CHAPTER 2 COMPILATION OF EXISTING GEOLOGICAL DATA

2-1 Geology

The survey area is situated in the Middle Tien-Shan folding zone of Hercynian folding system which extends from the central Kyrghyz to the western Kyrghyz. It is in the west of the dividing Talas-Fergansky fault, near the border with the Republic of Uzbekistan. It lies on the southern slopes of the Pskem mountains, in the right bank of upper stream of Chatkal river.

The Middle Tien-Shan folding zone lies between the Northern Tien-Shan folding zone of Caledonian folding system and the Southern Tien-Shan folding zone of the Hercynian age. It is believed that the geosyncline had been formed to produce land at least partially by the middle Proterozoic (Ripheian age). A regional geological map of this survey area is shown in Fig. I -3-1.

The stratigraphy, intrusive activity and geological structure of the survey area are described below.

2-1-1 Sedimentary rocks

1) Proterozoic formations

(1) Uzunbulak formation (middle Proterozoic: Ripheian system)

These strata consist mainly of molasse and are divided into two parts, the lower and the upper. The thickness of this formation is 100m～600m. Lower molasse distributed in the Sandalash mountains is characterized by poor succession to the strike direction, conglomeratic slate with large rock fragments and sandstone in various size. Conglomeratic slate looks greenish gray, and contains medium to coarse grained pebble which consist of chart, siliceous silt, granite, shale and basic igneous rocks. The lower conglomeratic sediments bearing coarse pebble become gray green sandstone, shale, and rhythmic interbeds of sandstone and shale with occasional thin layers of limestone as they go higher.

Mineralization in this formation is specialized for gold and copper. There are good possibilities for discovering placer deposits in fine-grained sandstone, siltstone and silty shale.

(2) Mursash formation (Upper Proterozoic : Vendian system)

This formation consists of carbonaceous conglomeratic shale, trachybasalt, trachyandesite and terrigenous deposits. It occurs around the watershed of the Pskem mountain range, with its thickness reaching 150m～200m.The lowest part of this formation consists of conglomerate and conglomeratic sandstone lying on

the erosion surface of tonality, plagioclase granite and granodiorite. Going up from the bottom it changes into volcanic rocks and sediments with its thickness reaching 100m. It consists of tuff, tufaceous shale, crushed lava, trachybasalt, trachyandesite and trachyte.

The upper part of this formation consists of sandstone -mudstone beds (100m in thickness), rarely intercalated with thin carbonate beds. Although characteristics of mineralization in this formation are not clear, deposits of porphyry copper - molybdenum ore may be expected in the trachybasalt - trachyandesite formation.

(3) Shorashuy formation (Upper Proterozoic : Vendian system)

These strata consist mainly of mudstone and carbonate rocks, and are divided into the upper and the lower parts. The thickness of this formation is estimated 450m～800m. In the Pskem mountain range this formation overlies the Mursash, and in the Sandalash mountain range it overlies the Uzunbulak. Poorly sorted tillite, bearing boulders in 1.5m diameter and pebbles composed of granitic rocks, carbonate rocks, meat-shale, slate and lava, occur at the bottom of this formation. The upper strata consist of fine grained, carbonaceous, crushed terrigenous sediments and are divided into beds sandstone (graywacke, arkose sandstone, quartz-feldspar sandstone and quartz sandstone) and shale (quartz-feldspar silt, quartz silt, silt-argillaceous shale, sericite shale and chlorite-sericite shale). They exhibit rather poor exposure on the surface.

Based on the fact that this formation is overlain by the Sandalash formation of the lower Cambrian to the middle Oldovician age, it has been confirmed that this formation is from the Vendian age.

This formation is intruded by middle Carboniferous diorite-granodiorite which tends to be associated mineralization of gold, tungsten, molybdenum, copper, polymetals, silver, antimony and others. Therefore, close attentions are paid to this formation and the upper Sandalash formation as embedding placer deposits of precious and rare metals.

2) Paleozoic groups

(1) Sandalash formation (Lower Cambrian Series～Middle Oldovician Series)

These strata consist mainly of terrigenous deposits (tillite and siliceous shale), limestone and dolomite, are distributed widely in the Sandalash and Pskem mountain ranges.

In the tillite and siliceous shale at the bottom of this formation occur

rhythmically altering beds of argillaceous limestone and siliceous shale. There are some pieces of fossil contained in those beds, and geologic ages have been determined by those fossils. The thickness of this formation varies from 80 m to 350m.

Mineralization in this formation is specialized for bedded polymetals accompanied with silver, vanadium and uranium. There are good possibilities for discovering bedded polymetals deposits in the areas occupied by tillite and siliceous shale which overlie the Beshtor body bearing copper, lead, zinc and precious metals.

The beds of tillite and siliceous shale change into beds of carbonaceous limestone-dolomite and carbonaceous, siliceous shale-terrigenous deposits as they go higher, and are overlain by the siliceous shale.

The carbonaceous, siliceous shale and terrigenous deposits are composed of tillitic conglomerate, tillite and carbonaceous, and siliceous shale, and reach as thick as 100m to 200m. At the middle part of this formation, occurs silty carbonaceous limestone, and the upper part is occupied by silt and the lens of silty limestone. Geologic ages of this formation have been determined by the fossils of graptolites.

In the Sandalash mountain range, this formation is composed of dark gray-black argillaceous, carbonaceous silty shale, limestone and argillaceous shale. Its thickness is estimated to be 1,000m～1,500m.

On the southern slope of Pskem mountain range, lower beds of this formation (tillitic conglomerate) lie on the upper Shorashuy, and as it goes higher it becomes interceded silt and argillaceous shale or dolomite limestone with intercalated sandstone beds.

At the valley of Shorashuy river the tillite (50m in thickness) of this formation occurs on the gravel of weakly eroded Shorashuy formation, changing upward into carbonaceous and siliceous shale including lenses of dolomite. The thickness of this formation is 180m. The fossils have determined geologic ages of this formation.

(2) Abutter formation (Middle～Upper Oldovician Series)

This formation consists of flysch which is composed mainly of interceded sandstone and shale, and is distributed in the Sandalash and Pskem mountain ranges. It is graywacke at the bottom and changes into rhythmically interbedded graywacke (1～15m) and siliceous sandstone (2～3m). The thickness of this formation reaches a maximum of 440m.

(3) Tulkubash formation (Lower～Middle Devonian Series)

This formation consists mainly of terrigenous carbonate sediments, and is distributed in the Pskem and Sandalash mountain ranges. According to the existing

data, this formation is divided into the lower and the upper parts. The lower part consists of conglomerate, graywacke and sandstone. Its thickness ranges from several meters to 630 meters. The upper part consists of arkose sandstone and slate, being accompanied with thin and lens shaped medium-grained conglomerate. Argillaceous shale and marl lie at the top. Their thickness reaches 350m～700m. The upper part of this formation has good possibilities for placer deposit as well as copper and barite-copper deposits. High probabilities of gold deposits are also suggested.

(4) Carbonaceous limestone (Upper Devonian Series : Fammennian series)

This formation is distributed on the ridges of the Sandalash mountains, and is divided into the biogenic limestone (100m～200mthick and the carbonaceous limestone (200m～250m thick). This formation is considered to be related with bedded copper-barite deposits. Occurrence of gold deposits is expected with high probabilities especially in the area where this formation overlies Sandalash formation directly or lies near it.

(5) Carbonaceous, biogenic limestone - dolomite (Lower Carboniferous : Tournaisian series)

This formation consists mainly of carbonate rocks, and is divided into the lower part of limestone-dolomite and the upper members of limestone-calcareous breccia. The total thickness of this formation is 1,200m～1,300m. Characteristics of mineralization in this formation are not clear.

In the central Asia silver bearing polymetal deposits are embedded in carbonaceous-biogenic limestone and dolomite in the Lower Carboniferous. Similar mineralization may be expected in the carbonate rocks of the upper Devonian and the lower Carboniferous which are distributed widely in the ridge areas of the Pskem mountains.

(6) Silty limestone - carbonaceous sediments (Lower Carboniferous : Visean series)

Silty limestone contains light brown silt and shows platy to massive forms. Its thickness is 600m. It bears a number of fossils of brachiopods, crinoids and foraminifera. Therefore, geologic ages of this formation have been determined by those fossils. Carbonaceous sediments consist of slaty, carbonaceous, silty limestone, shale and slate, and are as thick as 2,000m. Characteristics of

mineralization in this formation are not clear.

(7) Carbonaceous limestone - pyroclastic, molasse (Lower～Middle Carboniferous: Visean ～Serpukhovian series)

The lower part of this formation is biogenic limestone being composed of the medium limestone and the limestone with interbedded thin slate. The thickness of this formation is 700m～850m. In the middle part, brecciated limestone and a thin layer of dolomitic limestone are found.

(8) Silt - limestone (Lower～Middle Carboniferous: Visean～Serpukhovian series)

This formation consists of light gray to gray colored limestone accompanied with dark thin layers of slate. Its thickness is 400m to 500m.

The upper and lower parts of this formation are occupied by crushed organic limestone, and in the middle part thin layers of carbonaceous dolomitic limestone are interbedded. Just below this formation are carbonaceous limestone and sediments of pyroclastic molasse which consist of rhythmic alternating beds of limestone, tuffaceous shale, slate and sandstone. Their total thickness is 310m. Characteristics of mineralization in this formation are not clear.

(9) Minbulak formation (Middle Carboniferous : Bashkirian series)

This formation consists of andesite lava, trachyandesite and tuff, and is distributed in the bottom of Turpac-Tushty valley. At its bottom lies pyroclastic conglomerate.

3) Cenozoic groups

(1) Alamuyum and Musabek formation (Neogene : lower Miocene series)

This formation is divided into two parts based on the lithofacies and the structure. The lower part consists of terrigenous carbonate rocks, and the upper part of terrigenous deposits. It is characteristically interbedded with alluvium, deltaic deposits and lake deposits, and is 1,500m thick. It is suggested that formation of these sediments is related with the activities of uplifting continent.

(2) Terrigenous molasse (Quaternary : Pleistocene ～Holocene series)

This formation consists of unsolidificated terrigenous molasse, and is separated by four unconformities. There are great differences in their origin, structure and constituents. Placer deposits occur in the alluvium and deltaic

sediments in each stage.

2-1-2 Intrusive Rocks

Various types of igneous activities in Kyrghyz, such as the ones caused by subduction of the plate and alkaline magma of the inner continent, are known to have existed from the Proterozoic era to the late Paleozoic era. In the Kichi-Sandyk area, igneous rocks of late Paleozoic (Carboniferous and Permian) is distributed broadly.

(1) Beshutor bodies (Early Proterozoic ?)

These bodies consist of tonalite, plagioclase granite and granodiorite. Most of them show light gray to pinkish color with porphyritic texture, and are composed of sericite and two-mica granitic rocks. They intrude along the axis of the Chandalah anticline located northeast of the watershed of the Pskem Mountain range. It extends 3 to 7km in width and 35km in elongation. Granodiorite in the above mentioned granitic rocks has an average 0.06 g/t and a maximum of 0.32 g/t gold in content. These bodies are related with gold deposits accompanied with copper and hydrothermal gold deposits in this area.

(2) Tunduk bodies (Late Proterozoic)

These bodies consist of small bodies and/or dikes of gabbro, diabae and dolerite. They are distributed in the Pskem and Sandalash mountains, and partly in the Chatkal mountain. They intrude Beshutor bodies, the Uzunbulak of middle Proterozoic and the Shorashuy of the upper Proterozoic, and are overlain by the Sandalash of the lower Cambrian to the middle Oldovician. They are related with mineralization of nickel, cobalt, platinum and titanium.

(3) Alabuka body (Late Silurian)

This body consists of granodioritic rock. It occurs in one place in the Chatkal mountains located in the southeast of the survey area. It may belong to the Caledonian orogene of the early Paleozoic. It intrudes the Sandalash of the lower Cambrian to the middle Oldovician.

(4) Sandalash-Chatkal complex (Late Carboniferous)

These bodies consist of diorite and granodiorite. They are widely distributed in the Sandalash and Pskem mountains, and partly in the Chatkal mountains. Major known bodies include the Middle Sandalash body which is

adjacent to the Kichi-Sandyk ore showing from southeast, Karayangryk body in the north of the Middle Sandalash, Lower Sandalash in the south of Kichi-Sandyk, Kayinsuy body, Ikhnach-Karakorum body in the west of Kichi-Sandyk ore showing, Jayaktor body, Tayalmysh small body, and Muzbel body at the upper stream of Sandalash river.

This complex shows a horizontally long and slender shape, and intrudes the folding structure discordantly. It has been identified as belonging to the activity of the late Carboniferous (303-326 million years) by isotopic dating of radioactive minerals, and intrudes as far as the Minbulak of the middle Carboniferous (Bashikirian series).

Most of t he deposits and ore showings in this area, particularly gold, tungsten, bismuth and copper bearing skarnization are related with this complex.

(5) Kyzylsay bodies (Late Carboniferous)

These bodies consist of coarsely grained porphyritic granodiorite and granite. They are widely distributed in the Sandalash and Chatkal mountains. There are two relatively large bodies - Almasay body in the west of Kichi-Sandyk ore showing and Kzyltor body in the southeast of the Chatkal mountains.

Skarn with mineralization of polymetals has relations to the intrusions of Kyzylsay bodies.

(6) Chalmansay complex (Early Permian)

This complex consists of coarsely grained porphyritic granodiorite and granite. They are similar to the first phase of Kyzylsay bodies. It frequently forms small stocks. Major bodies of this complex include Kichi-Sandyk body which forms main mineralization zone of Kichi-Sandyk ore showing, Kurutegerek small body on the upper stream of Sandalash river, and Kachalator body in the south of the Chatkal mountains

Many skarn deposits with mineralization of polymetals related to many dikes and small stocks of the Chalmansay complex are known. Copper-gold mineralization zones occur in Kichi-Sandyk and Kurtegerek ore showings.

2-1-3 Geological Structure

The Kyrghyz Republic has undergone remarkable diastrophism four times (Baikal age, Caledonian age, Hercynian age and Alpine age), and is made up of several blocks separated with each other by faults and lineaments which accompanied these

tectonic movements. There was no large diastrophism until the late Mesozoic after the Hercynian age, and the peneplain was formed once in Kyrgyz. Present mountain topography has been formed because of block movements and upheavals of the blocks.

The survey area is situated within the Middle Tien-Shan folding zone of Hercynian folding system, in the western Kyrghyz on the western side of the dividing Talas-Fergansky fault. It is located in the right bank of the upper stream area of Chatkal river, adjacent to the border with the Republic of Uzbekistan.

Geological Structure of the Kichi-Sandyk area has been complicated by many folding structures. Sandalash large syncline, which include the whole survey area, is continuous 30~40km in width and more than 180km in length. Pskem anticline is located in the northwest of the survey area, in the center of which Beshtor granitic body of the early Proterozoic intrude. Molasse sediments are distributed on the eroded surface of Beshtor and Tunduk granitic bodies, and change upward into tillite, volcanic and terrigenous deposits of the middle to the late Proterozoic.

A tectonic belt of the Caledonian age is 7km in length is formed by carbonate, silt and terrigenous deposits of the Cambrian to the middle Ordovician system and volcanic terrigenous flysch sediments of the middle to the upper Ordovician system. Red sandstone beds of the middle to the upper Devonian cover it unconformably.

The deposits of parageosyncline of the early Hercynian age change into terrigenous carbonate sediments of the upper Devonian system, carbonate rocks of the lower Carboniferous system and silt-carbonate rocks of the lower to the middle Carboniferous system, toward the upper strata. The thickness of this formation reaches 4,500m.

These sediments are intruded by many stocks and dikes of the Sandalash-Chatkal and Kyzylsay bodies of the late Carboniferous and Chalmansay complex.

Developments of sediments in the late Hercynian orogeny are rather poor with limited surface distribution of Middle Carboniferous andesite and reddish molasse of the upper Carboniferous to the lower Permian system, and appear 500m in thickness.

2-2 Mineral Deposits

In the present survey area, which includes the Kichi-Sandyk deposit, skarn is frequently formed at the contact areas between the lower Carboniferous limestone and the Carboniferous and Permian intrusive rocks such as diorite, granodiorite, monzonite and granodiorite porphyry. Mineralization of copper-gold, antimony, tungsten and molybdenum are observed in the skarn. It is suggested that the skarn formed by early Permian granodiorite porphyry(Chalmansay complex) exhibits higher gold content

than that by the Sandalash-Chatkal complex.

According to the results of the previous explorations by the Kyrghyz, two ore showings of Kichi-Sandyk and Turpac-Tushty have been identified as promising areas for copper-gold deposits. Furthermore, several other ore showings have been also entrapped. 200 tons of gold (140t in the Kichi-Sandyk district) and 350 thousand tons of copper are expected as the potential for this area.

Outlines of each mineral showing are described below.

2-2-1 Kichi-Sandyk ore showing area

The Kichi-Sandyk ore showing is situated in the 25 km^2 area on the southern slopes of the Pskem mountain range between the valley of Achyktash and the valley of Karayangryk. This region is known for having many ore showings, and is divided into two major sub-areas -- the Kichi-Sandyk ore showing area (consisting of the central and northern mineralization zones) in the central part of the Kichi-Sandyk anticline; and the surrounding ore showing area (Drevneye, Opolznevoye, Pologoye, Achyktash Left-bank, Kichi-Sandyk, Kvartzevoye and Neogenovoye) (Fig. II-2-2).

1) Kichi-Sandyk ore showing area

This is situated in the central part of the Kichi-Sandyk anticline which runs northeast, and mineralization occurs in association with the skarn which develops between silt-carbonate sediments of the upper Cambrian to the lower Carboniferous systems (Visean series) and the Chalmansay body of early Permian. A sharp fault topography running northwest is characteristically seen in this area, and it determines vein shaped mineralization zones in the granodiorite porphyry in the central mineralization zone.

The surface area is completely oxidized. The zone of oxidation (the residual of weathering) was mined in the 6th and the 7th century as deep as 10 to 20 meters. There are many sites of old open mining, of which the largest one is 800m long and 500m wide. It is expected that oxidization extend as deep as 20 to 25 meters below the surface.

There are two types of mineralization, bedded mineralization of exo-skarn and vein shaped mineralization of endo-skarn, identified by the trenching survey, tunnel exploration (20m) in the shallow depth and cleaning of a group of ore veins conducted by the Kyrghyz.

Occurrence of gold (3.7 ~ 4.3g/t) and copper (0.52%) in the bedded mineralization zone (4~9.4m wide), and also gold (2.7~9.3g/t) and copper (0.38~

1.28%) in the vein shaped mineralization zone (4～8.5m) has been confirmed and reported by the Kyrghyz.

Mineralization is related with garnet skarn, and rarely with pyroxene skarn. The garnet is composed of andradite-grossularite and pale green to brown in color, and it is replaced by carbonate minerals and epidote. The pyroxene is hedenbergite.

The major ore minerals in the mineralization zone are native gold, silver and copper minerals. Chrysocolla malachite and azurite are found frequently as secondary minerals of copper, in aggregate of 0.1mm～several millimeters. Native gold accompanies with these copper secondary minerals. The sizes of its grain are 0.01mm～1.0mm, and smaller grains are more numerous than larger grains.

As for sulfide minerals, bornite and chalcopyrite are most common, and chalcocite and covellite are found rarely. Bornite and chalcopyrite form closely aggregate, and high grade gold (10g/t～300g/t) and silver (100g/t～1,500g/t) are found in it.

2) The surrounding ore showing area

There are seven ore showing zones, Drevneye, Opolznevoye, Pologoye, Achyktash Left-bank, Kichi-Sandyk II, Kvartzevoye, and Neogenovoye, surrounding the western and southern sides of the Kichi-Sandyk ore showing area (Fig.II-2-2).

(1) Drevneye ore showing zone

This zone is situated about 1km west of the Kichi-Sandyk central mineralization zone. Skarn is found at the contact of granodiorite porphyry and crystalline limestone, part of which is covered with talus. There is evidence for past mining.

Distribution of the skarn is estimated to extend 150m×250m,and some bornite and a small amount of chalcopyrite are disseminated in the mineralized skarn (mining waste). Mineralization zones of gold with the grade at 9.0g/t and 18g/t have been found by the trenching survey.

(2) Opolznevoye ore showing zone

This zone is situated about 2.2km southwest of Kichi-Sandyk central mineralization belt, on the left side of Achyktash valley at the altitude between 2,700m and 2,750m.

Crystalline limestone is intruded by a small body of granodiorite porphyry,

and pyroxene and garnet skarn is found along the boundary. The northern and eastern sides of the skarn are covered with talus. The skarn is as thick as 35m, and partially silicified. Sulfide copper and its secondary minerals are disseminated irregularly. There is evidence of past mining.

Lens and vein like garnet skarn develops in the granodiorite porphyry, Gold content of 2g/t is found in the skarn collected by the trenching survey, and lump samples with gold content of 12.5g/t, silver of 19.4g/t and copper of more than 1% have been confirmed.

(3) Pologoye ore showing zone

This zone is situated about 2.4km west of Kichi-Sandyk central mineralization zone. Crystalline limestone is intruded by dykes and small bodies of granodiorite porphyry, and garnet skarn is found along the boundary. Vein skarn is also fund in granodiorite porphyry. The thickness of the skarn is 3m to 7m and copper sulfide and its secondary minerals are disseminated. There is evidence of past mining. The skarn sample from the old trench contains 3.2g/t of gold.

(4) Achyktash left bank ore showing zone

This zone is situated about 3km west of Kichi-Sandyk central mineralization zone. Crystalline limestone is intruded by the stock of granodiorite porphyry, and skarn occurs in the limestone. The skarn zone composed of garnet skarn, garnet-clinopyroxene skarn and skarnized limestone occupies in approximate range of 180m×250m, in which native gold bearing copper sulfide and its secondary minerals are observed.

There is evidence of past mining, and a range between 2.5g/t to 10g/t of gold content is confirmed.

(5) Kichi-Sandyk II ore showing zone

This zone is situated about 3.8km west of Kichi-Sandyk central mineralization zone, on the left side of Achyktash valley at the altitude between 2,800m and 2,900m.

Crystalline limestone is intruded by dykes and stocks of granodiorite porphyry, and is partially overlain by reddish conglomerate of upper Neogene and talus of Quaternary. Along the contact between granodiorite porphyry and limestone, clinopyroxene-garnet skarn and garnet skarn extend about 30m×180m. In the skarn sulfide minerals such as chalcopyrite, chalcocite, bismuthinite and

stibnite and in the oxidized zone the secondary minerals are found.

Gold content ranges 0.5g/t to 1g/t and rarely reaches 5g/t, and copper of less than 0.5% and silver of 41.9g/t are also confirmed. The area with strong pyrite dissemination in granodiorite porphyry, extends in an approximate range of 250m ×300m , in which low gold content of 0.1g/t to 0.7g/t are known.

(6) Kvartzevoye ore showing zone

This zone is situated 0.7km to the south of Kichi-Sandyk central mineralization zone.

Networks of quartz veinlets have developed in the granodiorite porphyry, in which the remains of exo-skarn and end-skarn are also included. The southern part of the body is partially overlain by the conglomerate and loam of the upper Neogene. Networks of quartz veins with diverse directions and 0.5 to 3cm in width have developed in an approximate range of 600m×500m, in which pyrite and chalcopyrite are disseminated. Low grade of gold at 0.7g/t (rarely 4.9g/t) are shown in this zone.

(7) Neogenovoye ore showing zone

This zone is situated 1.4km to the south of Kichi-Sandyk central mineralization zone. Granodiorite porphyry and skarn occur in brown clay and conglomerate of the Neogene like fenster. Skarn occupies a range of 360m^2, and quartz veins with diverse directions are observed. In this skarn chalcopyrite and stibnite are weakly disseminated in association with a small amount of native gold. Gold content of 1～1.5g/t, silver content of 4g/t, and copper content of 1.1% are obtained.

2-2-2 Turpac-Tushty Ore Showing District

This zone is situated about 13km to the south of Kichi-Sandyk ore showing and is located in the left bank of lower part of Sandalash river and around the valley of Turpac-Tushty.

Geological survey of this mineral showing area began in 1963, the survey from 1969 to 1987 revealed a lot of mineral showings in the area between the Aksay valley and the Aktush valley (Fig. II-2-1).

Crystalline limestone of lower Carboniferous, volcanic sediments (Minbulak formation) of middle Carboniferous and diorite – granodiorite (Sandalash-Chatkal complex) of early Permian age which intrude into the Minbulak, are overlain on this area. A small quartzporphyry stock (Chalmansay complex) of early Permian and dikes of granodiorite-diorite are also intruded.

In the mineral showings fault geography is developed and the Dzhetyzingan fault and the Kokusay fault are exhibited as major fault.

Mineralization in this mineral showing is specialized for hydrothermal quartz-sulfide vein, bedded skarn and polymetals mineralization accompanied with gold and bismuth. In this area there are about 20 mineral showings such as Turpac-Tushty, Tegermen, Jetyzindan, Akkomou, Otvalnoe and Kokayky, and more than 55 mineralization points are confirmed.

1) Turpac-Tushty ore showing zone

This zone is situated on the left side of Sandalash valley and in the edge of the southwest of the Sandalash mountains, at the altitude between 2,780m and 3,200m.

From 1969 to 1976 geological survey, excavation by trenching and digging of a short tunnel were carried out in this mineralization area.

In the granodiorite porphyry accompanied with abundant pyrite, hydrothermal alteration zone consists of quartz and sericite, and embeds the mineralization of gold. The mineralization zone tends to northeast strike and strict inclination of 80° to 85° dip. This zone changes crushed zone in limestone associated wit sulfide toward the northeast direction. The width of this mineralization varies 1m to 12.6m and its average is 1.95m to 2.2m. The continuity of mineralization can be pursued for 1.5km to strike and might be estimated for 100m below.

The main constituent minerals are quartz, feldspar, chlorite, sericite and calcite, accompanying with pyrite, native gold, a little of chalcopyrite, galena, sphalerite, bismuth and molybdenite. As a result of the survey from 1980 to 1987, ore reserve (P1) are 695 thousand tons and 2.9 ton in gold (average grade is 4.22g/y).

2) Tegermen ore showing zone

This zone is situated on the right side of Akkomou valley and in the southwest of the Turpac-Tushty. Limestone of lower Carboniferous and granodiorite, by which limestone is intruded, are overlain in this mineralization zone. Mineralization is controlled by the Jetyzindan fault with the northeast strike and is embedded in skarn and quartz vein. The width of quartz vein is 0.1m to 2m and its length reaches several meters to 50 meter. The mineralization in skarn is weak and quartz vein includes gold content of trace to 3 g/t and silver content of trace to 181 g/t.

3) Otavalno ore showing zone

This zone is situated on the northeast slope of the Jetyzindan mountains and 3 km southwest of the Turpac-Tushty mineralization zone. Mineralization is exhibited in the skarn developed at the contact between granodiorite and limestone, and copper mineralization also occurs in silicified limestone.

3) Akkomou ore showing zone

This zone is situated on the upper stream of the Akkomou river and 2 km southwest of the Turpac-Tushty mineralization zone. Limestone of lower Carboniferous and granodiorite, by which limestone is intruded, are overlain in this mineralization zone. The Jetyzindan fault zone with the northeast strike is developed as main fault, in which the mineralization is shown. The strike of mineralization extends east-northeast and east, 1m to 15m in width. Mineralization is related with crushed zone of quartz and hematite and The content of gold varies trace to 33g/t. Average grade in high grade ore is gold content of 3.6 g/t and silver content of 1 g/t, its width is several centimeter to2.5 meter and its length reaches 170meter.

In this mineralization zone it is excavated until 10m below surface in the past. From the assay results of the waste from there, we conjecture that there was probably high grade ore in the old pits.

4) Kokayky ore showing zone

This mineralization zone is situated on the upper stream of the Kokayky river and 2 km north of the Turpac-Tushty mineralization zone.

Quartz vein of crushed zone with the northeast strike in diorite – granodiorite exhibits mineralization of pyrite and copper. The width of the crushed zone is 50 m

and extends about 800 m. From the place strongly mineralized gold content of 8.5g/t, silver content of 643g/t and copper content of 0.7% are obtained.

6) Turpac-Tushty Skarn ore showing zone

This zone is situated on the lower stream of the Turpac-Tushty river and about 3.5km northwest of the Turpac-Tushty mineralization zone.

Limestone of lower Carboniferous is intruded by granodiorite. Skarn is developed at the contact of both and mineralization of polymetals accompanied with gold is developed in the skarn. A maximum width of the skarn is 30m and 400m in length. Gold content of trace to 5g/t, silver content of several g/t to 258 g/t are obtained. Average grade of whole skarn is not economic. It changes into limestone – dolomite of Devonian (Famenian age). The dip of these strata shows low angle (15° to 20°) and also fold structure with gently dip. Above mentioned sediments are intruded by Sandalash – Chatkal complex of later Carboniferous.

2-2-3 Other Ore Showing Area

1) Sandalash Ore Showing

This zone is situated on the upper to lower stream of the Sandalash river and exhibits a rectangle of 15km in length and 2 to 3 km 3.5km.

There are 35 mineralization zones and 15 ore showings and 20 gold – copper mineralization points in this area. It is situated in the southwest end of the Brachia syncline. Limestone and terrigenous deposits of Sandalash formation in Cambrian to middle Ordovician period are overlain. These sediments are intruded by Sandalash – Chatkal complex of later Carboniferous. Felsite of Chalmansay complex (early Permian period) and a small dike of quartz porphyry also intrude in 5 to 6 meter width and associated with arsenopyrite, pyrite and chalcopyrite.

In this area there are rare two mineralization of metal – molybdenum – tungsten and gold – copper, the later is developed. Gold – copper mineralization is exhibited in the skarn formed on the contact between limestone of lower Carboniferous and the intrusive rocks of Sandalash body. Its width reaches several meters.

2) Tunduk Ore Showing

This ore showing is situated in the axis adjacent to the Pskem mountain range and about 10km WWN direction, in which 25 ore showings and 16 mineralization points were discovered.

Plagioclase granite of early Proterozoic and leucocratic two mica granite of Beshtor complex are intruded in this area, on which molasse deposits of middle to upper Proterozoic bearing conglomerate on the basement are overlain in related with unconformity.

Gold bearing quartz veins, silicification zone in granite associated with sulfide and veins along to fault with sulfide are exhibited. In which mineralization of gold, gold – copper, gold – polymetals, silver and arsenic are recognized, gold content of trace to 2 g/t, silver content of 40 g/t and copper content of 1% are obtained.

3) Karayangryk Ore Showing

This ore showing is situated in the upper most stream of Karayangryk river, near the watershed of the south slope of Pskem mountain range. Plagioclase granite belonging to the Beshtor complex of the early Proterozoic, diabase, dikes of quartz porphyry, small veins and a group of veinlets of pegmatite is distributed in this area. These bodies are divided by the northeast-striking Karakanysh fault, and mineralization is observed along this fault zone. This mineralization zone is 1.5km long and 70m wide, and runs northwest and northeast. Pyrite, hematite and chalcopyrite are found in the silicified rocks. Gold content of 3g/t has been also confirmed in the sample taken from silicified granite.

Many ore showings have been found also outside the Karakanysh fault zone with the sizes ranging from several meters to 40 meters in width and 300 meters in length. Gold content of tr.3g/t has been confirmed in some samples.

Not sufficient amount of survey has been conducted in this area because of geographical inaccessibility. However, there are known old gold exploration sites in granite north of this area in the territories of the Republic of Uzbekistan .

2-2-4 Potential of Gold Deposit

According to the state concern Kyrghyzaltyn (project finding study, 1997), the gold deposit potential (C2+P1+P2) in the Kichi-Sandyk ore showing area, which includes both Kichi-Sandyk (central and northern ore zones) and the surrounding ore zones, is estimated, based on the past surveys by the Kyrghyz, as 140 tons. Its details are shown below.

Districts	C2(t)	P1(t)	P2(t)	Sub-total(t)
Central/North min. zone	16.7	16.1	32	65
Drevneye			30	30
Kichi-Sandyk West			35	35
Kichi-Sandyk Northwest			10	10
Total	16.7	16.1	107	140

There is no report about gold deposit potential for other mineralization zones due to different levels of advancement in mineral exploration, except for the southern Turpac-Tushty mineralization zone where 3 tons (gold content) of P1 resources are expected. However, it is suggested that there is a total of 60 tons of gold deposits in the entire area.

1) Kichi-Sandyk Ore Showings Area

(1) Kichi-Sandyk ore showing

Deposit potential is estimated for the central and the northern mineralization zones. For those ore bodies whose continuity has been sufficiently confirmed by trenching at several places and those bodies whose boundary can be determined by the outcrops in the geological map, the reserves have been calculated. And for those ore bodies which lie below the pits of past mining and skarn outcrops, P1 resources are estimated. It is not possible to mine selectively from smaller veins of ore, because their width varies between 0.3m and 4.4m. Therefore, smaller veins are put together, including non-mineralization parts in between, and treated as a single ore body.

The width and ore grade of each ore body are estimated based on the results of chemical analysis for ore blocks. Continuity to the bottom is estimated as a half of the greatest figure obtained -- i.e. average of 100m.

Average specific gravity is estimated to be 3.3t/m^3 from the results of the

rock density measurements.

On the bases of those assumptions, 8,517,000 tons of ore tonnage and 33 tons (gold content) of reserves (average grade 3.85g/t) are estimated as category C2 and P1. However, there is no detailed data available about determination of ore blocks and standards for calculation of ore reserves are not at all clear. Therefore, it is best to assume that those figures are still provisional.

Table II-2-3 Summary of Reserves & Resources in the Kichi-Sandyk Deposit

Ore body	C2			P1			Total		
	Amount	Au grade	Au metal	Amount	Au grade	Au metal	Amount	Au grade	Au metal
	× 1000t	g/t	t	× 1000t	g/t	t	× 1000t	g/t	t
Centralny*1	3,711	4.0	15.0	4,203	3.6	15.3	7,914	3.8	30.3
Severny*2	403	4.3	1.7	202	4.3	0.9	605	4.3	2.6
Total	4,114	4.1	16.7	4,405	3.7	16.1	8,519	3.9	32.9

＊ 1 : central ore zone、＊2 : north ore zone

The above figures are for parts of the central and the northern mineralization zones only, and do not indicate the entire potential.

No detailed surveys have been conducted in the southwestern part of the mineralization zone where there are past open pit mining sites, and the eastern part where exo-skarn and endo-skarn are covered with deposits of the Neogene and Quaternary systems. In addition, the northern part, where no trenching has been done, is promising given the scale of mining operations in the past. It is expected that there is 32 tons (gold content) of P2 resources in the above areas that have not been covered by the past surveys (assuming that similar geological conditions continue from the central and northern areas to these areas). Therefore, a total of 65 tons (gold content) of C2+P1 resources is estimated as the entire area's potential.

(2) Surrounding Areas of Ore showing

Drevneye ore showing is similar to the northern mineralization zone of Kichi-Sandyk ore showing area in development and distribution of the skarn, and

30 tons (gold content) of P1 resources is estimated.

There is a development of skarn along the edges of granodiorite porphyry stock in the western part of Kichi-Sandyk ore showing zone, and mineral showings of Pologoye, Achyktash Left-bank, Opolznevoye are distributed. This stock is the exposed top of a huge rock, and a larger distribution of skarn is expected in a relatively shallow area. 35 tons (gold content) of P2 resources is expected in those areas.

There is a distribution of crystalline limestone covered with thick layers of Quaternary sediments from the central mineralization zone to its northwest. Results from the past physical prospecting suggest that there is a granitic body at 150m～200m below the marble, with the skarn accompanied probably with copper-gold mineralization on the border between the two bodies. 10 tons of potential gold content is estimated for this area. In addition, a total of 75 tons (gold content) of P2 resources is expected in the remaining parts of the surrounding mineral showing zone.

Thus, it is assessed that Kichi-Sandyk ore showing area as a whole has a total of 140 tons (gold content) in resources.

2) Turpac-Tushty ore showing

For the silicification and sericitization zone with pyrite in the hydrothermal-altered granodiorite porphyry, P1 resources of 695,000 tons of crude ore and 2.9 tons of gold content (average grade 4.22g/t) is estimated.

3) Other Ore showing areas and zones

A total of 65 to 70 tons (gold content) of P2 resources is reported for the entire area including Tegermen ore showing area within the Turpac-Tushty and Sandalash ore showing areas. However, details are not clear.

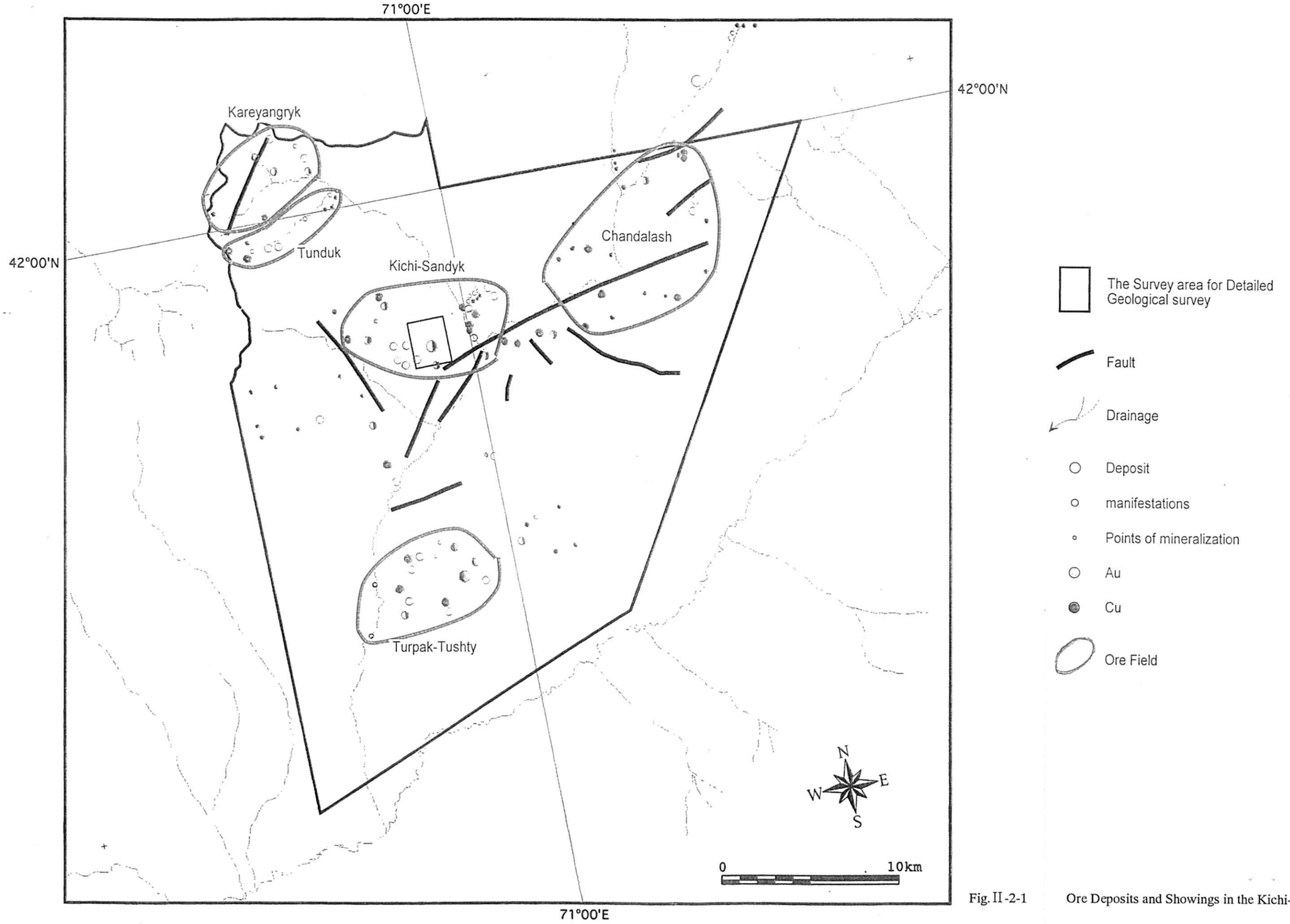

Fig. II-2-1 Ore Deposits and Showings in the Kichi-Sandyk Area

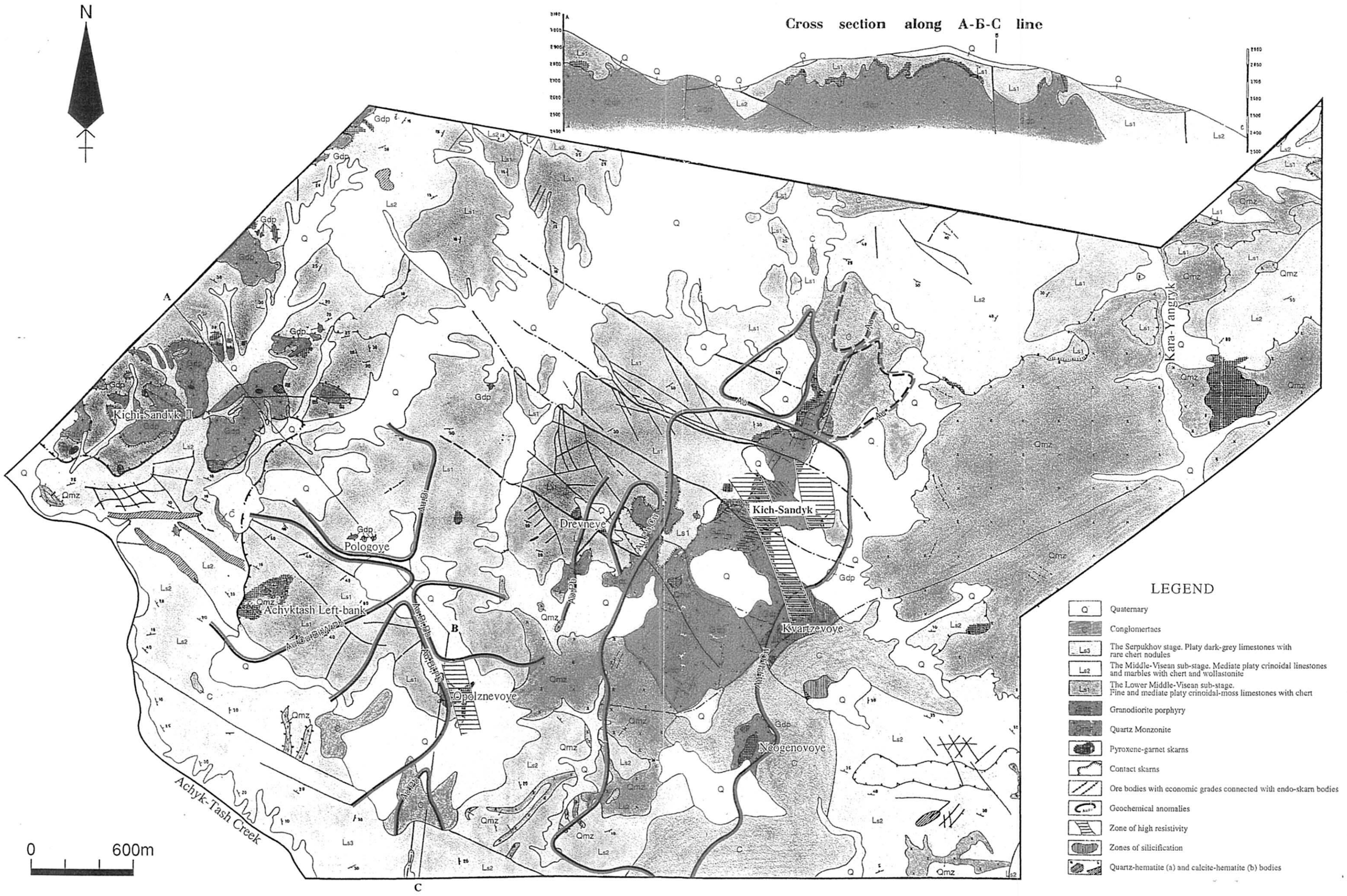

Fig. II -2-2 Summary of the Compilation in the Kichi-Sandyk District