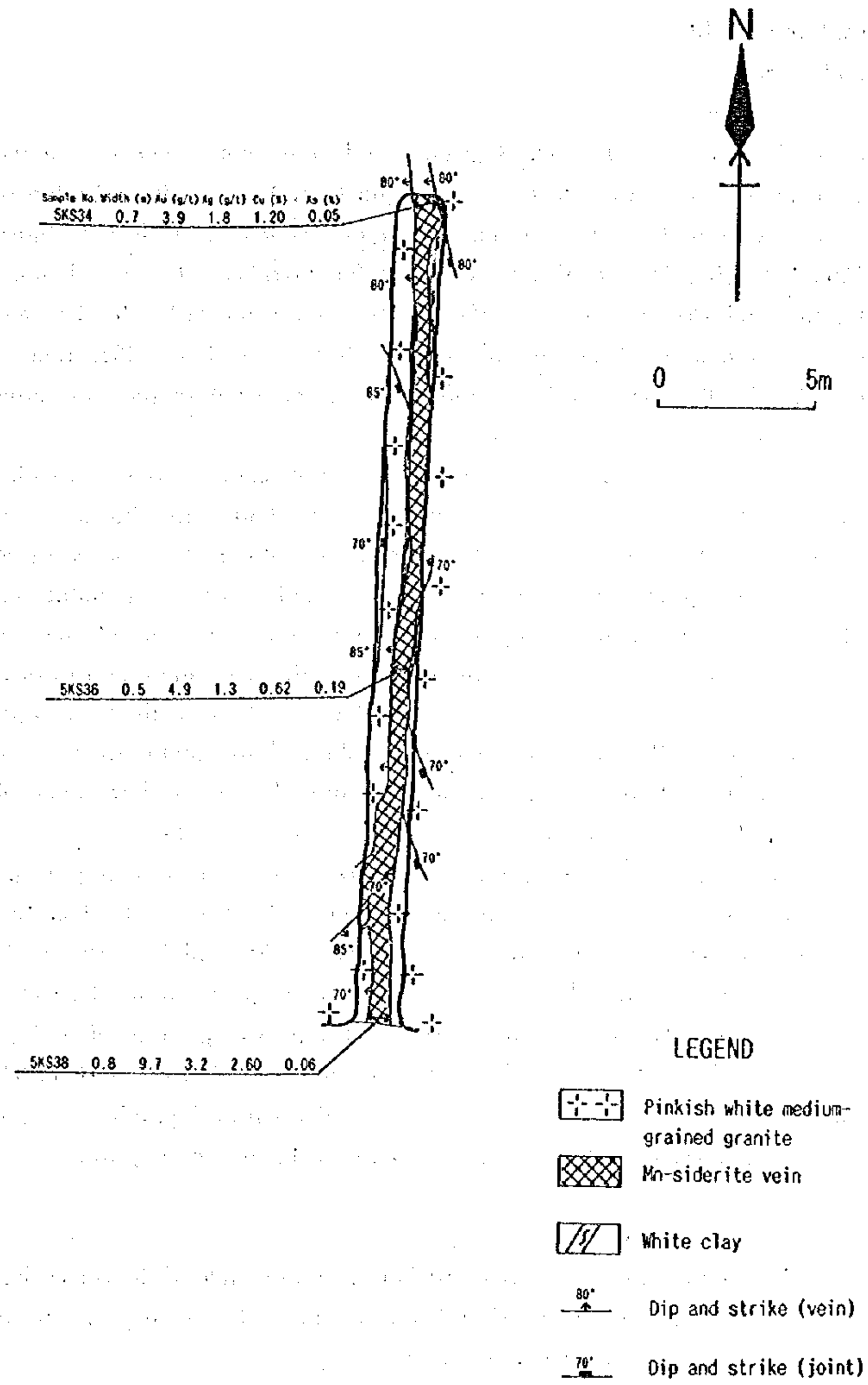

Fig. II-3-5 Geological Sketch of the Adit in the Shyraldzhyn Deposit vein. The latter is 40°C to 30°C higher than the former. Coexistence of gaseous and liquid inclusion proving a boiling phenomenon is not observed. Polyphase inclusion containing halite and sylvite is not observed in quartz from veins, granite porphyry and granite.

This deposit is characterized by greisen ranging from 1 to 5 m in width, which occurs between country rock of granite and manganous siderite vein including quartz vein. Greisen consists mainly of quartz and muscovite and often remains equigranular texture of the original rock in naked eyes. Under the microscope (Apx-2; 5KS07, 5KS09, 5KS19), it shows lepidogranoblastic and glomeroblastic texture, and is composed mainly of quartz and muscovite with subordinate amount of carbonate mineral, zircon, sphene and thorite. By X-ray diffraction analysis (Apx-9; 5KS07, 5KS09, 5KS19), plagioclase is detected as remnant mineral of country rock.

Plagioclase altering to potassium feldspar is recognized in country rock around the deposit by microscopic observation (Apx-2; 5KS40). X-ray diffraction analysis detects a great deal of potassium feldspar and sericite in white clayey altered rock collected vein side (Apx-9; 5KS50, 5MS11, 5MS16). Thus horizontal zoning of alteration is distinct in this deposit, and divide into potassium feldspar · sericite zone and quartz · sericite · potassium feldspar zone from vein to country rock.

Kaolinite representing acidic altered zone is detected by X-ray diffraction analysis (Apx-9; 5KS43) in altered granite collected from 300 m to the east of the main vein. This altered granite are 10 m × 10 m in dimension, shows pale yellowish white in color and separate distinctly from non-altered granite.

For an isotopic age determination, muscovite is collected from greisen of vein side exposed in the northern part of the main vein. The result of absolute age determination by K-Ar method represents 412±21 Ma and 397±20 Ma (Apx-10). Average age is calculated to 405±21 Ma. It corresponds to late Silurian (S_2) to early Devonian (D_1). This is same dating as Kumyshtag granite, which have been dated as 406±14 Ma by absolute age determination of U-Pb method. This fact indicate that mineralization chained to greisenization in Shyraldzhyn deposit had been taken place at the latest stage of formation of Kumyshtag granite

3-4 Consideration

This survey area is covered with hornfels and shale of the Sarydzhonskaya and Chatkaragaiskaya group of Riphean system, and is intruded by Kumyshtag granite of late Silurian to early Devonian.

Shyraldzhyn gold deposit consists of four veins, and each vein is composed of manganous siderite vein and quartz vein in Kumyshtag granite. The vein trends north-northeast, and the prominent joints in granite trends north-south. Thus occurrence and place of ore deposition presumes to be related to the formation of shear joint which have been developed during cooling process of granitic intrusion.

The vein dips 75°W at the slope to the southern extension, though it dips 35° to 48°W at outcrop on the ridge of the main vein. According to three dimensional distributions of vein, true dipping is assumed to be steep angle of 70° to 80°. The gentle dipping on the ridge is respected that topographic tops would be moved to deform by creep.

In a general view of assay, the gold to silver ratio is (2~5) to 1 in Shyraldzhyn deposit. It assays high in gold. The fact indicates that this deposit has a sign of predominant gold mineralization. Secondary copper oxide minerals such a malachite and azurite occur in the outcrops of vein. The outcrops would be situated in oxidation zone.

In general of vein, ore-forming fluid being reduction and high temperature had mixed with ground water being oxidation and low temperature near ground water level. The mixture had resulted in changes of temperature, pH and oxidation and reduction condition. Finally gold deposit had been formed by the deposition of gold (Hedenquist and Henly, 1984). The nearest headstream in Shyraldzhyn deposit is situated on about 1 km to the northwest of the peak. It is an altitude of 2,600 m. The above interpretation presumes that ground water level beneath the vein would be an altitude of 2,700 to 2,600 m.

A favorable temperature where gold precipitates from hydrothermal water, is different from individual deposit. In general, homogenization temperature of fluid inclusion from economical gold vein-type deposit represents ranging from 300°C to 200°C (Roedder, 1984). Average homogenization temperature of quartz from outcrops of Shyraldzhyn deposit centers ranging from 180°C to 150°C in the main vein, centers ranging from 220°C to 180°C in the near contact south vein. The latter is 40°C to 30°C higher than the former. The location of specimens from the main vein is an altitude of 2,850 m. That of the near contact south vein is an altitude of 2,150 m. Relative elevation is 700 m. In general, homogenization temperature grade high in lower and inner part of vein. The occurrence of veins suggest that these veins have been taken place by same sort of mineralization at same stage. Consequently, average homogenization temperature of quartz from outcrops in the main vein centers ranging from 180°C to 150°C, reveals lower temperature compared with the above mentioned favorable temperature for gold deposition. These facts suggest that high concentrate gold ore could exist in the downward extension of the vein.

In general, alteration of gold-bearing quartz vein is characterized by potassium feldspar alteration of plagioclase or by addition of potassium feldspar and sericite. Altered zone of potassium feldspar and sericite recognized along the outcrop of these veins proves that ore deposit has the worthy condition for gold deposition.

The results of absolute age measurement by K-Ar method of muscovite produced by greisenization shows 405±21 Ma, which corresponds to late Silurian to early Devonian. This is same dating as Kumyshtag granite showing 406±14 Ma by U-Pb method.

Consequently, the formation process of Shyraldzhyn gold deposit infers as follows:

When Kumyshtag granitic magma rose rapidly to shallow underground from deeper place, the outer margin of magma was cooled and resulted in forming fine rock facies in outer margin. High temperature gas (more than 400°C) separated from magma concentrated in upper part of magma reservoir. The high temperature gas being stable in chemical equilibrium when it separated from magma, could not be stable in equilibrium with crystallized minerals. It migrated and diffused along the structural weakness such as fault and shear fracture. At last it formed greisen composed of quartz and muscovite along fractures by pneumatolytic metasomatism. After forming greisen, hydrothermal water less than 300°C concentrating metal, rose along fractures again as ore pass, was filled with fractures under the most favorable temperature and pressure, and finally form gold-bearing vein.

PART Ⅲ

CONCLUSION AND RECOMMENDATION

CHAPTER 1 CONCLUSION

The survey area is located in the western edge of the Northern Tien-Shan massif. Basement rock of this area is Riphean system of Proterozoic era which was folded in Baikalian stage, is covered with Vendian system, Paleozoic group and Cenozoic group unconformably. The area is bordered on the Middle Tien-Shan massif by the Talas-Fergansky fault in the southern edge of the area. Riphean system consists of the Uzunahmatskaya group, the Sarydzhonskaya group, the Chatkaragaiskaya group, and the Kyzylbelskaya formation. The Uzunahmatskaya group is composed mainly of carbonate rock of limestone and dolomite and clastic rock of phyllite, sandstone and shale, the Sarydzhonskaya group is composed mostly of sandstone, shale and siltstone, the Chatkaragaiskaya group is composed of carbonate rock including clastic rock, and the Kyzylbelskaya formation is characterized by red, purple and green siltstone. Vendian system consists of conglomerate, sandstone and siltstone including tillite. Cambrian-Ordovician system is predominant in limestone and dolomite.

This area is intruded by Kumyshtag and Babahan batholith. The prominent facies of Kumyshtag batholith is potassium feldspar-rich medium-grained pink granite. The result of absolute age measurement analyzed by U-Pb method represents 406±14 Ma, which corresponds to late Silurian to early Devonian. The predominant facies of Babahan batholith is light gray to yellowish orange medium-grained tonalite. The result of absolute age measurement analyzed by U-Pb method represents 1,050±50 Ma, which corresponds to middle to late Riphean.

The result of satellite image lineament analysis in the phase I survey, had clearly extracted the principal faults such as Talas-Fergansky fault, Uzunahmat-Kumyshtagsky thrust fault and Dzholsay fault. The faults had presumed to be related to mineral deposits. The result of this field survey also interpreted that Kumyshtag silver deposit, Uchimchek arsenic deposit and Dzholsay silver deposit occur confining along the west-northwest trending faults, the east-west faults and their subordinate faults, or geological discontinuity.

Ground truth was performed to check the anomalous zones delineated from the satellite image spectral analysis in upper reaches of Taldyblak river, a branch of Kumyshtag river. The anomalous zones corresponded to limonite disseminated schist in Uzunahmat group of Riphean series. Ground truth revealed that diagenesis alteration instead of hydrothermal alteration had produced the anomalous zones.

Although Kumyshtag deposit is composed of large-scale silver-bearing manganous siderite veins, gold mineralization is poor and it corresponds to the result of geochemical survey. In Babahan area, geochemical silver anomaly was extracted on the Dzholsay fault near Kuru-Bakair silver deposit. Geochemical small anomaly and small-scale silver deposits presumes that a large-scale ore deposit would not be expected near the surface.

The most economical deposit could be Shyraldzhyn gold deposit from the viewpoint of scale and grade of deposits in this area. Shyraldzhyn deposit is composed of manganous siderite veins and quartz veins in Kumyshtag granite of late Silurian to early Devonian. The deposit consists of four veins paralleled to each other, striking N 10°E with dipping 70° to 80°W. The width of main orebody ranges from 0.6 to 3.7 m with extension of 1,500 m along strike. Gold grade ranges from 1.0 to 19.6 g/t and average gold grade is 8.6 g/t. As ratio of gold to silver is (2~5) to 1, the deposit has undergone prominent gold mineralization. Goscomgeology has calculated ore reserves of Shyraldzhyn deposit on trench survey. The prognostic P1 category reserves are 1,740 thousand tones of crude ore, 5 g/t of average gold grade, 8.1 tones of gold. P2 category reserves are 8 tones of gold. Totally 16 tones of gold with 5 g/t of average gold grade are estimated. Homogenization temperature of fluid inclusions in quartz collected from trenches was measured. Average homogenization temperatures in quartz ranges from 180°C to 150°C. This temperature is lower than temperature ranging from 300°C to 200°C, that is most favorable temperature for gold mineralization of vein-type deposit. The above mentioned interpretation suggests that gold concentration could exist in the downward extension of the vein. Potassium feldspar and sericite produced by hydrothermal alteration are partly detected along vein and around country rock in this deposit. These altered zone prove that ore deposit has the worthy condition for gold deposition. Outcrops of veins belong to oxidation zone and primary reduction zone could exist in the downward extension. High grade of gold ore is produced by changes of oxidation-reduction condition near ground water level beneath deposit. Ground water level around the deposit presumes to be situated in the elevation ranging from 2,700 to 2,600 m (150 to 200 m beneath the surface), according to the location and elevation of the nearest headstream. Consequently, drilling survey will be expected to catch a favorable gold mineralization in the downward of vein in Shyraldzhyn deposit.

CHAPTER 2 RECOMMENDATION FOR THE PHASE III SURVEY

Shyraldzhyn gold deposit found out by Goscomgeology in the survey area, has been confirmed the mineralization and alteration, the scale and grade of vein on surface by the detailed geological survey. Consequently, the above information suggest that high grade gold ore could exist in the downward extension of the vein.

Based upon the results of the phase II survey, the following positive exploration is recommended to be carried out in the phase III survey.

Drilling survey will be conducted to clarify directly the downward extension of vein and the gold mineralization in Shyraldzhyn deposit.

Comprehension of occurrence and circumstances of whole deposit, will be performed to result in evaluation of ore reserve.

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APPENDICES

APPENDIX. -1

List of Rock and Ore Samples

Apx.-1 List of Rock and Ore Samples (1)

No.	Sample No.	Locality	Rock name	T	P	C	X	D	F	Remarks
1	5KS01	Shyraldzhyn deposit	Mn-siderite vein			○				3.2m K-175
2	5KS02	Shyraldzhyn deposit	Altered granite			○	○			0.5m K-175
3	5KS04	Shyraldzhyn deposit	Mn-siderite vein			○				3.0m K-174
4	5KS05	Shyraldzhyn deposit	Quartz vein			○				1.3m K-174
5	5KS06	Shyraldzhyn deposit	Muscovite-quartz rock			○	○			0.6m K-174
6	5KS07	Shyraldzhyn deposit	Muscovite-quartz rock	○		○	○	○		0.5m K-174
7	5KS08	Shyraldzhyn deposit	Quartz vein		○	○			○	0.6m K-172
8	5KS09	Shyraldzhyn deposit	Muscovite-quartz rock	○			○	○		1.6m K-172
9	5KS11	Shyraldzhyn deposit	Quartz Mn-siderite vein		○	○			○	1.3m K-170
10	5KS12	Shyraldzhyn deposit	Muscovite-quartz rock				○			0.4m K-170
11	5KS13	Shyraldzhyn deposit	Mn-siderite vein			○				0.2m K-169
12	5KS18	Shyraldzhyn deposit	Sheared altered granite			○				0.6m
13	5KS19	Shyraldzhyn deposit	Muscovite-quartz rock	○	○	○	○			6.4m
14	5KS22	Shyraldzhyn deposit	Quartz vein with Mn-siderite			○			○	1.5m K-106
15	5KS23	Shyraldzhyn deposit	Mn-siderite vein			○				2.0m K-106
16	5KS24	Shyraldzhyn deposit	Mn-siderite vein			○				3.7m K-107
17	5KS25	Shyraldzhyn deposit	Mn-siderite vein			○				1.2m K-102
18	5KS27	Shyraldzhyn deposit	Mn-siderite vein		○	○				2.5m
19	5KS28	Shyraldzhyn deposit	Sheared Mn-siderite ore			○				1.1m
20	5KS29	Shyraldzhyn deposit	Sheared granite with muscovite			○				1.0m K-120
21	5KS30	Shyraldzhyn deposit	Sheared quartz vein			○				1.0m K-120
22	5KS31	Shyraldzhyn deposit	Sheared granite			○				1.0m K-120
23	5KS34	Shyraldzhyn deposit	Mn-siderite vein			○				0.7m adit
24	5KS36	Shyraldzhyn deposit	Mn-siderite vein		○	○				0.5m adit
25	5KS38	Shyraldzhyn deposit	Mn-siderite vein			○				0.8m adit
26	5KS39	Shyraldzhyn deposit	Mn-siderite vein		○	○				0.4m
27	5KS40	Shyraldzhyn deposit	Fine-grained granite	○						
28	5KS41	Shyraldzhyn deposit	Medium-grained granite	○						
29	5KS42	Shyraldzhyn deposit	Granite porphyry	○						
30	5KS43	Shyraldzhyn deposit	Altered granite				○			

T:Thin section P:Polished section C:Chemical analysis X:X-ray diffraction analysis

D:Dating F:Homogenization temperature messurement of fluid inclusion

Apx.-1 List of Rock and Ore Samples (2)

No.	Sample No.	Locality	Rock name	T	P	C	X	D	F	Remarks
31	5KS44	Shyraldzhyn deposit	Mn-siderite vein			○				1.2m B-5
32	5KS45	Shyraldzhyn deposit	Mn-siderite vein		○	○				1.0m B-4
33	5KS46	Shyraldzhyn deposit	Mn-siderite vein			○				0.3m B-3
34	5KS48	Shyraldzhyn deposit	Mn-siderite vein		○	○				2.0m B-1
35	5KS50	Shyraldzhyn deposit	White altered rock				○			0.5m K-165
36	5KS52	Shyraldzhyn deposit	Quartz vein			○				0.2m K-101
37	5KS53	Shyraldzhyn deposit	Quartz vein		○	○			○	0.3m K-101
38	5KS54	Shyraldzhyn deposit	Muscovite-quartz rock			○				0.8m K-101
39	5MS01	Shyraldzhyn deposit	Mn-siderite vein with green copper			○				0.7m K-188
40	5MS02	Shyraldzhyn deposit	Altered granite				○			K-188
41	5MS03	Shyraldzhyn deposit	Altered rock				○			adit
42	5MS05	Shyraldzhyn deposit	Quartz Mn-siderite vein			○				0.3m K-190
43	5MS06	Shyraldzhyn deposit	Quartz vein		○	○			○	0.4m K-191
44	5MS08	Shyraldzhyn deposit	Altered rock				○			K-191
45	5MS09	Shyraldzhyn deposit	Mn-siderite vein			○				0.3m
46	5MS10	Shyraldzhyn deposit	Quartz vein with Mn-siderite			○			○	0.3m K-194
47	5MS11	Shyraldzhyn deposit	Clay vein with green copper			○	○			0.3m K-530
48	5MS12	Shyraldzhyn deposit	Mn-siderite vein			○				0.3m K-528
49	5MS13	Shyraldzhyn deposit	Limonitizated granite			○				4.0m K-160
50	5MS14	Shyraldzhyn deposit	Mn-siderite vein			○				0.7m K-102
51	5MS15	Shyraldzhyn deposit	White clay				○			0.3m K-102
52	5MS16	Shyraldzhyn deposit	White altered rock				○			K-102
53	5MS17	Shyraldzhyn deposit	Limonitizated granite			○				1.4m K-105
54	5KK14	Kumyshtag	Limestone/hornfels skarn gossan		○	○				2.0m
55	5KK18	Kumyshtag	Hornfels gossan			○				6.0m
56	5KK21	Kumyshtag	Quartz vein			○				0.1m
57	5KK23	Manka-Bulak	Quartz vein			○				0.1m
58	5KK26	Chetyn	Altered granite				○			
59	5KK29	Chetyn	Medium-grained granite	○						
60	5KK41	Cheten deposit	Granite porphyry	○		○				1.0m

T:Thin section P:Polished section C:Chemical analysis X:X-ray diffraction analysis

D:Dating F:Homogenization temperature messurement of fluid inclusion

Apx.-1 List of Rock and Ore Samples (3)

No.	Sample No.	Locality	Rock name	T	P	C	X	D	F	Remarks
61	5KK54	Uchimcheck deposit	Altered limestone/shale			○	○			1.0m
62	5KK55	Uchimcheck deposit	Arsenopyrite ore		○	○				waste
63	5KK56	Kumyshtag deposit	Arsenopyrite-pyrite ore		○	○				waste
64	5KK57	Kumyshtag deposit	Arsenopyrite ore		○					waste
65	5KK60	Uzuntashty deposit	Quartz vein			○				0.8m
66	5KK62	Uzuntashty deposit	Vesuvianite-pyroxene-garnet skarn	○						pit
67	5KK64	Uzuntashty deposit	Magnetite ore		○					pit
68	5KK65	Uzuntashty deposit	Fluorite vein			○	○		○	0.8m pit
69	5KK66	Uzuntashty	Quartz vein			○				15.0m
70	5KK68	Shyraldzhyn	Aplite vein				○			
71	5MK02	Taldybulak	Sandstone schist	○						
72	5YK02	Tuktuarcha deposit	Quartz vein		○	○			○	0.3m adit
73	5YK03	Tuktuarcha deposit	Quartz vein			○				0.2m adit
74	5KB05	Babahan	Medium-grained tonalite	○						
75	5KB16	Kuru-Bakair deposit	Manganese gossan		○	○				2.0m
76	5KB18	Kuru-Bakair deposit	Altered shale				○			
77	5KB19	Kuru-Bakair deposit	Quartz vein			○				0.3m
78	5KB20	Babahan deposit	Quartz vein			○			○	0.1m adit
79	5KB24	Babahan deposit	Sphalerite ore		○					waste
80	5KB25	Dzholsay deposit	Mn-siderite vein		○	○				0.7m
81	5KB26	Dzholsay deposit	Mn-siderite vein			○				1.5m
82	5KB27	Dzholsay deposit	Altered shale/sandstone				○			
83	5KB28	Dzholsay deposit	Mn-siderite ore		○	○			○	waste
84	5YB04	Stock deposit	Quartz vein						○	

T:Thin section P:Polished section C:Chemical analysis X:X-ray diffraction analysis

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APPENDIX. -2

Result of Microscopic Observations of Thin Sections

Apx.-2 Result of Microscopic Observation of Thin Sections

No.	Sample No.	Locality	Rock name	Primary minerals: Quartz	Plagioclase	K-feldspar	Biotite	Muscovite	Amphibole	Tourmaline	Apatite	Zircon	Sphene	Fluorite	Secondary minerals: Quartz	Albite	Muscovite	Diopside	Garnet	Epidote	Amphibole	Scapolite	Chlorite	Fluorite	Vesuvianite	Calcite	Malachite	Azurite	Thorite	Magnetite	Pyrite	Limonite
1	5KS07	Shyraldzhyn deposit	Muscovite-quartz rock (Greisen)				(△)					·	·		◎		○							·		△			·	·	·	
2	5KS09	Shyraldzhyn deposit	Muscovite-quartz rock (Greisen)				(△)					·	·		◎		○										·	·	△			
3	5KS19	Shyraldzhyn deposit	Muscovite-quartz rock (Greisen)				·					·	·		◎		○										·	·	·			·
4	5KS40	Shyraldzhyn deposit	Fine-grained granite	◎	○	○					·	·					·															
5	5KS41	Shyraldzhyn deposit	Medium-grained granite	◎	△	○	△	·		·	·	·					·						·									
6	5KS42	Shyraldzhyn deposit	Granite porphyry	○	○	○	△	·			·	·	·				·															
7	5KK29	Chetyn	Medium-grained granite	○	○	○	△				·	·		·			·						·									
8	5KK41	Cheten deposit	Granite porphyry	○	○	○	△				·	·																				
9	5KK62	Uzuntashty deposit	Vesuvianite-pyroxene-garnet skarn												·	·		○	○	○	△	·		△	△	△						
10	5MX02	Taldybulak	Sandstone schist	◎	○	○				·		·					△						△			△						
11	5KB05	Babahan	Medium-grained tonalite	○	◎	△	△		·		·	·	·				·			·												

◎:Abundant(+50%) ○:Common(50-20%) △:Poor(20-5%) ·:Rare(-5%) ( ):Pseudomorph

Description of Microscopic Observation of Thin Section

1. THIN SECTION 5KS07

Rock name: Muscovite - quartz rock (Greisen).

Structure: Lepidogranoblastic, glomeroblastic.

Texture: Massive, mottled.

Composition: Quartz 55-60%, muscovite 30-35%, carbonate 5%, ore minerals pyrite, magnetite) 1-2%, fluorite - isolated signs, zircon - isolated signs, thorite - isolated sings.

The rock consists of quartz and muscovite in considerable amounts. Quartz is observed in a shape of grains of irregular, equidimensional form, with meandering, sometimes polygonal boundaries. Quartz marks up lenticular accumulations, veinlets. Grain sizes are within 0.3 mm 1.0 mm. Quartz contains inclusions of muscovite and ore minerals scales.

Muscovite is represented by isolated scales of 0.3 mm - 5.0 mm size. These scales are pseudomorphs over biotite of the primary rock. The bulk of muscovite forms accumulations of gray-yellowish scales in the rock, which are of random orientation, sometimes crowding in rosettes. These aggregates appear to have substituted for feldspathose grains of the primary rock. Hightened hydrous ferric oxide content is confined to the same areas making them rusty-brown colored, which determines mottled texture of the sample.

Carbonate occurs in a shape of isolated grains and insignificant concentrations among quartz-muscovite aggregates.

Fluorite is found as fine monometric violet-colored grains of 0.02 mm - 0.03 mm size, which are confined to muscovite aggregate.

Accessory minerals: zircon, sphene, thorite, observed as fine (0.03 mm - 0.05 mm) idiomorphic grains in muscovite and quartz.

2. THIN SECTION 5KS09

Rock name: Muscovite - quartz rock (Greisen).

Structure: Lepidogranoblastic, glomeroblastic, sutured.

Texture: Massive, mottled.

Composition: Quartz 55-60%, muscovite 40%, ore minerals - isolated signs, zircon - isolated signs, sphene - isolated signs, malachite, azurite 1-2%.

The rock consists of more or less equidimensional quartz grains of 0.2 mm - 2.0 mm size, observed as both isolated grains and accumulations.

Coalescence border-lines are straight and flexuous. Quartz grains contain inclusions of fine scales of muscovite and ore minerals. Muscovite makes up near-monomineral glomeroblastic accumulations of fine grains in the rock which are of random orientation, rarely grouping in rosettes. Sizes of scales composing these areas vary from 0.02 mm to 0.2 mm. Besides those, there are isolated muscovite scales of up 1.0 mm size observed in the rock, which are pseudomorphs over biotite of the primary rock. Ore mineral (magnetite, hematite) is distinct at the cleavage planes. Muscovite color is gray-greenish yellow. Muscovite areas often acquire irregularly mottled, rusty-brown color, owing to limonitized sulphides and other minerals.

Accessory minerals are represented by thorite, sphene, zircon in a shape of idiomorphic grains of 0.05 mm -0.15 mm size. Among quartz-muscovite aggregates, thin-aggregated 0.1 mm - 0.5 mm separations, with rugged margins and permeative boundaries of green, blue color are found; those are malachite and azurite.

3. THIN SECTION 5KS19

Rock name: Muscovite - quartz rock (Greisen).

Structure:. Glomeroblastic, lepidogranoblastic, sutured.

Texture: Massive, mottled.

Composition: Quartz 55-60%, muscovite 35-40%, malachite, azurite 1%, limonite 1%, biotite - isolated signs, thorite, zircon, sphene - isolated grains.

The rock consists of more or less monometric quartz grains with even and castellated facets, of 0.3 mm to 1.5 mm size. Quartz contains numerous muscovite inclusions and isolated biotite ones.

Muscovite is observed as separate scales, pseudomorphically replacing biotite and accompanied by ore mineral show at cleavage planes, and also forms accumulations of fine grains of random orientation in the rock. These accumulations have rectangular outlines, which may be indicative of their replacement of feldspars. Hightened hydrous ferric oxide content is confined to these areas, giving them rusty-brown color and causing the mottled texture of the rock.

Accessory minerals are represented by fine (0.05 mm - 0.1 mm) idiomorphic grains of thorite, zircon, sphene, which are confined to biotite, muscovite. Pleochroic haloes are observed around thorite in biotite. At the background of quartz-muscovite aggregates, various fine (0.1 mm - 0.5 mm) blue and green colored areas composed by malachite and azurite are distinguished.

4. THIN SECTION 5KS40

Rock name: Fine-grained granite.

Megascopic description: Pink-colored dense rock.

Structure: Hypidiomorphic-grained, poikilitic.

Texture: Massive

Composition: Microline 40%, quartz 30-35%, plagioclase 20-25%, sericite + muscovite app. 1%, zircon - isolated signs, apatite - isolated signs, ore mineral - isolated sign.

Common potash feldspar is represented by microcline, chesterlite in a shape of tabular grains of pink, meat-like red color, of 0.5 mm - 2.0 mm size. It forms coalescence with all minerals of the rock. The coalescence boundaries are straight, step-like, flexuous. Potash feldspar is strongly corroded by quartz, albite.

Plagioclase are represented by oligoclase and albite in a shape of elongated-prismatic grains of 0.2 mm - 1.0 mm size. Metasomatic albite has a wide-spread occurrence, being developed over potash feldspar, substituting for it as spots, strips, up to formation of the complete pseudomorphs.

These are two kinds of quartz: magmatic quartz has a xenomorphic shape of 0.3 mm - 1.0 mm size, corroding the minerals separated earlier; metasomatic quartz occurs as isolated grains, nests in the rock, of up to 3.0 mm size. It contains numerous inclusions of microline and other minerals.

Muscovite, sericite are developed in a shape of small accumulations at the boundary of quartz and feldspar.

Accessory minerals are represented by zircon, apatite fine (0.05 mm - 0.1 mm) idiomorphic grains, found in quartz.

5. THIN SECTION 5KS41

Rock name: Medium-grained granite.

Megascopic description: Pink-colored dense holocrystalline rock.

Structure: Hypidiomorphic-grained, poikilitic.

Texture: Massive

Composition: Quartz app. 35%, microcline app. 40%, plagioclase app. 20%, biotite app. 5%, muscovite, sericite, apatite, zircon, ore minerals, chlorite, tourmaline.

Common potash feldspars are represented by chesterlite and microcline in a shape of irregular tabular grains of 1.0 mm - 3.0 mm size. Potash feldspar is intensively pelitized and albitized. Strong pelitization is irregularly distributed in a shape of spots and strips. Chesterlite and microcline grains are of pink, meat-like red, brown color. Potash feldspars contains biotite, muscovite, ore mineral inclusions.

Plagioclase are represented by two varieties: oligoclase and albite in a shape of elongated-prismatic grains of 0.5 mm - 2.0 mm size. Oligoclase is insignificantly pelitized, sericitized. Sericite is observed in a range from isolated scales to the considerable amounts. Metasomatic albite is abundant in the sample, being confined mainly to microcline as numerous replacement perthites, rims of potash-feldspathose grains.

Quartz is represented by xenomorphic grains of 0.5 mm - 3.0 mm size, contains inclusions of ore minerals, tourmaline, zircon, muscovite.

Biotite occurs in s shape of idiomorphic brown-colored plates of 0.3 mm - 2.0 mm size, partly substituted at the margins by chlorite. Some scales are replaced by muscovite with intensity from initial stages up to formation of the complete pseudomorphs.

Accessory minerals are fine (0.1 mm - 0.2 mm) idiomorphic grains of apatite, zircon, found in quartz, biotite.

6. THIN SECTION 5KS42

Rock name: Granite porphyry.

Structure: Hypidiomorphic-grained, glomeroporphyric, porphyric.
Texture: Massive.
Composition: Microcline, chesterlite, plagioclase, quartz, biotite, muscovite, sphene, zircon, apatite.

Porphyric separations (10%) are represented by microcline prisms, quartz and also by aggregates of feldspathose grains. Porphyric separation amounts are 2.0 % - 3.0 %.

Rock parenchyma tissue is made up by plagioclase, microcline, quartz, biotite, muscovite. Parenchyma grain sizes are within 0.2 mm - 0.5 mm, in rare cases reaching 1.0 mm.

Common potash feldspar is represented by microcline in a shape of tabular grains with ragged boundaries due to their corrosion by quartz and other minerals.

Potash feldspar is strongly pelitized and albitized. Plagioclase is represented by oligoclase and albite, occurring as prismatic grains replaced by sericite at a variable degree. Metasomatic albite is widespread, being confined to microcline as replacement perthites as well as fringes and rims around potash-feldspathose and oligoclase crystals. Quartz is observed in a shape of xenomorphic grains of 0.2 mm - 0.5 mm size.

Biotite is almost completely substituted by muscovite, with relics remaining as dark-brown inclusions in muscovite, parallel to cleavage planes.

Accessory minerals are represented by fine idiomorphic grains of sphene, zircon, apatite in quartz and biotite.

7. THIN SECTION 5KK29

Rock name: Medium-grained granite.
Megascopic description: Pink-colored dense holocrystalline rock.
Structure: Hypidiomorphic-grained, poikilitic.
Texture: Massive.
Composition: Microcline 40%, plagioclase 20%, quartz 30-35%, biotite 5%, chlorite, sericite, apatite, zircon, fluorite, ore minerals.

Common potash feldspar is represented by microcline and chesterlite in a shape of irregular tabular-formed grained of 1 mm - 5 mm size. It makes up coalescence with all minerals, composing the rock. The coalescence boundaries are straight, step-like, flexuous. Its color is meat-like red, pink because of a considerable pelitization. Potash feldspar contains inclusions of muscovite, quartz, plagioclase, biotite and ore minerals

Plagioclase is represented by oligoclase and albite in a shape of elongated-prismatic grains of 0.3 mm - 2.0 mm size. Their color is white, gray-white. Oligoclase is insignificantly sericitized. Albite is metasomatic, occurring as replacement perthites in microcline and also as isolated grains, rims around potash-feldspathose and oligoclase crystals.

Quartz is represented by xenomorphic grains, often corroding the minerals separated earlier, such as potash feldspar, plagioclase and biotite. Grain sizes are within 0.3 mm - 2.0 mm range.

Biotite is observed as isolated scales of 0.2 mm - 0.5 mm size, being partly substituted by chlorite and muscovite.

There are 0.2 mm - 2.0 mm fluorite grains found in the rock, which occur interstitially between grains of plagioclase, potash feldspar, biotite, and corrode them.

Accessory minerals are represented by fine idiomorphic grains of zircon and apatite, confined to biotite and feldspar.

8. THIN SECTION 5KK41

Rock name: Granite porphyry.

Structure: Porphyric, glomeroporphyric, with hypidiomorphic-grained bulk.

Texture: Massive.

Composition: Microcline, plagioclase, quartz, biotite, zircon, apatite, ore mineral.

Porphyric separations (50%) are represented by quartz, microcline, plagioclase, biotite of 1.5 mm - 2.0 mm size. Quartz has no limitations, contains numerous feldspathose inclusions. Biotite scales contain fine inclusions of feldspar and quartz.

Rock parenchyma tissue (50%) is holocrystalline, consisting of the same minerals as the porphyric separations. Parenchyma grain sizes are 0.1 mm - 0.3 mm.

Plagioclase is the most idiomorphic. Biotite has meandering outlines, due to a significant corrosion by the minerals separated later.

9. THIN SECTION 5KK62

Rock name: Vesuvianite-pyroxene-garnet skarn.

Megascopic description: Brownish-green dense rock. At the background of the fine-grained white-gray parenchyma tissue, spots of 3 mm - 20 mm size, composed by garnet, fluorite, vesuvianite and others, are distinguished.

Structure: Glomeroblastic, nematoblastic, poikiloblastic.

Texture: Mottled

Composition: Garnet, fluorite, vesuvianite, pyroxene, amphibole, epidote, carbonate, feldspar, scapolite, quartz, magnetite.

The rock is a skarn of a complex composition, characterized by a mass development of epidote, amphiboles, chlorite, quartz, fluorite, calcite, additionally to the essential skarn minerals (garnet, pyroxene, vesuvianite and others). Presence of the mineral associations, different in their composition, is indicative of the mineralization having taken place in a wide temperature interval.

Pyroxene is one of the earliest skarn minerals. It occurs in a shape of columnar crystals, sometimes forming sheaf-like aggregates. Grain sizes vary within the range from 0.n mm up to 3.0 mm. Its hue is from achromatic to grayish-green. By the optical constants, it corresponds to diopside. Pyroxene is replaced by the later minerals, such as epidote, calcite, quartz, colorless amphibole. The replacement can be observed in different intensities: from the initial stages at the grain margins and cleavage planes up to formation of the complete pseudomorphs.

Garnet has a wide-spread occurrence in the sample. There are two varieties of it to be marked out. The first is dense fine-grained garnet, with grain size of 0.0n mm to

0.n mm, makes up separations of elliptic, elongated form. The larger well-bounded crystals occur in cavities. Garnet color is brown, anomalous, with sector extinction. The garnet is substituted by later minerals, such as calcite, chlorite, quartz and magnetite.

Vesuvianite occurs in a shape of round-columnar individuals of 1.0 mm - 2.0 mm size and contains numerous inclusions of carbonates, pyroxene, amphibole and epidote. Some vesuvianite grains form close coalescence with garnet, which shows their almost simultaneous formation.

Epidote is abundant in the rock. It has been separating over a long period of time. Only small part of it was separating at the same time as pyroxene, garnet, forming corresponding intergrowth. As to its bulk, it is a product of replacement of garnet, vesuvianite, pyroxene, composing isolated grain accumulations of irregular form and sometimes considerable monomineral aggregates. Epidote is, in its turn, replaced by chlorite, quartz and calcite.

Amphibole is represented by its achromatic variety developed over pyroxene, and also by uralite hornblende with grain sizes of 0.1 mm to 0.3 mm. Amphiboles are partly substituted by chlorite and carbonate.

Fluorite is widespread in the sample (app. 10 %) and is represented by well-bounded crystals of sizes variable within the limits of 0.1 mm - 2.0 mm. Fluorite is colorless or irregularly colored in violet tints. It is found in a shape of isolated grains, small accumulations in vesuvianite, garnet, pyroxene, carbonate. Coalescence border-lines are straight.

Carbonate is of a wide-spread occurrence in the rock. There are areas totally composed by fine-grained calcite, which is a parenchyma tissue for the subsequent development of skarn minerals such as pyroxene, garnet, vesuvianite - relics of the near-contact rocks. Later on, calcite is being formed over a long period of time as a product of replacement of pyroxene, garnet, vesuvianite, epidote, etc. The latest, crystalline calcite fills up cavities and joints in the rock.

Scapolite is found in insignificant quantities (less than 5%). It is observed as tabular crystals with uneven margins, of 1.0 mm - 2.0 mm size. Scapolite is replaced by epidote, calcite, albite; contains fluorite grains.

10. THIN SECTION 5MK02

Rock name: Sandstone schist.

Megascopic description: Gray dense rock with rusty-brown spots.
Spot sizes are 1 mm - 3 mm. Spot form is elliptic, monometric.

Structure: Siltypsammitic, lepidogranoblastic.

Texture: Mottled, foliated, flaser.

Composition: Quartz, common potash feldspar, plagioclase, carbonate, sericite, muscovite, ore minerals, zircon, tourmaline.

The rock is shown being formed in two stage. Primary rock is silty-sandstone. Its detrital part is composed by quartz, common potash feldspar, plagioclase, carbonate, ore mineral, isolated grains of tourmaline, zircon. Grain size in the detrital part makes up 0.05 mm - 0.3 mm. Debris form is angular, monometric, elliptic, tabular, often with ragged margins. Cement type is porous.

As a result of cataclasis, development of foliated texture as well as structure transformation through blastic deformation took place. Owing to the cement and also to the detrital part of the rock, sericite aggregate, grouping in interrupted partings, was formed. Fragmental relics, oriented parallel to foliation of the rock, have remained of the primary minerals (quartz, feldspars, carbonates). Here there, thin fringes of sericite are developed around debris, due to which the texture acquires flaser character.

Rock mottling is caused by the presence of monometric aggregate separations, composed by quartz, feldspars and hydrous ferric oxides.

11. THIN SECTION 5KB05

Rock name: Medium-grained tonalite.

Megascopic description: Light-gray colored dense rock.

Structure: Hypidiomorphic-grained, glomeroblastic.

Texture: Massive.

Composition: Plagioclase 60%, quartz 25%, biotite 10%, common potash feldspar 5%, amphibole 1%, epidote, sericite, zircon, apatite, sphene.

Plagioclase is represented by andesine in a shape of short-prismatic, tabular grains with prevailing size of 1 mm - 2 mm. Plagioclase has a zonal structure. It is slightly replaced by sericite, pelitic matter, with them being irregularly distributed - by growth zones. Fringe-zones are pure, while inner zones are substituted by secondary minerals. Plagioclase makes up coalescence with all rock minerals. Coalescence boundaries are straight, step-like, flexuous.

Quartz occurs as xenomorphic grains, often corroding minerals separated earlier, such as plagioclase, common potash feldspar and biotite. Grain sizes are from 0.2 mm to 2.0 mm. Aggregate accumulations of quartz grains are also met.

Biotite is represented by brown, greenish-brown scales of 0.3 mm - 2.0 mm size. Some biotite scales at the margins and cleavage planes are replaced by epidote.

Common potash feldspar is represented by microcline in a shape of xenomorphic grains located in the interstices between biotite, plagioclase grains. Some potash feldspathose grains become overgrown with a thin rim of 0.1 mm - 0.2 mm thickness, consisting of plagioclase and containing numerous vermicular intergrowth of quartz composition - myrmekite.

Accessory minerals are represented by idiomorphic grains of zircon, apatite, sphene which are confined to biotite.

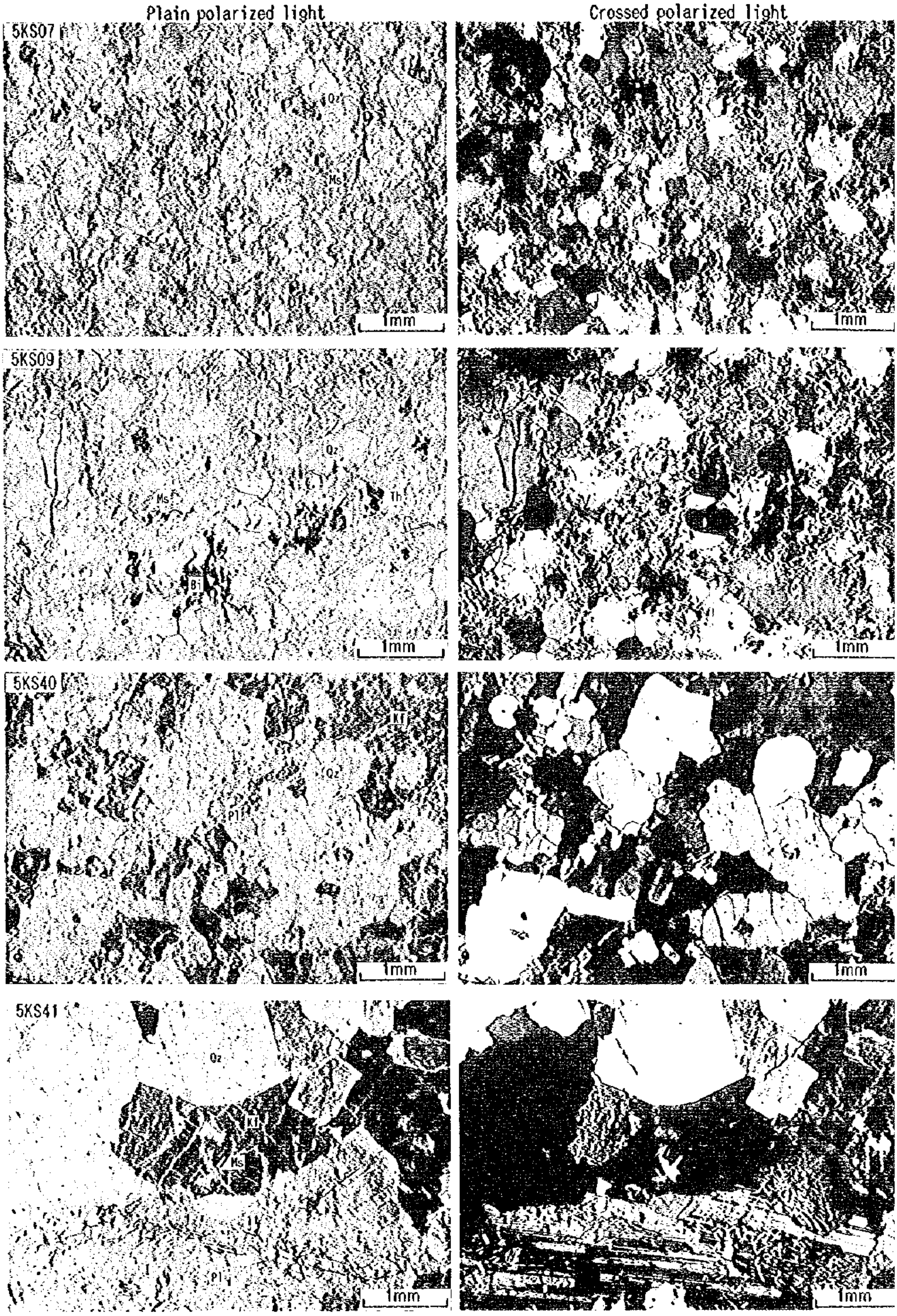
APPENDIX. -3

Microscopic Photographs of Thin Sections

Abbreviations (Thin section)

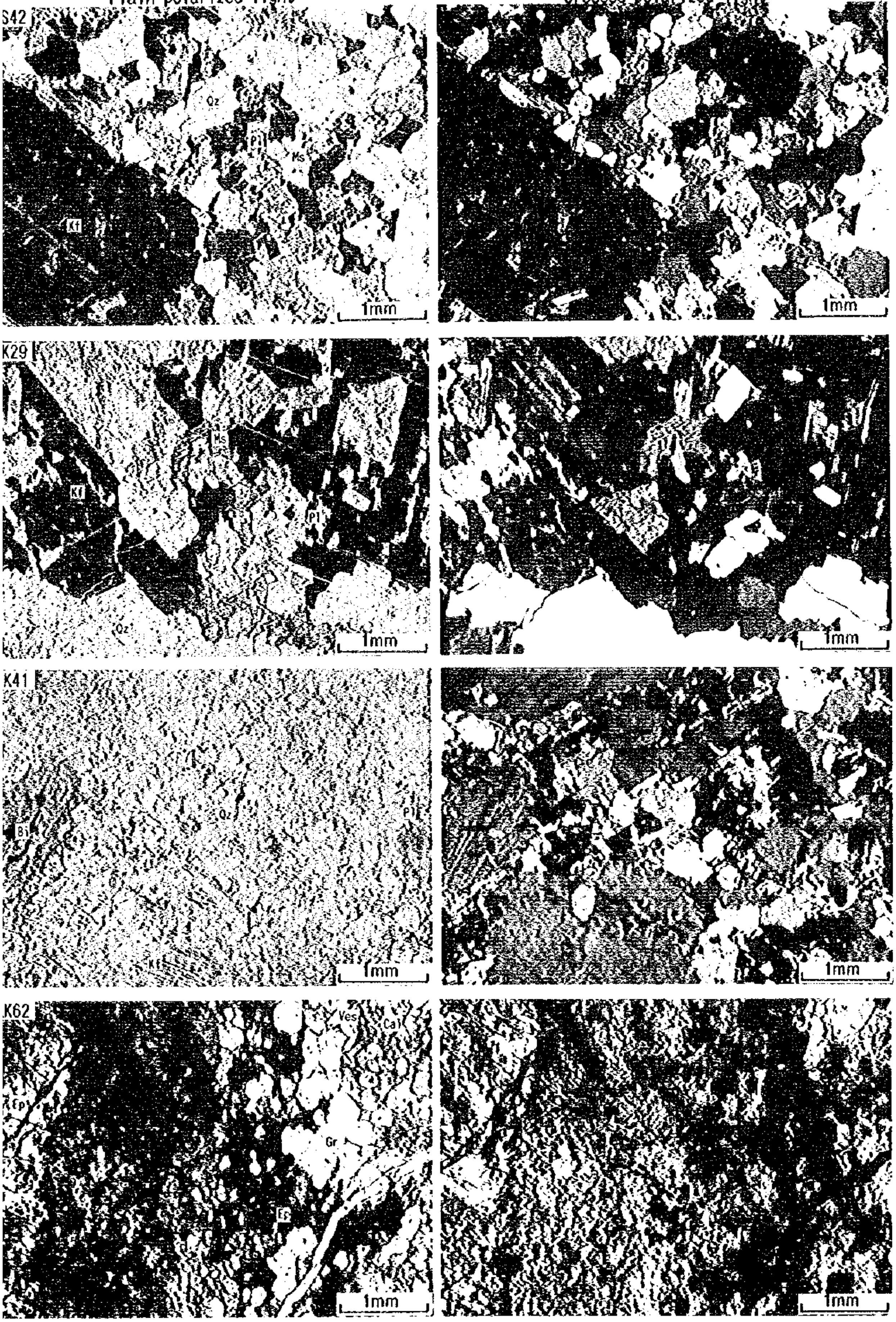
Bi	: Biotite
Cal	: Calcite
Ep	: Epidote
Gr	: Garnet
Kf	: K-feldspar
Ms	: Muscovite
Pl	: Plagioclase
Qz	: Quartz
Spn	: Sphene
Th	: Thorite
Ves	: Vesuvianite

Apx. -3 Microscopic Photographs of Thin Sections (1)

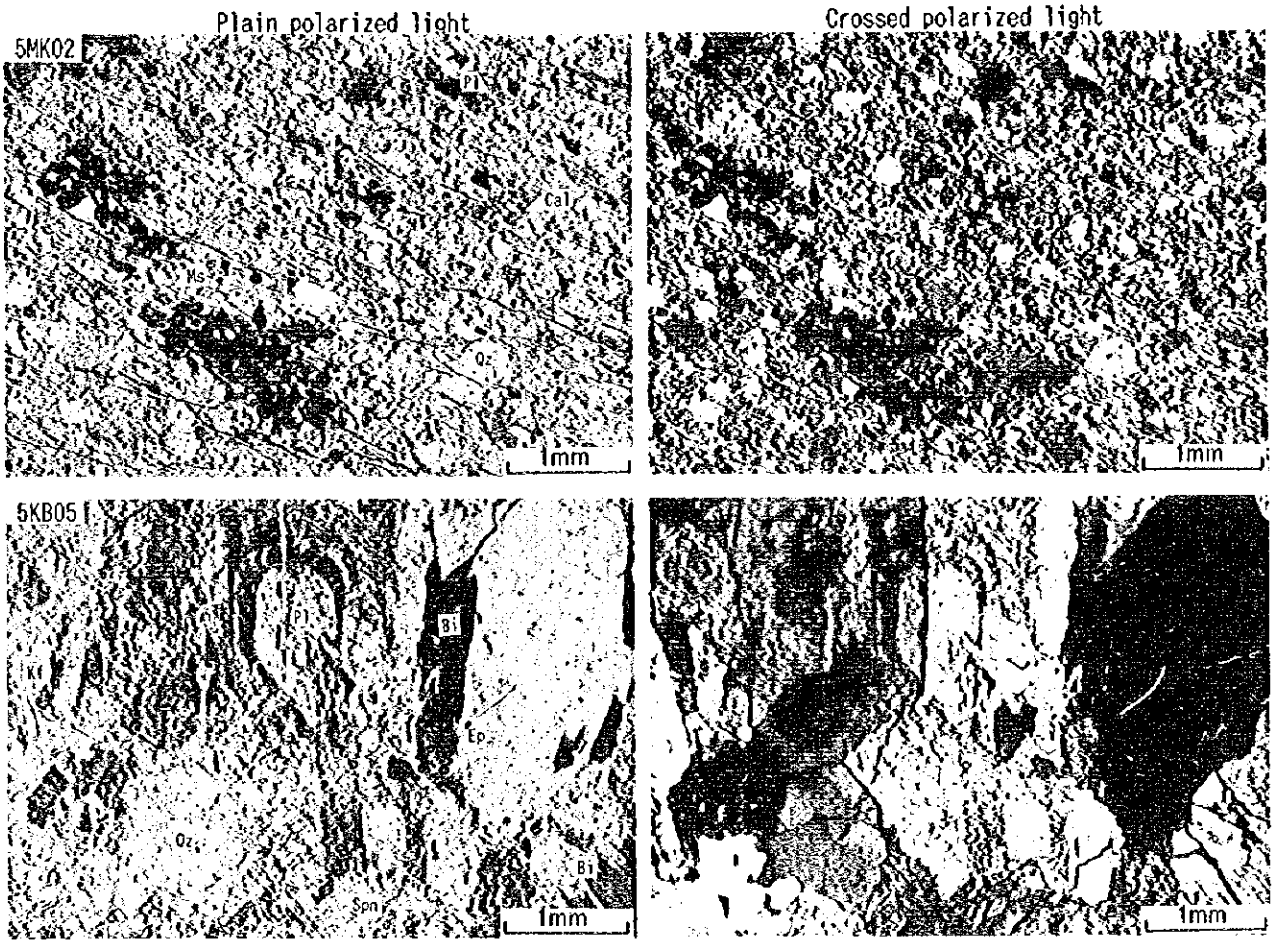


Apx. -3 Microscopic Photographs of Thin Sections (2)

Plain polarized light | Crossed polarized light



Apx. -3 Microscopic Photographs of Thin Sections (3)



APPENDIX. -4

Result of Microscopic Observations of Polished Sections

Apx.-4 Result of Microscopic Observation of Polished Sections

No.	Sample No.	Locality	Rock name	Pyrite	Pyrrhotite	Arsenopyrite	Melnikovite	Magnetite	Hematite	Goethite	Chalcopyrite	Chalcocite	Bornite	Tetrahedrite	Tennantite	Jamesonite	Bismuthinite	Sphalerite	Galena	Scheelite	Native gold	Native silver	Unknown Ag-mineral	Braunite	Pyrolusite	Psilomelane	Psilomelane-wad	Chalcophanite	Cryptomelane
1	5KS08	Shyraldzhyn deposit	Quartz vein	·						·	·									·	·								
2	5KS11	Shyraldzhyn deposit	Quartz Mn-siderite vein	·						·	·														·				
3	5KS19	Shyraldzhyn deposit	Muscovite-quartz rock	·						·															·				
4	5KS27	Shyraldzhyn deposit	Mn-siderite vein							◎																△		△	
5	5KS36	Shyraldzhyn deposit	Mn-siderite vein							○															○				○
6	5KS39	Shyraldzhyn deposit	Mn-siderite vein	·						◎												·				·		·	
7	5KS45	Shyraldzhyn deposit	Mn-siderite vein							○	·														△				△
8	5KS48	Shyraldzhyn deposit	Mn-siderite vein	·						◎											·				△				
9	5KS53	Shyraldzhyn deposit	Quartz vein	·							·										·								
10	5MS06	Shyraldzhyn deposit	Quartz vein	·						○															△				△
11	5KK14	Kumyshtag	Limestone/hornfels skarn gossan		△						·																		
12	5KK55	Uchimcheck deposit	Arsenopyrite ore	·		◎																·							
13	5KK56	Kumyshtag deposit	Arsenopyrite-pyrite ore	○	·	△					·	·	·	△		·	·						·						
14	5KK57	Kumyshtag deposit	Arsenopyrite ore			◎					·		·		·	·			·										
15	5KK64	Uzuntashty deposit	Magnetite ore	·				○	△	△											·								
16	5YK02	Tuktuarcha deposit	Quartz vein	△			△																						
17	5KB16	Kuru-Bakair deposit	Manganese gossan	·						○	·														△				
18	5KB24	Babahan deposit	Sphalerite ore	·							△			·				◎											
19	5KB25	Dzholsay deposit	Mn-siderite vein							△											·			○	○			○	
20	5KB28	Dzholsay deposit	Mn-siderite ore							○																	○		

◎:Abundant ○:Common △:Poor ·:Rare

Description of Microscopic Observation of Polished Section

1. POLISHED SECTION 5KS08

Composition: Chalcopyrite 3%, hydrous ferric oxides (limonite) 1-2%, pyrite -isolated signs, scheelite - isolated signs, free gold - 2 signs.

Structure: Allotriomorphic granular.

Texture: Impregnated, microstructure: reticulate, rim.

Ore mineralization in the polished section is represented by chalcopyrite, hydrous ferric oxides and isolated grains of pyrite and scheelite.

Chalcopyrite forms allotriomorphic aggregates measuring 0.024 - 0.8 mm in non-metalliferous mass. The color in reflected light is rich-yellow, bright, anisotropic effects are weak, reflection is moderate. Chalcopyrite is fractured and to a considerable extent is substituted by limonite with the formation of reticulate and rim microstructure and, in its turn, replaces pyrite.

Limonite replaces chalcopyrite and pyrite pseudomorphically. It forms variously shaped rims, crusts, reniform and rhythmically zonal aggregates with indented boundaries. The dimensions of grains is from 0.018 to 0.3 mm. The color is gray with the bluish tint, reflection is low, internal reflections are brownish-yellow.

Pyrite is represented in relict configuration, dimensions are from 0.012 to 0.1 mm. The shape is irregular, isometric, sometimes cubic. Pseudomorphically substituted by limonite and chalcopyrite.

Scheelite forms isometric crystals measuring 0.012 - 0.09 mm in non-metalloferous mass.

Free gold is observed in aggregates with quartz and chalcopyrite. Dimensions are 0.006 x 0.006; 0.003 x 0.003 mm. The shape is isometric or near isometric. The color is bright yellow.

2. POLISHED SECTION 5KS11

Composition: Non-metalliferous mass (quartz) 100%, pyrite, chalcopyrite, limonite and pyrolusite - isolated grains.

The polished section is of scanty ore mineralization, represented by separate grains of chalcopyrite, pyrite, limonite and pyrolusite.

Pyrite: Dimensions are 0.008 - 0.03 mm. It is intensively substituted by limonite with the formation of rims. The shape is irregular.

Chalcopyrite : Dimensions are 0.006 - 0.012 mm. Observed in the shape of small isometric impregnation in non-metalloferous mass.

Limonite forms aggregates of irregular shape and veinlets. Pseudomorphically replaces pyrite. Dimensions of the grains are from 0.008 to 0.06 mm. The thickness of the veinlets is from 0.003 to 0.006 mm.

Pyrolusite is observed in the shape of irregular aggregates measuring 0.012 - 0.05 mm and veinlets of 0.006 mm thickness.

3. POLISHED SECTION 5KS19

Composition: Limonite, pyrite, pyrolusite - isolated grains, non-metalliferous matter - 100%.

Ore mineralization is scanty and is represented by isolated grains of pyrite, limonite and pyrolusite.

Limonite is developed in the shape of irregular grains measuring 0.006 - 0.12 mm. It pseudomorphically replaces pyrite, sometimes up to complete pseudomorphes. The thickness of thin veinlets in the non-metalloferous mass is from 0.003 to 0.012 mm.

Pyrite: Dimensions are 0.006 - 0.012 mm. It forms a thin impregnation in non-metalloferous mass. It is also observed in the shape of relics in limonite aggregates.

Pyrolusite is observed in the non-metalloferous mass in the shape of tabular strongly anisotropic crystals measuring 0.03 - 0.6 mm.

4. POLISHED SECTION 5KS27

Composition: Limonite or hydrous ferric oxides 75%, hydrous manganic oxides 15 %, non-metalloferous minerals 10 %.

Texture: U-shaped, vesicular.

Structure: Cryptocrystalline.

The polished section is mainly composed of minerals of group of hydrous ferric and manganic oxides, which are tightly aggregated. The polished section is characterized by hydrous ferric and manganic oxides replacing rhombic crystals of calcite or some other carbonaceous mineral along cleavage cracks and boundaries of grains with partial or complete preservation of crystallographic forms. The direction of the replacement is carbonate - hydrous ferric oxides - hydrous manganic oxides. The minerals of group of hydrous ferric oxides form the main mass of the polished section (75%). The shape of separations is irregular, rhombic, prismatic and has the shape of concentric and festoony formations and veinlets. Dimensions are 0.006 - 0.6 mm. The thickness of the veinlets is from 0.003 to 0.015 mm. The color in the reflected light is gray, reflective power is moderate, weakly anisotropic, internal reflections are brown. The minerals of group of hydrous manganic oxides are represented by psilomelane and chalcophanite.

Psilomelane forms pseudomorph on limonite in the shape of irregular, aggregative and dendrite-shaped separations measuring 0.003 - 0.012 mm. The color in the reflected light is grayish-white, the reflective power is average.

Chalcophanite (variety with low content of zinc) forms tabular crystals, matted-fibrous and radiate-fibrous aggregates measuring 0.003 - 0.3 mm. The color is white, strongly anisotropic with brown internal reflections. Replaces psilomelane pseudomorphically.

5. POLISHED SECTION 5KS36

Composition: Hydrous manganic oxides 50%, hydrous ferric oxides 30%, non-metalliferous minerals 20%.

Structure: Concentric-zonal.

Texture: Vesicular.

In this polished section ore mineralization is represented by minerals of group of hydrous manganic oxides and hydrous ferric oxides which are in a tight intergrowth with each other.

Hydrous manganic oxides are represented by pyrolusite and cryptomelane. They form concentric-zonal, colloform and festoony formations measuring 0.04 - 0.06 mm. The color is gray (various tints), reflection is moderate, anisotropy is distinct, internal reflections are brownish-yellow.

Hydrous ferric oxides (goethite, hydrogoethite) are represented by aggregates of shelly, rhythmically-zonal, net-like shape, their dimensions vary from 0.03 to 0.06 mm. Pseudomorphically replace manganic minerals. The color in the reflected light is gray, reflection is moderate, anisotropic, internal reflections are brownish-red.

6. POLISHED SECTION 5KS39

Composition: Hydrous ferric oxides (limonite) 55%, hydrous manganic oxides (psilomelane, chalcophanite) 5%, non-metalloferous minerals 40%, pyrite - isolated signs, free silver - 1 sign.

Structure: Cryptocrystalline.

Texture: Subgraphic, vesicular.

In this polished section ore mineralization is represented by limonite with some admixture of psilomelane and chalcophanite.

Limonite forms subgraphic intergrowth with non-metalloferous mineral (quartz and carbonate ?) with the formation of grains of irregular shape measuring 0.012 - 0.1 mm. It contains inclusions of relict grains of pyrite, multiple cavities and emptiness and is replaced by psilomelane and chalcophanite along cracks and in periphery.

Psilomelane in tight intergrowth with chalcophanite pseudomorphically replaces limonite with the formation of matted-fibrous, needle-shaped and prismatic crystals. Dimensions are from 0.006 to 0.05 mm.

Pyrite is observed in relict form and forms in limonite mass small isometric crystals measuring 0.006 - 0.012 mm.

Free silver is observed in limonite aggregate. The shape is isometric, dimensions - 0.009 x 0.009. The color is white with slight cream tint.

7. POLISHED SECTION 5KS45

Composition: Hydrous ferric oxides 45%, hydrous manganic oxides 30%, chalcopyrite 15%, non-metalliferous minerals 10%.

Structure: Cryptocrystalline.

Texture: Vesicular, U-shaped.

Ore mineralization is represented by hydrous ferric and manganic oxides, chalcopyrite, pyrite.

Hydrous manganic oxides are represented by pyrolusite and cryptomelane. They are in tight intergrowth with each other. These minerals form clustered-shelly, rhythmically zonal aggregates measuring 0.04 - 0.8 mm. The microstructure of minerals is concentric-zonal.

Hydrous ferric oxides (goethite, hydrogoethite) form aggregates of lattice-like, rhythmically-zonal shape, and also pseudomorphes on chalcopyrite, pyrite with the formation of lattice-like microstructures and rims. Dimensions are from 0.05 to 1.0 mm.

Chalcopyrite forms grains of irregular shape. Dimensions are from 0.04 to 0.2 mm. It is pseudomorphically replaced by limonite with the formation of relict microstructure. The color is bright-yellow, reflection is moderate, weakly anisotropic.

8. POLISHED SECTION 5KS48

Composition: Hydrous ferric oxides 80%, hydrous manganic oxides 5%, non-metalliferous minerals 13%, pyrite - isolated signs, free gold - 3 signs.

Structure: Cryptocrystalline, in some places - colloform.

Texture: U-shaped, vesicular.

The major mass of the polished section consists of minerals of the group of hydrous ferric oxides (goethite, hydrogoethite) - 80%, some minerals of group of hydrous manganate (pyrolusite) - 5-7% and relic grains of pyrite.

Hydrous ferric oxides form prismatic rhombic-shaped crystals, irregular, festoony, colloform, columnar formations. Very often the form of crystals of hydrous ferric oxides depends on the form of crystals of mineral substituted by them. The color in reflected light is gray, reflective power is moderate, internal reflections are bright- red, weakly anisotropic.

Aggregates of hydrous ferric oxides contain multiple emptiness and cavities of leaching, small relict grains of pyrite and drop-shaped inclusions of free gold. Dimensions of the grains are from 0.018 to 0.3 mm.

The minerals of group of hydrous manganic oxides are observed in the shape of thin veinlets and colloform formations measuring 0,006 - 0.12 mm.

Free gold: The form is elongated, drop-shaped, wire-shaped. The color is bright yellow. Dimensions of separations: 0.015 x 0.006 mm, 0.003 x 0.003 mm, 0.012 x 0.003 mm. The boundaries of intergrowth are regular. Observed in goethite - hydrogoethite mass.

9. POLISHED SECTION 5KS53

Composition: Limonite 1%, non-metalliferous mass 99%, pyrite, chalcopyrite - isolated signs, free gold - 6 signs.

Structure: Hypidiomorphic-granular.

Texture: Impregnated; microstructure: relict.

This ore mineralization is rather scanty and is represented by limonite, isolated grains of pyrite and chalcopyrite.

Limonite forms grains of irregular, isometric, cubic and prismatic shape, dimensions - from 0.006 to 0.7 mm. It pseudomorphically replaces pyrite and chalcopyrite with the preservation of their crystallographic shape. Limonite also forms thin veinlets (of 0.006-0.06 mm thickness) in non-metalloferous mass.

Pyrite is observed in the shape of small crystals of prismatic, cubic and isometric shape. It is also observed in the shape of relics in limonite. Dimensions of grains are from 0.006 to 0.1 mm.

Chalcopyrite forms in non-metalloferous mass small isometric and irregular aggregates measuring 0.01-0.12 mm. It is substituted by limonite up to formation of complete pseudomorph. Sometimes it is observed in limonite aggregates in the shape of non-replaced relics.

Free gold (6 signs). It forms small crystals of isometric, sometimes elongated shape. The color is bright yellow. Dimensions of the crystals are: 0.003 x 0.003, 0.006 x 0.006, 0.006 x 0.012, 0.012 x 0.012, 0.006 x 0.006, 0.015 x 0.015 mm. Observed in intergrowth with non-metalloferous minerals.

10. POLISHED SECTION 5MS06

Composition: Hydrous ferric oxides (goethite, hydrogoethite) 35%, hydrous manganic oxides (pyrolusite, cryptomelane ?) 25%, pyrite - isolated signs, non-metalloferous mass 40%.

Structure: Cryptocrystalline.

Texture: Vesicular, U-shaped.

Hydrous manganic oxides are represented by oolitic-shaped, concentric-zonal, reniform and cluster-shaped aggregates with the formation of colloform microstructure of manganic separations. Their composition is non-uniform and two phases can be pointed out here. Phase I is represented by pyrolusite. It is gray with some cream tint in reflected light, its reflective power is high, double reflection is distinct, anisotropic. It forms aggregates measuring 0.06-0.5 mm. Phase II is represented by cryptomelane. It is observed in a tight intergrowth with pyrolusite and replaces it. Pyrolusite forms irregular, ameba-shaped and bay-shaped aggregates measuring 0.03-1,0 mm. Reflection is moderate, color is grayish-white, anisotropic.

Hydrous ferric oxides form aggregates of irregular and fibrous shape, dimensions from 0.03 to 0.6 mm. It replaces non-metalloferous mineral (presumably carbonaceous) along the cleavage zones and inter-granular seams with the formation of lattice-like microstructure. It forms reniform aggregates and aggregates of concentric-zonal shape in a tight intergrowth with the minerals of group of hydrous manganic oxides. The color in reflected light is grayish-blue, reflection is low, anisotropy is weak, internal reflections are reddish-brown.

Pyrite is observed in the shape of small relict grains in goethite-hydrogoethite mass and also small isometric separations in quartz. Dimensions are from 0.012 to 0.04 mm.

11. POLISHED SECTION 5KK14

Composition: Pyrrhotite 15%, chalcopyrite 1%, non-metalliferous minerals 84%.

Structure: Hypidiomorphic.

Texture: Impregnated.

The ore mineralization is represented by pyrrhotite and small quantities of chalcopyrite.

Pyrrhotite forms impregnation of irregular, isometric, tabular and prismatic shape in non-metalliferous mass. Dimensions of grains are from 0.018 to 0.06 mm. Along the cracks the grains of pyrrhotite are replaced by marcasite. It contains multiple inclusions of non-metalliferous minerals and forms aggregates with chalcopyrite. The color in reflected light is light-yellow with cream tint, reflective power is high, anisotropy is strong.

Chalcopyrite forms small isometric and irregular aggregates in non-metalliferous mass measuring 0.006 -0.12 mm. It forms aggregates with pyrrhotite with the formation of indented boundaries. The color in reflected light is bright--yellow, the effects of anisotropy are weak, reflection is moderate.

12. POLISHED SECTION 5KK55

Composition: Arsenopyrite 70%, pyrite - isolated signs, non-metalliferous minerals, silver - 1 sign.

Structure: Hypidiomorphic-granular.

Texture: Massive.

The ore mineralization is represented by arsenopyrite.

Arsenopyrite forms hypidiomorphic grains with negligible crenulation. Dimensions of grains is from 0.06 to 5.0 mm. The shape is tabular, prismatic with typical rhombic cross-section.

The crystals of arsenopyrite are strongly fractured and contain multiple inclusions of non-metalliferous minerals.

The color in reflected light is white, the effects of anisotropy are strong with considerable color effects, reflection is high.

Pyrite is observed in the shape of small impregnation in non-metalliferous mass. Dimensions of grains are from 0.006 to 0.03 mm.

Free silver (1 sign), dimensions are 0.03 x 0.012 mm. The shape is slightly elongated. The color is white with cream tint. It is observed in intergrowth with non-metalliferous minerals (in a crack).

13. POLISHED SECTION 5KK56

Composition: Pyrite 20%, arsenopyrite 5%, gray ore 5%, jamesonite 1-2%, chalcopyrite, bornite 1%, chalcocite, pyrrhotite, minerals of silver.

Texture: Veinlet-impregnated.

Ore mineralization is widely developed and makes up 30-35% of the area of the section.

Pyrite composes 1.0 cm thick veinlets and grains measuring 01 - 0.5 mm. The boundaries of the intergrowth of grains have polygonal profile. Some small quantities of pyrite are observed in non-metalliferous mass in the form of isolated metacrystals. The surface of pyrite grains is irregular and of cribrate form because of large quantity of inclusions of non-metalliferous minerals.

Microstructures for pyrite: allotriomorphic-granular, metablastic.

Arsenopyrite is represented by separate columnar-radial grains, aggregates of grains having isometric, irregular shape. Dimensions of the grains is from 0.01 to 0.2

mm. It is observed in the form of inclusions in non-metalliferous minerals (quartz, carbonate) and also in all the ore minerals with the exception of pyrite.

Microstructure: metablastic, poikiloblastic, interstitial.

Gray ore is represented by copper-antimony variety - tetrahedrite. It is observed in the form of aggregate of isometric slightly indented grains, composing separations measuring 1.0 - 1.5 mm and also in the form of thin rims surrounding the grains of quartz. Gray ore contains multiple inclusions of needles of arsenopyrite, separations of chalcopyrite having irregular form, bornite, chalcocite, silver minerals, bismuthite. Some separations of gray ore have tabular separations of bournonite (?).

Microstructures: interstitial, limbate, poikiloblastic, structure of disintegration (bismuthite, bournonite in gray ore).

Jamesonite is observed in the shape of isolated needle-shaped crystals with the typical rhombic cross-sections, dimensions from 0.01 to 0.3 mm, and also forms continued palmate-indented intergrowth the dimensions of which vary from 0.2 to 1.5 mm. Needle-shaped jamesonite forms intergrowth with non-metalliferous mineral. Other jamesonite separations form intergrowth both with non-metalliferous and ore minerals - arsenopyrite, gray ore, chalcopyrite.

The boundaries of intergrowth: straight, sinuous.

Microstructures: interstitial, metablastic.

Chalcopyrite is spread uniformly both in non-metalliferous and ore areas. It does not form large separations. The shape of separations is irregular, palmate with sinuous boundaries. Dimensions of separations are from 0.02 to 0.3 mm. In the form of inclusions it is observed in gray ore, arsenopyrite, pyrite, jamesonite and also fills interstice between non-metalliferous minerals.

Microstructures: poikilitic, interstitial.

Bornite is observed mainly in gray ore together with chalcocite in the form of transformation twins having the shape of "oleander leaves" as a result of disintegration of solid solution with the separation of chalcocite and bornite in the shape of peculiar net-like formations having convex bornite part and concave chalcocite part.

Pyrrhotite is observed in subordinate quantity in gray ore in the intergrowth with quartz in the shape of small elongated grains measuring 0.07 mm.

Bismuthite is observed in gray ore in the shape of isolated needle-like separations measuring 0.05 - 0.1 mm.

Minerals of silver are observed in gray ore in the form of products of disintegration of solid solutions. These are multiple separations of oval, isometric and drop-like shape, measuring 0.001 - 0.02 mm.

14. POLISHED SECTION 5KK57

Composition: Arsenopyrite 55%, non-metalliferous mass 45%, tennantite, jamesonite, galena, bornite, chalcopyrite - isolated grains.

Structure: Hypidiomorphic-granular.

Texture: Impregnated.

The ore mineralization is mainly represented by arsenopyrite, which forms irregular impregnation in non-metalliferous mass. Jamesonite, chalcopyrite, galena, bornite are observed in small quantities. They are mainly observed in non-metalliferous mass, but sometimes they form aggregates with each other or with arsenopyrite.

Arsenopyrite forms prismatic crystals, aggregates of crystals, including stellate, columnar, radial ones. Their dimensions are from 0.018 to 1.5 mm. The color is white in reflected light with slight color tint, reflection is high, double reflection is not strong. It is distinctly anisotropic with color effect in crossed nicols.

Tennantite forms grains of irregular, isometric form, measuring from 0.006 to 0.028 mm. Aggregates with arsenopyrite, jamesonite, chalcopyrite have dented boundaries. Sometimes on periphery chalcopyrite replaces arsenopyrite.

Chalcopyrite forms small crystals of irregular and sometimes of tabular form measuring 0.003 - 0.08 mm. It contains inclusions of arsenopyrite and is replaced by tennantite, bornite.

Bornite is observed in the shape of irregular grains measuring 0.03 - 0.1 mm. It pseudomorphically replaces chalcopyrite and contains inclusions of arsenopyrite.

Galena forms irregular isometric grains measuring 0.01 - 0.3 mm. It contains inclusions of jamesonite.

Jamesonite forms isometric, irregular and drop-like aggregates measuring 0.026 - 0.12 mm. It also forms aggregates with tennantite, galena, arsenopyrite.

15. POLISHED SECTION 5KK64

Composition: Magnetite 30%, hydrous ferric oxides (limonite) 10%, pyrite - isolated signs, non-metalliferous mass 45%, free gold - 2 signs.

Structure: Hypidiomorphic-granular, fibrous in places.

Texture: Impregnated.

Magnetite forms needle-like, matted-fibrous, radial, irregular and isometric aggregates. Hematite is developed along magnetite with the formation of relict microstructure. Hematite replaces magnetite up to formation of complete pseudomorph. Dimensions of grains are from 0.008 to 1.0 mm. The color in reflected light is gray with brown tint, reflection is moderately low, isotropic.

Hematite is represented by thin-needle-like aggregates measuring 0.004 - 0.06 mm. It replaces magnetite pseudomorphically and, in its turn, is replaced by limonite. The color is gray with blue tint, anisotropy is distinct, internal reflections are ruby-red, reflection is moderately low. It is much lighter in color than magnetite. Microstructure of corrosion.

Limonite is observed in the form of irregular shelly and concentrated-zonal masses measuring 0.02 - 1.0 mm. It pseudomorphically replaces pyrite and hematite with the formation of relict microstructure. It contains multiple relics of hematite, magnetite, pyrite.

Free gold (2 signs). The color is bright yellow. The dimensions are 0.004 x 0.004, 0.08 x 0.004 mm. The shape is isometric and is observed in intergrowth with non-metalliferous mineral, presumably mica. The boundaries of intergrowth are regular.

Pyrite is observed in the shape of small relict grains in limonite mass, dimensions are from 0.004 to 0.06 mm.

16. POLISHED SECTION 5YK02

Composition: Pyrite 5%, melnikovite 10%, non-metalliferous mineral 85%, magnetite - isolated signs.

Structure: Allotriomorphic-metagranular.

Texture: Impregnated.

The ore mineralization is represented by pyrite and melnikovite (Fe_3S_4). These minerals form tight intergrowth with each other with the formation of indented boundaries.

Melnikovite is represented by fine-granular aggregates of concentric-zonal, calcium-like banded, irregular and more seldom isometric shape. Dimensions are from 0.006 to 1.0 mm. The aggregates of melnikovite are strongly fractured and contain multiple cavities of leaching. In some places melnikovite forms subgraphic intergrowth with non-metalliferous mineral. The microstructure of the mineral is concentric-zonal, sometimes powdery. The reflective power is somewhat lower than that of pyrite, the color is light-yellow, the effects of anisotropy are not present.

Pyrite forms crystals of isometric, cubic and irregular shape, dimensions from 0.04 to 0.8 mm. The crystals of pyrite are fractured and contain multiple inclusions of non-metalliferous minerals. The color in reflected light is straw-yellow, reflective power is moderately high, isotropic.

17. POLISHED SECTION 5KB16

Composition: Hydrous ferric oxides 40%, pyrolusite 15%, non-metalliferous minerals 45%, pyrite - isolated signs, chalcopyrite - isolated signs.

Structure: Allotriomorphic-granular.

Texture: Banded, microstructure of border rims, relic.

The major area of the polished section is occupied by minerals of group of hydrous ferric oxides (limonite) - 40% with some admixture of manganic minerals (pyrolusite ?) - 15%. Hydrous ferric oxides form aggregates of irregular form measuring 0.006 - 0.12 mm. It also forms veinlets 0.001 - 0.006 mm thick in non-metalliferous mass.

It replaces pyrite in the shape of concentric-zonal formations and periphery margins with the formation of microstructure of border rims. The color in reflected light is gray of various tints, weakly anisotropic with multiple reddish-brown internal reflections.

In tight intergrowth with limonite are minerals of group of hydrous manganic oxides (here, pyrolusite). Pyrolusite makes cryptocrystalline formations measuring 0.006 -0.36 mm. The color is bluish-gray in reflected light, anisotropic.

The aggregates of pyrolusite contain multiple cavities and also inclusions of thin-needled minerals (presumably rutile or amphibole).

In non-metalliferous mass and in limonite along cracks pyrolusite forms 0.003 - 0.03 mm thick veinlets.

Pyrite forms dimensions from 0.003 to 0.012 mm, observed in relict shape in the mass of concentric-zonal and festoony formations of limonite. The color in reflected light is light-yellow, isotropic.

18. POLISHED SECTION 5KB24

Composition: Sphalerite 84%, chalcopyrite 5%, pyrite 1%, non-metalliferous minerals 5-10%, tetrahedrite - isolated signs.

Structure: Allotriomorphic-metagranular.

Texture: Massive.

The ore mineralization is mainly represented by sphalerite and some small quantity of chalcopyrite and pyrite.

Sphalerite forms granular aggregates, dimensions of the grains making up 0.06 - 1.5 mm. Its grains are strongly fractured, cracks are filled with non-metalliferous mineral (quartz). It contains emulsionous impregnation of chalcopyrite and inclusions of small idiomorphic grains of pyrite. The color in reflected light is light-gray, reflective power is low, isotropic, internal reflections are light-brown.

Chalcopyrite is observed exclusively in sphalerite in the form of emulsion impregnation. The shape of grains is isometric, sometimes elongated, dimensions are from 0.006 to 0.03 mm. Microstructure of the mineral is emulsionous. Pyrite is also observed in the form of impregnation in sphalerite, dimensions are from 0.006 to 0.18 mm. The shape of separations is cubic, octahedral and in the form of veinlets, composed of crystals of pyrite tightly joining each other, thickness is from 0.006 to 0.06 mm.

Tetrahedrite forms crystals in sphalerite irregularly. The color is grayish-green with bluish tint, dimensions from 0.012 to 0.15 mm. The thickness of the veinlets is from 0.006 to 0.06 mm.

19. POLISHED SECTION 5KB25

Composition: Psilomelane-wad 80%, hydrous ferric oxides (limonite) 5 %, non-metalliferous minerals 15%, free gold - 1 sign.

Structure: Cryptocrystalline.

Texture: Vesicular.

Almost all the area of the polished section is occupied by minerals of group of psilomelane-wad, which are of different composition. Pyrolusite, braunite, chalcophanite and limonite are observed here. The description of these minerals is as follows.

Braunite forms rather large crystals measuring 0.03 - 0.06 mm. The color in reflected light is grayish-white with cream tint, weakly anisotropic, reflective power is average, internal reflections are not observed. Braunite is strongly replaced by pyrolusite, beginning from internal parts, with the formation of various margins, bays, veinlets. The color of pyrolusite in reflected light is bluish-gray, distinctly anisotropic, reflective power is the same as that of braunite. The average dimensions of grains are from 0.006 to 0.06 mm.

Chalcophanite is observed in this braunite-pyrolusite mass in the shape of islands, veinlets and small often bent tablets. Its color is white, reflective power is high; effects of anisotropy are strong. It is obvious that it is developed both on braunite and pyrolusite, sometimes it forms emulsionous impregnation in these minerals. The dimensions of aggregates are from 0.003 to 0.06 mm, the thickness of the veinlets is from 0.015 to 0.06 mm.

Limonite is observed in the shape of irregular aggregative accumulations, veinlets and separate isometric separations, dimensions are from 0.006 to 0.03 mm. The thickness of veinlets is from 0.03 to 0.06 mm. The color is gray, reflective power is low, internal reflections are brown.

Free gold (1 sign). The color is light-yellow, the shape is isometric, dimensions are 0.003 x 0.003 mm. In association with manganic minerals.

20. POLISHED SECTION 5KB28

Composition: Psilomelane-wad 55%, hydrous ferric oxides (limonite) 10%, non-metalliferous mass 35%.

Texture: Banded, microstructure subgraphic.

Structure: Cryptocrystalline.

The major area of the polished section is composed of minerals of group of psilomelane-wad, which may be divided into three components. The first two components are manganic minerals which differ from each other in color (in reflected light), reflective power and type of separations. The third component are the minerals of group of hydrous ferric oxides or limonite. The description of the above mentioned minerals is as follows.

Component No 1. : This is an anisotropic mineral of gray color with slight greenish tint and of moderate reflective power. It forms small cryptocrystalline masses of irregular form (dimensions are from 0.006 to 0.018 mm).

Component No 2. : This mineral is of higher reflective power than mineral No 1. Its color in reflected light is bluish-gray, distinctly anisotropic. It forms pseudomorph on mineral No 1 with the formation of margins on periphery, rhythmic and thread-like veinlets, bay-shaped and ameba shaped aggregates. It corrodes mineral No 1 from inside, along cracks and boundaries of grains. The dimensions of separations are from 0.006 to 0.03 mm.

Component No 3. Hydrous ferric oxides (limonite). Here all the transitions of intergrowth of manganic minerals with limonite through thin branching of cracks are observed with further separate granular, but rather thin-granular masses measuring 0.003 - 0.006 mm.

Limonite also forms very thin (0.006 - 0.012 mm) veinlets in non-metalliferous mass.

All these minerals intergrow in each other and form variously shaped aggregates and isolations, which, in their turn may be divided into three groups:

1. Thin intergrowth of manganic minerals into non-metalliferous minerals or so called subgraphic replacement of non-metalliferous minerals (of carbonaceous-quartz composition) by manganic minerals.

2. "Vast" psilomelane areas (dimensions from 0.2 to 1.5 mm) containing multiple inclusions of non-metalloferous minerals.

3. Oolite-like formations, composed of thin granular psilomelane masses, located in the form of concentric zonal bands around the central part, which is composed of the same material.

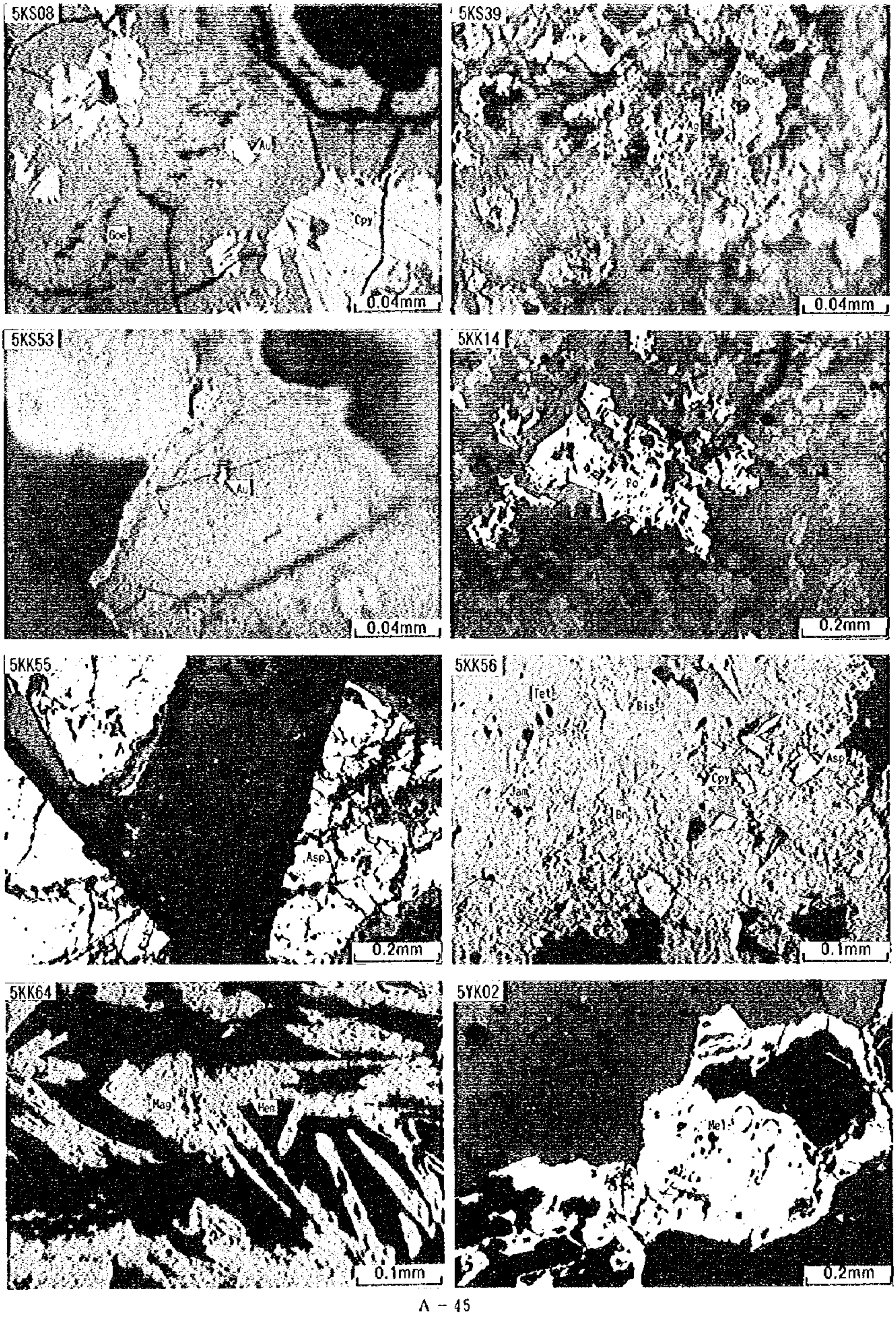
APPENDIX. -5

Microscopic Photographs of Polished Sections

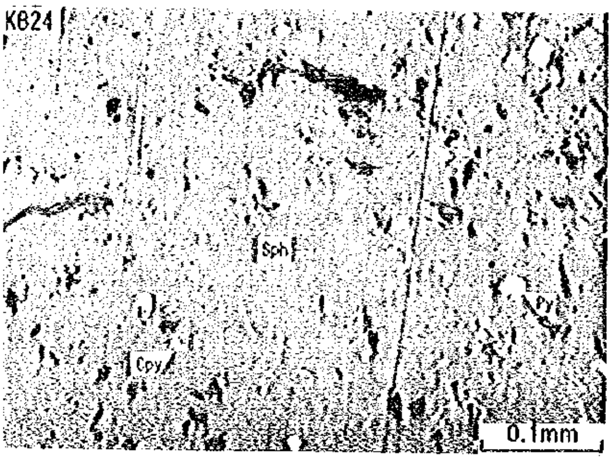
Abbreviations (Polished section)

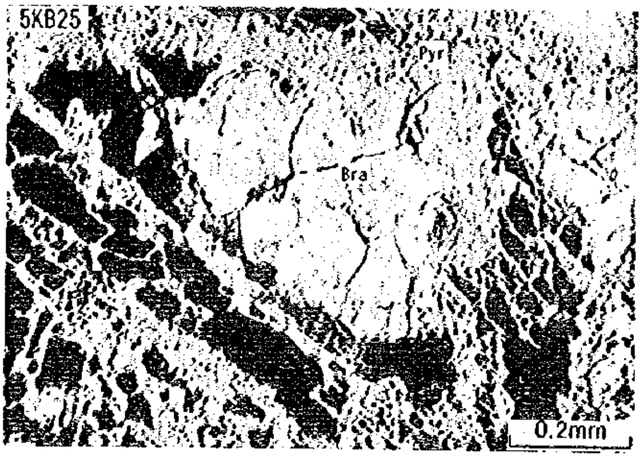
Ag	: Native silver
Asp	: Arsenopyrite
Au	: Native gold
Bis	: Bismuthinite
Bn	: Bornite
Bra	: Braunite
Cpy	: Chalcopyrite
Goe	: Goethite
Hem	: Hematite
Jam	: Jamesonite
Mag	: Magnetite
Mel	: Melnikovite
Po	: Pyrrhotite
Py	: Pyrite
Pyr	: Pyrolusite
Sph	: Sphalerite
Tet	: Tetrahedrite

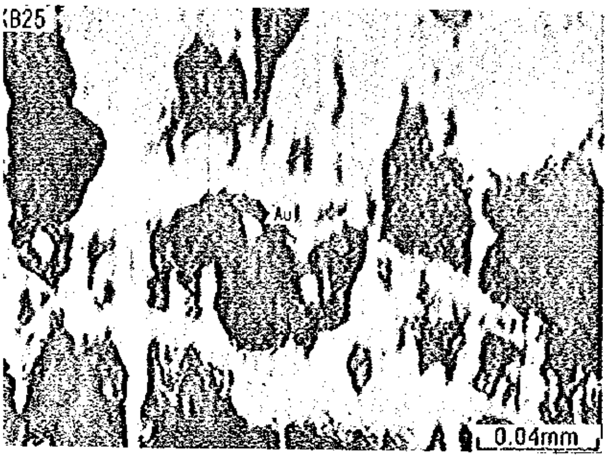
Apx. -5 Microscopic Photographs of Polished Sections (1)



Apx. -5 Microscopic Photographs of Polished Sections (2)







APPENDIX. -6

Assay Results of Ore Samples

Apx.-6 Assay Results of Ore Samples (1)

No.	Sample No.	Location	Ore name	Width (m)	Au (g/t)	Ag (g/t)	Cu (%)	As (%)
1	5KS01	Shyraldzhyn main orebody, K175	Mn-siderite vein	3.2	19.6	3.5	3.40	<0.05
2	5KS02	Shyraldzhyn main orebody, K175	Altered granite	0.5	<0.1	3.6	<0.05	<0.05
3	5KS04	Shyraldzhyn main orebody, K174	Mn-siderite vein	3.0	12.8	0.94	3.00	<0.05
4	5KS05	Shyraldzhyn main orebody, K174	Quartz vein	1.3	4.5	1.0	0.43	<0.05
5	5KS06	Shyraldzhyn main orebody, K174	Muscovite-quartz rock	0.6	0.3	1.2	0.08	0.05
6	5KS07	Shyraldzhyn main orebody, K174	Muscovite-quartz rock	0.5	<0.1	<0.3	<0.05	0.05
7	5KS08	Shyraldzhyn main orebody, K172	Quartz vein	0.6	3.9	49.9	0.81	0.06
8	5KS11	Shyraldzhyn main orebody, K170	Quartz Mn-siderite vein	1.3	9.3	1.7	0.78	0.06
9	5KS13	Shyraldzhyn main orebody, K169	Mn-siderite vein	0.2	15.5	6.6	0.55	0.05
10	5KS18	Shyraldzhyn main orebody,K101SE	Sheared altered granite	0.6	<0.1	0.34	0.07	0.23
11	5KS19	Shyraldzhyn main orebody,K101SE	Muscovite-quartz rock	6.4	<0.1	1.6	0.05	0.06
12	5KS22	Shyraldzhyn main orebody, K106	Quartz vein with Mn-siderite	1.5	0.6	<0.3	0.28	0.05
13	5KS23	Shyraldzhyn main orebody, K106	Mn-siderite vein	2.0	1.1	0.65	0.47	0.08
14	5KS24	Shyraldzhyn main orebody, K107	Mn-siderite vein	3.7	2.9	1.0	0.92	<0.05
15	5KS25	Shyraldzhyn main orebody, K102	Mn-siderite vein	1.2	7.7	6.4	0.73	<0.05
16	5KS27	Shyraldzhyn main orebody, K102	Mn-siderite vein	2.5	0.2	1.0	0.50	<0.05
17	5KS28	Shyraldzhyn main orebody, K102	Sheared Mn-siderite ore	1.1	1.0	3.4	0.39	0.07
18	5KS29	Shyraldzhyn main orebody, K120	Sheared granite with muscovite	1.0	<0.1	<0.3	<0.05	0.05
19	5KS30	Shyraldzhyn main orebody, K120	Sheared quartz vein	1.0	<0.1	<0.3	<0.05	<0.05
20	5KS31	Shyraldzhyn main orebody, K120	Sheared granite	1.0	<0.1	1.6	<0.05	0.05
21	5KS34	Shyraldzhyn near contact north	Mn-siderite vein (from adit)	0.7	3.9	1.8	1.20	0.05
22	5KS36	Shyraldzhyn near contact north	Mn-siderite vein (from adit)	0.5	4.9	1.3	0.62	0.19
23	5KS38	Shyraldzhyn near contact north	Mn-siderite vein (from adit)	0.8	9.7	3.2	2.60	0.06
24	5KS39	Shyraldzhyn near contact north	Mn-siderite vein	0.4	1.4	0.7	0.99	0.05
25	5KS44	Shyraldzhyn near contact, B-5	Mn-siderite vein	1.2	0.4	0.32	0.64	0.06
26	5KS45	Shyraldzhyn near contact, B-4	Mn-siderite vein	1.0	5.8	2.6	2.60	0.05
27	5KS46	Shyraldzhyn near contact, B-3	Mn-siderite vein	0.3	0.6	0.3	0.06	0.05
28	5KS48	Shyraldzhyn near contact, B-1	Mn-siderite vein	2.0	1.4	0.32	0.88	0.05
29	5KS52	Shyraldzhyn main orebody, K101	Quartz vein	0.2	<0.1	<0.3	<0.05	<0.05
30	5KS53	Shyraldzhyn main orebody, K101	Quartz vein	0.3	0.95	<0.3	2.60	<0.05

Apx.-6 Assay Results of Ore Samples (2)

No.	Sample No.	Location	Ore name	Width (m)	Au (g/t)	Ag (g/t)	Cu (%)	As (%)
31	5KS54	Shyraldzhyn main orebody, K101	Muscovite-quartz rock	0.8	<0.1	<0.3	<0.05	0.09
32	5MS01	Shyraldzhyn contact south K188	Mn-siderite vein with green copper	0.7	28.4	3.6	1.40	0.10
33	5MS05	Shyraldzhyn contact south K190	Quartz Mn-siderite vein	0.3	19.4	1.2	0.18	0.24
34	5MS06	Shyraldzhyn contact south K191	Quartz vein	0.4	9.8	2.2	0.22	0.42
35	5MS09	Shyraldzhyn contact south	Mn-siderite vein	0.3	2.0	1.2	0.40	0.14
36	5MS10	Shyraldzhyn contact south K194	Quartz vein with Mn-siderite	0.3	1.35	<0.3	0.50	<0.05
37	5MS11	Shyraldzhyn contact,K530 south	Clay vein with green copper	0.3	0.2	187.0	0.13	0.24
38	5MS12	Shyraldzhyn contact,K530 south	Mn-siderite vein	0.3	1.8	0.82	3.40	<0.05
39	5MS13	Shyraldzhyn main orebody, K101	Limonitizated granite	4.0	0.6	<0.3	<0.05	0.05
40	5MS14	Shyraldzhyn main orebody, K102	Mn-siderite vein	0.7	4.2	1.8	0.65	0.05
41	5MS17	Shyraldzhyn main orebody, K101	Limonitizated granite	1.4	0.1	1.2	<0.05	<0.05
42	5KK14	Kumyshtag river middle reaches	Limestone/hornfels skarn gossan	2.0	0.55	1.0	0.06	<0.05
43	5KK18	Kumyshtag river middle reaches	Hornfels gossan	6.0	0.1	<0.3	<0.05	<0.05
44	5KK21	Kumyshtag river middle reaches	Quartz vein	0.1	0.35	<0.3	<0.05	<0.05
45	5KK23	Manka Bulak upper reaches	Quartz vein	0.1	0.1	<0.3	<0.05	<0.05
46	5KK41	Cheten deposit	Granite porphyry	1.0	<0.1	<0.3	<0.05	<0.05
47	5KK54	Uchimcheck mine site	Altered limestone/shale	1.0	0.2	16.2	<0.05	16.50
48	5KK55	Uchimcheck mine site,waste	Arsenopyrite ore		0.8	1.2	0.08	10.47
49	5KK56	Kumyshtag mine site,waste	Arsenopyrite-pyrite ore		0.3	1,927.8	<0.05	1.85
50	5KK60	Uzuntashty deposit	Quartz vein	0.8	0.1	<0.3	0.47	<0.05
51	5KK65	Uzuntashty deposit	Fluorite vein	0.8	<0.1	<0.3	<0.05	<0.05
52	5KK66	Uzuntashty deposit	Quartz vein	0.8	0.15	<0.3	<0.05	<0.05
53	5YK02	Kumyshtag river	Quartz vein	0.3	0.5	3.4	<0.05	0.14
54	5YK03	Kumyshtag river	Quartz vein	0.2	<0.1	<0.3	<0.05	<0.05
55	5KB16	Kuru Bakair	Manganese gossan	2.0	0.1	14.6	<0.05	<0.05
56	5KB19	Kuru Bakair	Quartz vein	0.3	<0.1	3.0	<0.05	<0.05
57	5KB20	Babahan deposit	Quartz vein	0.1	<0.1	<0.3	<0.05	<0.05
58	5KB25	Dzholsay deposit	Mn-siderite vein	0.7	<0.1	15.9	<0.05	<0.05
59	5KB26	Dzholsay deposit	Mn-siderite vein	1.5	0.1	16.5	<0.05	0.11
60	5KB28	Dzholsay deposit,waste	Mn-siderite ore		0.1	14.5	<0.05	<0.05

APPENDIX. -7

List of Chemical Analyzed Values of Soil Samples

Apx.-7 List of Chemical Aanalyzed Values of Soil Samples (1)

Sample No.	Location	Depth(m)	Geology	Au(ppm)	Ag(ppm)	Cu(ppm)	As(ppm)	Sb(ppm)
SAK001	Kara Buura	0.25	siltstone	0.015	<0.3	70	<70	<10
SAK002	Kara Buura	0.20	siltstone	<0.005	0.3	120	<70	<10
SAK003	Kara Buura	0.25	siltstone	<0.005	0.3	120	<70	<10
SAK004	Kara Buura	0.20	sandstone, shale	<0.005	0.3	70	<70	<10
SAK005	Kara Buura	0.20	sandstone, shale	<0.005	0.3	90	<70	<10
SAK006	Kara Buura	0.20	sandstone, siltstone	<0.005	0.3	90	<70	<10
SAK007	Kara Buura	0.30	sandstone, siltstone	0.015	0.3	70	<70	<10
SAK008	Kara Buura	0.20	sandstone, siltstone	<0.005	0.3	40	<70	<10
SAK009	Kara Buura	0.25	siltstone	<0.005	0.3	30	<70	<10
SAK010	Kara Buura	0.20	shale	<0.005	0.3	50	<70	<10
SAK011	Kara Buura	0.20	limestone	<0.005	0.3	50	<70	<10
SAK012	Kara Buura	0.20	limestone	<0.005	0.3	40	<70	<10
SAK013	Kara Buura	0.25	siltstone, limestone	<0.005	0.3	70	<70	<10
SAK014	Kara Buura	0.20	sandstone	<0.005	0.3	70	<70	<10
SAK015	Kara Buura	0.30	sandstone, limestone	<0.005	0.3	50	<70	<10
SAK016	Kara Buura	0.20	sandstone, limestone	<0.005	<0.3	40	<70	<10
SAK017	Kara Buura	0.20	sandstone	<0.005	0.3	40	<70	<10
SAK018	Kara Buura	0.20	limestone	<0.005	0.3	40	<70	<10
SAK019	Kara Buura	0.30	limestone, shale	<0.005	0.4	40	<70	<10
SAK020	Kara Buura	0.30	limestone, siltstone	<0.005	0.3	40	<70	<10
SAK021	Kara Buura	0.20	sandstone, shale	<0.005	0.3	70	<70	<10
SAK022	Kara Buura	0.20	limestone, siltstone	<0.005	0.3	50	<70	<10
SAK023	Kara Buura	0.15	limestone, siltstone	<0.005	0.3	50	<70	<10
SAK024	Kara Buura	0.30	limestone, sandstone	<0.005	0.3	40	<70	<10
SAK025	Kara Buura	0.30	sandstone, gritstone	<0.005	0.3	30	<70	<10
SAK026	Kara Buura	0.20	siltstone, limestone	<0.005	0.3	50	<70	<10
SAK027	Kara Buura	0.20	siltstone, limestone	<0.005	0.3	40	<70	<10
SAK028	Kara Buura	0.25	limestone	<0.005	0.3	50	<70	<10
SAK029	Kara Buura	0.20	siltstone	0.007	0.3	50	<70	<10
SAK030	Kara Buura	0.20	limestone, shale	0.005	0.3	40	<70	<10

Apx.-7 List of Chemical Aanalyzed Values of Soil Samples (2)

Sample No.	Location	Depth(m)	Geology	Au(ppm)	Ag(ppm)	Cu(ppm)	As(ppm)	Sb(ppm)
SAK031	Kara Buura	0.20	limestone, shale	0.007	0.3	50	<70	<10
SAK032	Kara Buura	0.20	limestone	<0.005	0.3	30	<70	<10
SAK033	Kara Buura	0.20	limestone, siltstone	<0.005	0.3	70	<70	<10
SAK034	Kara Buura	0.30	limestone	<0.005	1.2	40	<70	30
SAK035	Kara Buura	0.20	shale	0.015	12.0	300	400	70
SAK036	Kara Buura	0.20	shale	<0.005	0.3	40	<70	30
SAK037	Kara Buura	0.20	shale	<0.005	0.3	50	<70	<10
SAK038	Kara Buura	0.20	shale	<0.005	0.3	30	<70	<10
SAK039	Kara Buura	0.25	limestone, siltstone	<0.005	7.0	300	120	<10
SAK040	Kara Buura	0.15	siltstone	<0.005	0.3	70	<70	<10
SAK041	Kara Buura	0.20	limestone, siltstone	<0.005	<0.3	50	<70	<10
SAK042	Kara Buura	0.25	siltstone	<0.005	1.2	50	<70	<10
SAK043	Kara Buura	0.15	limestone, siltstone	<0.005	0.3	50	<70	<10
SAK044	Kara Buura	0.20	limestone, shale	<0.005	<0.3	40	<70	<10
SAK045	Kara Buura	0.20	limestone, shale	<0.005	<0.3	40	<70	<10
SAK046	Kara Buura	0.25	limestone, shale	<0.005	<0.3	40	<70	<10
SAK047	Kara Buura	0.20	sandstone, shale, siltstone	<0.005	<0.3	50	<70	<10
SAK048	Kara Buura	0.20	sandstone, shale	<0.005	<0.3	40	<70	<10
SAK049	Kara Buura	0.20	shale	<0.005	<0.3	50	<70	<10
SAK050	Kara Buura	0.20	shale	<0.005	<0.3	300	<70	<10
SAK051	Kara Buura	0.20	shale	<0.005	<0.3	40	<70	<10
SAK052	Kara Buura	0.20	shale	<0.005	<0.3	30	<70	<10
SAK053	Kara Buura	0.20	siltstone	0.007	<0.3	40	<70	<10
SAK054	Kara Buura	0.20	shale	<0.005	<0.3	70	<70	<10
SAK055	Kara Buura	0.20	shale	<0.005	<0.3	40	<70	<10
SAK056	Kara Buura	0.20	shale	<0.005	<0.3	40	<70	<10
SAK057	Kara Buura	0.20	shale	<0.005	<0.3	30	<70	<10
SAK058	Kara Buura	0.20	shale	<0.005	<0.3	70	<70	<10
SAK059	Kara Buura	0.20	shale	<0.005	<0.3	30	<70	<10
SAK060	Kara Buura	0.20	siltstone	<0.005	<0.3	50	<70	<10

Apx.-7 List of Chemical Aanalyzed Values of Soil Samples (3)

Sample No.	Location	Depth(m)	Geology	Au(ppm)	Ag(ppm)	Cu(ppm)	As(ppm)	Sb(ppm)
SAK061	Kara Buura	0.30	siltstone, limestone	0.015	<0.3	30	<70	<10
SAK062	Kara Buura	0.25	siltstone	<0.005	<0.3	40	<70	<10
SAK063	Kara Buura	0.20	siltstone	<0.005	0.3	70	<70	<10
SAK064	Kara Buura	0.20	siltstone	<0.005	<0.3	50	<70	<10
SAK065	Kara Buura	0.20	siltstone	0.005	0.3	50	<70	<10
SAK066	Kara Buura	0.20	siltstone	3.000	0.3	50	<70	<10
SAK067	Kara Buura	0.20	sandstone, siltstone	0.009	0.3	70	<70	<10
SAK068	Kara Buura	0.20	sandstone, siltstone	0.007	0.3	50	<70	<10
SAK069	Kara Buura	0.20	sandstone, siltstone	<0.005	0.3	70	<70	<10
SAK070	Kara Buura	0.20	sandstone, shale	<0.005	0.3	50	<70	<10
SAK071	Kara Buura	0.20	sandstone, shale	0.012	0.3	150	<70	<10
SAK072	Kara Buura	0.20	sandstone, siltstone, shale	0.007	0.3	40	<70	<10
SAK073	Kara Buura	0.20	sandstone, siltstone, shale	0.005	0.3	40	<70	<10
SAK074	Kara Buura	0.20	sandstone, siltstone, shale	<0.005	0.3	30	<70	<10
SAK075	Kara Buura	0.20	sandstone, siltstone, shale	0.005	<0.3	30	<70	<10
SAK076	Kara Buura	0.20	limestone, siltstone	<0.005	<0.3	70	<70	<10
SAK077	Kara Buura	0.20	gritstone, sandstone, phyllite	<0.005	0.3	30	<70	<10
SAK078	Kara Buura	0.20	sandstone, phyllite	<0.005	0.3	70	<70	<10
SAK079	Kara Buura	0.20	limestone, sandstone	<0.005	0.3	70	<70	<10
SAK080	Kara Buura	0.20	sandstone, shale	<0.005	0.3	70	<70	<10
SAK081	Kara Buura	0.20	sandstone, shale	0.005	0.3	120	<70	<10
SAK082	Kara Buura	0.20	sandstone, shale	<0.005	<0.3	70	<70	<10
SAK083	Kara Buura	0.20	sandstone, mylonite - fracture	<0.005	<0.3	40	<70	<10
SAK084	Kara Buura	0.20	sandstone, phyllite	<0.005	0.3	70	<70	<10
SAK085	Kara Buura	0.20	limestone, siltstone	<0.005	0.3	30	<70	<10
SAK086	Kara Buura	0.25	siltstone	<0.005	0.3	50	<70	<10
SAK087	Kara Buura	0.20	siltstone	0.007	0.3	40	<70	<10
SAK088	Kara Buura	0.25	sandstone	0.005	0.4	70	<70	<10
SAK089	Kara Buura	0.15	sandstone	<0.005	0.3	30	<70	<10
SAK090	Kara Buura	0.25	sandstone, siltstone	<0.005	<0.3	40	<70	<10

Apx.-7 List of Chemical Aanalyzed Values of Soil Samples (4)

Sample No.	Location	Depth(m)	Geology	Au(ppm)	Ag(ppm)	Cu(ppm)	As(ppm)	Sb(ppm)
SAK091	Kara Buura	0.20	sandstone, siltstone	<0.005	0.3	40	<70	<10
SAK092	Kara Buura	0.20	sandstone, shale	<0.005	0.3	30	<70	<10
SAK093	Kara Buura	0.20	sandstone, phyllite	0.005	0.3	30	<70	<10
SAK094	Kara Buura	0.30	sandstone, siltstone	<0.005	0.3	30	<70	<10
SAK095	Kara Buura	0.20	sandstone, siltstone	<0.005	<0.3	30	<70	<10
SAK096	Kara Buura	0.25	sandstone, siltstone	<0.005	0.3	40	<70	<10
SAK097	Kara Buura	0.20	siltstone, limestone	<0.005	0.3	30	<70	<10
SAK098	Kara Buura	0.20	siltstone	<0.005	0.3	40	<70	<10
SAK099	Kara Buura	0.20	shale	<0.005	<0.3	90	<70	<10
SAK100	Kara Buura	0.20	limestone, sandstone	<0.005	0.3	30	<70	<10
SAK101	Kara Buura	0.20	limestone, shale	<0.005	0.3	30	<70	<10
SAK102	Kara Buura	0.20	limestone, shale	<0.005	0.3	30	<70	<10
SAK103	Kara Buura	0.30	sandstone, siltstone	0.005	0.3	30	<70	<10
SAK104	Kara Buura	0.20	limestone, siltstone	<0.005	0.3	50	<70	<10
SAK105	Kara Buura	0.20	limestone, shale	<0.005	0.3	40	<70	<10
SAK106	Kara Buura	0.20	sandstone, siltstone	<0.005	0.3	30	<70	<10
SAK107	Kara Buura	0.30	siltstone	<0.005	0.3	30	<70	<10
SAK108	Kara Buura	0.30	sandstone, siltstone	<0.005	0.3	40	<70	<10
SAK109	Kara Buura	0.25	sandstone, siltstone	<0.005	<0.3	40	<70	<10
SAK110	Kara Buura	0.20	limestone, sandstone	<0.005	<0.3	40	<70	<10
SAK111	Kara Buura	0.20	sandstone, siltstone	<0.005	<0.3	40	<70	<10
SAK112	Kara Buura	0.20	marble, siltstone	<0.005	0.3	30	<70	<10
SAK113	Kara Buura	0.20	limestone, shale	<0.005	0.3	40	<70	<10
SAK114	Kara Buura	0.20	limestone, shale	<0.005	0.3	40	<70	<10
SAK115	Kara Buura	0.20	sandstone, shale	0.007	<0.3	120	<70	<10
SAK116	Kara Buura	0.20	sandstone, shale	0.009	0.3	50	<70	<10
SAK117	Kara Buura	0.20	sandstone, shale	0.009	<0.3	30	<70	<10
SAK118	Kara Buura	0.20	sandstone, shale	0.005	<0.3	70	<70	<10
SAK119	Kara Buura	0.20	sandstone, shale	<0.005	0.3	30	<70	<10
SAK120	Kara Buura	0.20	sandstone, shale	<0.005	0.3	40	<70	<10

Apx.-7 List of Chemical Aanalyzed Values of Soil Samples (5)

Sample No.	Location	Depth(m)	Geology	Au(ppm)	Ag(ppm)	Cu(ppm)	As(ppm)	Sb(ppm)
SAK121	Kara Buura	0.20	sandstone, shale	<0.005	<0.3	30	<70	<10
SAK122	Kara Buura	0.20	sandstone, shale	<0.005	0.4	40	<70	<10
SAK123	Kara Buura	0.20	sandstone, shale	<0.005	0.4	150	<70	<10
SAK124	Kara Buura Pass	0.20	siltstone, limestone	0.005	0.3	40	<70	<10
SAK125	Kara Buura Pass	0.20	limestone	<0.005	0.3	50	<70	<10
SAK126	Kara Buura Pass	0.20	marble - fracture	0.005	<0.3	12	<70	<10
SAK127	Kara Buura Pass	0.20	granite	0.020	0.4	30	<70	<10
SAK128	Kara Buura Pass	0.20	granite, marble, hornfels	0.030	0.5	30	<70	<10
SAK129	Kara Buura Pass	0.20	marble	0.005	0.3	40	<70	<10
SAK130	Kara Buura Pass	0.25	granite, hornfels	<0.005	0.4	30	<70	<10
SAK131	Kara Buura Pass	0.25	granite	<0.005	0.3	30	<70	<10
SAK132	Kara Buura Pass	0.20	granite	0.005	0.4	30	<70	<10
SAK133	Kara Buura Pass	0.25	marble, siltstone - fracture	0.005	0.3	30	<70	<10
SAK134	Tegerek Too	0.20	sandstone, shale	<0.005	<0.3	30	<70	<10
SAK135	Tegerek Too	0.20	sandstone, shale	0.007	0.4	40	<70	<10
SAK136	Tegerek Too	0.20	sandstone, shale	<0.005	0.3	70	<70	<10
SAK137	Tegerek Too	0.20	sandstone, shale	<0.005	<0.3	40	<70	<10
SAK138	Tegerek Too	0.20	clay, sandstone rock debris	<0.005	0.3	30	<70	<10
SAK139	Tegerek Too	0.20	sandstone, shale	<0.005	0.3	50	<70	<10
SAK140	Tegerek Too	0.20	sandstone, shale	0.020	0.7	50	<70	<10
SAK141	Tegerek Too	0.20	sandstone, shale	<0.005	1.2	40	<70	<10
SAK142	Tegerek Too	0.20	sandstone, shale	<0.005	0.3	40	<70	<10
SAK143	Tegerek Too	0.20	sandstone, shale	<0.005	<0.3	40	<70	<10
SAK144	Tegerek Too	0.20	sandstone, shale	<0.005	0.3	50	<70	<10
SAK145	Tegerek Too	0.20	sandstone, shale	<0.005	<0.3	30	<70	<10
SAK146	Tegerek Too	0.20	sandstone, shale	<0.005	0.3	40	<70	<10
SAK147	Tegerek Too	0.20	sandstone, shale	<0.005	0.3	40	<70	<10
SAK148	Tegerek Too	0.20	sandstone, shale	0.005	0.3	30	<70	<10
SAK149	Tegerek Too	0.20	sandstone, shale	<0.005	0.3	30	<70	<10
SAK150	Tegerek Too	0.20	sandstone, shale	0.009	0.3	40	<70	<10

Apx.-7 List of Chemical Aanalyzed Values of Soil Samples (6)

Sample No.	Location	Depth(m)	Geology	Au(ppm)	Ag(ppm)	Cu(ppm)	As(ppm)	Sb(ppm)
SAK151	Tegerek Too	0.20	sandstone, shale	0.007	0.3	30	<70	<10
SAK152	Sarymsak	0.20	sandstone, siltstone	<0.005	0.3	30	<70	<10
SAK153	Sarymsak	0.20	clay, sandstone rock debris	0.005	0.4	30	<70	<10
SAK154	Sarymsak	0.25	sandstone, siltstone	<0.005	0.5	70	<70	<10
SAK155	Sarymsak	0.30	sandstone, siltstone	0.005	0.7	40	<70	<10
SAK156	Sarymsak	0.15	sandstone, siltstone	0.005	0.3	30	<70	<10
SAK157	Sarymsak	0.20	granite, hornfels	<0.005	0.4	40	<70	<10
SAK158	Sarymsak	0.20	granite, hornfels	<0.005	0.5	30	<70	<10
SAK159	Sarymsak	0.20	granite, hornfels	0.007	0.3	30	<70	<10
SAK160	Sarymsak	0.20	hornfels	<0.005	0.5	50	70	<10
SAK161	Sarymsak	0.20	hornfels	<0.005	0.3	30	<70	<10
SAK162	Sarymsak	0.20	granite, hornfels	<0.005	0.3	30	<70	<10
SAK163	Sarymsak	0.30	sandstone, siltstone	<0.005	0.7	30	<70	<10
SAK164	Sarymsak	0.15	sandstone, siltstone	<0.005	0.7	40	90	<10
SAK165	Sarymsak	0.20	sandstone, siltstone	<0.005	0.3	30	<70	<10
SAK166	Sarymsak	0.25	sandstone	<0.005	0.3	30	<70	<10
SAK167	Sarymsak	0.20	sandstone, siltstone, shale	<0.005	0.3	30	<70	<10
SAK168	Sarymsak	0.20	sandstone	<0.005	0.5	40	200	120
SAK169	Sarymsak	0.20	sandstone	<0.005	<0.3	30	<70	<10
SAK170	Sarymsak	0.20	sandstone	0.007	0.3	40	<70	<10
SAK171	Sarymsak	0.20	siltstone	<0.005	0.3	40	<70	<10
SAK172	Sarymsak	0.20	sandstone, siltstone	<0.005	<0.3	40	<70	<10
SAK173	Sarymsak	0.20	limestone, sandstone	<0.005	0.3	40	<70	<10
SAK174	Sarymsak	0.30	siltstone, limestone	0.005	0.3	30	<70	<10
SAK175	Sarymsak	0.30	gritstone, sandstone	<0.005	0.3	30	<70	<10
SAK176	Sarymsak	0.20	siltstone	<0.005	0.9	30	<70	<10
SAK177	Sarymsak	0.30	siltstone, sandstone	0.030	0.3	30	<70	<10
SAK178	Sarymsak	0.30	hornfels	<0.005	0.3	40	<70	<10
SAK179	Sarymsak	0.20	hornfels	<0.005	0.5	40	<70	<10
SAK180	Sarymsak	0.20	shale	0.005	0.4	20	<70	<10