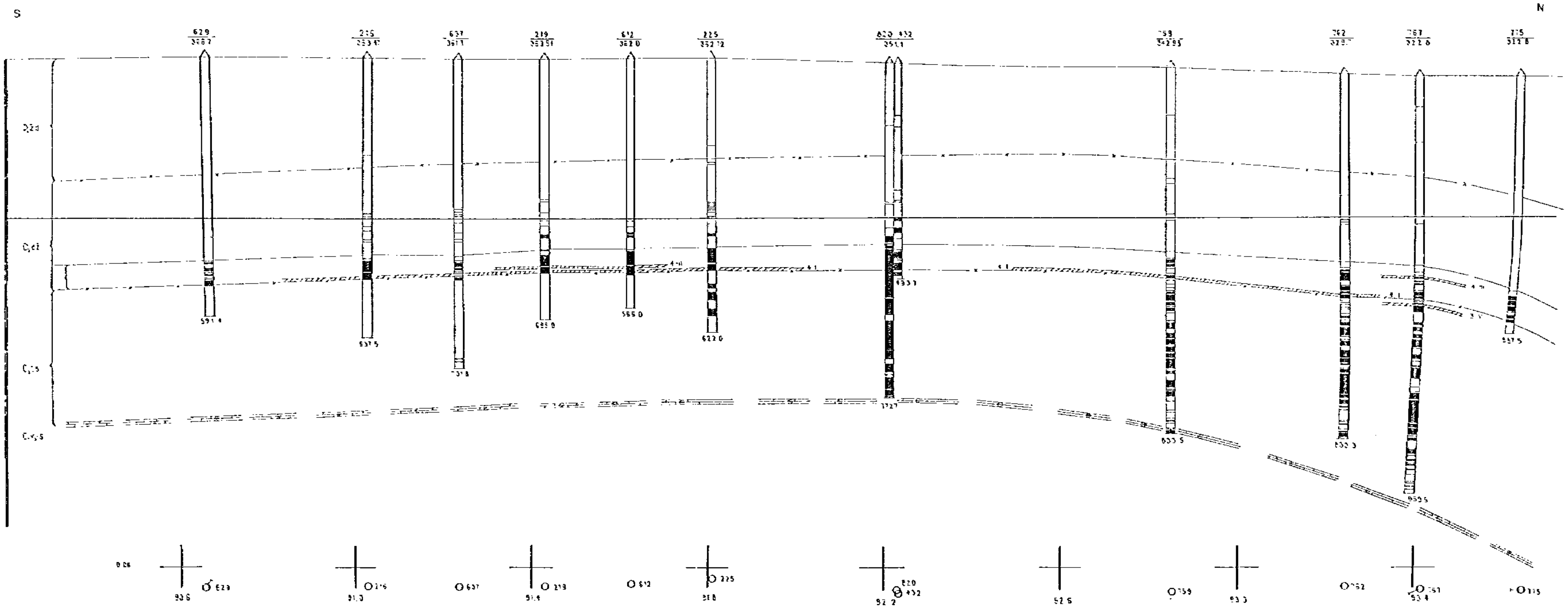
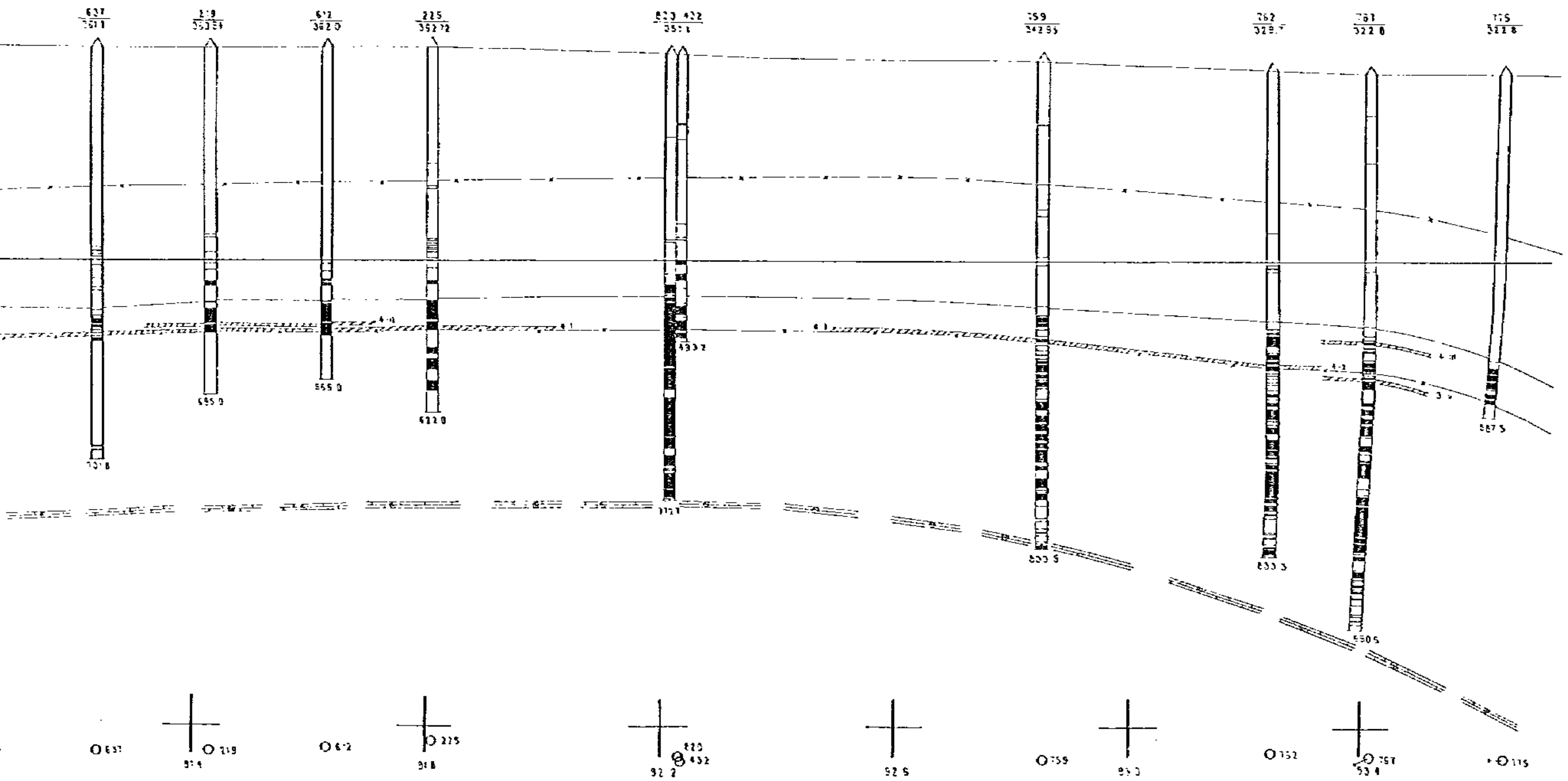
SCHEMATIC GEOLOGICAL CROSS-SECTION 235-235



Well no	mineralization horizon from	to	thickness m	core recovery			grade Cu %	Pb %	Zn %	Au g/t	Ag g/t	S %	deposit	commercial characteristics	ore type
629	52975	5307	0.95	100			0.55			0.1	5.83	0.16	4-1	mineraliz	copper
215	4312	4922	1.0	100			0.23				1.0	0.11		–"–	–"–
	4357	4512	0.5	100			0.28				2.2	<0.1	4-1	min.inbol	–"–
	4344	4361	1.5	100			1.0			<0.5	4.25	0.9	4-1	balance	–"–
637	4512	4921	0.85	100			2.07				24.5		4-1	–"–	–"–
	4321	4355	3.8	100			0.73				0.28		4-1	mineral	–"–
	4355	4393	3.4	100			0.74				6.15		3-V	balance	–"–
219	4778	4783	1.0	100			0.23				7.5			min.intop	–"–
	4785	4795	1.0	100			4.71				4.15		4-II	balance	–"–
	4798	4357	5.9	100			0.19				2.25		4-1	min.intop	–"–
	4857	4897	3.6	100			1.25				5.30		4-1	balance	–"–
612	4773	4789	1.5	100			7.37			4.5	45.47	3.45	4-1	–"–	–"–
	4738	4733	0.5	100			0.23			0.24	1.2	0.26	4-1	min.inbol	–"–
	4944	4949	0.5	100			0.15			2.1	34.6	1.25	4-1	balance	–"–
225	4710	4723	1.3	100					0.33		1.1			mineraliz	zinc
	4751	4803	5.1	100			1.23			1.82	8.47	1.03	4-1	balance	copper
	5724	5734	1.0	100			0.31			0.48	2.5	0.37	3-V	mineraliz	–"–
432														barren	

Well no	mineralization horizon from	to	thickness m	core recovery			grade Cu %	Pb %	Zn %	Au g/t	Ag g/t	S %	deposit	commercial characteristics	ore type
620	5257	5262	0.5	100				0.16	0.33	0.05	1.0	0.09	3-V	mineraliz	Pb-Zn
	5350	5372	1.2	100			0.31			<0.04	1.3	1.34		–"–	copper
759	4556	4573	1.7	100			0.25			0.09	3.33	<0.1		min.intop	–"–
	4573	4790	11.7	100			3.9			0.54	13.62	0.22	4-1	balance	–"–
762	4934	4944	1.0	85			0.53			0.07	6.4	0.1		min.intop	–"–
	4944	50595	11.55	37			3.54			2.12	57.43	1.5	4-1	balance	–"–
	5826	5883	5.7	100			0.24			0.1	0.74	<0.1	3	mineraliz	–"–
767	45590	45597	0.7	100			0.35			0.55	3.1	0.1		mineraliz	–"–
	45597	4584	2.5	100			3.58			0.25	14.23	0.78	4-II	balance	–"–
	4723	4731	0.5	100			0.55			<0.04	1.3	0.12		mineraliz	–"–
	5061	5271	1.0	100			0.26			0.51	2.74	<0.1		–"–	–"–
	5140	5155	0.55	100			0.25			1.0	4.75	0.13		–"–	–"–
	5134	5206	0.75	100			1.93			1.0	14.0	0.59	3-V	balance	–"–
775	5480	5522	4.2	100				0.29			10.5		3-V	mineraliz	lead

SCHEMATIC GEOLOGICAL CROSS-SECTION 235-235



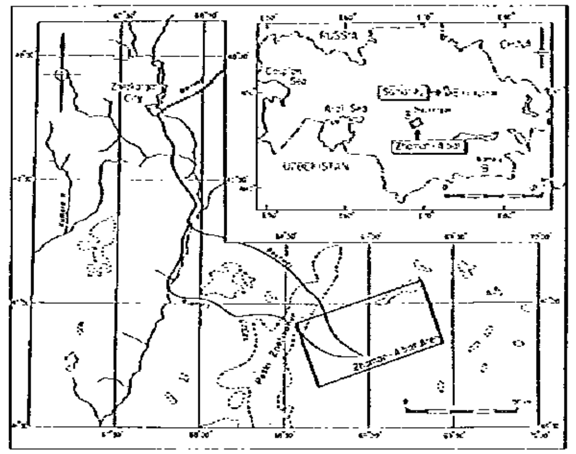
Ag g/t	S %	deposit	commercial characteristics	ore type
5.53	0.15	4-I	mineraliz	copper
1.0	0.11		—"—	—"—
2.2	<0.1	4-I	min.inter	—"—
4.25	0.19	4-I	balance	—"—
24.5		4-I	—"—	—"—
0.36		4-I	mineral	—"—
5.13		3-V	balance	—"—
3.5			min.inter	—"—
4.15		4-I	balance	—"—
3.55		4-I	min.inter	—"—
5.30		4-I	balance	—"—
45.47	3.45	4-I	—"—	—"—
4.2	3.35	4-I	min.inter	—"—
24.5	1.5	4-I	balance	—"—
1.1			mineraliz	zinc
8.47	1.07	4-I	balance	copper
2.5	0.3	3-V	mineraliz	—"—
			barren	

Well no	mineralization horizon		thickness m	core recovery			grade						deposit	commercial characteristics	ore type
	from	to					Cu %	Pb %	Zn %	Au g/t	Ag g/t	S %			
320	525.7	526.2	0.5	100				0.15	0.30	0.05	16	0.08	3-IV	mineraliz	Pb-Zn
	531.0	532.2	1.2	100			0.3			<0.04	10	1.34		—"—	copper
759	455.6	457.3	1.7	100			0.25			0.09	3.03	<0.1		min.inter	—"—
	457.3	479.0	11.1	100			0.9			0.84	135.5	0.22	4-I	balance	—"—
762	493.4	494.4	1.0	85			0.33			0.07	64	0.1		min.inter	—"—
	494.4	505.9	11.59	51			3.54			2.12	574.3	1.5	4-I	balance	—"—
	593.5	598.3	5.7	100			0.24			0.7	37.4	<0.1	3	mineraliz	—"—
767	455.5	456.5	0.7	100			0.35			0.05	3.7	0.1		mineraliz	—"—
	456.5	465.4	18.5	100			3.59			0.25	412.3	0.18	4-III	balance	—"—
	472.5	473.0	0.5	100			0.56			<0.04	2.0	0.12		mineraliz	—"—
	526.1	537.1	1.0	100			0.25			0.07	2.74	<0.1		—"—	—"—
	[illegible]	[illegible]	0.55	100			0.25			1.5	17.5	0.13		—"—	—"—
	[illegible]	[illegible]	0.75	100			1.35			1.9	24.0	0.55	3-V	balance	—"—
775	[illegible]	[illegible]	4.2	100				0.33			<0.5		3-IV	mineraliz	lead

Plate 2

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

Schematic Section of the Eastern and Northern Orebody in the Zhaman-Aibat Ore Deposit (along the line DH629-DH775)



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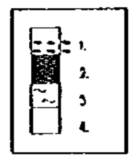
Scale 1 : 5,000

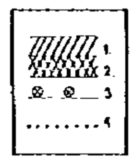
0 100 200 300 400 500m

LEGEND

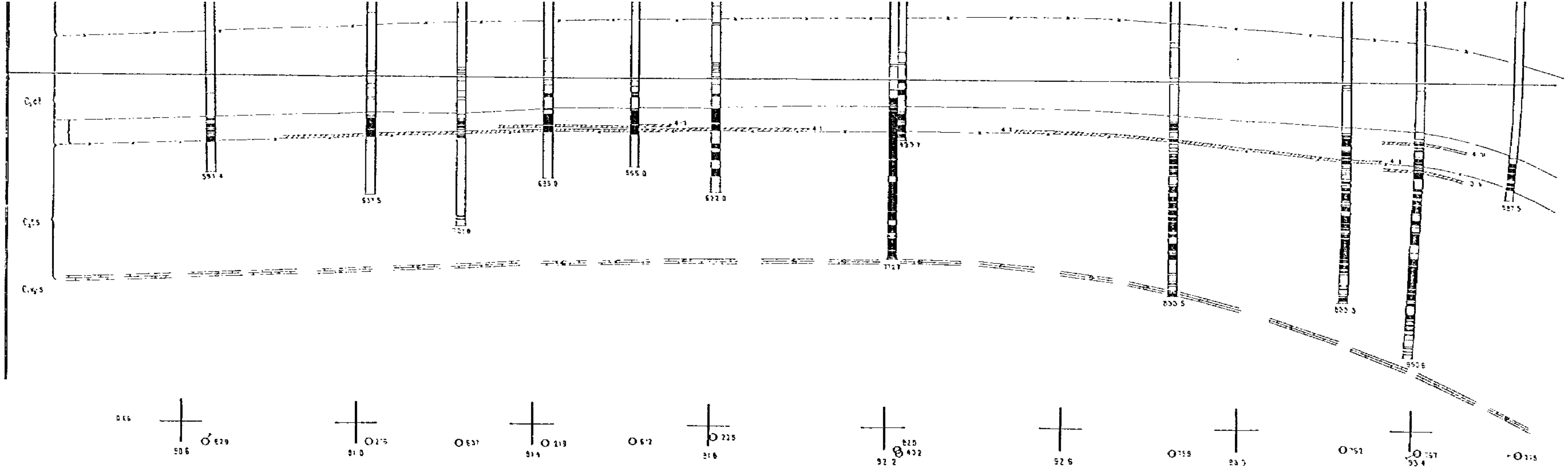


1 Conglomerate interformational ("Raimundo")
2 Fine-coarse grained sandstone
3 Aleurolite, aleurosandstone, sandstones (fine grained grey)
4 Sandstone (fine-coarse grained), aleurolite, aleurosandstone red

Ore

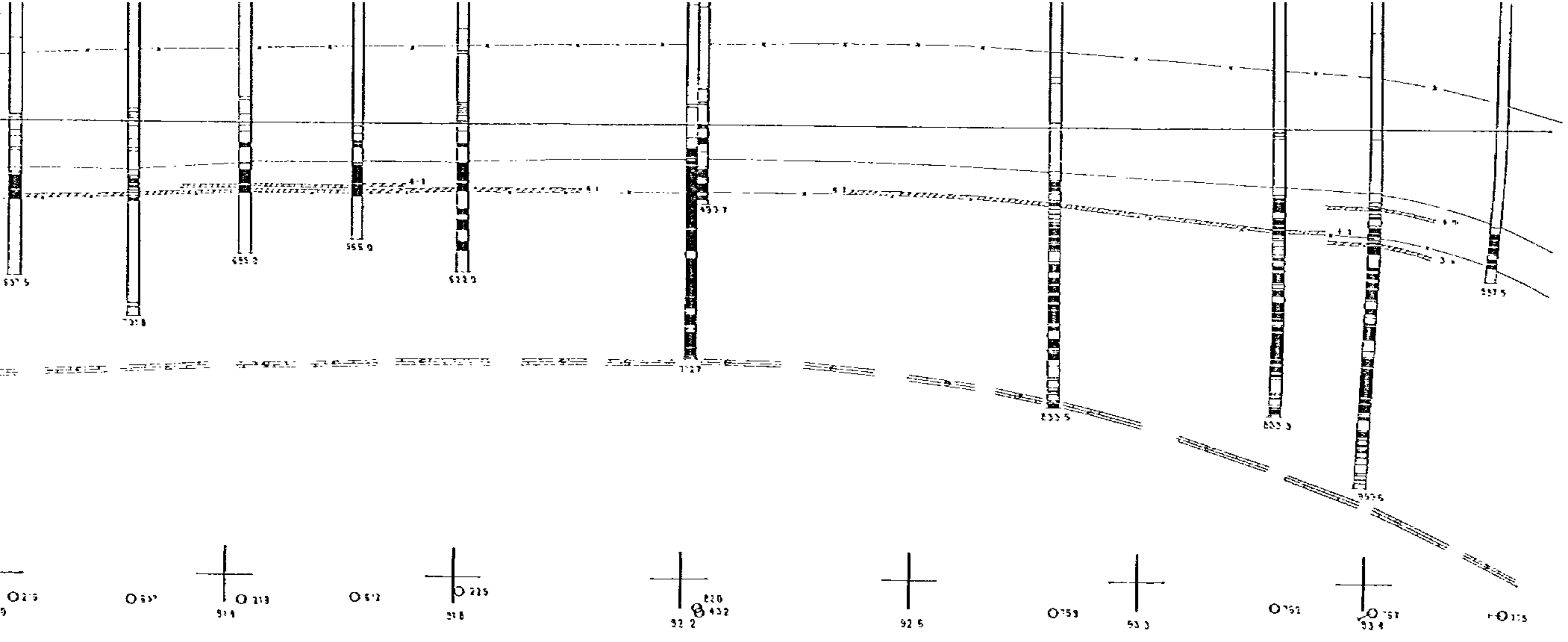


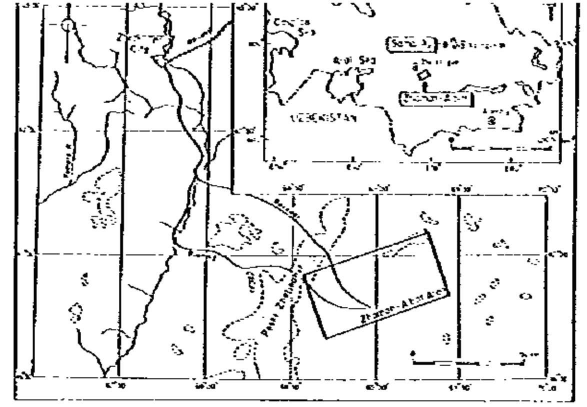
1. Copper (balanced)
2. Complex (balanced)
3. Silver containing balanced
4. Mineralization



Well no	mineralization horizon from	to	thickness m	core recovery			grade Cu %	Pb %	Zn %	Au g/t	Ag g/t	S %	deposit	commercial characteristics	ore type
[illegible]	50375	5107	0.35	100			0.55			0.1	5.89	0.15	4-1	mineraliz	copper
215	4912	4922	1.0	100			0.29				1.0	0.11		—"—	—"—
	4367	4372	0.5	100			0.25				2.0	<0.1	4-1	min. intbd	—"—
	4344	4580	1.5	100			1.0			<0.5	4.25	5.9	4-1	balance	—"—
537	49125	4921	0.85	100			2.07				24.5		4-1	—"—	—"—
	4921	4959	3.8	100			0.13				0.29		4-1	mineral	—"—
	4959	4983	9.4	100			0.54				6.5		3-V	balance	—"—
219	4778	4785	1.0	100			0.23				2.5			min. intbd	—"—
	4785	4795	1.0	100			4.72				4.15		4-1	balance	—"—
	4785	4857	5.9	100			0.19				3.99		4-1	min. intbd	—"—
	4857	4887	3.0	100			1.26				5.31		4-1	balance	—"—
612	4773	4795	1.5	100			7.37			4.15	154.1	3.45	4-1	—"—	—"—
	4784	4723	0.5	100			0.23			0.34	1.2	0.28	4-1	min. intbd	—"—
	4844	4849	0.5	100			3.15			2.1	34.5	1.05	4-1	balance	—"—
225	4710	4723	1.3	100					0.33		1.1			mineraliz	zink
	4751	4801	5.1	100			1.23			1.82	8.41	1.07	4-1	balance	copper
	5720	5730	1.0	100			0.37			0.45	2.5	0.37	3-V	mineraliz	—"—
132														barren	

Well no	mineralization horizon from	to	thickness m	core recovery			grade Cu %	Pb %	Zn %	Au g/t	Ag g/t	S %	deposit	commercial characteristics	ore type
820	5157	5162	0.5	100				0.16	0.33	0.05	1.0	0.08	3-V	mineraliz	Pb-Zn
	5310	5322	1.2	100			0.01			<0.04	1.3	1.34		—"—	copper
759	4555	4573	1.7	100			0.25			0.09	0.83	<0.1		min. intbd	—"—
	4573	4790	11.7	100			0.9			0.64	13.52	0.22	4-1	balance	—"—
752	4924	4314	1.0	85			0.33			0.01	6.4	0.1		min. intbd	—"—
	4844	5055	1.55	61			3.54			2.22	57.43	1.5	4-1	balance	—"—
	5855	5933	5.7	100			0.24			0.1	0.74	<0.1	3	mineraliz	—"—
757	45550	4555	0.7	100			0.35			0.05	3.1	0.1		mineraliz	—"—
	4555	4634	1.65	100			0.98			0.25	14.25	0.18	4-1	balance	—"—
	4725	4731	0.6	100			0.56			<0.04	7.3	0.12		mineraliz	—"—
	5051	5311	1.0	100			0.16			0.01	7.74	<0.1		—"—	—"—
	5740	57455	0.65	100			0.25			1.0	1.75	0.13		—"—	—"—
	[illegible]	[illegible]	0.75	100			1.93			1.0	24.0	0.59	3-V	balance	—"—
715	[illegible]	[illegible]	4.1	100				0.19			<0.5		3-V	mineraliz	lead





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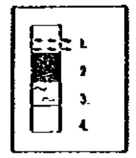
Scale 1 : 5,000

0 100 200 300 400 500 m

...de					
Pb %	Ag g/t	S %	deposit	commercial characteristics	ore type
0.1	5.89	0.16	4-1	mineraliz	copper
	1.0	0.11		-"-	-"-
	2.0	<0.1	4-1	min. int bal	-"-
<0.5	4.25	0.19	4-1	balance	-"-
	24.5		4-1	-"-	-"-
	2.25		4-1	mineral	-"-
	6.13		3-IV	balance	-"-
	2.5			min. int bal	-"-
	4.15		4-1	balance	-"-
	1.95		4-1	min. int bal	-"-
	5.33		4-1	balance	-"-
4.15	45.87	3.45	4-1	-"-	-"-
0.24	1.2	0.28	4-1	min. int bal	-"-
2.1	34.2	1.05	4-1	balance	-"-
	1.1			mineraliz	zinc
1.82	6.47	1.07	4-1	balance	copper
0.49	1.5	0.31	3-V	mineraliz	-"-
				barren	

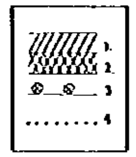
Adit no	mineralized interval from	to	thickness m	core recovery			grade Cu %	Pb %	Zn %	Au g/t	Ag g/t	S %	deposit	commercial characteristics	ore type
820	525.7	526.2	0.5	100				0.16	0.33	0.05	1.0	0.03	3-IV	mineraliz	Pb-Zn
	531.0	532.2	1.2	100			0.31			<0.04	1.3	1.34		-"-	copper
759	455.5	[illegible]	1.1	100			0.25			0.09	3.03	<0.1		min. int bal	-"-
	457.0	475.0	11.7	100			3.9			0.64	13.52	0.22	4-1	balance	-"-
762	423.4	431.4	7.8	85			0.33			0.07	6.4	0.4		min. int bal	-"-
	424.4	505.5	1.55	97			3.54			2.12	57.43	1.5	4-1	balance	-"-
	593.5	599.3	5.7	100			0.24			0.4	0.74	<0.7	3	mineraliz	-"-
757	455.3	455.5	0.7	100			0.35			0.05	3.1	0.1		mineraliz	-"-
	455.5	464	1.95	100			0.98			0.25	14.23	0.16	4-1	balance	-"-
	472.5	473.1	0.5	100			0.56			<0.24	7.0	0.12		mineraliz	-"-
	525.1	[illegible]	1.0	100			0.25			0.01	2.24	<0.1		-"-	-"-
	514.0	514.55	0.55	100			0.25			1.0	1.35	0.13		-"-	-"-
	[illegible]	[illegible]	0.75	100			4.99			1.0	24.0	0.98	3-V	balance	-"-
775	[illegible]	[illegible]	4.2	100				0.29			<0.5		3-IV	mineraliz	lead

LEGEND



1 Conglomerate Interformational (Raimundo")
2 Fine-coarse-grained sandstone
3 Aleurolite, aleurosandstone, sandstones (fine grained grey)
4 Sandstone (fine-coarse grained), aleurolite, aleurosandstone red

Ore



1 Copper (balanced)
2 Complex (balanced)
3 Silver-containing balanced
4 Mineralization

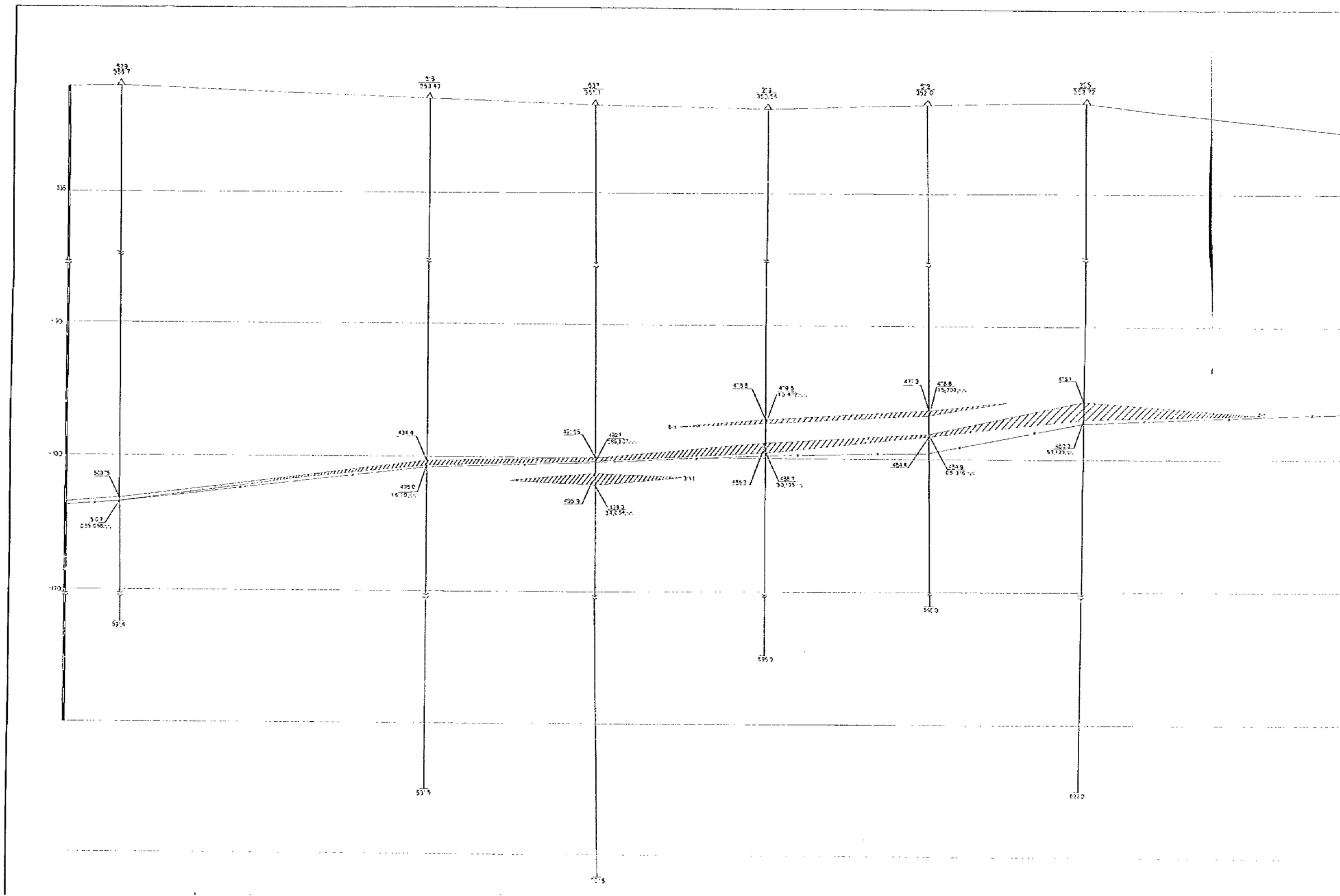
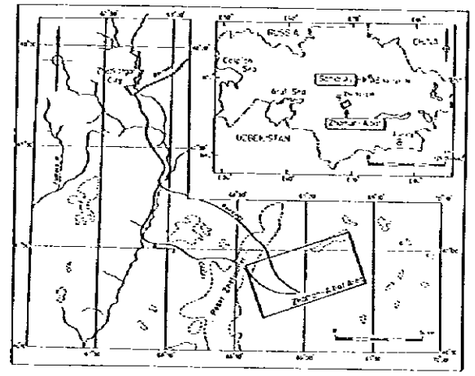

335
190
170

Plate 3-1

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

Detailed Section of the Eastern and Northern Orebody in the Zhaman - Aibat Ore Deposit (along the line DH629 - DH820)



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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, %;

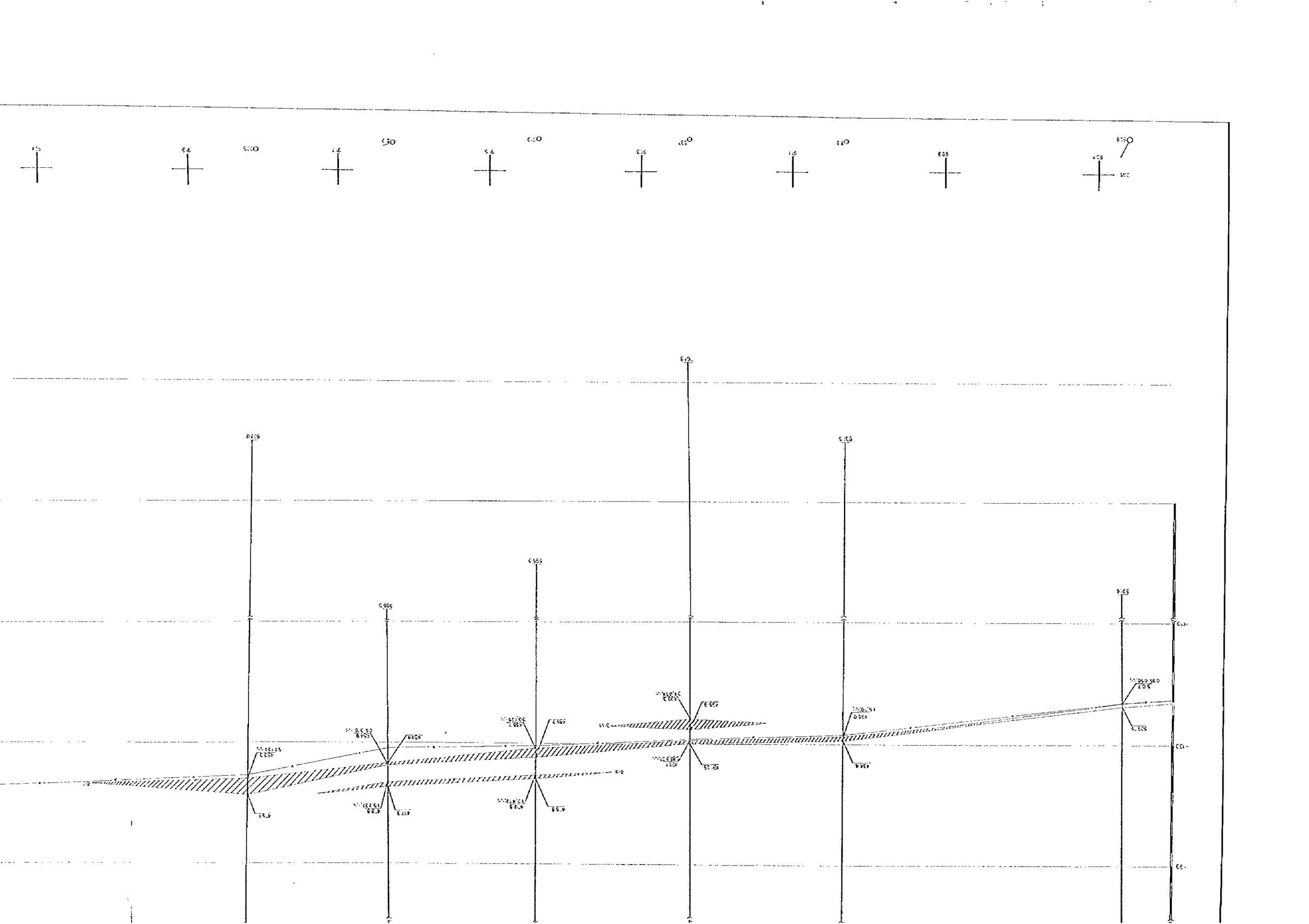
Copper ore : 1. balance
2. off-balance

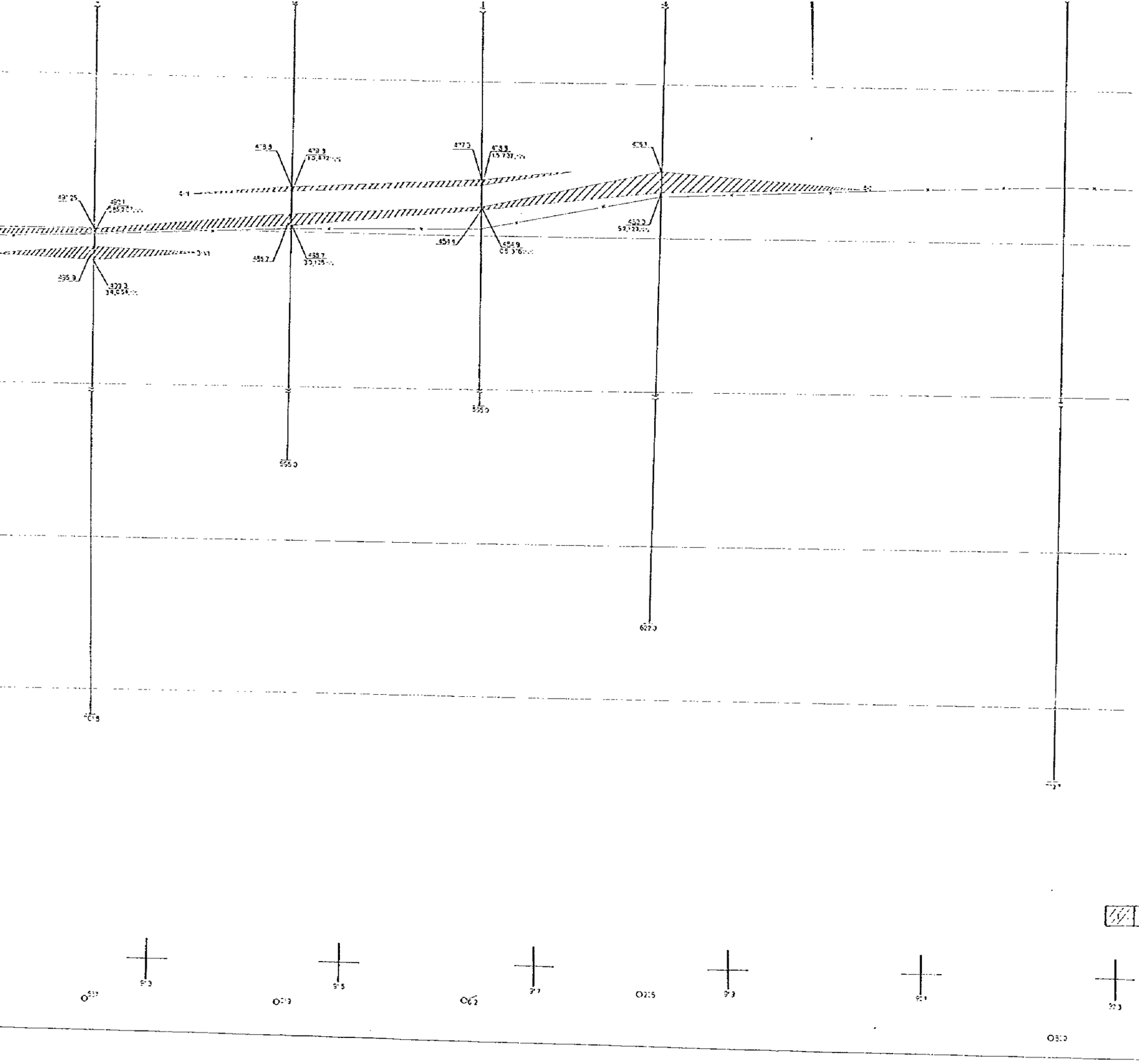
Comp'ex ore : 1. balance
2. off-balance

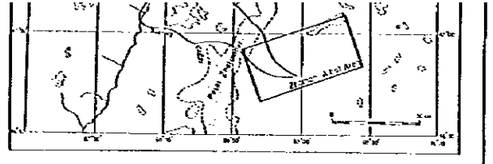
Lead ore : 1. balance
2. off-balance

Zinc ore : 1. balance
2. off-balance

Lead-zinc off-balance ore







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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

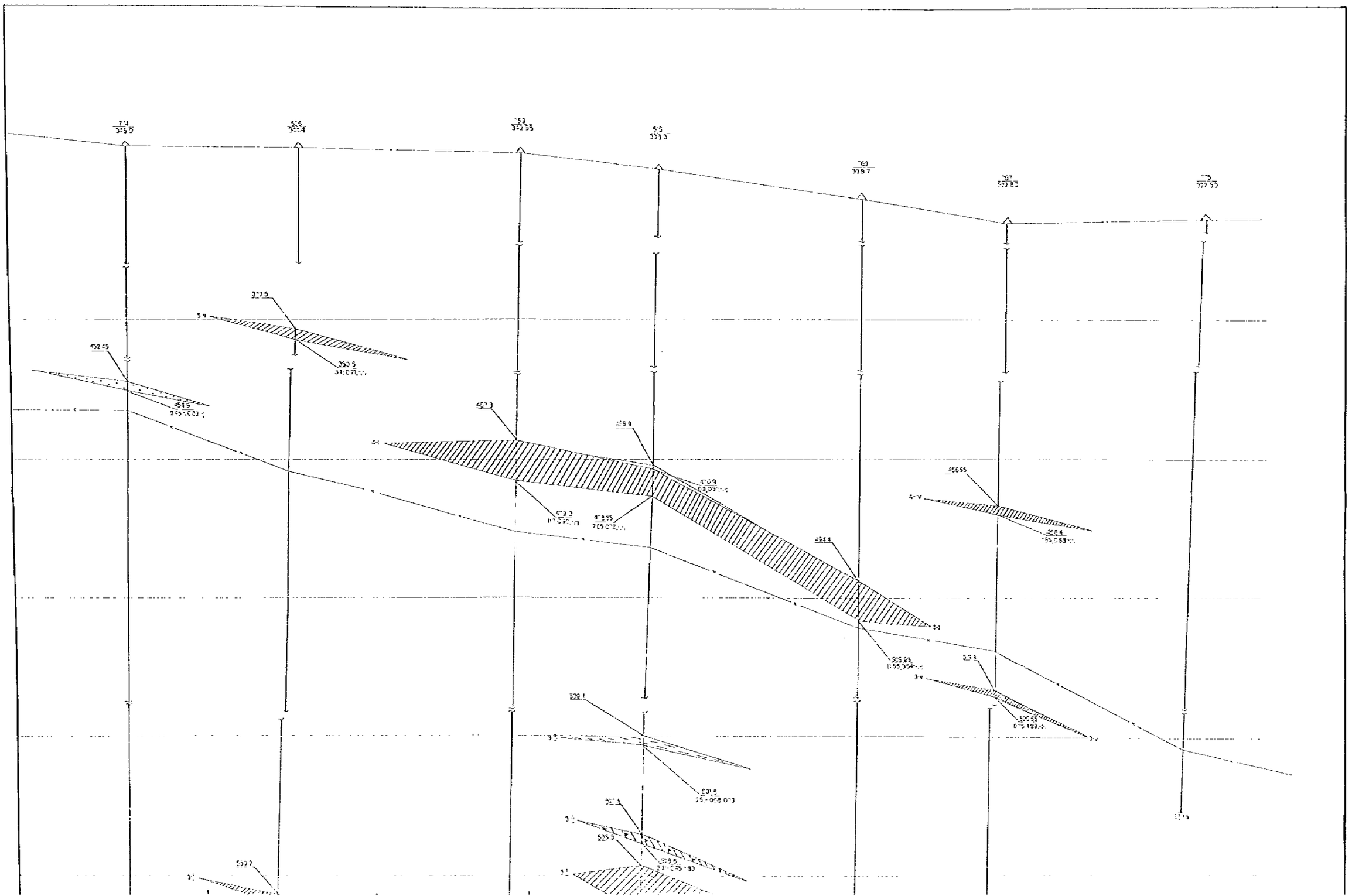
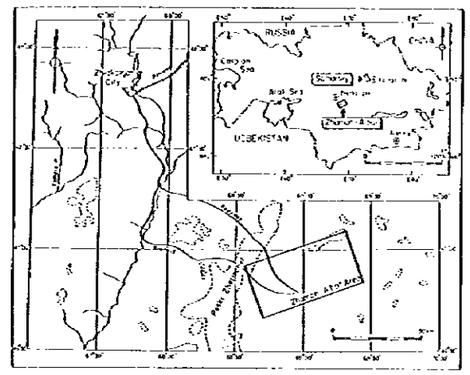


Plate 3-2

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

Detailed Section of the Eastern and Northern Orebody in the Zhaman - Aibat Ore Deposit (along the line DH774 - DH775)



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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, %;

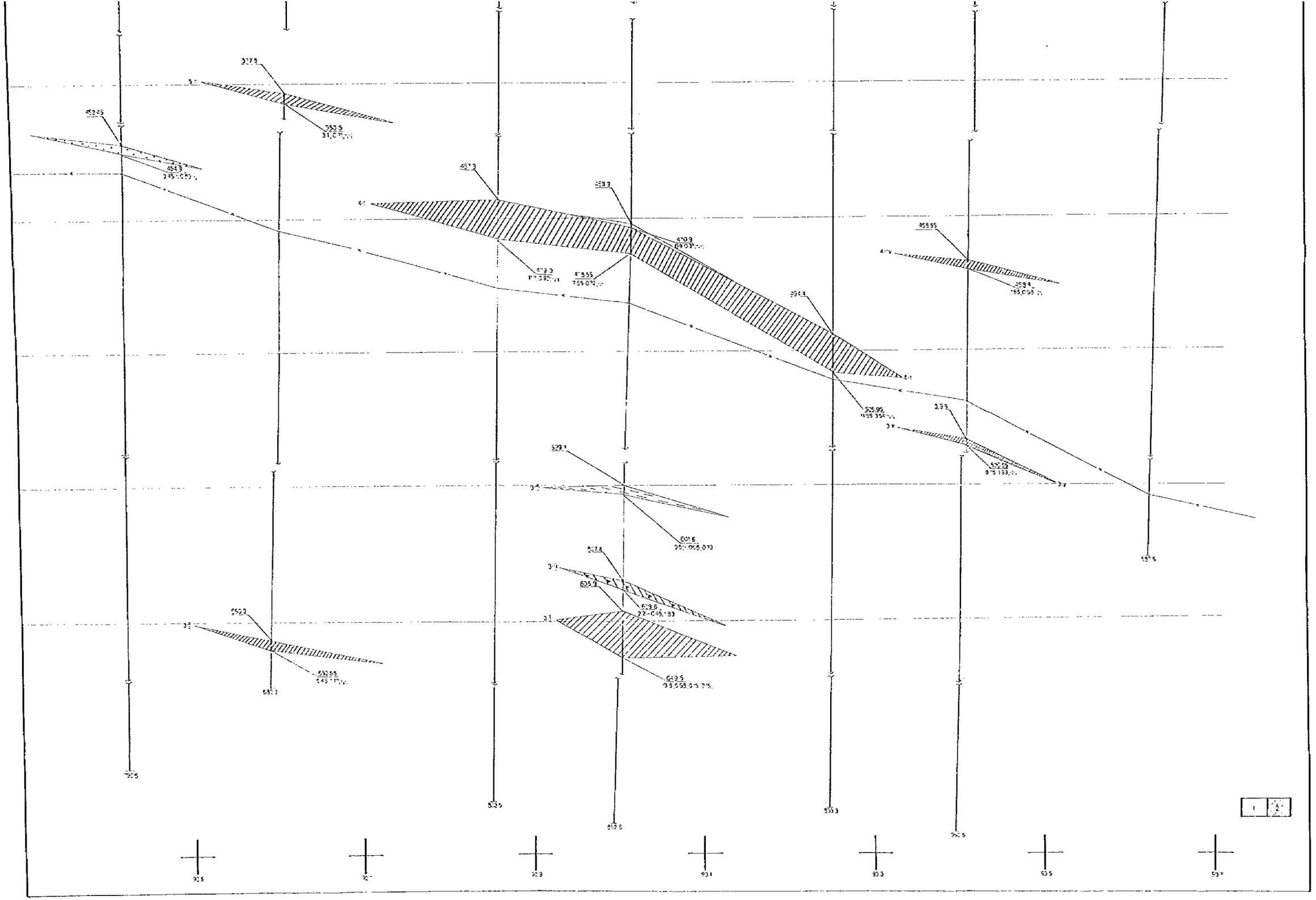
Copper ore : 1. balance
2. off-balance

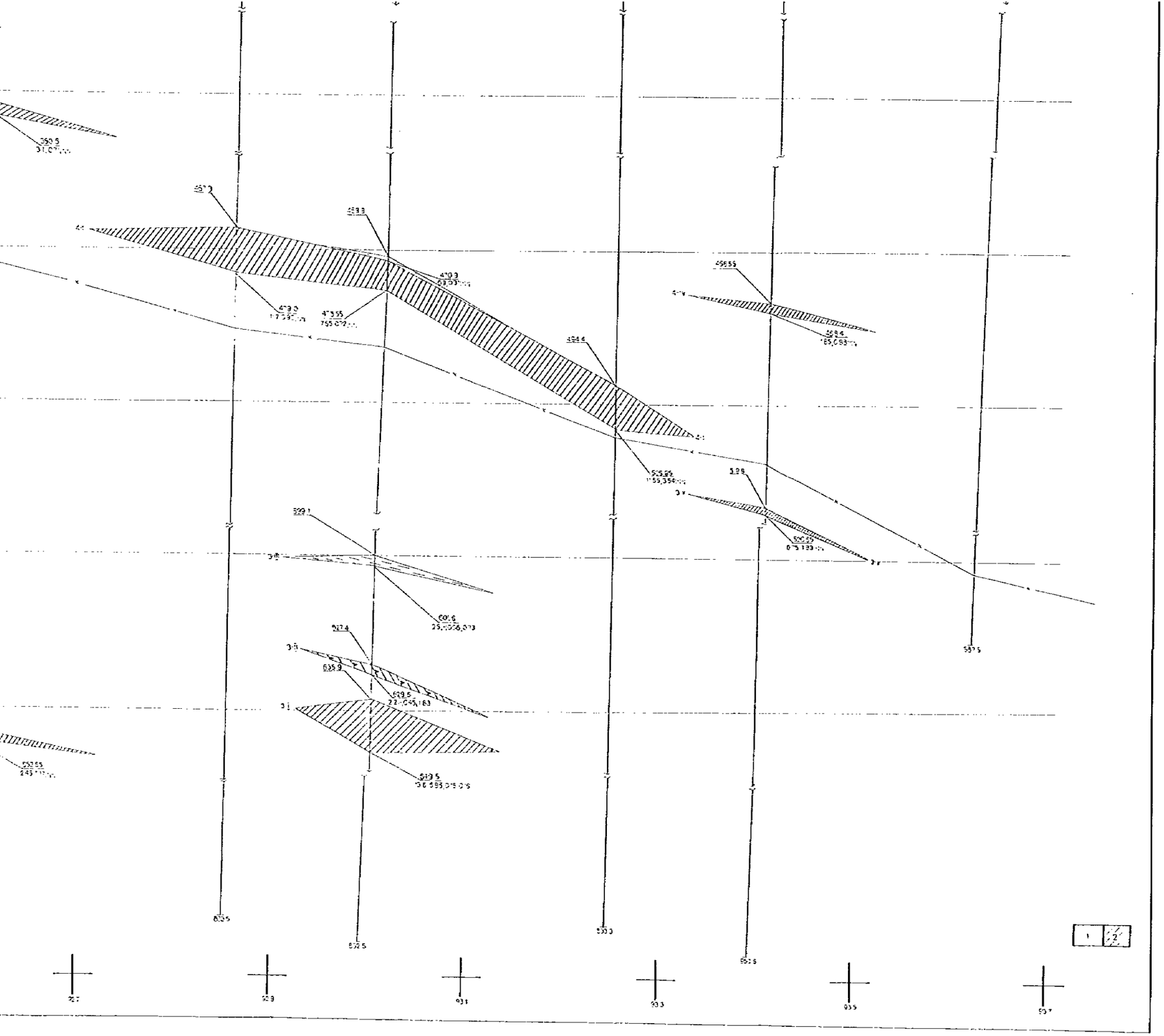
Complex ore : 1. balance
2. off-balance

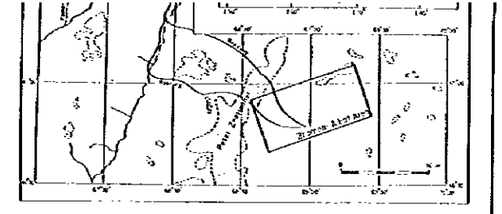
Lead ore : 1. balance
2. off-balance

Zinc ore : 1. balance
2. off-balance

Lead-zinc ore : off-balance







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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, %;

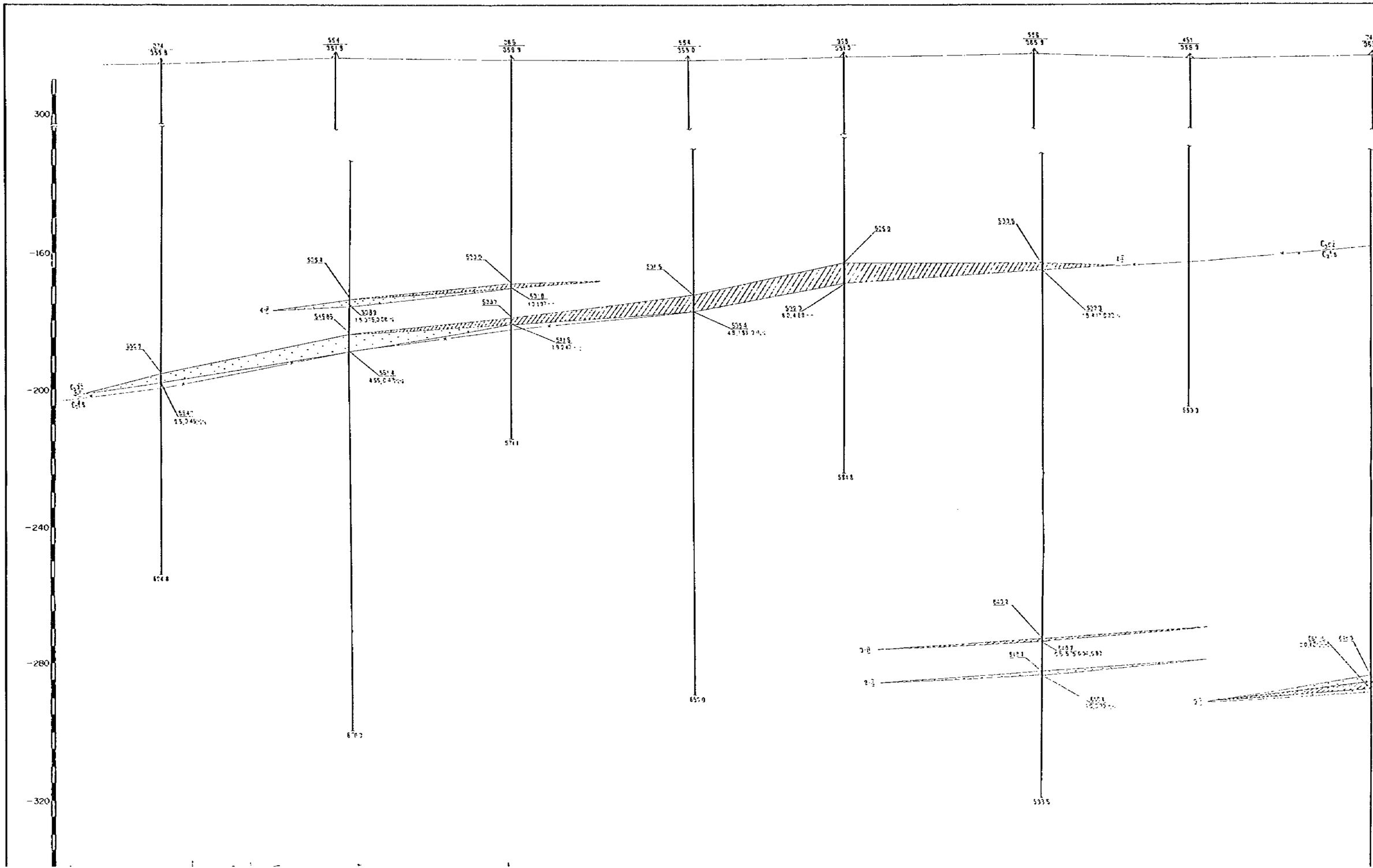
Copper ore : 1. balance
2. off-balance

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


300
-160
-200
-240
-280
-320

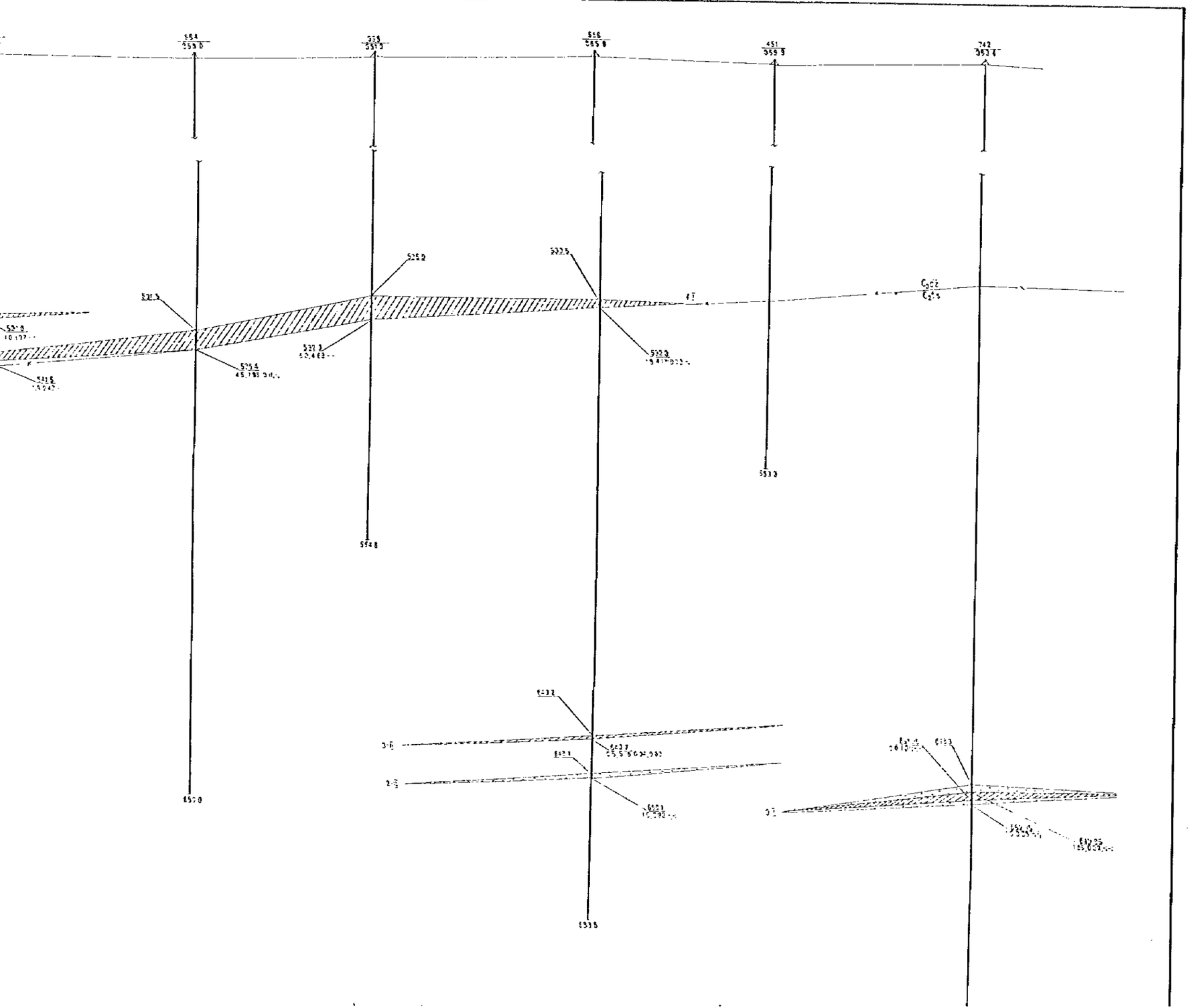
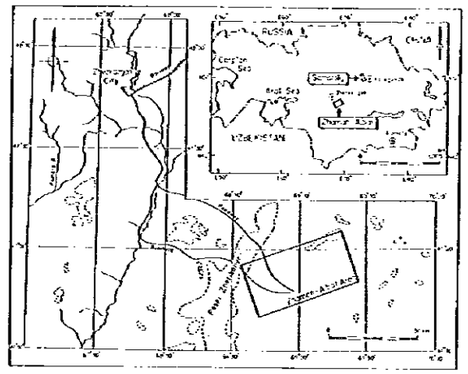


Plate 4-1

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

Detailed Section of the Eastern and Northern Orebody in the Zhaman - Aibat Ore Deposit (along the line DH374 - DH742)



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, %;

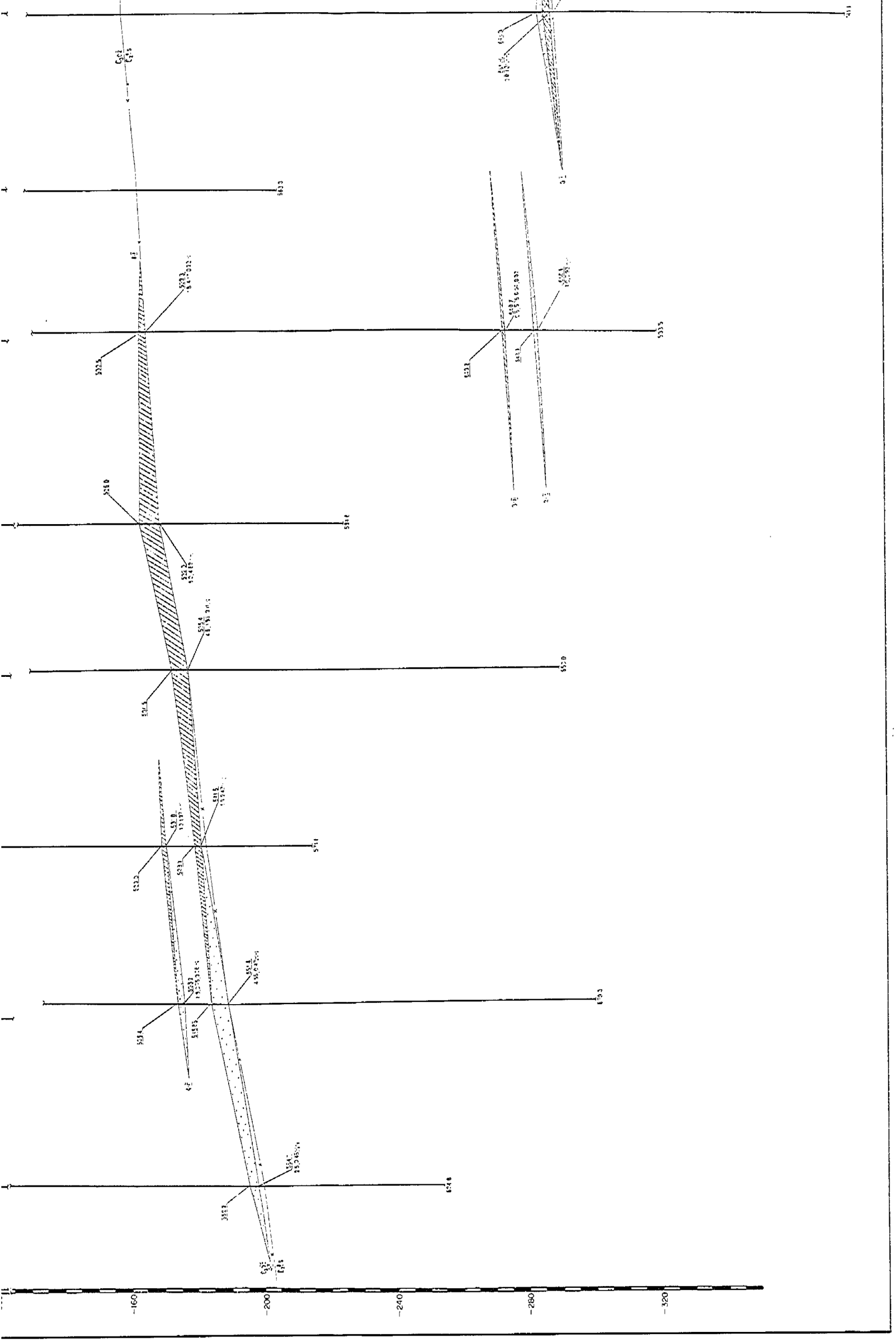
Copper ore : 1. balance
2. off-balance

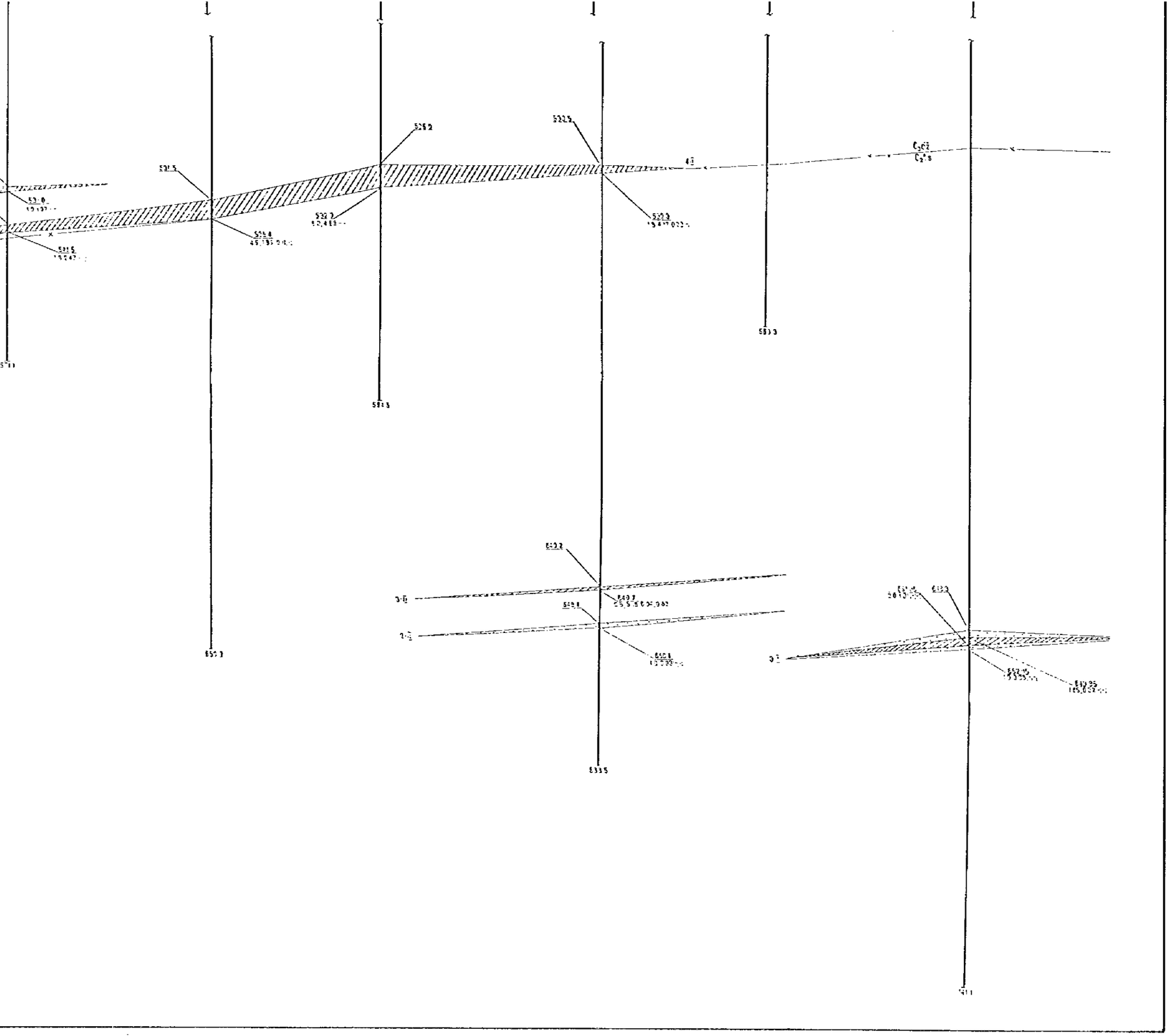
Complex ore : 1. balance
2. off-balance

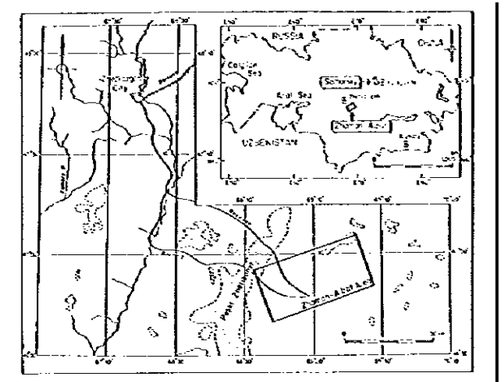
Lead ore : 1. balance
2. off-balance

Zinc ore : 1. balance
2. off-balance

Lead-zinc off-balance ore


-160
-200
-240
-280
-320





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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

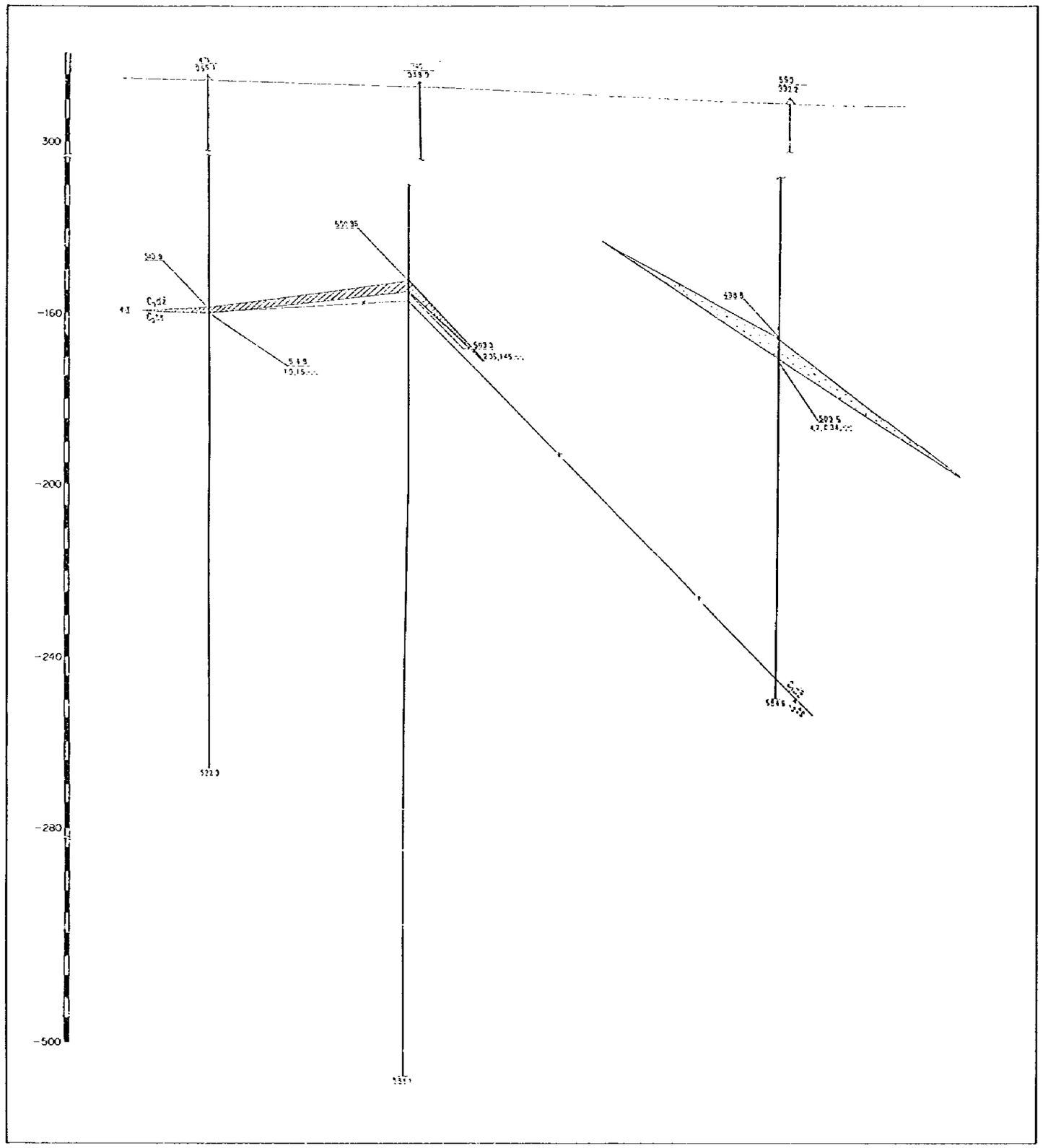
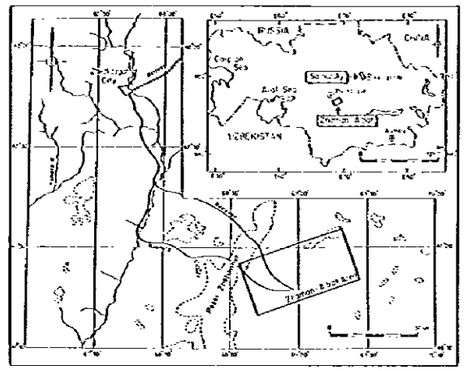


Plate 4-2

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

Detailed Section of the Eastern and Northern Orebody in the Zhaman-Aibat Ore Deposit (along the line DH471-DH590)



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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, %;

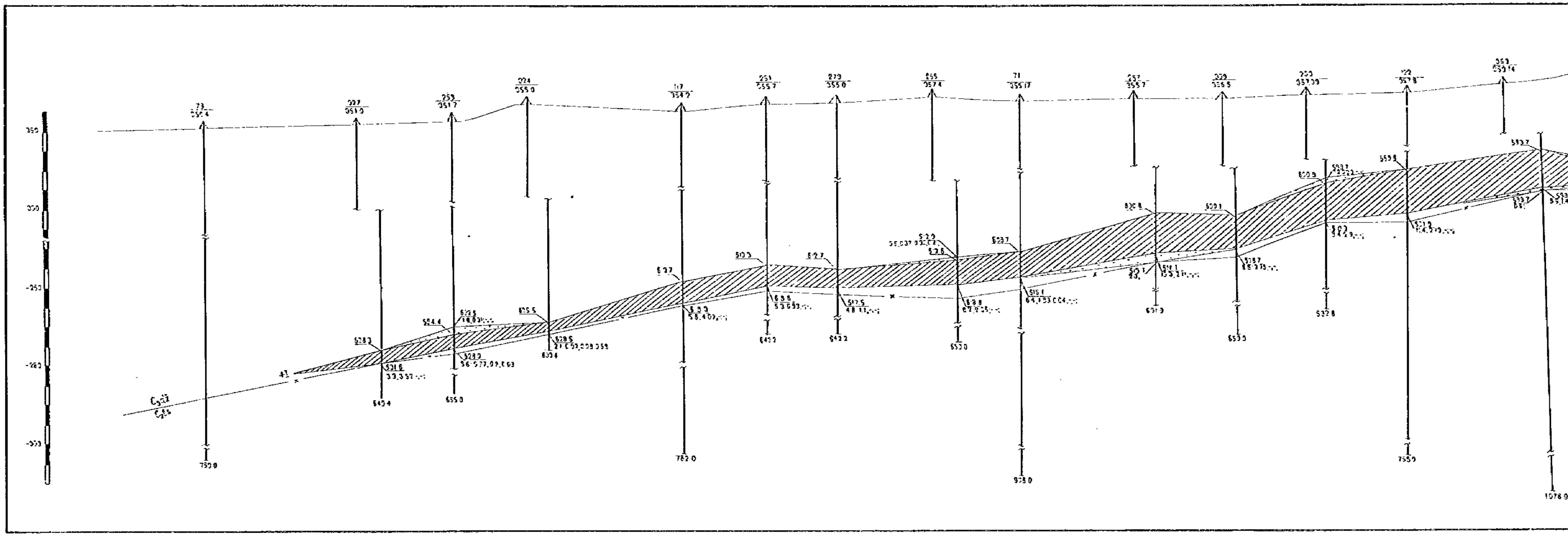
Copper ore : 1. balance
2. off-balance

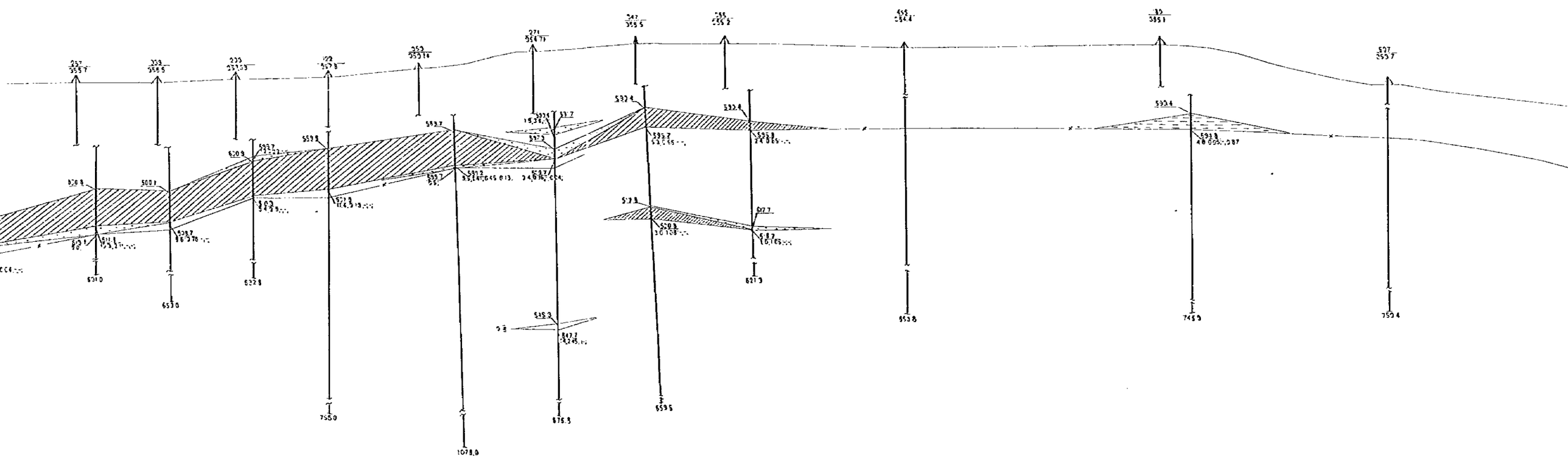
Complex ore : 1. balance
2. off-balance

Lead ore : 1. balance
2. off-balance

Zinc ore : 1. balance
2. off-balance

Lead-zinc off-balance ore





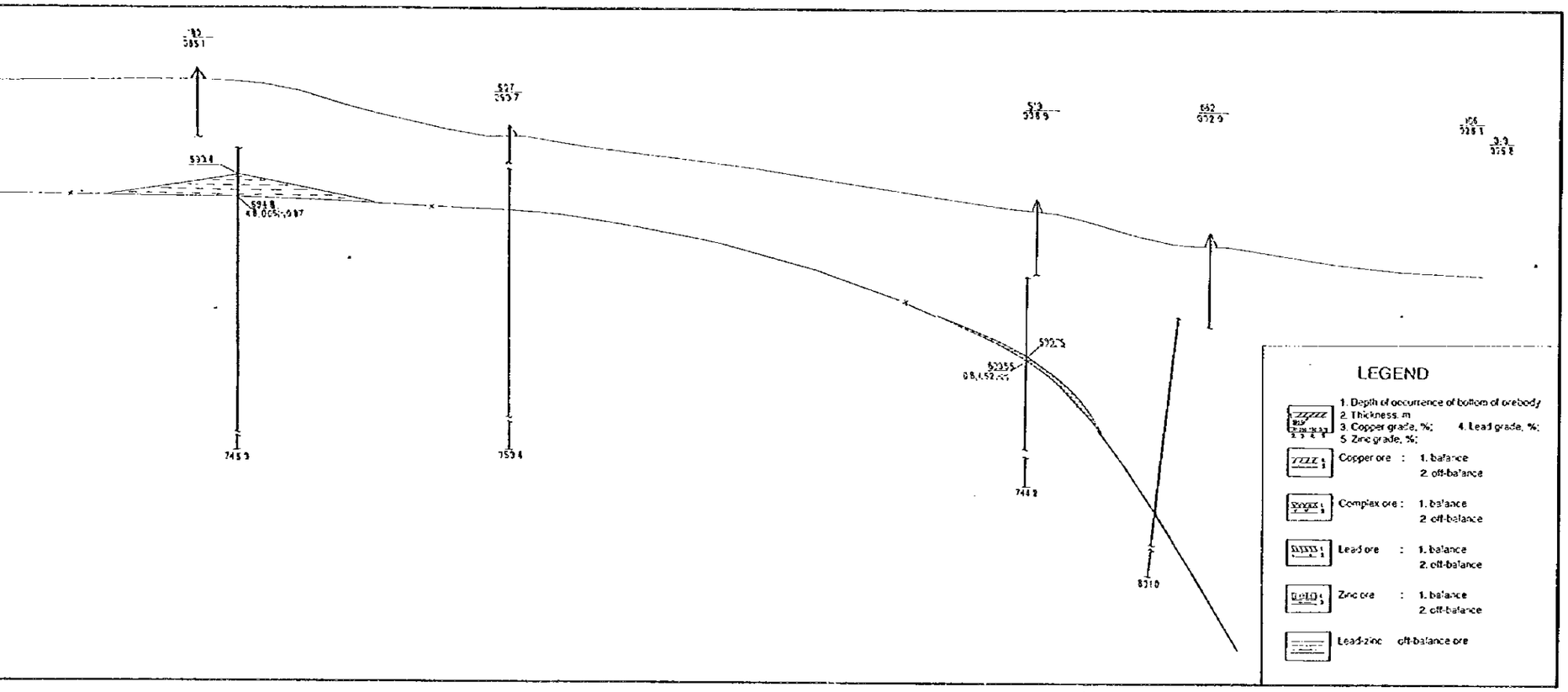
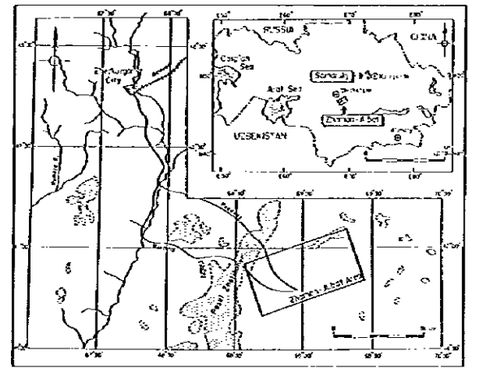


Plate 5

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

Detailed Section of the Eastern and Northern Orebody in the Zhaman - Aibat Ore Deposit (along the line DH79 - DH682)



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Metal Mining Agency of Japan

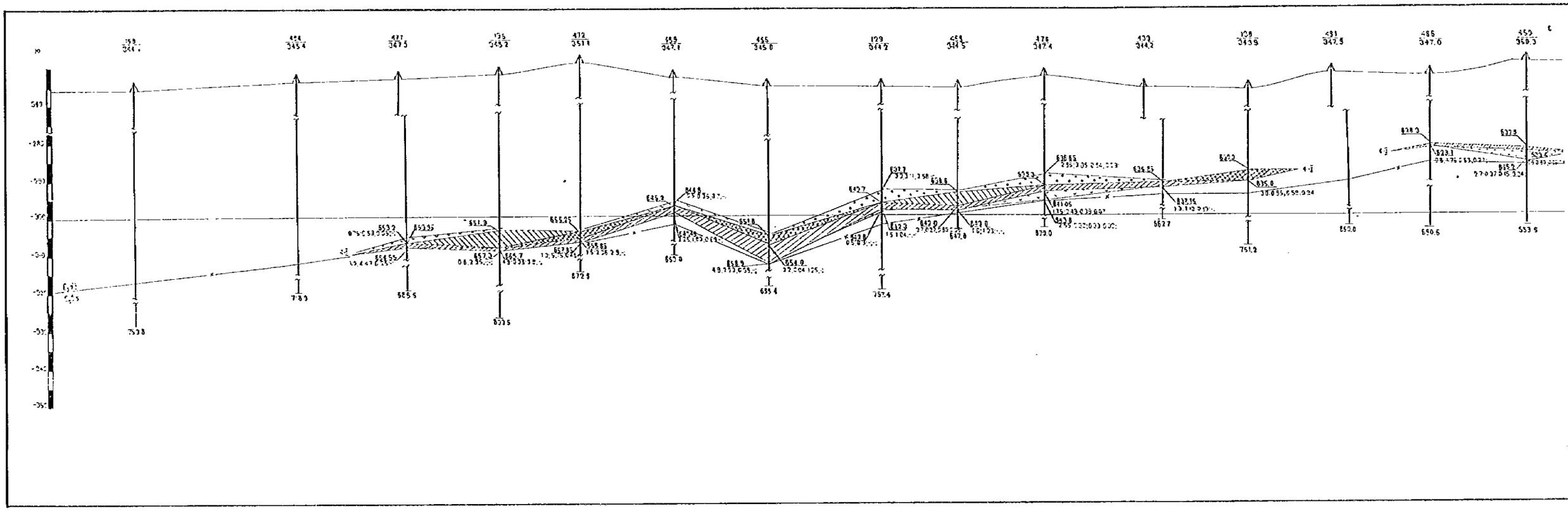
February 1997

Scale 1 : 500 (Vertical)

0 10 20 30 40 50m

Scale 1 : 2,000

0 100 200 m



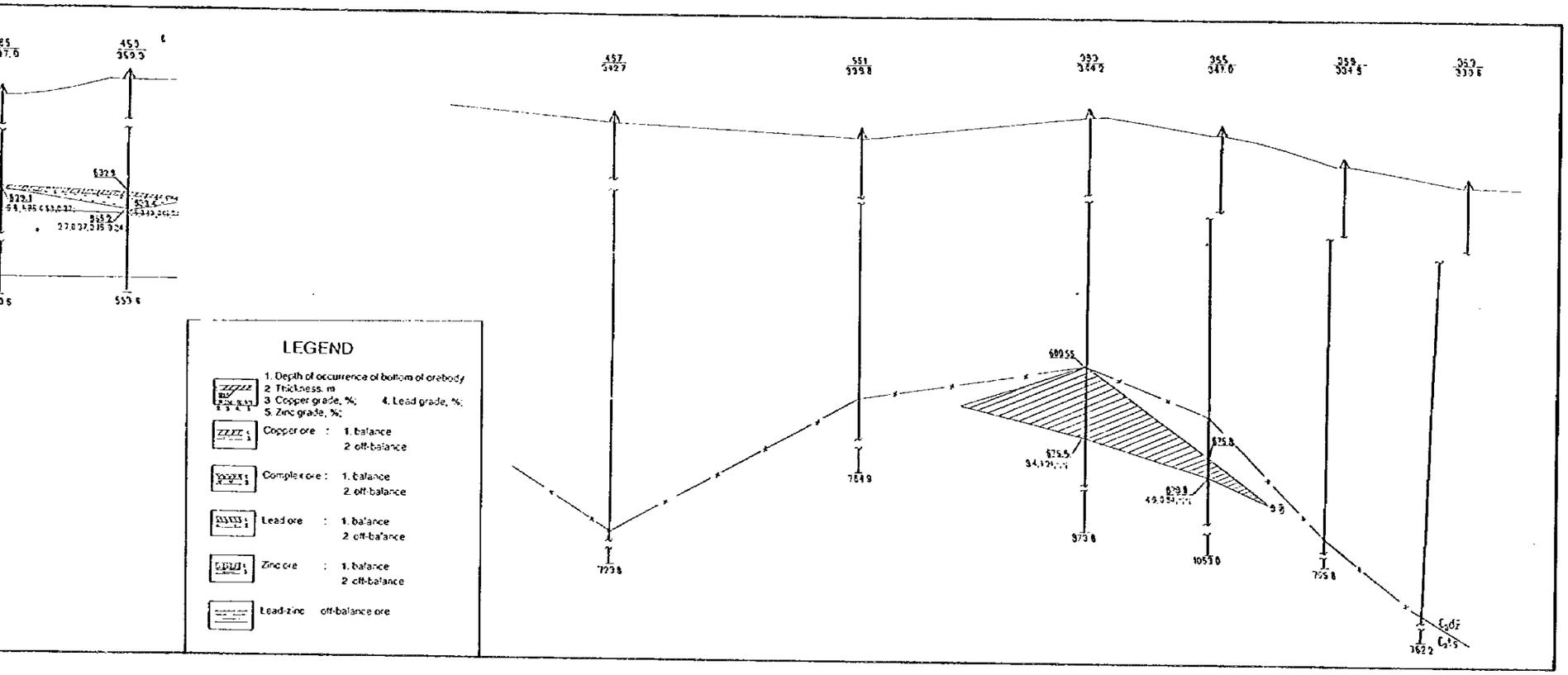
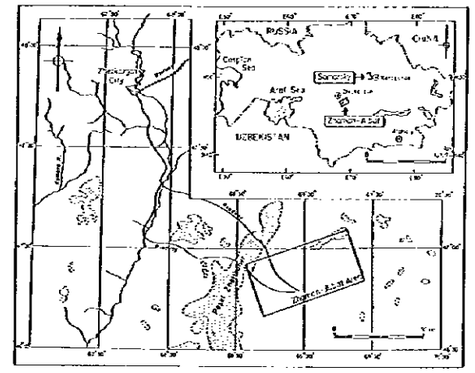


Plate 6

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

Detailed Section of the Central and Northern Orebody in the Zhaman - Aibat Ore Deposit (along the line DH159 - DH363)



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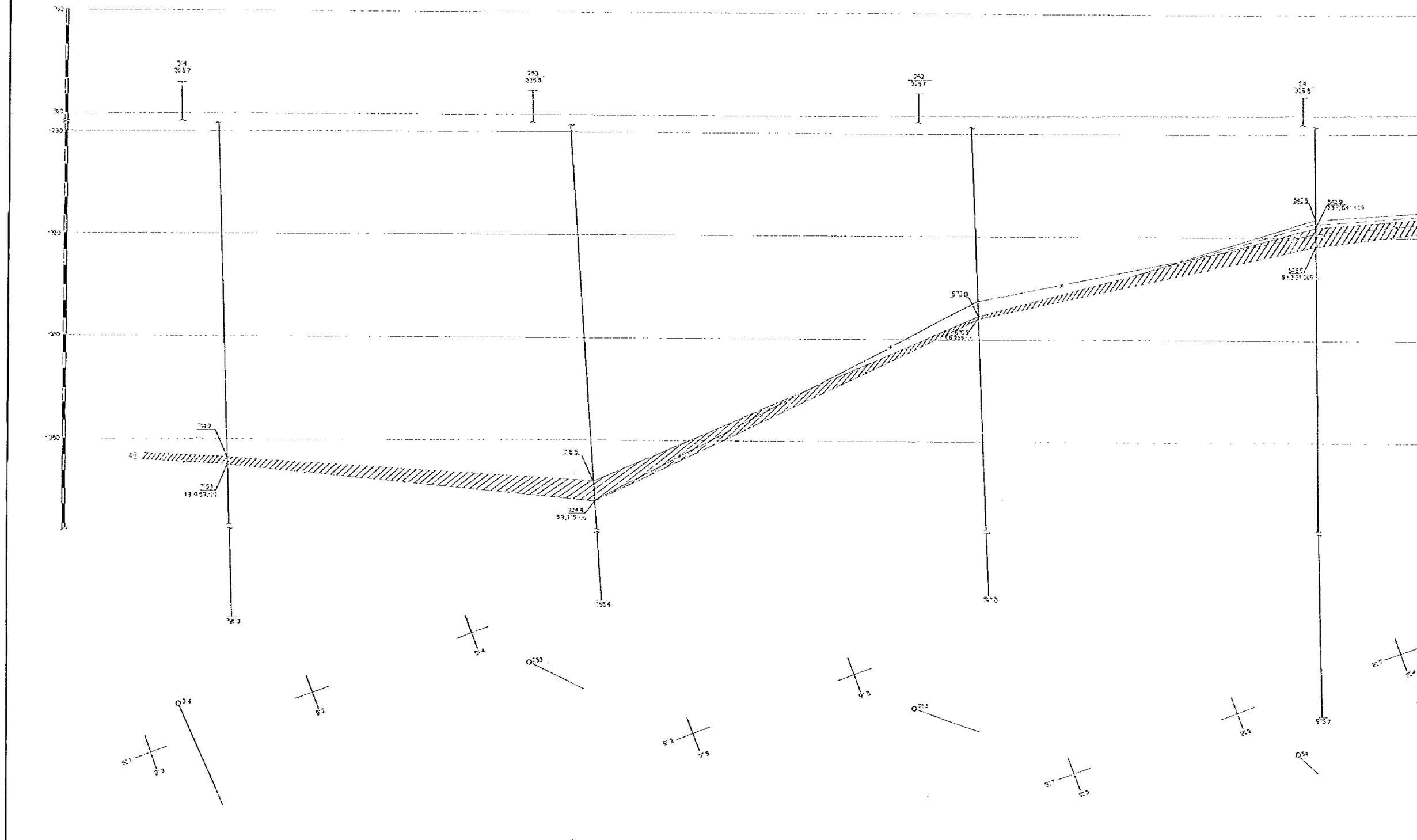
February 1997

Scale 1 : 500 (Vertical)

0 10 20 30 40 50m

Scale 1 : 2,000

0 100 200 m



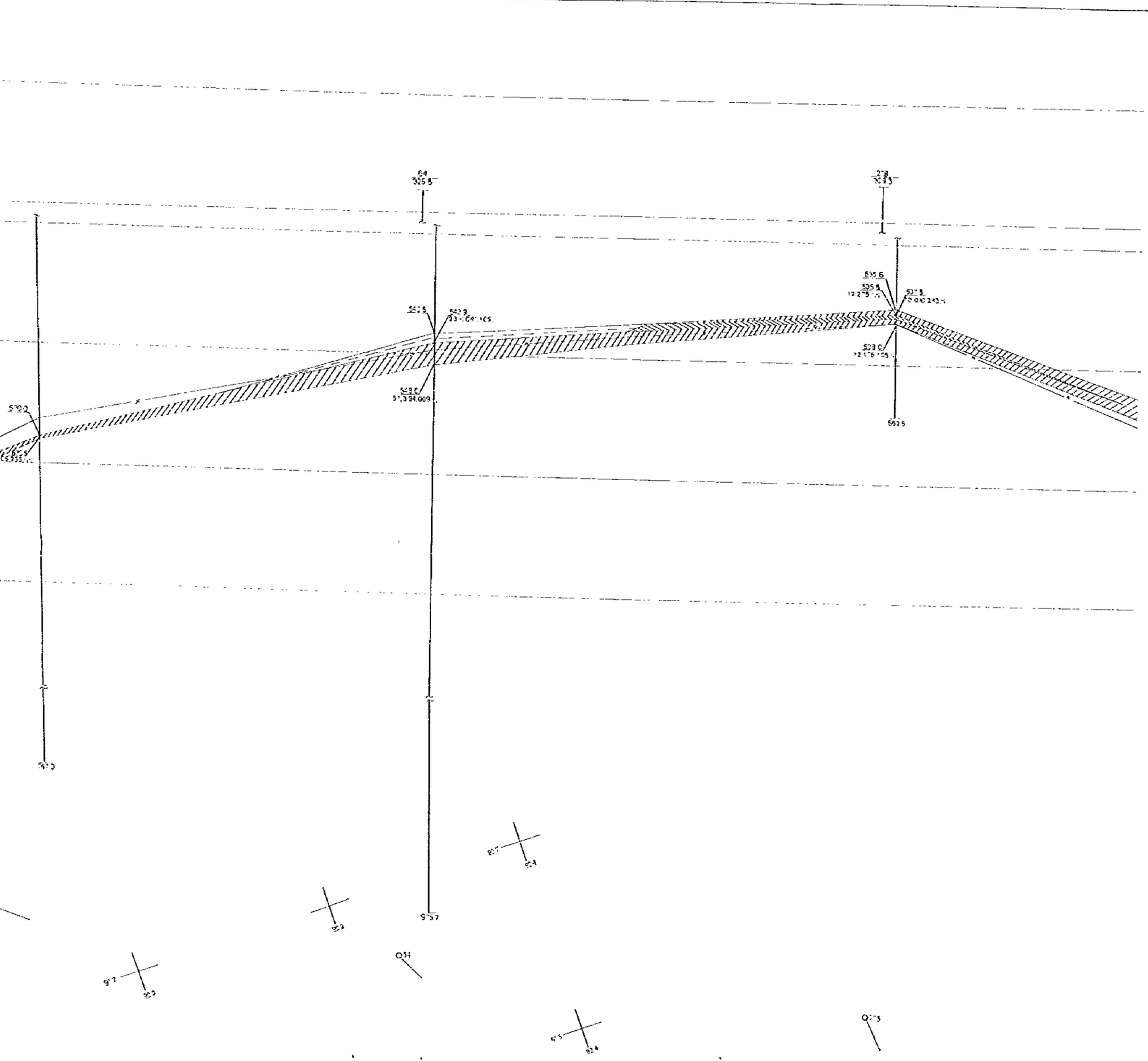
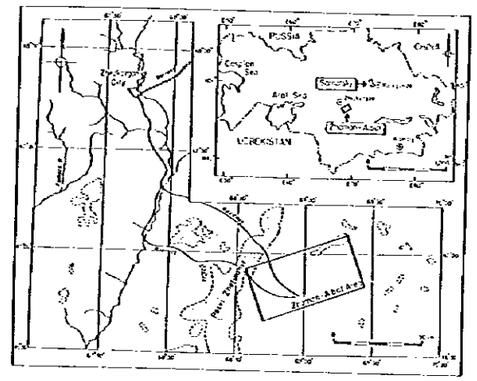


Plate 7-1

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

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



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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, %;

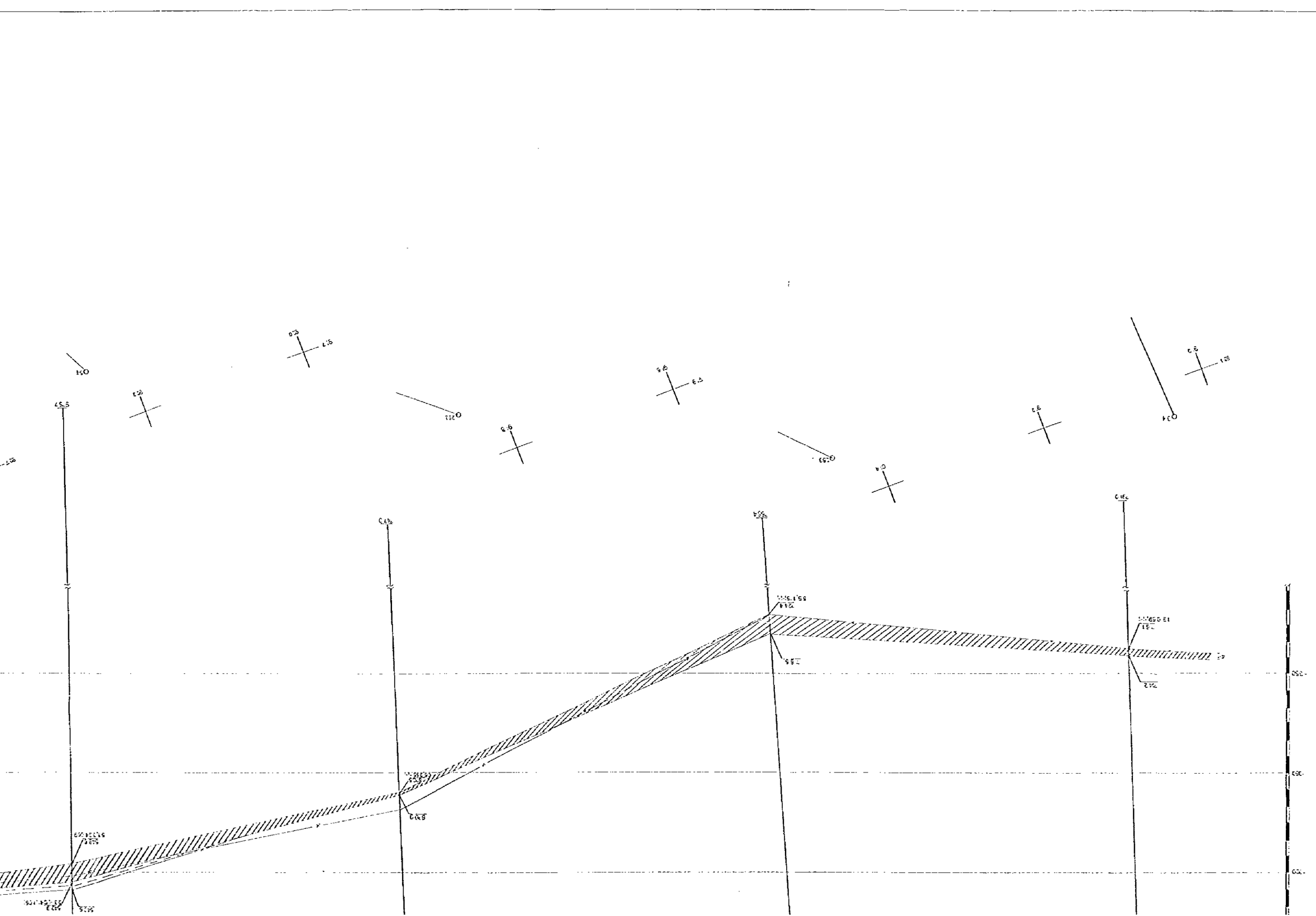
Copper ore : 1. balance
2. off-balance

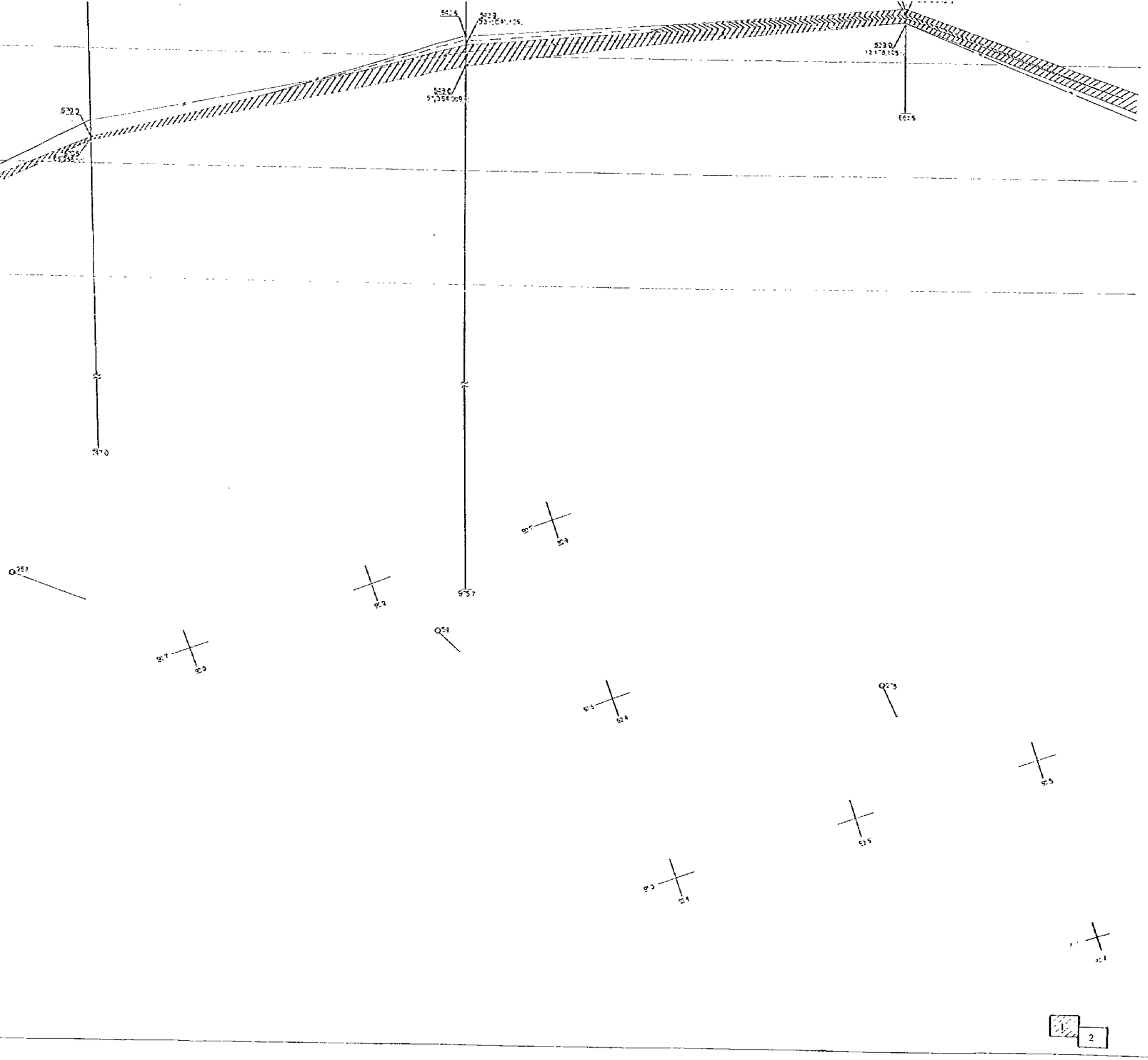
Complex ore : 1. balance
2. off-balance

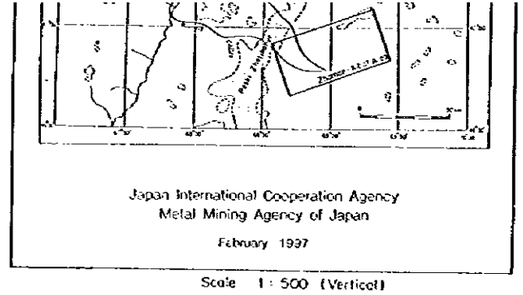
Lead ore : 1. balance
2. off-balance

Zinc ore : 1. balance
2. off-balance

Lead-zinc off-balance ore







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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, %;

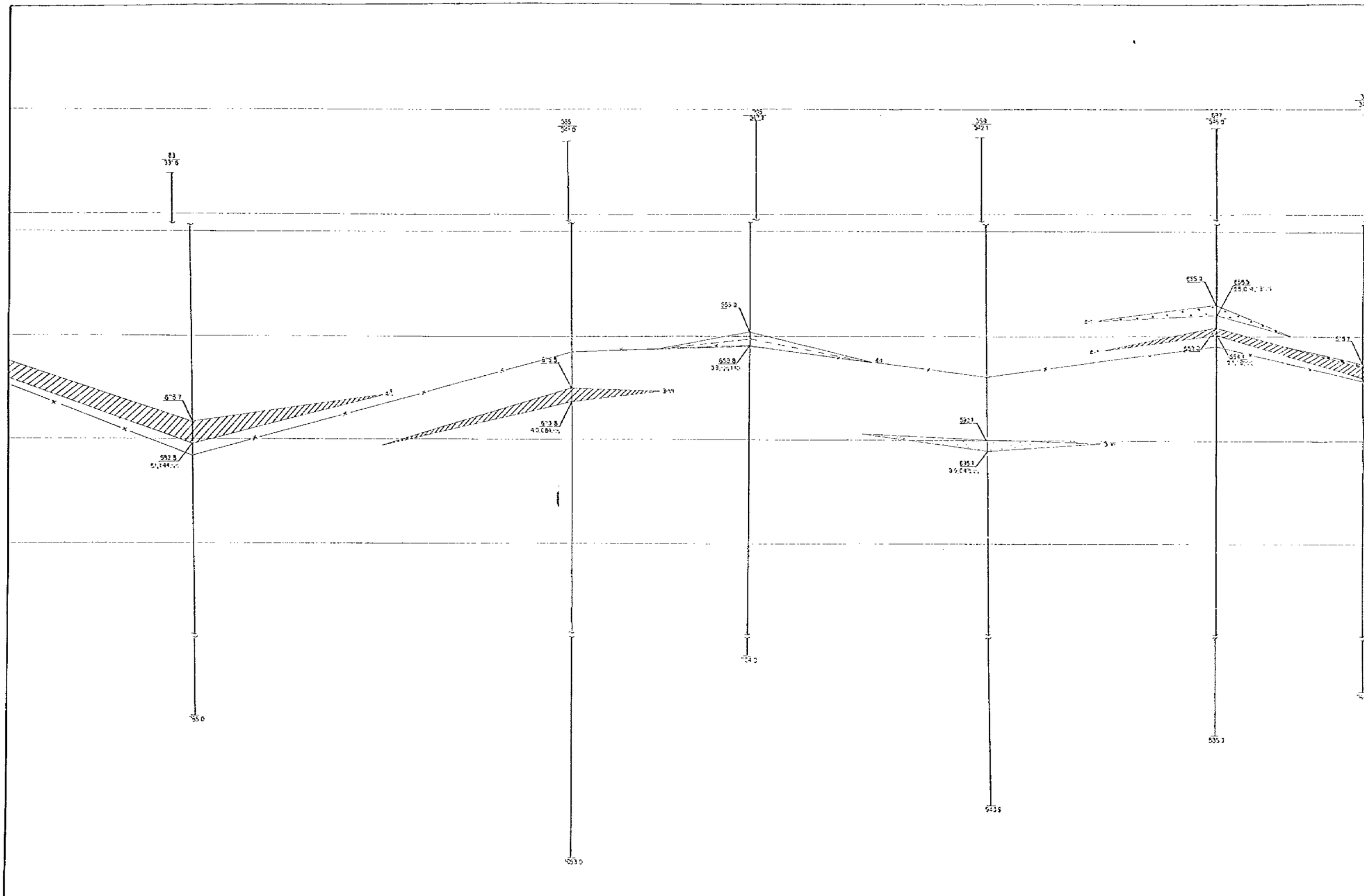
Copper ore : 1. balance
2. off-balance

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



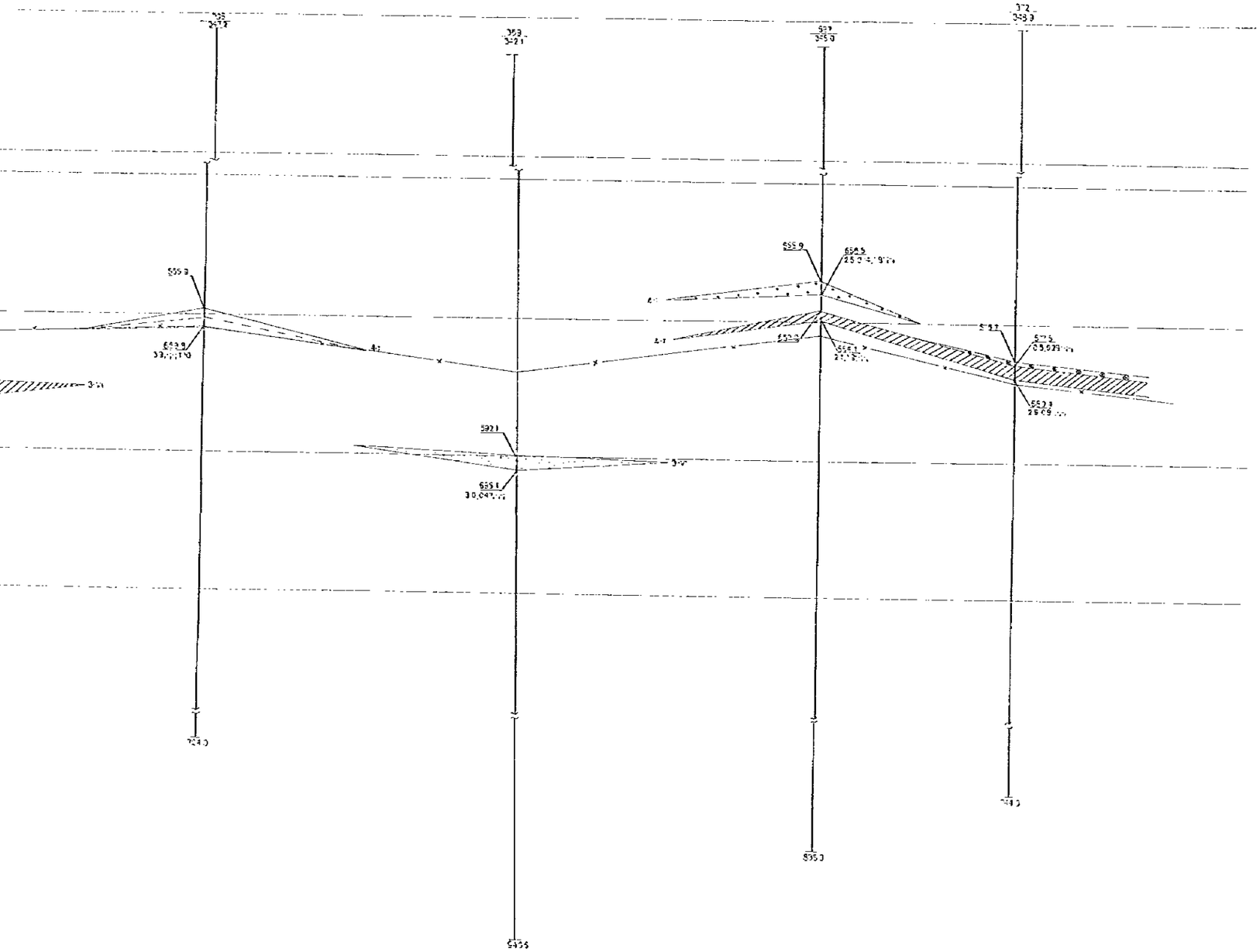
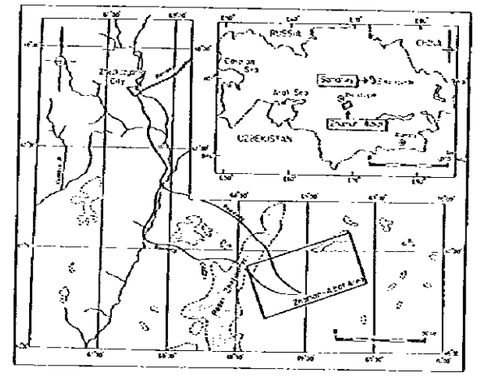


Plate 7-2

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)



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Metal Mining Agency of Japan

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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, %;

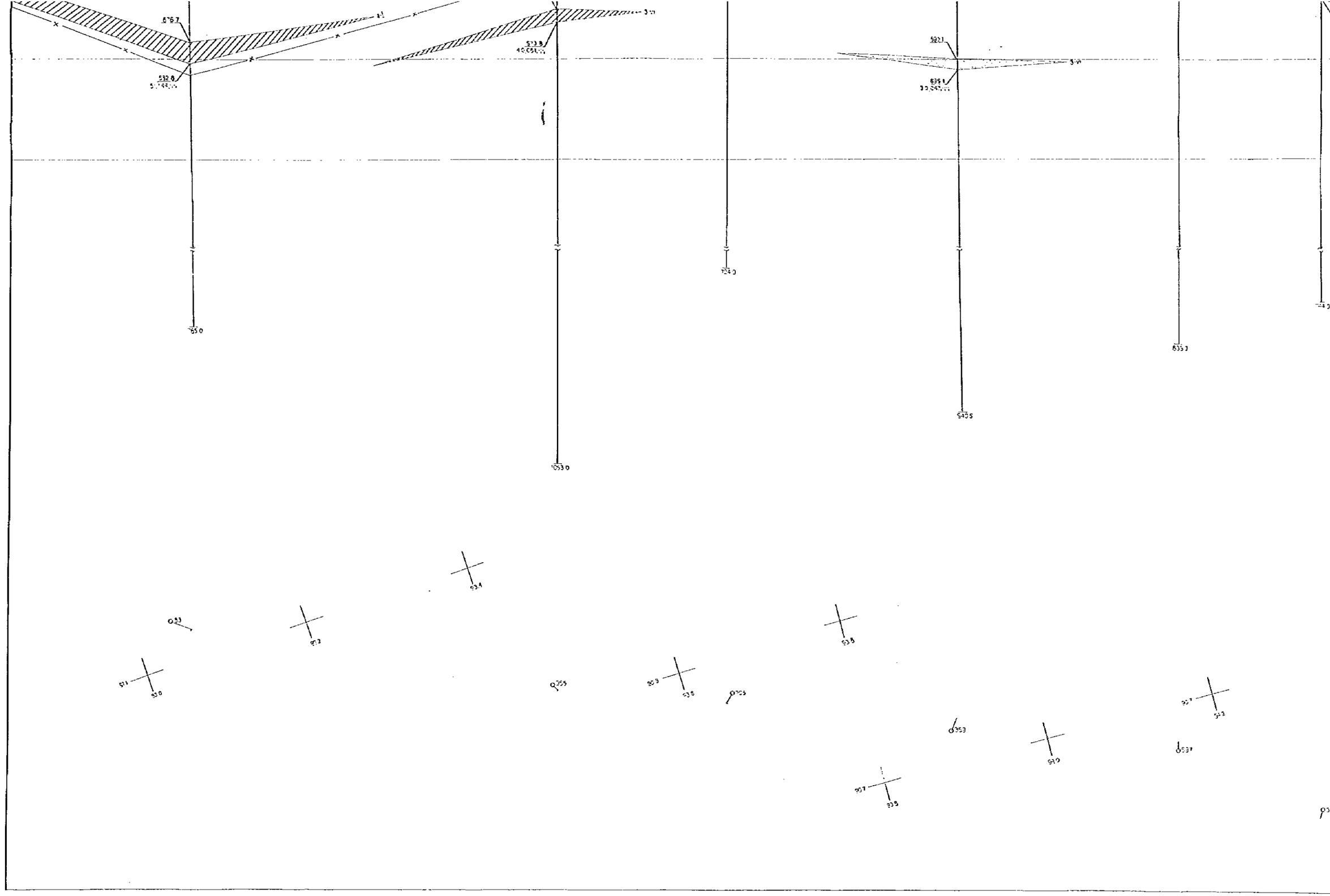
Copper ore : 1. balance
2. off-balance

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



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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, %;

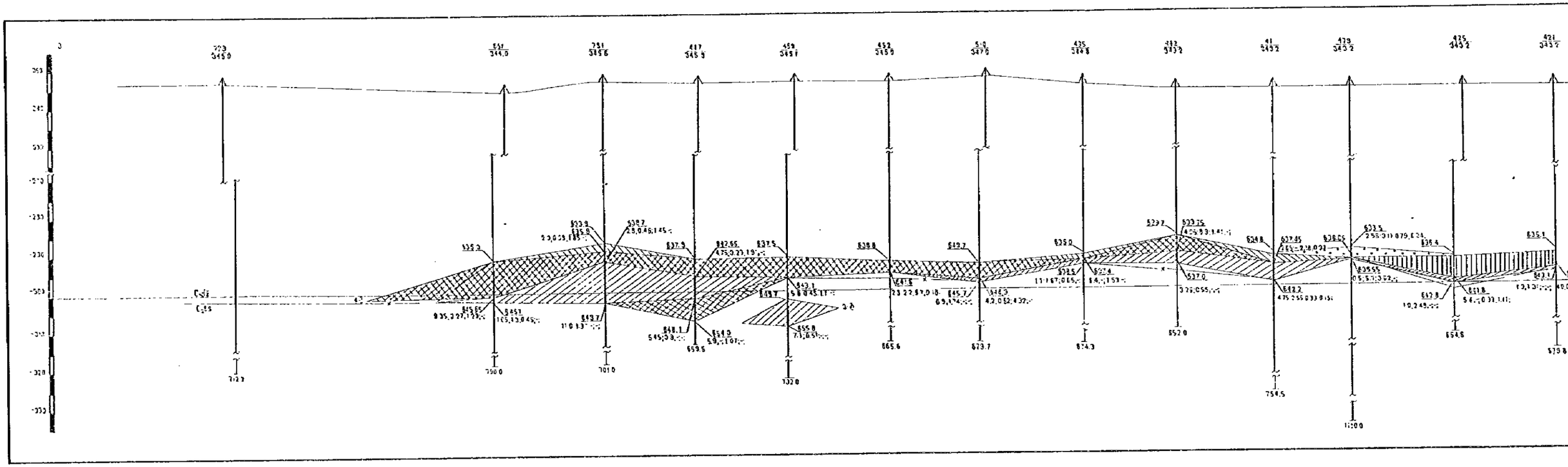
Copper ore : 1. balance
2. off-balance

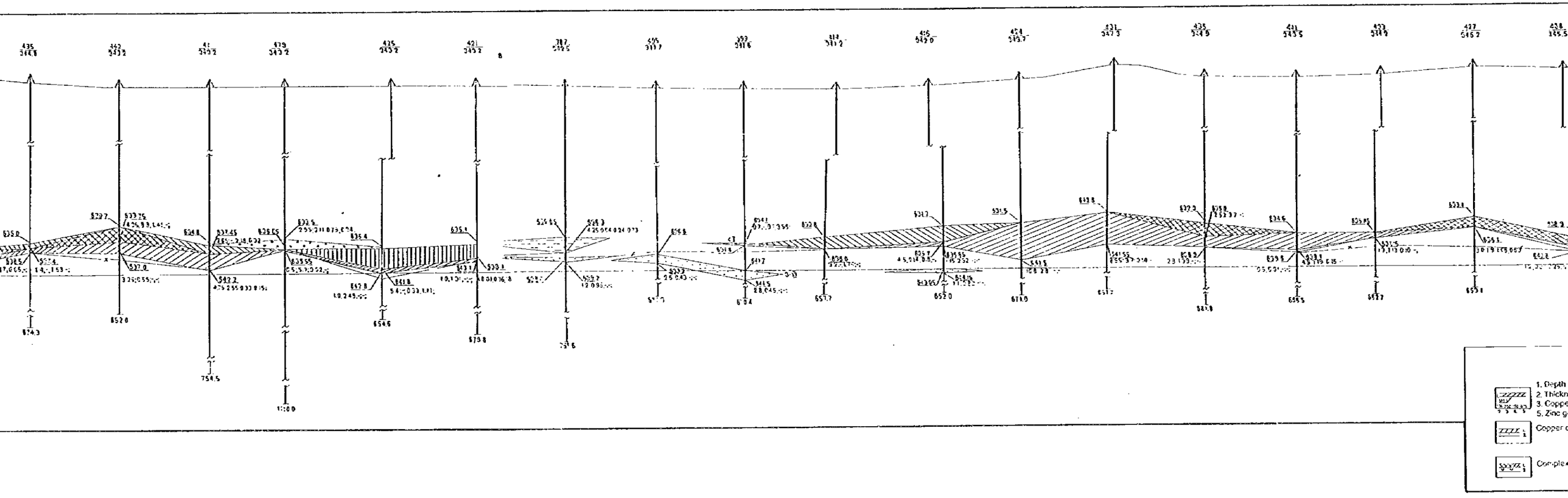
Complex ore : 1. balance
2. off-balance

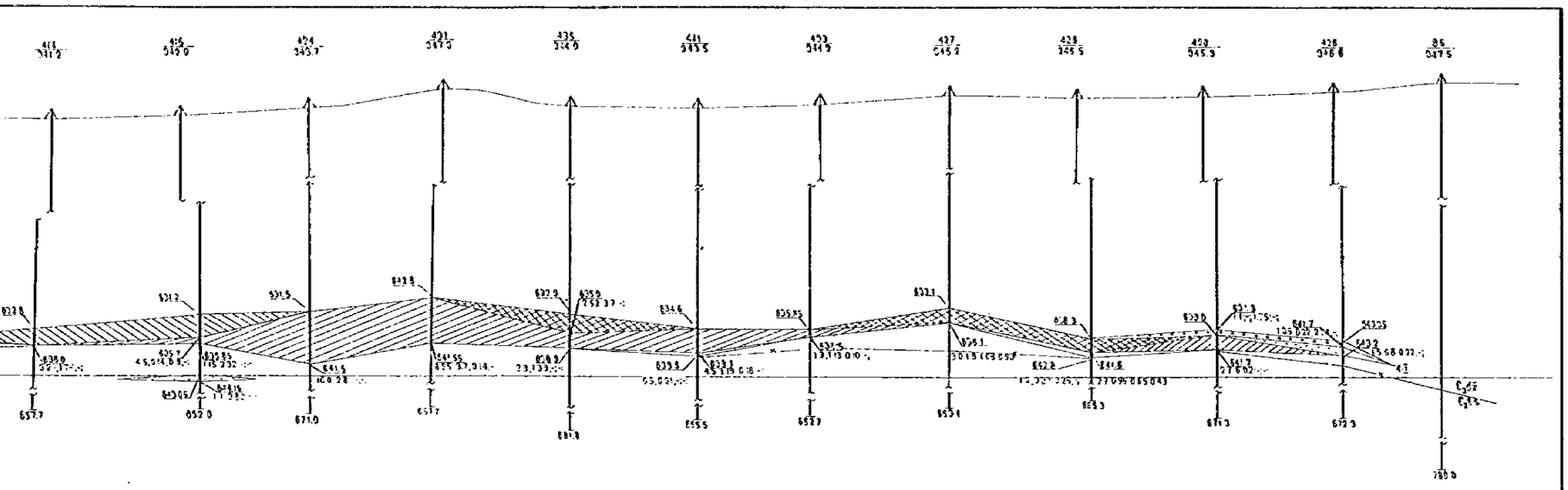
Lead ore : 1. balance
2. off-balance

Zinc ore : 1. balance
2. off-balance

Lead-zinc off-balance ore




1. Depth
2. Thickn
3. Coppe
5. Zinc g
Copper c
Comple



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

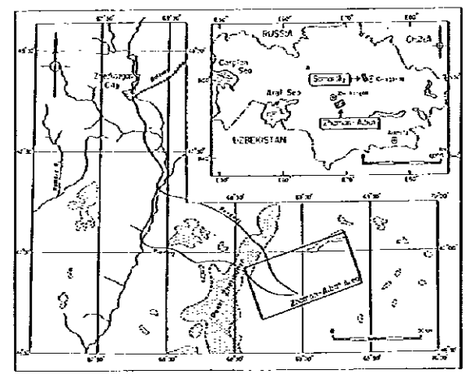
Zinc ore : 1. balance, 2. off-balance

Lead-zinc off-balance ore

Plate 8

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

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



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Metal Mining Agency of Japan

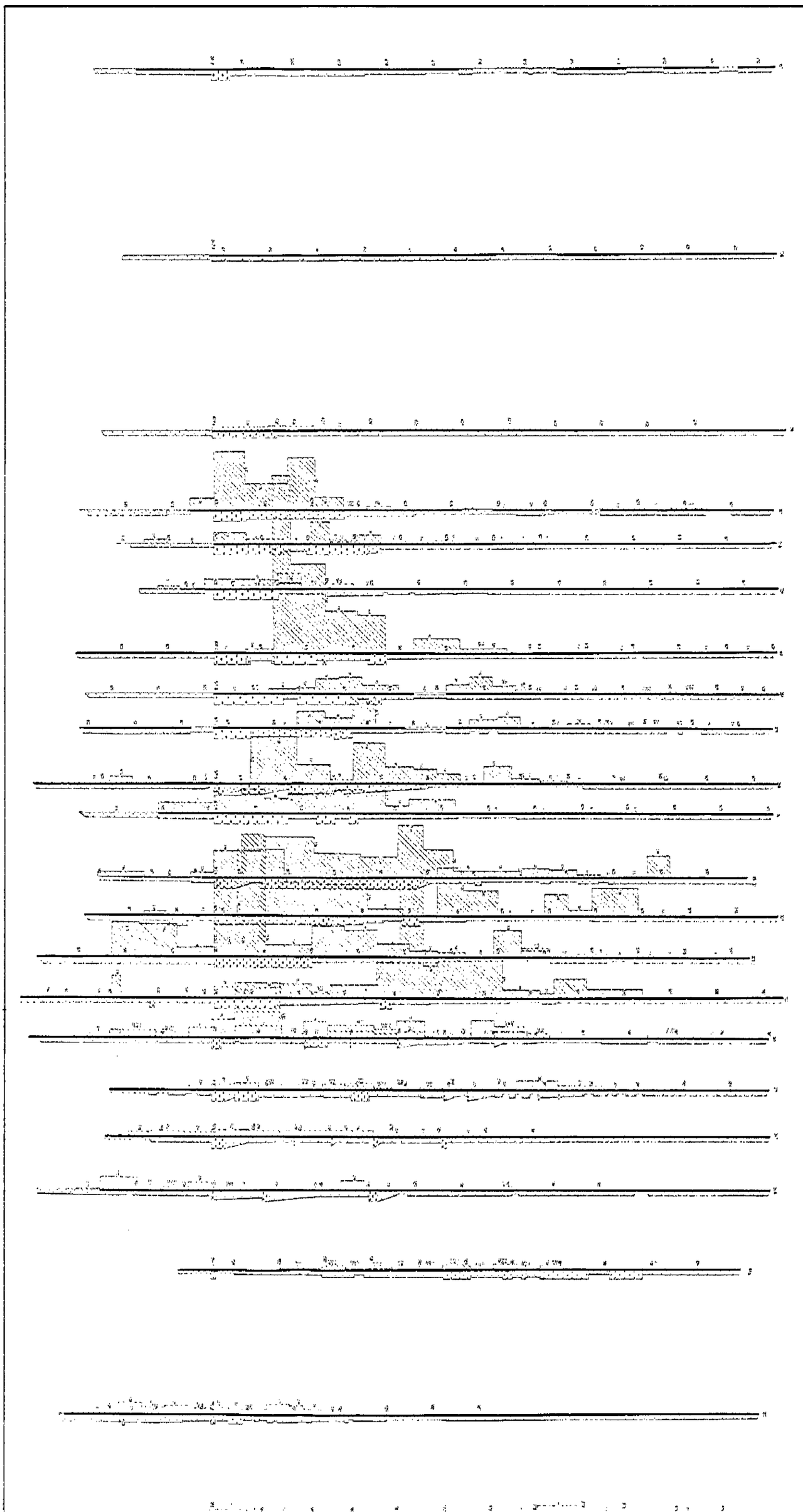
February 1997

Scale 1 : 500 (Vertical)

0 10 20 30 40 50m

Scale 1 : 2,000

0 100 200 m



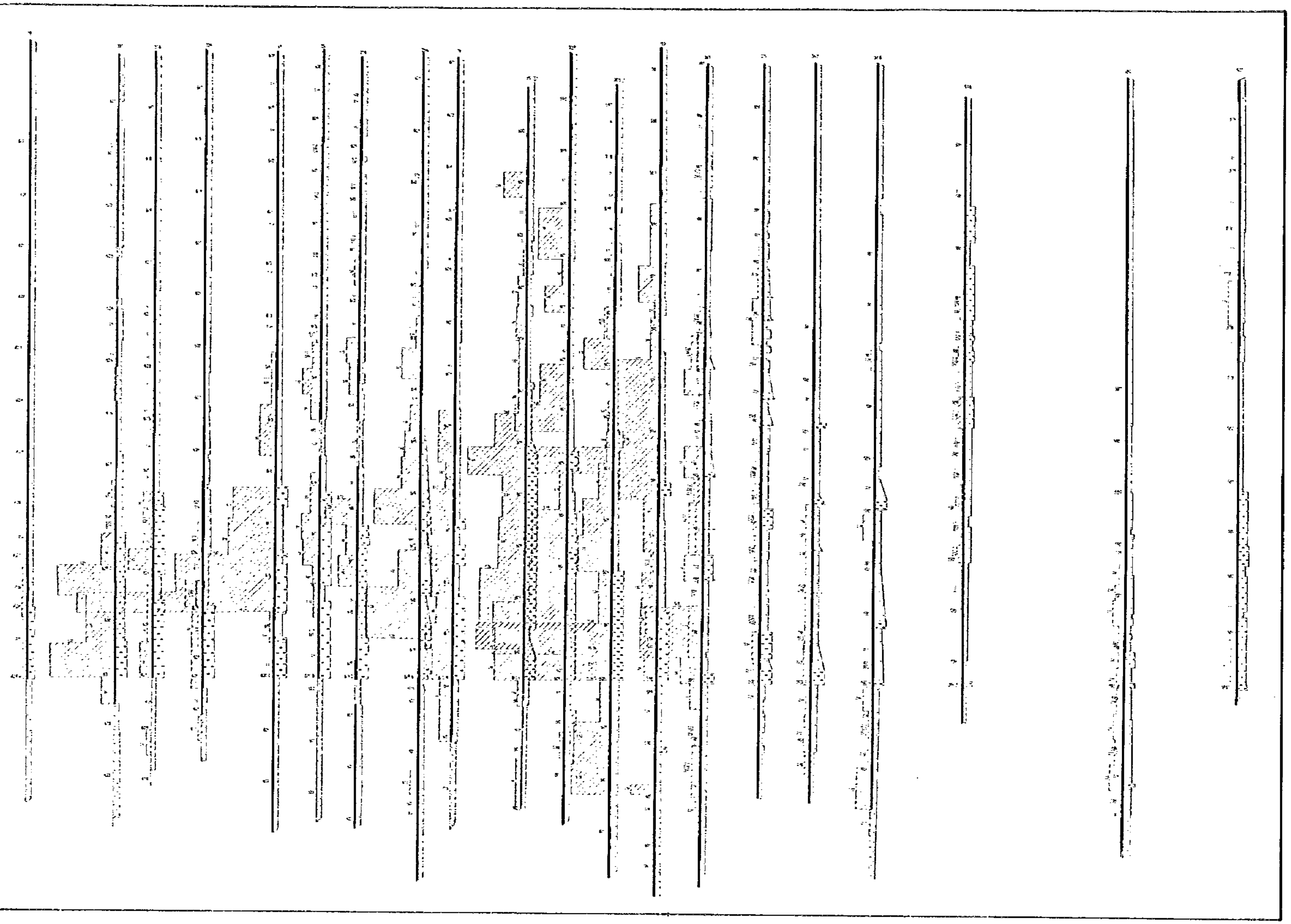
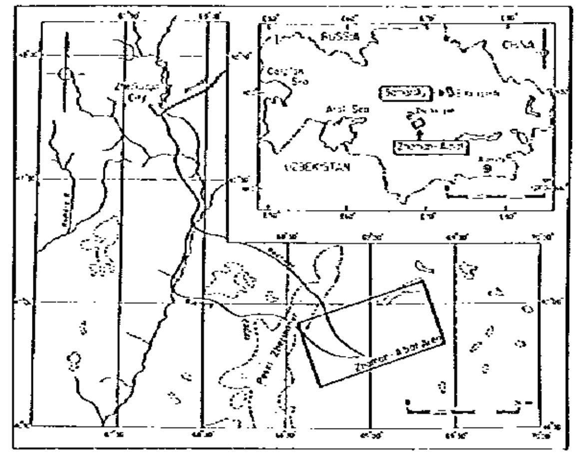


Plate 9

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

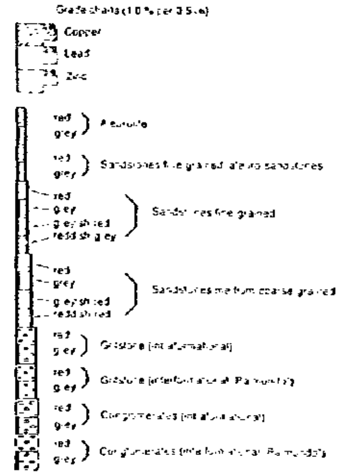
Scale 1 : 40 (Vertical)

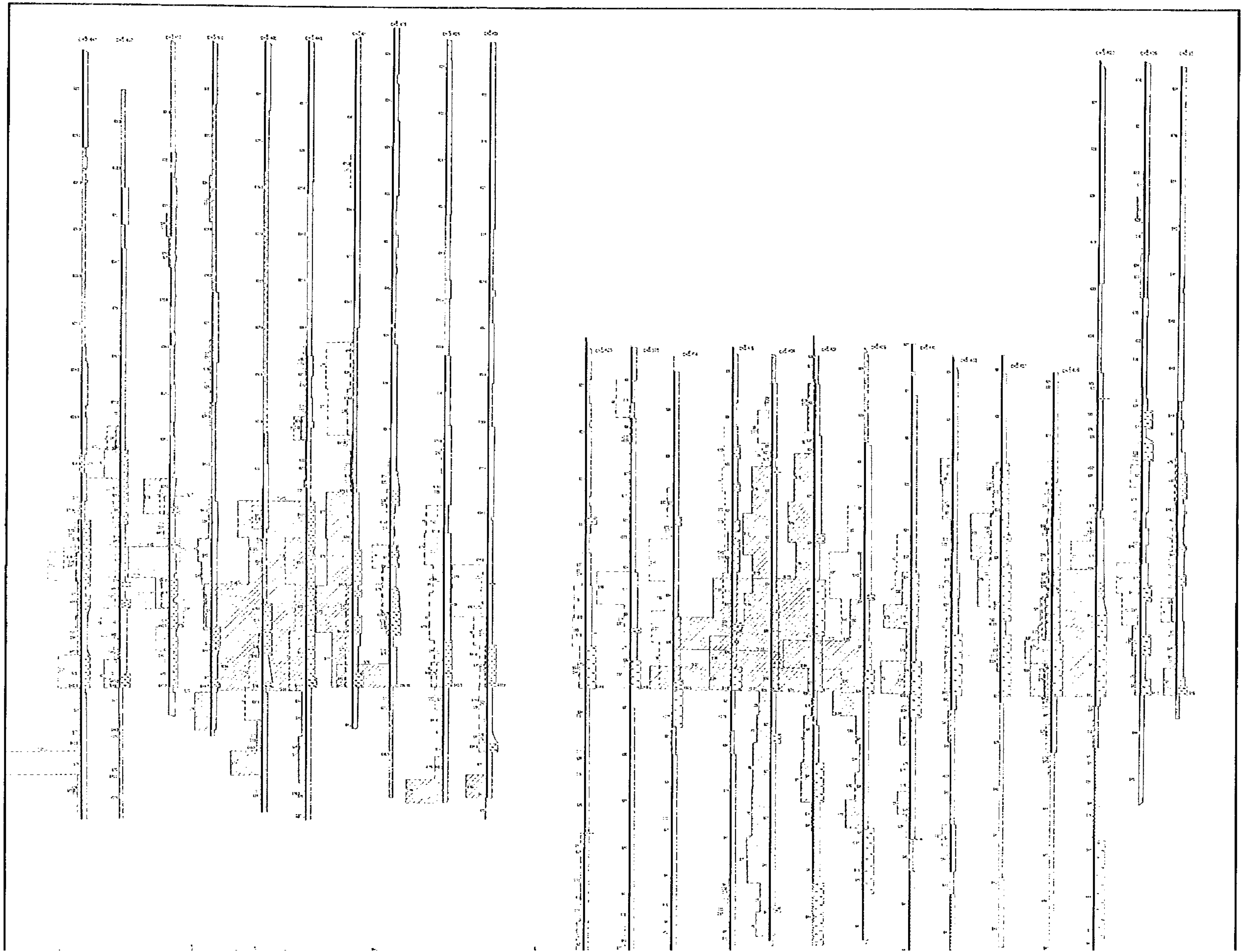
0 1 2 3 4 m

Scale 1 : 4,000

0 100 200 300 400 m

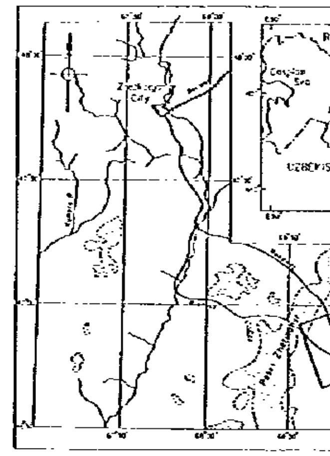
LEGEND





Report on the Mineral Ex
in
the Zhanan-Aitat and Samarsky Area, R
(Phase III)

Lithostratigrap
of Raimundo Conglomera
in the Central
(along the line D



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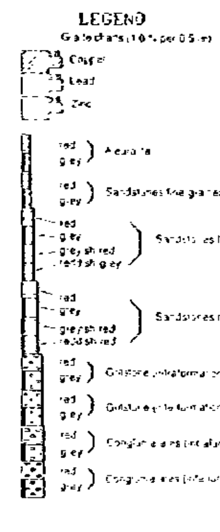
Scale 1 : 40

Scale 1 : 4,0



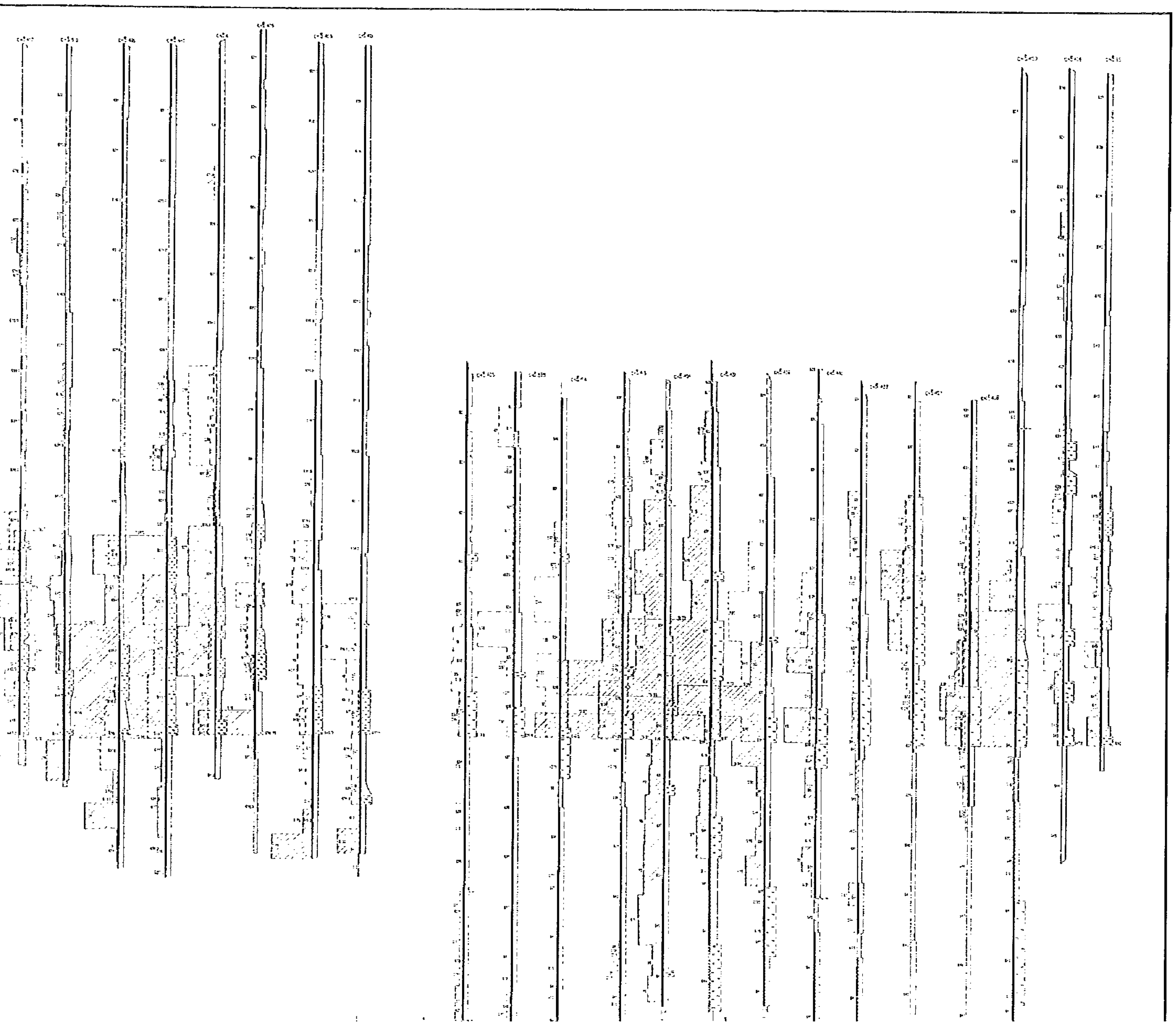
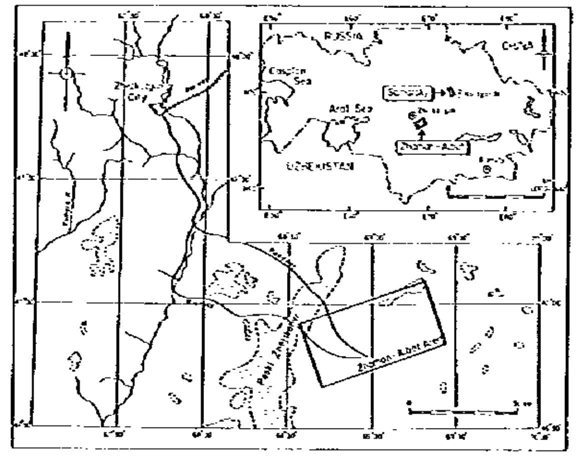


Plate 10

Report on the Mineral Exploration
in
the Zhaman-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

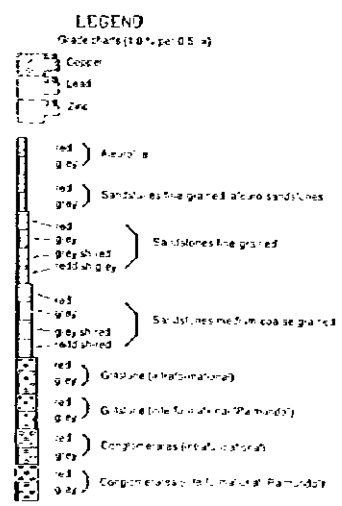
February 1997

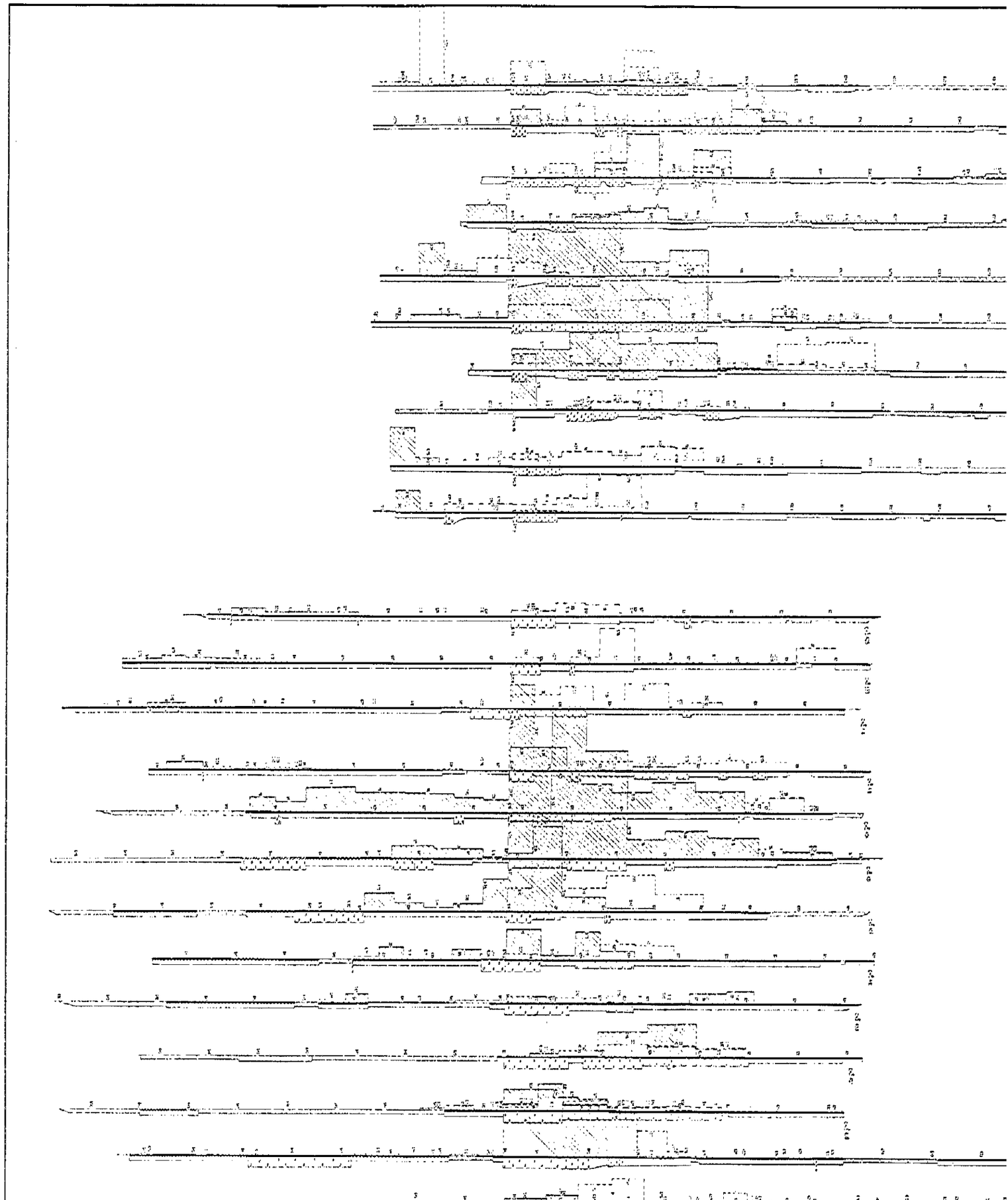
Scale 1 : 40 (Vertical)

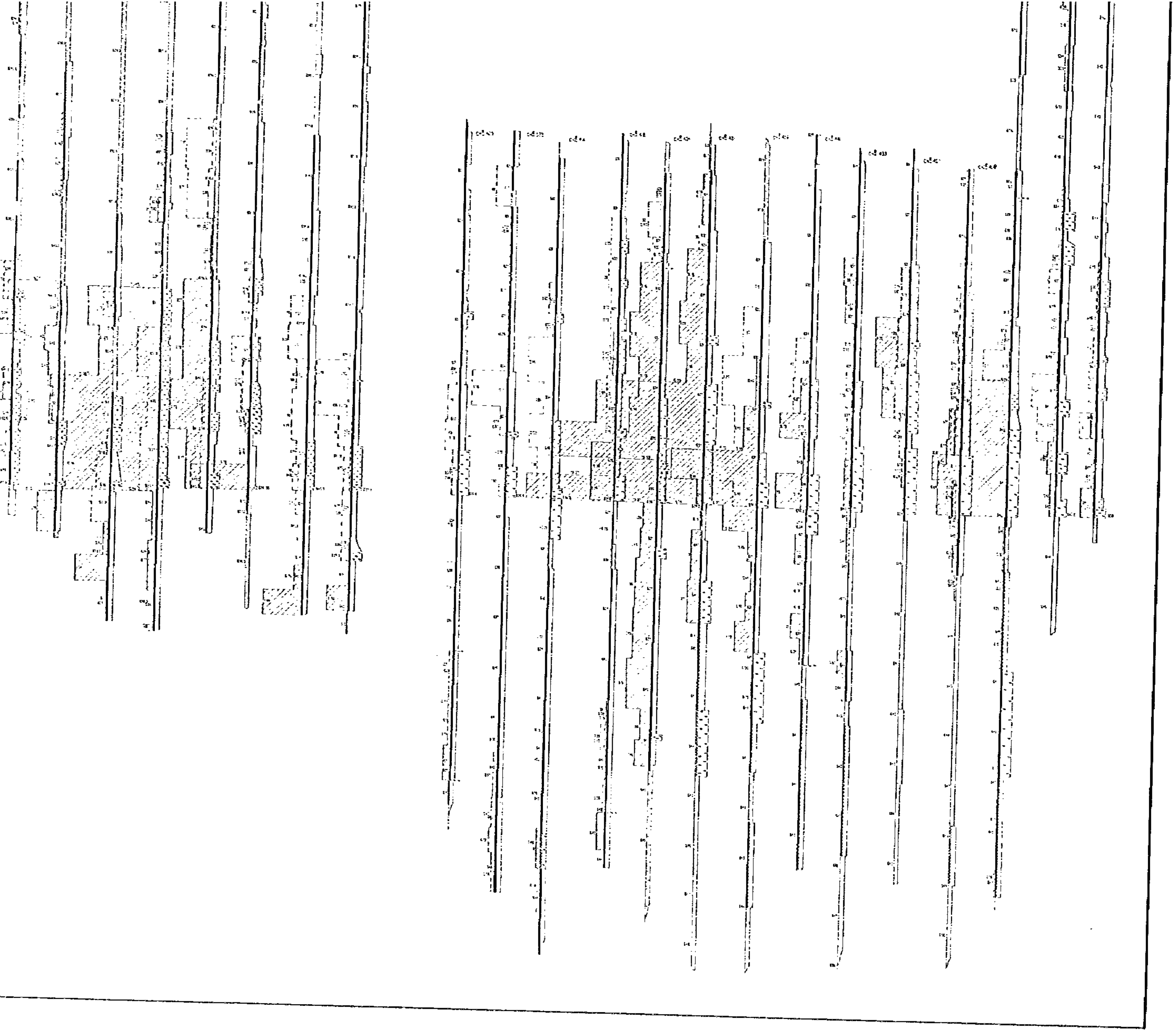
0 1 2 3 4m

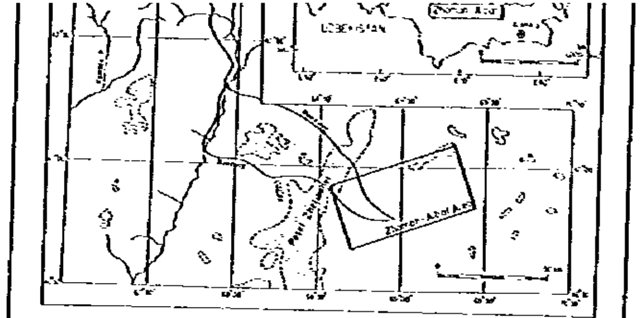
Scale 1 : 4,000

0 100 200 300 400m









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Scale 1 : 40 (Vertical)

Scale 1 : 4,000

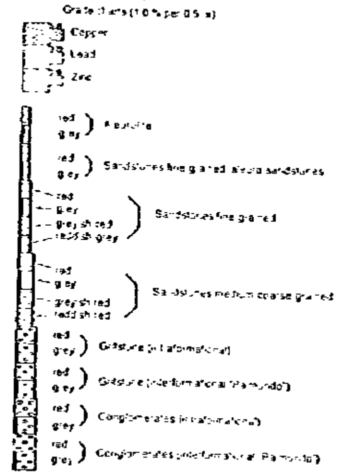
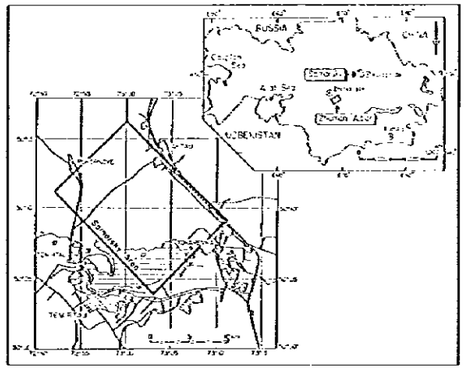


Plate II

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

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



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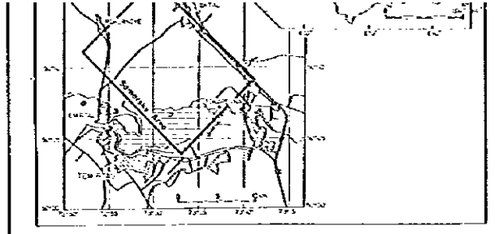
Scale 1 : 2,000

0 100 200m



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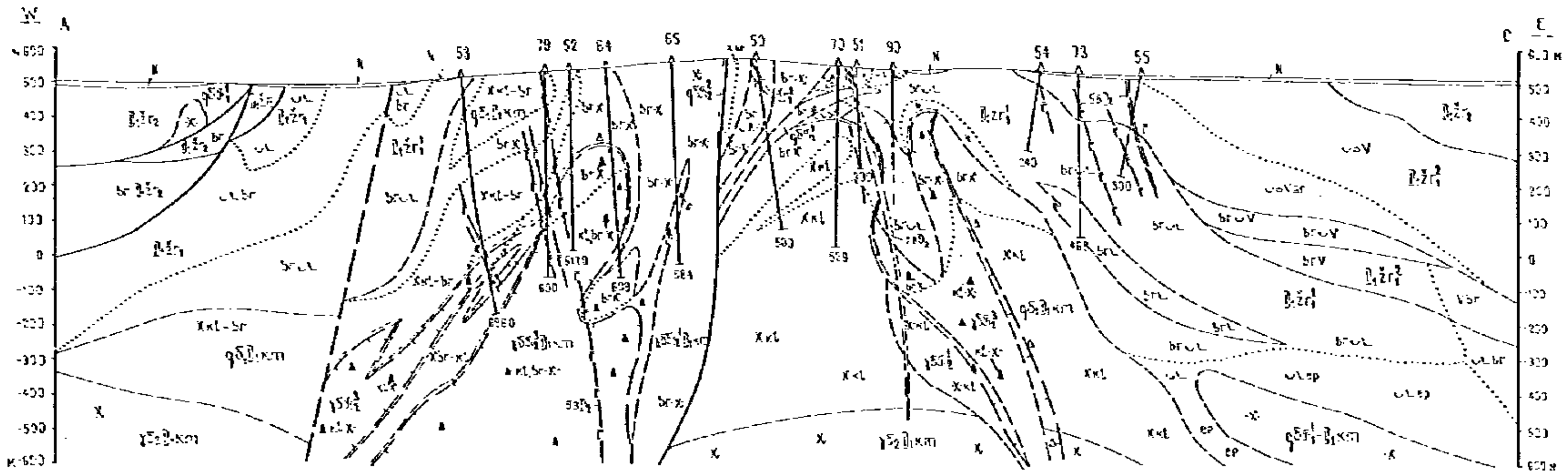
Scale 1 : 2,000

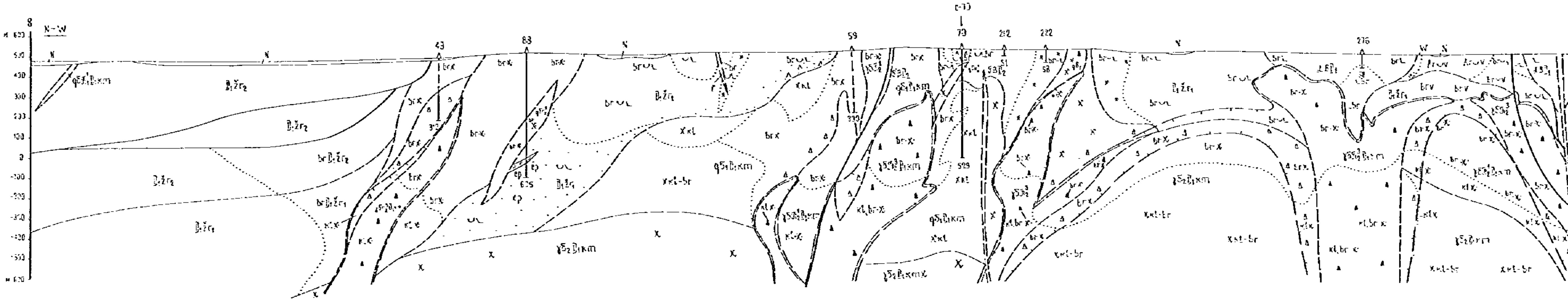
0 100 200m

※ Originally Prepared by Karagandy Geological Exploration Expedition



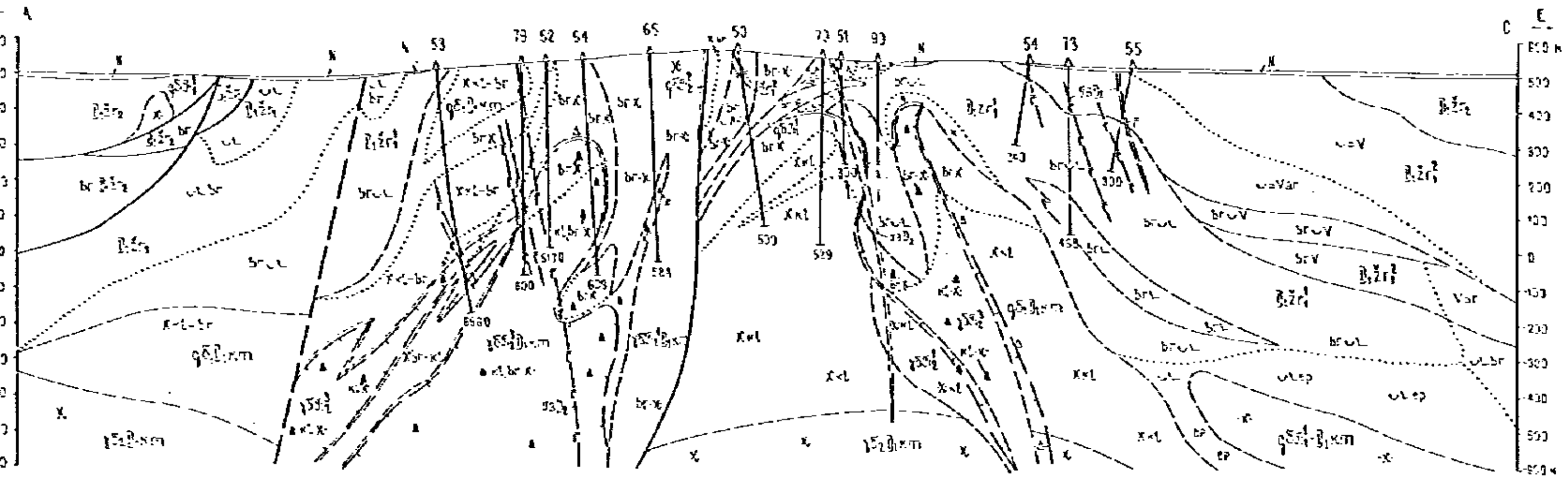
Geological cross-section at line A-C

Scale 1:10000 Compiled by E.Dosmamov I.V



Geological cross-section at line B-c-79

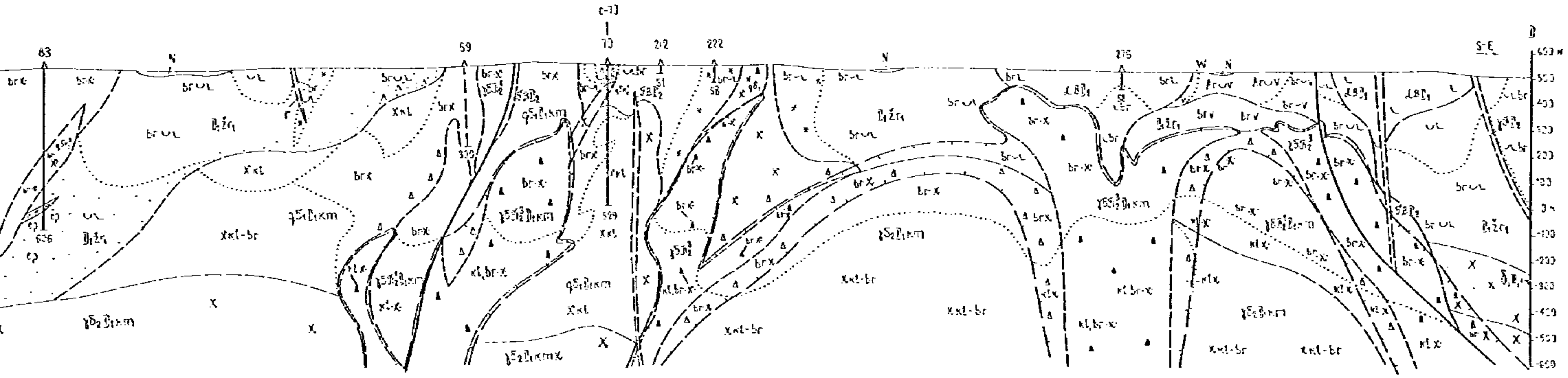
Scale 1:10000 Compiled by E



Boader of copper ore with Cu content > 55%

Geological cross-section at line A-C

Scale 1:10000 Compiled by Evdokimov I.V.



Assumed boader of copper ore with Cu-content > 05%

Geological cross-section at line B-C-73-D

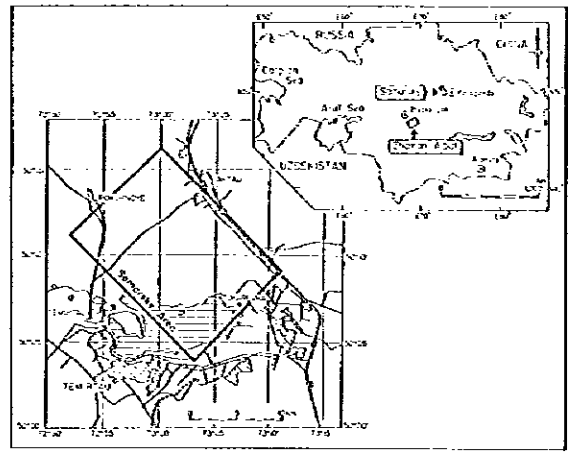
Scale 1:10000 Compiled by Evdokimov I.V.

※ Originally Prepared by Joint Stock Company "Karagandageologiya"

Plate 12

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

Geological Section of the Samarsky Area



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Scale 1 : 10,000

0 500 1000m

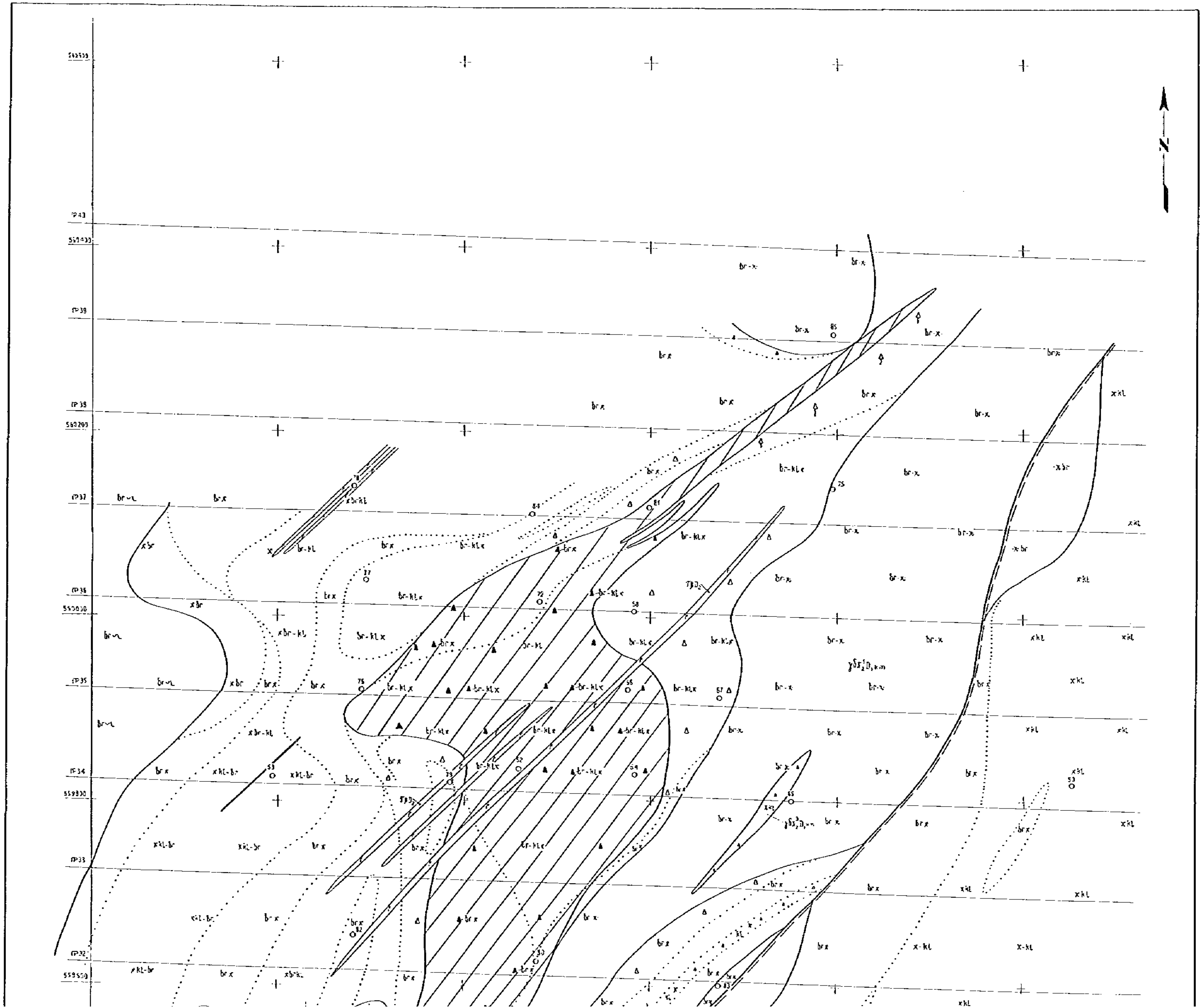
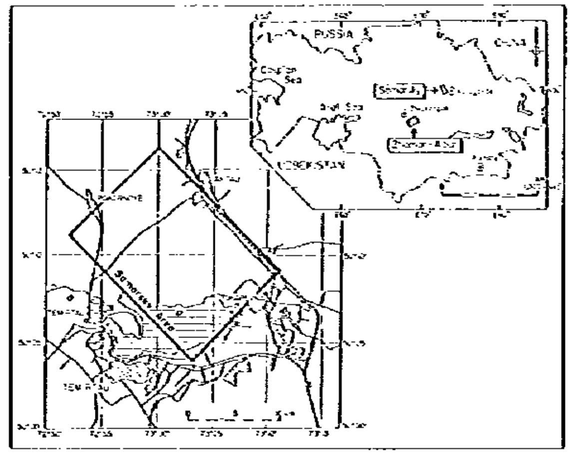


Plate 13

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

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



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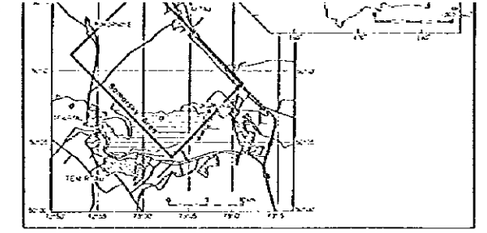
Scale 1 : 2,000

0 100 200m



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Metal Mining Agency of Japan

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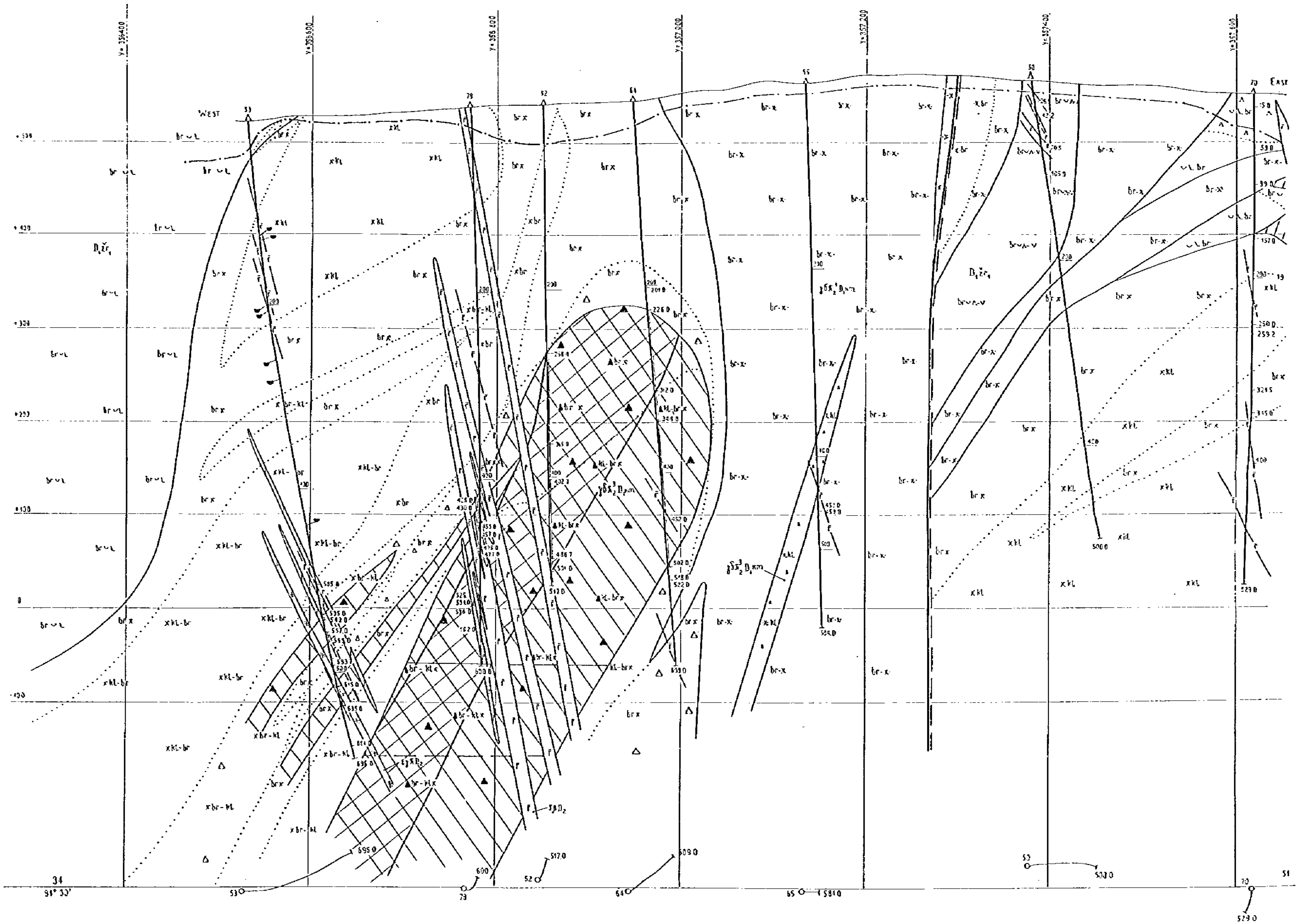
Scale 1 : 2,000

0 100 200 m

※ Originally Prepared by Kurigenda Geological Exploration Expedition.

				Cu, %	Mo, %	Au g/t	Ag g/t
1	2	3	4	5	6	7	8
52	248.4	530.0	282.6	2.03	0.0332		2.61
	261.4	365.0	56.6	2.33	0.0075		2.25
	402.7	455.7	84.0	2.55	0.0149		3.57
53	535.0	542.0	6.0	1.55	0.0361	0.71	2.17
	557.0	566.0	9.0	0.59	0.030	0.173	3.97
	615.0	635.0	20.0	0.55	0.020	0.169	2.71
64	226.0	592.0	276.0	1.02	0.002		1.01
	226.0	392.0	86.0	1.15	0.0030		1.55
	344.0	522.0	153.0	0.69	0.0023		0.63
	344.0	452.0	108.0	1.26	0.0021		0.13
	470.0	502.0	32.0	0.77	0.0034	0.310	0.50
	516.0	522.0	6.0	0.84	0.0033	0.43	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	0.035	1.43	3.9
	430.0	434.0	4.0	0.53	0.003	0.4	2.6
	420.0	494.0	74.0	0.28	0.059	0.8	3.4
79	425.0	430.0	5.0	0.55			
	453.0	457.0	4.0	0.75			
	475.0	562.0	87.0	2.54			
			(32.0)				

				Cu, %
1	2	3	4	5
53	505.0	536.0	31.0	0.24
	559.0	592.7	26.7	0.34
	635.0	681.0	46.0	0.27
50	25.0	42.2	16.2	0.44
	71.5	105.0	34.5	0.22
64	201.0	226.0	25.0	0.46
	592.0	603.0	107.0	0.33
51	7.5	52.0	44.5	0.41
	98.0	120.0	22.0	0.48
	494.0	254.0	69.0	0.27
65	453.0	458.0	5.0	0.24
70	15.0	59.0	44.0	0.20
	99.0	157.0	58.0	0.47
	250.0	259.8	9.6	0.23
	321.5	345.0	23.5	0.45
79	419.4	425.0	5.6	0.30
	430.0	438.0	8.0	0.28
	449.0	453.0	4.0	0.24
	457.0	475.0	18.0	0.45
	552.0	565.0	4.0	0.26

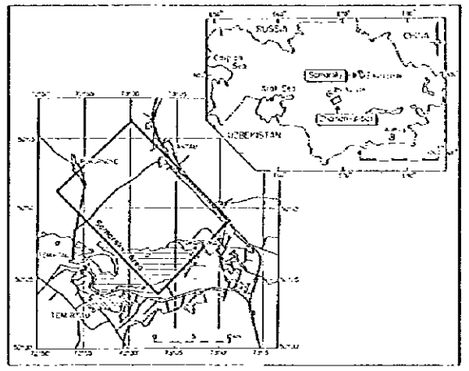


※ Originally Prepared by [illegible] Geological Exploration Expedition.

Plate 14

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

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



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Scale 1 : 2,000

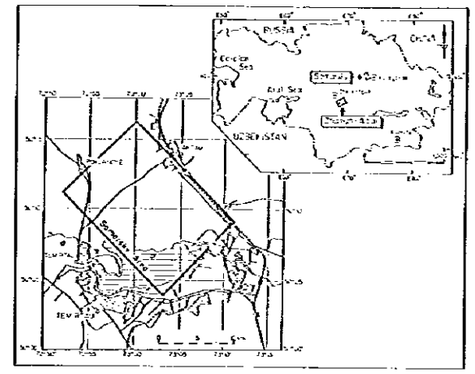
0 100 200 m

* Originally Prepared by Saragandy Geological Exploration Expedition

Plate 15

Report on the Mineral Exploration
in
the Zhanaa-Arbat 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)



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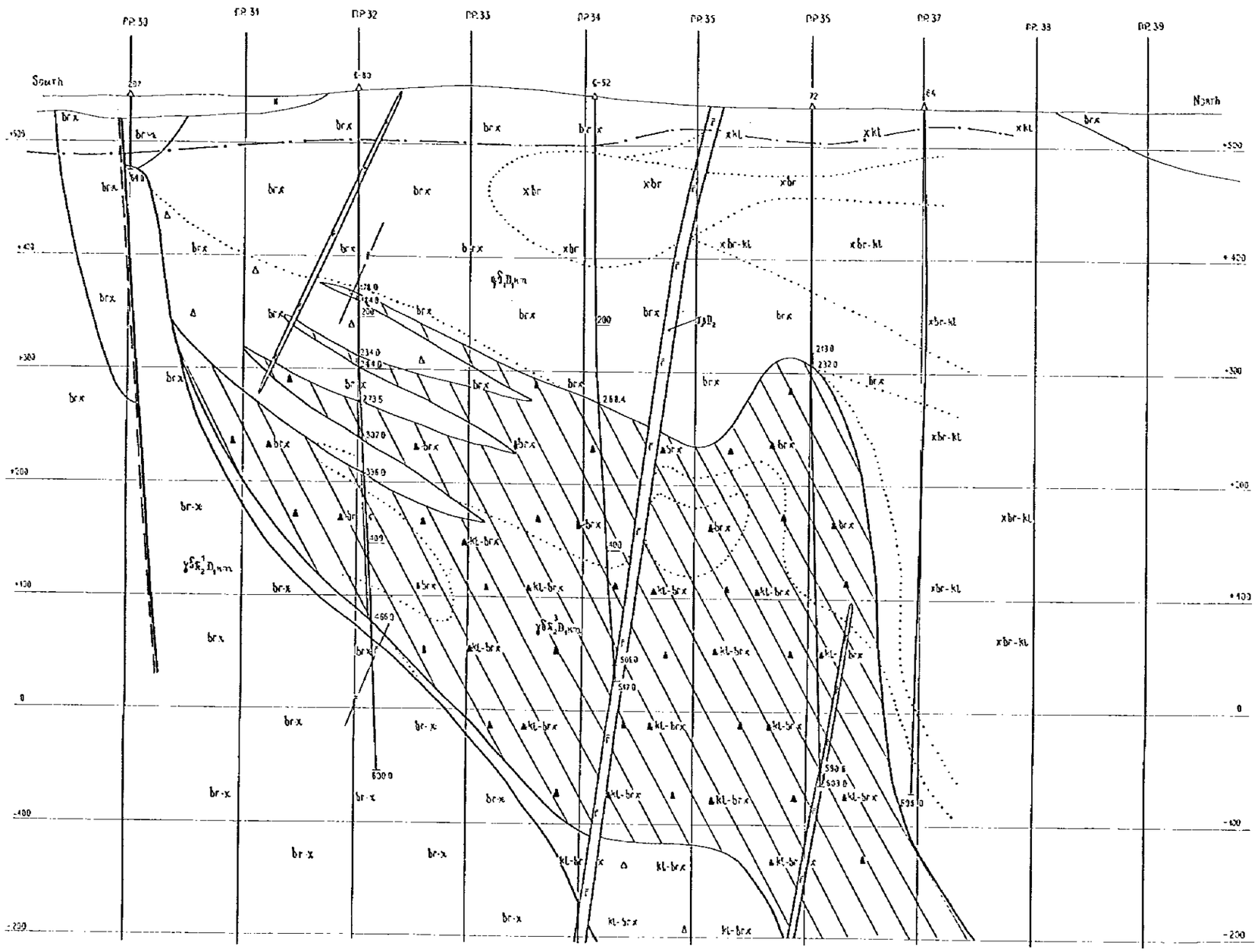
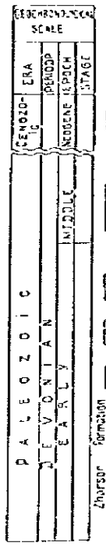


Scale 1 : 2,000

0 100 200 m

※ Originally Prepared by Koraganda Geological Exploration Expedition.

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 (τγ₂), and granite porphyry (τγ)

Minor body of trachyandesite (τd)

KARAMENDIN INTRUSIVE COMPLEX

Intrusives and dikes additional to the second phase and associated metasomatic formations: granodiorite-porphyry (γδ₂), quartz-diorite-porphyry coarse impregnated and biotite-plagioclase-like (qδ₂), eruptive breccias of granodiorite-porphyry (γδ₂), beresite (br₂), potassium feldspar facies (kl₂).

The first phase and associated metasomatic formations: quartz diorite, medium grained, medium-fine grained (qδ₁), microdiorite and quartz-diorite-porphyry of exocontact facies (δ₁), beresite (br₁), potassium feldspar facies (kl₁), secondary quartzite (vk₁), additional intrusive of quartz diorite porphyry (qδ₁).

Early Devonian Subvolcanic Complex

Natron andesite basalt (νB)

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

Upper Stratum, Tuff, tefroid and volcanomictic clastic rocks of andesite composition, mostly red coloured.

Lower Stratum, Tuff, tefroid and volcanomictic clastic rocks of andesite 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 (А), borders of metasomatic facies (е), hornfels facies (ж).

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

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

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

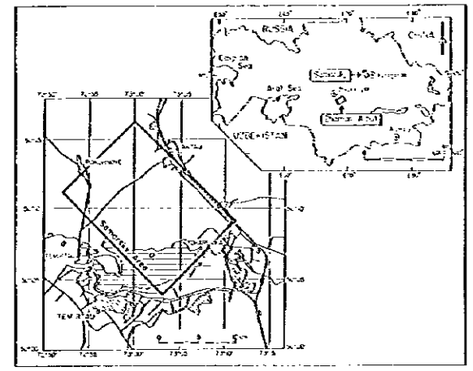
Drill and Drill No. : prospecting drill (а), mapping drill completed in 1994 (б), mapping drill completed before 1994 (в), hydrogeological drill (г).

Asphalt road

Plate 16

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

Legend for the Plate 12



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February 1997

LEGEND

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)
Minor body of trachyandesite (τd)

KARAMENDIN INTRUSIVE COMPLEX

Intrusives and dikes additional to the second phase and associated metasomatic formations. granodiorite-porphyry ($\gamma\delta\pi^1_2$), quartz-diorite-porphyry 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-fine grained ($q\delta_1$), microdiorite and quartz-diorite-porphyry of exocontact facies ($mq\delta_1$), beresite (br_1), potassium feldspar facies (kl_1) propylite (P_1), secondary quartzite (vk_1).

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 (б).

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 (a), 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 (e), beresite derived from quartz diorite, accompanied by unevenly distributed potassium feldspar (ж).

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

Eruptive (intrusion) breccia-breccia with different composition of fragments or with different composition of fragments and cementing rocks (a), tectonic pre-ore breccia: fragmnets 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), liminotization (e), local silicification (ж)

Border of subdivisions with different age: confirmed (a), 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 (e), hornfels facies (ж).

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

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

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 (б), hydrogeological drill (в), CPSE (previous expedition) prospecting drill (г), technological drill (д), CPSE drill completed by Karaganda expedition in 1993 (e).

C_2 category reserves contour (a) 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 (a).

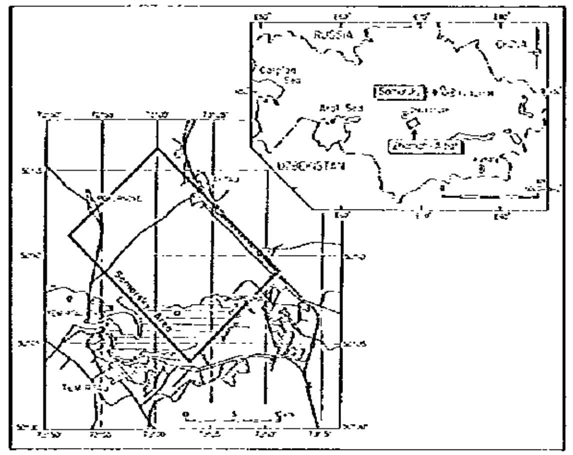
Contour of copper ore, suitable for operations (cut-off 0 5% Cu) (б)

Contour of rich copper ore.

Plate 17

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

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



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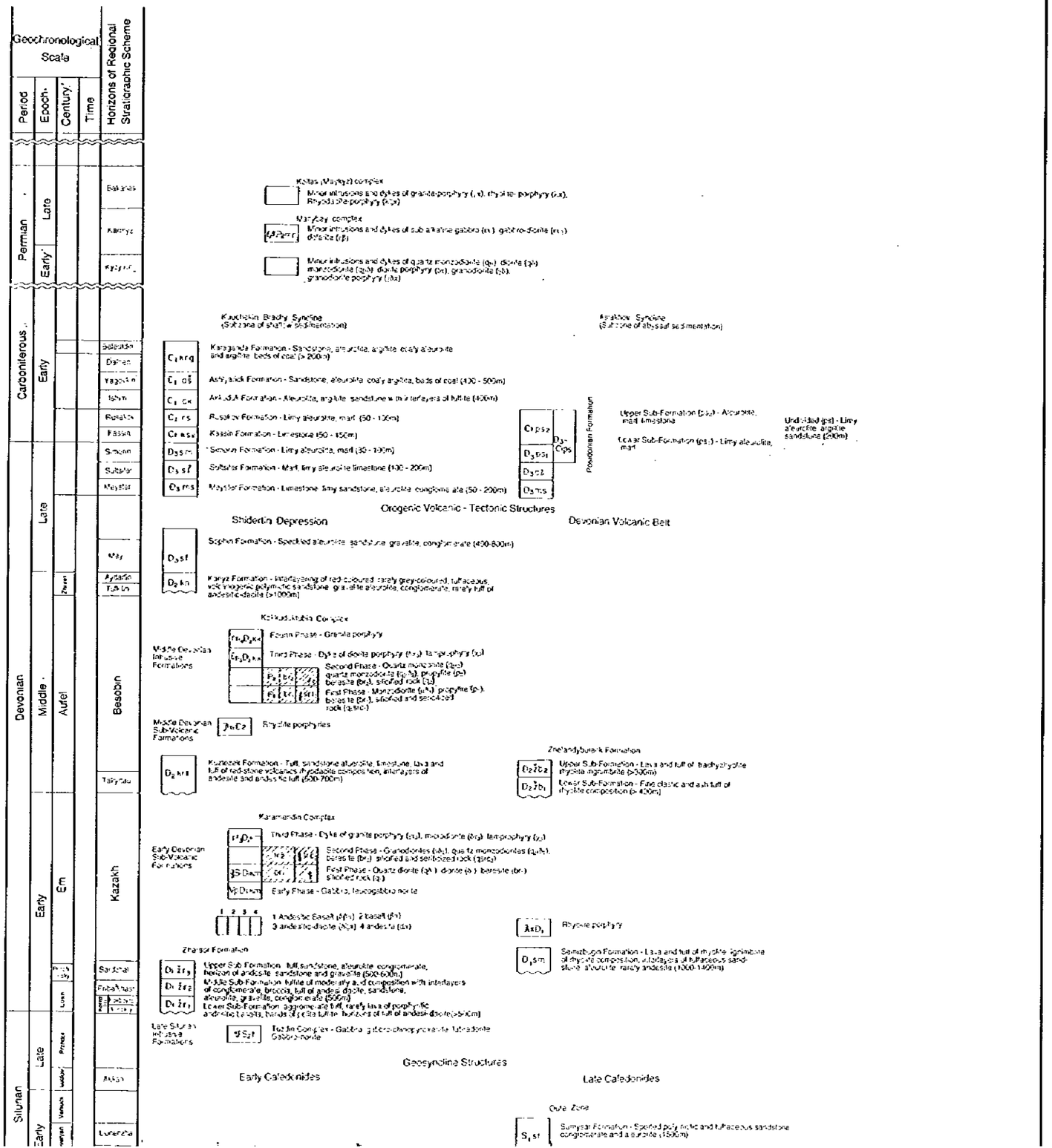
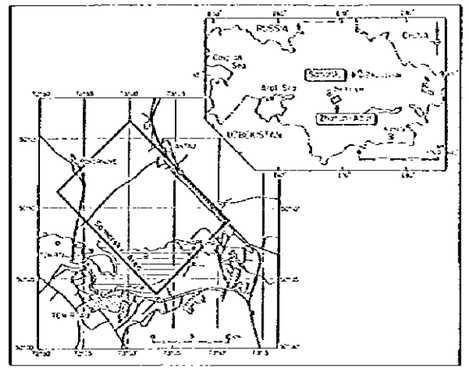


Plate 18

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

Stratigraphic Setting in the Samarsky Area



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Devonian: Late (Kassin, Simorin, Sulsifer, Meyster, May, Aydarlin, Tulkulin); Middle (Aufol – Besobin, Takyrtau); Early (Em – Kazakh, Sardahal)

Silurian: Late (Pridoli, Ludlov – Akkan); Early (Wenlock, Llandovery – Ucnorazhal, Aspiy)

Ordovician: Late; Middle; Early

Cambrian: Late; Middle; Early

Proterozoic: Late; Early

$C_1 ks_4$	Kassin Formation - Limestone (50 - 150m)
$D_3 sm$	Simorin Formation - Limy aleurolite, marl (50 - 100m)
$D_3 sl$	Sulsifar Formation - Marl, limy aleurolite limestone (100 - 200m)
$D_3 ms$	Meyster Formation - Limestone, limy sandstone, aleurolite, conglomerate (50 - 200m)

$C_1 ps_2$, $D_3 ps_1$ (D_3-$C_1 ps$, Posidonian Fm.), $D_3 zl$, $D_3 ms$

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

aleurolite, argillite, sandstone (200m)

Orogenic Volcanic - Tectonic Structures

Shidertin Depression

$D_3 sf$	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 (>1000m)

Koktuduktubin Complex

Middle Devonian Intrusive Formations

$\gamma\pi_4 D_2 kk$	Fourth Phase - Granite porphyry
$\delta\pi_3 D_2 kk$	Third Phase - Dyke of diorite porphyry ($\delta\pi_3$), lamprophyry (χ_3)
p_2, br_2, q_2	Second Phase - Quartz monzonite ($q\mu_2$), quartz monzodiorite ($q\mu\delta_2$), propylite (p_2), beresite (br_2), silicified rock (q_2)
p_1, br_1, qsr_1	First Phase - Monzodiorite ($\mu\delta_1$), propylite (p_1), beresite (br_1), silicified and sericitized rock (qsr_1)

Middle Devonian Sub-Volcanic Formations

$\lambda\pi C_2$	Rhyolite porphyries
$D_2 kz$	Kuzlczek Formation - Tuff, sandstone aleurolite, limestone, lava and tuff of red-stone volcanics rhyodacite composition, interlayers of andesite and andesitic tuff (500-700m)

Karamendin Complex

Early Devonian Sub-Volcanic Formations

$\gamma\pi_3 D_1 km$	Third Phase - Dyke of granite porphyry ($\gamma\pi_3$), microdiorite ($\delta\mu_3$), lamprophyry (χ_3)
br_2, qsr_2	Second Phase - Granodiorites ($\gamma\delta_2$), quartz monzodiorites ($q\mu\delta_2$), beresite (br_2), silicified and sericitized rock (qsr_2)
$\gamma\delta_1 D_1 km$, br_1, q_1	First Phase - Quartz diorite ($q\delta_1$), diorite (δ_1), beresite (br_1), silicified rock (q_1)
$\nu\beta D_1 km$	Early Phase - Gabbro, leucogabbro norite

1 2 3 4	1 Andesitic Basalt ($\alpha\beta\pi$) 2 basalt ($\beta\pi$) 3 andesitic-dacite ($\alpha\zeta\pi$) 4 andesite ($\alpha\pi$)

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)

Late Silurian Intrusive Formations

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

Devonian Volcanic Belt

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)
$\lambda\pi D_1$	Rhyolite porphyry
$D_1 sm$	Samichugin Formation - Lava and tuff of rhyolite, ignimbrite of rhyolite composition, interlayers of tuffaceous sandstone, aleurolite, rarely andesite (1000-1400m)

Geosyncline Structures

Early Caledonides

$O_2 kt$	Karatal Formation - Sandstone, gravelite, sedimentary conglomerate-breccias, aleurolite with olystolite of fine basalt and ultrabasite (> 200m)
$\epsilon_3 O_2 ck$	Akdym Group - Jasper, microquartzite, flinty aleurolites, interlayers of phthanite, vanadium-bearing schist, basalt, conglomerates (> 2500m)

Astafiev - Sub-alkaline delaminated complex

Late Cambrian Plutonic Formation

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

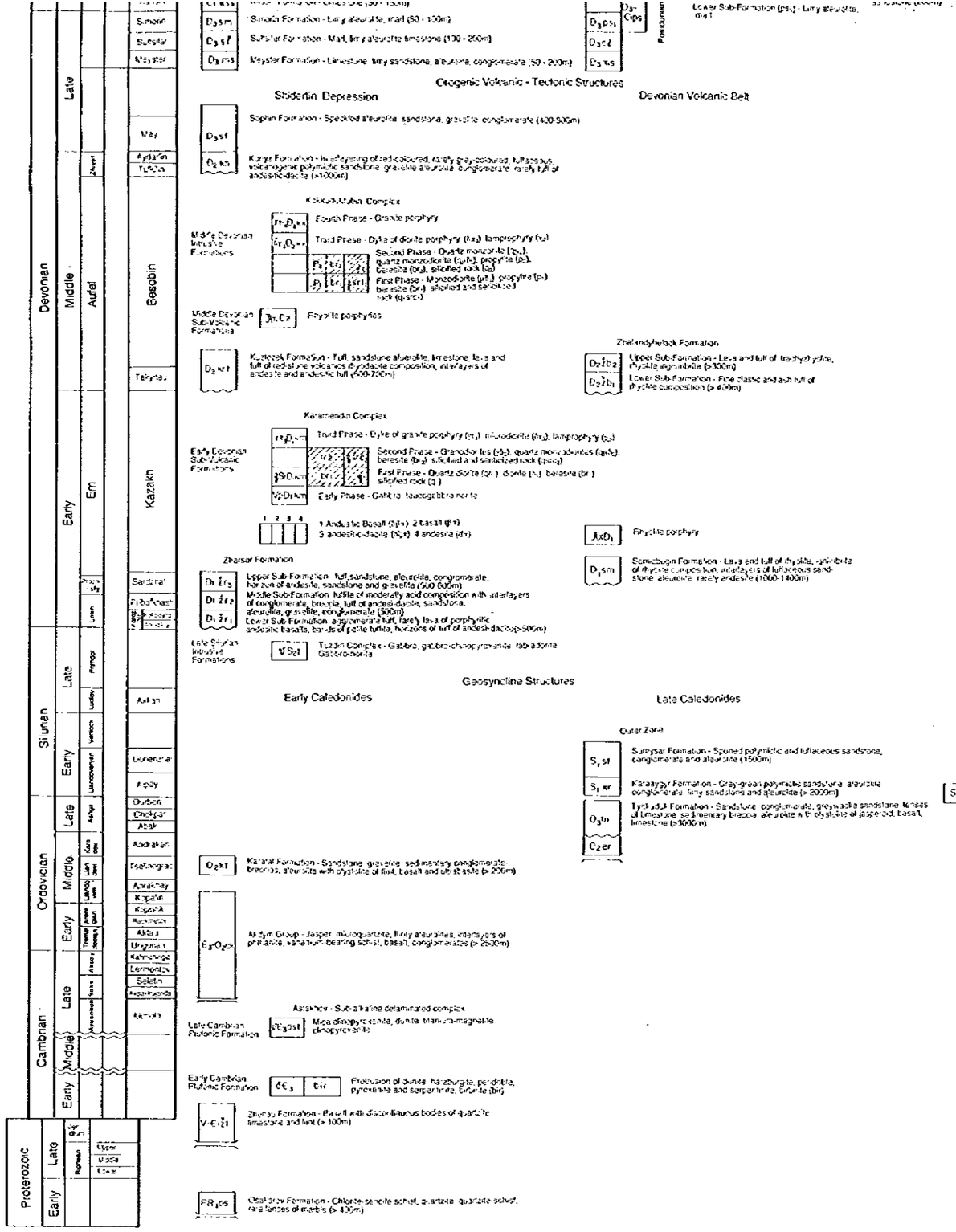
Early Cambrian Plutonic Formation

$\sigma\epsilon_1$, br	Protrusion of dunite, harzburgite, peridotite, pyroxenite and serpentinite, birbirite (br)
V-$\epsilon_1 zt$	Zhellau Formation - Basalt with discontinuous bodies of quartzite, limestone and flint (> 100m)
$PR_1 os$	Osakarov Formation - Chlorite sericite schist, quartzite, quartzite schist, rare lenses of marble (> 400m)

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)
$O_3 tn$	Tyndudk Formation - Sandstone, conglomerate, greywacke sandstone, lenses of limestone, sedimentary breccia, aleurolite with olystolite of jaspered basalt, limestone (>3000m)
$O_2 er$	
$S_1 st$	Sarpayev Formation - Grey-green rarely red coloured sandstone, aleurolite and gravelite with interlayers of conglomerate



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