· Paleogene ·

⑰ Kokturnakskaya formation (P_{kk})

This formation consists of pleochroic clay and granule conglomerate. It is 20 m in thickness.

· Neogene ·

⑱ Ulubashatskaya formation (N_{1ul})

This formation consists of pleochroic clay, sandstone and granule conglomerate. It is 700 m in thickness.

⑲ Eachkeletauskaya formation (N_{2ic})

Lower member (600m): It consists of conglomerate, green gray and red clay.

Middle member (350m): It consists of green and grayish yellow clay and granule conglomerate.

Upper member (400m): It consists of light brown and greenish yellow clay, and a little amount of conglomerate and sandstone.

· Neogene ~ Quaternary ·

⑳ Sharpyrdakskaya formation

It consists of gravel, sand, silt and clay. Its thickness exceeds 600 m.

2-2 Ore deposits

The survey area is known by many deposits and large ore occurrences of gold, silver, lead, zinc, arsenic, beryllium, copper and tungsten. As typical mineral, silver was produced in ancient time in the area. Numerous ancient workings are distributed there and archaeological surveys are made. The peak of the mining was in 9th - 12th centuries. An ancient Sheldzhy city was the most import center of silver production in the area. The city is presumed to be located at the distance of 3 km to northeast from Kirovskoye.

Mineral resources maps and their explanations of Ministry of Geology, USSR (1963 c, & d) and a report of Ryabko (1992) are referred to for main data of the ore deposit.

Forty objects are selected as known ore deposits and mineral occurrences in the area (Fig.II-2-5, Table II-2-1, PL.-4). These objects consist of one gold, six silver, four copper, seventeen lead, four arsenic, five beryllium and three tungsten deposits.

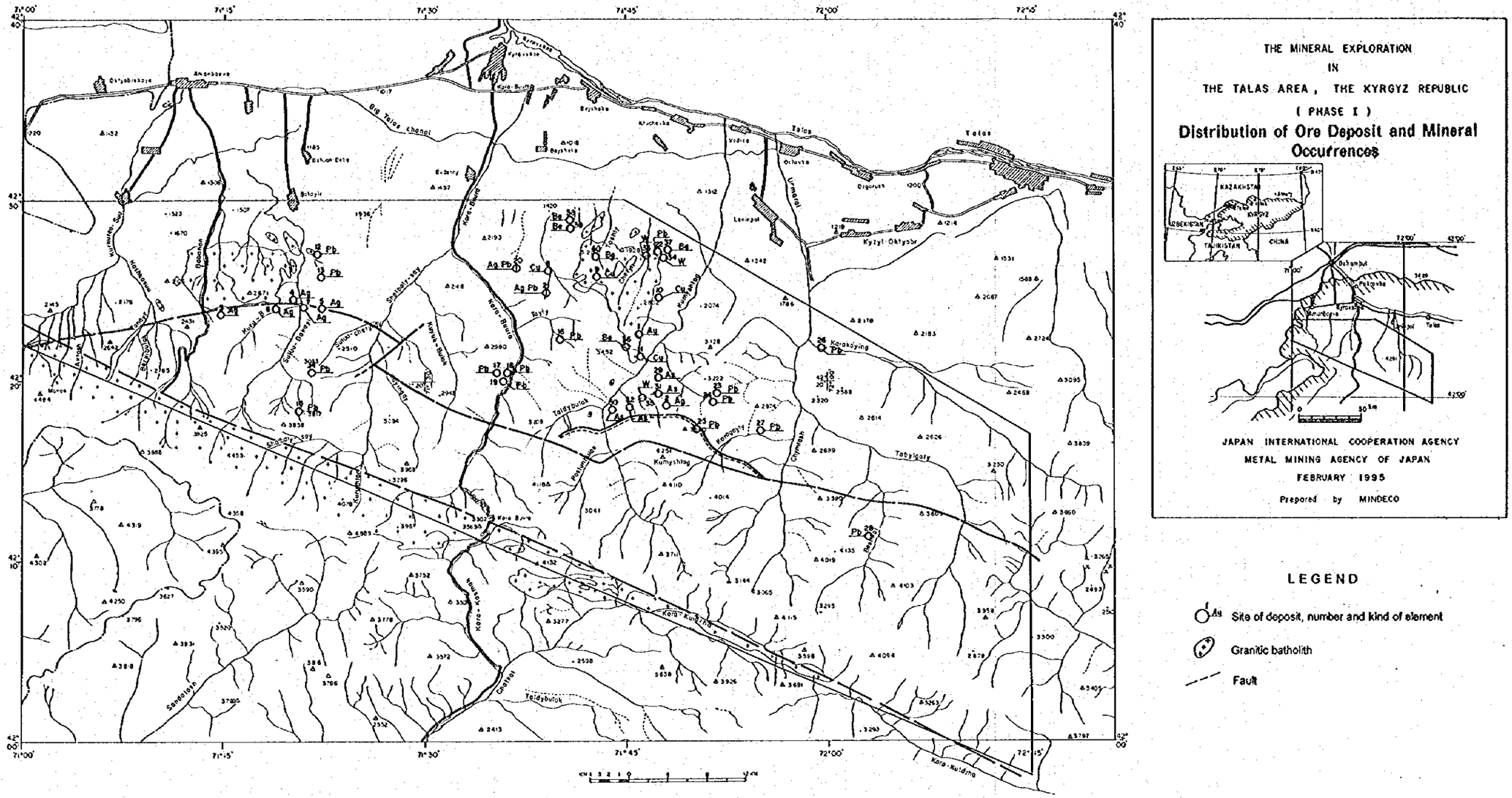


Fig. II-2-5 Distribution of Ore Deposits and Mineral Occurrences

Table Ⅱ -2-1 List of ore deposits and mineral occurrences (1)

Number on map	Deposit name	Kinds of elements	Description of occurrences	Note
1	Shyraldzhyn	gold	Vein type deposit in Kumyshtag batholith. Ferrous-manganese carbonate vein, quartz vein, quartz-tourmaline vein. Width of veins : 0.2 ~ 5.4 m (average 1 m) Length of veins : 200 ~ 700 m Gold grade : 2.3 ~ 5.5 g/t	P1 reserve : 8.1 t of gold P2 reserve : 8 t of gold with totally average gold grade of 5 g/t About 80 trenches of 1,964m^3 were made in 1980's.
2	Kumyshtag	silver	Composed of siderite-sulfide, siderite and quartz-sulfide veins in sandstone, siltotone and limestone. Paralleled 5 main veins at main deposit. Width of veins : 0.4 ~ 3.6 m Length of veins : 350 ~ 600 m	C2+P1 reserves : 1,523 t of silver with average silver grade of 256 g/t Exploration were carried out with total length of adits of 1,617 m, and 16 surface and 2 underground drill holes of total 2,561.4 m.
3	Babahan	silver lead zinc	Lens and bed shaped in limestone. Dissemination and veinlets of galena, sphalerite in manganosiderite vein. Width of veins : 0.5 ~ 2-3 m Length of veins : 3-10 ~ 30-50 m Lead grade : 0.08 ~ 6.47% Zinc grade : 1 ~ 5.8%	Reserves of lead and zinc sulfide are almost mined out by ancient workings.
4	Stock	silver lead	Veins in granite. Width of vein : 0.1-0.2 ~ 1.5 m Silver grade : 186 ~ 1,697 g/t Lead grade : less than 1 %	400 ancient workings are situated in 2-3 lines. Width of workings : up to 10 m Length of workings : 180m

Table Ⅱ -2-1 List of ore deposits and mineral occurrences (2)

Number on map	Deposit name	Kind of elements	Description of occurrences	Note
5	Dzholsay	silver	Quartz veins, quartz manganosiderite veins. Average length of orebodies : 245 m Average width of orebodies : 0.7 m Silver grade : 20 ～ 584 g/t	More than 400 ancient workings. A few workings and drill holes were made in 1962, 1978-1981.
6	Kuru-Bakair	silver	Quartz-carbonate veins with sulfides of galena and sphalerite. Siderite mineralization with silver is overlapped. Width of vein : several cm ～ 1 m Length of vein : 10 ～ 50 m	Siderite veins with silver are worked out by ancient mines.
7	Suluu-Bakair	silver	Siderite vein with silver in the zone of limonitization Length of vein : 20 ～ 30 m With of vein : 2 ～ 10 cm Depth of vein : 30 m Average silver grade : 10 ～ 20 g/t	
8	Sarymsak	copper	Quartz-carbonate veinlets with chalcopyrite.	
9	Cheyen	copper	Quartz veins.	
10	Bezymyannoye	copper	Pyrrhotite veins with chalcopyrite.	
11	Bezymyannoye	copper	Pyrrhotite veins with chalcopyrite.	
12	Uyuzuvaly I	lead	Quartz vein with galena .	

Table Ⅱ -2-1 List of ore deposits and mineral occurrences (3)

Number on map	Deposit name	Kind of elements	Description of occurrences	Note
13	Uyuzuvaly Ⅱ	lead	Quartz vein with galena.	
14	Maybel	lead	Quartz-carbonate veins.	Ancient adits
15	Tuyuktor	lead	Quartz-carbonate veins with galena.	
16	Egizsay	lead	Quartz vein with galena.	
17	Darbazakol Ⅰ	lead	Vein of ferrous-manganese carbonate with galena and sphalerite.	
18	Darbazakol Ⅱ	lead	Vein of ferrous-manganese carbonate with galena and sphalerite.	
19	Darbazakol Ⅲ	lead	Vein of ferrous-manganese carbonate with galena and sphalerite.	
20	Tekeli	lead silver	Silver-bearing manganosiderite veins.	Ancient mines
21	Sarymsak	lead silver	Silver-bearing manganosiderite veins. Horizontal width : 0.71 m Silver grade : 1.6 ~ 202.4 g/t Average lead grade : 2.33 % Average zinc grade : 1.36 %	2 adits and trenches were studied in 1950's.
22	Bulaksay	lead	Quartz-carbonate veins with galena and chalcopyrite.	

Table Ⅱ -2-1 List of ore deposits and mineral occurrences (4)

Number on map	Deposit name	Kind of elements	Description of occurrences	Note
23	Kyzylbel	lead zinc	Lens shaped orebodies. Length : several meters ~ 10-20 m Width : 1-3 cm ~ 1-3 m	
24	Yelchin	lead	Lens of galena (7-8 cm long). Sulfide dissemination in brecciated limestone. Average lead grade : 2.7 % Average zinc grade : 17 % Silver grade : 6 ~ 273 g/t	
25	Aktash	lead	Small beds of galena and sphalerite (5-8 cm in diameter) in the zone of crushing among limestone.	
26	Karagoin	lead	Cavity of limestones containing quartz, carbonate with a few grains of galena.	
27	Karagayly	lead	Carbonate veins with galena.	
28	Kuarcha	lead	Quartz detritus with galena dissemination.	
29	Uchimcheck	arsenic	Massive and disseminated arsenopyrite ore. Length on the strike : 60 ~ 180 m Width : 0.5 ~ 10-15 m Length on the dip : 40-50 ~ 350 m Scorodite, piticite, pyrite, pyrrhotite and many bismuth minerals.	The deposit was explored simultaneously with production since 1930 until 1957. Reserves : 65,000t of arsenic with average arsenic grade of 8.35%, 800t of bismuth with average bismuth grade of 0.1%, 395t of Bi_2O_3, 2.7t of selenium and 9t of tellurium

Table II -2-1 List of ore deposits and mineral occurrences (5)

Number on map	Deposit name	Kind of elements	Description of occurrences	Note
30	Taldybulak	arsenic	Arsenopyrite dissemination in limestones.	
31	Basaltbel	arsenic	Quartz vein with arsenopyrite.	
32	Kichiknurtobe	arsenic	Quartz-carbonate veins with arsenopyrite.	
33	Cheten	tungsten	Fine veins with scheelite.	
34	Bulak-Say	tungsten	Garnet-pyroxene skarn with scheelite.	
35	Kichiknurtobe	tungsten	Lenses of garnet-pyroxene-vesuvian garnet skarn with scheelite	
36	Tuktuarcha	beryllium	Veinlets of stockwork type related with granite intrusion. Quartz-feldspar, flourite, quartz and quartz-tourmaline veinlets.	Preliminary exploration was made 105 trenches, 9 pits, 4 adits and 3 drillhles
37	Uzuntashty	beryllium	Vesuvian garnet skarn zone with mica-fluorite-magnetite -beryl-bearing matasomatite greisen. Length of zone : 600 ~ 700 m Width of zone : 100 ~ 120 m	Surface studies were carried out by trenches and pits. The lower levels consist of one adit and drillholes. C2 reserves : rather large, with average beryllium oxide grade of 0.116% Prospective reserves of beryllium : two time larger than already calculated reserves, with average beryllium oxide grade of 0.118% Prospective reserves of fluorite : 7.4 mt with average fluorite grade of 14.5%.

Table Ⅱ -2-1 List of ore deposits and mineral occurrences (6)

Number on map	Deposit name	Kind of elements	Description of occurrences	Note
38	Cheten Ⅰ	beryllium	Pegmatite veins.	
39	Cheten Ⅱ	beryllium	Pegmatite veins.	
40	Cheten Ⅲ	beryllium	Pegmatite veins.	

They are divided into the following six types from their kinds of elements and their occurrence.

① Gold bearing vein in Kumyshtag granite (Shyraldzhyn)

② Silver veins in limestone and sandstone of Upper Riphean series - Vend series (Kumyshtag, Stock, Dzholsay etc.)

②' Lead (and silver) veins in limestone and sandstone of Upper Riphean series - Vend series (Tekeli, Sarymsak, Kyzylbel etc.)

③ Massive and disseminated arsenic deposits in limestone and sandstone from Upper Riphean series (Uchimckek etc.)

④ Greisen type beryllium deposits in Kumyshtag intrusive (Uzuntashty etc.)

④' Stockwork type beryllium deposit in Kumyshtag intrusive (Tuktuarcha)

⑤ Copper vein around Kumyshtag intrusive (Sarymsak etc.)

⑥ Vein and skarn types tungsten deposits around Kumyshtag intrusive (Cheten etc.)

The important deposits are described based on Ryabko (1992) as follows.

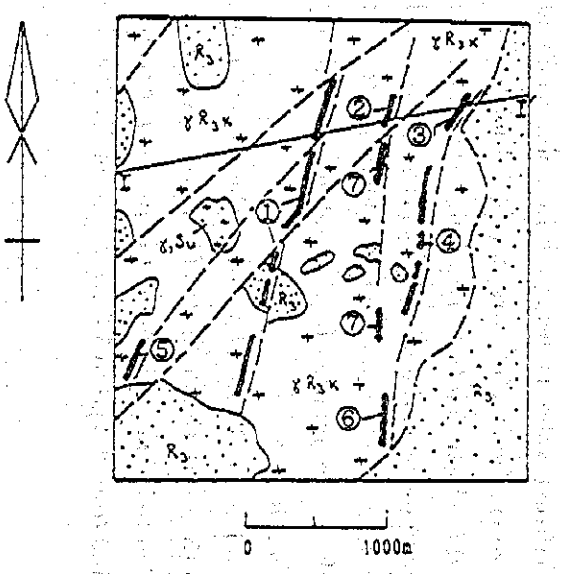
2-2-2 Gold deposit

(1) Shyraldzhyn deposit (Fig. II-2-6, PL.-5)

The deposit is located on the left bank of Kumyshtag river within the valley. Absolute elevation marks ranging from 1,900 m to 2,800 m. It is shown on the number 1 in Fig. II-2-5. It is easy to get to the deposit by automobiles. It is located at the distance of 130 km from the nearest railroad station, Dzhambul.

The area of deposits is composed of Silurian pink leucocratic granite of Kumyshtag batholith. The granite have angles of 60°- 70° of overthrust on sandstone, siltstone, limestone and hornfels of Chydygoloskaya and Tagytauskaya formations of Upper Riphean. Overthrust zone is oriented in submeridional direction. Parallel to the overthrust zone, shear joints are developed in granite. Vein orebodies are situated within the shear joints. The vein orebodies are composed by brown-black ferrous manganese carbonate, light-gray quartz and quartz tourmaline veins. Mineralization is characterized by dissemination of chalcopyrite and malachite-chrysocolla. In quartz, fine lamellae of gold are indicated ranging from 0.1 mm to 0.2 mm in size.

At present, four steeply dipping veins are discovered within the deposit area. The veins are located parallel to each other with the distance of hundreds of meters. The width of the veins ranges from 0.2 m to 5.4 m, with about 1 m in average width. Basically, gold grade is not high, ranging from 2.3 g/t to 5.5 g/t, occasionally ranging



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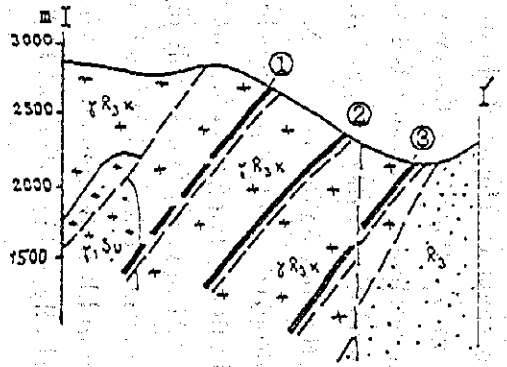

LEGEND

- Sandstone, siltstone, limestone(hornfels)
- Fine-grained granite(Uzuntashtinskiye)
- Fine to medium-grained granite, coarse-grained porphyritic granite(Kumyshtagskiye)
- Orebodies: quartz-manganosiderite veins with vein numbers
- Faults

Orebodies

① Main orebody
② Middle orebody
③ Near-contact orebody(north)
④ Near-contact orebody(central)
⑤ Southwestern orebody
⑥ Near-contact orebody(south)
⑦ Southern extension of middle orebody

Fig. II-2-6 Schematic Geological Map of Shyraldzhyn Deposit

from 8 g/t to 12 g/t.

In 2 aggregate samples, which were taken from ancient mining site, gold grade of 293.2 and 61.4 g/t was discovered. At the same site, coarse visible gold was discovered in pieces of rocks - that is dissemination and films along the cracks in manganosiderite.

The P1 category reserves are calculated within the four veins, studied with the surface up to 350 m depth. The P1 reserves are 8.1 tones of gold. The P2 category reserves are calculated up to the depth of 400 m considering the discovery of new orebodies. Including the P2 reserves, resources of the deposit are doubled - totally it can be 16 tones of gold with average gold grade of approximately 5 g/t (Table II -2-2).

2-2-2 Silver deposit

Silver forms a large silver ore-bearing nodules in the survey area. These nodules are distributed from Babahan to Kurgan, located to the east of 15 km from the eastern boundary of the area, along the Talas Ala-Too mountains, which stretch to the length of more than 100 km. These nodules form dozens of large ore deposits; that is Babahan, Dzholsay, Suluu-Bakayir, Tekeli, Sarymsak and Kumyshtag group. Hundreds of small occurrences of silver are distributed in the sites of ancient mines. At present, ore deposits of silver in the survey area are not properly studied. The most advanced level of studying has the deposits of Kumyshtag group.

(1) Kumyshtag deposits group (Fig.II-2-7, PL.-7)

Kumyshtag deposits group is located at the basin of Kumyshtag river on the northern slope of Talas Ala-Too mountains. The area is a high mountain region with ranging from 2,300 to 3,200 m of elevation, and in some places elevation are from 400 to 600 m higher. It is shown on the number 2 in Fig.II-2-5. Ground road can be used for transportation and communication with regional center of Leninpol, the nearest living area, located 40 km apart from the deposits. The village of Leninpol is connected with Talas town, located 38 km apart, and Dzhambul railroad station, located 100 km apart, by good asphalt roads.

The main deposits of Kumyshtag group are named as the Southwestern slope of Uchimchek mountain, the Left bank of Kichi-Konurtobe river, Vodorazdelnoye and Askaly. The deposits are located in ore-bearing formation which is confined to technically complicated contact with flysch bed of clastic carbonate of

Table II-2-2 List of Reserve Calculation of Shyraldzhyn deposit

P1 reserve

Name of orebody	Main orebody	Middle orebody	Near contact orebody		Total
			Northern part	Southern part	
Length (m)	650	300	170	350	
Width (m)	1.8	0.6	0.6	0.6	
Depth (m)	350	150	100	175	
Gravity (t/m^3)	3.6	3.6	3.6	3.6	
Gold grade (g/t)	4.5	3.1	2.5	8.6	4.7
Gold amount (t)	6.6	0.3	0.1	1.1	8.1

P2 reserve

approximately 8 tones of gold

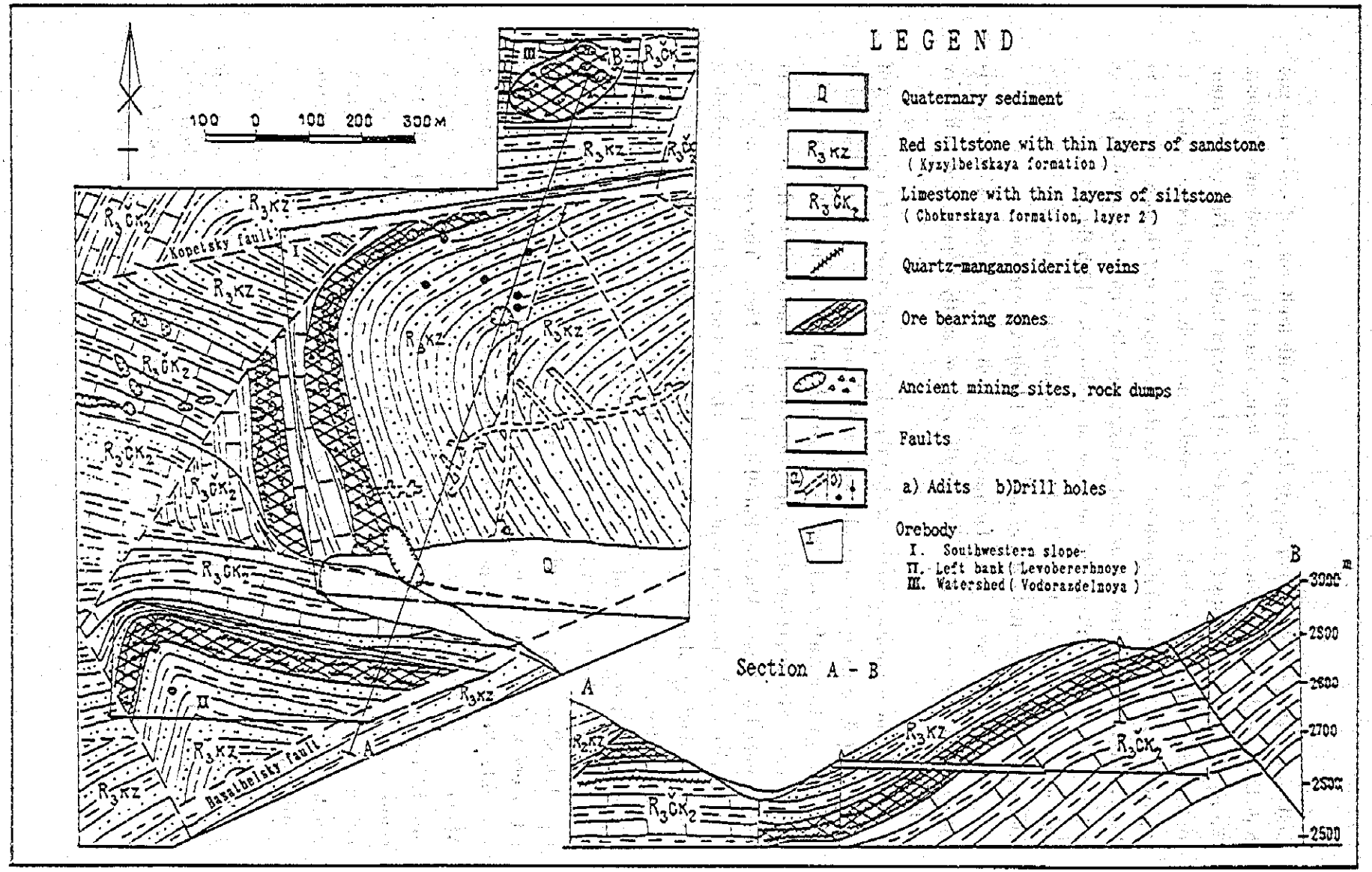

Fig. II-2-7 Schematic Geological Map of Kumyshtag Deposit

Chatkaragayskaya formation of Upper Riphean, with multi-colored sandstone and shale bed of molasse sediments of Kyzylbel formation of Upper Riphean - Vendian. The above mentioned contact is complicated by thrust faults. The area of main ore-bearing formation, which is favorable for silver exploration work, is approximately 1.5 square kilometers. In its outcrop on the surface, the area is clearly indicated by continuous ancient mining sites which go to the depth on the dip, at least, 40 - 70 m. Silver grade in a few ore pillars, in which they believe, ore is high grade ranging from 187 to 1,022 g/t. In ancient rock dumps, silver grade indicates ranging from 100 - 200 grams, up to 1 kilogram per tone.

The similar ore-bearing formation, according to surface orientation, is suggested to exist on Basat deposit, in the zone of gently sloping Uchimcheksky fault.

Based on exploration works, within the whole prospective ore-bearing area of Kumyshtag deposits group, one adit was worked horizontally, with total length of 1,617 m. Sixteen surface and two underground drill holes of total 2,561.4 m were carried out. Five quartz-manganosiderite veins are located within the ore-bearing zones, named as Lower, Middle, Parallel, Upper and New. The zones have also metasomaticaly changed marginal parts. The thickness of the veins, including mineralized marginal parts, ranges from 1-10 cm to 2 - 3 m (Fig. II-2-8, Fig. II-2-9).

It is believed that ore is basically formed by siderites and ore mineralization, which is closely connected with siderites in "ore-siderite stage".

The mineralization consists of : ① siderite sulfide substage (light-yellow siderite); ② honey-yellow siderite substage; ③ quartz sulfide substage. The latter one is the richest in terms of silver grade, has the smallest volume and is unevenly distributed in vein mass that proves unevenness of mineralization. Mineral composition of ores is extremely complicated. Apart from siderite, ankerite, quartz, calcite and fluorite, there are many other metallic minerals in the composition, such as bournonite, boulangerite, arsenopyrite, pyrite, chalcopyrite, galena, sphalerite, gudmundite, tetrahedrite, freibergite, native antimony, pyrrhotite, stibunite, bornite, tennantite, sternbergite, stromeyerite, argentite, native silver, safflorite and rammelbersgite.

In the most studied deposit, that is the Southwestern slope of Uchimchek mountain, the level of adit 1 is discovered. Totally 26 orebodies are contoured in shape at the deposit. Their length ranges from 5 to 275 m, average horizontal thickness ranges from 0.42 to 2.12 m, average silver grade ranges from 75.4 to 636.9 g/t. Average silver grade of the deposit is 206.1 g/t, bismuth grade - 0.048%,

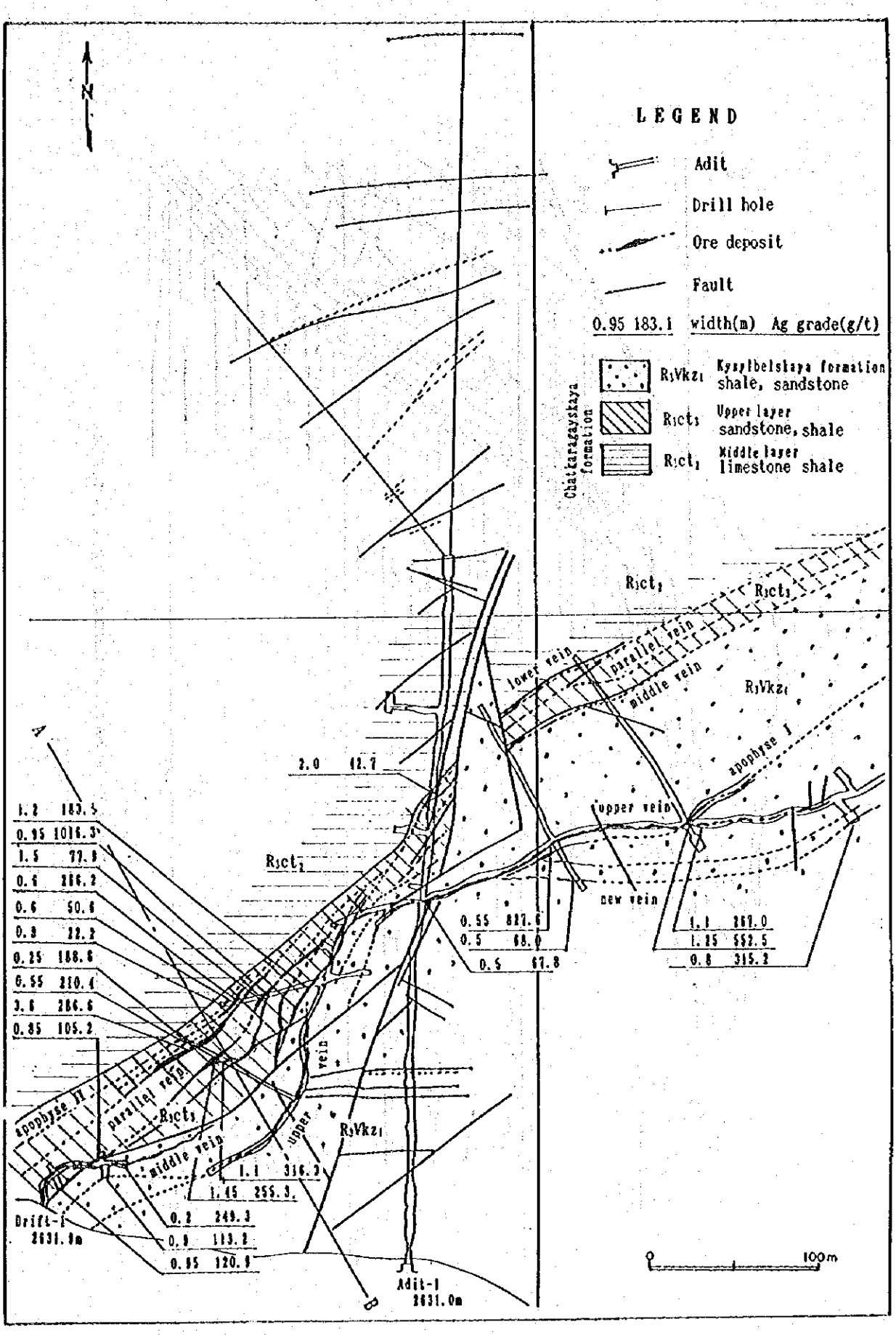

Fig. II-2-8 Underground Plan of the Southwestern Slope of Uchimchek Mountain in Kumyshtag Deposit

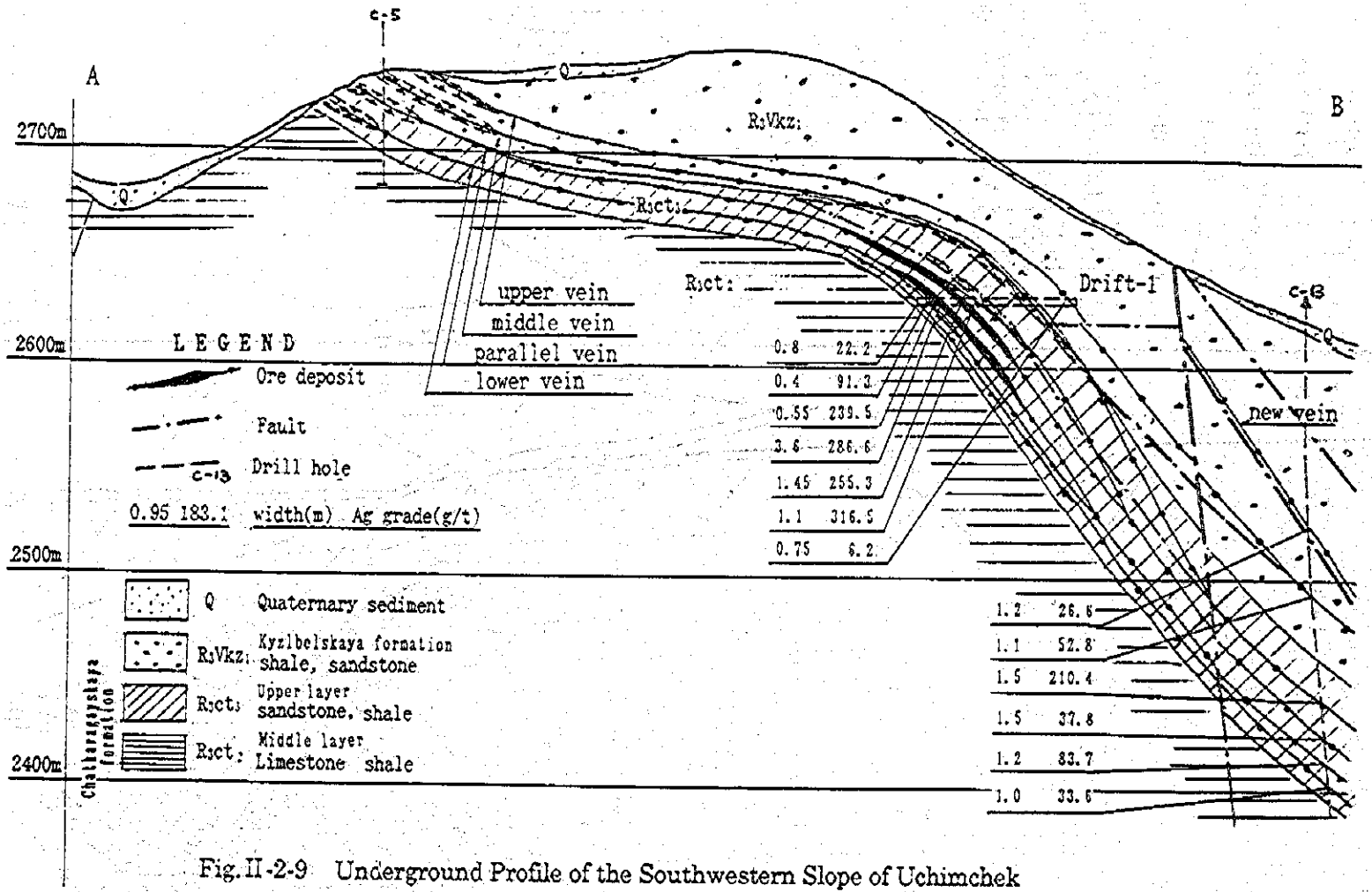

Fig. II-2-9 Underground Profile of the Southwestern Slope of Uchimchek Mountain in Kumyshtag Deposit

antimony grade - 0.4944%, lead grade - 0.365%, copper grade - 0.12%. Average true thickness of orebodies is 0.74 m, and horizontal thickness of orebodies is 1.11 m.

The ore of the deposit is characterized by a simple mineral dressing, and a produced concentrate is characterized by good recovery of silver and most by-products. Using double flotations, they produce with a silver recovery ratio of 96.1% in concentrate. Silver grade in concentrate is 3.12 kg/t. Apart from silver, concentrate contains bismuth grade of 0.01% with 6.66% of recovery; antimony grade of 12.25% with 83% of recovery; arsenic grade of 1.3% with 44.5% of recovery.

Taking into account silver cut-off grade of 40 g/t, the C2 +P1 reserves are calculated at the deposit. They are 1,523.0 tones totally, accounting conditional silver, with the average silver grade of 256 g/t.

2-3 Lead and zinc deposit

Lead and zinc in the survey area form large ore deposits. Within the area, the deposits of lead and zinc are closely associated with silver and tin. The deposits are named as Kumyshtag and Babahan groups of small size polymetallic deposits, which are combined with ore nodule. The ore nodule is known by a very high silver-bearing ore and is distributed in many of ancient mining sites.

The polymetallic deposit is characterized by small size hydrothermal veins. Hydrothermal metasomatic disseminated and massive ores form large lens and pipe shaped orebodies. They spread rarer than vein. Country rocks for both kinds of orebodies are clastic carbonate rocks of Riphean and Cambrian - Ordovician; and rarely granite of Babahan batholith.

(1) Kumyshtag ore field

Kumyshtag ore field, located around Kumyshtag batholith where are many occurrences of beryllium, arsenic, bismuth, tin, tungsten, copper and fluorite, is characterized by a wide spreading of polymetallic mineralization. Mineralization within the field is mainly controlled by Uchimchek - Dzholsay fault zone.

1-1) Kyzylbel and Yelchin group

Kyzylbel and Yelchin group consist of ten ore deposits and small size occurrences of polymetal. The group of deposits is located at the Kumyshtag basin and the Urmaral basin in some parts. It is shown on the number 23 and 24 in Fig. II-2-5.

The deposits are distributed in flysh rock masses of Chatkaragayskaya and Sarydzhonskaya formations of Riphean. The deposits are composed of small size lens shaped orebodies varying from several meters to 10 - 20 m, occasionally up to 100m. The width of the orebodies ranges from 1 - 3 cm to 3 m. Average grade of lead and zinc at the largest ore deposits, Yelchin, is 2.7 % and 17 % respectively. Silver grade in ores ranges from 6 to 273 g/t, usually it ranges from 30 to 60 g/t. An amount of tin is very small.

1-2) Sarymsak and Tekeli deposits

Sarymsak and Tekeli deposits are located at the foothill zone, at the distance about 35 km apart from Leninpol, and 80 km apart from Dzhambul. It is shown on the number 21 and 20 in Fig. II-2-5.

Sarymsak deposit is situated at the distance of 2 km, to the west from the boundaries of Kumyshtag intrusive. Zone of ancient workings is discovered there. The zone is controlled by sublatitudinal Sarymsak fault. Mineralized tectonic breccias of fault zone was studied by two adits and trenches in 1950's.

Tekeli deposit is located at the distance of 3 km to the northwest from the boundaries of Kumyshtag intrusive. The deposit is controlled by the Sarymsak fault, which is overlapped in the interval by thick cover, up to 100 m, of Quaternary sediments. Both Sarymsak and Tekeli deposits were worked out silver containing manganosiderite veins by ancient minings. Total length of ancient workings of Tekeli deposit is twice longer than those of Sarymsak.

At Sarymsak deposit, average lead grade is 2.38 %; average horizontal width of orebody is 0.71 m; average zinc grade is 1.36 %; average tin grade is 0.23 %. Based on the analyzed data of 22 channel samples in the 1st and 2nd adits, silver grade ranges from 1.6 to 202.4 g/t, and tin grade ranges from 0.01 to 0.48 %.

In 1956, quartz-pyrite-pyrrhotite vein with the width of 0.4 m was opened by the 2nd hole of 190m in depth. The vein contained 3.4 g/t of gold, 232 g/t of silver, 3.04 % of tin, 1.98 % of lead and 0.64 % of zinc. On the surface, such veins are not registered.

(2) Babahan ore field

Babahan ore field is located at the foothill zone, within the basin of Suluu-Bakair valley. About 15 ore deposits with their names and many ore occurrences without name of ancient mining, are controlled by plagiogranite of Babahan batholith. All these deposits are situated along the arc of about 12 km in length

with ranging from 1 to 3 km in width. This arc belts the southeastern and eastern contacts of Babahan batholith. Apart from the batholith, the zone of mineralization is also controlled by the Uchimchek - Dzholsay fault zone. The faults divide flysh rocks of Catokaragayskaya and Sarydzhonskaya formations of Upper Riphean.

Main deposits of Babahan ore field such as Babahan, Stock etc. were studied on lead and zinc in the 1950's, and Dzholsay deposit and a series of smaller deposits were studied in the 1960's and in later years on silver.

2-1) Babahan deposit

It is easy to reach Babahan deposit by automobiles. It is shown on the number 3 in Fig. II-2-5. The deposit is situated at the distance of 60 km from Dzhambul, located on the north from it. Mineralization is developed along the southern contact of plagiogranite of Babahan batholith. The zone of mineralization consist of three areas with about 2 km of total length.

Lens and bed shaped orebodies, which are dissemination and veinlets of galena and sphalerite in manganosiderite vein, occur in limestone. The width of the orebodies ranges from 0.5 to 2 - 3 m; length ranges from 3 - 10 to 30 -50 m. Also, ore-bearing veins are identified with manganosiderite-quartz-barite composition in plagiogranite.

Lead grade in ores ranges from 0.08 to 6.47 %; zinc grade ranges from 1 to 5.8 %. There is no data about silver-bearing and tin-bearing characteristics of Babahan deposit.

2-2) Dzholsay deposit (Fig. II-2-10, -11, -12, & -13)

Dzholsay deposit is located at the distance of 5 km to the east from Babahan intrusive. It is shown on the number 5 in Fig. II-2-5. The deposit is known by its ancient workings. There are more than 400 of the workings, which can be discovered along the foot wall of the Uchimchek - Dzholsay fault to the distance of more than 900 m. At the Dzholsay deposit area, three ore zones are defined with the total length of 3,120 m. The ore zones contain quartz veins and quartz-manganosiderite veins, which sometimes contain barium. The most intensive mineralization is observed at the areas of the zone of total 3,200 m in length. The area was worked out from the surface by ancient miners. Average length of orebodies is 245 m, and average width of the orebodies is 0.7 m. It prove to be contained silver in orebodies, basically on the results of sampling from worked out

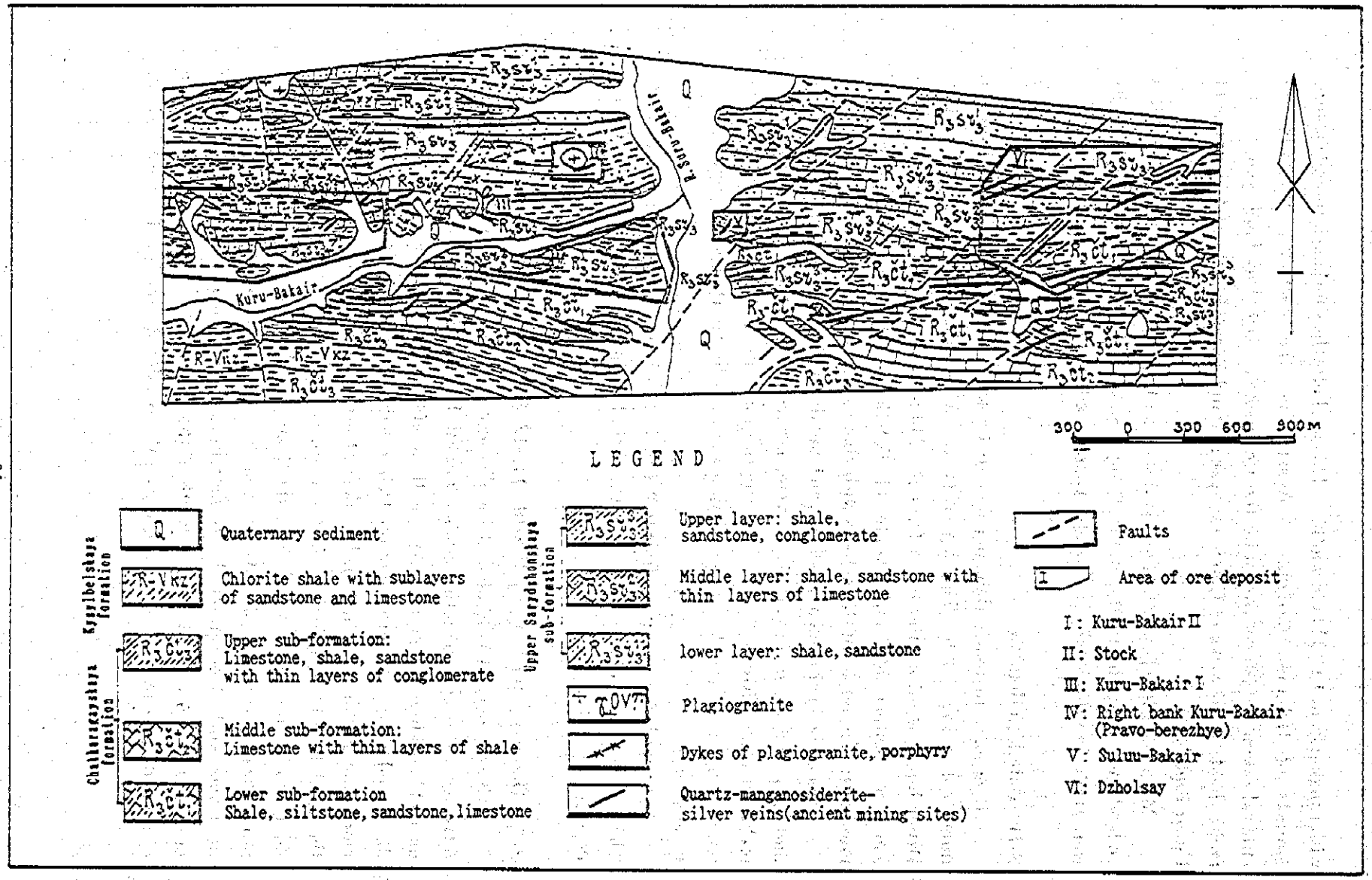

Fig. II-2-10 Schematic Geological Map of Dzholsay Ore Field

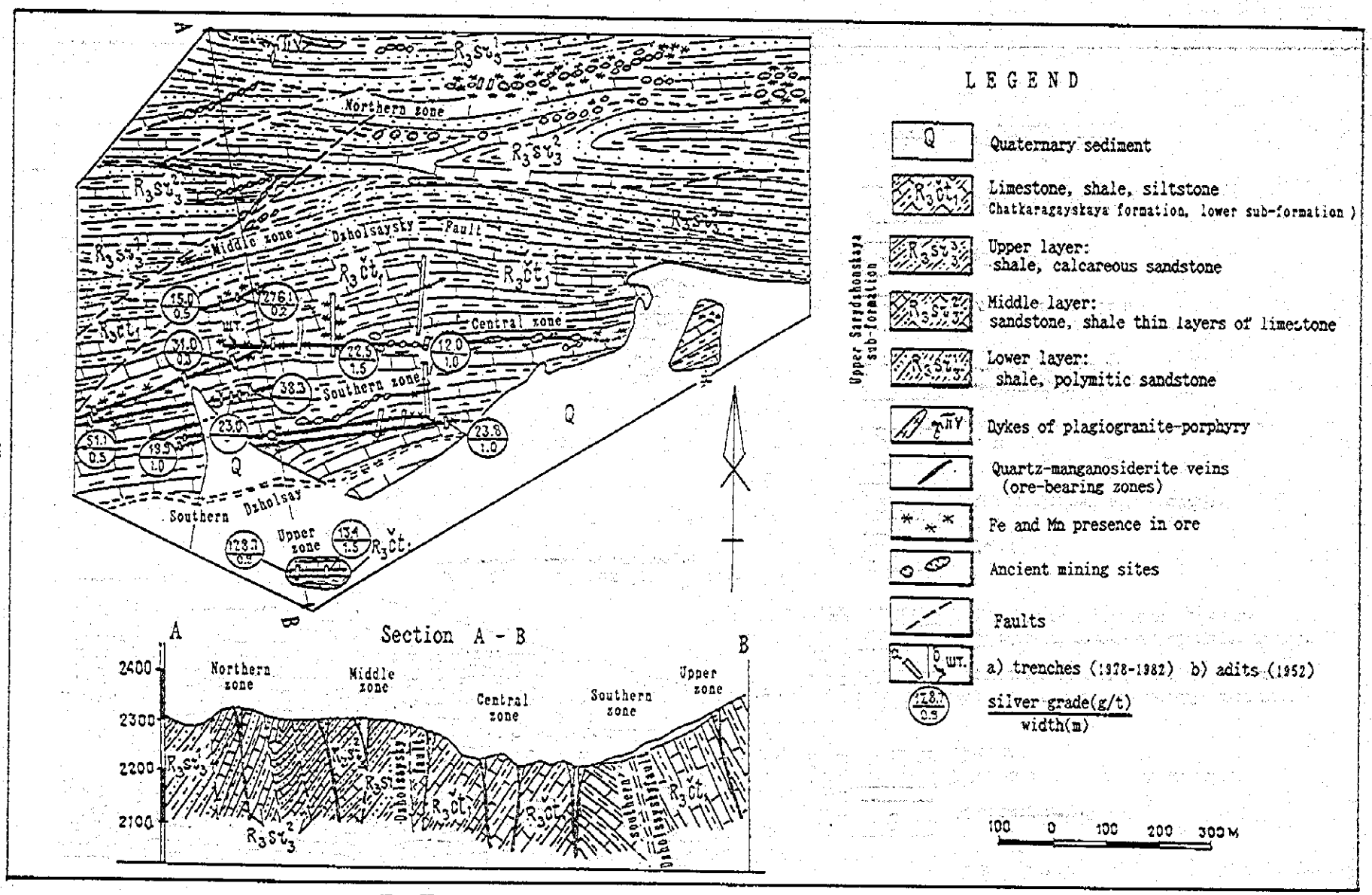

Fig. II-2-11 Schematic Geological Map of Dzholsay Deposit

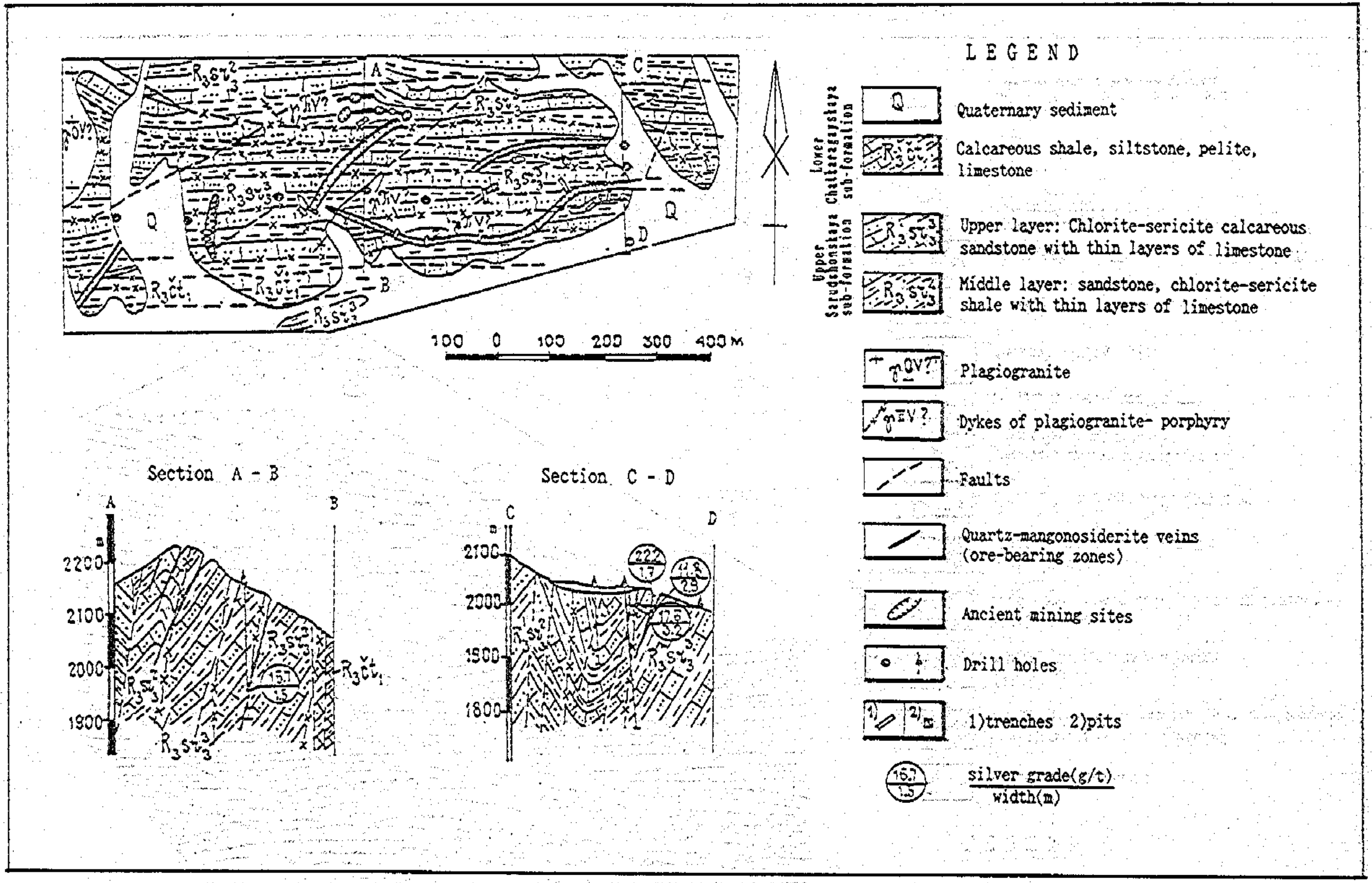

Fig.II-2-12 Schematic Geological Map of Kuru-Bakair Deposit

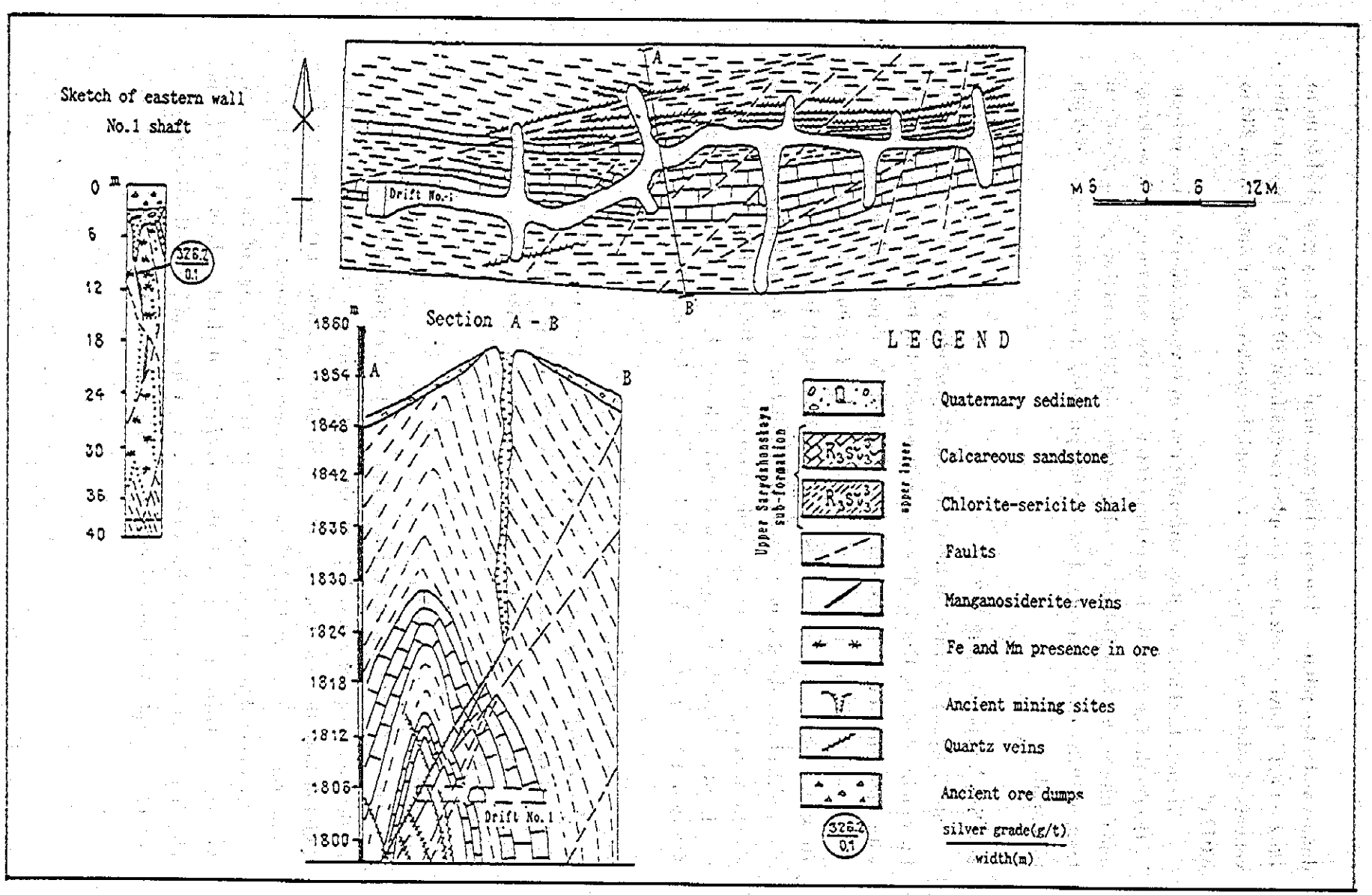

Fig. II-2-13 Schematic Geological Map of Suluu-Bakair Deposit

dumps and a few pillars. The sampling was made by Dzholsay geological team in 1962 - 1963. Silver content in samples ranges from 20 to 584 g/t. In some thin veinlets of siderite, metal grade increases and the grade of silver ranges from 235 to 3,047 g/t.

Vertical thickness of silver mineralization in manganosiderite veins, judging by the depth of erosion cut, is more than 500 m. At the same time, a few workings and drillholes, made by Dzholsay geological team in 1962 and Kumyshtag geological team in 1978 - 1981, as a rule, showed a fast pinching of mineralization when depth increased.

2-3) Stock deposit (Fig.II-2-10)

Stock deposit is located at the western to the Dzholsay deposit. It is shown on the number 4 in Fig.II-2-5. The deposit is controlled by the stock of plagiogranite with approximately 1 hectare of area. Around the deposit, about 400 ancient workings are known. The workings are situated in 2 - 3 lines, at the interval of 5 - 20 m each other. One of the workings has width of up to 10m and length of 180 m. The width of mined out vein ranges from 0.1 - 0.2 m to 1.5 m judging by the size of ancient workings. Silver grade in pillars ranges from 186.0 to 1,697.6 g/t.

Lead grade in the ores of the Stock and Dzholsay deposits is low, ranging from less than 1 % to 1.5 %. There is no data about tin-bearing of the Stock deposit.

2-2-4 Arsenic deposit

Arsenic deposits can be found in many ore occurrences of small and middle size, such as Kurgan deposit, Ashutorskaya ore-bearing area of Jeruy ore field, located to the east of the survey area. The minerals form their largest concentrations at Uchimchek deposit.

(1) Uchimchek deposit (PL.-7)

Uchimchek deposit is located on the right bank of Kumyshtag valley, on the northeastern slope of Kumyshtag mountain, at the distance of ranging from 500 to 1,000 m from the top of the mountain. Absolute elevation of main ore outcrops marks ranging from 2,600 to 2,800 m. It is shown on the number 29 in Fig.II-2-5.

The mineable mineralization is concentrated at the area of about 0.7 square kilometers. Orebodies crop out in the area of sublatitudinal strike of about 1 km in length, of about 100 m in width, within the boundaries of the northern part of the core of the so-called Uchimchek anticline. The anticline is composed of sandstone,

limestone and shale flysch of Chatkaragayskaya formation of Upper Riphean. The anticline is complicated by many faults, among which the main thrust and Uchimchek fault with a big throw have the largest effect on the localization of mineralization. Meridional fault and fissure structures cut and separate orebodies, which are basically connected with longitudinal structures. Together with structural study, lithological control is an important part for the localization of mineralization. The lithological control means a selective attraction of orebodies to carbonate rocks. The largest orebodies are formed in the areas of the flattening of thrust plane and in the areas of latitudinal fault junctions with thrust plane.

Orebodies are controlled by structures and formations. Post-ore tectonics and different depth of erosion result in division of ore field. Three areas were identified, such as Western, Central and Eastern. Orebodies are composed of massive and disseminated arsenopyrite ores. The length of the orebodies on the strike ranges from 60 to 180 m, and thickness ranges from 0.5 m to 10 - 15 m. The length on the dip ranges from 40 - 50 m to 350 m. Strike of orebodies is sublatitudinal with a steep dip.

Basic mineral of the deposit is arsenopyrite with the products of its hypogenesis. They are scorodite and pitticite, also basic minerals are pyrite and pyrrhotite. As for other minerals, they are about 60, and these of the most interest - bismuthinite, wittichenite galenobismuthite, bismutite, basobismutite. This is because the deposit area and its vicinities have developed sulfide quartz veins, in which a weak arsenic mineralization is often accompanied by increasing bismuth grade up to ranging from 0.1 to 1 %. Sometimes this arsenic type of mineralization is spatially combined with silver polymetallic mineralization in quartz manganosiderite veins.

The deposit was discovered by geological team "Druzhba" in 1922, and it was explored simultaneously with production since 1930, up to 1957. Several levels workings and several open pits were carried out. For the deposit, 65,000 tons of minable reserves are calculated and confirmed for arsenic at the State Committee on Reserves of the USSR, with average arsenic grade of 8.35 % , about 202 tones of bismuth reserves, about 395 tones of boron trioxide reserves, about 2.7 tones of selenium reserves and about 9 tones of tellurium reserves. Reserves of associated components were calculated only in contours of growth for 1955 - 1957. Total reserves of bismuth in economic arsenic ores are estimated as 800 tones, with average grade of about 0.1 %.

2-2-5. Beryllium

Beryllium in survey area forms substantial concentrations in exocontact zone (zone of external contact) of leucocratic granites of Kumyshtag batholith. Several types of deposits can be identified by genesis. The largest one is an exocontact greisen type, such as Uzuntashty, with beryl as a basic ore mineral. The other is a beryl-bearing pneumatolytic hydrothermal vein type, such as Tuktuarcha.

(1) Uzuntashty deposit

Uzuntashty deposit is located in the basin of Uzuntashty stream, with ranging from 1,400 to 2,000 m of absolute elevation. It is shown on the number 37 in Fig. II-2-5.

The deposit area comprises clastic carbonate and flysch type clastic sediments of Chatkaragayskaya and Sarydzhonskaya formations of Upper Riphean, which are broken by granite of Kumyshtag batholith. Basic structure of ore field is the depression of intrusion roof along its northern contact, with ranging from 2 to 2.5 km in width and 8 km in length. Within the boundaries of depression, vesuvianite garnet skarns are developed, and mica-fluorite-magnetite-beryl-bearing metasomatite of greisen type is associated with the skarns. The zones of metasomatic mineralization and skarns are related to basically limestone layers. The limestone layers alternate with the layers of hornfels. They develop in conformity with strike of rock. Width of zones ranges from 100 to 120 m, length ranges from 600 to 700 m. As mineralization approaches the contact with granites, concentration of minerals increase.

Ore is characterized by a complex composition and structure, because of a frequent interchanging among skarns, fine-grained metasomatic greisens and mica-fluorite-feldspar veinlets, put on the greisens. Beryllium, apart from beryl, bavenite, chrysoberyl and milarite is discovered in the composition of vesuvianite, garnet, magnetite, axinite and clinozoisite, in which the form of beryllium is not quite clear. Chrysoberyl in mica-fluorite-magnetite metasomatite is a main beryllium mineral.

As a rule, ore with beryllium oxide grade of more than 0.12 %, is related to mica-fluorite-magnetite greisens; with the grade of 0.08 - 0.12 %, - to skarns; with the grade of lower than 0.08 % , - to skarned rocks. As for associated mineral, fluorite can be of interest, its grade in ore ranges from 10 % to 27 %.

Within the deposit area, 28 large orebodies in metasomatites were found, and 18 of the largest ones were estimated. Orebodies are of bed and lens shaped forms with clear contacts. The thickness of the orebodies ranges from several meters to

100 m. The traced length of the orebodies ranges from 200 to 300 m. It is suggested that most orebodies would go to the depth of about 200 m.

The surface of the deposit is studied by trenches and pits at regular interval of 40 m. The lower levels consist of one adit and drillholes. Technological features of ore were studied by Giredmet Institute (State Institute of Rare Metals) in Moscow and the Academy of Sciences of Kazakhstan. Positive results have been produced in the metallurgical process, with beryllium recovery ratio of up to 86 %. But this process of recovery is not profitable.

The C2 category of beryllium oxide reserves are rather large. Average grade is 0.116 %. Prospective reserves of beryllium oxide with average beryllium grade of 0.118 %, are two times larger than C2 reserves. Prospective reserves of fluorite are 7.4 million tones, and average grade of fluorite is 14.5 %.

(2) Tuktuarcha

Tuktuarcha deposit is located on the left side of middle stream of Kumyshtag river, with ranging from 1,650 to 2,020 m of absolute elevation. It is shown on the number 36 in Fig.II-2-5.

The deposit comprises dislocated clastic carbonate of flysh type sediments of Chatkaragayskaya formation of Upper Riphean. It is related to the southern limb of compressed Chon-Konurtobinskaya anticline, which is complicated by a series of faults.

Igneous rocks are represented by granite of Kumyshtag batholith, which occur at the depth and exposure to the northwest from the deposit. Igneous rocks are also represented by a dike complex of diorite porphyrite and basaltic composition. Beryllium mineralization, judging by all indications, is genetically connected with granite intrusion and it is related to the development of thin veinlets of stockwork type. The most part of the veinlets is controlled by sublatitudinal system of fissures.

Among ore veinlets, quartz-feldspar, fluorite, quartz, and quartz-tourmaline differences with beryl can be identified; rarely - with bavenite, chrysoberyl or fenaksite. Quartz-sulfide and sulfide (pyrite-pyrrhotite) veinlets are post ore ones, and they do not have a beryllium mineralization. As for post ore veins, we can identify also manganosiderite, quartz-tourmaline, siderite, polymetallic, barite, fluorite-calcite veins.

Preliminary exploration, consist of 105 trenches, 9 pits, 4 adits and 3 drillholes was carried out at the deposit. Two ore samples were studied for laboratory work.

First quality concentrates of beryllium oxide were produced. Recovery ratio was ranging from 72 to 75% of beryllium oxide.

2-3 Geochemical survey

2-3-1 Outline

Geological department of defunct Kyrgyz SSR had carried out geochemical prospect using heavy mineral panning from all the rivers in survey area until 1960's. The result was published in a 1:200,000 mineral resources map (Ministry of Geology, USSR, 1963c,1963d). Sampling density was about one sample per square kilometers. Samples were taken from the upstream to the lower reaches of all the rivers. As the results of quantitative analysis using blowpipe analysis method, gold and other 13 minerals are made. The mineral resources maps are useful as reconnaissance investigation result. The elements of analyzed 14 minerals are gold, copper, lead, tin, molybdenum, arsenic, tungsten, bismuth, beryllium, mercury, phosphorus, vanadium, tantalum-niobium and rare earth.

On the other hand, Geological department of defunct Kyrgyz SSR had done geochemical semi-detailed prospect using stream sediment in the area from the Kumyshtag deposits to Kumyshtag intrusive, 20 km in east and west, 30 km in north and south, from 1982 to 1987. Samples are taken from every stream with water of 500 m in interval. Fifteen elements are analyzed that consist of gold, silver, copper, lead, tin, molybdenum, arsenic, tungsten, antimony, bismuth, niobium, beryllium, cerium and lithium. Though the analysis method would be atomic absorption method, it is not confirmed.

2-3-2 Result of reconnaissance geochemical survey

The location of panning points and detected elements was plotted on a drainage system map from the 1:200,000 mineral resources map. Based on distributions of analyzed elements, the following nine elements are marked on geochemical anomaly maps. Gold, lead, copper, bismuth and vanadium are shown in PL.-8(1) and arsenic, mercury, tungsten and molybdenum are shown in PL.-8(2). The distribution of each element is described as follows:

(1) Gold

Gold in the panning heavy sand is scattered in almost all the river. Gold concentration was found in thirteen sites. These sites are the most upstream of Kurkureo-Suu river, the upper reaches of Babahan river, the middle reaches of

Suluu-Bakayir river, Shalbaly-Say river that is branch of Kara-Buura river, the upper reaches of Kara-Buura river, Chymtash river that is branch of Tabylgaty river and the upper and lower reaches of Tabylgaty river. Each sites ranges from 2 km by 3 km to 3 km by 10 km in diameter.

Compared with geological map, gold concentration is recognized to occur around Uzunahmat-Kumyshtagsky thrust fault. This result is presumed to suggest that the gold mineralization may be related to the thrust fault and subordinated faults.

(2) Lead

Although lead is distributed much wider than gold, the center of distribution shows good agreement with the location of Uzunahmat- Kumyshtagsky thrust fault. This result suggests that mineralization of lead is related to the fault.

(3) Copper

Copper is scattered around Kumyshtag intrusive and the upstream of Chymtash river in a small scale.

(4) Bismuth

Bismuth is distributed partially around the upstream of Kara-Buura river and the upper reaches of its branch, Shalbaly-Say river. Especially, the region of the most upper reaches of Shalbaly-Say river is 10 km in length, and a part of which get to Manas batholith that is the south side of Talas-Fergansky fault (Fig. II-2-1). Moreover the region around Kumyshtag river is studded with bismuth on a small scale.

(5) Vanadium

Vanadium is widely distributed around the north part of Kumyshtag intrusive. This result seems to suggest that mineralization of vanadium is related to Kumyshtag intrusive.

(6) Arsenic

The region around Kumyshtag intrusive is studded with arsenic on a small scale.

(7) Mercury

Mercury is distributed successively over 20 km along Karagain river in the eastern part of this area. Beshtashsky fault extends along Karagain river (Fig. II-

2-2). Around 5 km east of this river, Chichicano-Volbinsky batholith crops out widely (Fig. II-2-1). This fact seems to suggest that mercury remove from the deep part of underground along the fault.

(8) Tungsten

Tungsten widespreads around the northeastern region of Bahahan intrusive, the northern region of Kumyshtag intrusive and its vicinity, and around the upper reaches of every river that runs from the western part to the central part of this area. In the latter place, Manas batholith crops out widely in the most upstream region.

As the concentration of tungsten is related to these granite masses, mineralization of tungsten is closely concerned with intrusive of granite, and it is found that granite of this area highly contain tungsten mineralization.

(9) Molybdenum

Molybdenum is distributed around the central-southern edge of this area on a small scale. The concentration of molybdenum is shown in Manas batholith around Talas-Fergansky fault. This is presumed that molybdenum is related with fractures in granite.

2-3-3 Result of semi-detailed geochemical survey

The geochemical prospecting anomaly map in the scale of 1: 200,000 is shown in PL. -9 that is reformed the 1: 50,000 map in Kumyshtag area. The anomaly sites were extracted, considering the drainage system and the topography enough. Each element is divided into three groups based on overlapping its high concentration of anomaly. Three groups are ① gold and silver, ② copper, lead and zinc, and ③ the other ten elements.

Ten high concentration anomalous sites of gold are recognized. These anomalous sites concentrate in the eastern edge of Kumyshtag batholith and in the neighborhood, and one of these sites covers Shyraldzhyn gold deposit. Whereas most of them extend about 2 km by 3 km in range, one in the northern of Kumyshtagsky extends 5 km by 4 km in range. Threshold of gold anomaly site ranges from 0.05 to 0.09 ppm.

Main anomaly sites of copper, lead and zinc are distributed in the region of 7 km in east to west and 3 km north to south centered Kyzylbel and Yelchin lead and zinc deposits to 5 km north of Kumyshtag deposits.

The anomaly sites of tin, tungsten, beryllium, cerium, lithium and niobium are

situated around Kumyshtag intrusive, especially concentrate in the northern part.

The mentioned above indicates that the mineralization of gold, tin, tungsten, beryllium and rare metal are related to Kumyshtag granite mass.

2-4 Consideration

2-4-1 Geological structure and mineralization

The various types of ore deposits of gold, silver, lead, zinc, arsenic, beryllium, copper and tungsten are known to occur in the survey area. They are classified into the following six types.

① Gold bearing vein in Kumyshtag granite
② Silver - lead vein in limestone or sandstone of Upper Riphean system - Vendian system
③ Massive and disseminated arsenic deposits in limestone or sandstone of Upper Riphean system
④ Greisen and stockwork beryllium deposits in Kumyshtag intrusive
⑤ Copper vein around Kumyshtag intrusive
⑥ Vein and skarn types tungsten deposits around Kumyshtag intrusive

Ore deposits of this area may be mainly classified into the followings.

(1)Vein and massive types mineralization related to the Uzunahmat-Kumyshtagsky thrust fault and its subordinate faults and fractures

(2)Vein, greisen and skarn types ore deposits related to Kumyshtag granite.

The above mentioned interpretation is conformable to the result of lineament analysis suggesting that the mineralization of this area is related to the faults - fractures and Kumyshtag granite.

2-4-2 Geochemical anomaly and Mineralization

As the results of the reconnaissance geochemical survey, the gold concentration has been formed in the thirteen places near Uzunahmat-Kumyshtagsky thrust fault. The present survey has also revealed that the mineralization of lead and mercury is related to the fault parallel to Uzunahmat-Kumyshtagsky thrust fault and the mineralization of copper, vanadium and arsenic is related to Kumyshtag granite, and the mineralization of tungsten is related to the granite of Kumyshtag, Babahan and Manas.

The semi-detail geochemical survey has revealed that the mineralization of gold, tin, tungsten, beryllium and rare metal is related to Kumyshtag intrusive.

The possibility of existence of gold veins but Shyraldzhyn deposit is presumed around geochemical gold anomalies.

As described above, the geochemical anomalies of the area are closely related to Uzunahmat-Kumyshtagsky fault and its subordinate faults and fractures. It is also suggested that the Kumyshtag granite is also closely related to the mineralization of this area.

2-4-3 Conclusion

The summary map is shown in Fig.II-2-14 and PL.-10 which was summarized from the existing data concerned with gold which is especially important in economics.

Anomalous areas of highly condensed gold were arranged in every drainage pattern as it can be considered that the results of geochemical prospect in this area are due to mineralization. In addition, considering the distribution of known deposit, the following six areas are extracted as high possibility of existing gold mineral deposit; in order of possibility, Kumyshtag, Kara-Buula, Babahan, Shalbaly-Say, Chymtash and Tabylgaty.

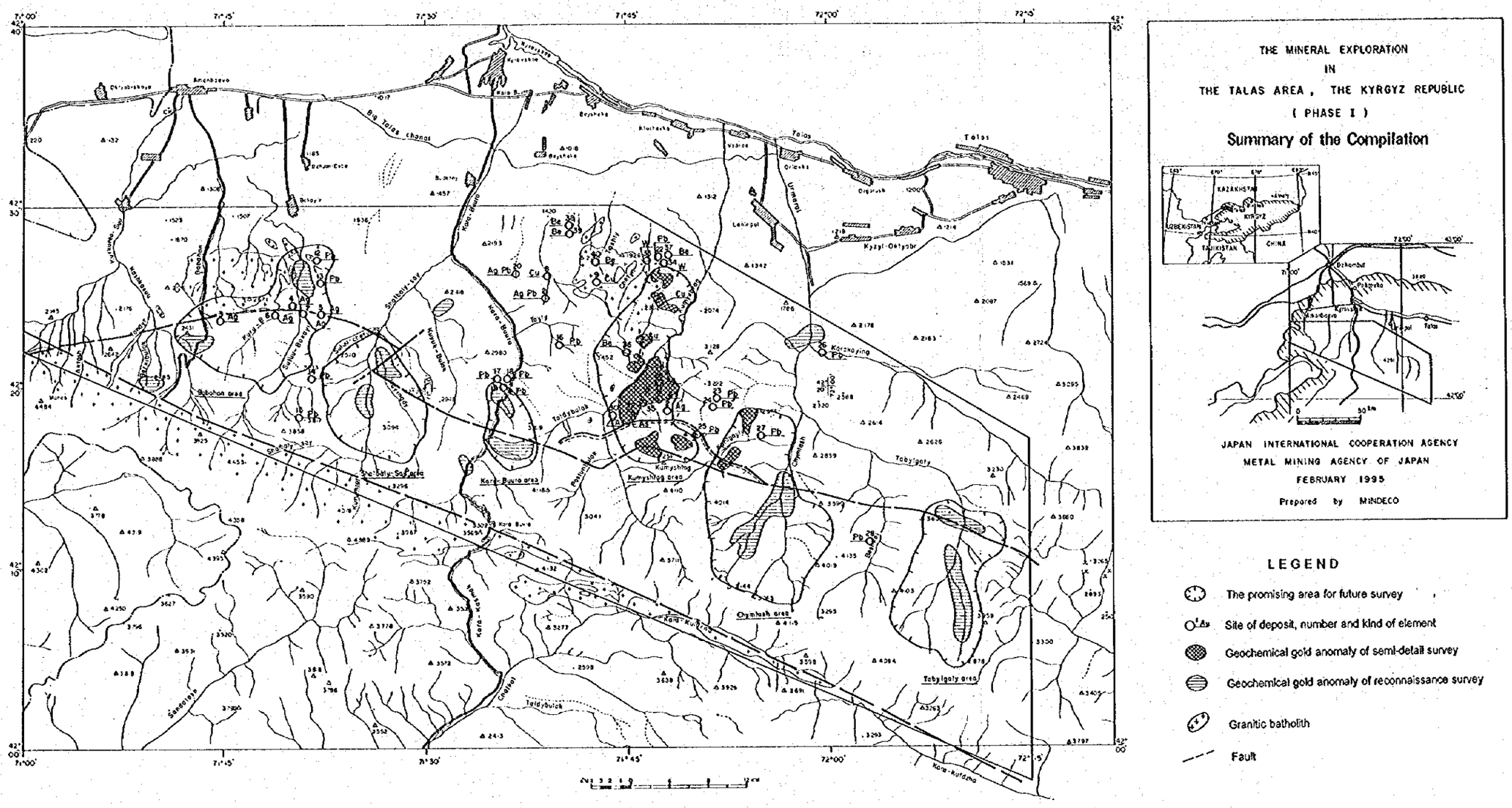

Fig. II-2-14 Summary of the Compilation

PART III

CONCLUSION AND RECOMMENDATION

CHAPTER 1 CONCLUSION

The survey area is comprised of Proterozoic Riphean system as a basement formation which is unconformably covered by Vendian series, Paleozoic group and Cenozoic group (Fig. II-2-2). Riphean system is composed of carbonate rocks, sandstone, shale and phyllite. Vendian system is comprised of conglomerate, sandstone, tuff and tillite. Proterozoic group is mainly formed of Cambrian-Ordovician carbonate rocks. Cenozoic group is formed of terrigenous sandstone, conglomerate and mudstone.

Babahan intrusive is located the western part of the survey area and Kumyshtag intrusive is located in the eastern part of the area. Babahan intrusive is composed of mainly coarse to fine grained biotite plagiogranite and partly plagiogranite porphyry. The result of dating (U/Pb method) shows 1,050±50 Ma which correspond to Middle to Late Riphean (R_2-R_3). Kumyshtag intrusive is composed of mainly leucocratic granite, and alaskite, partly associated with dioritic rock. Dating (U/Pb method) result shows 406±14 Ma which correspond to Late Silurian (S_2).

The result of lineament analysis of the satellite image (Fig. II-1-3) shows that a group of silver deposits including Dzholsay deposit in the western part of the area are located along the east-west fault. In the area of 20 km in length and 5 km in width, covering the west of Kumyshtag deposits in the eastern part of the survey area and around Sarymsak deposit of the north-central part of the area, the lineament of north-northwest - south-southeast to northwest - southeast are predominantly developed. And three circular structures are recognized in the geological unit corresponding to Babahan intrusive.

Thirteen geological units composing the survey area were recognized in the satellite image analysis (Fig. II-1-4, Table II-1-2). Comparison of the above analytical result with the existing geological map showed good correlation expect for a small unit of the Riphean system, and the area of Kumyshtag granite in the image is much wider than that of geological map.

A spectral analysis to extract alteration zones has detected three anomalous zones (Fig. II-1-5). A number of small spectral anomalies elongating west-northwest - east-southeast direction has been observed along the west-northwest - east-southeast fault in R_1 unit in the upstream of Suluu-Bakayir and Shalbaly-Say (here named "upstream of Babahan") of the western part of the survey area. A few small spectral anomalies are scattered in R2 unit with parallel to the bedding in

the upstream of Kumyshtag river of the central part of the area. In the upstream of Chymtash river of the southeastern part of the area, a series of elongated spectral anomalies are lined along the west-northwest - east-southeast fault in the unit of R_1. These spectral anomalies are presumed to be the alteration zones formed by the hydrothermal activity along the west-northwest - east-southeast fault or skarn deposits formed in the carbonate rock of Riphean system.

Various type ore deposits of gold, silver, lead, zinc, arsenic, beryllium, copper and tungsten are know to occur in the survey area. Among them, large amount of silver has been produced in this area since the ancient time. Forty ore deposits or mineral occurrences are known in the area, which are gold(1), silver(6), lead(17), arsenic(4), beryllium(5), copper(4) and tungsten(3). These ore deposits are classified into the following six types.

① Gold bearing vein in Kumyshtag granite
② Silver-lead vein in limestone and sandstone of Upper Riphean system - Vendian system
③ Massive and disseminated arsenic deposits in limestone, sandstone of Upper Riphean system
④ Greisen-stockwork type beryllium deposits in Kumyshtag intrusive
⑤ Copper vein around Kumyshtag intrusive
⑥ Vein and skarn types tungsten deposits around Kumyshtag intrusive

Mineralization of the area is related to the thrust faults and fractures of west-northwest - east-southeast Uzunahmat-Kumyshtagsky fault and intrusion of Silurian Kumyshtag granite. Shyraldzhyn deposit, only known gold vein in the area, has been explored by trenching. Although the downward extension is not yet explored, reserves of P ore (Probable ore) is estimated to be 16 tones of gold with average gold grade of 5 g/t. As there are geochemical anomaly for gold around this deposit, the gold mineralization is expected to be wider.

As the results of reconnaissance geochemical survey, the gold concentration was found in thirteen sites near Uzunahmat-Kumyshtagsky thrust fault, and lead and mercury mineralization are related to Uzunahmat-Kumyshtagsky thrust fault and paralleled fractures. The geochemical survey results also indicate the relationship between the mineralization of copper, vanadium, arsenic with Kumyshtag granite, and tungsten mineralization with the granites of Kumyshtag, Babahan and Manas.

The results of semi-detail geochemical survey indicate that the relationship

between the mineralization of gold, tin, tungsten, beryllium and rare metals with Kumyshtag intrusive.

As described above, the geochemical anomalies support the relationship between mineralization and geological structure of the known ore deposits. Furthermore, the presence of a wide potential area for gold is presumed near Uzunahmat-Kumyshtagsky thrust fault.

From the results of geochemical survey and the distribution of known ore deposits, the following six areas are selected as potential areas for gold. They are in order of potentiality, Kumyshtag, Kara-Buura, Babahan, Shalbaly-Say, Chymtash and Tabylgaty area (Fig.II-2-14). Further exploration is required in these areas.

CHAPTER 2 RECOMMENDATION FOR THE PHASE II SURVEY

From the results of trenching and geochemical survey worked by the State Committee on Geology, Usage and Protection of Natural Resources, Shyraldzhyn gold deposit seem to be most potential. In order to find out the character of mineralization, the size and grade of the deposit, detail geological survey and diamond drilling are to be carried out.

The results of geochemical survey using panning done by the State Committee on Geology, Usage and Protection of Natural Resources, are thought to be reliable by the present survey. Therefore further geological reconnaissance and semi-detail geochemical survey are advisable to the areas of Kumyshtag, Kara-Buura, Babahan, Shalbaly-Say, Chymtash and Tabylgaty where the gold anomalies have been found in the previous geochemical survey.

By the spectral analysis of the satellite image, possible alteration zones have been found in the upstream of Babahan, Kumyshtag and Chymtash rivers. They are probably formed by hydrothermal alteration, taken place along the west-northwest - east-southeast fault or skarn formed in the carbonate rocks. Geological reconnaissance survey is needed to check for them.

Detail geological investigation to find out the character of mineralization and the size and grade of ore deposits are to be conducted for the known ore deposits and mineral occurrences.

Table I-6 shows the summary of recommendation for further exploration considering their priorities.

COLLECTED DATA

1. Geological Department, Kyrgyz SSR (1984) : Geological map of Kumyshtagsky ore field 1:10,000.
2. Geological Department, Kyrgyz SSR (1987a) : Schematic geological map of Shyraldzhyn gold deposit. 1:10,000.
3. Geological Department, Kyrgyz SSR (1987b) : Sampling plane of Sterzhnevoyl orebody at Shyraldzhyn gold deposit. 1:1,000.
4. Geological Department, Kyrghyz SSR (1987c) : Lithochemical results map of the Central part of Talas mountain range. 1:50,000.
5. Kyrgyz State Department of Map Making (1977) : Topographic maps. "Talas", "Kirovskoe". 1:200,000.
6. Ministry of Geology, USSR (1963a) : Geological map of USSR. Series of Northern Tien-Shan. "K-42-XⅧ". 1:200,000. Explanation 105p. (in Russian)
7. Ministry of Geology, USSR (1963b) : Geological map of USSR. Series of Northern Tien-Shan. "K-42-XⅢ". 1:200,000. Explanation 85p. (in Russian)
8. Ministry of Geology, USSR (1963c) : Mineral resources map of USSR. Series of Northern Tien-Shan. "K-42-XⅧ". 1:200,000.
9. Ministry of Geology, USSR (1963d) : Mineral resources map of USSR. Series of Northern Tien-Shan. "K-42-XⅢ". 1:200,000.
10. Ministry of Geology, USSR (1980) : Geological map of Kyyrghystan of USSR. 1:500,000.
11. Ministry of Geology, USSR (1987) : Geological map and mineral resources map of the Central part of Talas mountain range. 1:50,000.
12. Ministry of Geology, USSR (1988) : Tectonic map of Kyrghystan of USSR. 1:500,000.