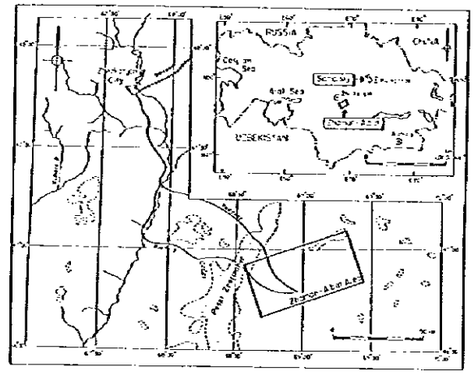
Plate 7-1

Report on the Mineral Exploration
in
the Zhaman-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase III)

Detailed Section of the Northern Orebody in the Zhaman-Aibat Ore Deposit (along the line DH314 - DH278)



Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 500 (Vertical)

0 10 20 30 40 50m

Scale 1 : 2,000

0 100 200m

LEGEND

1. Depth of occurrence of bottom of orebody
2. Thickness, m
3. Copper grade, %; 4. Lead grade, %;
5. Zinc grade, %;

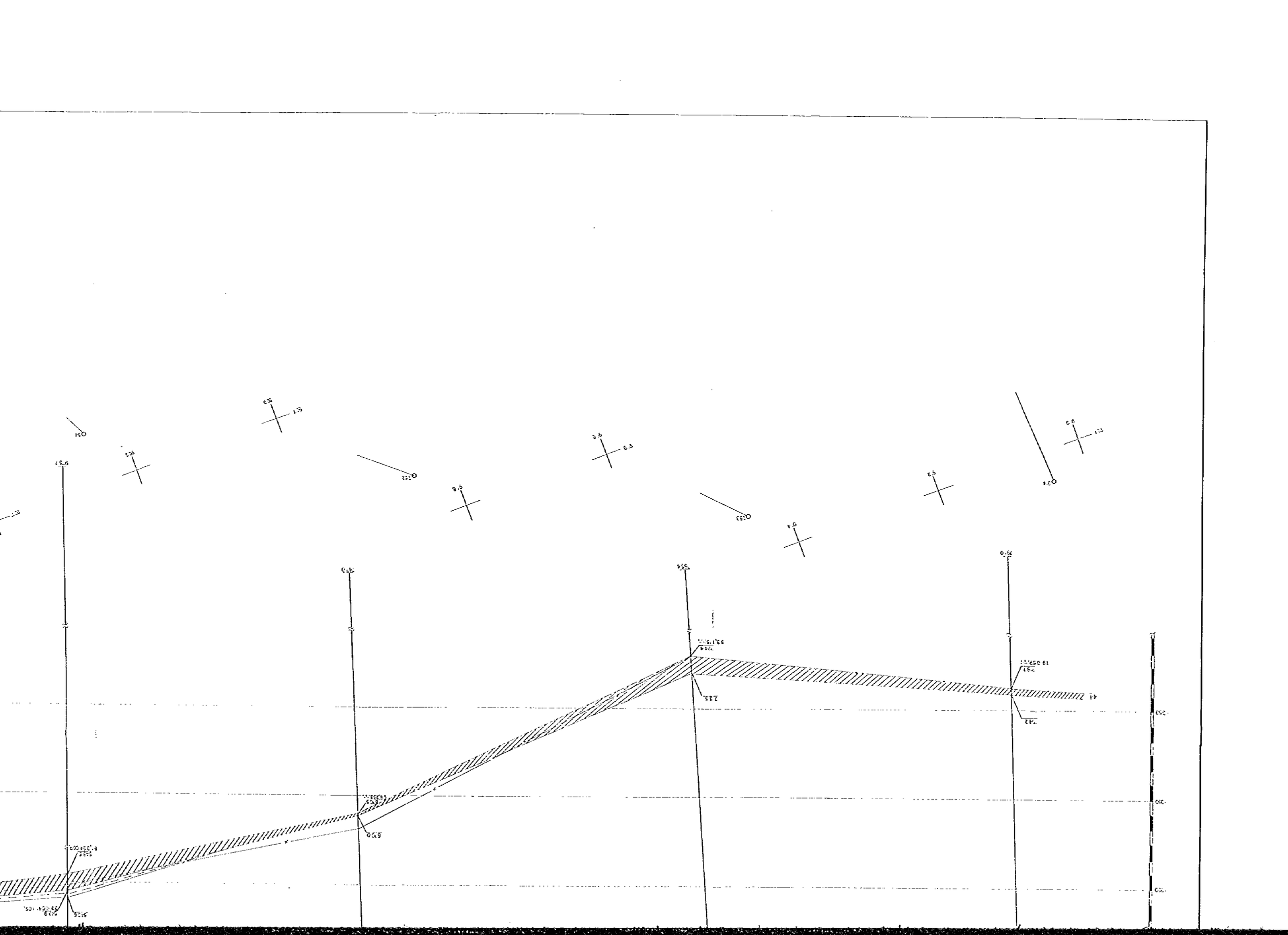
Copper ore : 1. balance
2. off-balance

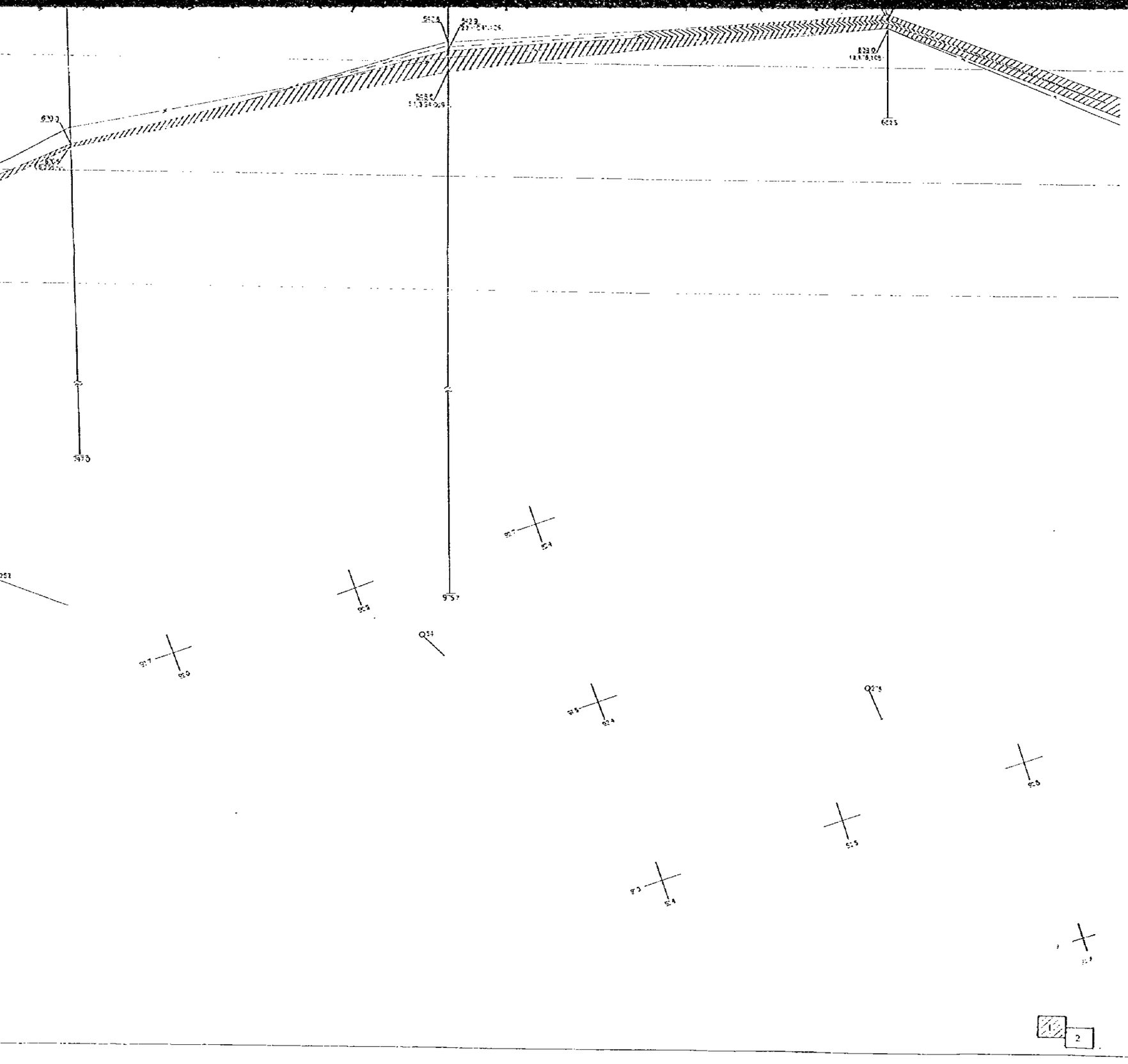
Complex ore : 1. balance
2. off-balance

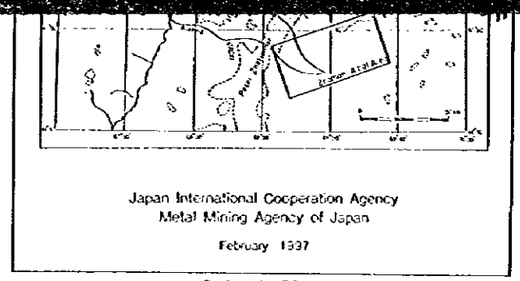
Lead ore : 1. balance
2. off-balance

Zinc ore : 1. balance
2. off-balance

Lead-zinc off-balance ore







Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 500 (Vertical)

0 10 20 30 40 50m

Scale 1 : 2,000

0 100 200 m

LEGEND

1. Depth of occurrence of bottom of orebody
2. Thickness: m
3. Copper grade, %; 4. Lead grade, %;
5. Zinc grade, %;

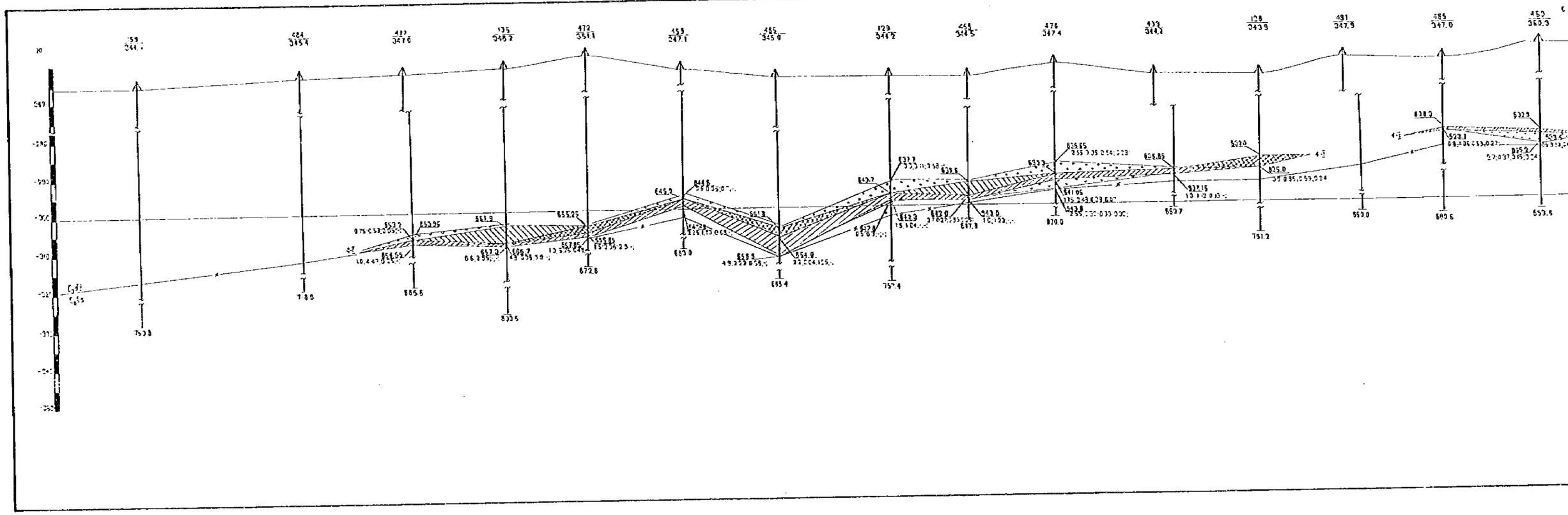
Copper ore : 1. balance
2. off-balance

Complex ore : 1. balance
2. off-balance

Lead ore : 1. balance
2. off-balance

Zinc ore : 1. balance
2. off-balance

Lead-zinc off-balance ore



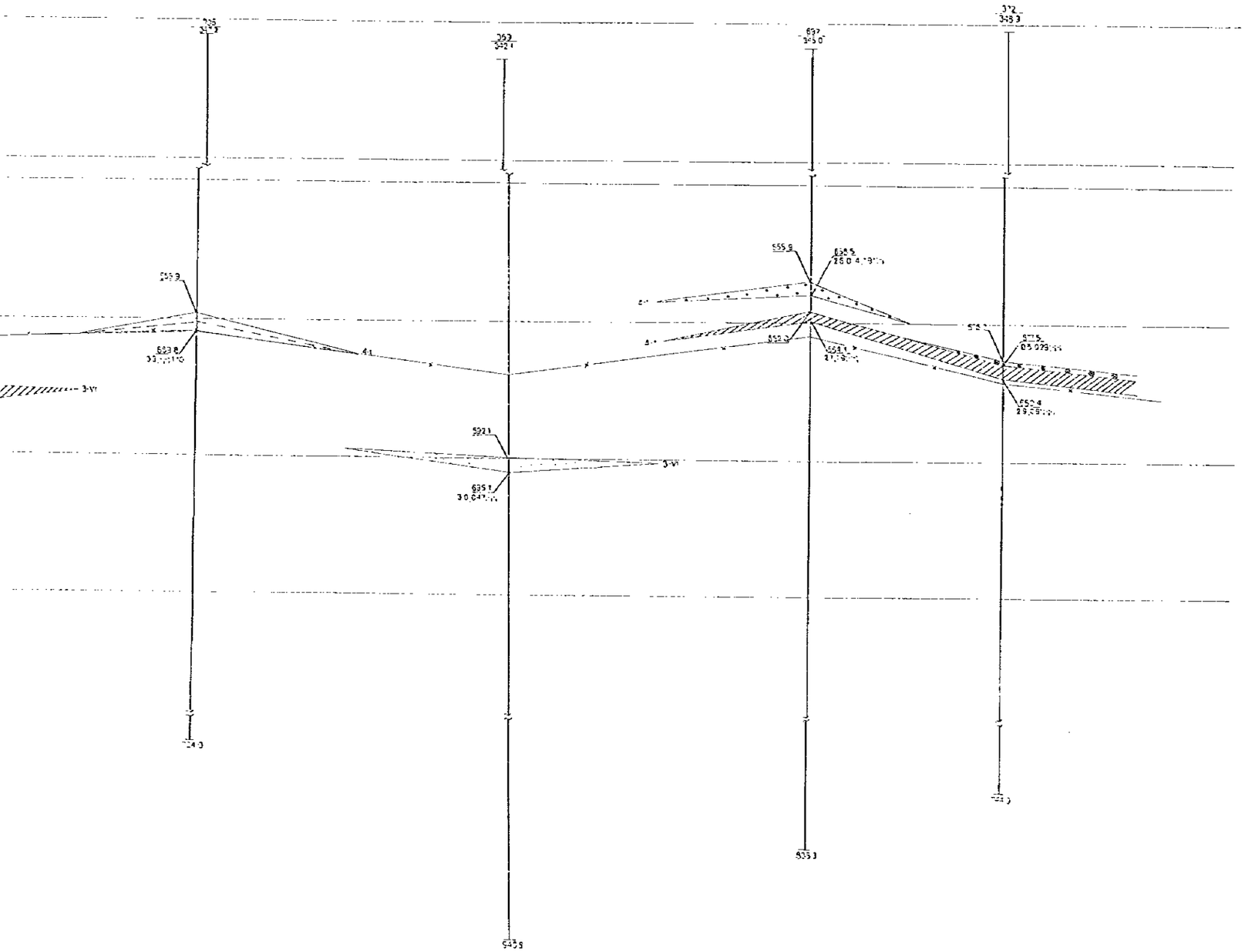
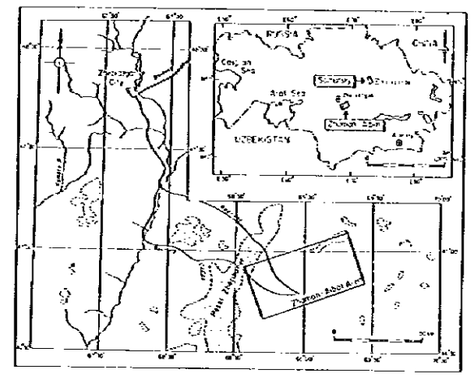


Plate 7-2

Report on the Mineral Exploration
in
the Zhaman-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase III)

Detailed Section of the Northern Orebody in the Zhaman - Aibat Ore Deposit (along the line DH83 - DH372)



Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 500 (Vertical)

0 10 20 30 40 50m

Scale 1 : 2,000

0 100 200 m

LEGEND

1. Depth of occurrence of bottom of orebody
2. Thickness, m
3. Copper grade, %; 4. Lead grade, %;
5. Zinc grade, %;

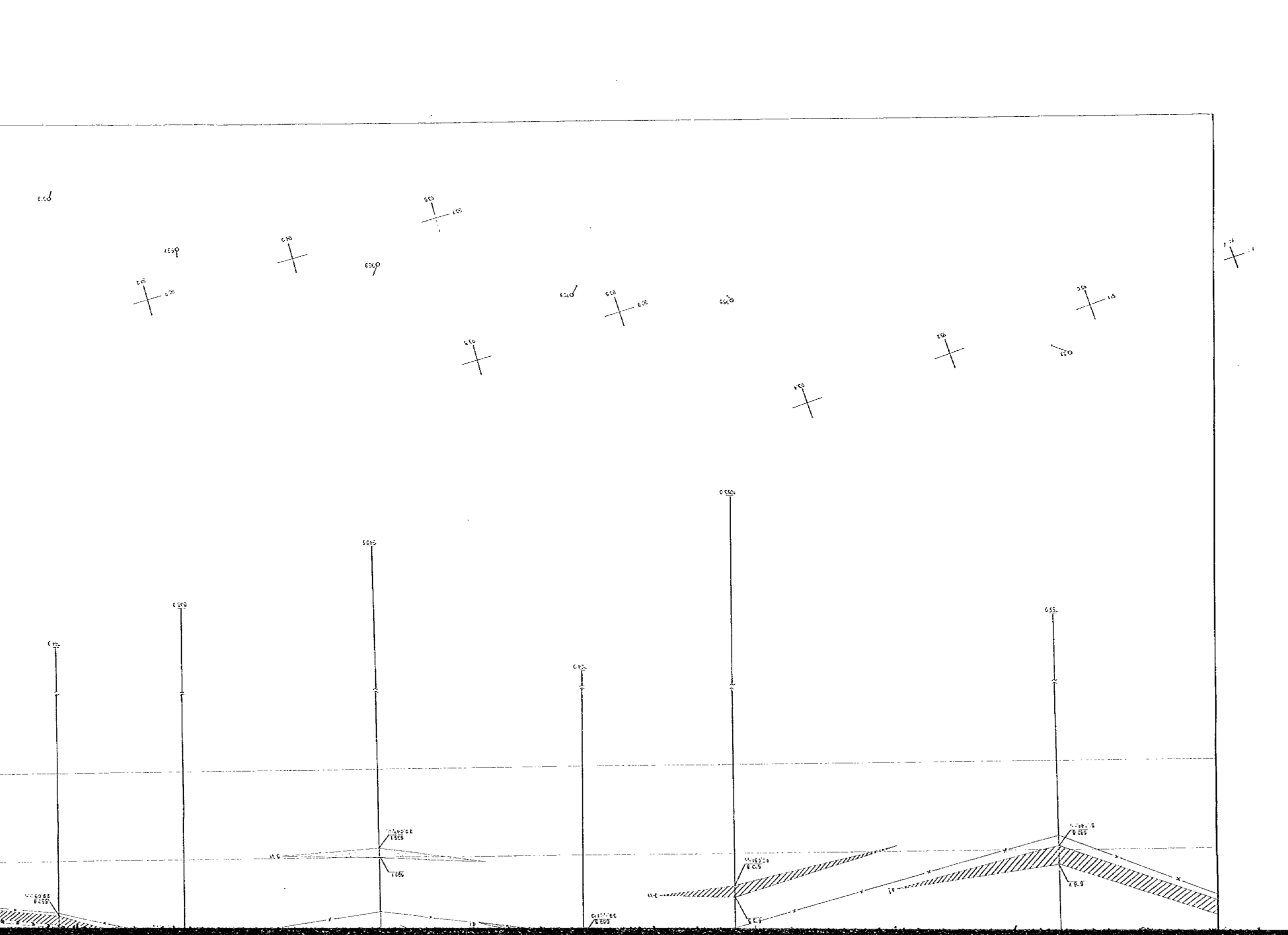
Copper ore : 1. balance
2. off-balance

Complex ore : 1. balance
2. off-balance

Lead ore : 1. balance
2. off-balance

Zinc ore : 1. balance
2. off-balance

Lead-zinc off-balance ore



Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 500 (Vertical)

0 10 20 30 40 50m

Scale 1 : 2,000

0 100 200m

LEGEND

1. Depth of occurrence of bottom of orebody
2. Thickness, m
3. Copper grade, %; 4. Lead grade, %;
5. Zinc grade, %;

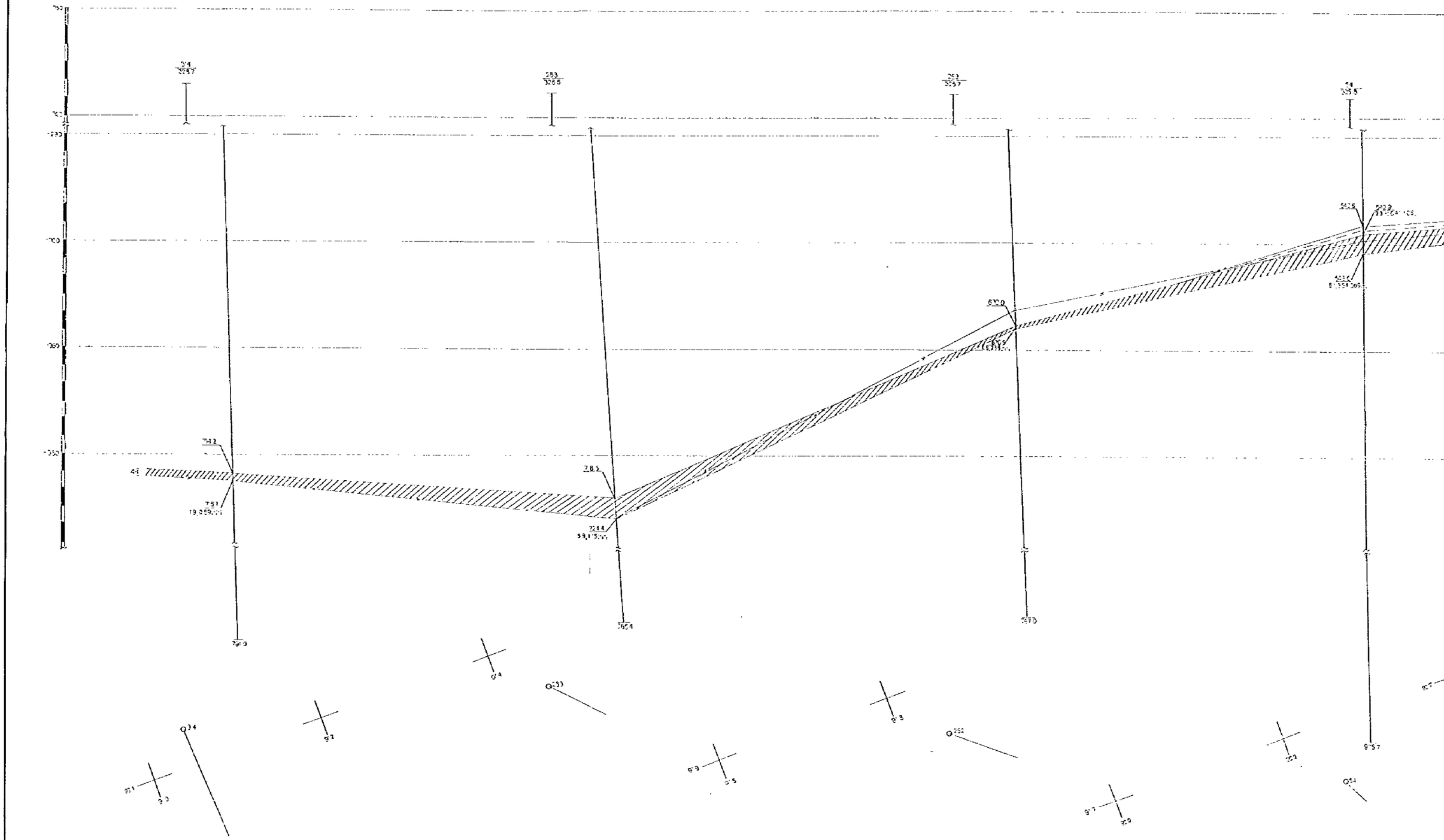
Copper ore : 1. balance
2. off-balance

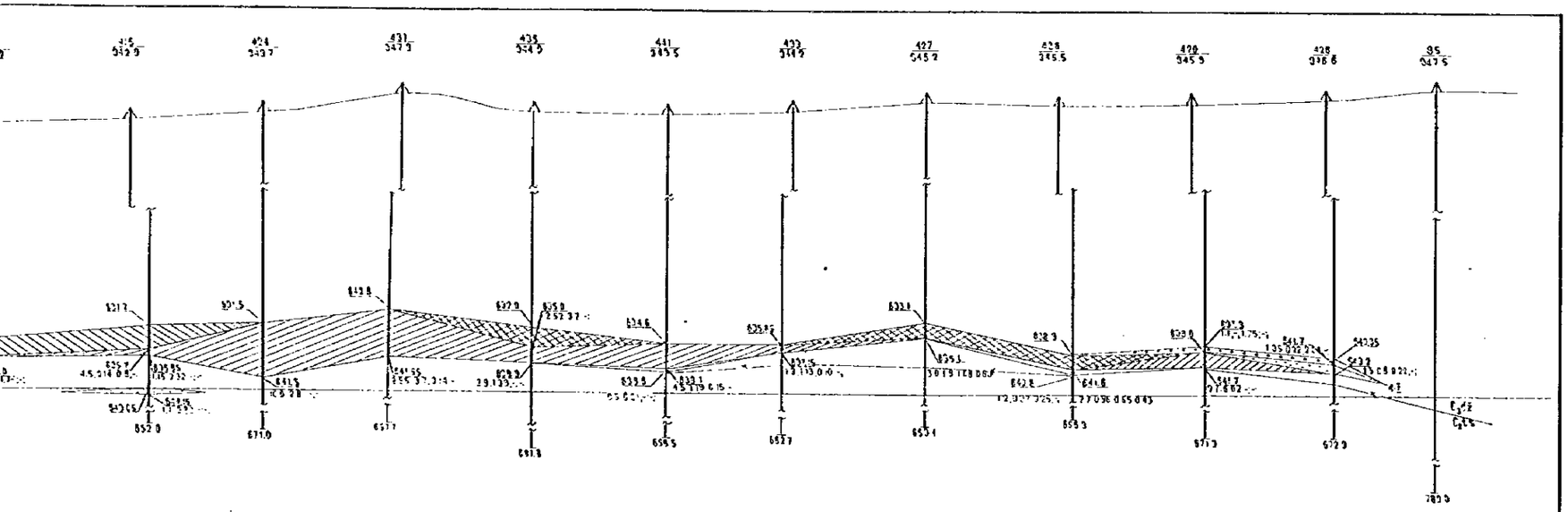
Complex ore : 1. balance
2. off-balance

Lead ore : 1. balance
2. off-balance

Zinc ore : 1. balance
2. off-balance

Lead-zinc off-balance ore





LEGEND

1. Depth of occurrence of bottom of orebody
2. Thickness m
3. Copper grade, %;
4. Lead grade, %;
5. Zinc grade, %;

Copper ore : 1. balance 2. off-balance

Complex ore : 1. balance 2. off-balance

Lead ore : 1. balance 2. off-balance

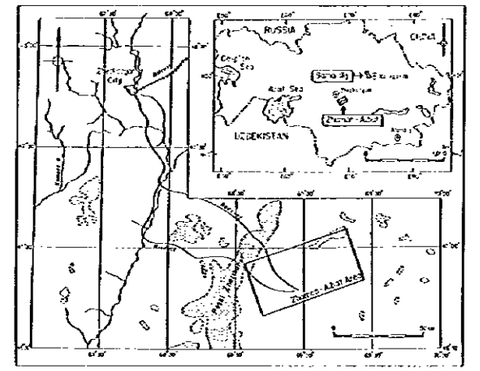
Zinc ore : 1. balance 2. off-balance

Lead-zinc off-balance ore

Plate 8

Report on the Mineral Exploration
in
the Zhaman-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase III)

Detailed Section of the Central Orebody in the Zhaman-Aibat Ore Deposit (along the line DH729-DH95)



Japan International Cooperation Agency
Metal Mining Agency of Japan

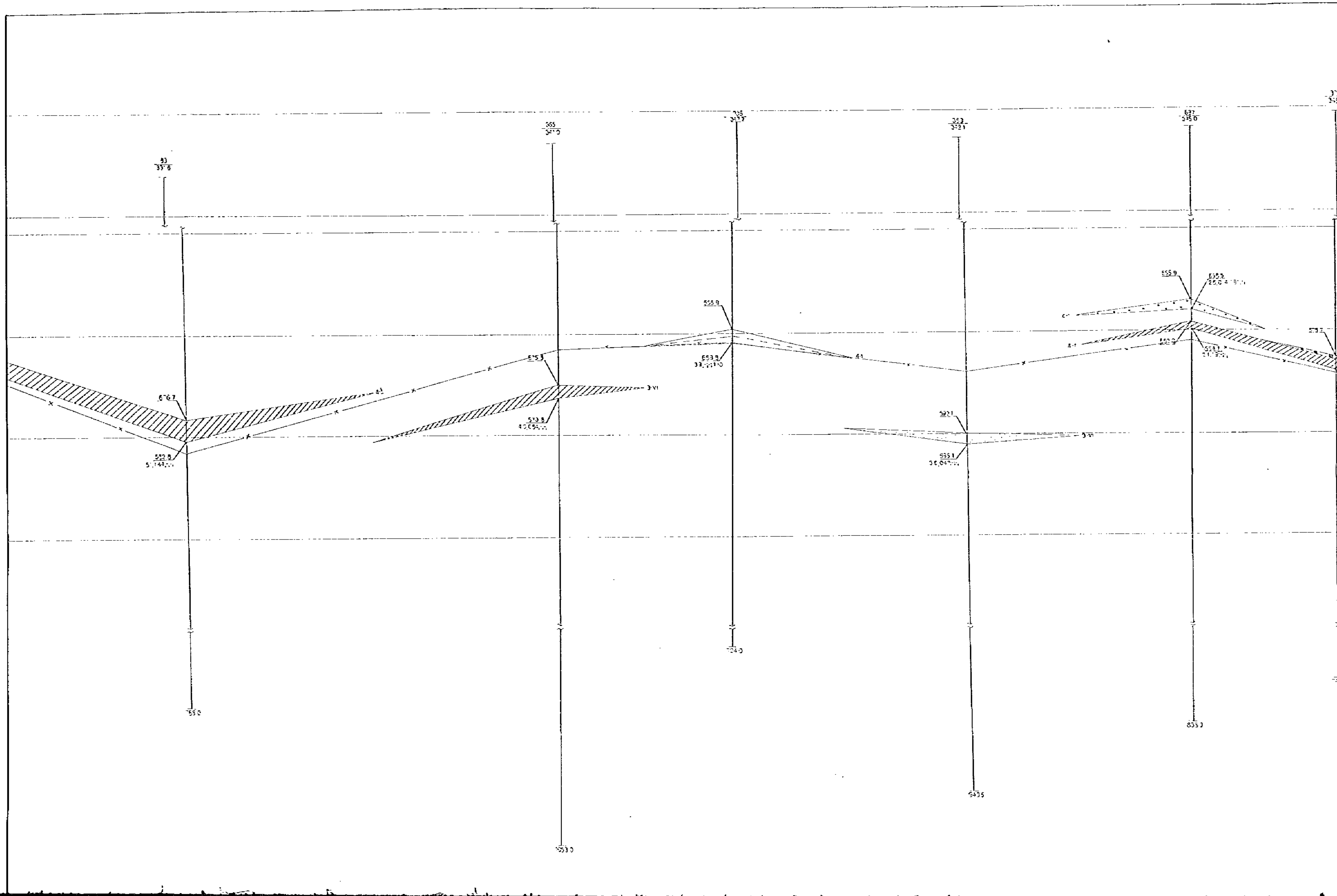
February 1997

Scale 1 : 500 (Vertical)

0 10 20 30 40 50m

Scale 1 : 2,000

0 100 200 m



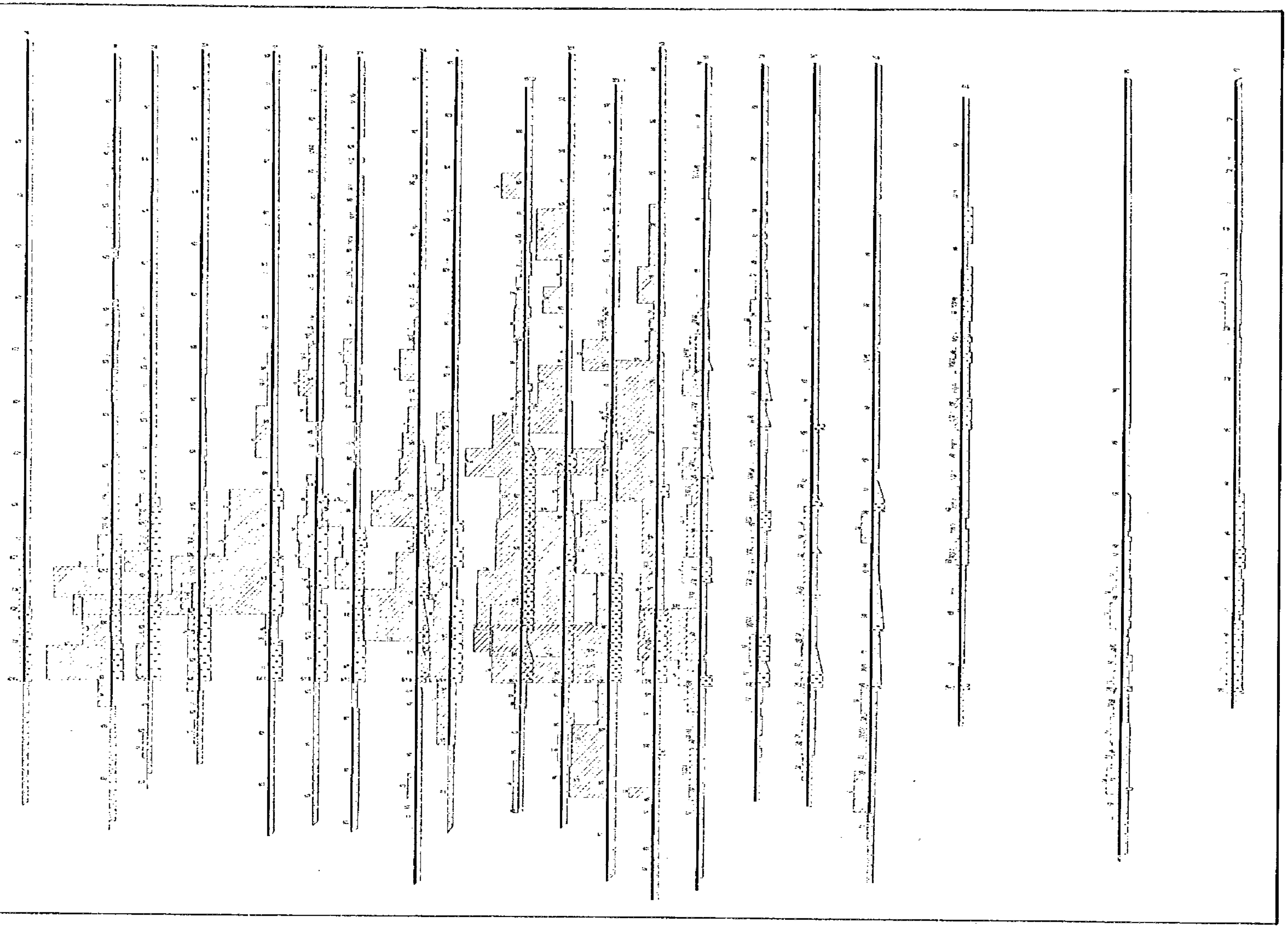
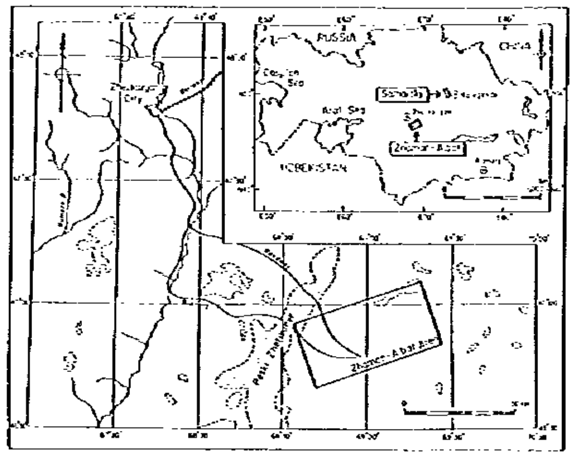


Plate 9

Report on the Mineral Exploration
in
the Zhaman-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase III)

Lithostratigraphic Units of Raimundo Conglomerates and Ore Grade in the Eastern Orebody (along the line DH67 - DH507)



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Metal Mining Agency of Japan

February 1997

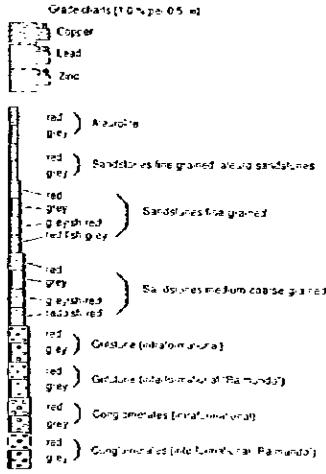
Scale 1 : 40 (Vertical)

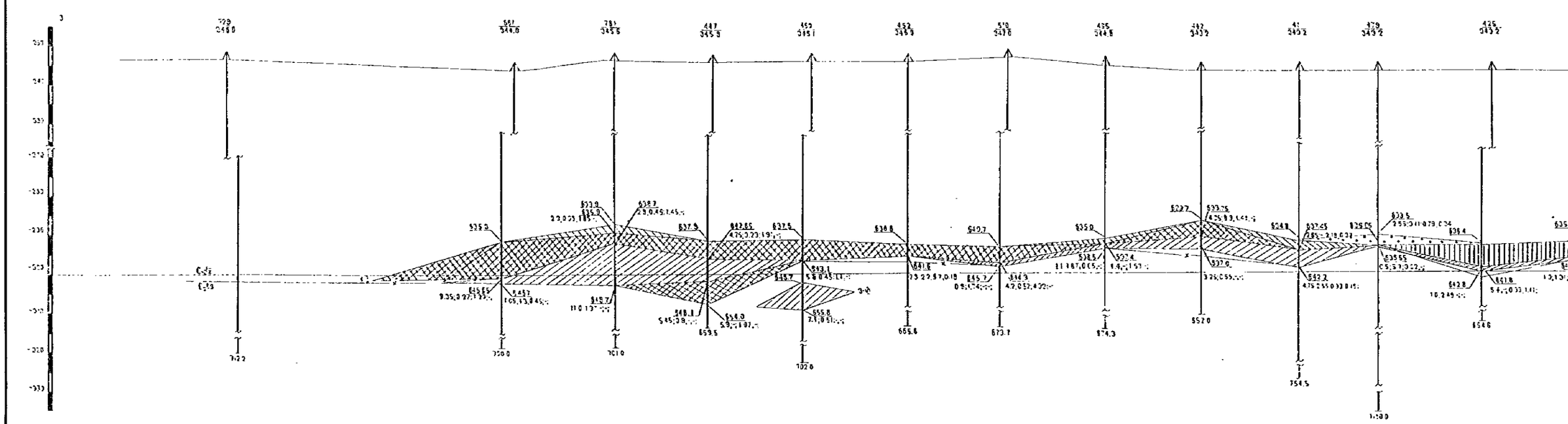
0 1 2 3 4 m

Scale 1 : 4,000

0 100 200 300 400 m

LEGEND





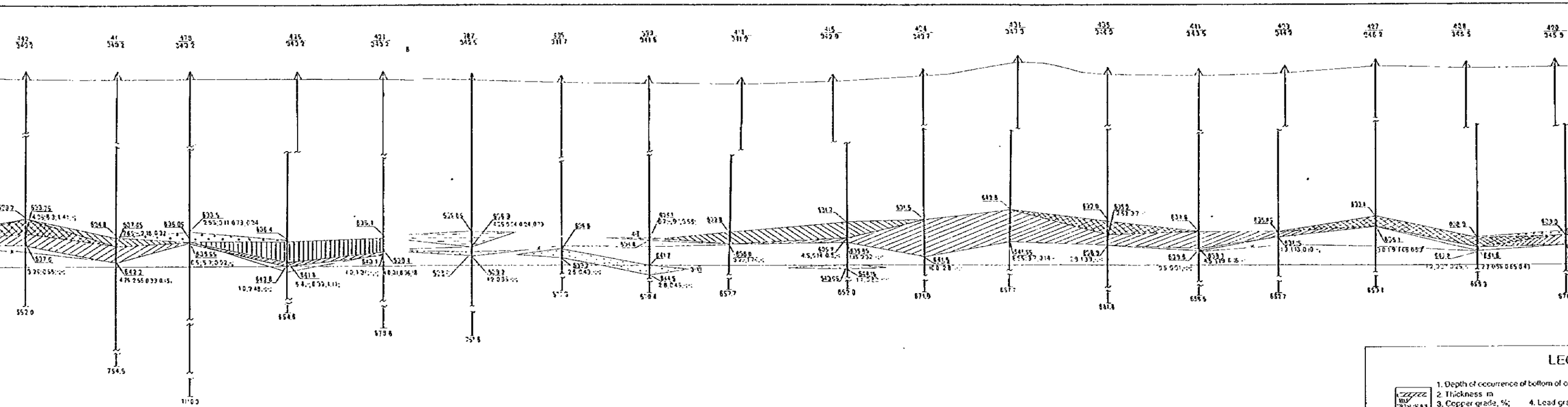
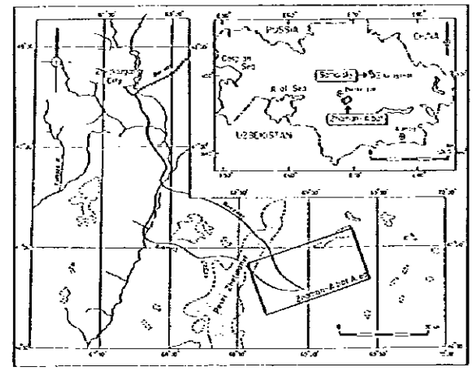

LEG
1. Depth of occurrence of bottom of o
2. Thickness m
3. Copper grade, %;
4. Lead gra
5. Zinc grade, %;
Copper ore : 1. balance
2. off-balance
Complex ore : 1. balance
2. off-balance

Plate 10

Report on the Mineral Exploration
in
the Zhoman-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase II)

Lithostratigraphic Units of Raimundo Conglomerates and Ore Grade in the Central Orebody (along the line DH447 - DH95)



Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 40 (Vertical)

0 1 2 3 4 m

Scale 1 : 4,000

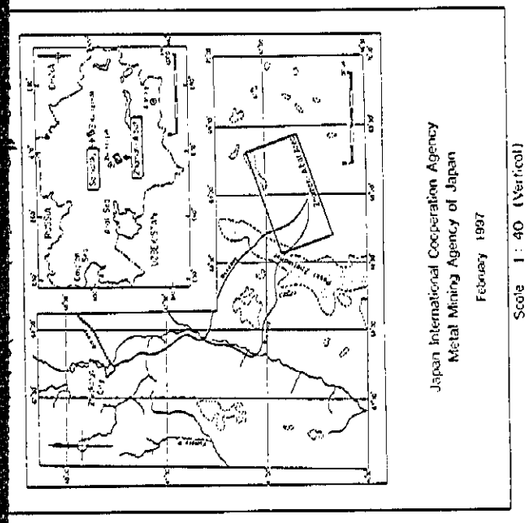
0 100 200 300 400 m

LEGEND

Grade charts (1% per 0.5 m)

- Copper
- Lead
- Zinc

- red / grey — Aleurolite
- red / grey — Sandstones fine grained as via sandstones
- red / grey / grey striped / reddish grey — Sandstones fine grained
- red / grey / grey striped / reddish grey — Sandstones medium to coarse grained
- red / grey — Gritstones (not deformation)
- red / grey — Gritstone (pre-formation of Raimundo)
- red / grey — Conglomerates (not deformation)
- red / grey — Conglomerates (pre-formation of Raimundo)



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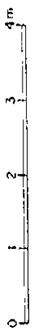
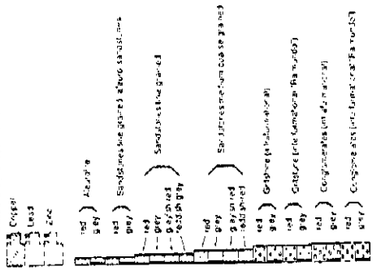
Metal Mining Agency of Japan
February 1997

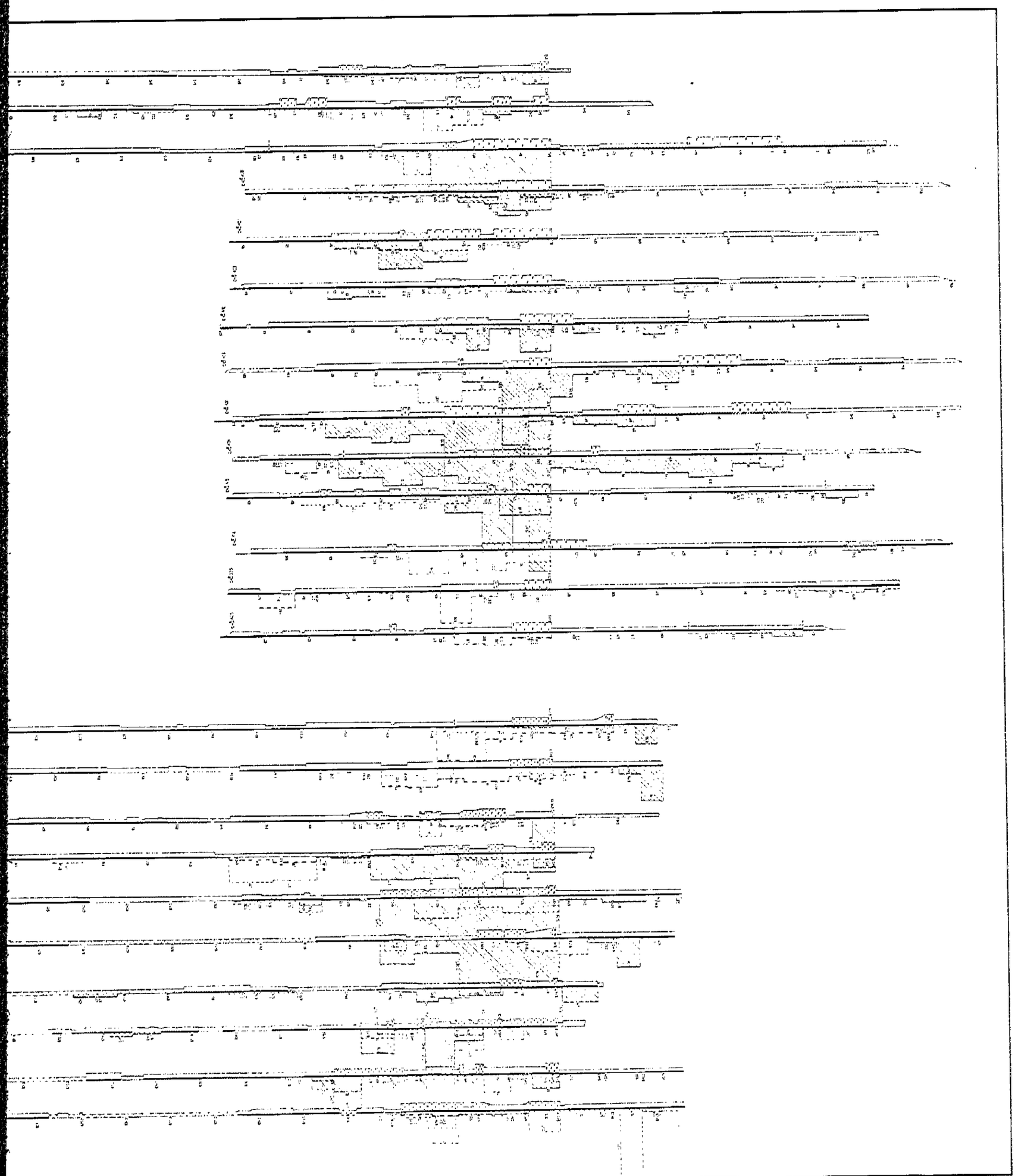
Scale 1 : 40 (Vertical)



Scale 1 : 4,000

LEGEND





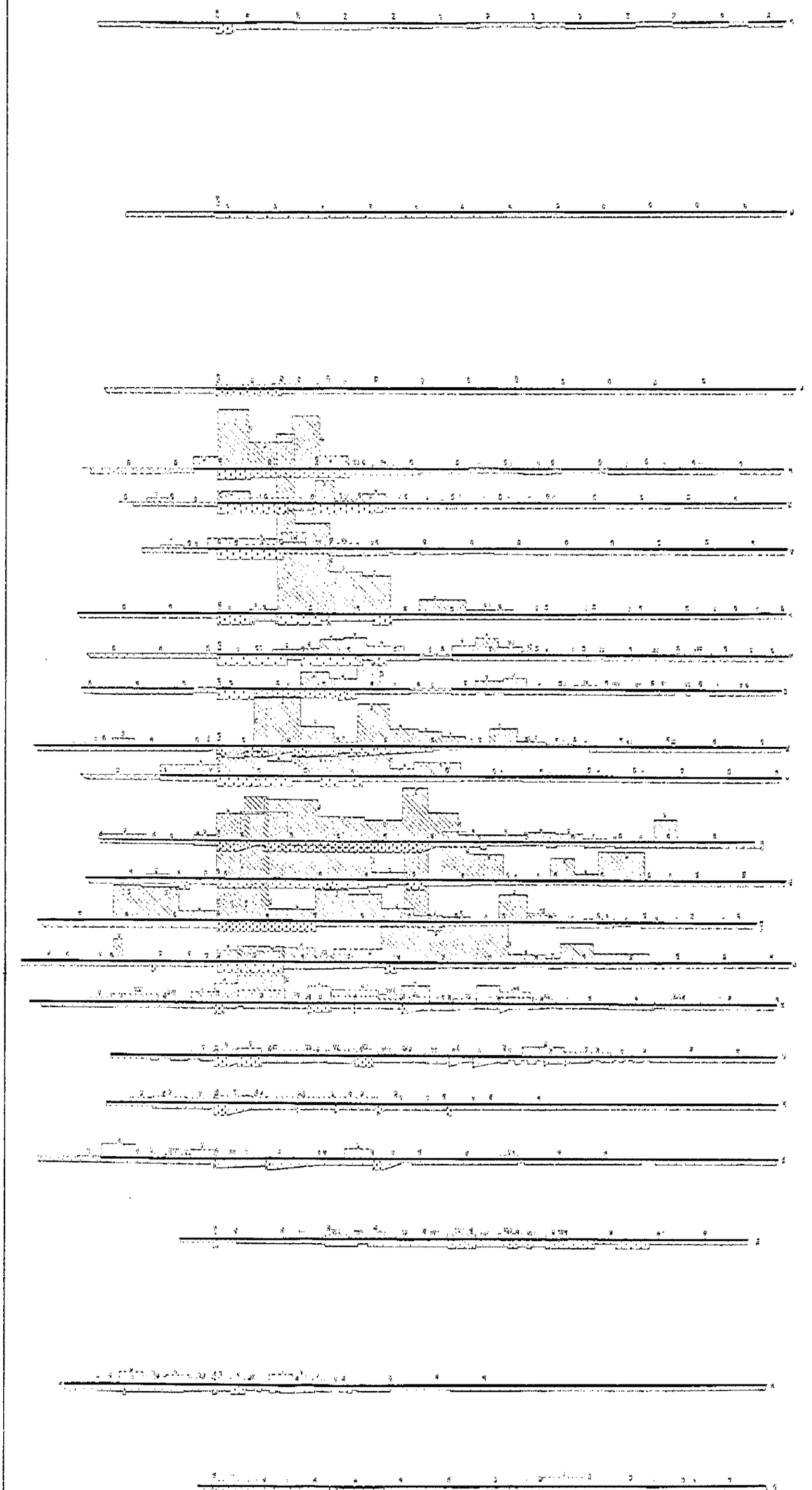
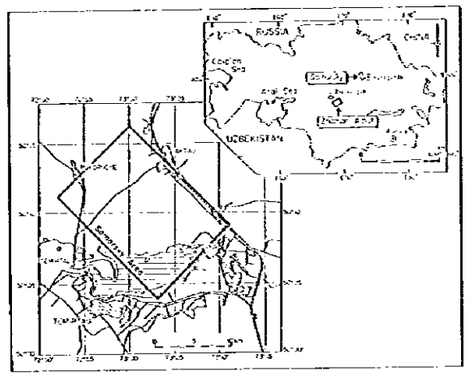


Plate II

Report on the Mineral Exploration
in
the Zhamai-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase III)

Detailed Geological Map of the Central Cu - Mo Deposit in the Samarsky Area

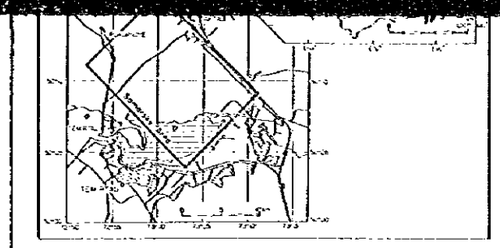


Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 2,000

0 100 200m



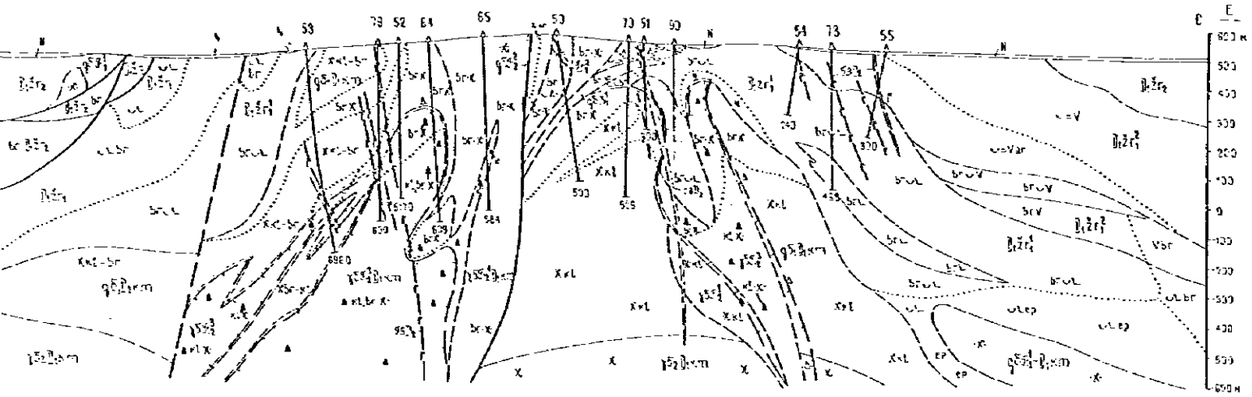
Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 2,000

0 100 200m

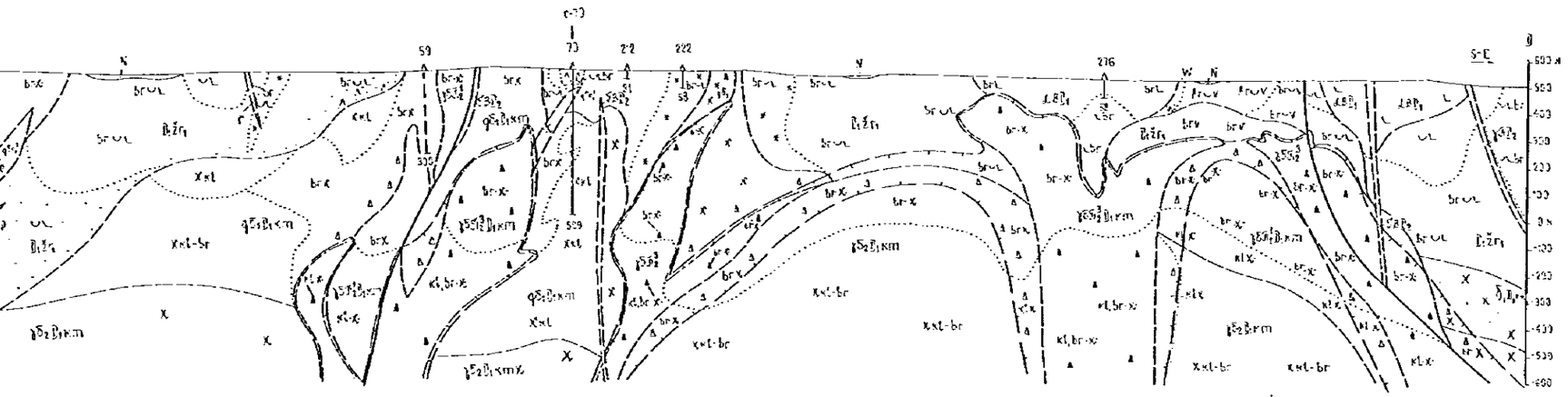
* Originally Prepared by Kanagawa Geological Exploration Expedition



Border of copper ore with Cu content > 0.5%

Geological cross-section at line A-C

Scale 1:10000 Compiled by Evdokimov I.V.



Assumed border of copper ore with Cu-content > 0.5%

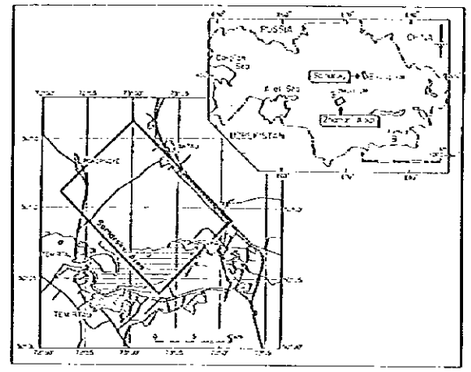
Geological cross-section at line B-c-10-D

Scale 1:10000 Compiled by Evdokimov I.V.

Plate 12

Report on the Mineral Exploration
in
the Zhamin-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase II)

Geological Section of the Samarsky Area



Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

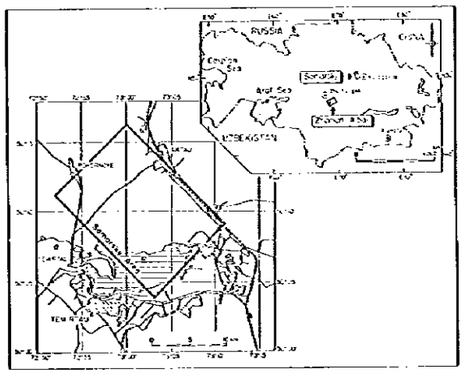
Scale 1 : 10,000

0 500 1000m

Plate 13

Report on the Mineral Exploration
in
the Zharman-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase II)

Detailed Plane View of the Central Cu-Mo Deposit in the Samarsky Area (+100m level sliced map)

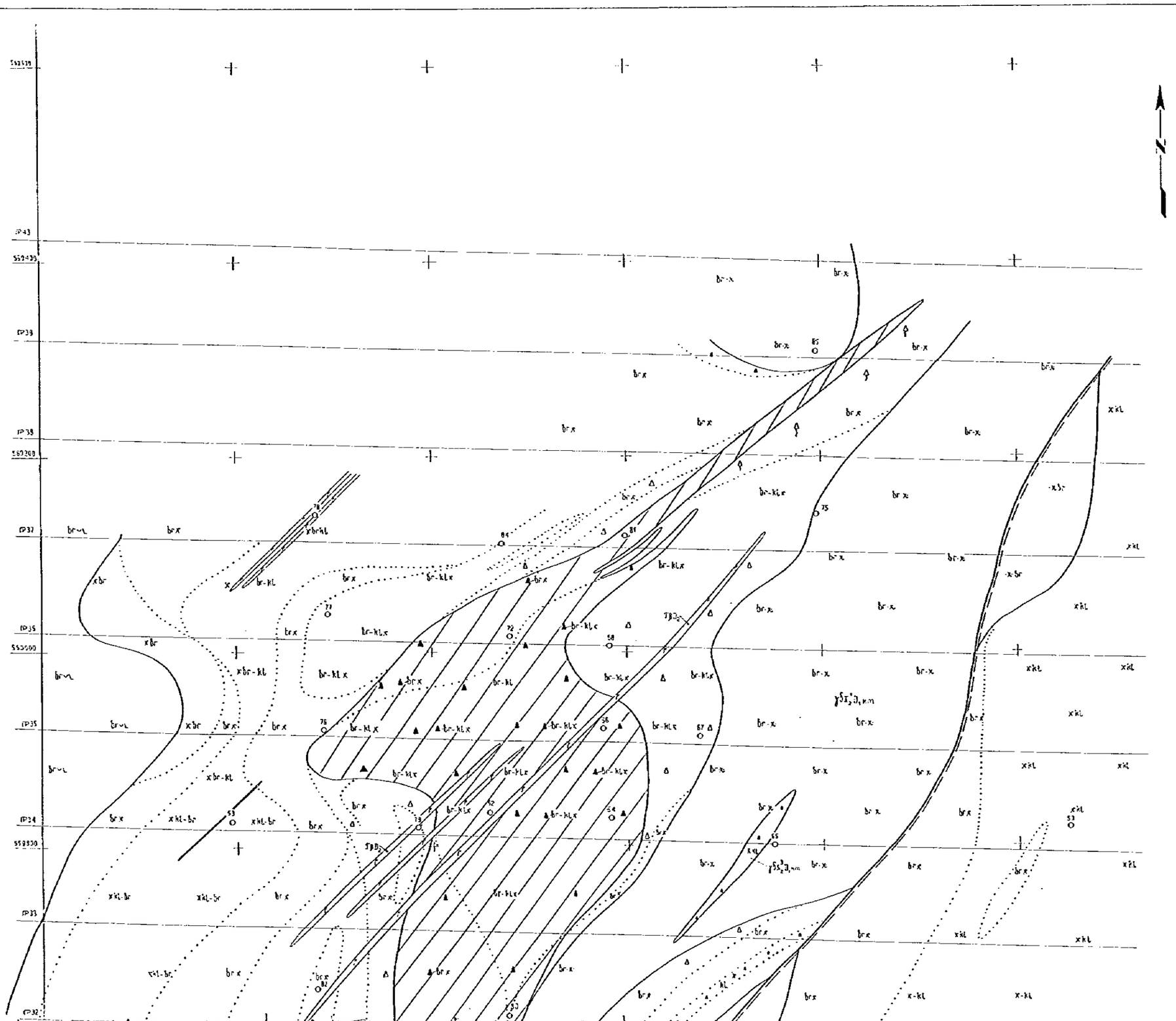


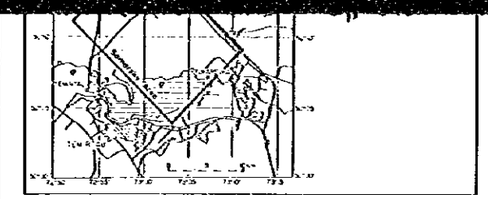
Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 2,000

0 100 200 m





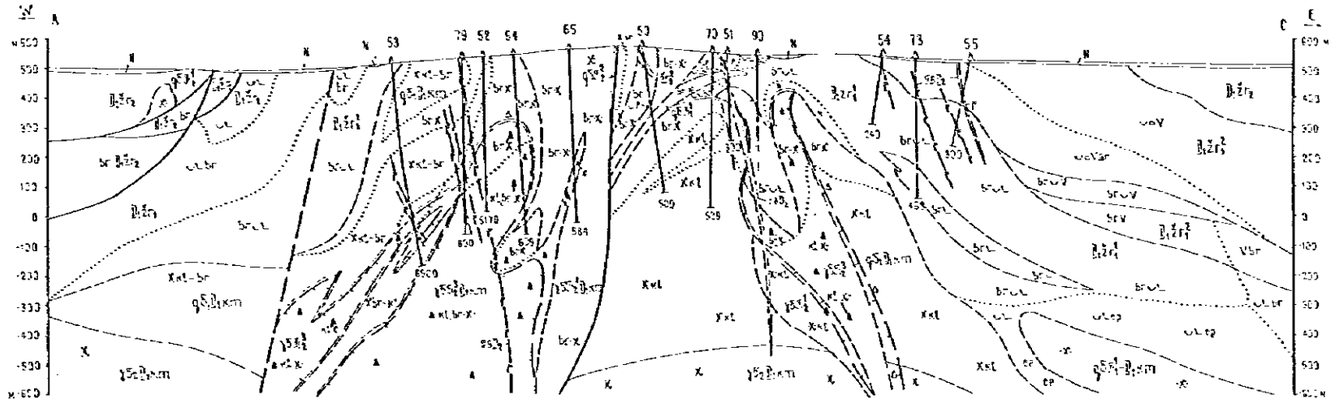
Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 2,000

0 100 200m

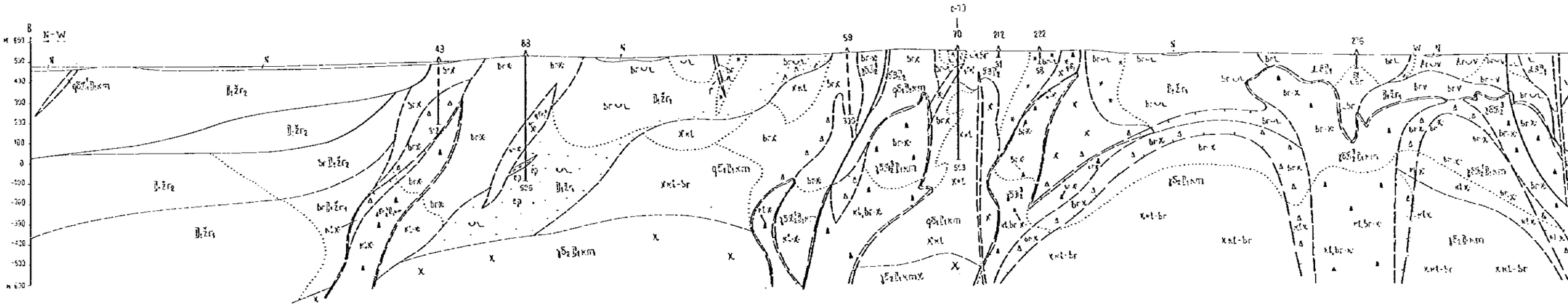
※ Originally Prepared by Karaganda Geological Exploration Expedition.



Border of copper ore with Cu content > 0.5%

Geological cross-section at line A-C

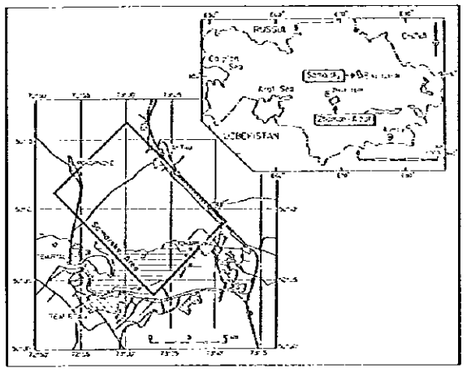
Scale 1:1000 Compiled by Exploration IV



Assumed border of copper ore with Cu-co

Geological cross-section at line B-C-D

Scale 1:1000 Compiled by Ex



※ Originally Prepared by Karaganda Geological Exploration Expedition.

Plate 14

Report on the Mineral Exploration
in
the Zhaman Aibat and Samarsky Area, Republic of Kazakhstan
(Phase III)

Detailed Section
of the Central Cu-Mo Deposit
in the Samarsky Area
(along the E-W line DH53-DH70)

Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

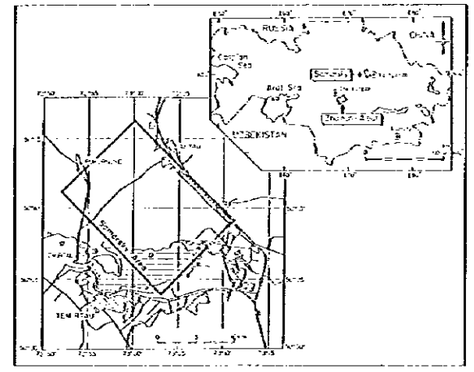
Scale 1 : 2,000

0 100 200m

Plate 15

Report on the Mineral Exploration
in
the Zhaman Aibat and Samarsky Area, Republic of Kazakhstan
(Phase III)

Detailed Section of the Central Cu - Mo Deposit in the Samarsky Area (along the N - S line DH207 - DH84)

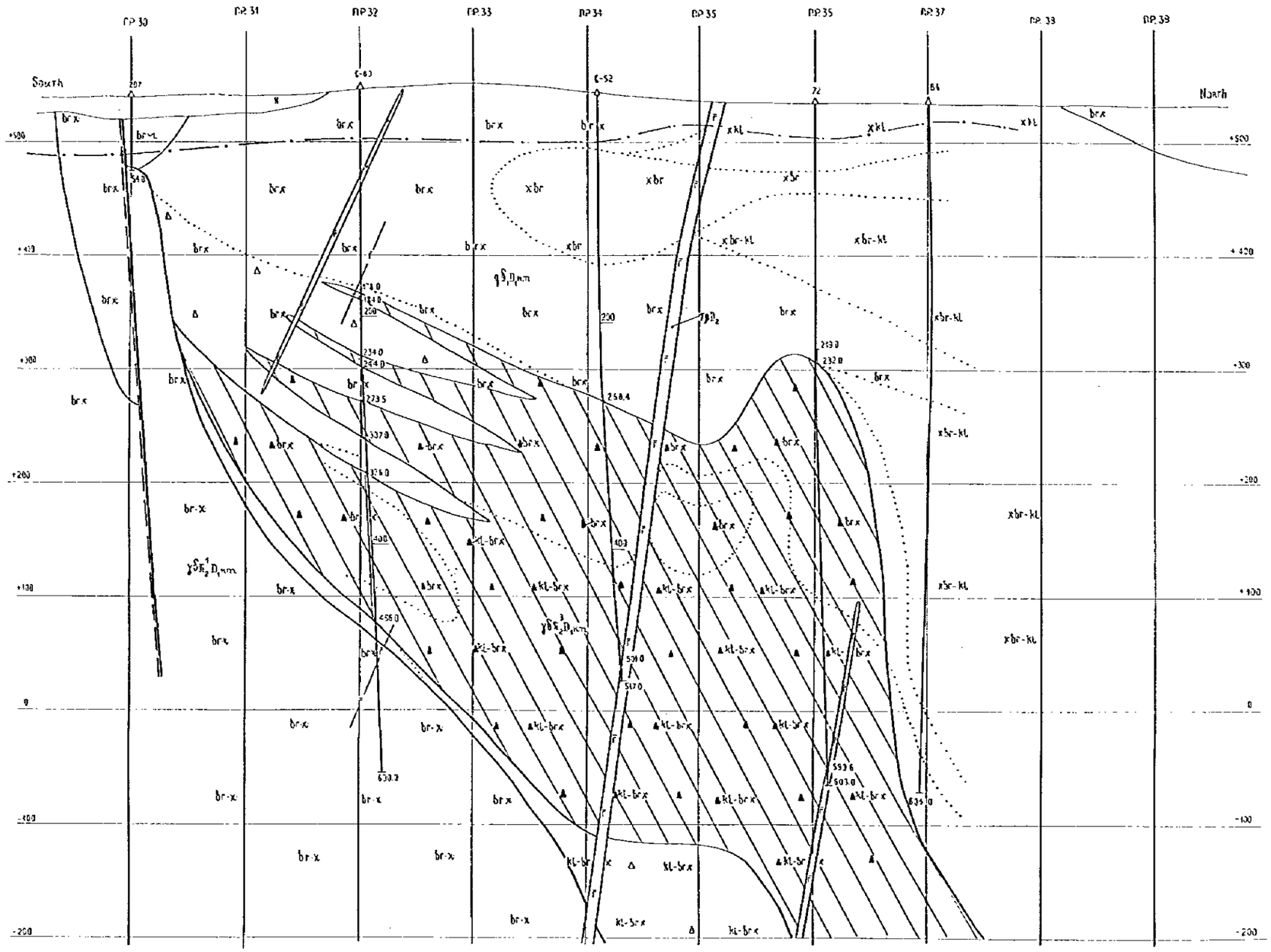


Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 2,000

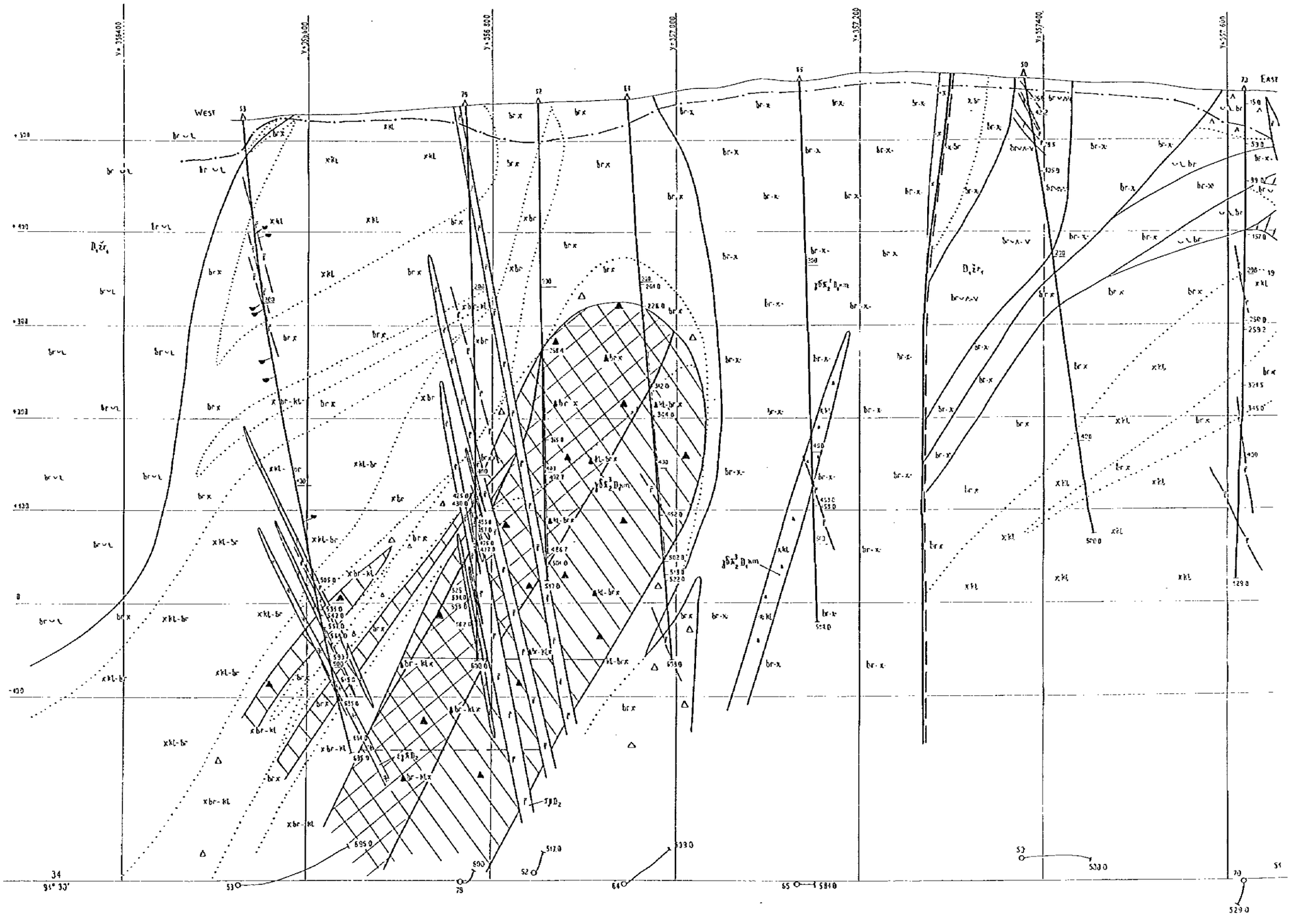
0 100 200 m



※ Originally Prepared by Karaganda Geological Exploration Expedition

				Cu, %	Mo, %	Au, g/t	Ag, g/t
1	2	3	4	5	6	7	8
52	268.4	304.0	232.6	2.03	0.0092		2.61
	268.4	365.0	96.6	2.33	0.0076		2.25
	452.7	496.7	44.0	2.59	0.0144		3.52
53	535.0	582.0	50	4.55	0.0636	0.24	2.67
	557.0	568.0	5.0	0.59	0.0030	0.173	3.97
	615.0	635.0	20.0	0.55	0.0120	0.469	2.74
64	226.0	582.0	276.0	1.07	0.0026		1.01
	226.0	342.0	86.0	1.85	0.0050		1.55
	364.0	502.0	138.0	0.69	0.0022		0.63
	344.0	452.0	108.0	0.76	0.0120		0.73
	480.0	502.0	32.0	0.77	0.0034	0.310	0.50
	516.0	522.0	6.0	0.84	0.0030	0.13	0.32
51	82.0	98.0	16.0	0.61	0.02	0.32	1.04
	120.0	126.0	6.0	0.87	0.005	0.43	3.5
	150.0	194.0	44.0	0.53	0.043	0.4	2.6
	120.0	194.0	74.0	0.88	0.059	0.8	3.4
79	425.0	430.0	5.0	0.56			
	453.0	457.0	4.0	0.75			
	475.0	552.0	77.0	2.54			
			(32.0				

				Cu, %
1	2	3	4	5
53	505.0	536.0	31.0	0.24
	559.0	587.3	28.3	0.34
	635.0	681.0	46.0	0.27
53	26.0	42.2	16.2	0.44
	26.5	105.0	34.5	0.22
64	204.0	226.0	25.0	0.46
	582.0	605.0	107.0	0.33
51	75	52.0	44.5	0.88
	98.0	120.0	22.0	0.88
	194.0	254.0	60.0	0.27
65	453.0	458.0	5.0	0.24
70	15.0	59.0	44.0	0.23
	99.0	157.0	58.0	0.47
	250.0	259.6	9.6	0.23
	321.5	345.0	23.5	0.45
79	419.4	425.0	5.6	0.30
	430.0	438.8	8.0	0.28
	449.0	453.0	4.0	0.24
	467.0	475.0	8.0	0.45
	552.0	556.0	4.0	0.26



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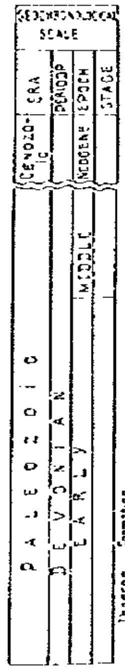
LEGEND



N — Speckled clay, clay with admixed pebbles, rock debris and gruss (in cross sections only)

Middle Devonian Post-ore Dike and Subvolcanic Complex

Dikes and Minor bodies of subalkaline diabase and trachybasalt (τB), subalkaline granite porphyry (εγπ), and granite porphyry (γπ)

Minor body of trachyandesite (τd)

KARAMENDIN INTRUSIVE COMPLEX

Intrusives and dikes additional to the second phase and associated metasomatic formations: granodiorite-porphyry ($\gamma\delta^1_2$), quartz-diorite-porphyry coarse impregnated and biotite-plagioclase-like ($q\delta\pi^2_2$), eruptive breccias of granodiorite-porphyry ($\gamma\delta\pi^3_2$), beresite (br_2), potassium feldspar facies (kl_2).

The first phase and associated metasomatic formations quartz diorite, medium grained, medium-fine grained ($q\delta_1$), microdiorite and quartz-diorite-porphyry of exocontact facies ($q\delta_1$), beresite (br_1), potassium feldspar facies (kl_1), secondary quartzite (vk_1), additional intrusive of quartz diorite porphyry ($q\delta\pi^1_1$).

Early Devonian Subvolcanic Complex

Natron andesitic basalt (αB)

Upper Subformation Sandstone, aleurolite, gravelite, polymictic conglomerate, mostly red coloured, with horizons of tuffite of acidic composition.

Lower Subformation:

- Upper Stratum. Tuff, lefroid and volcanomictic clastic rocks of andesitic composition, mostly red coloured
- Lower Stratum. Tuff, lefroid and volcanomictic clastic rocks of andesitic composition, mostly green coloured

Lower Subformation. Tuff and tephrite of andesite and andesitic basalt composition of different sizing (without defining rock types and stratum at ore zone)

Border of subdivisions with different age: confirmed (a), possible (б), steeply dipping faults defined by a combination of features (в), possible (г), borders of formations of the same age and different composition (д), borders of metasomatic facies (е), hornfels facies (ж).

Border of low-angle overthrust: confirmed (a), possible (б).

Border of depressions with Neogene sediments (a), shaft (б), open pit (в), sampling point for silicate analysis and its No. (г). Contour with hypergenic veinlet copper mineralization (д).

Inclination of rock laminations, as measured in drill cores (a), in the area (б); inclination of the contact, as measured by graphical method (в).

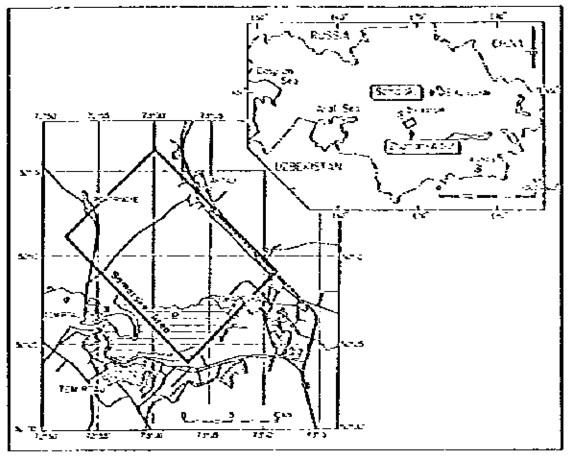
Drill and Drill No. : prospecting drill (a), mapping drill completed in 1994 (б), mapping drill completed before 1994 (в), hydrogeological drill (г).

Asphalt road.

Plate 16

Report on the Mineral Exploration
in
the Zhaman-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase III)

Legend for the Plate 12



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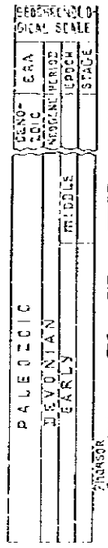
LEGEND



N — Speckled clay, clay with admixed pebbles, rock debris and gruss (in cross sections only)

Middle Devonian Post-ore Dike and Subvolcanic Complex

Dikes and Minor bodies of subalkaline diabase and trachybasalt (τδ),
subalkaline granite porphyry(σγ₂)
Minor body of trachyandesite (τd)

KARAMENDIN INTRUSIVE COMPLEX

Intrusives and dikes additional to the second phase and associated metasomatic formations: granodiorite-porphyry (γδ₂³), quartz-diorite-porphyry biotite-plagioclase-like (qδ₂³), eruptive breccias of granodiorite-porphyry (γδ₂³), beresite (br₂), potassium feldspar facies (kl₂).

The first phase and associated metasomatic formations: quartz diorite, medium-fine grained (qδ₁), microdiorite and quartz-diorite-porphyry of exocontact facies (mqδ₁), beresite (br₁), potassium feldspar facies (kl₁) propylite (P₁), secondary quartzite (vk₁).

KARAMENDIN FORMATION

Upper Subformation: Sandstone, aleurolite, gravelite, polymictic conglomerate with horizons of tuffite of acidic composition

Lower Subformation: Tuff and tefroid of andesite and andesitic basalt composition of different sizing

Tuffite of acidic composition aleurolite and aleuropelite-like (a), trachyandesite (δ).

Tuff of andesitic basalt (a), tuff of mixed composition with prevailing fragments of dacite and andesite (б), automagmatic breccia of granodiorite-porphyry : fragments located at fluidal cement of the same composition (в)

Diabase, gabbro-diabase (а), quartz diorite medium-fine grained, including quartz diorite porphyry in ore zone (б), quartz diorite fine grained (в), quartz diorite porphyry (г), granodiorite-porphyry (д), granite porphyry (е), beresite derived from quartz diorite, accompanied by unevenly distributed potassium feldspar (ж).

Beresite derived from quartz diorite (а) beresite derived from tuff and tefroid of andesitebasalt (б), beresite (в), (composition of initial rocks is shown by corresponding stripes), beresitized quartz diorite (г), quartz diorite with potassium feldspar (д), secondary quartzite (е), hematitization (и)

Eruptive (intrusion) breccia-breccia with different composition of fragments or with different composition of fragments and cementing rocks (а), tectonic pre-ore breccia: fragments of one type are cemented by powdered material of the same composition (б), tourmalinization (в), veinlet silicification, possible orientation of veinlets (г), quartz veins (д), limonitization (е), local silicification (ж).

Border of subdivisions with different age: confirmed (а), possible (б); faults defined by a combination of features (в), possible (г), borders of formations of the same age and different composition (д), borders of metasomatic facies (е), hornfels facies (ж).

Contour of hypergenic veinlet copper mineralization (а), impregnation and veinlets of minerals: pyrite (б), galena (в), sphalerite (г), chalcopyrite (д), bornite (е), carbonate (ж), (а- on geological columns only).

Border of depressions with Neogene sediments (а), shaft (б), open pit (в).

Inclination of rock laminations, as measured in drill cores (а), in the area (б), inclination of the contact, as measured by graphical method (в).

Drill and Drill No. : prospecting drill (а), mapping drill (б), hydrogeological drill (в), CPSE (previous expedition) prospecting drill (г), technological drill (д), CPSE drill completed by Karaganda expedition in 1993 (е)

C_2 category reserves contour (а) outlined by prospecting drilling, (б) addition (on cross sections)

P_1 resources contour (on geological map)

Oxidation zone border (on the cross sections)

Contour of magnetic dome of quartz diorite at the depth of approx. 300 m as per drilling and prospecting data (а)

Contour of copper ore, suitable for operations (cut-off 0.5% Cu) (б).

Contour of rich copper ore.

Plate 17

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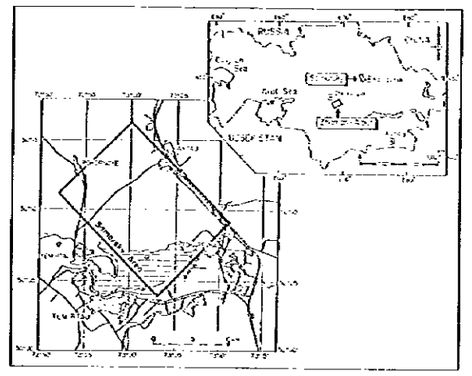
Legend for the Plate 11, Plate 13, Plate 14, Plate 15



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Kotas (Maykyz) complex

Minor intrusions and dykes of granite-porphyry (γπ), rhyolite porphyry (λπ), Rhyodacite-porphyry (λζπ)

Marybay complex

[illegible] Minor intrusions and dykes of sub-alkaline gabbro (ν), gabbro-diorite (νδ) dolerite (βμ)

Minor intrusions and dykes of quartz monzodiorite (qμδ), diorite (δ), monzodiorite (μδ), diorite porphyry (δπ), granodiorite (γδ) granodiorite porphyry (γδπ)

Kuoshokin Brachy Syncline
(Subzone of shallow sedimentation)

C_1krg Karaganda Formation - Sandstone, aleurolite, argillite, coaly aleurolite and argillite beds of coal (> 200m)

C_1as Ashlyarick Formation - Sandstone aleurolite, coaly argillite beds of coal (400 - 500m)

C_1ak Akkuduk Formation - Aleurolite, argillite, sandstone with interlayers of tuffite (100m)

C_1rs Rusakov Formation - Limy aleurolite, marl (50 - 100m)

C_1ks Kassin Formation - Limestone (50 - 150m)

D_3sm Simonov Formation - Limy aleurolite, marl (80 - 100m)

D_3sl Sulfsiler Formation - Marl, limy aleurolite limestone (100 - 200m)

D_3ms Meyster Formation - Limestone limy sandstone aleurolite conglomerate (50 - 200m)

Asrakhov Syncline
(Subzone of abyssal sedimentation)

Posidonian Formation

C_1ps_2 Upper Sub Formation (ps_2) - Aleurolite marl limestone

D_3ps_1 Lower Sub-Formation (ps_1) - Limy aleurolite, marl

D_3-C_1ps Undivided (ps) - Limy aleurolite, argillite, sandstone (200m)

D_3sl

D_3ms

Orogenic Volcanic - Tectonic Structures

Shidertin Depression

Devonian Volcanic Belt

D_3sf Sophin Formation - Speckled aleurolite, sandstone, gravelite conglomerate (400-600m)

D_2kn Konyz Formation - Interlayering of red-coloured, rarely grey-coloured, tuffaceous volcanogenic polymictic sandstone gravelite aleurolite conglomerate rarely tuff of andesitic-dacite (>1000m)

Korkudukstabin Complex

Middle Devonian Intrusive Formations

$\gamma\pi_4D_2kk$ Fourth Phase - Granite porphyry

$\delta\pi_3D_2kk$ Third Phase - Dyke of diorite porphyry (δπ₃), lamprophyry (χ₃)

p_2 br_2 q_2 Second Phase - Quartz monzonite (qμ₂), quartz monzodiorite (qμδ₂), propylite (p₂) beresite (br₂), silicified rock (q₂)

p_1 br_1 $qsrc_1$ First Phase - Monzodiorite (μδ₁), propylite (p₁), beresite (br₁) silicified and sericitized rock (q-src₁)

Middle Devonian Sub-Volcanic Formations

$\lambda\pi D_2$ Rhyolite porphyries

D_2kz Kuzlozek Formation - Tuff, sandstone aleurolite, limestone, lava and tuff of rad-stone volcanics rhyodacite composition, interlayers of andesite and andesitic tuff (600-700m)

Zhelandybuluck Formation

D_2zb_2 Upper Sub-Formation - Lava and tuff of trachyrhyolite rhyolite ignimbrite (>300m)

D_2zb_1 Lower Sub-Formation - Fine clastic and ash tuff of rhyolite composition (> 400m)

Karamendin Complex

Early Devonian Sub-Volcanic Formations

$\gamma\pi_3D_1km$ Third Phase - Dyke of granite porphyry (γπ₃) microdiorite (δμ₃) lamprophyry (χ₃)

$\gamma\delta_2D_1km$ br_2 $qsrc_2$ Second Phase - Granodiorites (γδ₂) quartz monzodiorites (qμδ₂) beresite (br₂), silicified and sericitized rock (qsrc₂)

br_1 q First Phase - Quartz diorite (qδ₁), diorite (δ₁), beresite (br₁) silicified rock (q)

ν_2D_1km Early Phase - Gabbro leucogabbro norite

1 Andesitic Basalt (αβπ) 2 basalt (βπ)
3 andesitic-dacite (αζπ) 4 andesite (απ)

$\lambda\pi D_1$ Rhyolite porphyry

D_1sm Semizbugin Formation - Lava and tuff of rhyolite ignimbrite of rhyolite composition, interlayers of tuffaceous sandstone aleurolite rarely andesite (1000-1400m)

Zharsor Formation

D_1zr_3 Upper Sub-Formation - tuff sandstone, aleurolite, conglomerate, horizon of andesite, sandstone and gravelite (500-600m)

D_1zr_2 Middle Sub-Formation, tuffite of moderately acid composition with interlayers of conglomerate, breccia tuff of andesi-dacite, sandstone, aleurolite, gravelite, conglomerate (500m)

D_1zr_1 Lower Sub Formation agglomerate tuff, rarely lava of porphyritic andesitic basalts bands of pelite tuffite horizons of tuff of andesi-dacite (>500m)

Late Silurian Intrusive Formations

νS_2t Tuzdin Complex - Gabbro gabbro clinopyroxenite labradorite Gabbro-norite

Geosyncline Structures

Early Caledonides

Late Caledonides

Outer Zone

S_1s_1 Sumysar Formation - Spotted polymictic and tuffaceous sandstone conglomerate and aleurolite (1500m)

Plate 18

Report on the Mineral Exploration
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Stratigraphic Setting
in the Samarsky Area

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Devonian	Late		Kassin, Simorin, Sultsfar, Meystar, May, Aydarlin, Tulkun
	Middle -	Aufol	Besobin, Takyrsai
	Early	Em	Kazakh, Sardzhal, Pribalkhash
Silurian	Late	Pridolian, Ludlow	Alkan
	Early	Wenlock, Llandovery	Gonenzha, Alpey
Ordovician	Late	Ashgill	Durben, Chukpar, Azat
	Middle	Caradoc, Llandeilo, Llanvirn	Andraken, Tselinograd, Karatchey, Kopalin
	Early	Arenig, Tremadoc	Kogashik, Raskmeri, Aktau, Ungulan
Cambrian	Late	Aksay, Sakh	Kalmakegan, Lermontay, Selehn, Kusakuansk, Aksmola
	Middle		
	Early		
Proterozoic	Late	Riphean	Upper, Middle, Lower
	Early		

$C_1 ks$ Kassin Formation - Limestone (50 - 150m)

$D_3 sm$ Simorin Formation - Limy aleurolite, marl (50 - 100m)

$D_3 sl$ Sultsfar Formation - Marl, limy aleurolite limestone (100 - 200m)

$D_3 ms$ Meystar Formation - Limestone, limy sandstone aleurolite conglomerate (50 - 200m)

$C_1 ps_2$, $D_3 ps_1$ — D_3-$C_1 ps$ Posidonian Formation

Lower Sub-Formation (ps_1) - Limy aleurolite, marl

sandstone (200m)

$D_3 cz$

$D_3 ms$

Orogenic Volcanic - Tectonic Structures

Shiderlin Depression

Devonian Volcanic Belt

$D_3 st$ Sophin Formation - Speckled aleurolite, sandstone, gravelite, conglomerate (400-800m)

$D_2 kn$ Konyz Formation - Interlayering of red-coloured, rarely grey-coloured tuffaceous, volcanogenic polymictic sandstone, gravelite aleurolite, conglomerate, rarely tuff of andesitic-dacite (>1200m)

Kokkuduktubin Complex

Middle Devonian Intrusive Formations

$\gamma\pi_4 D_2 kk$ Fourth Phase - Granite porphyry

$\epsilon_3 D_2 kk$ Third Phase - Dyke of diorite porphyry, lamprophyry

Second Phase - Quartz monzonite, quartz monzodiorite, propylite, beresite, silicified rock

First Phase - Monzodiorite, propylite, beresite, silicified and sericitized rock

Middle Devonian Sub-Volcanic Formations

$\lambda\pi D_2$ Rhyolite porphyries

$D_2 kz$ Kuzkizek Formation - Tuff, sandstone aleurolite, limestone, lava and tuff of red-stone volcanics rhyodacite composition, interlayers of andesite and andesitic tuff (600-700m)

Zhelandybulack Formation

$D_2 zb_2$ Upper Sub-Formation - Lava and tuff of trachyrhyolite rhyolite ingnimbrite (>300m)

$D_2 zb_1$ Lower Sub-Formation - Fine clastic and ash tuff of rhyolite composition (> 400m)

Karamendin Complex

Early Devonian Sub-Volcanic Formations

$\gamma\pi_3 D_1 km$ Third Phase - Dyke of granite porphyry, microdiorite, lamprophyry

Second Phase - Granodiorites, quartz monzodiorites, beresite, silicified and sericitized rock

$q\delta D_1 km$ First Phase - Quartz diorite, diorite, beresite, silicified rock

$\nu D_1 km$ Early Phase - Gabbro, leucogabbro norite

1 2 3 4

1 Andesitic Basalt 2 basalt

3 andesite-dacite 4 andesite

$\lambda\pi D_1$ Rhyolite porphyry

Zharsor Formation

$D_1 zr_3$ Upper Sub-Formation, tuff, sandstone, aleurolite, conglomerate, horizon of andesite, sandstone and gravelite (500-600m)

$D_1 zr_2$ Middle Sub-Formation, tuffite of moderately acid composition with interlayers of conglomerate, breccia, tuff of andesi dacite, sandstone, aleurolite, gravelite, conglomerate (500m)

$D_1 zr_1$ Lower Sub-Formation, agglomerate tuff, rarely lava of porphyritic andesitic basalts, bands of pelite tuffite, horizons of tuff of andesi-dacite (>500m)

$D_1 sm$ Semizbugin Formation - Lava and tuff of rhyolite ignimbrite of rhyolite composition, interlayers of tuffaceous sandstone, aleurolite, rarely andesite (1000-1400m)

Late Silurian Intrusive Formations

$\nu S_2 t$ Tuzdin Complex - Gabbro, gabbro-clinopyroxenite, labradorite Gabbro-norite

Geosyncline Structures

Early Caledonides

Late Caledonides

Outer Zone

$S_1 st$ Sumysar Formation - Spotted polymictic and tuffaceous sandstone conglomerate and aleurolite (1500m)

$S_1 kr$ Karaaygyr Formation - Grey-green polymictic sandstone, aleurolite, conglomerate, limy sandstone and aleurolite (> 2000m)

$S_1 st$ Satpayev Formation - Grey green rarely red coloured sandstone aleurolite and gravelite with interlayers of conglomerate

$O_3 tn$ Tyntuduk Formation - Sandstone conglomerate, graywacke sandstone, lenses of limestone, sedimentary breccia, aleurolite with olystolite of jasperoid, basalt limestone (>3000m)

$O_2 er$

$O_2 kr$ Karatal Formation - Sandstone, gravelite, sedimentary conglomerate-breccias, aleurolite with olystolite of flint, basalt and ultrabasite (> 200m)

$\epsilon_3 O_2 ak$ Akdym Group - Jasper, microquartzite, limy aleurolites, interlayers of phtanite, vanadium-bearing schist, basalt, conglomerates (> 2500m)

Astafnov - Sub-alkaline delaminated complex

Late Cambrian Plutonic Formation

$\nu\epsilon_3 ast$ Mica clinopyroxenite, dunite, titanium-magnetite clinopyroxenite

Early Cambrian Plutonic Formation

$\zeta\epsilon_3$ bir Protrusion of dunite, harzburgite, peridotite, pyroxenite and serpentinite, birbirite (bir)

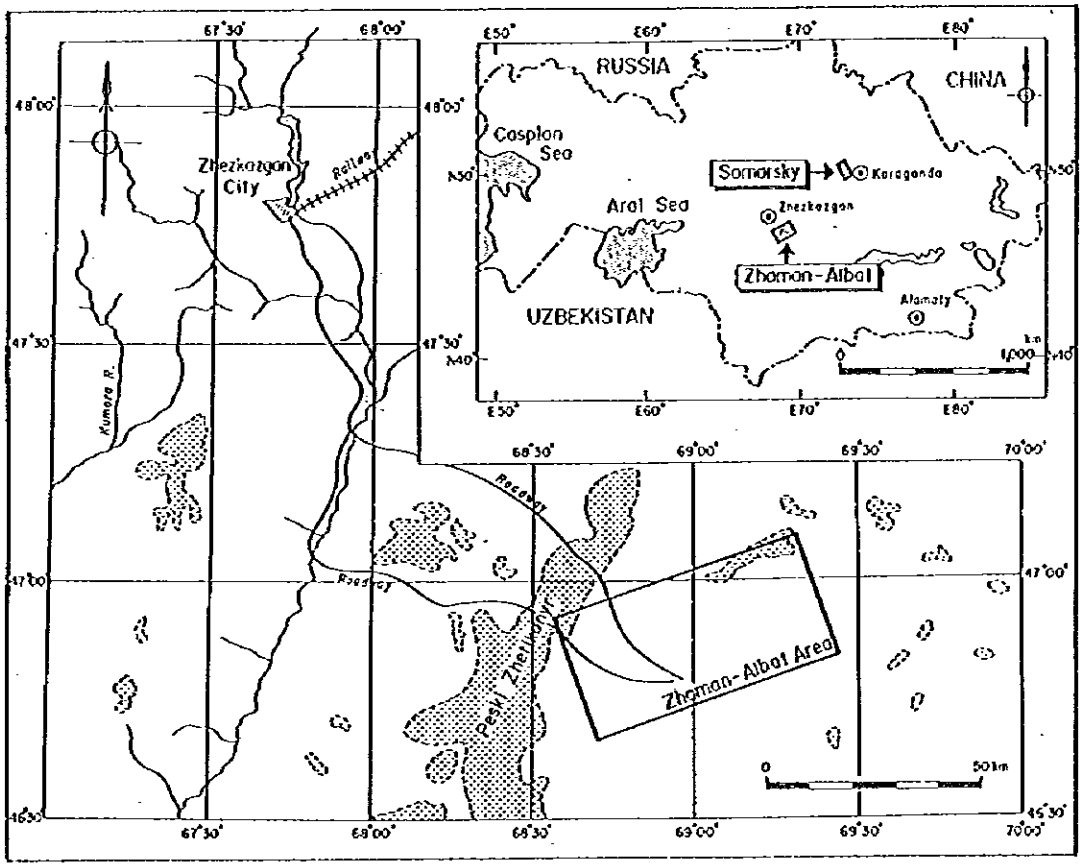
V-$\epsilon_1 zt$ Zhelau Formation - Basalt with discontinuous bodies of quartzite limestone and flint (> 100m)

$PR_1 cs$ Osakarov Formation - Chlorite-sericite schist, quartzite, quartzite-schist, rare lenses of marble (> 400m)

Plate 19

Report on the Mineral Exploration
in
the Zhaman-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase III)

Geological Logging of the Drill Hole "MJK-1" (1/10~10/10), Zhaman-Aibat Ore Deposit



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Scale 1 : 200

0 10 20m

Plate 19-1 Geological Logging of the Drill Hole "MJK-1"(1/10), Zhaman-Aibat Ore Deposit

MJK-1 INCLINATION: -90°

AREA: ZHAMAN-AIBAT BEARING: — ELEVATION: 357.04m FINAL DEPTH: 650.50m

SCALE (m)	COLUMN	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	SILICA	CLAY	CARBONATE	SULFATE	SAMPLE No.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. %
		1.20	Strongly weathered rock with fragments of red siltstone and fine-grained sandstone. Content of fragments is up to 50%											100
												∠10-80°	10	100
			Reddish brown weathered siltstone with uncleanly expressed bedded structure, partially fractured Leached caverns are partly filled in by calcite.	∠5°								〃	10	93
												〃	10	93
			Interlayer : Grayish-red weathered, fine-grained, sandstone at the depth of 1.40 m with thickness, equal to 30 cm.									〃	10	91
		6.00												91
														92
														94
														94
10			Reddish brown siltstone with fine grained, partially porous sandstone. Lamination angle is equal to 5°. These rocks are strongly fractured. Fractures surface is coated by gypsum, traces of iron oxide and dendrite of manganese. Leached caverns are sizing up to 0.5x1.5 cm, filled in by calcite.	∠5°								∠40°	1	94
												∠25°	1	94
														94
														94
												∠5°	1	94
												〃	4	94
												〃	4	94
		17.00										〃	4	94
			Light reddish brown fine grained sandstone. Interlayers of red coarse-grained sandstone (5-20 cm thick) with clayey-carbonate-ferrous cement is strongly weathered. This sandstone is sometimes porous, uncleanly expresses bedded structure. Gravels included in									〃	4	95
20				∠5°								∠80°	4	95
		21.40	sandstone orient at 5°.									∠35°	4	95
												〃	4	94
												〃	4	94
												〃	4	93
					23.9-26.2m; weakly argillized							〃	3	93
			Reddish brown, sandy siltstone, uncleanly expressed bedded structure, strongly fractured. Traces of ferruginization, manganese dendrite and thin films of gypsum and chlorite at walls of fractures. Lamination angle is equal to 5°. Leached caverns filled in by calcite are described all through the horizon sizing up to 2.0 x 2.0 cm. Numerous layers of gypsum (selenite) are observed below 28.6 m with thickness 0.1-1.0 cm, oriented at 5-10° (partly 35-60°).									〃	2	94
												∠5°	4	94
												〃	4	91
												〃	4	91
30												〃	4	91
												〃	4	90
												〃	4	90
												〃	4	90
												〃	4	90
												〃	4	91
												〃	4	91
		39.05		∠5°								〃	4	91
												〃	4	91
												〃	4	92
												〃	4	92
40			39.05-44.8m,46.1-47.9m. Light reddish brown fine-grained sandstone with carbonate-clayey cement, including interlayers of kaolinized coarse-grained sandstone layers up to 6 cm, express lenticular and horizontally-bedded structure due to red fine-grained sandstone interlayers(0.2cm).There are numerous interlayers of fiber-like gypsum with thickness from 2 to 4, oriented at 5-0°.	∠5°								〃	4	92
												〃	4	92
												〃	4	92
												〃	4	92
												〃	4	92
			44.8-46.1m:Granule - pebble conglomerates, composed by quartz, limestone, flintstone with fragments of red aleurosandstone from 0.5 x 2 cm to 2 x 4 cm in amount up to 30%. The gravels and flat fragments are shaped as lamination oriented at 5°.									〃	4	92
		47.90										〃	4	92
												〃	4	92
												〃	4	93
50				∠5°-10°								∠5-10°	4	93
												〃	4	93
												〃	4	93
												〃	4	94
			Reddish brown siltstone (or fine-grained muddy sandstone) with carbonate-ferrous cement. Partially brecciated, sliding surfaces and chlorite films are observed along the fractures.									〃	4	94
			Muddy sandstone has an horizontally bedded structure at 5° due to interlayers of limy sandstone. The thickness of the limy sandstone layers is from 10 to 30 cm and maximum thickness is 1.0 m.									〃	4	94
			rocks fractures are filled in by fiber-like gypsum with thickness from 1 to 3 cm, oriented mostly at 5°									〃	4	94
			55.65-65.85m.Brecciated, chloritization weak									〃	4	94
60				∠5°								〃	4	94
												〃	4	94
				∠5°								〃	4	94
												〃	4	95
												〃	4	95
					65.65-65.85m. Brecciated, chloritization weak							∠30-60°	4	95
		66.50		∠70°								∠30-70°	4	95
												∠10-30°	3	95
												∠10°	2	95
												∠5-10°	2	95
70												〃	2	95

Zhidelisai Formation (Gypsum - rich Red Siltstone)

Plate 19-2 Geological Logging of the Drill Hole "MJK-1"(2/10), Zhaman-Aibat Ore Deposit

MJK - I

AREA: ZHAMAN-AIBAT INCLINATION: -90° BEARING: — ELEVATION: 357.04m FINAL DEPTH: 650.50m

DEPTH (m)	DESCRIPTION	
74.55	Red sandstone, including light-red limy sandstone layers (intervals: 10-30cm, thickness : 2-5mm). These rocks are medium-fractured; gypsum at fractures is oriented at 5°.	∠5°
77.90	Red sandstone, fine-grained with carbonate-ferrous cement, horizontally bedded structure due to fine lamination with siltstone. The rock is medium fractured. Rare veinlets of gypsum (5°) with thickness up to 2 cm. Contact with underlying horizon is clear, at 5°. Including rare fragments of brown colored siltstone.	
86.50	77.9-79.1m: Red siltstone with spotted structure due to spots of light-red colored limy sandstone. Rare interlayers of fiber-like gypsum (selenite) with thickness up to 0.5 cm, oriented at 5°. Contact with underlying horizon is gradual. 79.1-79.8m: Red sandstone, fine-grained, bedded due to interlayers of aleurosandstone 5° with gypsum veinlets 0.2-0.4 cm thick, oriented at 10-20°. 79.8-86.5m. Red siltstone with interlayers of fine-grained (83.9-84.15 m) gypsum and single gypsum veinlets 0.3-0.4 cm thick.	
89.50	Light-red sandstone, fine grained with carbonate-ferrous cement; horizontally-bedded structure at 5°. Graded bedding and lamina structures are developed. The rock is medium fractured; veinlets of gypsum with thickness up to 1.5 cm. Carbonate-gypsum inclusions sizing up to 1.0 x 1.5 cm within the interval from 87.2 to 87.8 m. Contact with underlying horizon is clear, at 10°.	∠5°~10°
92.00	Red siltstone with unclearly expressed bedded structure. Including rare siliceous-carbonate accumulations, veinlets of gypsum with thickness 5 mm, interlayer of fine-grained grayish-red colored sandstone with thickness 20 cm. Contact with underlying horizon is at 0°.	∠5°
93.25	Reddish brown sandstone, fine-grained with carbonate-ferrous cement. Lenticular bedded structure at 10-15° due to interlaying with fine-grained siltstone. The rock is medium fractured with gypsum (up to 1.5 cm thick) filling in fractures. Contact with underlying horizon is at 0°.	
127.20	Reddish brown siltstone with spotted or rarely horizontally-bedded (at 5°) structure due to interlaying with fine-grained sandstone. Interlayers of fine-grained sandstone with thickness up to 25 cm, maximum. 140cm. There is an interlayer of green colored siltstone at the depth 94.8m, 106.25m and 110.6m with thickness 10 - 30 cm. These rocks are medium fractured, fractures are filled in by gypsum with thickness from 1mm to 5 cm. Contact with underlying horizon is unclear and gradual.	∠5°
128.30	Red colored laminated sandstone, fine-grained, with carbonate-ferrous cement. Banded structure at 5-15. The rock is medium fractured, gypsum (1mm to 4 cm thick) filling in fractures. Contact with underlying horizon is at 5°.	∠5°
	Reddish brown massive siltstone. The rock is medium fractured; gypsum veinlets at rare fractures (thickness up to 5 mm). There are numerous Interlayers of fine-grained sandstone with thickness 7-10 cm. The layer is continued below.	

REMARKS

Zhidelisoi Formation (Gypsum — rich Red siltstone)

MINERALIZATION

SAMPLE No.

ROCK PROPERTY		
Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. %
∠5°	2	95
〃	2	95
〃	2	95
〃	2	95
〃	2	95
〃	2	95
〃	2	95
∠5~10°	4	95
〃	4	95
〃	4	95
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	36
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	4	96
〃	2	96
∠5°	4	96
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
∠10°	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
∠10~40°	4	97
∠5°	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97

Plate 19-3 Geological Logging of the Drill Hole "MJK-1"(3/10), Zhaman-Aibat Ore Deposit

MJK - I

AREA: ZHAMAN-AIBAT
INCLINATION: -90°
BEARING: —
ELEVATION: 357.04m
FINAL DEPTH: 650.50m

DESCRIPTION

Reddish brown colored siltstone with banded and spotted structure due to the interlayers of limy sandstone. Partings with thickness from 1 to 3 cm and interlayers of fine-grained sandstone are described at intervals 145.40-145.70 m, 147.3-147.6, 148.2-148.6, 156.9-157.20 m. Graded bedding structure (inclination: 10-15°) is observed in the above intervals. The rock is medium fractured, fractures are filled in by gypsum and are oriented at 5°, 45° and 15°; thickness of gypsum layers varying from1 mm to 2 cm. Contact with underlying horizon is gradual.

159.00 – 160.50: Brown sandstone, fine grained, with carbonate-ferrous cement. Structure is horizontally bedded at 5° due to interlaying with red colored siltstone. The rock is medium fractured; fractures are filled in by gypsum. Contact with underlying horizon is gradual.

160.50 – 174.20: Reddish brown siltstone. Structure is basically horizontally-bedded at 5° due to partings of fine-grained sandstone with thickness up to 1 mm. Interlayers of red fine-grained sandstone with thickness 10-15 cm occur all through the layer. Interlayer of medium-grained sandstone with thickness 30 cm is described at the depth 165.0m and 169.9m

174.20 – 176.10: Red sandstone, fine grained, with carbonate-ferrous cement. Structure is horizontally bedded at 5° due to the graded bedding structure. Interlayer of siltstone with thickness 33 cm. The rock is medium fractured; fractures are filled in by gypsum with thickness up to 2 cm. Contact with underlying horizon is at 0°.

176.10 – 200.80: Brown massive siltstone. Unclearly expressed bedded structure. Rare partings of fine-grained sandstone with thickness up to 5 cm and interlayers up to 25 cm. The rock is medium fractured; fractures are filled in by gypsum with thickness up to 3 cm, oriented at 10° and 30°. The layer is continued below.

200.08-208.65m: Brown colored massive siltstone. Unclearly expressed bedded structure. The rock is medium fractured. Frequent veinlets of gypsum with thickness up to 1 cm. Fractures are oriented at 45°, 15° and 5°. Gypsum veinlets at the interval from to 207.5 to 208.65 m are oriented by two groups (at 15° and 5° and along core axis). Contact with underlying horizon is at 5°.

208.70-209.15m: Grayish-green siltstone. Horizontally-bedded structure resulted from partings of red siltstone with thickness up to 1 cm. The rock is medium fractured; fractures are filled in by gypsum with thickness up to 2 cm. Contact with underlying horizon is at 10°.

209.15-210.0m: Brown sandstone, fine-grained, with carbonate-ferrous cement. Structure is sometimes bedded at 10°, 5° due to fine lamination with siltstone. The rock is medium fractured; fractures are filled in by gypsum and are oriented at 30°, 10°; their thickness varies from 1 mm to 2 cm. Contact with underlying horizon is clear, at the angle 0°.

REMARKS

Zhidelisai Formation (Gypsum — rich Red Siltstone)

MINERALIZATION

156.50-156.55m: weakly argillized

ROCK PROPERTY

Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. %
∠5~10°	4	97
〃	4	97
〃	4	97
〃	4	97
∠20°	4	97
∠5~10°	4	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
∠10~30°	3	97
∠5~10°	3	97
〃	3	97
〃	3	93
〃	3	93
〃	3	93
〃	3	97
〃	3	97
〃	3	97
〃	3	97
∠5~20°	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
〃	2	97
∠5~10°	3	97
〃	4	97
〃	4	97
〃	2	97
〃	1	97
〃	2	97
〃	3	97
〃	4	97
〃	6	97
〃	2	97
〃	4	97
〃	3	97
〃	1	97
〃	0	97
〃	1	97
〃	0	97
〃	2	97
〃	4	97
〃	3	97
〃	4	97
〃	7	97
〃	7	97
〃	4	97
〃	2	97
〃	2	97
〃	2	97
〃	1	97
〃	1	97
〃	4	97
〃	4	97
〃	4	97
〃	4	97
〃	3	97
〃	2	97
〃	2	97

Plate 19-4 Geological Logging of the Drill Hole "MJK-1"(4/10), Zhaman-Aibat Ore Deposit

MJK - 1 INCLINATION: -90°

AREA: ZHAMAN-AIBAT BEARING: — ELEVATION: 357.04m FINAL DEPTH: 650.50m

SCALE (m)	COLUMN	DEPTH (m)	DESCRIPTION		REMARKS	MINERALIZATION	SULFIDE	SILICA	CLAY	CARBONATE	SULFATE	SAMPLE No.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. %
220		212.80	210.00-211.15m: Brown sandstone, fine-grained, with carbonate-ferrous cement.. Bedding Structure at the angle 10°, 5° due to fine lamination, alternation with siltstone. The rock is medium fractured; fractures are filled in by gypsum and are oriented at 30°, 20°; their thickness varies from 1 mm to 2 cm. Contact with underlying horizon is clear, at the angle 0°. 211.15-212.80m: Red sandstone, fine-grained, with carbonate-ferrous cement.. Bedding Structure (resulted from partings of dark-red fine-grained sandstone; thickness of partings is up to 1 cm) at the angle 15-10°. The rock is medium fractured; fractures are filled in by gypsum, oriented at 0°, 15°. Contact with underlying horizon is clear, wavy, at the angle 0°.	∠5°~15° ∠5°	Zhidelisai Formation (Gypsum-rich Red Siltstone)							∠5-10°	2	97
		219.05	Brown siltstone, bedding structure (due to partings of greenish-gray siltstone with thickness up to 1 mm) at the angle 5°. The rock is medium fractured. Contact with underlying horizon is gradual.	∠5°											
		223.00	219.05-219.55m: Brown colored fine-grained (muddy) sandstone with carbonate-ferrous cement. with graded bedding structure at the angle 5°. Contact with underlying horizon is sharp at the angle 5°. 219.55-223.00m: Brown siltstone with unclearly expressed bedded structure. Interlayers of dark-greenish-gray siltstone with thickness 13 cm and interlayers of red colored fine-grained sandstone with thickness 25 cm. The rock is medium fractured; fractures are filled in by gypsum, oriented at 5°. Contact with underlying horizon is clear, at the angle 10°.	∠10° ∠5°~15° ∠10°											
230		228.05	223.00-226.20m: Red sandstone, fine-grained, with carbonate-ferrous cement. with the bedding structure (due to partings of red fine-grained sandstone) at the angle 15°, 5°. Interlayers of siltstone with thickness from 6 to 25 cm are observed. The rock is medium fractured; fractures are filled in by gypsum, fractures oriented at 10°, thickness of gypsum veinlets is up to 5 cm. Contact with underlying horizon is at <10°. 226.20-227.10m: Brown siltstone with unclearly expressed bedded structure. The rock is medium fractured. Contact with underlying horizon is clear, at the angle 0°. 227.10-228.05m: Red sandstone, fine-grained, with carbonate-ferrous cement.. Bedding structure due to partings of dark aleurolites is horizontal at the angle 5°. Interlayers of dark-red siltstone with thickness 10-15 cm are described there. Contact with underlying horizon is unclear and gradual.	∠5°~15° ∠5°		238.10-238.40m: weakly silicified zone with gypsum veinlets								
240		242.30	Brown siltstone. Bedding structure (due to fine interlaying with fine-grained sandstone) is horizontal at the angle 5°. The rock is medium fractured; fractures are filled in by gypsum and oriented at 30°, 10°. Interlayer with calcite-gypsum-anhydrite aggregate with thickness 30 cm occurs at the depth 233.0 m; interlayer of fine-grained sandstone with thickness 35 cm described at 239.7 m. Contact with underlying horizon is gradual.	∠5°~15°										
250		252.40	242.30-242.75m: Light-brown colored, fine-grained sandstone with carbonate-ferrous cement. Bedding structure (due to partings of dark-brown siltstone with thickness 1mm) shows the angle 5-15°. Partings of dark brown colored siltstone with thickness up to 2 cm are observed as well. Contact with underlying horizon is clear, at 0°. 242.75-252.40m: Brown siltstone. Unclearly expressed bedded structure. Interlayers of fine-grained sandstone with thickness 5-7 and 10-25 cm. The rock is medium fractured; fractures are filled in by gypsum (sienite), oriented at 5°, sometimes at 45°. Contact with underlying horizon is gradual.	∠5° ∠0°~5°										
260		265.70	252.40-253.15m: Light-red colored fine-grained sandstone, with carbonate-ferrous cement. Bedding structure (due to fine interlaying with dark-red aleurolite, thickness of partings is up to 1 cm) is horizontal at the angle 5°. The rock is slightly fractured. Contact with underlying horizon is gradual. 253.15-258.00m: Brown siltstone with interlayers of fine-grained sandstone. 258.00-265.70m: Light-red colored, fine-grained sandstone with frequent interlayers of fine-grained sandstone (thickness is up to 20 cm). Bedding structure (due to partings of dark-red fine-grained sandstone) is horizontal at the angle 85°, lamination at the bottom of each layer at the angle 5-15°. Interlayer of brown siltstone(30 cm thick) is also observed. The rock is fractured; fractures are filled in by gypsum veinlets and films with thickness 5 mm. Contact with underlying horizon is gradual.	∠5°~15° ∠15	Zhidelisai Formation (Red Siltstone)										
270		271.20	Light-red colored siltstone. Partings of fine-grained sandstone with thickness 3-5 cm are described through all the layer. The rock is slightly fractured, fractures contain films of gypsum.	∠5°											
			Light-red colored fine-grained sandstone with bedding structure (due to changing granulometric composition) at the angle 15°. The rock is slightly fractured; fractures contain films of gypsum oriented at the angle 5°. Contact with underlying horizon is at 5°.	∠15°											
280			Brown, massive siltstone with unclearly bedded structure. Films of gypsum at fractures with thickness 1 mm, oriented at 55°,45°. At the bottom of layer, the rock is strongly fractured (283.0-287.25 m). Contact is at 15°.												

Plate 19-5 Geological Logging of the Drill Hole "MJK-1"(5/10), Zhaman-Aibat Ore Deposit

MJK - 1 INCLINATION: -90°

AREA: ZHAMAN-AIBAT BEARING: — ELEVATION: 357.04 m FINAL DEPTH: 650.50 m

SCALE (m)	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	SILICA	CLAY	CARBONATE	SULFATE	SAMPLE No.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. %
		Brown, massive siltstone with unclearly bedded structure. Films of gypsum at fractures with thickness 1 mm, oriented at 55°,45°. At the bottom of layer, the rock is strongly fractured (282.9-287.40 m). Contact is at 15°. Thin layers of green-dark green colored siltstone are observed within the interval from 286m to 287.20m										0	98
												0	98
											∠ 20°	3	98
											∠ 30°	4	98
											∠ 10°	10	98
											〃	10	98
	287.40	Light-red colored, fine-grained sandstone, with carbonate-ferrous cement., cross-bedded at 5-15° due to partings of dark-red siltstone. Interlayers of dark-red siltstone with total thickness 0.6 m are observed as well. The rock is slightly fractured; fractures are filled in by gypsum. Contact with underlying horizon is at 0°.	∠ 15° / ∠ 5°~15°								∠ 10°-15°	10	98
												0	98
											∠ 10°-15°	2	98
290											∠ 10°	2	98
												0	98
	291.40		∠ 0°								∠ 10°-15°	2	98
											∠ 10°	1	98
												0	98
												0	98
												0	98
												0	98
												0	98
		Brown siltstone with unclearly bedded structure. Including the interlayers of fine-grained sandstone with thickness up to 30 cm, maximum thickness reaching 0.8 m. These rocks are fractured; fractures are filled in by gypsum (up to 1 mm thick). Contact with underlying horizon is at 0°. Thin layers of green-dark green colored siltstone are observed within the interval from 312.90m to 313.10m									∠ 10°	1	98
300			∠ 0°									0	98
												0	98
												0	98
												0	98
												0	98
												0	98
												0	98
												0	98
												0	98
												0	98
310												0	98
												0	98
												0	98
	316.60	Red colored fine-grained sandstone with carbonate-ferrous cement.. Structure is horizontally-bedded at the angle 5° due to partings of dark-red siltstone; thickness of partings reaching 1 cm. Contact with underlying horizon is at 0°.									∠ 20°	1	98
												0	98
											∠ 5°	2	98
	318.70		∠ 5° / ∠ 0°									0	98
												0	98
320	320.20	Light green colored siltstone										0	98
												0	98
		Red, massive siltstone with unclearly bedded structure. Including interlayers of fine-grained sandstone. Contact with underlying horizon is gradual.										0	98
	323.90											0	98
												0	98
		Alternation of dark-red siltstone and fine-grained sandstone. Siltstone layers are dominant.. Fine-grained sandstone layers occur at the intervals 324.0-324.4, 325.3-325.55, 328.1-328.4, 329.3-329.6 m. Structure is horizontally-bedded at the angle 5°. Fractures are filled in by gypsum films.	∠ 5°									0	98
												0	98
												0	98
												0	98
											∠ 10°	1	98
	329.90											0	98
330			∠ 5°									0	98
		Alternation of dark-red siltstone and fine-grained sandstone. Sandstone layers are dominant. Sandstone layers are light-red colored, and matrix is composed of carbonate-ferrous cement.. Bedding structure (due to interlaying with siltstone) is horizontally-bedded at the angle 5°. Stretched-shaped fragments of red aleurolite 0.3 x 1.0 cm in size occur at the bottom of the Sandstone layer. Contact with underlying horizon is clear at 15° as to core axis										0	98
	332.40		∠ 15°									0	98
											∠ 25°	1	98
												0	98
			∠ 10°~15°								∠ 5°	1	98
												0	98
												0	98
												0	98
		Brown, sandy siltstone with frequent interlayers of fine-grained sandstone with thickness 10-15 cm with lamination at 15-10°. The rock is medium fractured, fractures are filled in by gypsum, its thickness varying from fiber-like to 1 mm; they are oriented at 5-15°. Contact with underlying horizon is gradual.									∠ 10°	1	98
340												0	98
												0	98
											∠ 20°	1	98
												0	97
												0	97
												0	97
		Light-red colored fine-grained sandstone with carbonate-ferrous cement. Sedimentary structure (due to partings of dark-red, fine-grained siltstone) is cross-bedded at 65°, 0°, 10°. The rock is slightly fractured. Interlayers of dark-red sandstone are also described there. Contact with underlying horizon is clear at 0°.	∠ 0°								∠ 5°	1	97
												0	97
	349.30											0	97
350												0	97

Zhidelisai Formation (Red Siltstone)

Plate 19-6 Geological Logging of the Drill Hole "MJK-1"(6/10), Zhaman-Aibat Ore Deposit

MJK - I

AREA: ZHAMAN-AIBAT
INCLINATION: -90°
BEARING: —
ELEVATION: 357.04m
FINAL DEPTH: 650.50m

Dark-reddish brown, sandy siltstone with potted / bedded structure due to interlaying with fine-grained sandstone. Interlayers of fine-grained sandstone show cross-bedded structure (thickness 15-25 cm). The rock is slightly fractured, fractures contain gypsum with thickness 5 mm.

Reddish brown, sandstone, medium-grained, sometimes coarse-grained, with carbonate-ferrous cement.. Graded bedding structure and cross-bedding structure are observed (at the angle 10-20°, 5°). Frequent accumulations of anhydrite / gypsum sizing up to 1.0 x 0.8 cm are described within the interval from 356.65 to 356.95 m. Fragments of red siltstone are described at the bottom of the layer with size up to 0.2 x 0.5 m. Contact with underlying horizon is clear at 5°. Gypsum interlayer (1 cm thick) is occurred at the contact.

Dark-gray, sandy siltstone with potted and lenticular-bedded structure due to interlayers and spots of light fine-grained limy sandstone. Interlayers of fine-grained sandstone with thickness 18 cm are also observed. Contact with underlying horizon is gradual.

Reddish brown, fine-grained sandstone with carbonate-ferrous cement. Structure is horizontally-bedded, sometimes cross-bedded at the angle 10-15° due to partings of fine-grained sandstone with darker shading with thickness of the partings equal to 0.1 mm. Partings of dark-red siltstone with thickness up to 3 cm. Accumulations of anhydrite (1.0 x 1.5 cm) are also observed there. The rock is slightly fractured; fractures are coated by gypsum film. Contact with underlying horizon is at 0°. Interlayer of intraformational conglomerate (8 cm thick) at the contact.

Red, sandy siltstone, horizontal-bedding, including interlayers of limy fine-grained sandstone with thickness up to 10 cm. The rock is fractured. Contact with underlying horizon is at the angle 5°.
371.6-372.1m: Red, fine-grained sandstone with carbonate-ferrous cement including interlayers of siltstone. Cross-bedded structure at the angle 5-10°.

Sandstone layers:
Reddish brown, fine-medium grained sandstone, with carbonate-ferrous cement., fine interlaying with fine-grained sandstone (0.2cm thick), cross-bedded at the angle 15-10°. The rock is slightly fractured, filled in by gypsum films. Contact with underlying horizon is wavy.
397.15-397.85m: Grayish-red, fine-grained laminated sandstone with siliceous-carbonate-ferrous cement..
Siltstone layers:
Reddish brown, sandy siltstone or aleurosandstone, including interlayers of light limy fine-grained sandstone with thickness 3-5 cm, horizontally-bedded. Contact with underlying horizon is sharp at the angle 0°.

Reddish brown, sandy siltstone including spots of light-red limy sandstone and rare spots of green aleurolite. Interlayer of greenish-gray fine-grained sandstone with thickness 25 cm occur at the depth 403.2 m; Thin interlayers of gray colored fine-grained sandstone with thickness 20 cm are observed at the interval from 413 to 419m. Contact with underlying horizon is gradual.

Reddish-gray, fine-grained sandstone with siliceous-carbonate-ferrous cement, horizontally-bedded at 5°. Sometimes transforming into medium-coarse-grained sandstone. Partings of greenish-gray aleurolite with thickness 3-5 cm, interlayer of red aleurolite with thickness 20 cm are observed as well. Fragments of dark-red aleurolites. Contact is with underlying horizon is gradual.

Reddish brown, sandy siltstone, spotted-bedded structure due to interlaying with fine-grained sandstone. Contact with underlying horizon is unclearly expressed, oriented at the angle 0°.

397.15-397.85m: Weakly silicified

403.20m:
Appearance of gray sandstone

415.75-417.60m.
Weakly disseminated by pyrite
Weakly silicified
419.80m-420.80m:
Weakly disseminated by pyrite
Pyrite grains are very fine

Plate 19-7 Geological Logging of the Drill Hole "MJK-1"(7/10), Zhaman-Aibat Ore Deposit

MJK-1 INCLINATION: -90°

AREA: ZHAMAN-AIBAT BEARING: — ELEVATION: 357.04m FINAL DEPTH: 650.50m

SCALE(m)	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	SILICA	CLAY	CARBONATE	SULFATE	SAMPLE No.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. %
		Reddish brown, sandy siltstone, massive with lamination due to interlaying with gray fine-grained sandstone. Interlayer of reddish-gray fine-grained sandstone occurs at the interval 421.3-421.75. Contact with underlying horizon is clear at the angle 5°.	Zhezkazgan Formation (Gray Sandstone)									0	97
												0	97
												0	97
												0	97
												0	97
	426.65	Gray medium-fine-grained sandstone with siliceous-carbonate-ferrous cement.. Interlayer of gray aleurolite with thickness 10 cm, fragments of dark-gray aleurolite 0.5 x 1.0 cm are observed as well. Contact with underlying horizon is clear at the angle 0°.	∠ 5°	426.65-428.40m: Pyrite accumulations with size up to 0.4-0.8 cm, and weakly disseminated by pyrite through the layer. Weak silicification								0	97
	428.40		∠ 0°									0	97
												0	97
	430.00	Reddish brown siltstone with gray spots. with interlayers of fine-grained sandstone with thickness 20 cm. Bedding structure is horizontal. Contact with underlying layer is gradual.	∠ 0°	430.00-432.25m. Calcite films								0	97
430												0	97
	432.25	Gray sandstone with red spots, fine-grained, with siliceous-carbonate cement.. Bedding structure is horizontal, cross-bedded at the angle 5-10° The rock is slightly fractured, with films of calcite at fractures. Contact with underlying layer is unclear at the angle 0°.	∠ 0° ~10°									0	97
												0	97
										435.0m ~435.3m	∠ 80°	1	97
										44		0	97
		Reddish brown, sandy siltstone, including "sandstone balls(2-4cm)" and thin layers of sandstone. Interlayer of grayish-red fine-grained sandstone with thickness 16 cm occurs at the depth 437.55 m. Contact with underlying layer shows load casting structure(wavy).										0	97
	438.80											0	97
											∠ 40°	1	97
				438.80-440.70m: Weakly disseminated by pyrite .						440.0m ~440.3m		0	97
440	440.70		∠ 5°							45		0	97
		Dark greenish gray, sandy siltstone, horizontally-bedded at the angle 5°. With lamination structure due to interlayers of sandstone. Contact with underlying layer is gradual.									∠ 40°	1	97
			∠ 5° ~10°	440.7-442.0m,442.4-443.2m: Disseminated by pyrite Weak silicification								0	97
	444.40											0	97
		Light-gray, coarse- fine-grained sandstone with siliceous-carbonate cement, with calcite films coating fractures .. Graded bedding structure is developed at the angles 5°, 10°. Contact with underlying layer is gradual. Frequent very fine grained pyrite crystals occurring at the rock mass.								445.0m ~445.3m		0	98
	445.50									46		0	98
		Reddish brown, sandy siltstone.		445.50-451.90m: Disseminated by pyrite								0	98
				446.5-447.7m: weak								0	98
				447.7-448.2m: strong								0	98
				448.2-451.9m: weak						450.0m ~450.3m		0	98
450										47		0	97
		445.50-449.00m: Dark-gray, laminated medium-grained sandstone with siliceous-carbonate cement., with siltstone thin layers. There are a lot of fragments of greenish-gray aleurolite with size up to 3 x 5 cm. Frequent small pyrite crystals occur in the rock mass. 449.00-451.90m: Black-dark gray, siltstone with the bedding structure due to the fine lamination of fine-grained sandstone layers. Joints are oriented at the angle 15-20, 80°. Contact with underlying layer is at the angle 0°. Frequent small pyrite crystals described in the rock mass.	∠ 0°									0	97
	451.90			451.90-454.60m: Weakly disseminated by pyrite.								0	97
												0	97
										455.0m ~455.3m		0	97
	454.60									48		0	97
		Gray, medium grained sandstone with siliceous-carbonate cement., with partings of dark-gray aleurolite with thickness 1-3 cm, and with fragments of dark-gray aleurolite sizing from 0.5 x 1.5 cm to 3 x 4 cm.										0	97
											∠ 10-60°	2	97
										460.0m ~460.3m	∠ 40°	1	97
460				454.60-464.80m: Weakly disseminated by pyrite						49		0	97
		Dark gray-black, sandy siltstone, with the bedding structure at the angle 5° due to partings of fine-grained sandstone. Joints are coated with calcite films, joints are oriented at the angle 5°, sometimes at the angle 45°. Contact with underlying layer is gradual. 459.10-460.45m: Light-gray, fine-grained sandstone with siliceous-carbonate cement..	∠ 5°	459.0-459.6m: Medium-strongly								0	97
												0	97
												0	97
	464.80									465.0m ~465.3m		0	97
										50		0	97
				464.80-474.80m: Weakly disseminated by pyrite 473.7-475.0m: Strongly disseminated by pyrite.								0	97
		Gray-Light gray, coarse-medium grained laminated sandstone, with siliceous-carbonate cement., horizontally bedded, including a lot of thin interlayers of black siltstone with thickness up to 1 mm. The rock is slightly fractured with calcite films coating joints. Interlayer of greenish-gray aleurolite occurs in the interval 470.7-470-85. The rock is slightly fractured. Contact with underlying layer is at the angle 10°.	∠ 0°									0	97
										470.0m ~470.3m		0	97
470										51	∠ 10-70°	3	97
												0	97
												0	97
												0	97
	474.80		∠ 10°							475.0m ~475.3m		0	97
										52		0	97
		Greenish gray-dark gray, siltstone, including lenses of gray fine-grained sandstone Joints oriented at the angle 50-55°, calcite films coating joints. Contact with underlying layer is gradual.		474.8-480m. Weak Chloritizatin 480-483.7m: Disseminated by pyrite								0	99
												0	99
												0	97
										480.0m ~480.3m		0	97
480										53		0	97
												0	97
											∠ 70°	1	97
	483.80											0	97
										485.0m ~485.3m		0	97
		Brown, Alternation beds of Bituminous sandstone(with siliceous-carbonate cement) and siltstone. Interlayer of greenish-gray colored fine-grained sandstone occurs in the interval 484.15-484.3m A lot of oil saturation zones are described in the interval 484.0-491.0m.	∠ 0°	484.0-491.0m: Appear Bituminous sandstone 487.4-489.0m: weakly disseminated by pyrite						54		0	97
												0	97
												0	97
												0	97
490												0	97

Plate 19-8 Geological Logging of the Drill Hole "MJK-1"(8/10), Zhaman-Aibat Ore Deposit

MJK – 1 INCLINATION: -90°

AREA: ZHAMAN-AIBAT BEARING: — ELEVATION: 357.04m FINAL DEPTH: 650.50m

SCALE(m)	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	SILICA	CLAY	CARBONATE	SULFATE	SAMPLE No.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. %
	491.90	Gray, fine-grained sandstone with siliceous-carbonate cement.. Accumulation of pyrite crystals observed at the interval 490.35-490.4m. Oil saturation in the interval 490.2-490.9m. The rock is slightly fractured; calcite films at fractures. Contact with underlying layer is at the angle 5°.	∠5°	490.2-490.9m: Appear Bituminous sandstone						55 490.0m ~490.3m		0	97
	493.20			493.20-495.10m: Disseminated by pyrite								0	97
	495.10	Dark-gray, siltstone with laminated and thinly bedded sandstone.	∠15°							56 495.0m ~495.3m	∠70°	1	97
		Gray, fine-grained sandstone with siliceous-carbonate cement., cross-bedded at the angles 15. Spots with increased pyrite content are also described through the layer, with calcite films coating joints, joints.		495.10-499.45m: Weak Chloritization Very weak pyrite dissemination								0	97
	499.45	Dark-gray, siltstone, with thinly bedded sandstone, at the angle 5°, including spots of light-gray limy sandstone. Joints contain calcite films. Contact with underlying layer is gradual.	∠5°	499.45-502.90m: Weakly disseminated by pyrite Veinlets of calcite						57 500.0m ~500.3m		0	97
500	502.90		∠0°									0	97
		Gray fine-grained sandstone with siliceous-carbonate cement., with thinly and horizontally bedded siltstone. Interlayer of intraformational conglomerate is observed within the interval 500.8-500.86. Calcite films coating joints and Veinlets of calcite 4 cm thick is observed at the bottom of the layer.		502.9-505.0m: Weakly disseminated by pyrite 502.9-506.1m: Weak Chloritization 505.0-505.3m: Cu, mineralization, Cu 12%, Ag 72.9 g/t						58 505.0m ~505.3m		0	97
	509.40	Greenish-gray-Dark-gray, fine-grained sandstone with siliceous-carbonate cement with horizontally and thinly bedded aleurosandstone. The rock is slightly fractured with calcite films coating joints. Contact with underlying layer is 0°.	∠0°							59 510.0m ~510.3m		0	97
510												0	97
		Greenish-gray - dark gray, sandy siltstone. Structure is bedded at the angle 0-5° due to fine lamination with dark-gray sandstone. Contact with underlying layer is gradual. Rare concretions of pyrite with size 1 x 1 - 1.5 - 2.0 cm are described through the layer.	∠0° 5°							60 515.0m ~515.3m		0	97
				515.6-516.2m, 519.3-525.0m; Weakly disseminated by pyrite								0	97
520	521.70	Gray-greenish gray, fine-medium grained sandstone with thinly and horizontally bedded red-green colored shade with siliceous-carbonate cement. Concretions of pyrite are observed within the layer. The rock is medium fractured with calcite films coating joints.	∠0°	521.70-524.60m: Disseminated by pyrite						61 520.0m ~520.3m		0	97
	524.60									62 525.0m ~525.3m		0	97
		Gray, sandy siltstone. Interlayer of horizontal micro-crystalline limestone is observed within the interval 535.5-535.9 mand 528.2-528.4m. Frequent concretions of calcite sizing from 0.1 x 0.2 cm to 0.5 x 1.0 cm are described within the interval 527.4--527.8mand 531.7-534.8 m. Contact with underlying layer is at the angle 0°.		527.4-534.8m: concretions of calcite						63 530.0m ~530.3m		0	97
530	535.45		∠0°							64 535.0m ~535.3m		0	97
		Dark gray-greenish gray, alternation beds of fine-grained sandstone and siltstone bedded at the angle 5° with calcite films and pyrite concretions at joints. Contact with underlying layer is at the angle 0°.		537.0-539.0m: Weakly disseminated by pyrite								0	97
540	540.75		∠0°							65 540.0m ~540.3m		0	97
		Pale gray-greenish gray, alternation beds of fine-grained sandstone (with siliceous cement and) siltstone bedded at the angle 0°. Lamination and graded bedding structure are developed. Weak pynte dissemination is observed at the sandstone layers. Oil saturation in the interval 544.45-545.80m and 549.50-550.35m.	∠0°	540.75-552.15m: Weak pyrite dissemination in the sandstone layers. 544.45-545.80m and 549.50-550.35m: Oil saturation						66 545.0m ~545.3m	∠5°	1	97
												0	97
550	552.15									67 550.0m ~550.3m		0	97
		Greenish-gray - dark gray, sandy siltstone. Structure is bedded at the angle 0-5° due to fine lamination with dark-gray sandstone Contact with underlying layer is gradual. 556.8-557.15m: gray, medium grained sandstone with weak pyrite dissemination and with Oil saturation.	∠0° 5°	556.8-557.15m: weak pyrite dissemination and Oil saturation.						68 555.0m ~555.3m	∠10°	2	97
	559.00	Pale gray, Coarse-fine grained sandstone, with graded bedding and lamination structure, bedding structure at the angle 10°.	∠10°	559.00-560.00m: Weak pynte dissemination								0	97
560													

Zhetkozgon Formation (Gray Sandstone)

Plate 19-9 Geological Logging of the Drill Hole "MJK-1"(9/10), Zhaman-Aibat Ore Deposit

MJK-1 INCLINATION: -90°

AREA: ZHAMAN-AIBAT BEARING: — ELEVATION: 357.04m FINAL DEPTH: 650.50m

SCALE(m)	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	SILICA	CLAY	CARBONATE	SULFATE	SAMPLE No.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. %
	561.70	Gray, coarse-fine grained sandstone, with siliceous cement. Graded bedding structure is developed at the angle 5°. Calcite films and fine abundant pyrite impregnation filling joint are observed through the layer.	∠5°	560.00-561.70m: pyrite dissemination(medium) and calcite films (weak)						69 560.0m ~560.3m		0	97
	568.00	Gray-pale greenish gray, fine alternation beds of sandy siltstone and fine grained sandstone, at the angle 5°-15°. Sometimes it contains sand-balls. Cristals and concretions of pyrite are observed at the interval from 564.6 to 565.0m. Contact with underlying layer is at the angle 0°.	∠5°~15° ∠0°	564.6-565.0m: Strongly disseminated by pyrite 565.0-568.0m: Weakly disseminated by pyrite						565.0m ~565.3m 70		0	97
570	578.20	Pale gray, coarse-fine grained sandstone with siliceous-carbonaceous cement, graded bedding structure is developed. Weak pyrite dissemination is observed all through the layer. Partially including brecciated siltstone fragments at the interval from 573.4 to 574.1m and from 576.0 to 577.9m. Bedding structure is horizontal, sometimes cross-bedded at the angle 5°-15°. Joints are oriented at the angle 5°-35°. Contact with underlying layer is wavy and gradual.	∠5°~15°	568.00-578.20m: Weak pyrite dissemination						570.0m ~570.3m 71		0	97
		Alternation beds of Sandstone and siltstone, horizontallly bedded. 583.0-585.3m: Weak pyrite dissemination **Sandstone layers:** Coarse-medium-fine grained sandstone layers showing graded bedding structure with Weak oil odor, Thickness: 0.9m-1.2m. Abundant fragments of greenish gray siltstone are observed in the layer. Contact with underlying layer is wavy (load cast ?). **Siltstone layers; Greenish gray,** Rare carbonaceous concretions with size up to 1.0 x 1.5cm and black mud ball are observed in the layer.	∠0°							575.0m ~575.3m 72		0	97
580	585.30	Gray, fine garined laminated sandstone, horizontally bedded. Dark gray colored interlayers with abundant pyrite are observed through the sandstone layer. Contact with underlying layer is at the angle 10°.		583.0-585.3m: Weak pyrite dissemination Sandstone layers: Weak oil odor						580.0m ~580.3m 73		0	97
		Gray-dark gray, laminated and thinly bedded sandstone including a small quantity of siltstone thin layers. Distinct graded bedding structure (bedding inclination; 0°-10°) is observed. Pyrite dissemination is observed all through the layers, strongly disseminated zones are distributed in the coarse grained sandstone layers.	∠0°	585.30-590.94m; Thin layers with pyrite concentration						585.0m ~585.3m 74		0	97
590	590.94		∠10°	590.94-597.60m: Pyrite dissemination 590.94-592.72m: strrong 592.72-593.95m: weak 594.35-594.64m: strrong 594.64-595.80m: weak 595.80-597.60m: strrong						Sample No. 1~43 (591.0m ~610.0m)		0	97
	597.60	Dark gray, alternating beds of fine grained sandstone(arenite) and siltstone, bedded at the angle 0°-5°. Chalcocite concentrated thin layers and weak pyrite dissemination (including a small amount of galena-chalcopyrite-bornite) are observed at the sandstone layers.	∠0°~10°							1		0	97
		Light gray-brown, medium graind massive sandstone, containing a small amount of conglomerate and siltstone thin layers, bedded at the angle 3°-7°. Dissemination by chalcocite (>>galena,bornite,chalcopyrite>pyrite) are observed within the interval 599.0-605.78m.	∠0°~5°	599.00-600.12m: Chalcocite concentration layers and weak pyrite dissemination						5		0	97
600	600.12									10	∠15° ∠5°	2 0	97 97
		Brownish light gray-greenish light gray, intraformational conglomerate (RAIMUNDO Conglomerate), consisting of angular fragments of white or pink-colored limestone and siltstone (sizing from 5 x 5mm to 15 x 30mm) and cement of green colored (caused by weak chloritization) muddy sandstone. At the bottom of the layer, cement is represented by red sandstone. No mineralization observed.	∠3°~7°	600.12-605.78m:Dissemination by chalcocite(>>galena,bornite, chalcopyrite >pyrite) 600.12-605.78m: strong 605.78-607.98m: very weak						15	∠5°	1	97
	608.27	Gray (partially brown), fine-medium grained sandstone(arenite) with siliceous-carbonaceous cement with horizontal graded bedding structure. Contact with underlying layer is wavy. Very weak pyrite dissemination is observed.	∠0°	609.30-610.75m: Very weak pyrite dissemination						20		0	97
610	609.30 610.75									25		0	97
	614.35	Reddish brown, siltstone with indistinct bedded structure. Calcite concretions with size 0.3 x 0.6cm and no mineralization observed.								30	∠10°	1	97
		Reddish light brown, laminated fine-medium grained sandstone, bedded at the angle 5°-10°. Reddish brown colored shale layer is observed within the interval 617.20-618.30m. Contact with underlying layer is wavy.	∠5°~10°	614.35-621.40m. Very weak pyrite dissemination						35		0	97
620	621.40									40	∠10°	2 0	97 97
		Reddish brown, horizontally bedded siltstone, containing calcite concretions sizing from 0.3 x 0.5cm to 0.5 x 2.0cm. Brown colored laminated sandstone layer is observed within the interval 624.65-625.80m and 628.00-630.00m.	∠0°							43		0	97
630										621.0m ~621.3m 75	∠5°	2 0	97 97
											∠10°	1 0	97 97
												0	97
												0	97
												0	97
												0	97
												0	97
												0	97
												0	97
												0	97

Zhezkazgan Formation (Gray Sandstone)

Weakly Mineralized Zone

Cu-Mineralized

Weakly Mineralized

Toskuduk Formation

Plate 19-10 Geological Logging of the Drill Hole "MJK-1"(10/10), Zhaman-Aibat Ore Deposit

MJK-1 INCLINATION: -90°

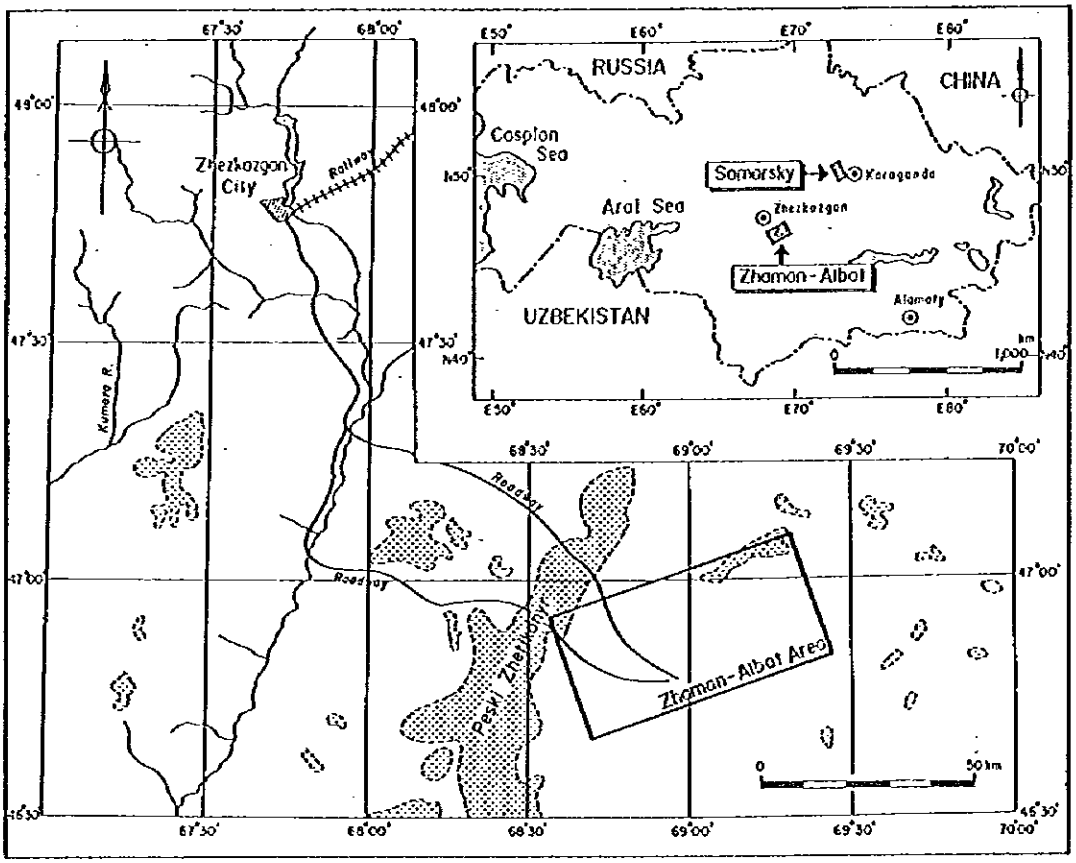
AREA: ZHAMAN-AIBAT BEARING: — ELEVATION: 357.04m FINAL DEPTH: 650.50m

SCALE(m)	COLUMN	DEPTH (m)	DESCRIPTION		REMARKS	MINERALIZATION	SULFIDE	SILICA	CLAY	CARBONATE	SULFATE	SAMPLE No.	ROCK PROPERTY: Angle of Fiss. (°)	ROCK PROPERTY: No. of Fiss. (/m)	ROCK PROPERTY: Core Rec. %
			Reddish brown, siltstone with indistinct horizontal bedded structute, containing calcite concretions sizing from 0.5 x 1cm to 2 x 3cm. Interlayers of medium grained sandstone and intraformational conglomerate are observed at the middle of the layer.	∠ 0°	Taskuduk Formation									0	97
													∠ 10°	2	97
														0	97
														0	97
														0	97
														0	97
														0	97
														0	97
														0	97
														0	97
640		639.80	Brownish gray, laminated medium grained sandstone, strongly fractured at the top of the layer. Contact with underlying layer is wavy.									642.0m ~ 642.3m 76		0	97
			Intraformational pebble conglomerate, consisting of red colored siltstone fragments and medium grained sandstone matrix. Contact with underlying layer is wavy.	∠ 5°										0	97
		646.90												0	97
		647.80	Red colored siltstone with indistinct bedded structure. Calcite concretions 0.5 x 1cm in size occur at the top of the layer. Interlayer of fine grained sandstone is observed within the interval 648.80-649.20m.											0	97
														0	97
650		650.50	(Final Depth)											0	97

Plate 20

Report on the Mineral Exploration
in
the Zhaman-Aibat and Samarsky Area, Republic of Kazakhstan
(Phase Ⅲ)

Geological Logging of the Drill Hole "MJK-2" (1/10~10/10), Zhaman-Aibat Ore Deposit



Japan International Cooperation Agency
Metal Mining Agency of Japan

February 1997

Scale 1 : 200

0 10 20 m

Plate 20-1 Geological Logging of the Drill Hole "MJK-2"(1/10), Zhaman-Aibat Ore Deposit

MJK-2 INCLINATION: −90°

AREA: ZHAMAN-AIBAT BEARING: ELEVATION: FINAL DEPTH: 700.00m

SCALE(m)	COLUMN	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	QUARTZ	CLAY	CARBONATE	SULFATE	SAMPLE NO.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. (%)
			Reddish brown weathered sand and clay. • 0.00-1.00m: Average 20% sand with clay matix. • 1.00-2.85m: Average 80% sand with clay matix										0	100
		2.85											0	100
													0	100
													0	81
													0	81
			Purplish brown siltstone with ligth brown sandstone patches and partings. Selenite,up to 25mm width, in lower horizon. • 12.00-12.40m: Pink fine grained sandstone. • 17.30-17.45m: Brown silty sandstone.	∠2°									0	81
													0	81
													0	81
													0	81
													0	81
													0	81
10				∠10°									0	81
													0	81
		12.00											0	81
		12.40											0	81
													0	81
													0	81
													0	81
													0	81
		17.30											0	81
		17.45											0	81
													0	81
		19.80											0	100
20			Light brown fine grained sandstone with brown silty sandstone and grey to white gypsum.	∠40° ∠5°									0	96
		21.40											0	93
			Weakly laminated brown siltstone with light grey spots o grained limestone • 23.10m: Gypsum spot (1.5×2.5 cm). • 26.00m-27.20:Selenite films up to 1.5cm width.										0	93
													0	93
													0	93
													0	93
													0	93
		27.20											0	100
			Light brown fine grained sandstone with selenite veins(up to 1cm width). • 29.90-30.10m :intraformational pebble conglomerate.	∠5°									0	100
30		30.20											0	100
													0	100
													0	100
													0	100
													0	100
			Light brown siltstone showing paralell lamination. • 27.00-32.00m:Gypsum up to 1.5cm width(average 2 veins/m)and sporadic selenite. • 36.10-51.40m:Selenite veins(2.5cm) and chlorite in tractures.									∠10°	1	100
												∠15°	2	100
												∠15°	1	100
													1	100
													1	100
													1	100
													1	100
													1	100
40				∠10°									1	100
				∠5°									1	100
													1	100
													1	100
													1	100
													1	100
													1	100
													1	100
50													1	100
		51.40											1	100
		52.25	Light brown sandstone.	∠5°									1	100
			Brown siltstone with spots of limy fine grained calcareous sandstone. Gypsum veins up to 8cm width.	∠5°									1	100
		55.40											1	100
		57.00	Reddish brown fine grained sandstone	∠0°									1	100
			Purplish brown siltstone showing parallel lamination . • 59.00m:Gypsum of 20cm width. • 63.00m:Gypsum of 10cm width. • 68.20m:Greyish green siltstone parting of 2cm thickness.										1	100
60													1	100
													1	100
													1	100
													1	100
				∠0°									1	100
													1	100
													1	100
													1	100
													1	100
													1	100

Plate 20-2 Geological Logging of the Drill Hole "MJK-2"(2/10), Zhaman-Aibat Ore Deposit

MJK-2 INCLINATION: −90°

AREA: ZHAMAN-AIBAT BEARING: ELEVATION: FINAL DEPTH: 700.00m

SCALE(m)	COLUMN	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	QUARTZ	CLAY	CARBONATE	SULFATE	SAMPLE NO.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (m)	Core Rec. (%)
70			Purplish brown siltstone showing parallel lamination . • 78.00m:Gypsum of 6cm width. • 76.00-86.00m:Numerous gypsum veins.	∠0°									0	100
													0	100
													0	100
													0	100
												∠5°	1	100
												∠10°	1	100
												∠50°	1	100
													0	100
													0	100
80													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
90													0	100
													0	100
													0	100
		94.80											0	100
			Brown fine to medium grained sandstone.	∠0°								∠5°	1	100
		97.40										∠10°	1	100
			Purplish brown siltstone interbedded with thin sandstone layers. • 100.00-104.00m:Numerous gypsum veins up to 12mm width.	∠5° ∠10°								∠25°	1	100
100													0	100
													0	100
													0	100
		102.40											0	100
			Reddish brown fine to medium grained sandstone.	∠20°								∠10°	0	100
		104.55										∠25°	0	100
			Dark brown siltstone with intercalations of greenish blue siltstone in:116.80-117.00m, 121.20-121.26m, 122.60-122.80m and 123.40-123.60m.										0	100
													0	100
													0	100
110													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
				∠0°									0	100
													0	100
													0	100
													0	100
													0	100
													0	100
		125.80											0	100
		126.60	Brown fine grained sandstone with intercalation of dark brown siltstone in 126.60-127.40m.	∠0°									0	100
		127.40		∠10°									0	100
		128.30		∠20°									0	100
			Thinly bedded alternation of purplish brown siltstone and reddish brown fine grained sandstone.										0	100
130													0	100
													0	100
													0	100
				∠0°									0	100
													0	100
		135.70											0	100
			.Purplish brown siltstone with fine grained sandstone.										0	100
													0	100
													0	100
													0	100
													0	100
140													0	100

Plate 20-3 Geological Logging of the Drill Hole "MJK-2" (3/10), Zhaman-Aibat Ore Deposit

MJK-2 INCLINATION: -90°

AREA: ZHAMAN-AIBAT BEARING: ELEVATION: FINAL DEPTH: 700.00 m

SCALE(m)	COLUMN	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	QUARTZ	CLAY	CARBONATE	SULFATE	SAMPLE NO.	ROCK PROPERTY: Angle of Fiss. (°)	ROCK PROPERTY: No. of Fiss. (/m)	ROCK PROPERTY: Core Rec. (%)
140			Purplish brown siltstone with fine grained sandstone. • 143.90-143.90m:Congrometric anhydrite(0.5×1.0cm).	∠0°									0	100
150		153.0											0	100
		154.0	Brown fine grained sandstone.	∠5°									0	100
			Purplish brown siltstone. • 154.00-166.40m:Massive facies is dominated. • 166.40-188.60m:Facies showing lamination is dominated. • Many interlayers of gypsum(selenite) up to 6cm in width. • Thin fine grained sandstone layers are interbedded in:166.50m-166.70m,170.50m-170.65m,170.70m-170.80m, 175.00m-175.10m, 170.90m-171.00m. • 184.70-185.20m:Carbonate concretion (0.5×1.0cm).										0	100
160													0	100
170													0	100
180				∠5° ∠20° ∠10°									0	100
190		188.6		∠5° ∠10°									0	100
		191.7	Brown siltstone interbedded with fine grained sandstones and breccia										0	100
		193.6	Brown fine grained sandstone.	∠5° ∠10°									0	100
200			Reddish brown fine grained sandstone with rare braccia parting. • 200.60: Gypsum fibers up to 6cm.	∠5° ∠10°									0	100
		201.6											2	100
		202.7	Reddish brown tectonic breccia consisting of fragments of light brown siltstone and gypsum cemented by fine grained sandstone.										3	100
			Dark brown siltstone. • Gypsum :203.10-203.60m, 204.90-206.30m, 206.70-207.60m and 208.40-208.80m. A few selenite interlayers up to 2cm width.										2	100
210													0	100

Plate 20-4 Geological Logging of the Drill Hole "MJK-2"(4/10), Zhaman-Aibat Ore Deposit

MJK-2 INCLINATION: −90°

AREA: ZHAMAN-AIBAT BEARING: ELEVATION: FINAL DEPTH: 700.00 m

SCALE(m)	COLUMN	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	QUARTZ	CLAY	CARBONATE	SULFATE	SAMPLE NO.	ROCK PROPERTY: Angle of Fiss. (°)	ROCK PROPERTY: No. of Fiss. (m)	ROCK PROPERTY: Core Rec. (%)
210		211.50											0	100
			Dark brown sandstone.	∠5°									0	100
		214.30											0	100
			Dark brown siltstone interbeded with fine grained sandstone.										0	100
			• Gypsum (up to 15cm width):217.20-217.40m,218.20-218.50m,219.90-220.20m,221.20-221.70m,225.40-225.90m,229.50-238.80m										0	100
220				∠5° ∠10°									0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
230													0	100
													0	100
													0	100
													0	100
													0	100
		235.70											0	100
		236.40	Brown fine grained sandstone.										0	100
			Dark brown siltstone interbeded with light brown fine grained sandstone.										0	100
240			• Gypsum(selenite) from 2cm to 15cm in all horizon.										0	100
			• Dark greenish grey siltstone partings (2-3cm thickness) in:251.10-251.40m.	∠5° ∠10°									0	100
													0	100
													0	100
													0	100
													0	100
													0	100
250													0	100
		251.50											0	100
			Brown siltstone,parallel lamination at the lower part by the interlayers of light brown fine grained sandstone.										0	100
			• 260.50-260.75m:Breccia of anhydrite										0	100
			• 263.90-264.65: White crystalline anhydrite.	∠10°									0	100
													0	100
260													0	100
													0	100
													0	100
													0	100
		264.65											0	100
			Massive~weakly parallel laminated dark brown siltstone									0° ∠5°	1	100
			• 265.00-267.50m:Greyish white anhydrite up to 8cm.										1	100
270													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
		279.00											0	100
280			Brown sandstone.											

Plate 20-5 Geological Logging of the Drill Hole "MJK-2"(5/10), Zhaman-Aibat Ore Deposit

MJK-2

INCLINATION: −90°

AREA: ZHAMAN-AIBAT BEARING: ELEVATION: FINAL DEPTH: 700.00 m

SCALE(m)	COLUMN	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	QUARTZ	CLAY	CARBONATE	SULFATE	SAMPLE NO.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. (%)
280		280.20	Brown siltstone interbedded with brown fine grained sandstone. • Parting of anhydrite: 289.90-290.00 m and 290.60-291.30m. • Tectonic breccia:298.80-299.00m,299.70-299.80m,300.15-300.45m and 300.60-300.90m. • 297.70-297.85m.:Carbonate concretion(1.5×1.0cm) with the traces of chlorite.	∠5° ∠10°								0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
290													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
													0	100
300		300.90	Brown siltstone,distinct parallel bedding by interlayers of fine grained sandstone. • Partings of anhydrite (up to 20cm thickness)in:311.30-311.95m,315.10-315.80m. • 317.80-318.00m:Greyish brown sandstone layers.	∠0°								3	100
												4	100
												5	100
												2	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
310												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
320		321.60										0	100
		322.10	Light brown fine grained sandstone.	∠0°							∠5°	2	100
			Brown siltstone • 322.10-333.10m:Gypsum up to 0.4cm. • 330.20-331.80m:Brown siltstone with green spots. • Breccias:327.00-327.20m,328.00-328.40m and 332.90-333.00m.									0	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
330												0	100
												0	100
												0	100
		333.10										0	100
		334.70	Light brown fine grained sandstone.									0	100
			Brown siltstone~silty sandstone with a few carbonate concretions up to 0.5×1.0cm.. • Interlayers of fine grained sandstone in:348.20-348.40m and 350.10-350.35m. • 346.40m: Concretion of chorite-carbonate. • Tectonic breccia consisting of sharp fractures of siltstone cemented by some fine mashed material in:336.10-336.20m,338.60-338.65m,341.20-341.60m,345.00,345.10m and 353.10-353.16m.								∠30°	3	100
												0	100
												0	100
											∠45°	2	100
340											∠10°	3	100
											∠65°	3	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
350												0	100

Plate 20-6 Geological Logging of the Drill Hole "MJK-2"(6/10), Zhaman-Aibat Ore Deposit

MJK-2 INCLINATION: −90°

AREA: ZHAMAN-AIBAT BEARING: ELEVATION: FINAL DEPTH: 700.00 m

SCALE(m)	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	QUARTZ	CLAY	CARBONATE	SULFATE	SAMPLE NO.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. (%)
350												0	100
												0	100
	353.2											0	100
		Light brown siltstone interbedded with fine grained sandstone.										0	100
		• 353.20-353.60m:Tectonic breccia consisting of small sharp fractured siltstone cemented by clay.	∠5°									0	100
												0	95
	359.0											0	95
		Light brown fine grained sandstone.	∠0°									0	95
360	361.10		∠5°			*					∠45°	2	100
		Light brown siltstone with interlayers of fine grained sandstone.										2	100
		• Sandstone: 366.90-367.00m,368.40-368.70m and 375.30-375.50m.						+				2	75
		• Fissures or minor fault:368.80-370.00m,372.70-372.90m,373.60-373.80m and 375.50-375.70m.										2	100
		• 369.50-369.90m :Tectonic breccia.										2	100
												2	100
												5	100
370												3	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
		Tectonic breccia consisting of strongly crushed and mashed siltstone. Fractures are cemented by clay and carbonate materials.										0	100
	375.70											2	75
	376.70							+			∠60°	3	80
	377.90	Light brown fine grained sandstone.									∠75°	5	84
		Brown siltstone.										4	98
380					*	*						4	100
												4	100
												4	100
												4	100
	384.40											4	90
		Light brown fine to medium grained sandstone. Fininng upwards sequence.	∠5°									4	100
	387.20											4	100
		Reddish brown siltstone with the interlayers of reddish grey fine grained sandstone.										4	97
390	390.60											4	100
												4	100
		Brown fine to medium grained sandstone interbedded with siltstone .	∠5°									4	100
			∠5°					+			∠5°	2	100
	394.10										∠5°-10°	0	100
		Light brown to purplish brown siltstone interbedded with thin sandstones.	∠0°									0	95
												0	95
		• 397.60-424.20: 3-10 veins of gypsum/ meter,each vein is 1-2mm width.	∠0°					+				0	93
												0	85
								+				0	100
400		• 395.00-398.20:Chlorite films on fracture plains.										0	100
		• 402.50-403.20:Greyish brown very fine grained sandstone										0	100
		• 404.40-405.20:Greyish brown to reddish brown fine grained sandstone with minor siltstone partings.										0	100
												0	100
		• 408.80-409.30:Sandstone fragments patch within siltstone matrix.										0	100
		• 413.50-414.45:Bandded and irregular chlorite alteration.										0	100
												0	100
												0	100
410												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
												0	100
	417.30											0	100
	418.30	Massive fine to medium grained sandstone.										0	100
420		Dark brown siltstone.										0	100

Plate 20-7 Geological Logging of the Drill Hole "MJK-2"(7/10), Zhaman-Aibat Ore Deposit

MJK-2 INCLINATION: −90°

AREA: ZHAMAN-AIBAT BEARING: ELEVATION: FINAL DEPTH: 700.00 m

SCALE(m)	COLUMN	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	QUARTZ	CLAY	CARBONATE	SULFATE	SAMPLE NO.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. (%)
420				∠5°									0	98
												∠5°	0	98
												∠20°	0	98
													0	98
		424.5											0	100
			Purplish grey fine grained sandstone.	∠5°									0	99
		425.9											0	99
			Reddish brown siltstone with the interlayers of grey fine grained sandstone.										0	99
430			• Sandstone in:426.80-427.00m,428.60-428.80m, 433.40-433.70m and 435.00-435.30m.										0	99
			• Breccia (mudball) in:428.00-428.10m,433.90-433.95m, 434.70-434.80m and 435.40-435.50m.										0	99
			Films of calcite and chorite in the fissures of all horizon.										0	99
													0	99
													0	99
													0	99
													0	99
		438.3											0	86
		439.0	Greyish brown medium grained sandstone.	∠5°									0	100
440			Reddish brown siltstone with rare spots of limy siltstone.										0	100
		441.7	Chlorite in the fissures.										0	100
			Greenish grey siltstone with reddish brown siltstone in: 442.50-442.90m,448.70-448.80m.										0	100
		444.0	Chlorite and calcite films in the fissures.										0	100
		446.2											0	100
		446.7											0	88
		448.3	Reddish brown siltstone with rare spots of green materials										0	80
		448.5											0	83
450		450.0	Medium-thick bedded alternation of reddish brown siltstone and greenish grey siltstone.										1	100
		451.2	• 446.70-448.30: Reddish brown siltstone with spots of grey materials.									∠5°	0	100
			• 448.30-448.80: Greenish grey siltstone.										0	100
			• 448.80-450.00: Reddish brown siltstone.										0	100
		456.3	• 450.00-451.20: Grey siltstone with calcite veins (up to 0.3cm. width).										0	100
		457.1											0	100
		457.6	• 451.20-456.30: Reddish brown siltstone with the interlayers of greennish dark grey tuff? in 453.70-454.00m.	∠5°								∠5°	2	100
460		460.3										∠15°	4	100
		461.3	Grey siltstone with the interlayers of grey to black fine grained sandstone.	∠5°	461.50-464.40m:Weak pyrite diss.							∠5°	1	100
			• 457.10-457.60: Brown siltstone.	∠5°	464.50-464.70m:Pyrite in fissures.								0	100
			• 460.30-461.30: Massive light brown siltstone.	∠5°								∠5°	2	100
		463.8	• 463.80-464.40: Grey fine grained sandstone									∠10°	0	100
		464.4	• 464.50-464.70m: Strongly sheared zone with films of calcite and pyrite.	∠5°								∠15°	2	100
			• 466.80-467.70: Massive brown siltstone.	∠5°	467.70-469.50m:Pyrite diss.							∠50°	2	100
		466.8	• 467.70-469.50:Grey siltstone with grey fine grained sandstone partings. Pyrite films and pyrite spots areal 469.10m.	∠5°									2	100
		467.7		∠5°								∠5°,10°	2	100
		469.5	• 469.50-470.00: Dark grey to black fine grained sandstone with the smell of oil.	∠15°	469.10m:Pyrite films/spots.							∠50°	2	100
470		470.0	Fissures filled with calcite and pyrite.		469.50-470.00m:Pyrite in fissures.							∠50°	4	100
		471.8	• 471.80-472.80:Tectonic breccia with calcite and pyrite.	∠5°								∠5%10°	2	100
		472.8		∠5°	471.80-472.80m:							∠50°	2	100
		473.6		∠5°	Tectonic breccia with pyrite.							∠50°	5	100
		474.1										∠10°	6	100
		475.1		∠10°								∠10°	2	100
		476.1										∠5%10°	3	100
			Purplish brown siltstone with grey siltstone at lower part.	∠5°	478.00-483.40m:Pyrite diss./films.							∠15°	1	100
		478.0		∠5°								∠60°	2	100
		478.9	Light brown siltstone with red fine grained sandstone.									∠10°	1	100
480		479.8	• 477.30-477.50m:Tectonic breccia.		482.50m:Spots of marcasite/pyrite.							∠85°	2	100
		481.4	Brown siltstone with brown fine grained sandstone	∠15°								∠65°	1	100
		482.8										∠50°	3	100
		483.3	Greyish brown to blackish grey fine grained sandstone with common pyrite dissimination and films.									∠0°	5	100
				∠5°								∠10°	2	100
			Brown siltstone with minor partings of brown fine grained sandstone									∠85%40°	0	100
												∠5°~20°	0	100
												∠5°~15°	0	100
													0	100
													0	100
													0	100
		489.3											0	100
490														

Plate 20-8 Geological Logging of the Drill Hole "MJK-2"(8/10), Zhaman-Aibat Ore Deposit

INCLINATION: −90°

AREA: ZHAMAN-AIBAT BEARING: ELEVATION: FINAL DEPTH: 700.00 m

SCALE(m)	COLUMN	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	QUARTZ	CLAY	CARBONATE	SULFATE	SAMPLE NO.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (m)	Core Rec. (%)
490			Greenish grey siltstone with grey fine grained sandstone.	∠10°	490.55-494.00m: Pyrite in matrix.								0	100
			• 493.40-494.00: Black fine grained oil-carrying sandstone with pyrite	∠5°									0	100
		493.40										∠30°	2	100
		494.00		∠5°								∠10°	0	100
		494.90	• 494.00-494.90: Massive grey siltstone with pyrite staine in fissures.		494.00-494.90m: Pyrite in fissures.							∠40°	1	100
				∠5°	494.90-497.00m: Spots of pyrite.							∠0°	2	100
		497.00										∠10°	0	100
			• 494.90-497.00: Dark grey to black fine grained sandstone with weak smell of oil. Films of calcite and spots of pyrite are common.									∠80°	3	100
				∠5°								∠70°		
		499.10										∠5°	0	100
		499.60	• 497.00-499.60: Dark greyish green siltstone with greyish brown fine grained sandstone in lower 50cm.										0	100
500		500.60		∠5°								∠5°	3	100
			Brown siltstone with greyish brown fine grained sandstone.	∠10°								∠85°	1	100
		501.80										∠10°		
		503.20		∠5°								∠5°,45°	2	100
			Greenish grey siltstone.		503.20-506.50m: Pyrite in matrix.							∠5°	1	100
			• Grey fine grained sandstone: 505.20-505.30m and 505.90-506.00m.									∠50°	1	100
												∠30°	1	100
		506.50										∠10°	1	100
			Grey fine to medium grained sandstone with the interlayers of grey to black sandstone.	∠5°									0	100
				∠5°	509.10-514.50m:								0	100
		509.10			Pyrite diss. in fissures.									
		509.80		∠5°								∠85°,50°	3	100
510		510.80	Dark-grey siltstone with grey fine grained sandstone.									∠15°	1	100
		511.50	Films of calcite and dissiminated pyrite are common in fissures	∠5°								∠5°		
		512.30										∠5°,30°	2	100
			• 509.80-510.80: Dark brown massive siltstone.	∠5°								∠10°,60°	2	100
		514.55	• 511.50-512.30: Brown siltstone.									∠85°,80°	2	100
			Brown siltstone with brown fine grained sandstone.									∠5°,45°	2	100
				∠5°								∠20°	1	100
												∠30°	1	100
			• 520.30-520.60m: Tectonic fissures consisiting of clay.									∠5°	1	100
			• 521.90-522.00m: Grey siltstone										0	100
520			• 523.30-524.10m: Dark grey sandstone with dark grey siltstone										0	100
			• 528.10-528.50m: Black fine grained sandstone with the smell of oil.										0	100
		523.30			523.30-524.10m: Pyrite in matrix.								0	100
		524.10		∠10°								∠5°	2	100
												∠15°	0	100
												∠50°	2	100
												∠30°	0	100
		528.10			528.10-528.50m: Pyrite in matrix.								0	100
		528.50											0	100
530													0	100
													0	100
													0	100
													0	100
		533.50			533.50-535.50m: Pyrite in matrix.								1	100
			Dark grey siltstone with the interlayers of red siltstone in: 534.90-535.20m.	∠5°								∠15°	1	100
		535.50										∠25°	0	100
			• 534.20-534.40m: Black fine grained sandstone with smell of oil.									∠0°,15°		100
													0	100
		539.40	Brown siltstone with a few interlayers of brown fine grained sandstone.	∠5°									0	100
540		539.70											0	100
			• 539.20-539.60m: Grey fine grained sandstone.										0	100
													0	100
		543.20											0	100
			Dark grey siltstone with the interlayers of dark-grey to black fine grained sandstone with smell of oil.	∠0°	544.20m: Pyrite in matrix.							∠5°	2	100
		546.40										∠20°	0	100
		547.50	Brown massive siltstone with minor fine grained sandstone.									∠5°	1	100
		548.00			549.20-551.70m: Pyrite in matrix.							∠20°	3	100
		549.20	547.50-548.00: Grey siltstone	∠10°								∠10°,20°	1	100
												∠10°	0	100
550			Dark grey siltstone with grey fine grained sandstone.		550.90m-552.10m:								0	100
			Films of pyrite and marcasite at 550.90m.	∠10°	Films of pyrite/marcasite.							∠10°	4	98
		551.70												
		552.35	Dark grey fine grained sandstone with smell of oil.	∠10°	554.30-554.80m: Pyrite films.							∠5°,15°	1	89
		553.35										∠10°	1	100
		554.35	• 552.35-553.35: Dark grey to black massive siltstone	∠5°	554.80-559.80m: Pyrite in matrix.							∠5°	0	100
		554.80	• 554.35-554.80: Grey siltstone	∠5°										
		555.30		∠10°								∠5°-0°	2	100
			Dark grey siltstone with grey fine grained sandstone.									∠10°	1	100
				∠5°								∠35°	1	100
560		559.80											0	100

Plate 20-9 Geological Logging of the Drill Hole "MJK-2"(9/10), Zhaman-Aibat Ore Deposit

MJK-2 INCLINATION: -90°

AREA: ZHAMAN-AIBAT BEARING: ELEVATION: 336.5m FINAL DEPTH: 700.00m

SCALE(m)	COLUMN	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	QUARTZ	CLAY	CARBONATE	SULFATE	SAMPLE NO.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (/m)	Core Rec. (%)
560		561.20	Grey fine grained sandstone with intercalations of black sandstone and dark grey siltstone. Pyrite is common in all horizon and its nests at 559.85m and 560.20m. • 564.20-565.90: Grey fine grained sandstone with fissures stained by pyrite. • 565.90-566.40: Greyish green massive siltstone. • 567.10-568.00: Dark grey siltstone	∠5°	559.80-568.60m: Common pyrite diss.							∠5°	2	100
		563.20										∠30°	1	100
		563.70		∠0°								∠5°	1	100
		564.20		∠5°	564.20-565.90m: Pyrite in fissures.							∠20°	1	100
		565.90		∠5°								∠15°	1	100
		566.40											0	100
		567.10		∠20°									0	100
		568.00		∠5°								∠10°-20°	2	100
		568.60		∠5°									0	100
570		574.90	Grey(weekly greenish) siltstone with partings of grey fine grained sandstone.	∠5°	568.60-593.60m: Rare pyrite spots.							∠5°	1	100
		576.40	Grey fine grained sandstone with smell of oil. • 574.90m: Thick nesty interlaying of pyrite.	∠15°	574.90m: Thick nesty pyrite.							∠60°	3	100
		578.50	Greyish-green siltstone with grey fine grained sandstone.	∠5°								∠15°	2	100
580		582.00	Grey fine grained sandstone with dark grey fine grained sandstone	∠5°								∠5°	2	100
		593.60	Thin bedded alternation of dark grey siltstone silty-sandstone and grey fine grained sandstone.	∠5°	593.60-599.60m: Common pyrite films.							∠10°	1	100
590		599.60	Grey fine grained sandstone with minor dark grey to greenish grey fine grained sandstone.	∠0° ∠10° ∠10°								∠0°	1	100
600		603.00	Thinnly bedded alternation of grey fine grained sandstone(40%) and laminated dark grey siltstone (60%).	∠5°	599.60-603.00m: Rare pyrite spots.							∠5°	0	100
		605.40	Greenish grey siltstone with thin sandstone layers.	∠5°	603.00-605.40m: Rare pyrite in fissures.							∠20°	2	100
		606.15	Medium bedded alternation of grey sandstone, grey conglomerate and grey siltstone.	∠10°	606.75-607.80m: Chalcocite in fissures.							∠5°	2	100
		606.75										∠15°	0	100
		607.80		∠15°	608.40-608.60m: Weak galena/bornite diss.								0	100
		609.00											0	100
610		618.40	Grey fine to coarse grained sandstone interbedded with granule-pebble conglomerate in: 614.6-615.6m, 617.5-617.65m, 618.4-619.5m and 619.45-619.85m.	∠5° ∠5° ∠5° ∠5°	609.00-610.40m: Abundant galena/chalcocite diss. 610.40-611.40m: Massively chalcocite/bornite diss. 611.40-615.60m: Frequent diss. of chalcocite/bornite. 615.60-618.40m: Chalcocite diss.							∠5°	1	100
		619.90		∠10°	618.40-619.90m: Spots/diss. of chalcocite.								0	100
620		624.30	Greenish grey fine grained sandstone with intraformational conglomerate in 623.30-623.70m.	∠5°								∠5°	2	100
		625.90	Brown massive siltstone.										0	100
		626.80	Brown to greenish grey fine grained massive sandstone.									∠45°	2	100
		628.40		∠5°	629.00-630.00m: Weak chalcocite diss.							∠5°	1	100
		629.00	Brown massive siltstone.										0	100
630												∠3°	0	100

Sample No. 1~133 (599.60~700.00)

Plate 20-10 Geological Logging of the Drill Hole "MJK-2"(10/10), Zhaman-Aibat Ore Deposit

MJK-2 INCLINATION: −90° AREA: ZHAMAN-AIBAT BEARING: ELEVATION: FINAL DEPTH: 700.00 m

SCALE(m)	COLUMN	DEPTH (m)	DESCRIPTION	REMARKS	MINERALIZATION	SULFIDE	QUARTZ	CLAY	CARBONATE	SULFATE	SAMPLE NO.	ROCK PROPERTY: Angle of Fiss. (°)	No. of Fiss. (m)	Core Rec. (%)
630			629.00-639.10 Greyish green medium to coarse grained sandstone with intraformational conglomerate in 633.20-633.50m,638.20-638.30m, 638.60-638.70m and 639.00-639.10m.	∠5°	630.00-630.30m: Densely diss. of chalcocite. 630.75-631.60m: Weak chalcocite diss.						45	∠5°	0	100
													0	100
													0	100
													1	100
											50		0	100
													0	100
													0	100
													0	100
											55	∠5°	2	100
		639.10										∠15°	0	100
		639.70	Greyish green massive siltstone with brown siltstone in upper 20cm.		639.70-644.15m: Weak chalcocite diss.								0	100
640			Greenish grey fine grained sandstone with scattered pebbles (up to 40%) of grey siltstone.	∠10°	642.80m: Bornite/chalcocite diss.						60	∠5° ∠10°	2	100
		644.00											0	100
			Greyish brown fine grained sandstone with brown siltstone in 644.00-644.15m and 644.90-645.00m and intraformational conglomerate (30cm. thick) at 646.00m.	∠10°									0	100
													0	100
		646.90									65		0	100
		647.60	Brown massive siltstone.	∠10°								∠50° ∠15°	3	100
			Grey fine grained sandstone with dark grey to greyish brown fine grained sandstone. Interlayers of greyish brown pebbles are common									∠20°	1	100
650												∠5°	0	100
		651.90									70		0	100
			Brown siltstone to fine grained sandstone with greenish brown fine grained sandstone(652.50-653.60m).	∠0°									0	100
													0	100
		655.00											0	100
		657.40	Greenish grey fine grained sandstone with silt-fragment in all horizon	∠5°							75	∠5°	1	100
			Greyish brown fine to coarse grained sandstone with brown siltstone. Intraformational conglomerate is common and silt-fragment patches in places.	∠5°									0	100
				∠5°									0	100
660				∠10°									0	100
											80	∠5°	1	100
													0	100
													0	100
													0	100
											85	∠5°	1	100
		665.90		∠20°									0	100
			Brown massive siltstone.										0	100
670											90	∠5°	1	100
												∠45°	2	100
												∠20°	1	100
												∠5°	0	100
													0	100
											95		0	100
												∠67°	1	100
		672.00											0	100
		673.20	Greyish brown fine grained sandstone	∠10°								∠5° ∠15°	2	100
			Greenish grey fine grained sandstone Intraformational conglomerate at 676.10m and 678.45m.	∠5°	673.20-679.50m: Scatter diss. of pyrite						100		0	100
													0	100
													0	100
												∠5°	0	100
													0	100
													0	100
		679.50									105	∠5°	3	100
680			Brown massive siltstone										0	100
												∠5°	2	100
		682.20		∠10°								∠5°	2	100
			Brown massive siltstone with greyish brown fine grained sandstone.	∠5°								∠5°	2	100
		684.60									110		0	100
		685.10	Greyish green siltstone.	∠5°	686.20-692.30m: Weak chalcocite/bornite diss.							∠5°	3	100
			Greenish grey fine grained sandstone with grey siltstone in 686.9-687.5m.									∠5°	0	100
				∠5°							115		0	100
													0	100
690												∠5°	1	100
											120	∠67°	1	100
		692.30											0	100
			Brown siltstone with brown fine grained sandstone.	∠5°									0	100
													0	100
		695.50	Greyish brown fine grained sandstone with brown fine grained sandstone.	∠5°							125	∠5°	1	100
		697.00										∠10°	2	100
			Brown massive siltstone									∠60°	0	100
		699.20	Grey fine grained sandstone.	∠5°								∠5°	1	100
700											130	∠5°	2	100
												∠10°	0	100
												∠5°	2	100
												∠15°