Chapter 2 Maulyan District

2-1 Geological Survey

2-1-1 Purpose of the survey

The geological survey is intended to clarify the relationship of geology and geologic structure with mineralization in the Maulyan District.

2-1-2 Methods of the survey

The geological survey in the quantities indicated in Table I-1-1 was carried out in the Maulyan District. A base camp for the survey was placed at a hotel in Millbazar,

The survey was conducted with a 1:10 000-scale route map enlarged from the 1:25 000-scale topography map. Outcrops of particular importance were sketched on 1:100 to 1:200 scales and photographed in color. Survey findings were incorporated in the 1:40 000 scale geological map.(Fig.II-2-1-1), as well as the 1:10 000 scale geological map (PL.II-2-1-1) and 1:10 000 geologic cross section (PL.II-2-1-2).

Simultaneously with the geological survey, various sampling in the quantities indicated in Appendix 2-1 was conducted, as well as laboratory testing.

The laboratory tests included chemical analysis of ores, microscopic observation of thin sections of rocks and polished sections of ores, X-ray diffraction analysis and measurement of homogenization temperature of fluid inclusions. Ore samples were collected from quartz veins and silicification zones for analysis. Results of the analysis are tabulated in Appendix 2-6, while major ore showings are indicated in Table II-2-1-1. Sampling points of the other samples for laboratory tests are indicated in PL.II-2-1-3. Results of observation of rock thin sections and the photomicrographs are exhibited in Appendices 2-2 and 2-3, respectively, while results of observation of ore polished sections and the photomicrographs are exhibited in Appendices 2-4 and 2-5. Results of the X-ray diffraction analysis are exhibited in Appendix 2-7 and the measurements of homogenization temperature of fluid inclusions in Appendix 2-8.

2-1-3 Survey findings

1) Geology of the Maulyan District

A schematic geologic column is exhibited in Fig.II-2-1-2. Descriptions of respective geologic units are given in the ascending order.

(1) Basement rocks

① Kalsarin Formation of Cambrian System

This Formation occurs in the WNW-ESE direction in the central part of the District. Its relationship with the underlying formation in the District has remained undetermined.

Limestone is dominant in the Formation, accompanied by crystalline limestone, slate, sandstone, calcareous sandstone and quartzite. Limestone of the Formation often forms thin alternations with slate. The alternated beds assumes a black color and widespread in the Formation from top to bottom. The Formation is estimated to be 190m thick.

② Badamchalin Formation of Ordovician System

This Formation occurs in the WNW-ESE direction in the central part of the District and comformably overlie upon the underlying Kalsarin Formation. Slate is dominant from top to bottom in the Formation, partially intercalating siltstone and sandstone. In the vicinity of the Dzhallaktau Range, the Formation is foliated by regional metamorphism, in which spots of biotite, garnet, staurolite, etc. are observed. Conodonts and graptolites also occur in the Formation. Estimated thickness of the Formation is 180m.

③ Nakrut Formation of Lower Silurian System

This Formation, extensively spreading out from east to west in the central part of the District and conformably overlie upon the underlying Badamchalin Formation. The formation is composed of slate, siltstone and sandstone, interbedded in the thickness of 20cm to 50cm, of which dominant is siltstone. In the southern part of the District, the Formation is foliated, in which biotite spots are frequently observed. They are markedly folded and same horizons are repeatedly exposed on the surface. Early Silurian graptolites occurs in the Formation. Estimated thickness of the Formation is 200m.

④ Dzhazbulak Formation of Lower Silurian System

This Formation spreads out extensively from east to west in the southern edge of the survey area, while, in the north of the Dzhallaktau Range, it occurs in small lenzes. It is composed mainly of sandstone, accompanied by siltstone, slate and conglomerate. In slate, spots composed of quartz, biotite and chlorite are observed. Early Silurian graptolites occurs in the Formation. Estimated thickness of the Formation is about 220m.

⑤ Aktau Formation of Upper Silurian to Lower Carboniferous System

This Formation extends from east to west in the central part of the District, forming the precipitous Dzhallaktau Range. Two more zones of the Formation are observable in the north of the Range, which also form precipitous topography. The Formation is composed of fine-grained to medium-grained limestone, assuming white to greyish white colors. Fossils are poorly preserved. The Formation lies in fault contact with the mentioned Cambrian to Lower Silurian System. In the northern part of the District, the underlying Cambrian System was presumably thrusted by an overthrust fault onto the Formation and the Darasai Formation of Carboniferous System mentioned below. The Formation is estimated to be more than 350m thick.

⑥ Darasai Formation of Carboniferous System

This Formation occurs in lenzes within the Aktau Formation in the Dzhallaktau Range and rests conformably upon the underlying Aktau Formation. It is composed mainly of slate, partially intercalating sandstone and limestone. Estimated thickness of the Formation is 200m or more.

(2) Intrusive rocks

① Aktau granitic complex of middle Carboniferous to early Permian age

The complex, occurring in the northern edge of the District, constitutes a principal part of the Aktau Range and can be classified by intrusion stage into the three bodies, Darasai, Shulak and Gatchin.

(i) Darasai body of middle to late Carboniferous age

The body intrudes into sedimentary rocks of Ordovician System and, in turn, is intruded by the late Carboniferous Shulak body. The Darasai body has been dated as 295-322 Ma in radioactive age. The lithofacies are mainly biotite, hornblende, quartz diorite and granodiorite.

(ii) Shulak body of late Carboniferous age

The body intrudes into the Darasai body and, in turn, are intruded by the Gatchin body of late Carboniferous to early Permian age. 260-286 Ma has been determined by the K-Ar method from body occurring in the Northern Nuratau Range, which are correlated with the subejct body. The lithofacies are chiefly muscovite granite, biotite granite and biotite ademellite.

(iii) Gatchin body of late Carboniferous to early Permian age

The body occurs as sills, intruding into the Shulak body. The radioactive age of 265-268 Ma has been determined. It is composed mainly of fine to medium-grained granite, includes muscovite and garnet and assumes a leucocratic color.

② Dikes of late Carboniferous to Triassic age

Lamprophyre and diabase dikes occur in the vicinity of the Aktau granitic complex in the northern part of the District. These dikes are 0.6m to1.5m wide, trending in the WNW-ESE direction and intruding almost vertically. Diabase dikes observed in the south piedmont of Dzhallaktau Range went through the same metamorphism as the surrounding sedimentary rocks and are turned into amphibolite. Under the microscope, altered minerals such as hornblende, chlorite, etc. are observed.

(3) Blanket strata

① Quarternary System

The strata extend mainly over river beds and flatlands in the District, composed of terrace sediments, alluvial fan sediments, colluvial soil and stream sediments.

2) Manifestations

In the District, there are five ore manifestations of gold-silver and niobium-tantalum (Fig.I-3-1). The ore manifestations in the District are classified into the following categories:

① Gold-silver bearing quartz veins (Maulyan, Taulyan, Beshbulak and Shur)

② Niobium-tantalum manifestation (Aktau)

Of these manifestations, exploration work is being carried out at Maulyan, Beshbulak and Shur.

(1) Gold

① Maulyan manifestation

The manifestation, located in the southwestern part of the District, between the Dzhazmansai Stream on the west and the Sebistansai Stream on the east, was discovered in 1965 and prospecting started in the same year. The maulyan manifestation is bordered on the north by crystalline limestone of the Devonian Aktau Formation, whilst the southern part is covered by Quarternary sediments. The altitude is 850m to 1,100m and the area is deeply dissected mainly by the north-south streams. The manifestation area is composed mainly of siltstone, sandstone, slate and schist of the Nakrut Formation of Lower Silurian System, and of slate, siltstone, sandstone and schist of the Badamchalin Formation of Ordovician System (Fig.II-2-1-3, 4). The schistosity strikes WNW-ESE and dips 80° to 85° northward or is vertical. About ten of fracture-silicification zones, 1m to 20-30m wide, with the WNW-ESE trend, which cut the both Formations, have been confirmed by the Uzbek trenching.

Along the fracture zone, occur quartz veins, 0.5m to 2m wide and 5m to 250m long. Gold is related mainly with quartz veins, accompanied by silicified sandstone or slate. Quartz veins are milky white-colored, often crushed and contain iron oxide, such as goethite and lepidocrocite, and sulfide minerals such as pyrite, pyrrhotite, arsenopyrite and chalcopyrite. So far confirmed are the three ore bodies, 1m to 4m in vein width, ie., the No.1 ore body, 900m long, the No.2 ore body, 300m long, and the No.3 ore body 200m long. Gold and silver grades vary substantially from Au 1 g/t to 33.4 g/t and from Ag 1 g/t to 47.2 g/t. The bonanzas confirmed in trenches are the No.3 ore body (confirmed at K-3), 2.4 m wide, grading Au 17.8 g/t and Ag 8.6 g/t; No.1 ore body (confirmed at K-31), 3.0m wide, grading Au 8.1 g/t and Ag 0.9 g/t; and No.2 ore body (confirmed at K-7), 4.2m wide, grading Au 11.0 g/t and Ag 1.4 g/t. The homogenization temperatures of fluid inclusions of quartz are 221°C to 329°C on average. In the manifestation, trenching and drilling surveys are still carried out by the Uzbek side while tunneling survey is under plan.

② Beshbulak manifestation

The manifestation, situated 3 km east of the Maulyan manifestation, was discovered in 1967 and prospecting was commenced. The Beshbulak manifestation area is composed of sandstone, siltstone, slate and schist of Lower Silurian System. The schistosity strikes WNW-ESE and dips 80° northward. Two ore zones have been confirmed at the two trenches excavated by the Uzbek side. The ore zone, 11m to 17m wide and 450m long, trends in the WNW-ESE direction. Gold accompanies quartz veins but is low in grade, the highest of all confirmed by the trenching being 4 g/t. The quartz veins, 1.7m to 2.5m wide and 25m to 75m long, are brecciated and limonitized, and accompanied by sulfide minerals such as chalcopyrite, pyrite and arsenopyrite. Of the analysis conducted of six samples during the Phase II survey, the highest gold grade obtained was 1.8 g/t. The homogenization temperature of fluid inclusions of quartz (one sample) was 328°C. In this manifestation, trenching survey is still being carried out by the Uzbek side.

③ Shur manifestation

The manifesation, situated 2 km east of the Beshbulak manifestation, was discovered by the Zarmitan Expedition. The altitude of the area is some 900m and the undulation is deeply dissected chiefly by the streams trending in the NW-SE direction.

The Shur manifestation area is composed mainly of sandstone, siltstone and slate of the Dzhazbulak Formation. The schistosity strikes WNW-ESE and dips 80° to 85° north and south. Trenching survey has found a fracture-silicification zone, 6m wide, in the WNW-ESE direction. Along these fracture zones, occur quartz veins, 1.2m wide and 7m to 8 m long. Gold occurs mainly in the quartz veins which are also accompanied by pyrite, chalcopyrite, arsenopyrite and iron oxide. Gold grade confirmed by the trenching was trace to 1.4 g/t. Analysis of an ore sample during the Phase II survey indicated Au 0.2 g/t. The homogenization temperature of fluid inclusions of quartz (one sample) was 290°C.

The Uzbek trenching survey is still underway in this manifestation, as well.

④ Taulyan manifestation

The manifestation, situated in the Central Aktau Range, 4 km north of the Maulyan manifestation, occurs near contacts of the Aktau intrusive body with the Badamchalin Formation of Ordovician System. Prospecting started at the manifestation in 1965 with trenching survey.

The Badamchalin Formation is composed of alternations of sandstone and slate, where rocks are intensively crushed and silicified. Granodiorite dikes, 1m to 4m wide, and diabase-porphyrite dikes, 10m to 12m in width and 250m in extension, intrude into the sedimentary rocks. A lenticular swarm of quartz veins and veinlets, about 1m wide, almost in parallel with the NW-SE fracture zone is observed. Quartz is milky white-colored, crushed and accompanied by iron oxide. Gold mineralization accompanies quartz veins, while sedimentary rocks and granodiorite as the host rocks also contain gold in minute quantities. Extension of the ore zones is several meters to 200-250m, rarely reaching 500m. Most of the

1919 pieces of trenching samples contained Au not more than 1 g/t while four pieces showed Au 1 g/t to 4 g/t (1m in width). Analysis of an ore sample effected during the Phase II survey indicated an Au grade less than 0.1 g/t. The homogenization temperature of fluid inclusions of a quartz sample was 184°C.

(2) Niobium and tantalum

① Aktau manifestation

The manifestation, situated 4 km east of the Taulyan manifetation, was discovered by geophysical survey conducted in 1963. The manifestation occurs in pegmatite, aplite, biotite - muscovite granite stocks that intrude into slate of Ordovician and Lower Silurian Systems, and also in quartz. The Nb-Ta grade was 0.035%, which has not been reconfirmed by subsequent prospecting. The homogenization temperature of fluid inclusions of a quartz sample measured in Phase II was 134°C on average.

2-2 Geochemical Survey

2-2-1 Purpose of the Survey

In the Maulyan (Au), Beshbulak (Au), Taulyan (Au) and Aktau (Nb, Ta) manifestations situated within the Maulyan District, alteration zones such as silicification, chloritization or pyritization zones develop around quartz veins and silicified veins. It was anticipated that, around such alteration zones, anomalous haloes of Au, Ag, Hg, etc. might develop and these could possibly be extracted by microanalysis of rocks.

2-2-2 Methods of the survey

Rock samples of 200 pieces collected by the Uzbek geologists at a rate of 4 pieces per km^2 in the Maulyan District were crushed at the Samarkandgeology and analyzed, of 23 elements, by Chemex Labs. Ltd., Canada. The sample collection points are indicated in Fig.II-2-2-1.

2-2-3 Survey findings

Analysis values and a table of statistics are exhibited in Appendix 2-9 and Table II-2-2-1, respectively. For the statistical processing, values below a lower limit of detection were replaced by values equivalent to "detection limit x 1/2." In case of W, all the 200 samples showed values below the detection limit. In case of Hg, only three samples showed 10ppb, the lower detection limit, but all the rest were below the limit. Correlation coefficients between respective elements are indicated in Table II-2-2-2, and scatter plots (logarithmic) of analysis values between some elements are indicated in Figs.II-2-2-2 thru -5.

Combinations of elements whose correlation coefficients are no less than 0.5 nor more than 0.7 are Cd-Sb, V-Ag, V-Cd, Cr-Ni, Mo-Ag, Mo-Cd, Mo-V, Li-Co, Li-Cr, LiBe, Ta-Be and P-Ta. Combinations of elements whose correlation coefficients are no less than 0.7 are Co-Ni, Cr-Co and Mo-Sb. Au, As and Hg showed no significant correlation nor dominantly negative correlation with any other elements.

In order to classify the background values and anomalous values of respective elements, a histogram of frequency distribution which has 20 divisions between the maximum and minimum values of respective elements was drawn, as well as a cumulative frequency diagram. For elements, the histogram of frequency distribution of whose analysis values shows the normal distribution, "average value + 2 x standard deviation (σ)" was applied as the threshold. For elements whose minimum values reach a greater number or substantially deviate from the normal distribution, a bending point of the curve was applied as the threshold. From these thresholds, geochemical anomaly distribution map was drawn of the 11 elements (Figs.II-2-2-3).

Anomalous points of Au are scattered in the southern part of the Maulyan manifestation, in the vicinity of the Taulyan manifestation and in the southern part of the Shur manifestation, but they are poor in continuity. Distribution of anomalous values of Au and As are relatively concordant in the vicinity of the Taulyan manifestation, which presumably suggests a high correlation between the two elements in that area. Anomalous points of Nb and Ta are spotted, though small in number, in the Aktau manifestation and in areas where granite occurs; correlation of anomalous points of the two elements is high. The subject geochemical survey did not result in extraction of clear continuation of anomalous points of Au, however, all the anomalous values of Au have been located in the vicinity of the known manifestation areas.

2-3 Drilling Survey

2-3-1 Purpose of the survey

Drilling survey aimed at collecting samples and confirming ore reserves was conducted at the Maulyan manifestation, in order to verify and describe the stratigraphy and occurrence of ore deposits.

2-3-2 Methods of the survey

1) Outline of drilling operation

With the personnel and equipment arranged by the Samarkandgeology, drilling work of 2 boreholes totaling 384.1m was performed.

Locations of the respective drillholes are indicated in Figs. II-2-3-1.

The drilling machines used were two units of Russian-made SKB-41, capable of drilling of 300m in case of 76 mm dia. and 500m in case of 59 mm dia., respectively.

In principle, the drilling operation was conducted in two 12-hour shifts, with one foreman and one operator per unit.

A bulldozer and a trailer were used for the transportation of drilling rigs and supplies, road construction, drill site leveling and for preparations.

For the drilling operation, the regular method was employed .

For the surface soil drilling, metallic bits of 93mm dia. were used. After drilling reaches the rock, casing pipes of 89 mm dia.were inserted and installed, and drilling operation was continued with the diamond bits of 76 mm dia. as the final diameter. Mud water was not prepared at the drilling site but at the mud water plant of the Zarmitan Expedition's base and transported to the drilling site by a $4m^3$ tank truck.

The drilling work lasted for 67 days from July 21 to September 25, 1998. The drilling lengths and core recovery by borehole are tabulated in Table II-2-3-1. The drilling efficiency, working time, consumption of drilling articles and bits are shown in Table II-2-3-2 thru -5. The main equipment used, results of work and progress record by drillhole are respectively shown in Appendices 3-1 thru 3-3.

2) Drilling operation

The drilling operation is outlined in Table II-2-3-6.

2-3-3 Results of the drilling survey

The survey results are displayed in the geologic cross section along the drillholes (Fig.II-2-3-2 and -3).

1) MJML-1 (Direction S20° W; inclination −75°; drilling length 201.1m)

The drilling was aimed to examine mineralization approx. 50m below the surface of the western extension (60m) of the bonanza of No.3 ore body (vein width 2.4m; Au 17.8 g/t) caught by the Uzbek trenching K-3.

(1) Geology : From the mouth to the end, the drillhole is composed of sandy phyllite beds of the Nakrut Formation of Lower Silurian System, accompanied by phyllite.

(2) Mineralization : Although quartz veins and veinlets were found in various parts of the drillhole, no showings of mineralization exceeding Au 1.0 g/t were verified, except for the low-grade gold mineralization (true width 0.2m; Au 2.0 g/t) in a quartz vein accompanied by pyrite, limonite and electrum, which was caught between 104.15m and 104.50m, as shown in Fig.II-2-3-2.

Main showings of mineralization are indicated in Table II-2-3-7.

2) MJML-2 (Direction S20° W; inclination -75°; drilling length 183.0m)

The drilling was aimed to examine mineralization approx. 110m below the surface of the bonanza of No.2 ore body (vein width 4.2m; Au 11.0 g/t) caught by the Uzbek trenching K-7.

(1) Geology : From the mouth to the end, the drillhole is composed of sandy phyllite beds of the Nakrut Formation of Lower Silurian System, accompanied by phyllite.

(2) Mineralization : Although quartz-pyrite veins were found in various parts of the drillhole, no showings_of mineralization exceeding Au 1.0 g/t were verified, except for the low-grade gold mineralization (true width 0.34m; Au 1.6 g/t) in a quartz vein accompanied by pyrite, which was caught between 159.70m and 160.30m, as shown in Fig.II-2-3-3.

Main showings of mineralization are indicated in Table II-2-3-7.

2-4 Summary and Considerations

The survey area pertains to the Southern Tien-Shan Geologic Tectonic Zone, underlain by terrigenous sediments of Cambrian to Lower Silurian System. In the central and northern parts of the area, occurs limestone of Upper Silurian to Middle Carboniferous System. These rocks are intruded by Upper Silurian to Triassic dikes of lamprophyre and diabase and by Carboniferous to Permian granites. The regional tectonic direction of the basment rocks trends in the WNW-ESE direction, which is intersected by fractures that develop in the NE-SW and NW-SE directions The geologic structure is inferred to have been formed by the Early Paleozoic Caledonian orogeny and the Late Paleozoic Hercynian orogeny.

Ore manifestations mainly of gold in the subject area extend along the fracture zones in the WNW-ESE direction, forming a part of the Aktau ore zone (70km east to west and 2km to 5km north to south) along the southern side of the Aktau granite bodies. The ore zone, aligned in parallel along the Aktau granite bodies, is inferred to have been formed by mineralization accompanying igneous activity of granites. There are gold manifestations such as Maulyan, Beshbulak, Taulyan and Shur. In the light of the findings of the Uzbek trenching survey and the subject Phase II geological survey, the gold manifestations at Beshbulak (vein width 1.7-2.5m; Au max. 4 g/t), Taulyan (1m; 4 g/t) and Shur (1.2m; 1.4 g/t) are not considered worthy of further exploration, due to the low grades of gold. The Aktau niobium-tantalum manifestation (Nb-Ta max. 0.035%) is also too low in grade to justify further exploration.

Main component minerals of the gold-bearing quartz veins in the survey area are quartz, pyrite and iron oxide, accompanied by minor quantities of arsenopyrite, chalcopyrite, sphalerite, graphite and electrum.

Analysis of ore samples made in Phase II indicated no correlation between gold, silver and arsenic. (Fig.I-4-1 thru -3) Analysis of samples collected near the Shur manifestation characteristically indicated relatively high silver content, unaccompanied by gold.

The geochemical survey indicated that combinations of elements whose correlation coefficients are no less than 0.5 nor more than 0.7 are Cd-Sb, V-Ag, V-Cd, Cr-Ni, Mo-Ag, Mo-Cd, Mo-V, Li-Co, Li-Cr, Li-Be, Ta-Be and P-Ta. Combinations of elements whose correlation coefficients are 0.7 or more were Co-Ni, Cr-Co and Mo-Sb. Au, As and Hg showed no significant correlation nor significant negative correlation with any other elements.

Anomalous points of Au are scattered in the southern part of the Maulyan manifestation near the Taulyan manifestation, and in the southern part of the Shur manifestation, but they are poor in continuity. Distribution of anomalous values of Au and As in the vicinity of the Taulyan manifestation are relatively concordant, which presumably suggests a high correlation between the two elements in that area. Anomalous points of Nb and Ta are spotted, though small in number, in the Aktau manifestation and in areas where granite occurs; correlation of anomalous points of the two elements is high. The subject geochemical survey did not result in extraction of clear continuation of anomalous points of Au, however, all the anomalous values of Au were located in the vicinity of the known manifestations; therefore, geochemical survey with higher density of sample collection around the anomalous points and the known manifestation areas is expected to reveal more details of behavior of microelements.

Homogenization temperatures of fluid inclusions of the quartz samples collected by the geological survey (37 samples) and drilling survey (6 samples) in the District ranged between min. 108°C and max. 423°C. The frequency distribution (Appendix 2-8) indicates the 130°C-370°C range, which can be divided into a low temperature group of 130°C-200°C and a high temperature group of 250°C-350°C. Comparison of respective samples indicated the three types: quartz with low temperatures only; quartz with high temperatures only; and, quartz with the both temperatures coexisting. Under the microscope, no difference is observed bewteen low-temperature fluid inclusions and high-temperature ones, in terms of occurrence and shape. The fluid inclusions are considered to have been generated by the same hydrothermal process. Quartz of the Aktau manifestation showed only low temperatures. The mentioned three types of quartz was verified in samples from the Maulyan manifestation, however, no clear tendency in their occurrence is recognizable due to the small number of sample. Correlation between homogenization temperature and depth is unclear. The average homogenization temperature of a sample grading Au 1.2 g/t obtained by the geological survey is 267°C, whereas those of drilling samples grading 2.0 g/t and 1.6 g/t are 221°C and 281°C, respectively, which are relatively low in the high-temperature group. As the gold grades of samples whose homogenization temperatures exceed 350°C were lower than the detection limit, correlation between quartz homogenization temperature and grade is not clear. Correlation between homogenization temperature and depth at which a drilling sample was taken is neither clear.

It is in the Maulyan manifestation, of all the gold manifestations in the subject District, that mineralization spreads over relatively extensive areas, where some ten of fracture-silicification zones, 1m to 20-30m wide, extending in theWNW-ESE direction, have been found by the Uzbek trenching survey. The quartz veins and silicification zones along the fracture zone are accompanied by gold mineralization. So far, three ore bodies, 1m to 4m in vein width, ie., the No.1 ore body, 900m long, as well as the No.2 ore body, 300m long, and the No.3 ore body, 200m long, have been confirmed. The gold grade varies widely from 1 g/t to 33.4 g/t. The trenching has confirmed bonanzas, 2.4m wide, grading Au 17.8 g/t at K-3, 3.0m wide, Au 8.1 g/t at K-31 and 4.2m wide, Au 11.0 g/t at K-7, respectively. The Uzbek trenching and drilling exploration is still underway in the manifestation while tunnel prospecting is under plan.

During Phase II, drilling was performed at two boreholes (MJML-1, 2), aimed at the western extension, 60m long, of the No.3 ore body (2.4m wide, grading Au 17.8 g/t) of the No.1 ore zone found at the Uzbek trench K-3 and also at the lower portion of the No.2 ore body (4.2m wide, grading 11.0 g/t) of the No.2 ore zone found at the trench K-7. Although the drilling caught pyryte-bearing quartz veins and veinlets in various parts, gold mineralization grading Au 1.0 g/t or higher was found only in the lower portion of the No.3 ore body (0.2m in true width, Au 2.0 g/t) and in the lower portion of the No.2 ore body (0.34m, Au 1.6 g/t).

In the subject fiscal year, drilling was carried out by the Uzbek side on their own at six boreholes(C-3, 6, 7, 8, 9, 10), which caught mineralization, 1.2m to 1.8m wide, grading Au 4 to 8 g/t, between 16m and 90m from the surface excepting C-10, of which analysis has not yet been obtained. From these findings, it has been confirmed that low-grade mineralization is continuous at the ore zones Nos. 1 and 2 of the Maulyan manifstation although gold grade considerably varies (Fig. II-2-3-4~6).

Table II-2-1-1 Major Assay Results in the Geological Survey Area

No.	Sample No.	Local grid(X-Y)	Au(g/t)	Ag(g/t)	As(%)	Remarks
1	GIO-6	73.86 - 62.37	0.4	1.8	0.02	Aktau manifestation, quartz vein, w=80cm
2	GIO-9	71.80 - 62.39	0.4	<1	0.02	silicified zone with quartz veinlets, w=32cm
3	GIO-10	72.18 - 62.37	0.2	<1	0.02	strong silicified zone,w=320cm
4	GIO-21	69.64 - 61.21	0.4	1.8	0.02	quartz vein, w=20cm
5	GIO-56	72.65 - 58.54	1.2	<1	0.02	quartz vein, w=10cm
6	GIO-59	72.89 - 58.90	0.4	<1	0.01	quartz vein, w=20cm
7	GIO-85	68.16 - 59.16	0.8	<1	0.02	quartz vein, w=15cm
8	GIO-94	74.59 - 57.22	0.2	<1	0.01	Shur manifestation, quartz vein, w=40cm

Table II-2-2-1 Statistical Factors of Assay Results of Geochemical Samples

No.	Element	Unit	Method	Lower limit	Min.	Max.	Average	S.D.(σ)	m+2σ
1	Au	ppb	FA-AAS	5	<5	960	11.325	70.16	151.64
2	Ag	ppm	AAS	0.2	<0.2	1.6	0.2	0.14	0.47
3	Hg	ppb	AAS	10	<10	10	5	0.61	6.29
4	Sb	ppm	AAS	0.2	<0.2	29	0.7	2.30	5.33
5	As	ppm	AAS	1	0.5	1560	22.0	113.02	248.05
6	Pb	ppm	AAS	2	4	52	21	6.94	34.61
7	Zn	ppm	ICP-AES	2	6	2650	97	199.56	495.65
8	Cd	ppm	ICP-AES	0.5	<0.5	4.5	0.4	0.47	1.32
9	Cu	ppm	ICP-AES	1	<1	129	30	23.63	77.25
10	Bi	ppm	ICP-AES	2	<2	12	2	2.07	5.93
11	V	ppm	ICP-AES	1	1	670	90.6	94.32	279.23
12	Ni	ppm	ICP-AES	1	<1	99	29	14.55	58.14
13	Co	ppm	ICP-AES	1	<1	40	11	5.96	22.70
14	Cr	ppm	ICP-AES	1	2	140	59	27.44	113.44
15	Mo	ppm	ICP-AES	1	<1	36	1	3.28	8.04
16	W	ppm	ICP-AES	10	<10	<10	<10	—	—
17	Be	ppm	ICP-AES	0.5	<0.5	7.5	1.6	1.04	3.65
18	Li	ppm	AAS	1	2	80	20	11.88	43.96
19	Nb	ppm	XRF	2	<2	16	1	1.43	4.16
20	Ta	ppm	NAA	2	<2	48	15	7.09	29.39
21	Te	ppm	AAS	0.1	<0.1	0.1	0.1	0.01	0.07
22	Mn	ppm	ICP-AES	5	40	4030	603	576.74	1756.35
23	P	ppm	ICP-AES	10	<10	1340	521	243.39	1007.75

S.D. : standard devitation

Table Ⅱ-2-2-2 Correlation among 23 Elements in Geochemical Samples

	Au	Ag	Hg	Sb	As	Pb	Zn	Cd	Cu	Bi	V	Ni	Co	Cr	Mo	W	Be	Li	Nb	Ta	Te	Mn	P
Au	1.00	-0.02	-0.01	0.04	0.04	0.04	0.03	0.19	0.11	-0.03	0.02	0.07	0.07	-0.04	0.02	-	-0.02	0.04	-0.02	-0.06	-0.02	0.20	-0.10
Ag		1.00	0.08	0.34	-0.01	0.00	0.04	0.27	0.12	-0.09	**0.61**	0.03	-0.19	0.08	**0.58**	-	0.05	0.02	-0.05	-0.04	-0.03	-0.06	-0.09
Hg			1.00	0.01	-0.02	-0.07	-0.04	-0.01	0.04	-0.01	0.03	-0.06	-0.11	-0.03	0.18	-	-0.04	-0.04	-0.03	-0.11	-0.02	0.07	-0.10
Sb				1.00	0.41	0.11	0.16	**0.51**	0.20	-0.06	0.46	0.34	-0.03	0.03	**0.73**	-	0.21	-0.04	-0.05	-0.04	-0.02	-0.05	0.24
As					1.00	-0.03	-0.01	0.05	-0.02	-0.05	0.01	-0.02	-0.03	0.05	0.02	-	0.04	-0.01	0.00	0.05	-0.01	-0.01	0.07
Pb						1.00	0.02	0.06	-0.09	-0.13	0.02	0.18	0.15	0.10	0.06	-	0.09	0.06	-0.05	-0.03	0.03	0.10	0.10
Zn							1.00	0.15	0.09	-0.06	0.10	0.16	0.09	0.09	0.10	-	0.06	0.02	-0.04	0.03	-0.02	-0.01	0.08
Cd								1.00	0.23	0.02	**0.54**	0.32	0.01	0.07	**0.57**	-	0.19	0.00	-0.02	0.04	0.06	-0.09	0.09
Cu									1.00	0.14	0.33	0.28	0.18	0.20	0.25	-	0.11	0.14	-0.05	-0.07	0.13	0.19	-0.14
Bi										1.00	-0.11	-0.17	-0.17	-0.20	0.00	-	-0.21	-0.26	-0.04	-0.10	0.09	-0.13	-0.12
V											1.00	0.37	0.11	0.43	**0.67**	-	0.23	0.19	-0.08	0.18	0.02	-0.06	0.15
Ni												1.00	**0.80**	**0.69**	0.16	-	0.33	0.45	-0.13	0.19	0.05	0.37	0.43
Co													1.00	**0.72**	-0.22	-	0.28	0.50	-0.11	0.29	-0.02	0.39	0.36
Cr														1.00	-0.04	-	0.36	**0.60**	-0.15	0.45	-0.05	0.16	0.31
Mo															1.00	-	0.09	-0.13	-0.04	-0.09	0.04	-0.12	0.00
W																-	-	-	-	-	-	-	-
Be																	1.00	**0.66**	0.43	**0.54**	-0.03	0.16	0.39
Li																		1.00	0.11	0.45	0.01	0.24	0.19
Nb																			1.00	0.45	0.00	0.05	0.21
Ta																				1.00	0.13	0.02	**0.51**
Te																					1.00	0.14	-0.12
Mn																						1.00	0.04
P																							1.00

Table II -2-3-1 Quantity of Drilling Works and Core Recovery in the Maulyan District

Hole No.	Programmed Length(m)	Drilled length (m)	Length of core (m)	Core recovery (%)
MJML- 1	200.00	201.10	168.90	84.0
MJML- 2	180.00	183.00	155.30	84.9
Total	380.00	384.10	324.20	84.4

Table II-2-3-2 Efficiency of Each Drillhole in the Maulyan District

Hole No.	Drilling Machine	Working Period	Drilling Length (m)	Core		Working Day			Efficiency		
				Length (m)	Recovery (%)	Drilling* (day*)	Others (day)	Total** (day**)	m/day*	m/day**	m/working Period
MJML-1	SKB-41	Aug.10,'98 ↓ Sept.25,'98	201.10	168.90	84.0	25.0	10.3	35.3	8.04	5.70	4.28
MJML-2	SKB-41	July 21,'98 ↓ Sept.21,'98	183.00	155.30	84.9	34.0	15.2	49.2	5.38	3.72	2.90
Total			384.10	324.20	84.4	59.0	25.5	84.5	6.51	4.55	3.49

* includes drilling and out drilling

** includes drilling, out drilling, regain of accident, preparation, dismount/mobilization and others.

Table II-2-3-3 Working Time of Diamond Drilling in the Maulyan District

Hole No.	Working Period		Number of Works		Working						
	Period	(day)	Foreman (man)	Worker (man)	Drilling (hour)	Out Drilling (hour)	Regain of Accident (hour)	Preparation (hour)	Dismount/ Mobilization (hour)	Others (hour)	Total (hour)
MJML-1	Aug.10,'98 ↓ Sept.25,'98	47	99	105	379.0	427.0	262.0	12.0	9.0	45.0	1,134.0
MJML-2	July 21,,'98 ↓ Sept.21,'98	63	157	133	384.0	431.0	286.0	12.0	21.0	45.0	1,179.0
Total	—	110	256	238	763.0	858.0	548.0	24.0	30.0	90.0	2,313.0

Table II-2-3-4 Consumable Drilling Articles in the Maulyan District

Item	Specifi-cation	Unit	Quantity		
			MJMI-1	MJMI-2	Total
Bentonite		kg			0
Clear mud		kg			0
Nl mud water		m^3	45	65	110
C. M. C.		kg			0
UNIFLOK		kg			0
Clay		kg			0
Diamond bit	93mm	pc			0
Diamond bit	76mm	pc	12	34	46
Diamond bit	59mm	pc			0
Diamond single bit	59mm	pc			0
Diamond reamer	76mm	pc	1	1	2
Diamond reamer	59mm	pc			0
Metal crown	112mm	pc			0
Metal crown	93mm	pc	1	1	2
Metal crown	76mm	pc	11	17	28
Metal shue	89mm	pc	1	1	2
Metal shue	73mm	pc			0
core box			29	26	55

Table II-2-3-5 Drilling Meterage of Bits in the Maulyan District

Size	Number of bits (pcs)	Drilling Meterage by Drillhole (m)		Total	Efficiency
		MJML-1	MJML-2		M/bit
Metal bits	11	83.80		83.80	7.62
(φ 76mm)	17		10.10	10.10	0.59
Sub total	28	83.80	10.10	93.90	3.35
Diamond bits	12	117.30		117.30	9.78
(φ 76mm)	34		172.90	172.90	5.09
Sub total	46	117.30	172.90	290.20	6.31
Grand total	74	201.10	183.00	384.10	5.19

Table II-2-3-6 Results of Drilling Works in the Maulyan District

Hole No.		MJML-1	MJML-2
Direction Dip		S20° W -75°	S20° W -75°
Bit (m)	φ 76mm	201.1	183.0
	φ 59mm		
Casing (m)	φ 89mm	20.00	15.00
	φ 73mm		

Table II-2-3-7 Major Mineralization Zones Revealed by Drillings in the Maulyan District

Hole No.	Depth (m)	True width (m)	Au (g/t)	Ag (g/t)	As (%)	Remarkas
MJML-1	104.15 ～ 104.5 (0.35)	0.20	2.0	<1.0	0.02	No.3 Ore body (No.1 Ore Zone)
MJML-2	159.70 ～ 160.3 (0.60)	0.34	1.6	<1.0	0.02	No.2 Ore body (No.2 Ore Zone)

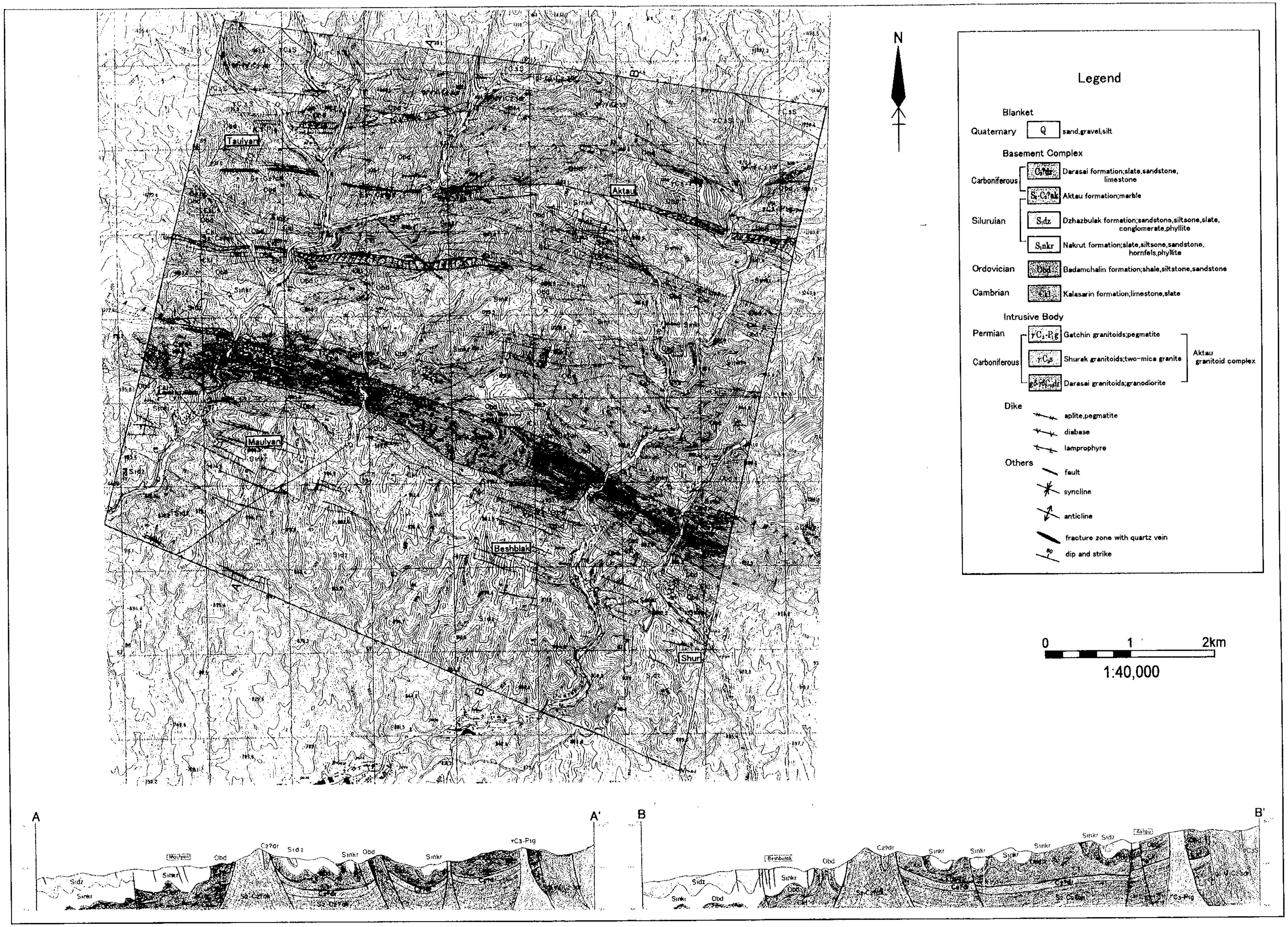


Fig.II-2-1-1 Geologic Map and Cross Sections of the Maulyan District

Age			Formation	Abbreviation	Geologic column	Thickness (m)	Lithology
Cenozoic	Quarternary			Q			sand,gravel,silt
Paleozoic	Carboniferous		Darasai	C_2?dr		>200	slate,sandstone, limestone
	Devonian		Aktau	S_2-C_2?ak		>350	marble
	Silurian	upper					
		lower	Dzhazbulak	S_1dz		220	sandstone,siltstone, slate,conglomerate, phyllite
			Nakrut	S_1nkr		200	slate,siltstone, sandstone,phyllite
	Ordovician		Badamchalin	Obd		180	slate,siltstone, sandstone
	Cambrian		Kalsarin	€kl		>190	limestone,marble, sandstone,slate, limy sandstone,flint

Fig.II-2-1-2 Schematic Geologic Column of the Maulyan District

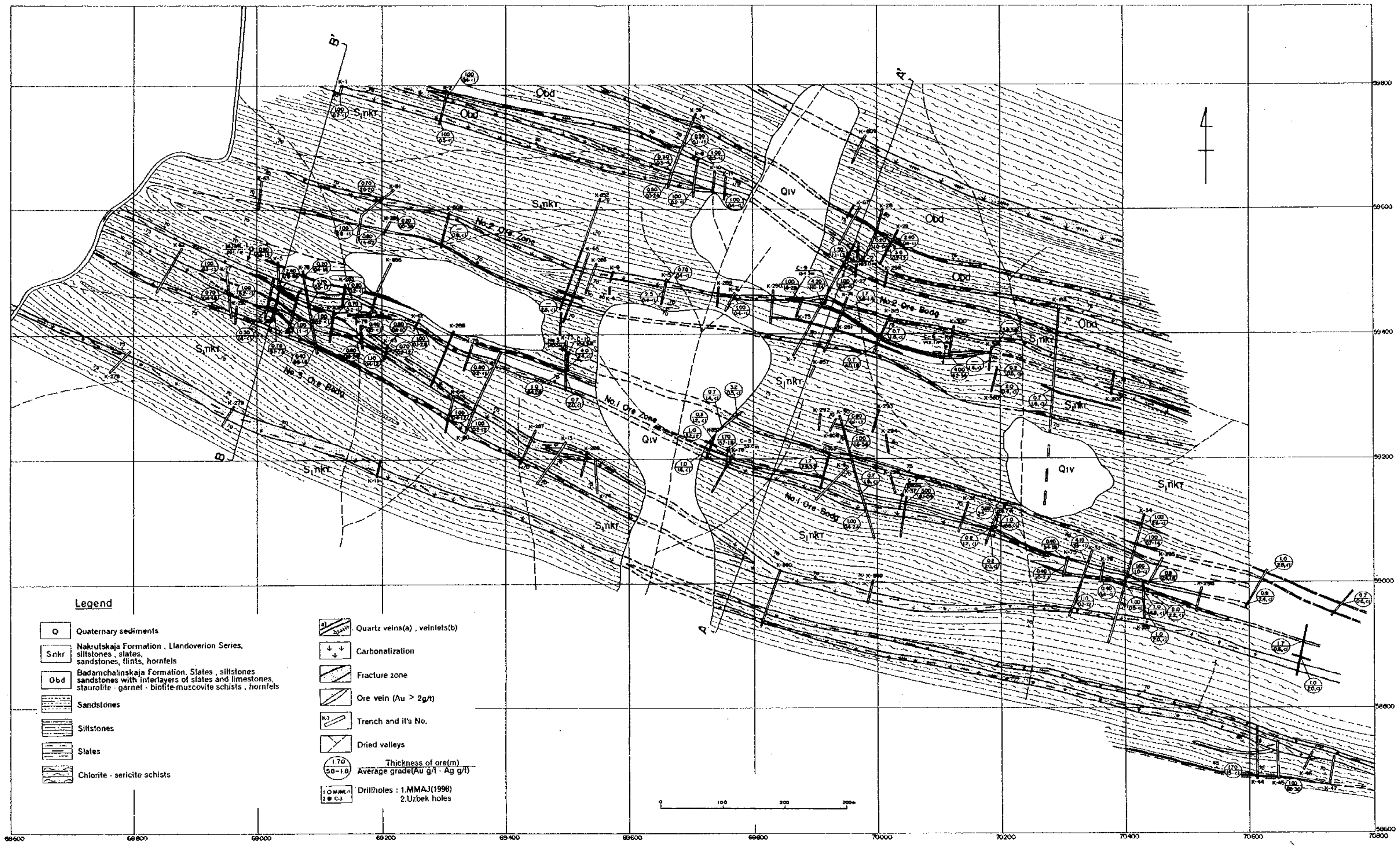


Fig.II-2-1-3 Geologic Map of the Maulyan Ore Manifestation

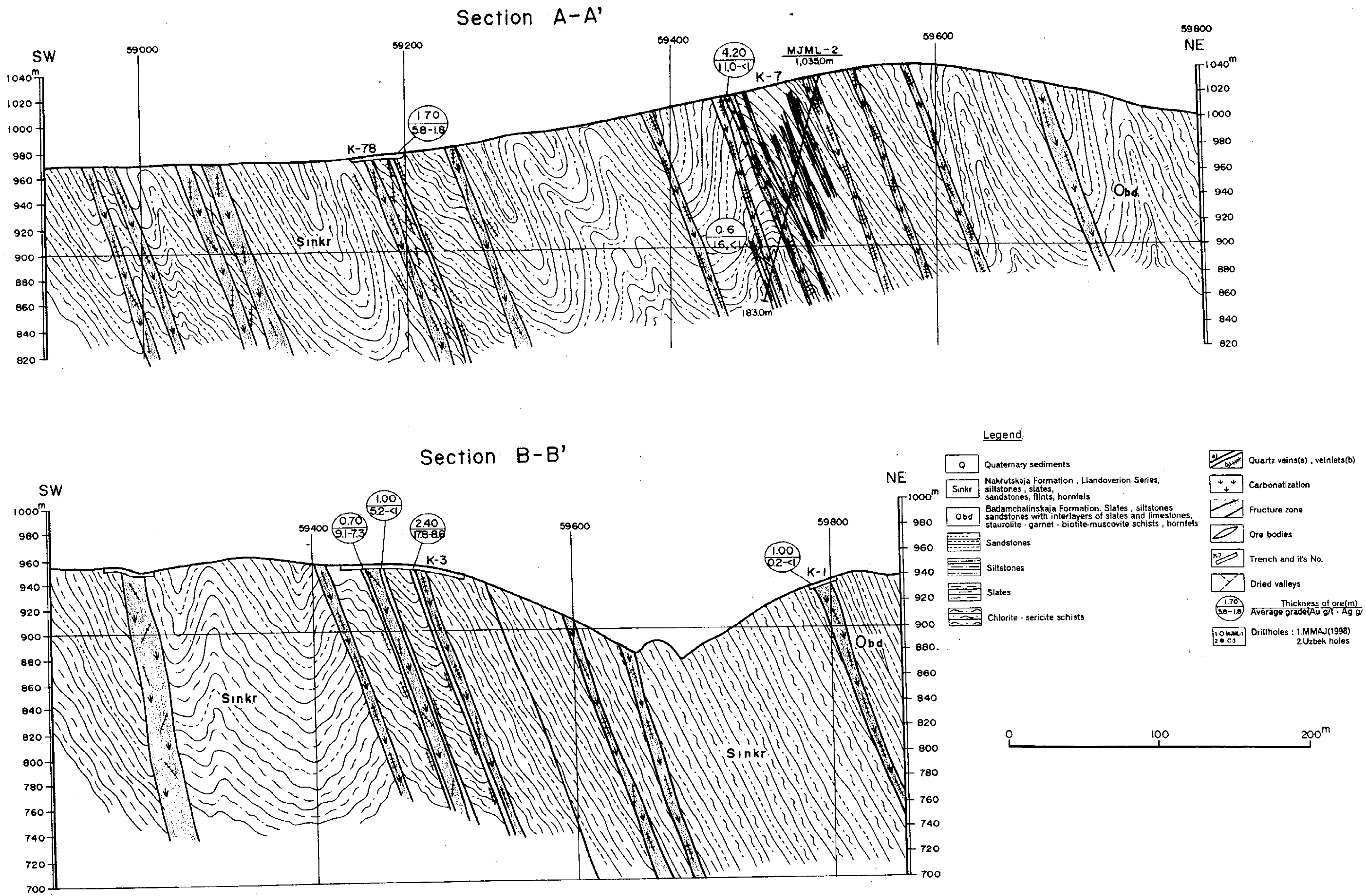
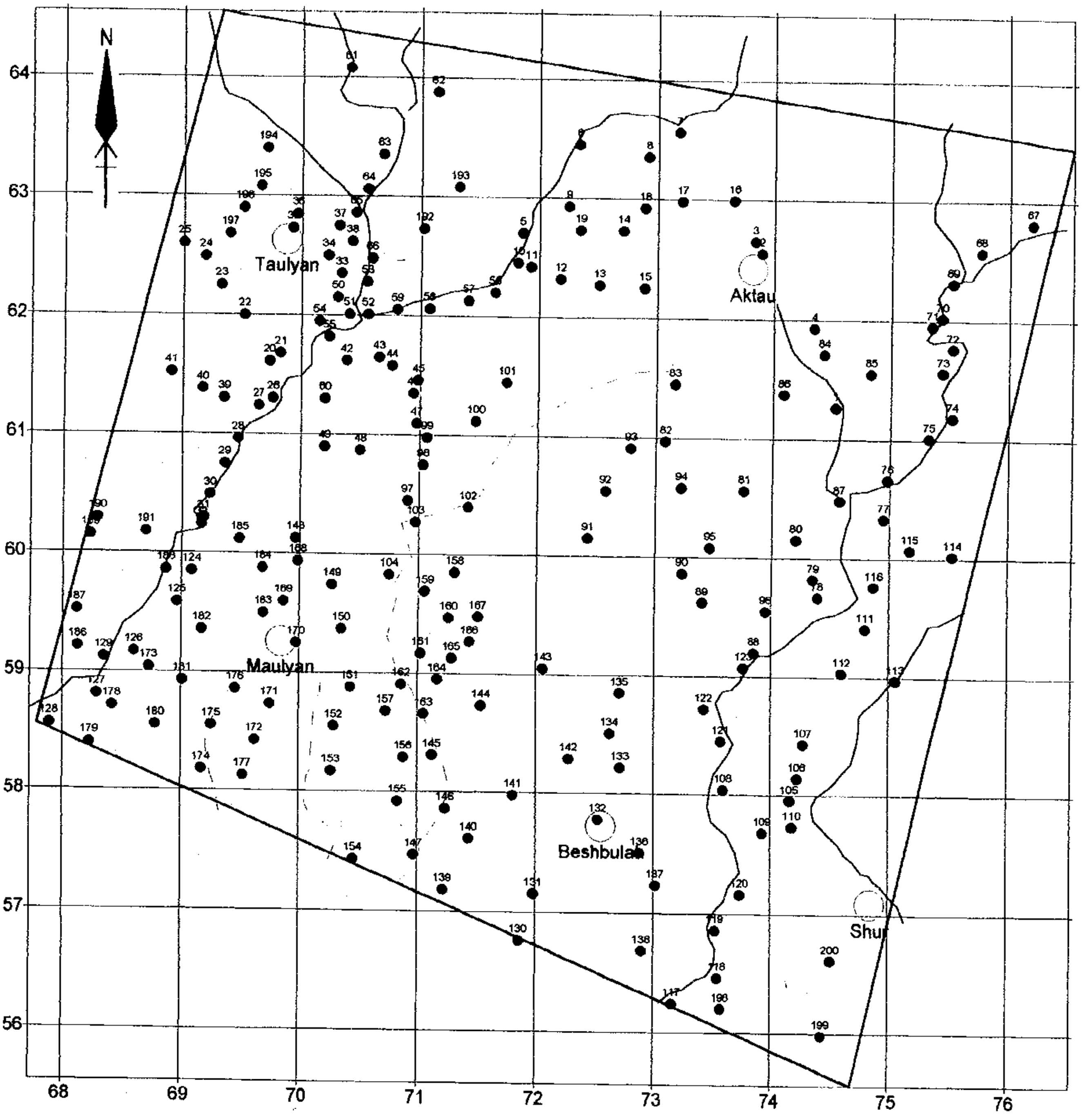


Fig.II-2-1-4 Geologic Cross Sections of the Maulyan Ore Manifestation



Legend

0 2km

120 Sampling point and its number

Maulyan Ore manifestation and its name

River and dry river

Fig.II-2-2-1 Location Map of the Geochemical Samples in the Maulyan District

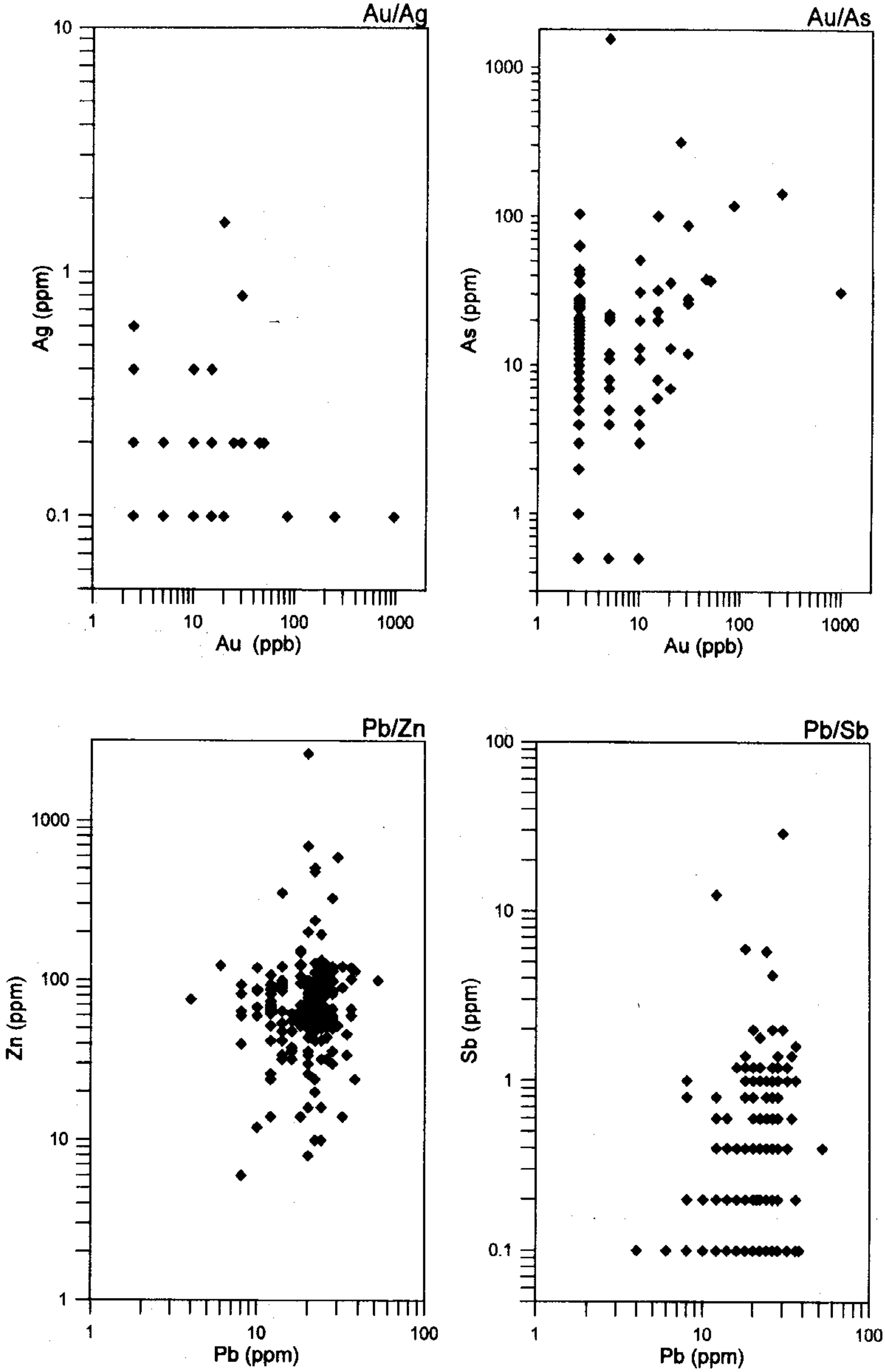


Fig.II-2-2-2(1) Scatter Plots (logarithmic) for Geochemical Samples in the Maulyan District (Au-Ag,Au-As,Pb-Zn,Pb-Sb)

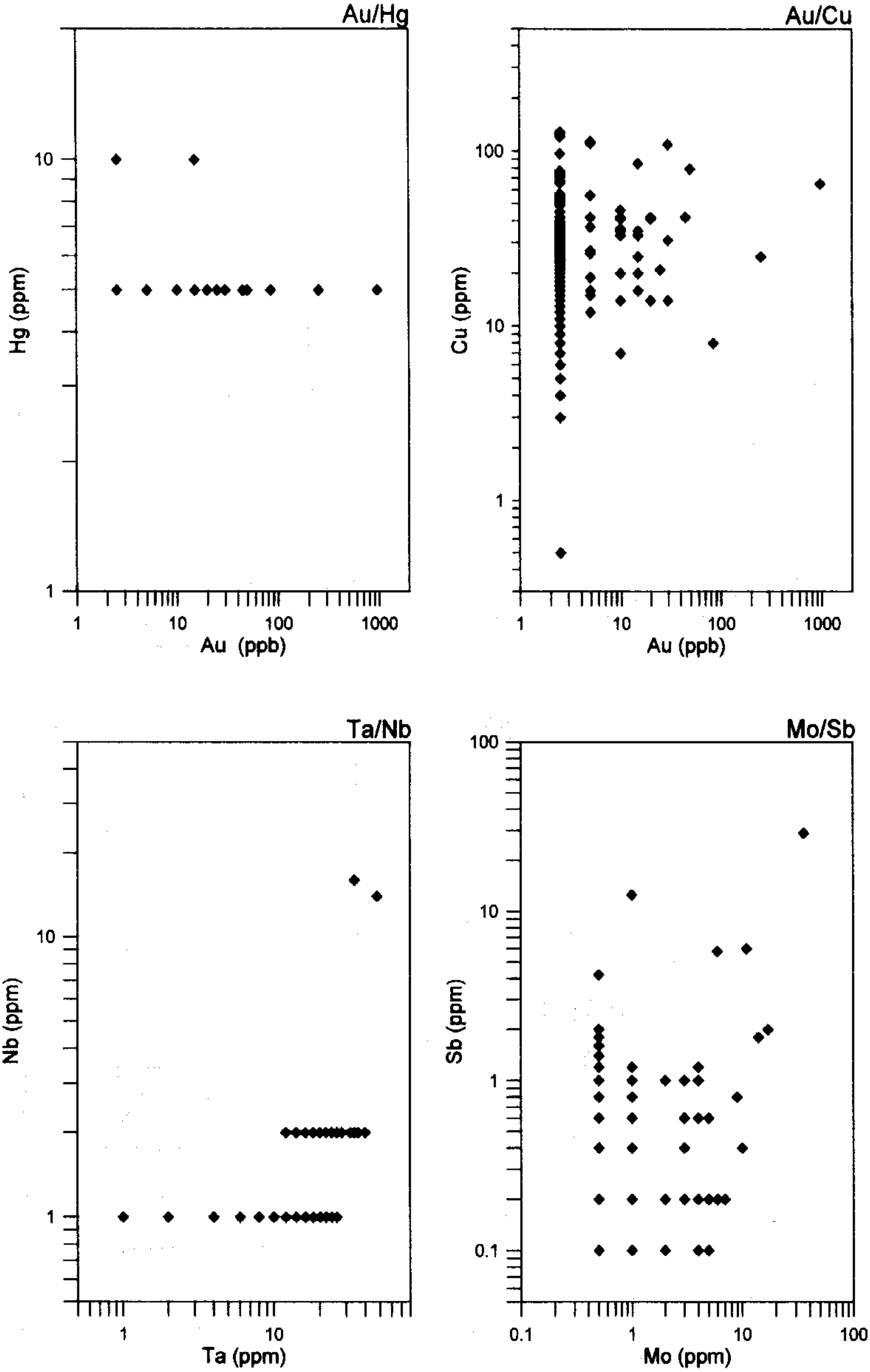


Fig.II-2-2-2(2) Scatter Plots (logarithmic) for Geochemical Samples in the Maulyan District (Au-Hg,Au-Cu,Nb-Ta,Sb-Mo)

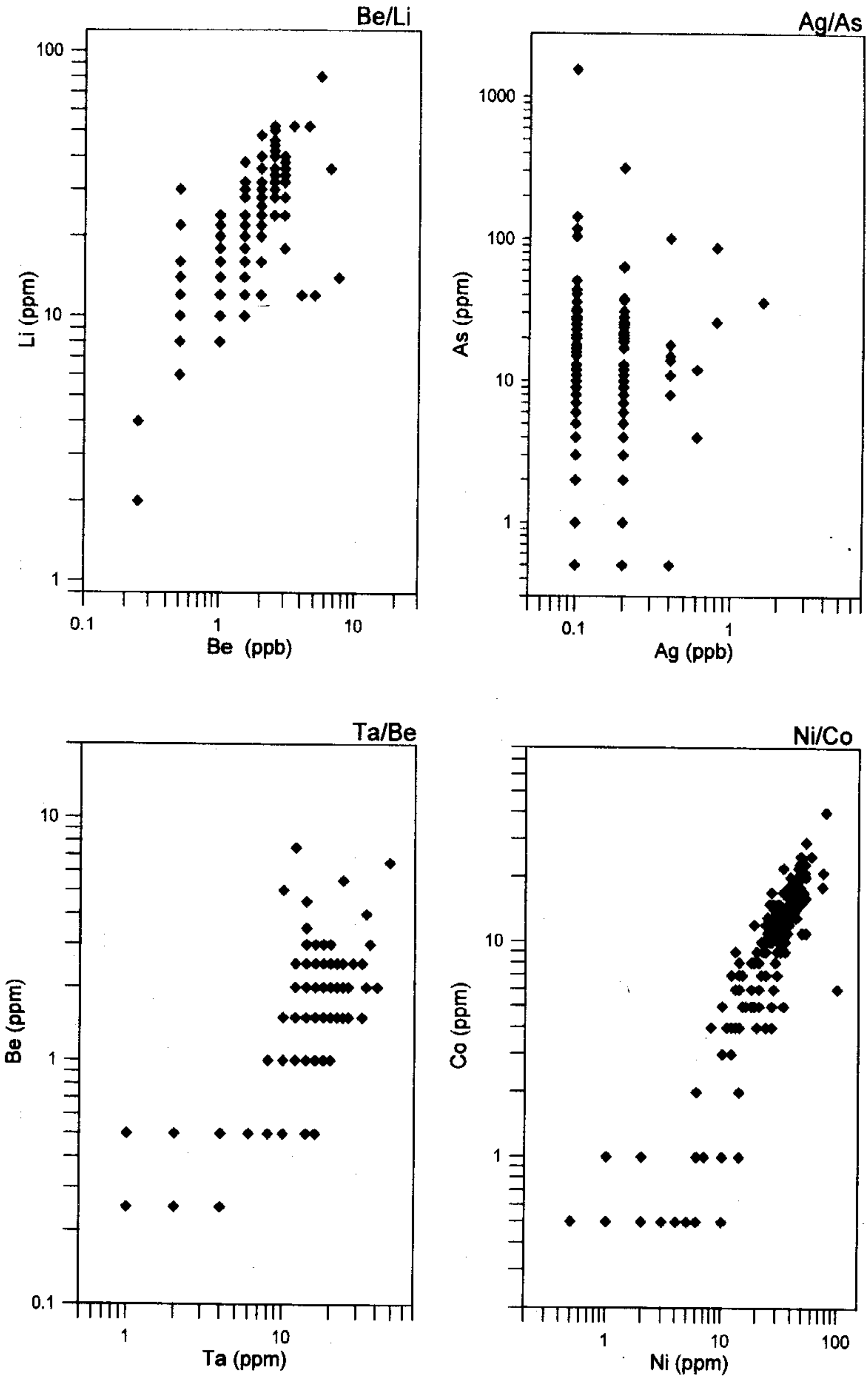


Fig.II-2-2-2(3) Scatter Plots (logarithmic) for Geochemical Samples in the Maulyan District (Be-Li,Ag-As,Ta-Be,Ni-Co)

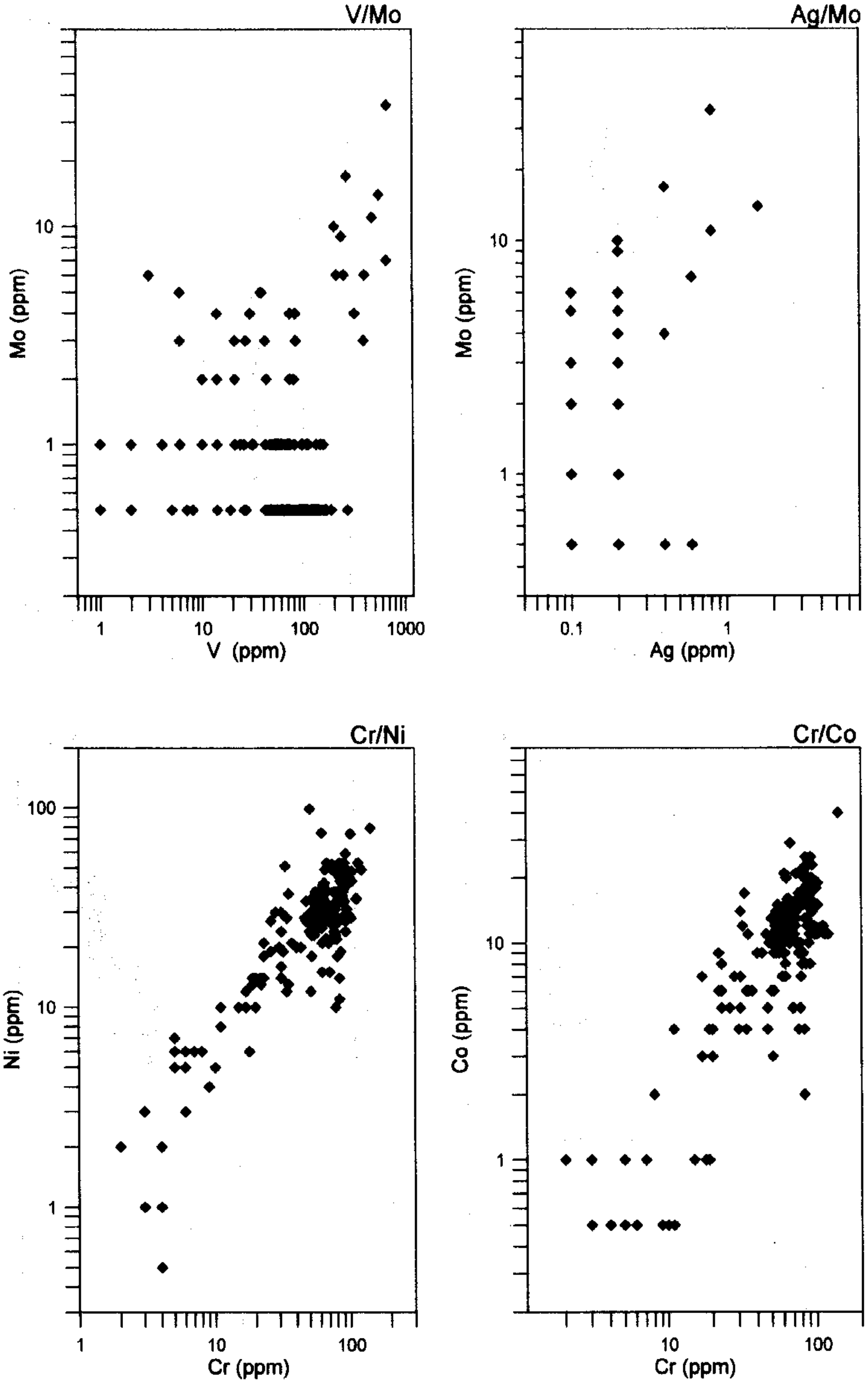


Fig.II-2-2-2(4) Scatter Plots (logarithmic) for Geochemical Samples in the Maulyan District (V-Mo,Ag-Mo,Cr-Ni,Cr-Co)

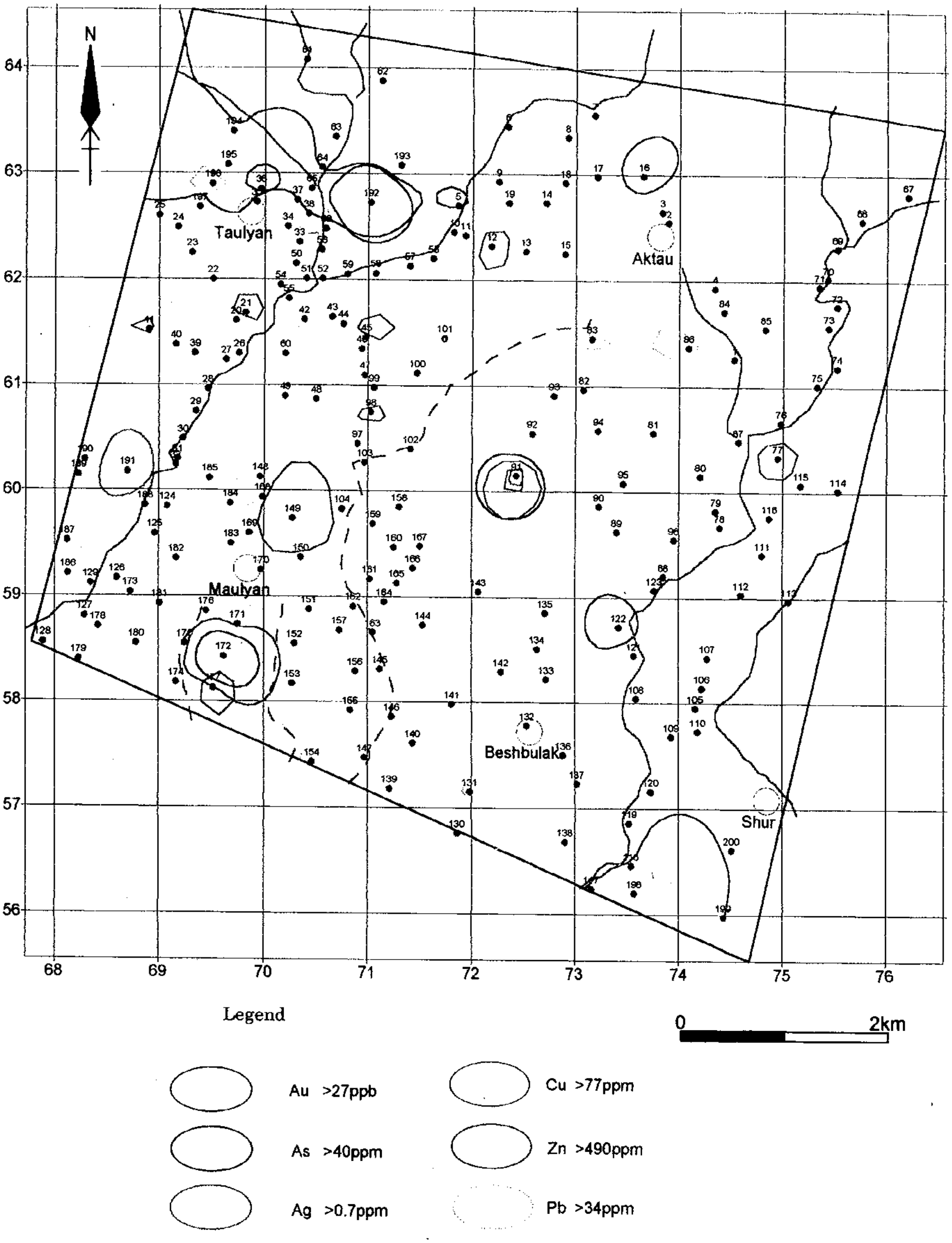


Fig.II-2-2-3(1) Geochemical Anomaly Map in the Maulyan District (Au,As,Ag,Cu,Zn,Pb)

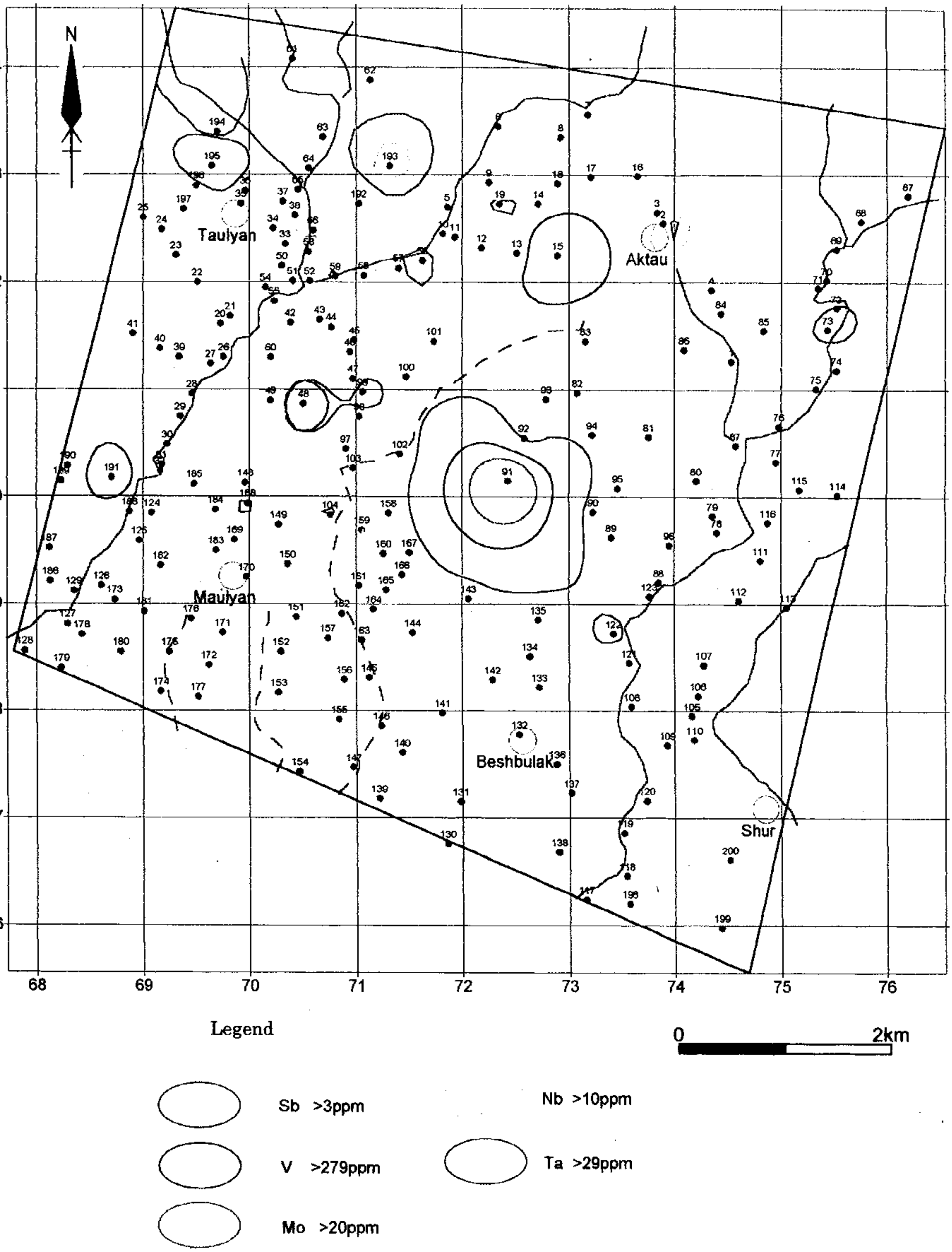


Fig.II-2-2-3(2) Geochemical Anomaly Map in the Maulyan District (Sb,V,Mo,Nb,Ta)

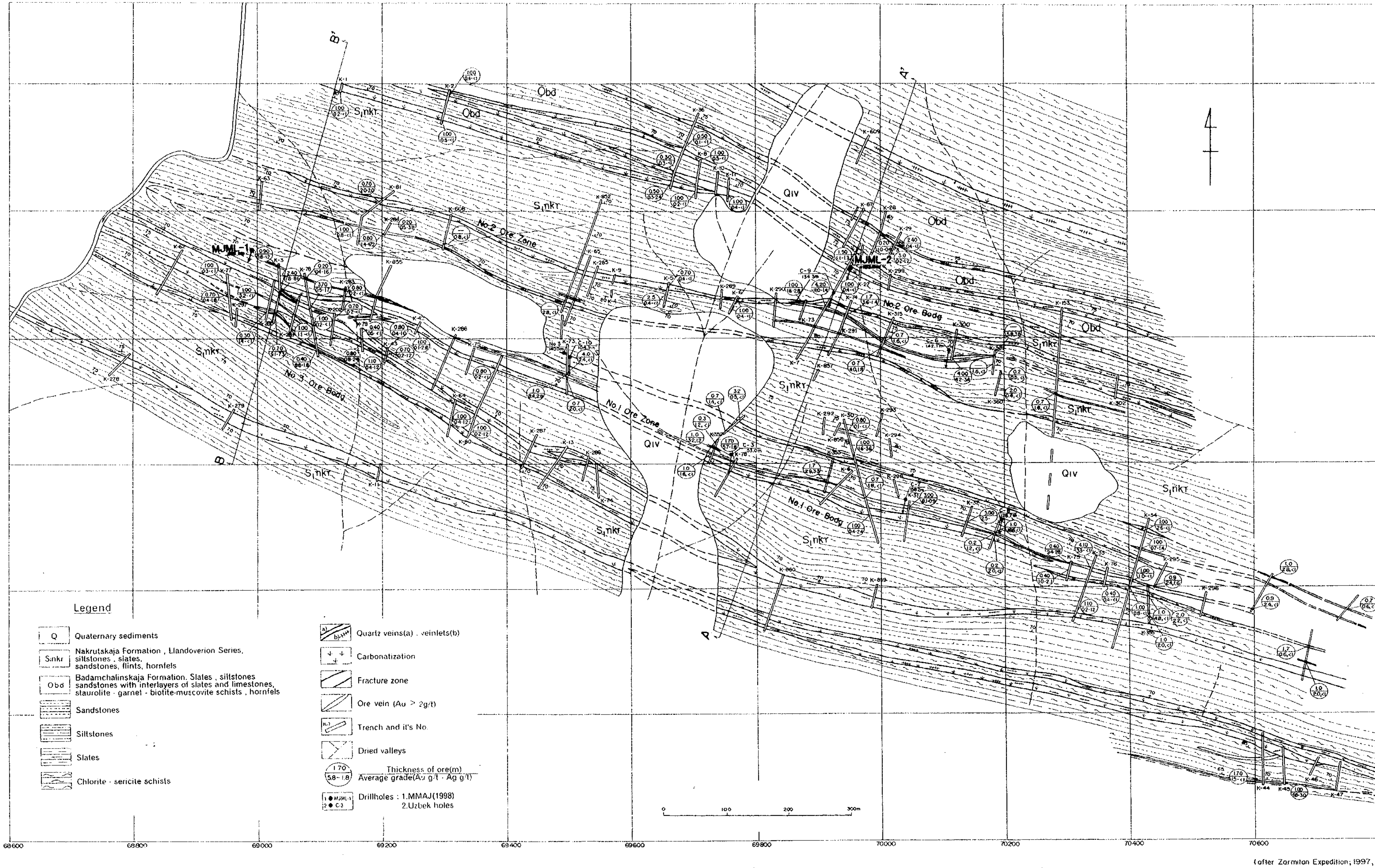


Fig.II-2-3-1 Location Map of the Drillholes in Maulyan District

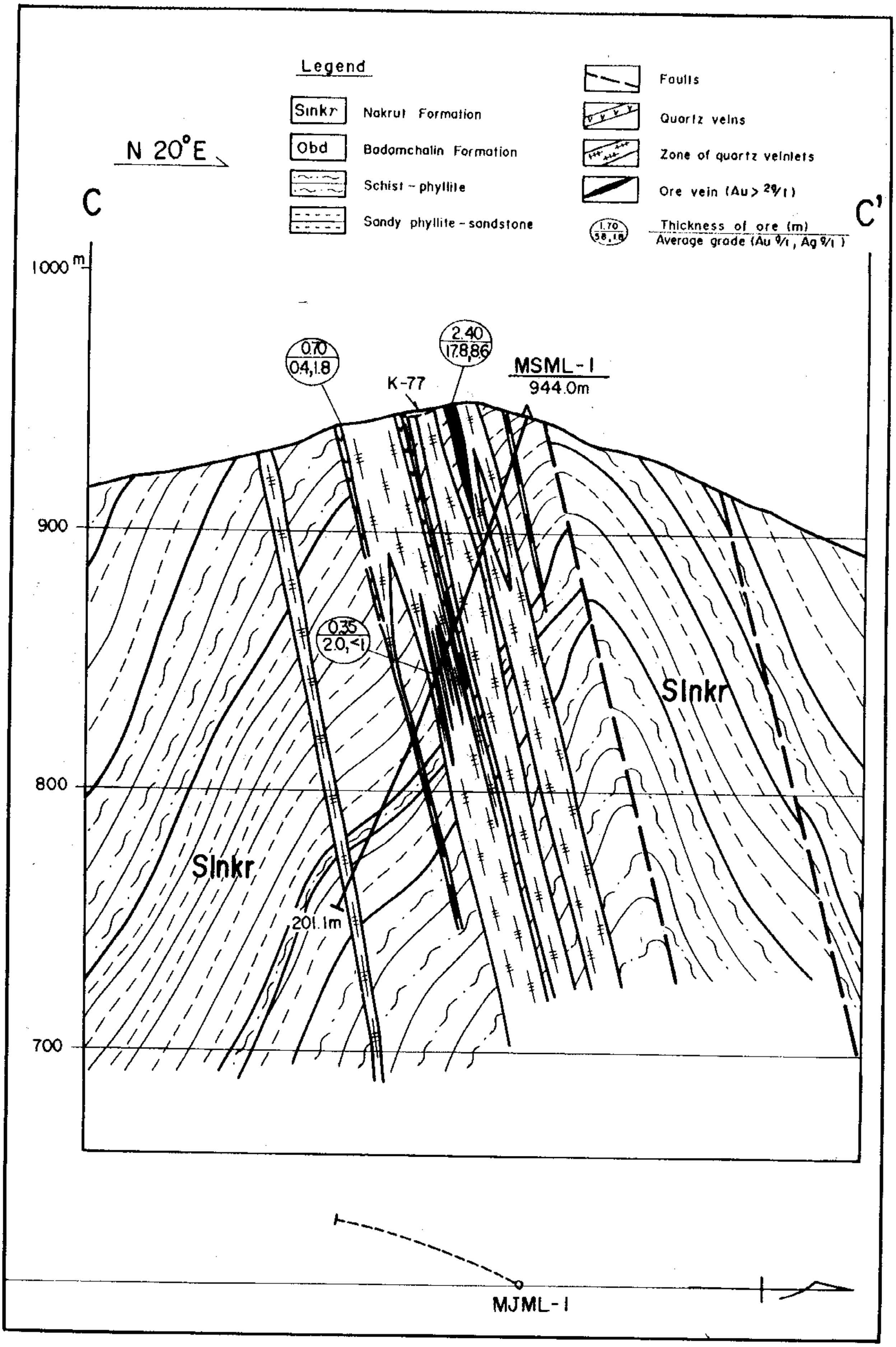


Fig.II-2-3-2 Geologic Cross Section along MJML-1

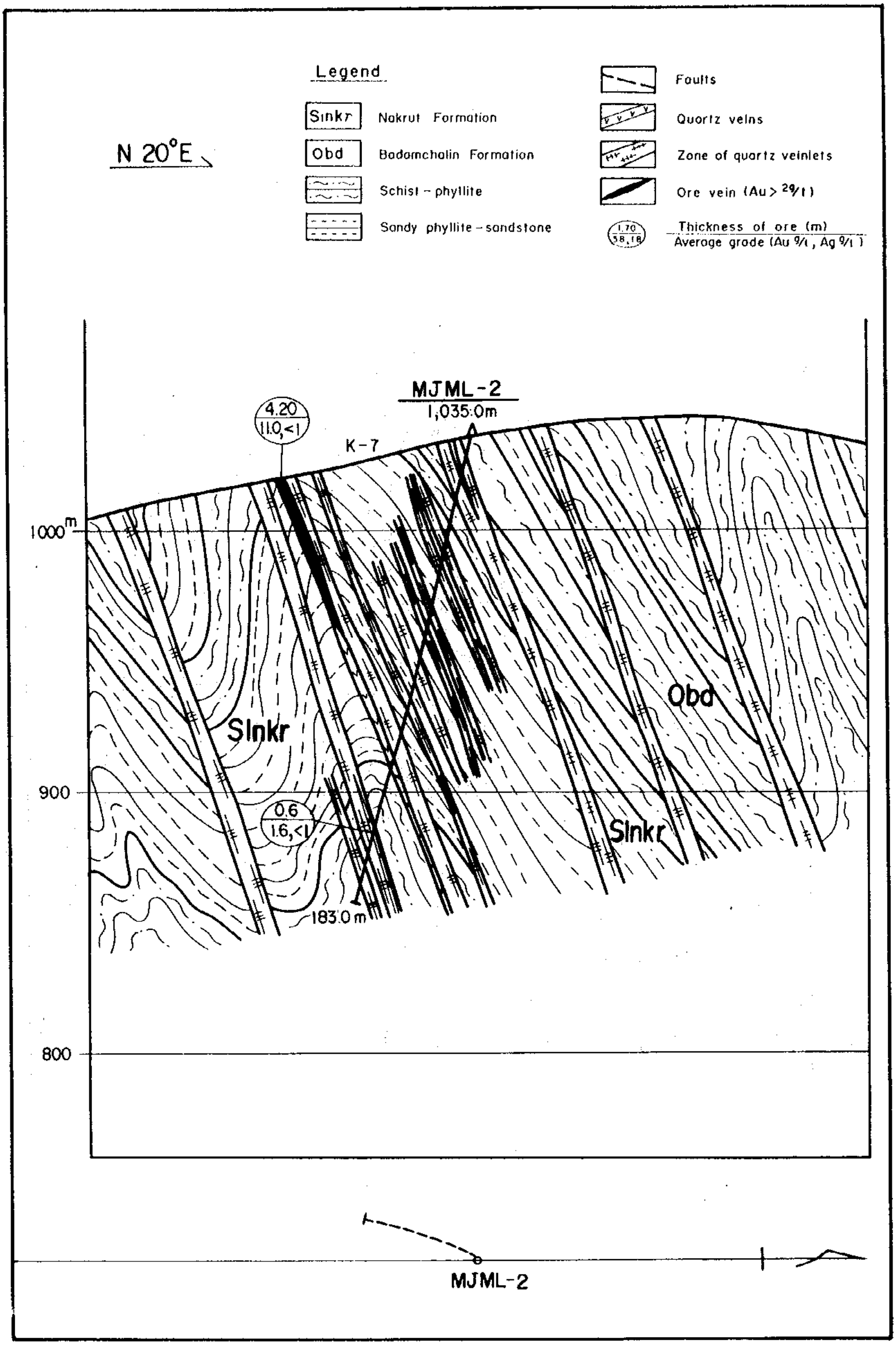


Fig.II-2-3-3 Geologic Cross Section along MJML-2

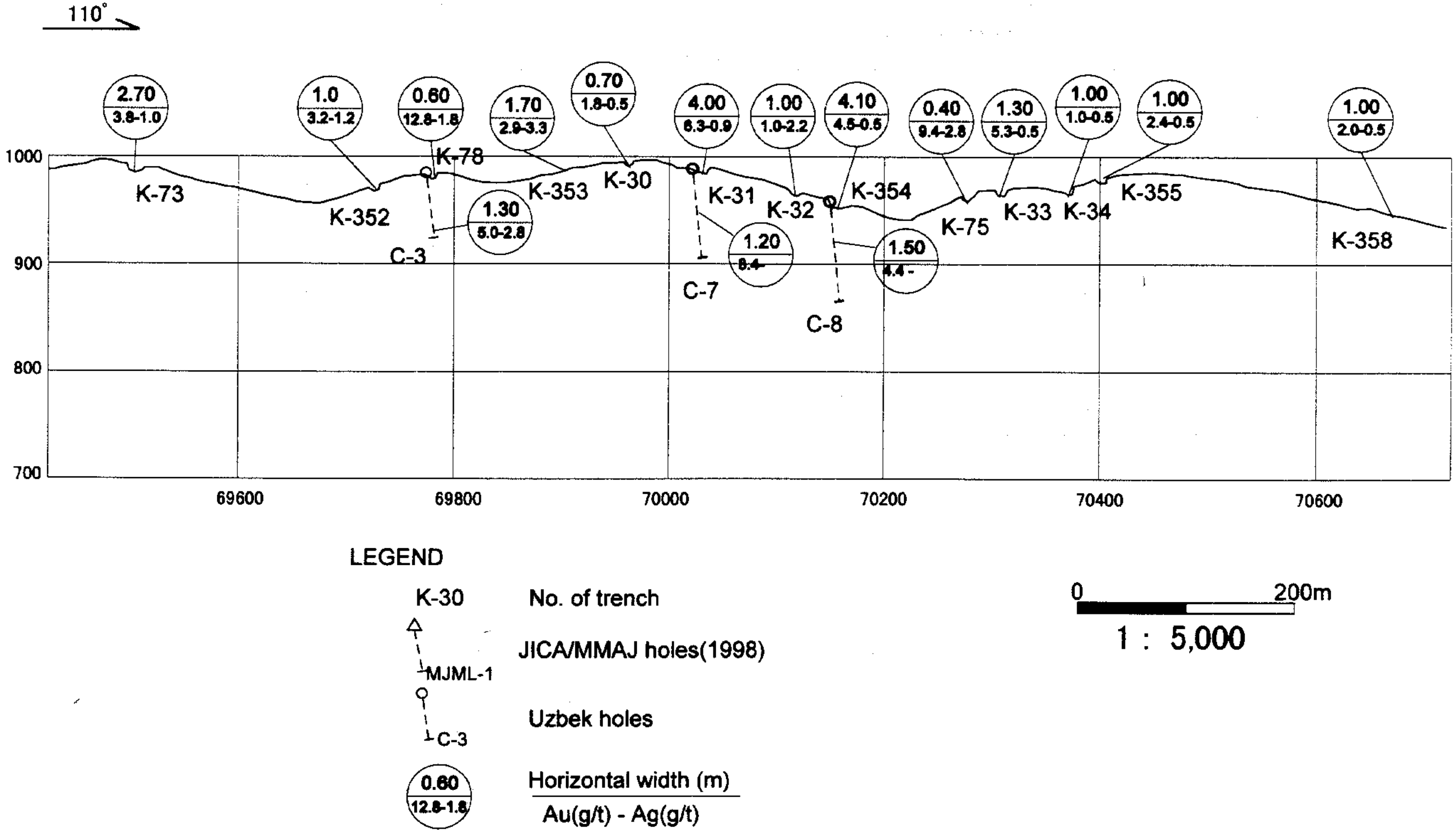


Fig. II-2-3-4 Perspective Section for Maulyan No.1 Ore Body(No.1 Ore Zone)

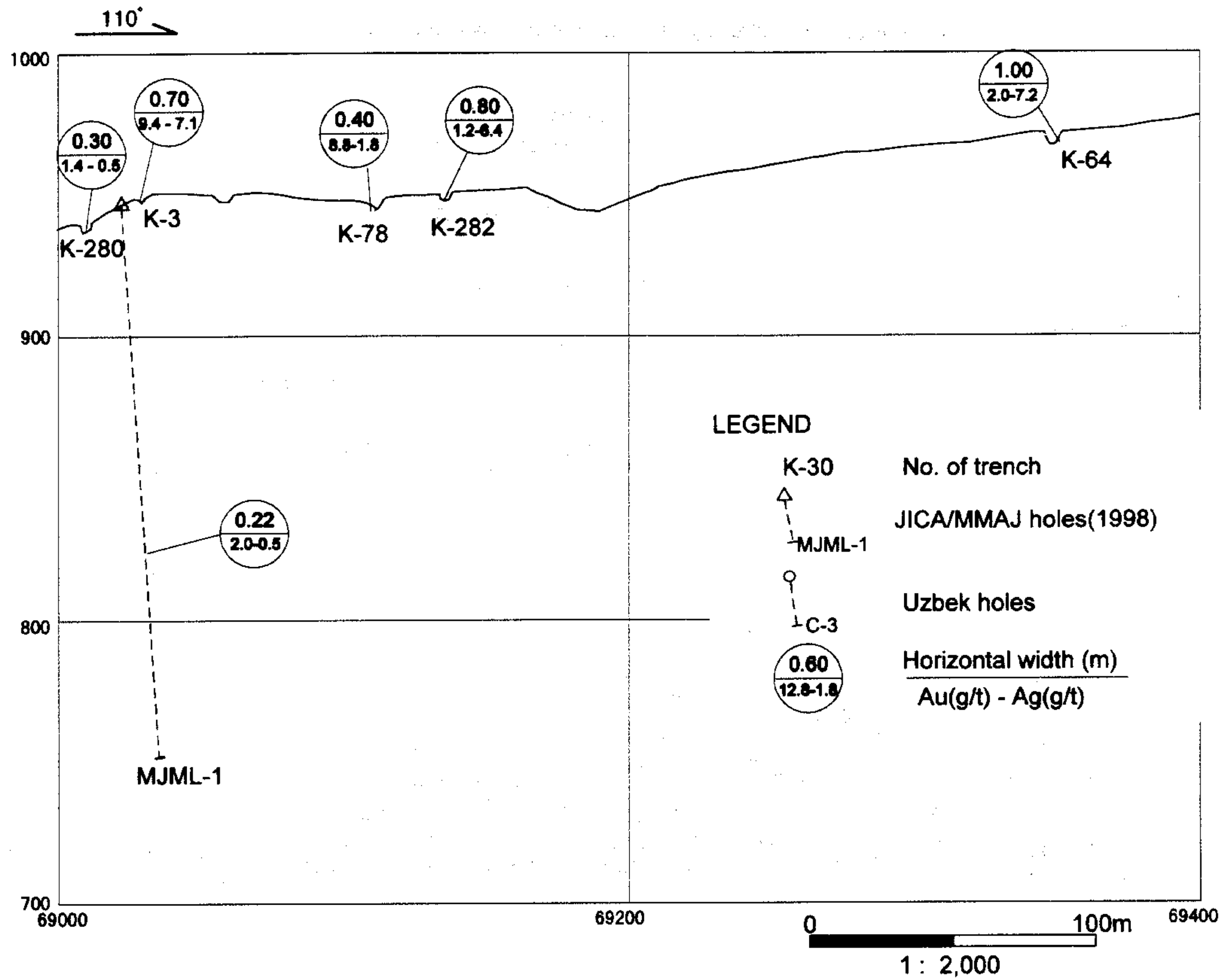


Fig. II-2-3-5 Perspective Section for Maulyan No.3 Ore Body(No. 1 Ore Zone)

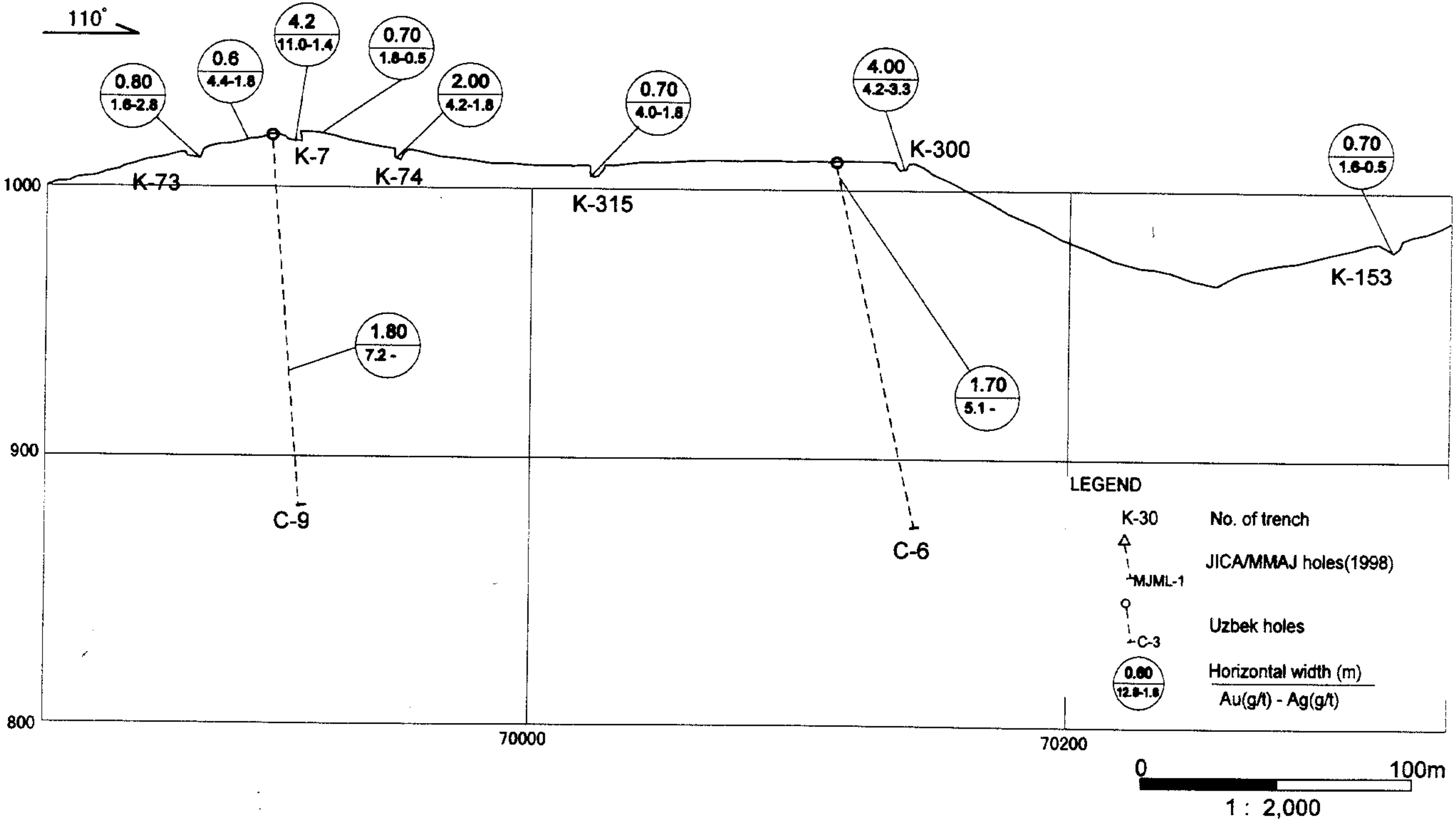


Fig. II-2-3-6 Perspective Section for Maulyan No.2 Ore Body(No.2 Ore Zone)

PART III CONCLUSIONS AND RECOMMENDATIONS

Chapter 1 Conclusions

1-1 Altynsai District

(1) Geology and ore deposit

- The District, underlain by sediments of Ordovician-Silurian System, intruded by late Permian to early Triassic lamprophyre, represents a fold structure along the axis in the WNW-ESE direction.
- Ore deposits in the District are vein-type deposits consisting of quartz veins, controlled by fracture zones with the WNE-ESE trend and those with NW-SE trend intersecting the former, and of tourmaline-quartz veins which accompany joints with the N-S trend.

(2) Ore zone

- Ore bodies of quartz veins such as the Nos. 1, 2, 5, 8 ("Northwest Vein"), 9 ("Kazanbulak Vein") and 10 ("Berkut Vein") have been confirmed in sedimentary rocks hornfelsed within an area of 2.5km in extension and 500m to 800m in width. Tourmaline-quartz veinlet zones with the N-S trend also develop in the areas where the ore zones occur.
- Bonanzas are located in zones where quartz veins at intersections of the WNW-ESE veins with the NW-SE fractures and tourmaline-quartz veinlets are concentrated.

(3) Size and continuity of ore deposit

- The drillhole MJSN-11, aimed at the eastern extension(120m) of the dominant mineralization (true width 1.6 m; Au 15.3 g/t) caught by the Phase I survey at the footwall of No.2 vein, confirmed the continuity but indicated that the mineralization is small in size and low in Au grade (1.27m in true width, grading Au 3.0 g/t).
- The Phase I and II drilling survey, including the borehole MJSN-13 aimed to examine mineralization of tourmaline-quartz veinlet zones with the N-S trend and also to examine feasibility of open pit mining, discovered low-grade gold mineralization (Au trace to 23.6 g/t) at various locations; however, the overall average of Au grade did not exceed 0.2 g/t which is insufficient for justifying the open pit mining.
- By the Uzbek drilling conducted in the subject year at the four boreholes C-47, C-50ª, C-53 and C-54, aimed at the lower extension of the bonanzas confirmed in the Adit No.4 at the veins Nos. 1 and 2, it has been confirmed that the mineralization degenerates below the depth of 100m (600m above sea level) under the adit. This is presumably attributable to denudation of main portions of the ore body by erosion.
- The ore body of the Northwest Vein (No.8 vein) as confirmed by the Uzbek trench No. 40 along the vein, 32m in confirmed extension, 1.35m in width, grading Au 8.1 g/t, is a massive quartz vein similar to the bonanza of No.1 vein in the adit. A 230m portion

between the trench along the vein and the ancient stopes remains unexplored, as well as the portion beneath the trench (860m above sea level), which are considered to be future exploration targets.

(4) Mineralization

- Homogenization temperatures of fluid inclusions of quartz veins with the WNW-ESE and NW-SE trends and the tourmaline-quartz veinlets with the N-S trend generally range between 270°C and 370°C, no significant difference being observable between them. The quartz veins and tourmaline-quartz veinlets are inferred to have been formed during the similar period of mineralization and under similar temperature ambience.
- The occurrence of ore zones and hornfels zones, and the anomalous zones of the Uzbek airborne magnetic survey are almost corresponding to each other, which suggests the possible existence of concealed granites at shallow levels. The ore zones are inferred to have been formed by the mineralization originating in intrusion of granites.
- The mineralization of the subject ore deposit represents continuity but is variable in grade, and is low in overall grade.

1-2 Maulyan District

(1) Geology

- The District is underlain by Paleozoic sedimentary rocks such as limestone, slate and sandstone, intruded by granites and dikes of lamprophyre, etc. Accompanied by biotite, muscovite, chlorite, staurolite, etc., the sedimentary rocks are metamorphosed into phyllites and schists through low temperature high pressure-type metamorphism.
- These strata are folded along an axis in the WNW-ESE direction and divided in blocks by faults in the WNW-ESE, NE-SW and NW-SE directions.

(2) Ore Zone

- The District forms a part of the Aktau ore zone, 70km E-W; 2km to 5km N-S, where gold manifestations occur in fractures and silicification zones in the WNW-ESE direction. Gold manifestations have been confirmed at Maulyan, Beshbulak, Taulyan and Shur.
- Geochemical survey did not extract clear continuity between the scattered Au anomalies. The Au anomalies are spotted around the known gold manifestations -- in the southern part of the Maulyan manifestation, in the vicinity of the Taulyan manifestation and in the southern part of the Shur manifestation.

(3) Manifestation

- The extent of the Maulyan manifestation on the surface is 1m to 4m wide and 900m long (No.1 ore body of the No.1 ore zone), 300m long (No.2 ore body of the No.2 ore zone) and 200m long (No.3 ore body of the No.1 ore zone), respectively. The gold grade varies from 1 g/t to 33.4 g/t. Drilling at the two boreholes, MJML-1 and -2, aimed to examine continuity into the lower portions only confirmed that quartz veins and fracture zones develop in various portions. Although the continuities of the No.3 and No.2 ore bodies were confirmed 100m to135m under the surface, their respective sizes and grades were 0.2m and 0.34m in true width and Au 2.0 g/t and 1.6 g/t.

- The Uzbek drilling survey on its own confirmed between 16m and 90m under the surface the continuity of the No.1 ore body (1.2m to 1.5m wide; Au 4 g/t to 8 g/t) at the boreholes C-3, C-7 and C-8, and the continuity of the No.2 ore body (1.7m to 1.8m wide; Au 5 g/t to 7 g/t) at the boreholes C-6 and C-9; the near-surface mineralization is inferred to be dominant.
- The Phase II geological survey and the subject year's Uzbek trenching survey indicate that the Beshbulak, Taulyan and Shur manifestations are low in Au grade.

(4) Mineralization

- Samples collected from gold-bearing quartz veins at the Maulyan manifestation are accompanied by ore minerals such as pyrite, goethite, lepidocrocite, arsenopyrite, chalcopyrite and sphalerite, while gold occurs as electrum. These associate minerals are the same as those of the Bitab gold manifestation situated west of the subject manifestation, both in the Aktau ore zone.
- Homogenization temperatures of fluid inclusions at the ore zone mostly fall within the range of 250°C-370°C. The homogenization temperatures of quartz samples grading Au 1.2-2.0 g/t were 221°C-281°C, higher than the general temperature range of gold occurrence, 100°C-250°C.
- In the light of the occurrence of the Aktau granites, characteristics of the surrounding manifestations, drilling results and homogenization temperatures, gold-bearing quartz veins at the Maulyan manifestation is inferred to have been formed under high temperature ambience in the vicinity of pegmatite-type mineralization, which is considered to lack the conditions required for a high-grade, large scale gold concentration zone.

Chapter 2 Recommendations for Phase III Survey

1) Altynsai District

(1) The ore body in the Northwest Vein, or No.8 vein, as confirmed by the Uzbek trench No.40 along the vein, 32m in confirmed extension, 1.35m in vein width, grading Au 8.1 g/t, is a massive quartz vein similar to the bonanza of No.1 vein in the Adit No.4. As the altitude of the outcrop, 860m above sea level, is higher than that of the veins Nos.1 and 2, denudation of the ore body may not have advanced; therefore, its continuity into the deeper portion can be expected. It is advisable to implement drilling survey to verify mineralization in the 230-m portion between the trench and the ancient stopes in the east and in its western extension.

2) Maulyan District

(1) It has been confirmed by the Uzbek drilling survey that the mineralization continues from 16m to 90m below the surface at the ore zones Nos. 1 and 2. Especially at the No.1 ore zone, the Uzbek trenching survey revealed that the mineralization continues over 1,700m in extension, which is inferred to continue further into the Beshbulak manifestation situated 3km east of the subject manifestation. It is advisable, therefore, to implement drilling survey to verify mineralization, mainly up to 100m under the surface, in the eastern extension of the ore bodies confirmed by the Uzbek trenching and drilling surveys.

(2) The lower portion of the No.3 ore zone remains unexplored. It is advisable to implement drilling survey to verify mineralization in the portion beneath the vein, 1m wide, grading Au 6.8 g/t, as confirmed by the Uzbek trench K-45.

Collected Data

1. Akobleva, N. A. (1953) : Altyn-kazgan geological expedition works in 1952, Samarkandgeology, 182p.
2. Chernjavsky, Yu. A. (1961) : Report of the Lyangar exploration in 1960 and copper ore reserves estimation, Samarkandgeology, 154p.
3. Dyukov, Yu. F. (1972) : Report on the results of the prospecting by the scope of geophysical methods in the region of Khalbashinsk, Maulyan-Beshbulak, Aktau areas and Sarmich-Altyn-kazgan ore zone, Samarkandgeology, 234p.
4. Karasiy, A. (1976) : Report on the results of preliminary exploration of Sarmich and Tsentralny sites of the Sarmich deposit and evaluation of the ore manifestations of Karatau ore zone, carried out during 1973-1975, Samarkandgeology.
5. Khan, R. S. (1989) : Geological structure and minerals of Aktau and Karakchatau mountains, Samarkandgeology, 175p.
6. Kumanikin, N. P. (1960) : Report on the results of geological prospecting at Altynkazgan deposit and works of Altynkazgan party in 1959, Samarkandgeology, 369p.
7. Loshkin, Yu. I. (1967) : Report on the geological survey works of Karakchatausk geological survey party during 1965-1966, Samarkandgeology, 138p.
8. Mezentsev, V. I. (1978) : Report on the results of detailed prospecting of gold and other minerals by the scope of geological-geophysical methods in the western part of Karatau and the central part of Bashtut ore zone and evaluation works at the ore manifestations of Tansarai, Bitab, Bashtut and others, Samarkandgeology, 175p.
9. Ogarev, D. M. (1970) : Geological structure and minerals of the quadrangles of K-41-131-г, K-41-132-в, K-41-143-б and K-41-144-А/б, Samarkandgeology, 368p.
10. Ogarev, D. M.(1974) : Report on the results of geological-geophysical prospecting for gold and other minerals in the western part of Karatau gold ore zone during 1972-1974, Samarkandgeology, 242p.
11. Ogarev, D. M. (1976) : Report on the results of geological prospecting for gold in the central and eastern parts of Karatau and Bashtut ore zones, Samarkandgeology, 147p.
12. Pyanovskaya, I. A., Enchikova A.F. and Pyanovski G.V.(1986): Geological structure of the southern Nuratau range, Ministry of Geology, 130p.
13. Shamshurin, I. (1950) : Report on the prospecting for tin in Karatau mountains of Nurata range, Samarkandgeology, 174p.
14. Shubin, E. N. (1983) : Report on the results of detailed prospecting at the Biran, Kuraim and Pirash sites and evaluation of the ore bodies No.1, 3, 4 and 7 of Biran site, Samarkandgeology, 199p.

15.Shurygin, V. (1957) : Report of the lead prospecting party of the works in 1956, Samarkandgeology, 163p.

16.Trojanov, M. (1956) : An overall calculation of tungsten-molybdenum reserves in the Lyangar deposit, Samarkandgeology, 411p.