PART II

PARTICULARS

Chapter 1 Analysis of Existing Data

1-1 Purpose of Survey

For the purpose of outlining the ore deposits and ore manifestations within the Kokpetinskaya area and clarifying their occurrence, the existing data were collected, sorted out and analyzed.

1-2 Outline of Past Surveys

The existing data concerning the survey area are listed in Fig. II-1-1.

1) Geological surveys

In 1952, G.I. Sokratov conducted a geological survey at a scale of 1:200,000 based on the topographic maps M-44-X X IX, publishing the geologic maps in 1964 and the explanatory notes in 1965.

From 1956 to 1958, B. F. Baranov, N. I. Bykova and M. A. Murakhovskiy carried out geological survey at a scale of 1:200,000 based on the maps M-44-XXX, and published the geologic maps in 1963.

In 1961, N. N. Popova and E. Popov elaborated a 1:200,000 geologic maps M-44-X X IX and the explanatory notes.

During the 1960's, the basic stratigraphy of the subject area and the concept of the intrusive igneous activity were established through the geological surveys at 1:200,000 scale, which have been utilized for the subsequent geological surveys and ore deposit surveys.

2) Exploration of ore deposits

(1) Karaotkel placer deposit

From 1965 to 1967, drilling survey aimed at coal resources was executed by the Party of Non-Ore Raw Materials, which resulted in the discovery of an ilmenite-zircon deposit at Karaotkel.

In 1972, the preliminary exploration of the Karaotkel placer finished by the same party; ilmenite-zircon ore reserves ($B+C_1$) were estimated and ore treatment tests were carried out.

In 1973, the State Institute of Rare Metals (GIREDMET) implemented a feasibility study of the Karaotkel placer, which revealed that the ore reserves and grades of the deposit were insufficient for economically viable development, unless feldspar concentrates are simultaneously produced.

From 1983 to 1989, ore reserves of the Karaotkel placer were revaluated, in which feldspar and quartz were considered. Ore reserves were recalculated on the basis of these studies. In 1990, the recalculated ore reserves were approved by the State Committee of Reserves of the USSR.

Table II-1-1 Ore Reserves and Grade of the Karaotkel Placer

Name of Ore Body	Category	Cut-Off Range (kg/m^3)	Ore Reserves (th. m^3)	Ilmenite Grade (kg/m^3)	Ilmenite Reserves (th. t)
Karaotkel	$B+C_1$	≧15	147,579	23.3	3,438

Besides ilmenite, the ore reserves of the categories B and C_1 of the following minerals were approved, as well.

a. Leucoxine --0.51(kg/m^3)
b. Zircon --3.5 (kg/m^3)
c. Feldspar--- 290.7 (kg/m^3)
d. Mica -- 107.4 (kg/m^3)
e. Clay---1,079.6 (kg/m^3)

However, it was concluded that development of the Karaotkel placer would not be feasible at this time or in the near future, for the following reasons:

a. The ilmenite contents are considerably lower than the cutoff grade, 70 kg/m^3 or more on the hanging wall side of ore bed and 100 kg/m^3 or more on the footwall side of ore beds, calculated by the Geoincenter, a consulting company.
b. Due to the small domestic market in Kazakhstan, feldspar concentrates are hard to sell, if produced.
c. Since clay contents in the ores are high while the titanium mineral size is so small that 86% falls within the range between -0.315 mm and +0.04 mm, the conventional treatment process for ilmenite-zircon is hard to apply; additional processes have to be introduced into the treatment line, which would inevitably raise the treatment cost.
d. Due to its characteristics, the ilmenite is not appropriate for production of titanium white, the most salable and profitable of all the titanium products.

(2) Bektemir placer

From 1988 to 1992, the Zyryanovsk Party of the Altai Geological Expedition executed geophysical prospecting (magnetic survey and the VES electrical survey) and geochemical prospecting (drlling and rock geochemical survey), to discover the Bektemir placer (Kudinov, 1992). Simultaneously with the prospecting, exploration - evaluation work was carried out at the Preobrazhenskiy intrusive rock body area

(Pakharukov, 1995). These surveys ascertained the Miocene placers accompanied by ilmenite - the Placer No.1, No.2 and No.3 - in the peripheries of the Preobrazhenskiy intrusive rock body. Of the three placers discovered, the Placer No.1 and the old buried valley zone in the southwest of the Placer No.3 were considered to have potentials worthy of further exploration.

Based on the findings of the drilling exploration undertaken by the Titanium - Magnesium Kombinat (TMK) from 1997 to 1998, the Bektemir placer was evaluated. The ore reserves were estimated and the guidelines for mining and treatment were drawn out (Geoincentre, 1998).

The ore reserves and the ilmenite and TiO_2 contents of the Bektemir placer as approved by the State Committee of Reserves of Kazakhstan in 1999 are indicated in the following Table.

Table II-1-2 Ore Reserves and Grade of the Bektemir Placer

Name of Ore Body	Category	Cut-Off Range (kg/m^3)	Ore Reserves (th. m^3)	Ilmenite Grade (kg/m^3)	Ilmenite Reserves (th. t)
No. 1	$B+C_1+C_2$	70/100	11,958	151.78	1,815
No.2	C_2+P_1	$\geqq 40$	36,048	80.24	2,893
No.3	C_2+P_1	$\geqq 40$	59,447	64.81	3,853

In 1999, guidelines (passport) for exploration of the southern flank of the Bektemir Placer No.1 and the Bektemir Placer No.3 were drawn out by the Geoincenter.

Also in 1999, the UNIDO implemented a feasibility study on Ilmenite Concentrate Plant Project for the Bektemir placer.

(3) Gold

From 1973 to 1975, K. S. Akhmenov of the Altayzoloto was engaged in preliminary evaluation of the Kalby gold deposit in an area that include the Kokpetinskaya area. Many of the quartz veins accompanied by gold and sulfide minerals, exploited from the second half of the 19th Century to the first half of the 20th Century, were judged to have certain potentials.

Recently, the Altai branch of the Institute of Geological Sciences recommended for implementation of geological exploration works.

(4) Coal

In 1951, V. G. Sagunov explored coal deposits in the Kokpetinskaya area, to seize small coal reserves of the $B+C_1+C_2$ categories amounting to 88,000 t.

Between 1965 and 1967, the Party of Non-Ore Raw Materials implemented coal drilling, ascertaining coal strata in the Upper Formation of the Kokpetinskaya Formation, although no promising potentialities were acquired.

So far, concentration of coal strata in the Upper Kokpetinskaya Formation has been unknown.

3) Geophysical prospecting

Simultaneously with the geological surveys, geophysical prospecting was conducted in the subject area, at 1:200,000 and 1:50,000 scales. Especially, from 1988 to 1992, the Zyryanovsk Geological Party conducted magnetic survey, electrical survey (the VES method) and geochemical survey for prospecting of the ilmenite placers of the maps M-44-118-B, C and D, and also of the maps M-44-119-A, B and C, which discovered the Bektemir ilmenite placer in 1989.

Regional gravity survey revealed that the areas around the Preobrazhenskiy and the Karaotkelskiy intrusive rock bodies are characterized by low anomalies under 10 to 30 mGL. The Charsko-Zimunayskaya fracture zones accompanied by ophiolite were found to be high anomalous.

As the result of the magnetic survey, the Preobrazhenskiy and the Karaotkelskiy rock bodies showed positive anomalies of 200 to 1,000 nTL, while the area underlain by the Carboniferous sedimentary rocks of about 10 m thick showed negative anomalies.

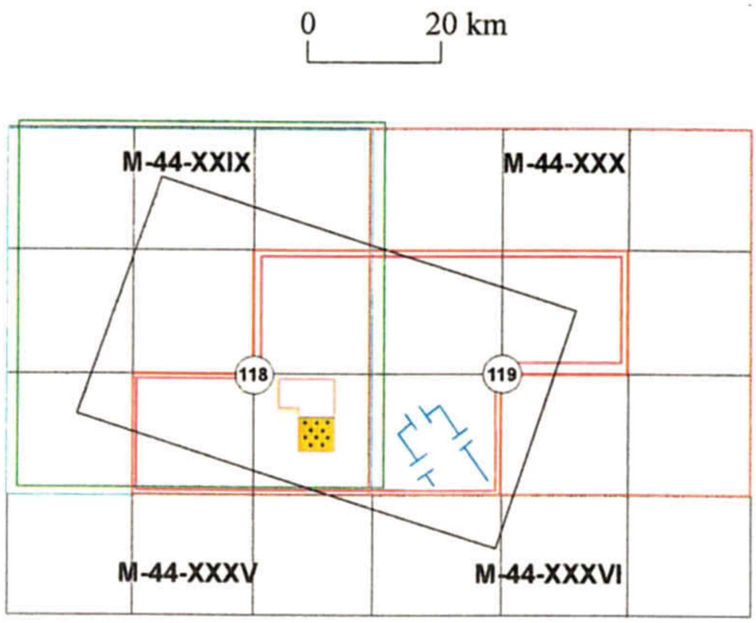
In the light of the geological and geophysical survey findings, the Preobrazhenskiy and Karaotkelskiy intrusive rock bodies are in a lopolith-like form, covering the areas by depth as mentioned below. These were inferred to form a single rock body, underneath.

Depth (km)	Area of Preobrazhenskiy Intrusive Body (km^2)	Area of Karaotkelskiy Intrusive Body (km^2)
Surface	164	126
-1.8	–	800
-3	340	450
-5	–	90

Rock composition of the Preobrazhensiky and Karaotkelskiy intrusive rock bodies are inferred as follows.

a. Preobrazhenskiy rock body :
Gabbros - 70%; granite, monzonite and syenite - 30%

b. Karaotkelskiy rock body:
Alkali granite and syenite - 90%; monzonite, gabbro -10%
(Monzonite and gabbro occur in the northeast and southwest of the rock body and inferred increase at the depths of 1.8 km.)



Survey Area

Scale 1:200.000 - Sokratov G.I. (1952): Geological survey of sheet M-44-XXIX.
Sokratov G.I. (1965): Explanatory note to geological map of the USSR sheet M-44-XXIX.

Scale 1:200.000 - Popova N.N., Popov V.E. (1961): Explanatory note to geological map of the USSR sheet M-44-XXIX.

Scale 1:200.000 - Baranov B.F., Murakhovskiy M.A. (1963) Geological survey and it's explanatory note to the sheet M-44-XXX.

Scale 1:50.000 - Altay GEE (1964-1968): Complex geophysical survey (magnetic exploration and electric exploration by using a method of VES).

Scale 1:10.000 - Pakharukov N.M. (1972): Report on exploration works and preliminary evaluation of Karaotkel ilmenite-zircon deposit.

Scale 1:50.000 - Kudinov I.F. (1988-1992): Report of Zyryanovsk party about the results of geological and geophysical study in North-West Prizaysanie within the limits of sheets M-44-118-B,C,D and M-44-119-A,B,C at Karaotkel.

Scale 1:5.000 - Pakharukov N.M. (1990-1995): Report on prospecting and evaluation works of ilmenite-zircon placers at Preobrazhenskaya area.

Topoev A.I. (1999): Report with design of industrial conditions and calculation of reserves on placer № 1 of Bektemir deposit of titanium sand (East-Kazakhstan).

UNIDO (1999): Feasibility study report on ilmenite concentrate plant project, Bektemir, The Republic of Kazakhstan

Fig. II-1-1 Existing Data of the Kokpetinskaya Area

Chapter 2 Geological Survey

2-1 Purpose of Survey

The survey is intended to grasp the relationship of geology and geologic structure with mineralization.

2-2 Method of Survey

In the Kokpetinskaya area, general geological survey in the quantities indicated in Table I-1-1 was implemented. The base camp was placed at a hotel in Samarskaya.

For the survey, 1:50,000 scale route maps were prepared by enlarging the 1:100, 000 topographic maps. The survey findings were consolidated in the geologic maps and cross sections at 1:200,000 scale (Fig. I-3-1) and 1:100,000 scale (PL.II-2-1).

Simultaneously, sampling in various methods in the quantities indicated in Appendix 2-1 was conducted in the localities indicated in Fig. II-2-1. The laboratory tests include observation of rock thin sections and X-ray diffractive analysis. Results of the observation of rock thin sections and photomicrographs are respectively exhibited in Appendices 2-2 and 2-3, while results of the X-ray diffractive analysis are exhibited in Appendix 2-4.

2-3 Survey Findings

The survey area is underlain by the Paleozoic basement rocks and the Neogene to Quaternary rocks of the Cenozoic age. The Carboniferous of the basement rocks consists of terrigenous and volcanic sedimentary rocks, intermediate lava and dykes. Intrusive rocks of different ages intrude into the basement rocks in several rock facies.

The Cenozoic is composed of sedimentary rocks that include the Neogene to Quaternary sandy clay, sand and gravels.

1) Basement rocks

(1) Lower Carboniferous Arkalyk Formation (C_1V_{2-3} ar)

The Formation lies in a narrow belt of 1.5 km wide along the south side of the Baladzhalskiy fault in the northwest of the survey area. The Formation is composed of shale, siltstone, sandstone, tuff and limestone, and includes fossils of brachiopods, coral, etc. The total thickness of the Formation is about 1,500 m.

(2) Middle Carboniferous Kokpeti Formation (C_1V_3-nkp)

The Formation is divided into the Lower, Middle and Upper Formations.

a. Lower Formation (C_1V_3-nkp$_1$)

The Formation spreads out on the north side of the Baladzhalskiy fault in the north of the survey area. It is composed of conglomerates, tuffaceous sandstone, siltstone and shale. The total thickness of the Formation is about 1,500 m.

b. Middle Formation (C_1V_3-nkp$_2$)

The Formation lies locally in the southwest of the survey area. It is composed of conglomerates, tuffaceous conglomerate, tuffaceous sandstone, siltstone, shale and limestone, and includes fossils of coral, brachiopods, etc. The total thickness of the Formation is about 1,000 m.

c. Upper Formation (C_1V_3-nkp$_3$)

The Formation lies locally in the southwest of the survey area. It is composed of conglomerates, greywacke sandstone, siltstone, shale and coal, and includes fossils of brachiopods, bivalves, coral, etc. The total thickness of the Formation is about 300 m to 500 m.

(3) Middle Carboniferous Bukon Formation (C_2 bk)

The Formation is scattered from the southwest to the central part on the south side of the Baladzhalskiy fault. The lower part of the Formation is composed of conglomerates, arkose sandstone, sandstone, siltstone and shale. Rocks are often crushed and include veinlets of quartz, carbonate minerals and aragonite. The upper part of the Formation is composed of alternations of shale, coaly shale and coaly siltstone, and rarely includes sandstone and tuffaceous sandstone. At the contacts with the Preobrazhenskiy intrusive rock body, rocks are metamorphosed to hornfels while coaly shale is graphitized. The total thickness of the Formation is 1,500 m to 2,000 m.

(4) Middle to Upper Carboniferous Maityab Formation (C_{2-3} mt)

The Formation is scattered from the west to east on the south side of the Baladzhalskiy fault. The Formation is composed of effusive rocks such as andesitic porphyrite and andesite that intercalate thin tuff and tuffaceous sandstone, and rarely basaltic porphyrite and diabasic porphyrite. Andesitic porphyrite and andesite often are of breccia texture that includes rock fragments of different crystalline size; accordingly, the rocks have external appearance of vesicular sponges on the weathered surface. The rocks are intensively metamorphosed to hornfels up to the amphibolite facies by the Preobrazhenskiy intrusive rock body.

2) Upper Cretaceous Weathering Crust

The weathering crusts overlies the Upper Carboniferous sedimentary rocks, volcanic rocks and the intrusive rocks, and are underlain by the Neogene and Quaternary rocks. They are classified by form into two types:

a. Widespread weathering crust:

It is 10 m to 20 m thick and widespread.

b. Linear weathering crust:

The type is limited only to fracture zones; the thickness reaches 50 m to 60 m.

Generally, weathering crusts are divided into the following zones in the descending order.

a. Kaolinite zone:

Bleached argillaceous weathering residuals, which have completely lost the original rock texture.

b. Illite zone:

Argillaceous weathered residuals consisting of clay formed by chemical decomposition, which still retain original rock texture. The original rock materials are partially or entirely replaced by illite-montmorillonite aggregates.

c. Decomposition zone:

Weathered residuals composed of weathered, bleached rocks fully retaining the source rock texture. In terms of alteration of original rocks, partial leaching of alkali contents and illitization of micas are observed. Small quantities of illite and limonite are included while feldspar is partially kaolinitized.

3) Neogene Aral Formation ($N_1^{1\text{-}2}$ ar)

The Aral Formation overlies unconformably the Paleozoic basement rocks or their weathering crusts and is extensively covered by the Quaternary Formation. The subject Formation is composed of sandy clay and argillaceous, coarse-grained quartz-feldspar sand, rarely intercalating pebbles. Ilmenite placers are emplaced in this Formation.

The Formation is divided into th e Lower and Upper Formations:

(1) Lower Formation

The Formation is blueish dark grey-colored argillaceous sand, which includes argillaceous, coarse-grained sand, gravels and wood splinters. In the ore deposit area, the Formation includes large quantities of ilmenite and bears placers.

(2) Upper Formation

The Formation changes its color from brownish grey to light grey, and is composed of clay which often appears to be multi-colored or brown to brownish grey-colored. Sandy elements are no more than 3% to 5%. It includes large quantities of oolite of iron hydroxide and manganese hydroxide, and rarely gysum crystals and their aggregates.

4) Quaternary System (Q)

The Quaternary rocks are widespread in the survey area. By the biofacies of fauna, sediments properties and topographic features, the System is divided into the Lower, Middle-Upper, Upper to Recent and Recent Formations.

(1) Lower Formation (Q_1)

The Lower Pleistocene, characterized by gravel beds, lies in the south and the west of the survey area, covering the Neogene and Paleozoic basement rocks. The upper part of the Formation is composed of reddish brown and brown-colored loam and clay accompanied by sand beds in lens forms, whereas the lower part consists of gravel beds. Gravels have medium to well roundness and is 2-3 cm to 7-12 cm in size although some boulders reach 30 cm. Types of the gravels are tuffaceous sandstone, flinty mudstone, porphyrite, andesite and hornfels. The Formation is 5 m to 13-14 m thick.

(2) Middle to Upper Formation (Q_{2-3})

The Formation, composed of brownish grey-colored loam, overlies the Aral Formation or the Paleozoic basement rocks. Usually, dark brown-colored sandy clay beds lie in the lower part, accompanied by coarse-grained beds of sand mixed with granules. Frequently observed in these beds is ilmenite of 5 to 12 kg/m^3 at the maximum. The thickness of the Formation varies from 2 m to 20 m.

(3) Upper to Recent Formation (Q_{3-4})

The Formation is composed of loam which includes large amounts of Paleozoic basement rock fragments, quantities and sizes of which increase toward the upper stream of valleys. The thickness of the Formation is not more than 1 m to 2 m.

(4) Recent Formation (Q_4)

The Formation comprises stream sediments composed of pebble, gravel, sandy loam, silt, loam and clay. Its thickness is 0.5 m to 2.5 m.

5) Intrusive rocks

The intrusive rocks in the area are the Preobrazhenskiy intrusive, complex rock body, the Karaotkelskiy intrusive, complex rock body and dikes.

(1) Preobrazhenskiy and Karaotkelskiy intrusive, complex rock bodies

These intrusive, complex rock bodies can be divided by the time of intrusion and rock facies, as follows:

a. Maksutskiy intrusive, complex rock body (P_2-Tmk)

The rock body is composed of gabbro, norite, monzonite and diorite which intruded in the Upper Permian to Lower Triassic time. From the fact that many Carboniferous roof pendants are existent on top of the rock body, the depths of erosion into the rock body are inferred to be small. Compared with other intrusive rocks, gabbro and monzonite are reported to have higher contents of apatite, ilmenite and magnetite. The analysis by the element analyzer as conducted in

Phase I indicated that TiO_2 content of monzonite is 1.10%. According to the existing data, gabbro has high TiO_2 contents -- max. 12% -- while its zircon contents are low.

b. Saykanskiy intrusive, complex rock body (T_{2-3}-sk)

The rock body is composed of syenite that intruded along the peripheries of the intrusive rock body in the Middle to Upper Triassic time. The rock body shows ununiform petrological composition, in which syenite, syenite-diorite and granodiorite are observed. Syenite includes small quantities of ilmenite not exceeding 2 kg/m^3.

c. Delbegeteyskiy intrusive, complex rock body (J_{1-2}-db)

The rock body is composed of granites which intruded in the Lower to Middle Jurassic time, and spreads over the Preobrazhenskiy intrusive, complex rock body and the Karaotkelskiy intrusive, complex rock body. The rocks are light grey with a pink tint and of medium-grained texture. These rock bodies are scattered in the form of weathering monadnocks.

(2) Dikes

Dikes of granite porphyry, syenite porphyry, quartz porphyry and aplite intrude into the Paleozoic.

6) Geologic structure

The Kokpetinskaya area is situated in the zone of collision of the Kazakhstan continent with the old Gorny Altai continent. The collision took place at the last stage of the Hercynian movement along the Charsko-Zimunayskaya fracture zone, which stretches in the N-W direction over 800 km in extension and 10-15 km to 70 km in width. The Baladzhalskiy fault in the WNW-ESE direction, which passes the northeast of the survey area, constitutes a part of the mentioned fracture zone (Fig. I-4-1).

The fracture zone is of complex structure where mélange dislocated by folds, faults and thrust faults, lies in belt, lens and block forms; the mélange is composed of Silurian to Visean (Lower Carboniferous) limestone, spilite, diabase, andesite, quartz, mudstone, etc.,

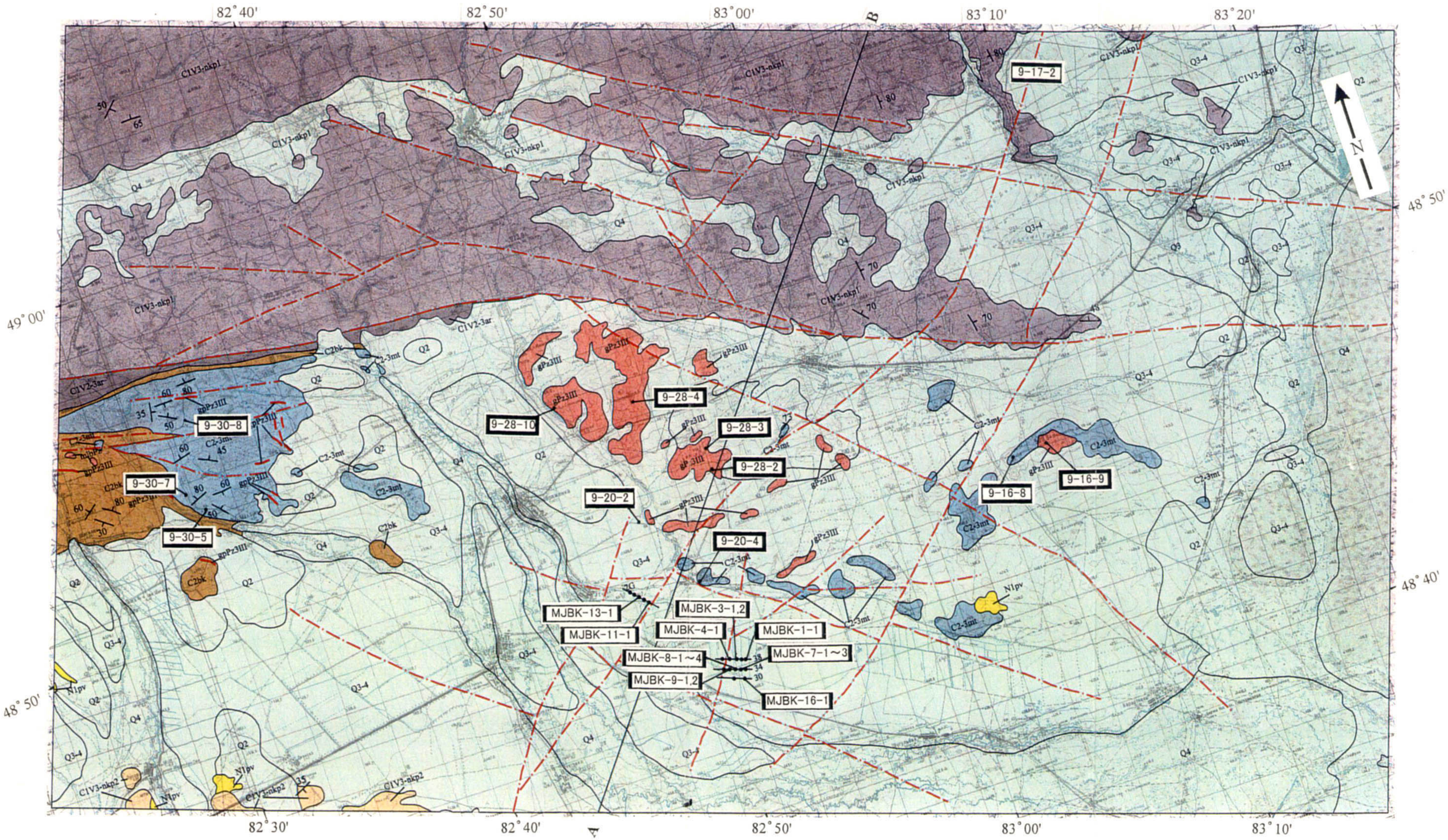
In the Middle to Upper Carboniferous Systems, thick molasse -- the Kokpeti Formation, the continental Bukon Formation and Maityab Formation -- was formed, which was folded together with the Pre-Upper Visean mélange, cut by faults and dislocated.

The Baladzhalskiy fault is inferred to be a passage of molten magma. The Preobrazhenskiy and the Karaotkelskiy intrusive, complex rock body, which intruded in the Early Permian to the Middle Jurassic time, are inferred to have intruded along the fracture zone .

In the Mesozoic time, the basement sedimentary rocks and intrusive rocks uplifted and were deeply eroded, forming the peneplain toward the end of the Mesozoic, where the Upper Cretaceous weathering crusts were formed. It is inferred that ilmenite, zircon, feldspar, quartz, illite and kaolinite concentrated in the weathering crusts over the intrusive rock bodies. The tectonic movement presumably continued during the Paleogene time, as well, forming the two graben-synclines in the WNW-ESE direction -- Maytuibinskaya and Terektinskaya -- and the Bektemirskaya horst-anticline in between the synclines. The Bektemirskaya horst-anticline was completed with the intrusion of these intrusive, complex rock bodies, and became the source of detritus that flowed into the surrounding recesses from then to the Quaternary time.

The faults in the NE-SW direction in the survey area -- the Bektemirskiy fault, Espinskiy fault, etc. -- are interpreted to be either lateral faults or faults with little dislocations. Since the Paleocene time, valleys were formed by denudation along the fracture zones of the faults, which provided the place of sedimentation of ilmenite placers.

It is inferred that, in the Cenozoic time, these valleys were submerged as the old Lake Zaisan expanded, where the Aral Formation which includes ilmenite-zircon ore sand depositing in the Miocene time.



9-16-8	Sample for thin sections
MJBK-1-1	Sample for X-Ray analysis
9-20-4	Sample for thin sections & X-Ray analysis

Fig. II-2-1 Location Map of the Samples

Chapter 3 Drilling Survey

3-1 Purpose of the Survey

Drilling survey was conducted in the Bektemir district in order to seize ore bodies in the southern flanks of the already known Bektemir Placer No.1 and No.3 and to grasp the occurrence.

3-2 Method of the Survey

With personnel, machinery and equipment arranged by the Geoincenter, local drilling contractor, the drilling work was performed at 12 boreholes totaling 471.0 m in the southern flank of the Placer No.1 and at 5 boreholes totaling 184.0 m in the southern flank of the Placer No.3.

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

Drilling lengths, core recoveries and efficiency by borehole are shown in Table II-3-1. Working hours, consumption of consunamble materials are respectively indicated in Tables II-3-2 thru -5, while main machinery and equipment used, drilling results by drillhole and progress record are respectively indicated in Appendices 3-1 to -3 at the back of this volume.

(1) The southern flank of the Bektemir Placer No.1

The drilling machines used were two units of the Russian-made percussion drill UGB-3UK.

The drilling operation was performed in two eight-hour shifts per day, while the preparatory setting and dismantling work were done in one shift.

The drilling team consisted of an engineer, two foreman, three drilling assistants, one coordinator and two water carriers, totaling nine.

A truck and a tractor were used for the transportation of drilling rigs and supplies to respective drill sites, the preparatory setting, etc.

For drilling of the surface soil and pebble-gravel were drilled by the percussion method with 240mm-dia. bailers were employed, and 10" casing pipes were driven and inserted. Clay, argillaceous sand and weathering crusts of the Aral Formation were drilled with 190mm-dia. percussion samplers.

The drilling work lasted for 38 days from August 30 to October 6, 2000.

(2) Southern flank of the Bektemir Placer No.3

A Russian-made rotary drilling machine UGB-2A-2 was used.

The drilling operation was performed in two eight-hour shifts a day, while the preparatory setting and dismantling work was done in one shift.

The drilling team consisted of an engineer, two foremen, three drilling assistants, one coordinator, one mechanic and two water carriers, totaling ten.

A truck and a tractor were used for the transportation of drilling rigs and supplies to respective drill sites, preparatory setting, etc.

Mud water was conveyed to the drill sites by a $2m^3$ tank truck.

The surface soil and pebble-gravel were drilled by the regular rotary method with 4" Tricone bits while recycling bentonite mud water, and the 127-mm casing pipes were inserted. Clay, argillaceous sand and weathering crusts of the Aral Formation were drilled by the regular rotary method with 92 mm-dia. metallic bits while recycling bentonite mud water.

The drilling work lasted for 15 days from September 12 to 26, 2000.

3-3 Survey Findings

3-3-1 Southern flank of the Bektemir No.1 ore body

The survey findings are exhibited in the geologic cross sections (Figs. II-3-3 ~ 6).

1) MJBK-1 (Direction - ; inclination –90° ; length 32.0m) (Line-38)

(1) Geology

The drillhole section from the mouth up to the depths of 12.80m consists of the surface soil and pebble-gravel, which is followed by the section between 12.80m and 29.90m composed of clay, sandy clay and argillaceous sand and the section from 29.90m to the bottom composed of weathering crust.

(2) Mineralization

As seen in Fig. II-3-3, weak ilmenite mineralization, 1.90m thick and grading 1.60 kg/m^3 of ilmenite, was intersected between the depths of 28.00m and 29.90m.

2) MJBK-2 (Direction - ; inclination –90° ; length 44.0m) (Line-38)

(1) Geology

The section from the mouth to 12.10m consists of the surface soil and pebble-gravel, followed by the section between 12.10m and 42.90m composed of clay, sandy clay and argillaceous sand of the Aral Formation, and the section between 42.90m and the bottom composed of weathering crust.

(2) Mineralization

The main indications of mineralization are shown in Table II-3-6.

As seen in Fig. II-3-3, an ilmenite ore body, 1.40m thick and grading $106.95kg/m^3$ of ilmenite, was seized between 26.00m and 27.40m.

3) MJBK-3 (Direction - ; inclination –90° ; length 41.0m) (Line-38)

(1) Geology

The section from the mouth to 10.30m consists of the surface soil and pebble-gravel, followed by the section between 10.30m and 38.20m composed of clay and sandy clay of the Aral Formation, and the section between 38.20m and the bottom composed of weathering crust.

(2) Mineralization

The main indications of mineralization are shown in Table II-3-6.

As seen in Fig. II-3-3, an ilmenite ore body, 8.90m thick and grading 106.52 kg/m^3 of ilmenite, was intersected between 29.30m and 38.20m.

4) MJBK-4 (Direction - ; inclination –90° ; length 36.0m) (Line-38)

(1) Geology

The section from the mouth to 9.80m consists of the surface soil and pebble-gravel, followed by the section between 9.80m and 33.90m composed of clay and sandy clay of the Aral Formation, and the section between 33.90m and the bottom composed of weathering crust.

(2) Mineralization

The main indications of mineralization are shown in Table II-3-6.

As seen in Fig. II-3-3, an ilmenite ore body, 4.70m thick and grading 118.95 kg/m^3 of ilmenite, was intersected between 29.20m and 33.90m.

5) MJBK-5 (Direction - ; inclination –90° ; length 37.0m) (Line-38)

(1) Geology

The section from the mouth to 7.80m consists of the surface soil and pebble-gravel, followed by the section between 7.80m and 29.90m composed of clay and sandy clay of the Aral Formation, the section between 29.90m and 34.00m composed of re-deposited weathering crust, and the section between 34.00m and the bottom composed of weathering crust.

(2) Mineralization

The main indication of mineralization is shown in Table II-3-6.

As seen in Fig. II-3-3, an ilmenite ore body, 0.90m thick and grading 123.61 kg/m^3 of ilmenite, was intersected between 29.00m and 29.90m.

6) MJBK-6 (Direction - ; inclination –90° ; length 30.0m) (Line-34)

(1) Geology

The section from the mouth to 8.80m consists of the surface soil and pebble-gravel, followed by the section between 8.80m and 27.70m composed of clay, sandy clay and argillaceous sand of the Aral Formation, and the section between 27.70m and the bottom composed of weathering crust.

(2) Mineralization

The main indication of mineralization is shown in Table II-3-6.

As seen in Fig. II-3-4, weak ilmenite mineralization, 2.00m thick and grading 52.43 kg/m^3 of ilmenite, was intersected between 25.70m and 27.70m.

7) MJBK-7 (Direction - ; inclination –90° ; length 43.0m) (Line-34)

(1) Geology

The section from the mouth to 9.20m consists of the surface soil and pebble-gravel, followed by the section between 9.20m and 37.30m composed of clay, sandy clay and argillaceous sand of the Aral Formation, and the section between 37.30m and the bottom composed of weathering crust.

(2) Mineralization

The main indication of mineralization is shown in Table II-3-6.

As seen in Fig. II-3-4, an ilmenite ore body, 7.80m thick and grading 151.94 kg/m^3 of ilmenite, was intersected between 29.50m and 37.30m.

8) MJBK-8 (Direction - ; inclination –90° ; length 43.0m) (Line-34)

(1) Geology

The section from the mouth to 8.00m consists of the surface soil and pebble-gravel, followed by the section between 8.00m and 41.00m composed of clay, sandy clay and argillaceous sand of the Aral Formation, and the section between 41.00m and the bottom composed of weathering crust.

(2) Mineralization

The main indications of mineralization are shown in Table II-3-6.

As seen in Fig. II-3-4, an ilmenite ore body, 2.10m thick and grading 201.10 kg/m^3 of ilmenite, was intersected between 28.50m and 30.60m.

9) MJBK-9 (Direction - ; inclination –90° ; length 42.0m) (Line-34)

(1) Geology

The section from the mouth to 8.00m consists of the surface soil and pebble-gravel, followed by the section between 8.00m and 37.70m composed of clay, sandy clay and argillaceous sand of the Aral Formation, and the section between 37.70m and the bottom composed of weathering crust.

(2) Mineralization

The main indications of mineralization are shown in Table II-3-6.

As seen in Fig. II-3-4, an ilmenite ore body, 7.70m thick and grading 110.87 kg/$m^3$of ilmenite, was intersected between 30.00m and 37.70m.

10) MJBK-10 (Direction - ; inclination –90° ; length 36.0m) (Line-34)

(1) Geology

The section from the mouth to 8.00m consists of the surface soil and pebble-gravel, followed by the section between 8.00m and 34.60m composed of clay, sandy clay and argillaceous sand of the Aral Formation, and the section between 34.60m and the bottom composed of weathering crust.

(2) Mineralization

The main indications of mineralization are shown in Table II-3-6.

As seen in Fig. II-3-4, an ilmenite ore body, 5.60m thick and grading 119.36 kg/m^3 of ilmenite, was intersected between 29.00m and 34.60m.

11) MJBK-16 (Direction - ; inclination –90° ; length 41.0m) (Line-30)

(1) Geology

The section from the mouth to 9.10m consists of the surface soil and pebble-gravel, followed by the section between 9.10m and 39.00m composed of clay, sandy clay and argillaceous sand of the Aral Formation, and the section between 39.00m and the bottom composed of weathering crust.

(2) Mineralization

The main indications of mineralization are shown in Table II-3-6.

As seen in Fig. II-3-5, an ilmenite ore body, 5.00m thick and grading 114.46 kg/m^3 of ilmenite, was intersected between 34.00m and 39.00m.

12) MJBK-17 (Direction - ; inclination –90° ; length 46.0m) (Line-30)

(1) Geology

The section from the mouth to 9.00m consists of the surface soil and pebble-gravel, followed by the section between 9.00m and 44.00m composed of clay, sandy clay and argillaceous sand of the Aral Formation, and the section between 44.00m and the bottom composed of weathering crust.

(2) Mineralization

The main indications of mineralization are shown in Table II-3-6.

As seen in Fig. II-3-5, an ilmenite ore body, 7.00m thick and grading 105.41 kg/m^3 of ilmenite, was intersected between 36.00m and 43.00m.

3-3-2 Southern flank of the Bektemir No.3 ore body

The survey findings are exhibited in the geologic cross sections (Fig.II-3-7).

1) MJBK-11 (Direction - ; inclination –90° ; length 37.0m) (Line-2G)

(1) Geology

The drillhole section from the mouth up to the depths of 11.70m consists of the surface soil and pebble-gravel, which is followed by the section between 11.70m and 24.00m composed of clay and sandy clay, the section between 24.00m and 27.20m composed of re-deposited weathering crust, and the section from 27.20m to the bottom composed of weathering crust.

(2) Mineralization

As seen in Fig. II-3-7, no ilmenite mineralization was seized.

2) MJBK-12 (Direction - ; inclination −90° ; length 41.5m) (Line-2G)

(1) Geology

The section from the mouth to 13.00m consists of the surface soil and pebble-gravel, followed by the section between 13.00m and 29.90m composed of clay, sandy clay and argillaceous sand of the Aral Formation, the section between 29.90m and 35.00m composed of re-deposited weathering crust, and the section between 35.00m and the bottom composed of weathering crust.

(2) Mineralization

The main indications of mineralization are shown in Table II-3-7.

As seen in Fig. II-3-7, an ilmenite ore body, 1.90m thick and grading 110.72kg/m^3 of ilmenite, was seized between 28.00m and 29.90m.

3) MJBK-13 (Direction - ; inclination −90° ; length 39.00m) (Line-2G)

(1) Geology

The section from the mouth to 12.30m consists of the surface soil and pebble-gravel, followed by the section between 12.30m and 23.00m composed of clay and sandy clay of the Aral Formation, the section between 23.00m and 32.80m composed of re-deposited weathering crust, and the section between 32.80m and the bottom composed of weathering crust.

(2) Mineralization

As seen in Fig. II-3-7, no ilmenite mineralization was seized.

4) MJBK-14 (Direction - ; inclination −90° ; length 32.00m) (Line-2G)

(1) Geology

The section from the mouth to 14.50m consists of the surface soil and pebble-gravel, followed by the section between 14.50m and 23.70m composed of clay and sandy clay of the Aral Formation, the section between 23.70m and 29.00m composed of re-deposited weathering crust, and the section between 29.00m and the bottom composed of weathering crust.

(2) Mineralization

As seen in Fig. II-3-7, no ilmenite mineralization was seized.

5) MJBK-15 (Direction - ; inclination −90° ; length 34.5m) (Line-2G)

(1) Geology

The section from the mouth to 12.50m consists of the surface soil and pebble-gravel, followed by the section between 12.50m and 28.90m composed of clay, sandy clay and argillaceous sand of the Aral Formation, the section between 28.90m and 29.80m composed of re-deposited weathering crust, and the section between 29.80m and the bottom composed of weathering crust.

(2) Mineralization

The main indication of mineralization is shown in Table II-3-7.

As seen in Fig. II-3-7, an ilmenite ore body, 4.40m thick and grading 121.11 kg/m^3 of ilmenite, was seized between 24.50m and 28.90m.

3-4 Ore Reserves Estimation of the Southern Flank of the Bektemir Placer No. 1

In Phase I, drilling was implemented up to 1 km from the south side of the ore blocks with confirmed ore reserves of the C_2 category of the No.1 ore body, on the three survey lines and on a 500m x 200m grid.

Tentative ore reserves estimation was made to evaluate the ore reserves acquired in Phase I.

3-4-1 Method of estimation

(1) Extent of ore body for ore reserves estimation

Of the ilmenite mineralization portions intersected by the drilling, those of 70 kg/m^3 or more on the hanging wall side and of 100 kg/m^3 or more on the footwall side; or, 2.0m in thickness x 100 kg/m^3 or more, whichever may be greater, are regarded as ore body.

(2) Extent of ore block

In case drilling at the flank of ore body which had been ascertained by other drilling fails to intersect the ore body, a portion up to the midpoint is regarded a s an ore block.

In case the flank of ore body ascertained by drilling remains unexplored, a portion up to 50m from a drillhole that intersected the ore body is regarded as an ore block, in principle.

(3) Grade by ore block

Average grade of an ore block confirmed by drilling, which is weighted by the thickness of ore body, is regarded as the ore block grade by survey line, to calculate average grade of an entire ore block (Table II-3-8).

(4) Formula for ore reserves calculation

Ilmenite ore reserves of an ore block are calculated in the following formula (Table II-3-9).

$$V = S \times W \times C \times 1/1{,}000$$

where,

V = Ilmenite ore reserves (t)

S = Horizontal area (m^2) = 909,000 m^2

W = Average thickness of ore body (m) = 5.51 m

C = Average ilmenite contents of ore body (kg/m^3) = 123.95 kg/m^3

3-4-2 Estimated ore reserves

According to the tentative ore reserves estimation, placer reserves of 5,009,000 m^3 and ilmenite reserves of 621,000 t were acquired. (Table II-3-9)

3-5 Summary and Considerations

3-5-1 Southern flank of the Bektemir Placer No.1

(1) Summary

The drilling was performed at 12 drillholes totaling 471 m, on a 500m x 200m grid on three survey lines (Lines-38, 34 and 30), with the percussion drill UGB-3UK.

The drilling was conducted over 1 km from the south side of the ore blocks with confirmed ore reserves of the C_2 category.

The drilling at 12 drillholes revealed that the ore body was 2.1m to 8.9m thick and the ilmenite contents are 105.41 to 201.10 kg/m^3, while the zircon contents are as low as 0.5 to 3.4 kg/m^3.

Widths of the ore body were confirmed by the drilling on the Line-38; at the west and east sides of the ore body, thinning of the ore body was confirmed by the MJBK-5 and -2, which are 0.9 m and 1.4 m, respectively. Consequently, the mineralization is under the cutoff criteria of 2.0m x 100 kg/m^3. The eastern limit of mineralization zone (30 kg/m^3 or more on the hanging wall side and 70 kg/m^3 or more on the footwall side) was confirmed by drillhole MJBK-1

On the Line-34, drillhole MJBK-6 seized a weak mineralization zone (52.99 kg/m^3 of ilmenite), thereby confirming the eastern limit of the ore body.

As for the west side of the Line-34 and the east, west and south sides of the Line-30, the extent of the ore body has not been defined.

(2) Considerations

Along the faults in the NE-SW direction, structural fracture zones were carved to form the valleys where placers are emplaced.

The ore body is embedded in the sandy clay and argillaceous sand of the lower formation of the Neogene Aral Formation which deposited in the riverbeds of old valleys.

From its features that it abounds in clay components but includes no gravel, the Aral Formation is inferred not to be riverbed sediments but lake sediments deposited in valleys submerged in consequence of the expansion of the Lake Zaisan.

Ilmenite is considered to derive from plutonic rocks of the Preobrazhenskiy intrusive rock body. It is reported that ilmenite contents are especially high in gabbro and monzonite. Ilmenite concentrated in weathering residuals, which caused placers to be formed.

The ore body increases its width and volume southward, whereas ilmenite contents slightly decline and stripping ratio rises as the depth of the ore body increases.

The following are the ore reserves of the C_2 category acquired by the Phase I exploration.

Cutoff criteria: 70 kg/m^3 or more on the hanging wall side
and 100 kg/m^3 or more on the footwall side; or,
2.0m x 100 kg/m^3 or more, whichever be greater.

Ore reserves: 5 million m^3

Ilmenite content: 621,000 t

Ilmenite average grade: 124 kg/m^3

Stripping ratio: 5.38 m^3/m^3

The additionally acquired ore reserves represents a substantial increase over the confirmed ore reserves of B, C_1 and C_2 categories of the No.1 ore body, which is 12 million tons grading 151.78 kg/m^3 of ilmenite.

In view of the above ilmenite contents and the stripping ratio, the ore body is economically exploitable by open-pit mining, under the Kazakh standards (ex-C.C.C.P. standard).

Table I -4-2 Ilmenite Content and Maximum Economical Stripping Ratio

Average content of ilmenite (kg/m^3)	Maximum economical stripping ratio (m^3/m^3)
100	2.58
110	3.90
120	5.21
124	**5.75**
130	6.56
140	7.87
150	9.21

3-5-2 Southern flank of the Bektemir Placer No.3

(1) Summary

Drilling survey was carried out at five drillholes at intervals of 200 m, totaling 184 m, on the Line-2G, using the rotary drills URB-2A-2.

At two of the five drillholes (MJBK-12 and -15), ilmenite mineralization exceeding the cutoff criteria was ascertained. The drillhole MJBK-12 intersected the ore body of 1.9 m in thickness, averaging 110.72 kg/m^3 of ilmenite, while drillhole MJBK-15 intersected that of 4.4 m, averaging 121.11 kg/m^3. The depths of the ore body for drillholes MJBK-12 and MJBK-15 are 28.0 m and 24.5 m, respectively.

(2) Considerations

As regards the sedimentary environment of the ilmenite deposit intersected by the drilling, two hypotheses are conceivable.

The first one holds that the ore deposit is an ilmenite placer depositing over the riverbeds of old valleys controlled by the fracture zone. On the basis of this hypothesis, the mineralization seized in Phase I is considered to have deposited in the two valleys controlled by the Bektemirskiy fault zone in the NE-SW direction.

The second one holds that it is a placer depositing over the sub-lacustrine flattened surface. According to the hypothesis, the drilling that intersected the ore body is interpreted to have seized the northeastern edge of the NW-SE ore body extending from the west side of the Placer No.3 and the south side of the Placer No.1.

It is therefore essential in drawing future prospecting lines to verify the directions of placers in the area.

Table II-3-1 Quantity of Drilling Works, Core Recovery and Efficiency of Drilling in the Kokpetinskaya Area

Hole No.	Drilling length (m)	Legth of casing pipes (m)	Core recovery (%)	Efficiency		Ratio of drilling work (%)						
				m/shift	m/hr	Drilling	Outdrilling	Recovery from accident	Preparation	Dismount/ Mobilization	Transportation of water	Others
MJBK−1	32.00	18.00	100.0	3.20	2.00	17.4	56.4	−	8.7	4.4	13.0	−
MJBK−2	44.00	13.00	100.0	6.29	2.44	28.1	28.1	−	25.0	6.3	12.5	−
MJBK−3	41.00	13.00 13.00	100.0	4.10	1.58	27.1	33.3	−	16.6	6.4	16.6	−
MJBK−4	36.00	9.20 33.00	100.0	2.00	2.00	10.7	59.5	2.4	9.5	3.6	14.3	−
BJBK−5	37.00	6.70	100.0	5.29	2.31	24.6	30.8	−	24.6	6.2	13.8	−
BJBK−6	30.00	9.10	100.0	5.00	1.67	32.7	32.7	−	7.3	14.6	12.7	−
MJBK−7	43.00	8.50	100.0	5.38	1.72	33.8	33.8	2.7	6.7	9.5	13.5	−
BJBK−8	43.00	13.00	100.0	3.31	1.87	19.8	18.1	34.5	13.8	3.5	10.3	−
MJBK−9	42.00	13.00	100.0	4.67	2.10	23.3	18.6	13.9	9.3	18.6	16.3	−
MJBK−10	36.00	9.00	100.0	3.60	1.33	27.6	17.3	16.3	8.2	12.2	18.4	−
MJBK−11	37.00	13.00	100.0	18.50	2.64	50.0	14.3	−	10.7	10.7	14.3	−
MJBK−12	41.50	13.50	100.0	6.92	1.30	47.8	13.4	−	11.9	10.5	16.4	−
MJBK−13	39.00	11.00	100.0	4.88	0.93	47.7	20.5	−	18.2	4.5	9.1	−
MJBK−14	32.00	16.00	76.3	6.40	1.19	38.5	18.6	8.6	9.7	9.7	13.9	−
MJBK−15	34.50	12.00	93.7	4.93	1.92	20.9	25.6	−	9.3	27.9	16.3	−
MJBK−16	41.00	10.00	100.0	8.20	2.41	34.0	22.0	−	8.0	16.0	20.0	−
MJBK−17	46.00	10.00	100.0	7.67	2.00	38.3	21.7	−	10.0	10.0	20.0	−
Total	655.00	244.00	1,600	100.34	31.41	522.3	464.7	78.4	207.5	174.6	251.4	−
Average by each hole	38.50	14.40	98.2	5.90	1.84	30.7	27.3	4.6	12.8	10.3	14.8	−

Table II -3-2 Results of Drilling Survey by Each Hole in the Kokpetinskaya Area

Hole No.	Period of Drilling	Drilling length	Quantity of working shift	Total workers				Contents of work								Consumable materials													Non-core	Core	Casing
				Engineer			Worker									Bit			Shoe												
				Japanese	Operator	Geologist	Assistant /driver	Drilling	Preparation	Dismount	Out-drilling	Recovery from accident	Transportation of water	Other	Total	4"T.B.	mm 190	mm 92	mm 400	mm 270	mm 220	mm 127	Deisel oil	Gasoline	Lubricating oil	Grease	Bentonite	Total amount of water			
		m						hr	hr	hr	hr	hr	hr	hr	hr	pc	pc	pc	pc	pc	pc	pc	l	l	l	kg	bag	m^3	m	m	m
MJBK 1	2000. 9.21 2000. 9.27	32.00	10	6	17	1.5	60	16.0	8.0	4.0	52.0		12.0		92.0		1			1			1,150	115	10	7		36	12.8	19.2	13.0
MJBK 2	2000. 9.18 2000. 9.21	44.00	15	4	11	1.5	35	18.0	16.0	4.0	18.0		8.0		64.0		1			1			1,280	60	8	5		24	12.0	32.0	13.0
MJBK 3	2000. 9. 1 2000. 9. 4	41.00	8	7	17	10.0	40	26.0	16.0	6.0	32.0		16.0		96.0		1		1	1			1,900	122	17	10		48	—	41.0	13.0 13.0
MJBK 4	2000. 9. 5 2000. 9.14	36.00	18	14	31	15.0	95	18.0	16.0	6.0	100.0	4.0	24.0		168.0		2			1	1		2,995	130	13	17		72	9.0	27.0	9.2 33.0
MJBK 5	2000. 9.14 2000. 9.17	37.00	7	4	8	3.0	35	16.0	16.0	4.0	20.0		9.0		65.0		2			1			1,190	55	6	6		27	7.8	29.2	6.7
MJBK 6	2000. 9.27 2000. 9.29	30.00	6	2	7	3.0	30	18.0	4.0	8.0	18.0		7.0		55.0		1			1			1,150	60	5	5		21	8.8	21.2	9.1
MJBK 7	2000. 9.23 2000. 9.26	43.00	8	2	12	1.5	40	25.0	5.0	7.0	25.0	2.0	10.0		74.0		1			1			1,595	80	12	11		30	8.5	34.5	8.5
MJBK 8	2000. 9.15 2000. 9.22	43.00	11	6	18	3.0	68	23.0	16.0	4.0	21.0	40.0	12.0		116.0		1			1			1,530	105	17	8		36	8.0	35.0	13.0
MJBK 9	2000. 9.27 2000.10. 2	42.00	9	4	12	2.0	50	20.0	8.0	16.0	16.0	12.0	14.0		86.0		1			1			1,520	120	13	12		42	8.0	34.0	13.0
MJBK 10	2000.10. 2 2000.10. 6	36.00	9	4	8	5.0	42	27.0	8.0	4.0	17.0	16.0	18.0		90.0		1			1			980	70	7	5		54	8.0	28.0	9.0
MJBK 11	2000. 9.20 2000. 9.20	37.00	2	1	3	1.0	10	14.0	3.0	3.0	4.0		4.0		28.0	1		2				2	420	55	7	3	40	12	13.0	24.0	13.0
MJBK 12	2000. 9.17 2000. 9.19	41.50	6	2	10	3.0	30	32.0	8.0	7.0	9.0		11.0		67.0	1		2				2	720	65	15	5	37	33	14.0	27.5	13.5
MJBK 13	2000. 9.14 2000. 9.16	39.00	5	3	19	6.0	50	42.0	16.0	4.0	18.0		8.0		88.0	1		2				3	680	85	10	5	43	24	9.0	30.0	11.0
MJBK 14	2000. 9.21 2000. 9.22	32.00	5	2	9	3.0	25	27.0	7.0	7.0	13.0	6.0	10.0		70.0	1		2				3	700	80	8	5	45	30	13.0	14.5	16.0
MJBK 15	2000. 9.24 2000. 9.26	34.50	6	2	12	4.0	30	18.0	8.0	24.0	22.0		14.0		86.0	2		2				5	630	70	10	5	40	42	12.0	21.1	12.0
MJBK 16	2000. 9.30 2000.10. 2	41.00	5	1	6	2.0	25	17.0	4.0	8.0	11.0		10.0		50.0		2			1			1,120	50	15	7		30	9.5	31.5	10.5
MJBK 17	2000.10. 2 2000.10. 4	46.00	6	1	5	3.0	32	23.0	6.0	6.0	13.0		12.0		60.0		1			1			970	60	8	7		33	9.0	37.0	10.0
Total	2000. 9. 1 2000.10. 6	655.00	136	65	205	67.5	697	380.0	165.0	122.0	409.0	80.0	199.0		1355.0	6	15	10	1	12	1	15	20,530	1,382	181	123	205	594	162.4	486.7	239.5

Table Ⅱ-3-3 Results of Drilling Survey by Each Machine in the Kokpetinskaya Area

Content of work		Quantity of working shift	Total workers				Contents of work								Consumable materials			
			Engineer			worker	Transport	Carrying	Prepa-ration	Waiting for material	Recovery from accident	Dism-ount	Other	Total	Gasoline	Diesel oil	Lubricanting oil	Grease
			Japnaese	Operator	Geologist	Locals												
Detailed survey (No.1 machine)							hr	hr	hr	hr	hr	hr	hr	hr	l	l	l	kg
Travel	Tokgo-Almaty-Samarskaya	5	5										40.0	40.0				
Preparation	2000. 8. 30～2000. 8. 31	1.5	2	4	2	10	8.0	6.0						16.0	20	250	20	5
Holiday																		
Dismount	2000. 10. 7～2000. 10. 7	1	1	1		8						8.0		8.0	10	300	15	10
Travel	2000. 10. 2～2000. 10. 8	7	7										56.0	56.0				
Total	2000. 8. 30～2000. 10. 8	14.5	15	5	2	18	8.0	6.0				8.0	96.0	120.0	30	550	35	15
Detailed survey (No.2 machine)																		
Travel	Tokgo-Almaty-Samarskaya																	
Preparation	2000. 9. 14～2000. 9. 14	1	1	2	1	12	10.0	2.0						16.0	10	130	10	5
Holyday																		
Dismount	2000. 10. 6～2000. 10. 6	1	1	1		7						8.0		8.0	9	250	15	8
Travel																		
Total	2000. 9. 14～2000. 10. 6	2	2	3	1	19	10.0	2.0				8.0		24.0	19	380	25	13
General survey (No. 3 machine)																		
Travel	Tokgo-Almaty-Samarskaya	5	5										40.0	40.0				
Preparation	2000. 9. 11～2000. 9. 11	1	1	3	1	8	9.0	1.0						20.0	15	280	20	10
Holyday																		
Dismount	2000. 9. 27～2000. 9. 27	1	1	3	1	10						12.0		12.0	10	300	25	15
Travel	2000. 10. 2～2000. 10. 8	7	7										56.0	56.0				
Total	2000. 9. 11～2000. 10. 8	14	14	6	2	18	9.0	1.0				12.0	96.0	128.0	25	580	45	25
Total		30.5	31.0	14.0	5.0	55.0	27.0	9.0				28.0	192.0	272.0	74	1,510	105	53

Table Ⅱ-3-4 General Results of the Drilling Works in the Kokpetinskaya Area

Drilling machine			NO.1 machine	NO.2 machine	NO.3 machine	Total	Description
District			South of Placer No.1	South of Placer No.1	South of Placer No.3		
Number of holes			7	5	5	17	
Length of drilling (m)			268.00	203.00	184.00	655.00	
Ave. length of drillholes (m)			38.29	40.60	36.80	38.53	
Survey days	Period		2000.8.30	2000.9.14	2000.9.11	2000.8.30	
			2000.10.7	2000.10.5	2000.9.27	2000.10.7	
	Drilling days		22.6	14.5	8.7	45.8	
	Other days		16.4	7.5	8.3	32.2	Travel, transport, preparation and dismount
	Holidays		—	—	—	—	
	Total days		39	22	17	78	
Workers	Local staff	Engineer	155	62	67	284	
		Worker	375	210	165	750	
		Geologist	34	12.5	17	63.5	
		Total	564	284.5	249	1,097.5	
	Japanese staff		54	32	17	103	
Efficiency of drilling days (m/day·machine)			11.86	14.00	21.15	14.30	
Efficiency of survey days (m/day·machine)			6.87	9.23	10.82	8.40	

Table Ⅱ-3-5 Consumable Drilling Articles in the Kokpetinskaya Area

Item	Unit	Quantity	Average		Note
Tricone bit (4″)	pcs	6	30.67 m/pc	1.20 pcs/hole	
Metal bit (φ92mm)	pcs	10	18.40 m/pc	2.0 pcs/hole	
Metal bit (φ190mm)	pcs	15	31.40 m/pc	1.25 pcs/hole	
Shoe (φ400mm)	pcs	1	13.00 m/pc	1.0 pcs/hole	
Shoe(φ270mm)	pcs	12	39.25 m/pc	1.0 pcs/hole	
Shoe(φ220mm)	pcs	1	36.00 m/pc	1.0 pcs/hole	
Shoe(φ127mm)	pcs	15	12.27 m/pc	3.00 pcs/hole	
Gas oil	liters	20,530	31.34 l/m	1,207.65 l/hole	
Gasoline	liters	1,382	2.11 l/m	81.29 l/hole	
Lubricating oil	liters	181	0.28 l/m	10.65 l/hole	
Grease	kg	123	0.19 l/m	7.24 kg/hole	
Bentonite	bags*	205	1.11 bags/m	41.0 bags/hole	
Total amount of water	m^3	594	0.91 m^3/m	34.91 m^3/hole	

*1bag=25kg

Table II-3-6 Major Mineralization Zones Revealed by Drillings on the Southern flank of Placer No.1

Hole No.	Depth (m)	Width (m)	Ilmenite content (kg/m³)	Zircon content (kg/m³)	Remarks
MJBK-2	26.00~27.40	1.40	106.95	2.71	
	27.40~30.20	2.80	40.64	0.73	
MJBK-3	28.50~29.30	0.80	42.35	1.22	
	29.30~38.20	8.90	106.52	1.84	
MJBK-4	28.00~29.20	1.20	41.04	1.24	
	29.20~33.90	4.70	118.95	2.44	
MJBK-5	29.00~29.90	0.90	123.61	1.62	
MJBK-6	25.70~27.70	2.00	52.43	0.89	
MJBK-7	29.50~37.30	7.80	151.94	2.33	
MJBK-8	25.30~28.50	3.20	58.07	1.51	
	28.50~30.60	2.10	201.10	3.40	
	30.60~41.00	10.40	49.14	1.40	
MJBK-9	29.00~30.00	1.00	65.92	1.28	
	30.00~37.70	7.70	110.87	1.90	
MJBK-10	27.00~29.00	2.00	31.50	0.63	
	29.00~34.60	5.60	119.36	1.84	
MJBK-16	28.20~34.00	5.80	63.20	1.16	
	34.00~39.00	5.00	114.46	1.71	
MJBK-17	34.00~36.00	2.00	38.95	0.87	
	36.00~43.00	7.00	105.41	1.56	
	43.00~43.50	0.50	60.84	1.22	

Table II-3-7 Major Mineralization Zones Revealed by Drillings on the Southern flank of Placer No.3

Hole No.	Depth (m)	Width (m)	Ilmenite content (kg/m^3)	Zircon content (kg/m^3)	Remarks
MJBK-12	24.30～28.00 28.00～29.90	3.70 1.90	19.34 110.72	0.55 4.22	
MJBK-15	24.50～28.90	4.40	121.11	3.28	

Table Ⅱ-3-8 Ilmenite Content, Ore Sands and Overburden Thickness at the Southern Flank of Placer No.1 in block III-C_2

No.	Profiles No.	Hole No.	Average thickness		Average ilmenite content	Thickness x ilmenite content	Stripping ratio
			Ore sands	Over - burden			
			m	m	kg/m³		m³/m³
1.	30	MJBK-17	7.0	36.0	105.41	737.87	
2.	30	MJBK-16	5.0	34.0	114.46	572.30	
Sum			**12.0**	**70.0**		**1,310.17.**	
Average at profile 30			**6.0**	**35.0**	**109.18**		**5.83**
1.	34	MJBK-10	5.6	29.0	119.36	668.42	
2.	34	MJBK-9	7.7	30.0	110.87	853.70	
3.	34	MJBK-8	2.1	28.5	201.10	422.31	
4.	34	MJBK-7	7.8	29.5	151.94	1,185.13	
Sum			**23.2**	**117.0**		**3,129.56**	
Average at profile 34			**5.8**	**29.25**	**134.89**		**5.04**
1.	38	MJBK-4	4.7	29.2	118.95	559.06	
2.	38	40-20	3.3	29.0	151.02	498.37	
3.	38	MJBK-3	8.9	29.3	106.52	948.03	
Sum			**16.9**	**87.5**		**2,005.46**	
Average at profile 38			**5.63**	**29.17**	**118.67**		**5.18**
TOTAL:		**9 holes**	**52.1**	**274.5**		**6,445.19**	
Average between Profiles 30-38			**5.8**	**30.5**	**123.70**		**5.26**
1.	40	40-16	6.0	27.5	103.54	621.24	
2.	44	44-14	2.5	24.0	177.94	444.85	
Sum			**8.5**	**51.5**		**1,066.09**	
TOTAL:		**11 holes**	**60.6**	**326.0**		**7,511.28**	
Average at block III-C_2			**5.51**	**29.64**	**123.95**		**5.38**

Table II-3-9 Ore Reserves Calculation of Category C_2 for the Southern Flank of Placer No.1

Block No.	Block area ths.m^2	Ore bed thickness m	Ore sands reserves ths.m^3	Ilmenite content kg/m^3	Ilmenite reserves ths. t	Overburden thickness m	Overburden volume ths. m^3	Stripping ratio m^3/m^3
III－C_2	909.0	5.51	5,008.59	123.95	620.81	29.64	26,942.76	5.38

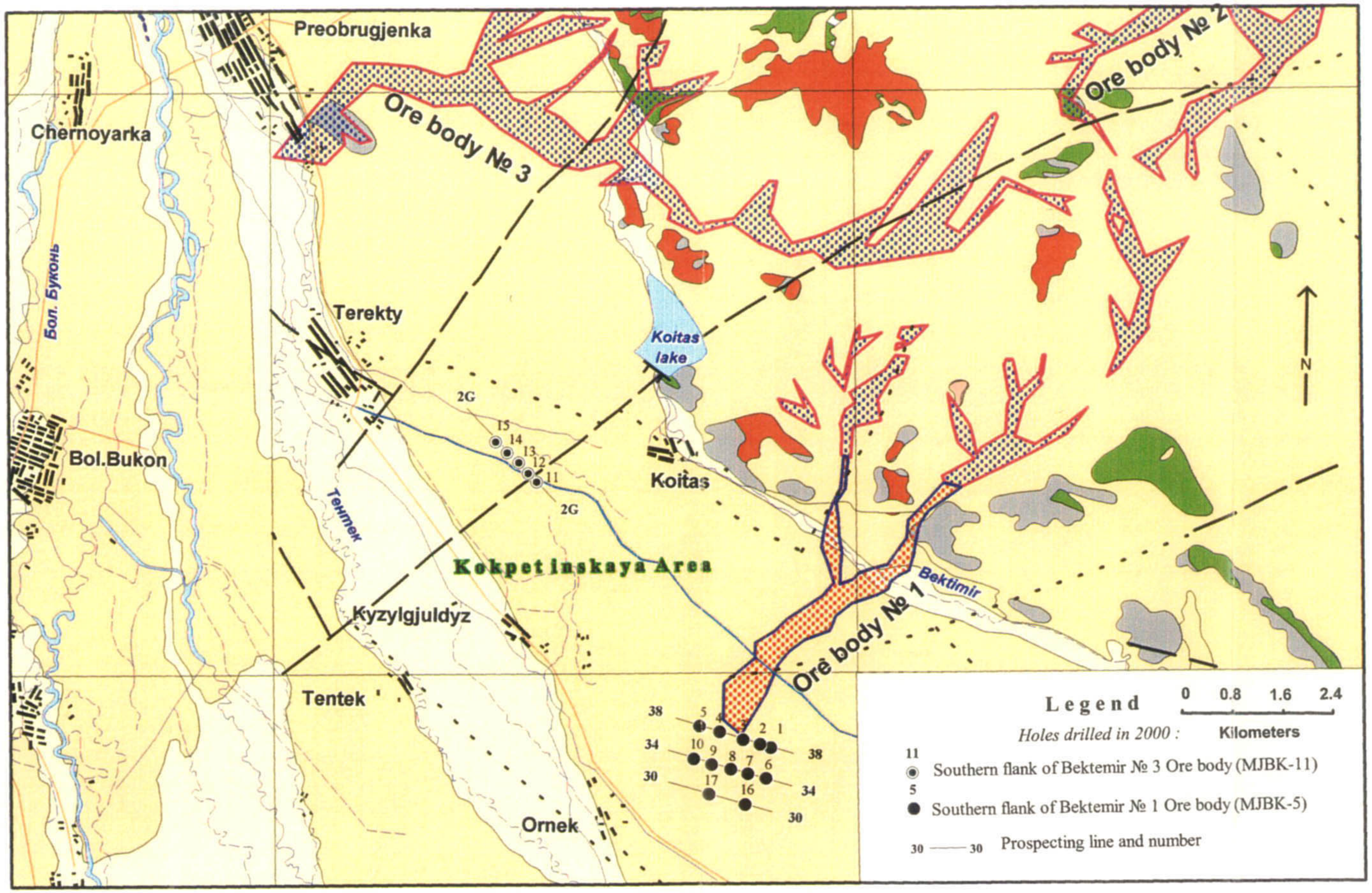


Fig. II-3-1 Location Map of the Drillholes in the Kokpetinskaya Area

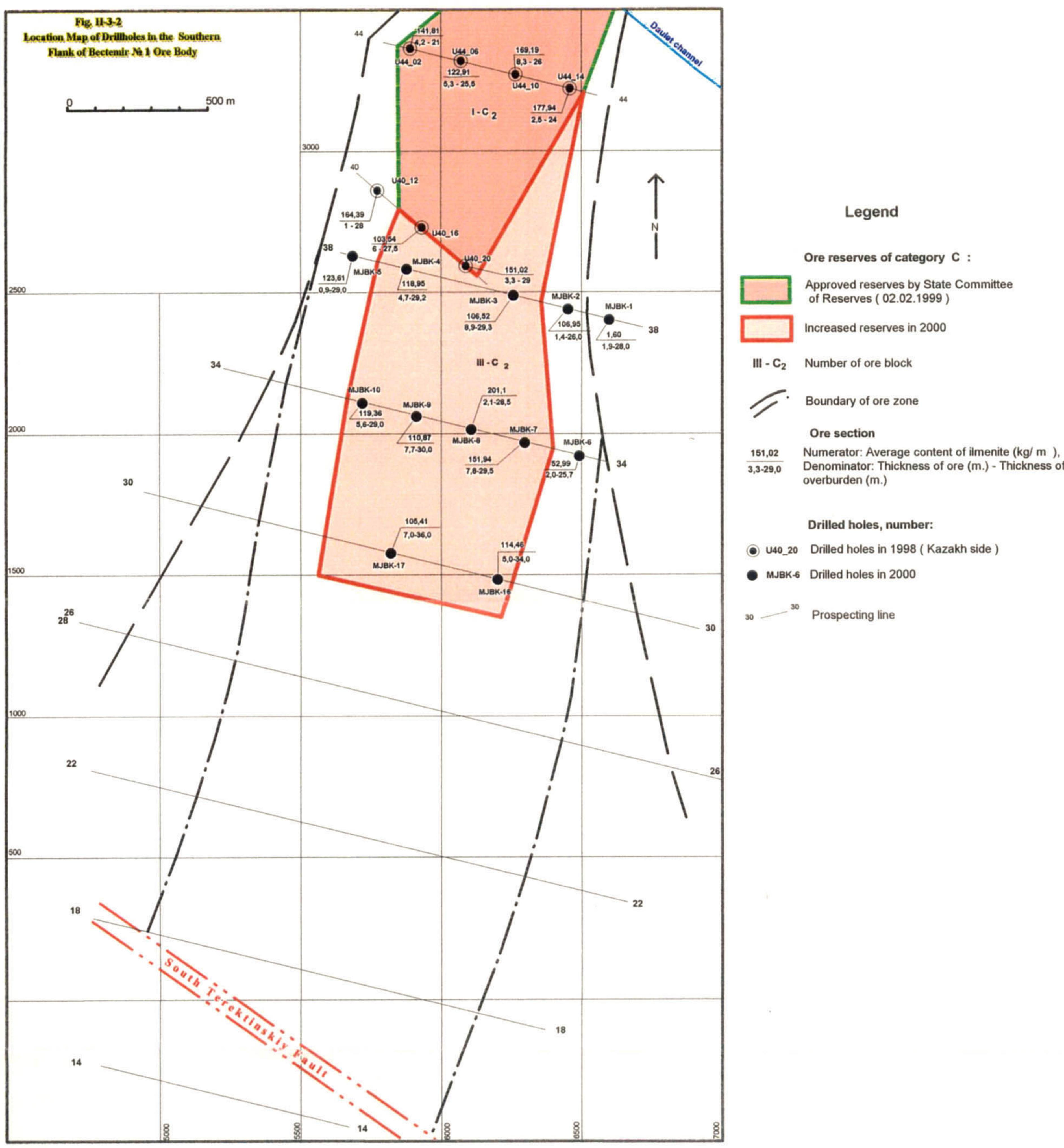
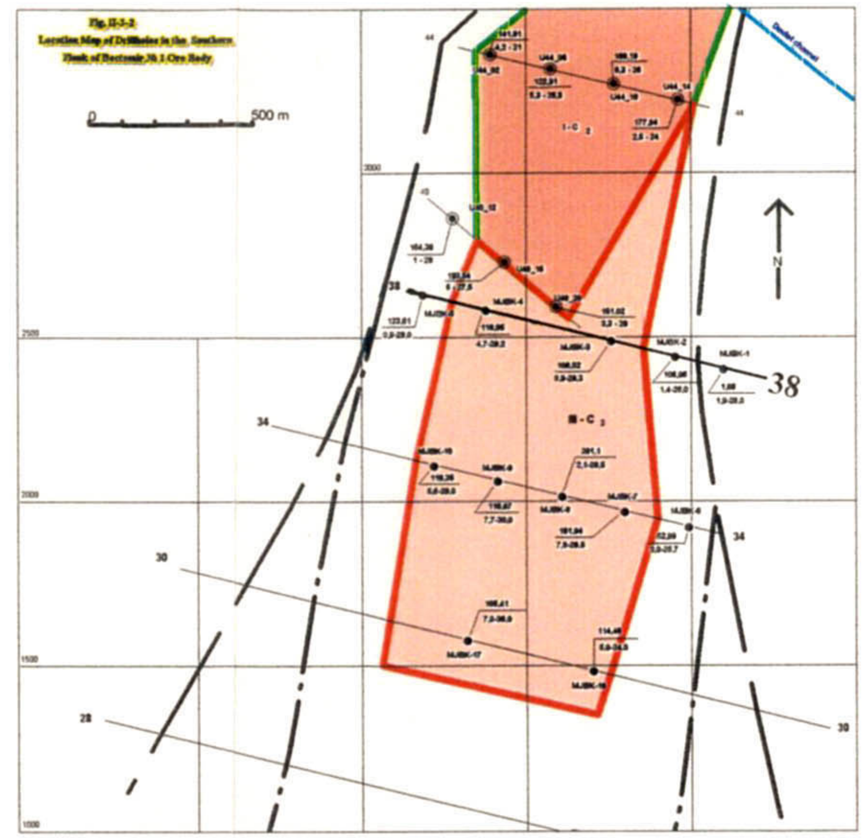


Fig. II-3-2 Location Map of the Drillholes on the Southern Flank of Bektemir No. 1 Ore Body



Legend

- Soil and loam with rock fragments
- Clay, sandy clay
- Ore body
- Sand-pebble-gravel deposits
- Crust of weathering
- Uneconomical ore (ore zone)

Drill hole
MJBK-9 Number of hole
42 Depth of hole

151.94 / 7.8-29.5 — Numerator: Average content of ilmenite (kg/m3); Denominator : Thickness of ore (m) - Thickness of overburden (m)

III-C — Boundary and number of ore block

Scale: Horizontal 1:5000
Vertical 1:500

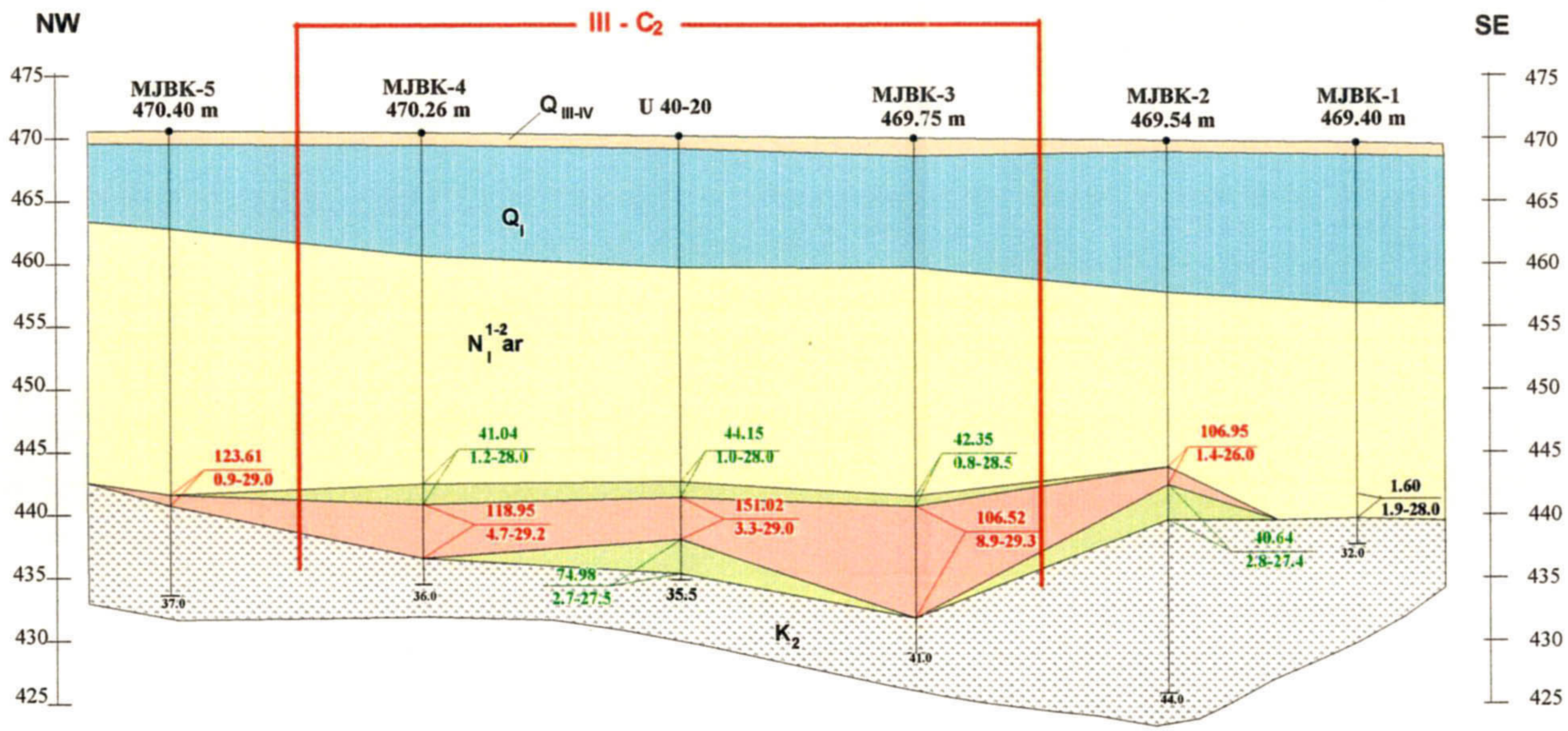
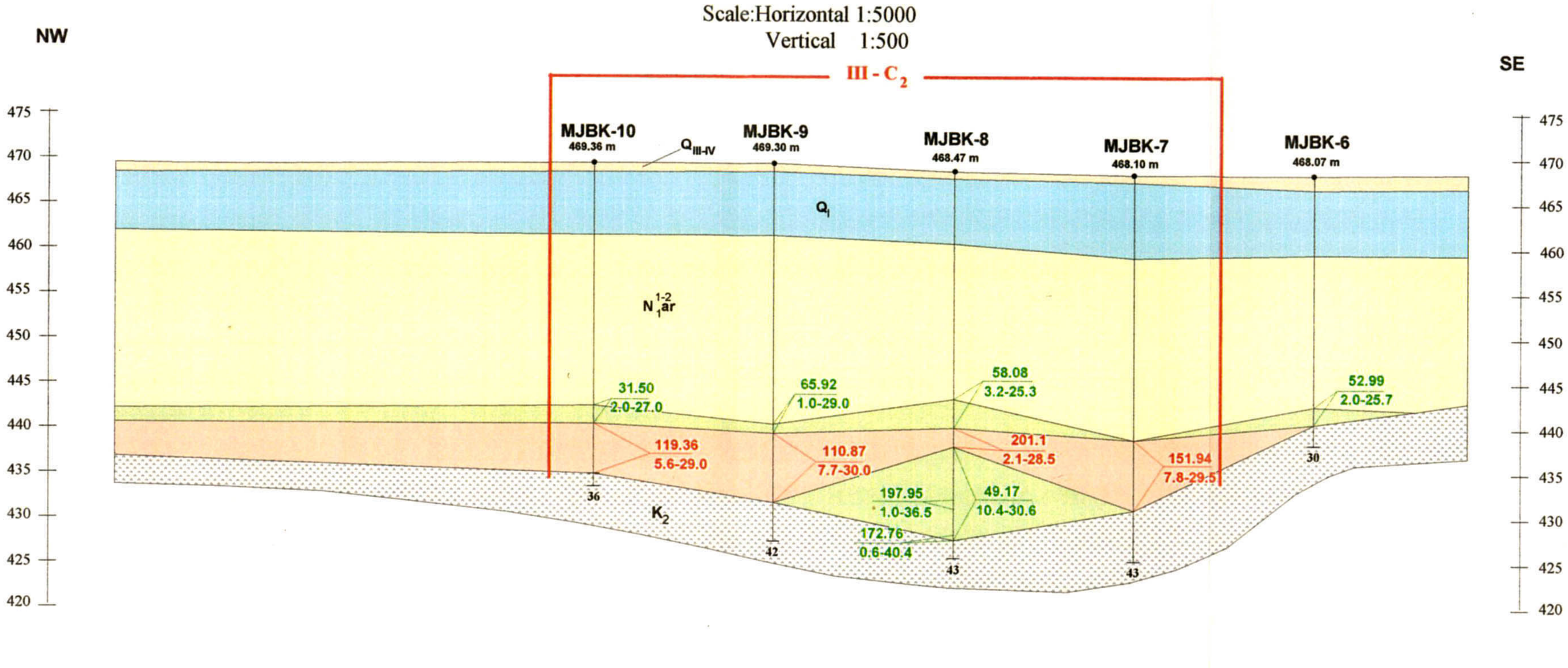


Fig. II-3-3 Geologic Cross Section along MJBK-1, 2, 3, 4 and 5 (Line-38)



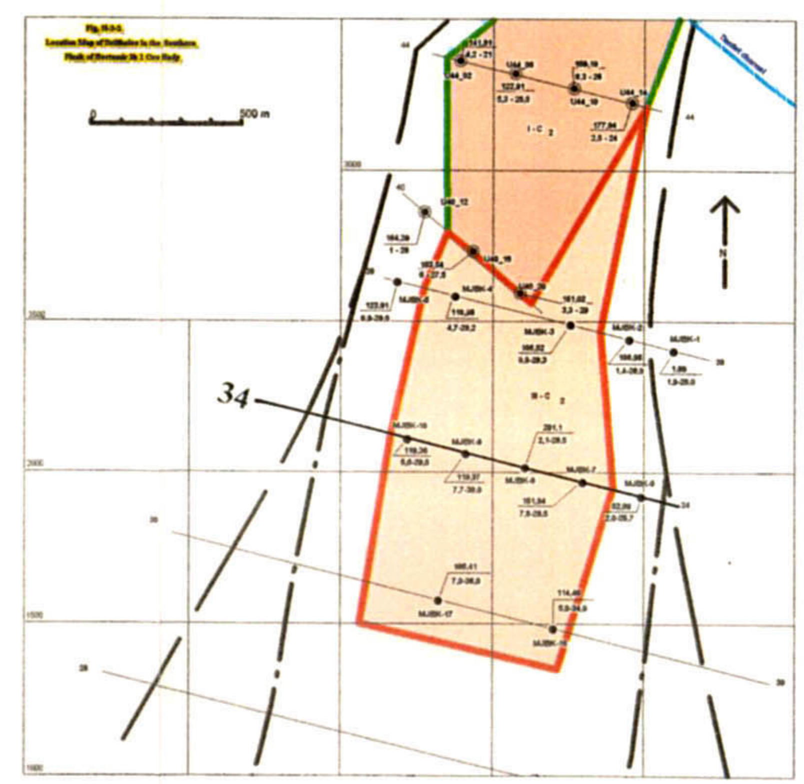


Fig. II-3-4 Geologic Cross Section along MJBK-6, 7, 8, 9, and 10 (Line-34)

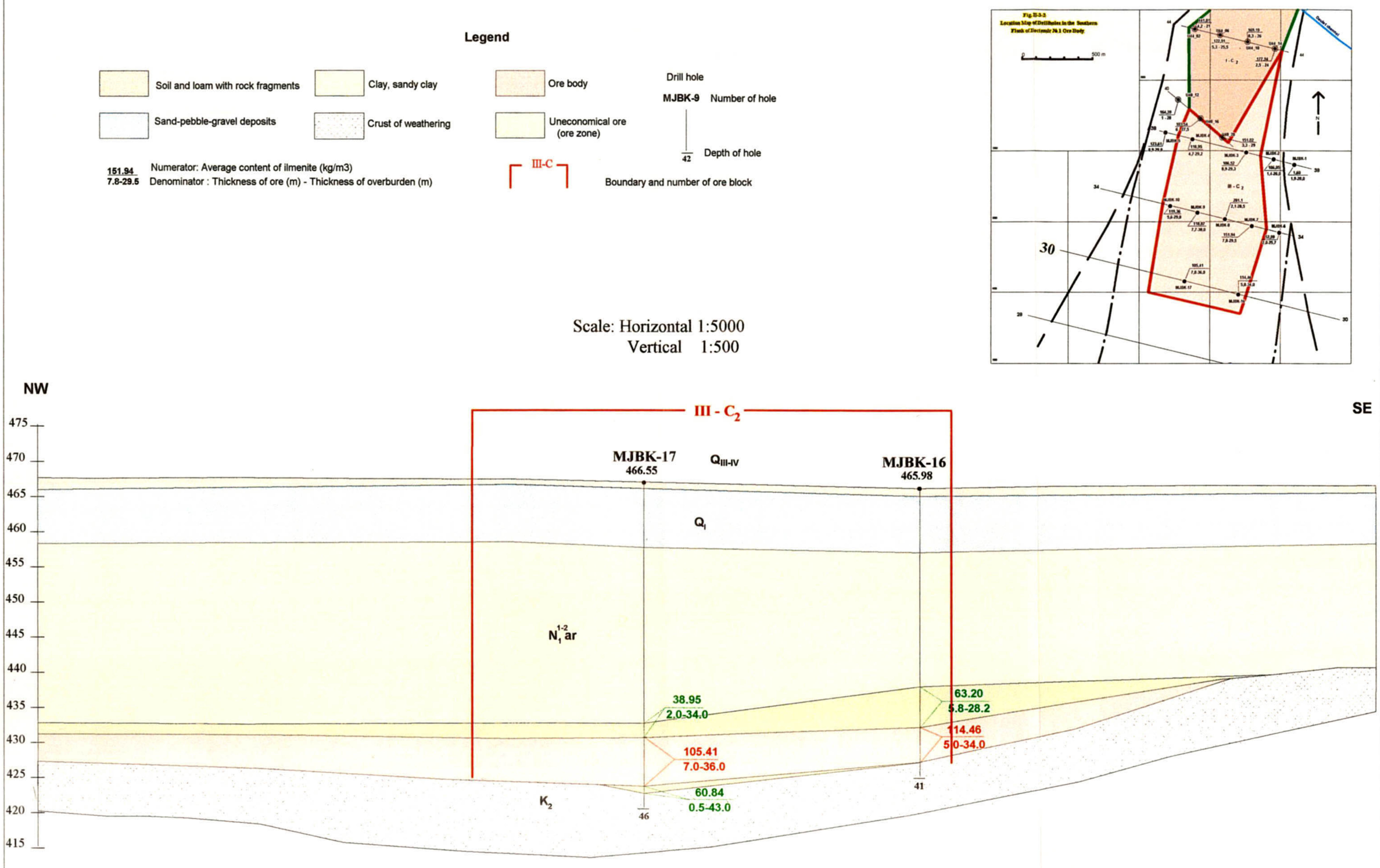


Fig. II-3-5 Geologic Cross Section along MJBK-16 and 17 (Line-30)

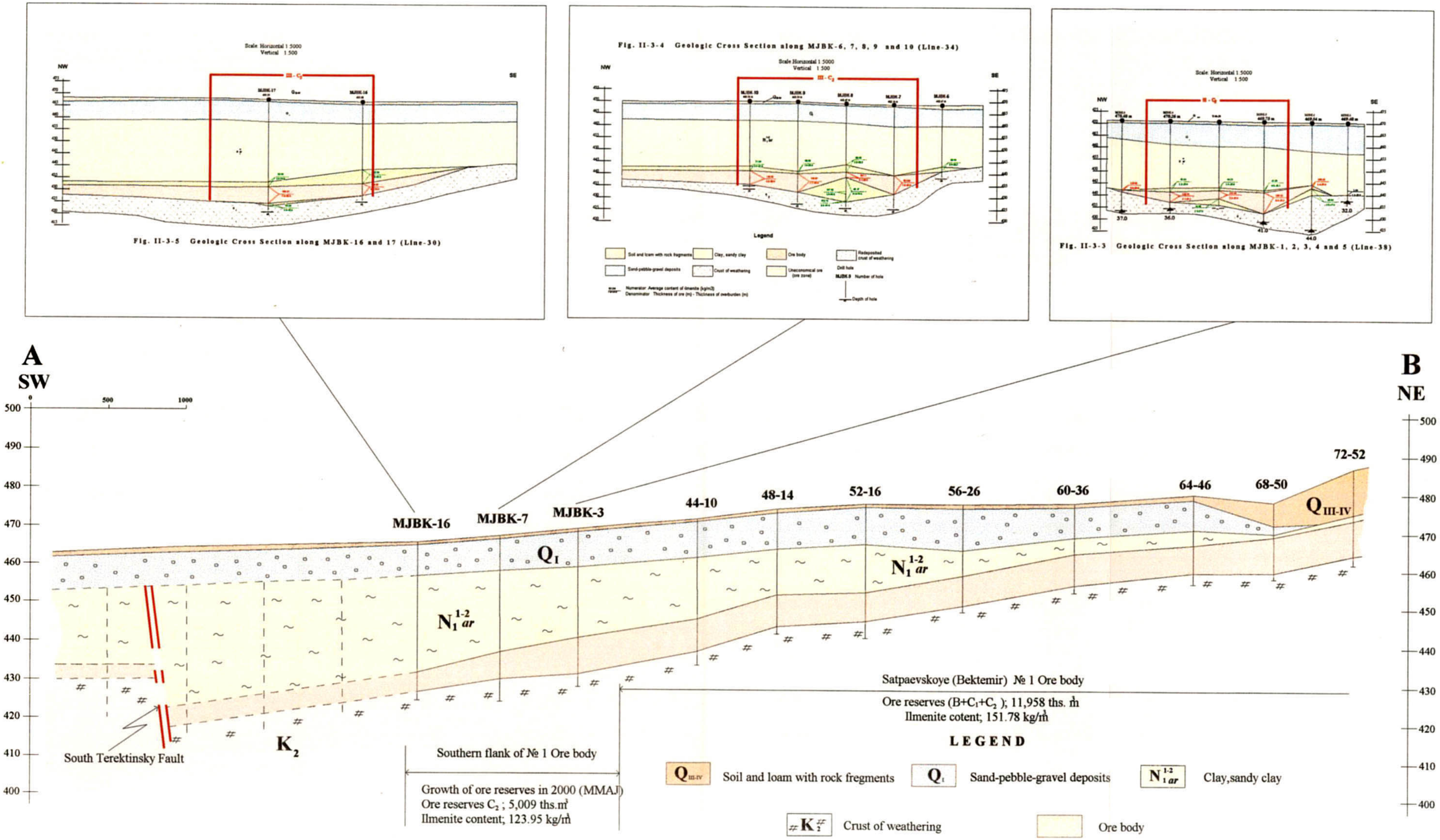


Fig. II-3-6 Longitudinal Section along Satpaevskoye (Bektemir) № 1 Ore body

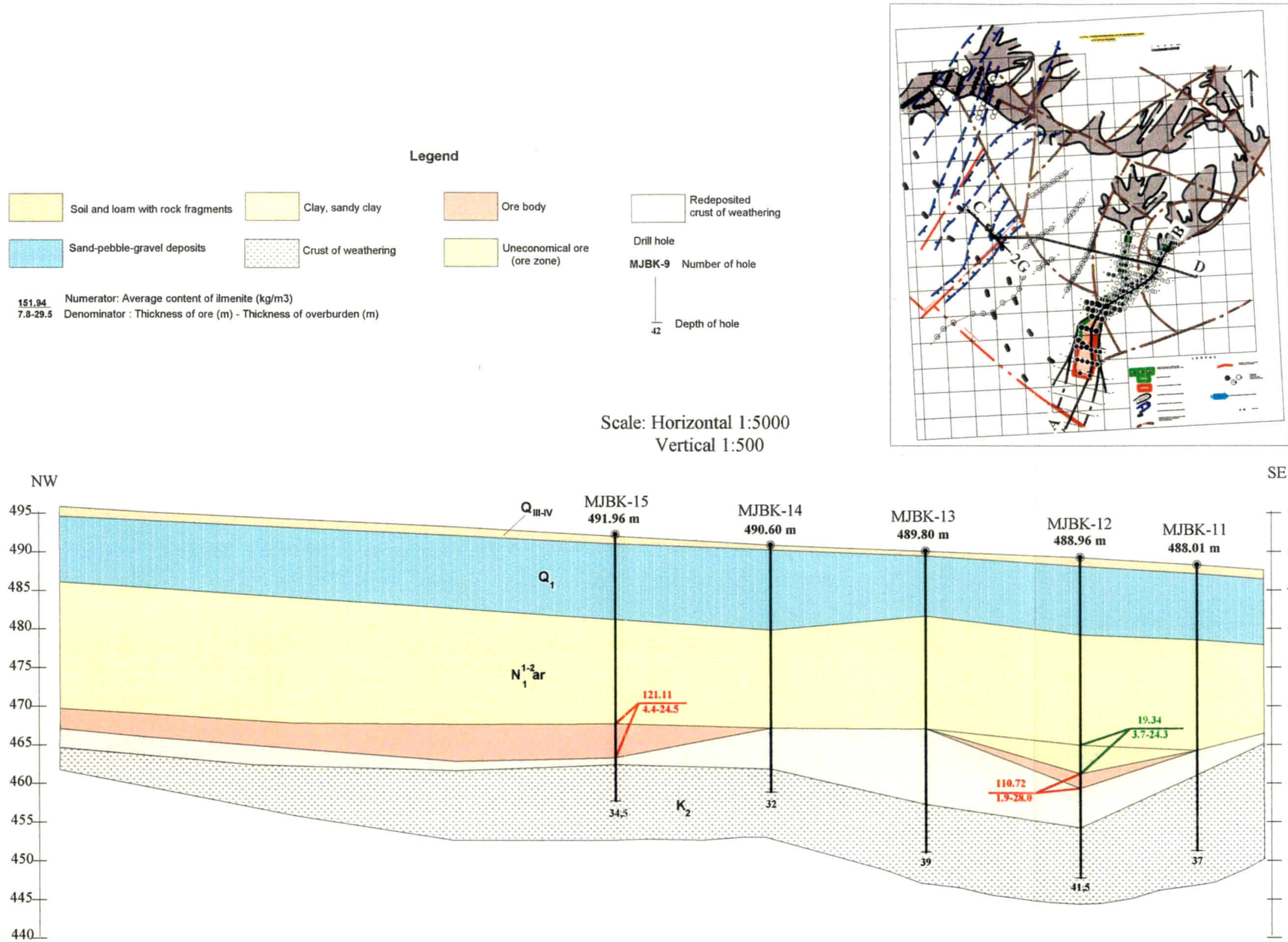


Fig. II-3-7 Geologic Cross Section along MJBK-11, 12, 13, 14 and 15 (Line-2G)

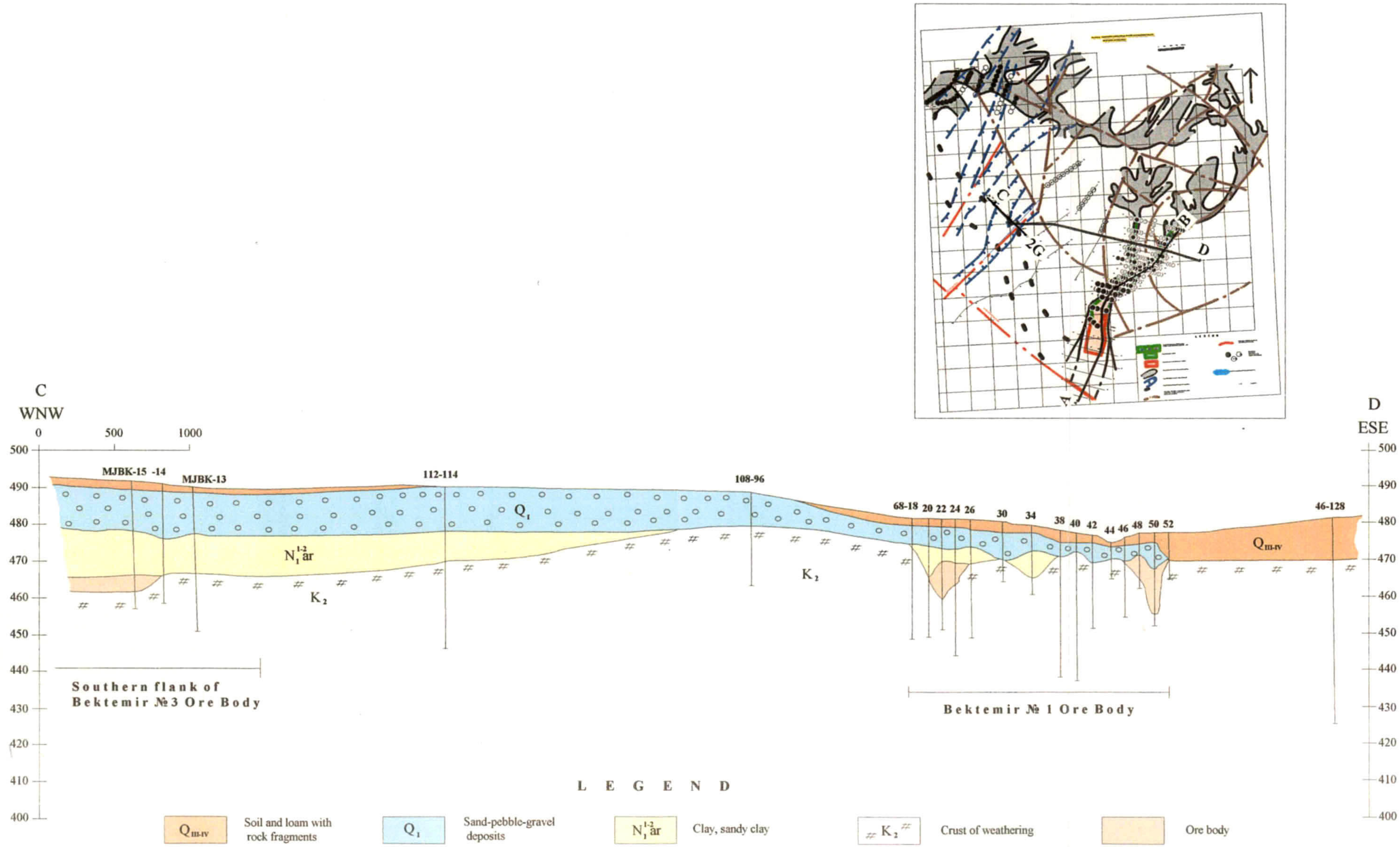


Fig. II-3-8 Geological Cross Section between the Bektemir №1 Ore Body and the Southern Flank of the Bektemir №3 Ore

PART III

Conclusions and

Recommendations for the Future Survey

Chapter 1 Conclusions

1-1 Geological Survey

1) Geology

The formations in the survey area consist of the Paleozoic basement rocks and the Neogene to Quaternary rocks of the Cenozoic age.

(1) Paleozoic basement rocks

The basement rocks are composed of the Carboniferous sedimentary rocks (shales, sandstones and conglomerates), pyroclastic rocks and lavas (andesite and porphyrites).

(2) Upper Cretaceous weathering crust

The weathering crusts are argillaceous weathering residuals developing over the Carboniferous sedimentary and volcanic rocks, and the intrusive rocks, and are overlain by the Neogene and Quaternary rocks. The thickness is generally 10 m to 20 m, reaching 50 m to 60 m in fracture zones.

The weathering crusts are intensively argillized (kaolinite, montmorillonite and illite).

(3) Neogene Aral Formation

The Formation unconformably overlies the basement rocks or their weathering crusts and underlies the Quaternary rocks. It is composed of clay, sandy clay and argillaceous sand, rarely intercalating pebbles. Ilmenite placers are embedded in sandy clay or argillaceous sand in the lower part of the Formation.

(4) Quaternary System

The System is composed of the Pleistocene gravel, loam, clay, aeolian sand and the Recent stream sediments.

(5) Igneous rocks

There lie Preobrazhenskiy intrusive, complex rock body and the Karaotkelskiy intrusive, complex rock body. The intrusive, complex rock bodies can be classified by intrusion time and rock facies, as follows:

- Upper Permian to the Lower Triassic: Gabbro, diorite and monzonite
- Middle to Upper Triassic: Syenite, diorite and granosyenite
- Lower to Middle Jurassic: Granite and granodiorite

Gabbro and monzonite have high contents of TiO_2, whereas granite and syenite are low in TiO_2 but high in ZrO_2. The Preobrazhenskiy rock body chiefly includes gabbroids and has high ilmenite contents.

2) Geologic structure

The ore field lies northwest of the Zaisan basin, located within the east Zharminskiy synclinorium zone. The north side of the ore field is bounded by the

Baladzhalskiy fault in the WNW-ESE direction, adjoing the west Kalbinskiy synclinorium zone.

The tectonic movement started in the Late Carboniferous to the Perminan time and presumably continued during the Paleogene time, to form the Maytuibinskaya and Terektinskaya graben-synclines in the WNW-ESE direction and, in between them, the Bektemirskaya horst-anticline. The Bektemirskaya horst-anticline is accompanied by intrusive, complex rock bodies and served as the source of detritus and ilmenite that flowed into the graben-synclines.

The faults in the NE-SW direction cut the intrusive complex rock bodies and the Carboniferous rocks to form valleys along the fracture zone of the faults, where the ilmenite placers were emplaced.

(3) Ore deposit

The ore bodies are ilmenite placers emplaced in the Neogene Aral Formation, lying in the Bektemir district, Karaotkel district and the North Bektemir district.

The ilmenite placers are embedded in sandy clay and argillaceous sand of the Lower Formation of the Neogene Aral Formation. From the features, it is argillaceous but includes no gravels. The Aral Formation is inferred to be lacustrine sediments deposited in old valleys submerged as the old Lake Zaisan expanded.

Ilmenite of the Bektemir deposit is considered to derive from plutonic rocks of the Preobrazhenskiy intrusive rock body. The concentration of ilmenite in weathering residuals and the subsequent formation of the placers are ascribable especially to the high ilmenite contents in gabbro and monzonite.

1-2 Drilling Survey

1) Southern flank of the Placer No.1

Over 1 km from the south side of the ore blocks with confirmed ore reserves of the C_2 category, the drilling survey was carried out 12 drillholes, totaling 471 m, in the 500m x 200m grid and on the three prospecting lines (Lines-38, 34 and 30).

The placer deposited on the riverbed of old valleys. The ore body intersected by the drilling is 2.1 m to 8.9 m thick, grading 105.41 to 201.10 kg/m^3 of ilmenite, while zircon contents are as low as 0.5 to 3.4 kg/m^3.

There is a tendency that the ore body increases in width and volume southward, whereas the grade of ore sand declines and the overburden volume increases.

The ore reserves of the C_2 category additionally acquired by the Phase I exploration are estimated as follows:

Cutoff criteria: 70 kg/m^3 or more on the hanging wall side and 100 kg/m^3 or more on the footwall side; or,
2.0m x 100 kg/m^3 or more, whichever be greater.

Ore reserves: 5 million kg/m^3
Ilmenite content: 621,000 t
Ilmenite average grade: 124 kg/m^3
Stripping ratio: 5.38 m^3/m^3

In view of the above ilmenite contents and the stripping ratio, the ore body is economically exploitable by open-pit mining, under the Kazakh standards (ex-C.C.C.P. standard).

2) Southern flank of the Placer No.3

On the Line-2G, five drillholes were carried out at intervals of 200 m, totaling 184 m. At two of the five drillholes (MJBK-12 and -15), ilmenite mineralization exceeding the cutoff criteria was ascertained. The drillhole MJBK-12 intersected the ore body of 1.9 m in thickness, averaging 110.72 kg/m^3 of ilmenite, while drillhole MJBK-15 intersected that of 4.4 m, averaging 121.11 kg/m^3. The depths of the ore body for drillholes MJBK-12 and MJBK-15 are 28.0 m and 24.5 m, respectively.

As regards to the sedimentary environment of the ilmenite ore body intersected by the drilling, two hypotheses are conceivable. The first one holds that the ore body is a placer depositing over the riverbed of old valleys controlled by the fracture zones. Based on this hypothesis, the seized mineralization is interpreted to have deposited in the two valleys controlled by the Bektemirskiy fault zone in the NE-SW direction.

The second one holds that it is a placer depositing over the sublacustrine flattened surface. According to the hypothesis, the drilling that intersected the ore body is considered to have seized the northeastern edge of the NW-SE ore body extending from the west side of the Placer No.3 to the south side of the Placer No.1.

It is therefore essential in drawing future prospecting lines to verify the directions of placer deposits in the area.

Chapter 2 Recommendations for Phase II Survey

From the Phase I survey findings, guiding principles for further exploration of the ore deposits have been drawn out, as discussed in the following paragraphs.

Concerning the genesis of ilmenite placer deposits in the survey area, it is interpreted that the source rocks such as gabbro and monzonite which have high TiO_2 content are present in the background, and two hypotheses of the sedimentary environment are possible as follows:

A. Placers depositing on the riverbeds of old buried valleys controlled by fracture zones; and,

B. Placers depositing on the sub-lacustrine flattened surface

Based on these hypotheses, drilling is an effective means for investigating extensions of the known ore deposits whilst, in totally unexplored areas, it is considered effective to grasp the underground structure such as the old buried valleys by methods such as geophysical prospecting.

The exploration plans for Phase II for the respective districts are summarized as follows:

1) Bektemir district

(1) Southern flank of the Placer No.1

It is necessary to implement additional drilling to confirm the southern limit and the widths of the Placer No.1, and to estimate ore reserves of the southern flank of the Bektemir Placer No.1. The drilling should be conducted while considering the depths of economically minable ore, as the thickness of overburden increases southward.

(2) Southern flank of the Placer No.3

Drilling is needed for determining the direction of the ore body ascertained in Phase I. Since it remains unknown whether hypothesis A or B is applicable to the mineralization seized in Phase I, it is necessary to implement drilling either on NE-SW prospecting lines passing through the MJBK-15 and -12 that intersected the ore body and traversing the Lines-2G at right angles, or on prospecting lines parallel on the northeast and southwest side of Line-2G. In case of continuity between the western portion of the Placer No.3 and the southern portion of the Placer No.1 is anticipated, drilling will have to be done between the two portions.

2) Karaotkel district

According to the existing data, the ilmenite contents of the Karaotkel placer deposit are low while zircon contents are rather high. Further work will be limited to revaluation based on the existing data, because of the low priority of the field survey such as drilling compared with the other districts.

3) Northern Bektemir district

Analysis of the existing data revealed that occurrence of placers depositing on the old buried valleys originating from the Preobrazhenskiy intrusive rock body and on the sub-lacustrine flattened surface are expected in this district, as well. It is necessary to implement geophysical prospecting to ascertain the old buried valleys and lacustrine topography, and drilling survey at portions where ilmenite is inferred to be deposited.

The possibility of occurrence of placer deposits depends largely on the occurrence of the Preobrazhenskiy intrusive, complex rocks and the Karaotkelskiy intrusive, complex rocks that are the source rocks of ilmenite and zircon, and also on geologic structure. Therefore, it seems possible to extract promising exploration targets of ilmenite if occurrence of these intrusive rocks is clarified by detailed geological survey in areas covering the North Bektemir, Bektemir and Karaotkel districts.

It is also conceivable to apply geophysical survey which are considered effective for extracting old buried valley topography, for grasping ilmenite-bearing geologic structure.

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Collected Data

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