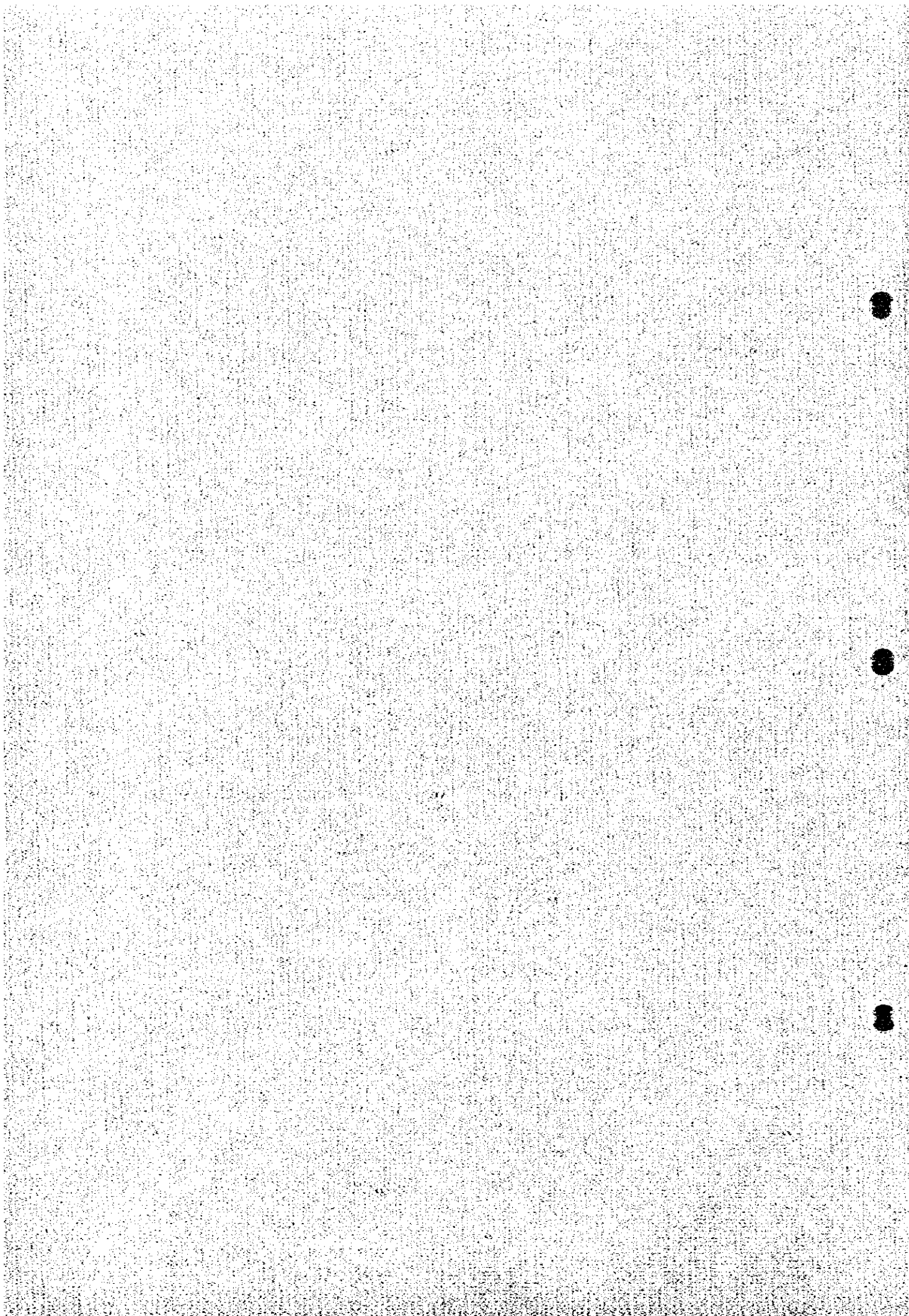


PART II

DETAILED DISCUSSIONS



PART II DETAILED DISCUSSIONS

Chapter 1 Western Area

1-1 Objectives, Localities of Holes and Geologic Boundaries

The Objectives of the drilling was to confirm the extension of Northern Area Shoot at the west and northwest of the shoot, and to discover new deposits.

The location and the collar elevation of holes and geologic boundaries are shown in Table 2-1-1, and summary of the drilling is appended.

1-2 Geology and Mineralization

1-2-1 MJZC-4

The geology of the drill hole is nearly similar to that of the survey area, which is described in 3-2 of PART I, except for lacking of the "Footwall Conglomerate" under the ore horizon. Description of the drill hole is as follows.

Lower Roan Group

"Feldspathic Quartzite and Grits": 968.10 to 1,051.00m. This unit is composed of pinkish gray and gray quartzites with intercalations of conglomerate, pebbly quartzite and pelitic bands. Anhydritization, biotitization and silicification are widely observed.

"Intermediate Conglomerate": 955.80 to 968.10m. It is composed of compact green conglomerates intercalated with micaceous bands. The conglomerate consists of various types of pebbles such as granite with particularly large mineral grains, mafic rock and schist, many coarse-grained crystal fragments such as biotite, quartz and pale green altered feldspar, and anhydrite matrix in part. Anhydrite veins occur near the boundary between this unit and the Footwall Quartzite.

"Footwall Quartzite": 937.40 to 955.00m. It mainly consists of gray pelitic quartzites with many pelitic bands. A pyrrho-

Table 2-1-1 Location of Holes and Geologic Boundaries (Western Area-1)

MJZC-4
Locality: Chambishi Southeast

Survey Data	Coordinates		Hole depth for calc	Elevation	Geologic boundary	
Hole depth (m)	Dip angle (°)	Northing				Easting
0.00	-50.00	8.50	0.00	1234.20	15300.04	-10748.74
100.00	-45.00	12.00	3.50	1180.20	15300.04	-10749.74
210.00	-77.00	-20.00	331.50	1075.98	15312.81	-10748.96
300.00	-76.00	-15.00	285.50	1000.96	15328.02	-10757.22
420.00	-75.00	-60.00	291.50	972.70	15353.77	-10760.34
500.00	-75.00	-10.00	341.50	869.98	15393.79	-10769.04
600.00	-77.00	8.00	359.50	775.27	15381.28	-10785.41
700.00	-77.00	-8.00	343.50	693.90	15378.37	-10790.47
800.00	-75.00	-20.00	331.50	595.80	15298.86	-10790.86
910.00	-76.00	-32.00	319.50	498.43	15420.49	-10797.05
				437.44	15431.33	-10803.06
				416.26	15434.47	-10804.67
				393.88	15439.29	-10805.75
				361.60	15440.26	-10806.44
				306.98	15442.64	-10810.46
				347.72	15445.25	-10813.12
				332.38	15448.23	-10815.24
				314.75	15451.08	-10817.67
				296.75	15453.99	-10820.16
				284.72	15455.92	-10821.82
				263.63	15460.04	-10833.21

MJZC-5
Locality: Chambishi Southeast

Survey Data	Coordinates		Hole depth for calc	Elevation	Geologic boundary	
Hole depth (m)	Dip angle (°)	Northing				Easting
0.00	-50.00	8.50	0.00	1246.12	16100.29	-10795.30
100.00	-42.00	-32.00	319.50	1196.12	16100.29	-10799.30
200.00	-75.00	288.00	250.50	1175.31	16102.52	-10801.20
300.00	-75.00	264.00	255.50	1097.09	16110.86	-10808.34
400.00	-75.00	203.00	254.50	998.76	16107.95	-10826.28
500.00	-75.00	203.00	254.50	907.93	16101.80	-10848.51
600.00	-75.00	-85.00	265.50	801.82	16101.41	-10850.01
700.00	-75.00	-68.00	263.50	689.70	16100.59	-10852.87
800.00	-64.00	262.00	263.50	604.87	16094.86	-10873.05
900.00	-62.00	263.00	254.50	719.52	16093.50	-10885.84
1000.00	-61.00	-22.00	329.50	708.10	16093.32	-10888.81
				623.30	16042.25	-10884.65
				529.23	16038.38	-10918.63
				449.37	16027.29	-10955.74
				439.45	16025.83	-10960.66
				430.49	16024.69	-10963.16
				396.34	16019.93	-10982.29
				382.59	16018.02	-10989.18
				351.10	16013.64	-11004.98
				350.75	16013.99	-11005.16
				330.56	16020.69	-11009.34
				302.56	16038.61	-11018.71
				274.13	16050.18	-11026.71
				263.29	16025.36	-11029.26
				251.16	16064.41	-11031.28
				223.23	16069.20	-11034.78

MJZC-6
Locality: Chambishi Southeast

Survey Data	Coordinates		Hole depth for calc	Elevation	Geologic boundary	
Hole depth (m)	Dip angle (°)	Northing				Easting
0.00	-50.00	8.50	0.00	1237.30	16795.74	-13075.83
100.00	-77.00	-3.00	348.50	1167.30	16799.74	-13079.87
200.00	-76.50	-2.00	349.50	1182.43	16800.85	-13080.36
300.00	-77.50	-3.00	348.50	1099.86	16821.79	-13094.32
400.00	-77.50	-3.00	348.50	992.63	16844.74	-13098.57
500.00	-76.50	-4.00	347.50	895.00	16855.95	-13092.49
600.00	-75.80	220.00	211.50	797.37	16887.16	-13097.20
700.00	-65.80	-6.00	345.50	788.10	16894.02	-13098.72
800.00	-70.20	204.00	195.50	700.13	16909.95	-13102.20
900.00	-65.00	-5.00	345.50	609.19	16889.03	-13115.07
				599.34	16922.46	-13123.72
				419.29	16889.62	-13132.77
				404.37	16894.73	-13134.04
				379.99	16905.74	-13136.89
				349.90	16919.32	-13140.40
				339.21	16924.15	-13141.63
				318.91	16935.32	-13144.02
				314.27	16933.60	-13144.09
				307.02	16929.07	-13147.10
				276.95	16916.94	-13150.12
				273.67	16915.60	-13156.01
				266.09	16912.57	-13158.02

Table 2-1-1 Location of Holes and Geologic Boundaries (Western Area-2)

MJZC--7

Locality: Chambishi Southeast

Survey Data		Hole depth for calc	Elevation	Coordinates		Geologic boundary
Dip angle (α)	Mag. angle (β)			Northing	Easting	
0.00	-90.00	8.50	0.00	1267.47	16120.08	-11649.91
85.00	-87.00	0.00	351.50	1204.97	16120.08	-11649.91
185.00	-86.50	-10.00	341.50	1121.53	16122.25	-11650.39
				1112.54	16129.30	-11650.44
285.00	-89.00	85.00	76.50	1012.72	16129.36	-11652.37
				929.04	16129.72	-11650.95
				972.74	16129.79	-11650.88
385.00	-88.50	90.00	81.50	854.65	16129.87	-11649.44
				812.77	16129.17	-11648.09
485.00	-86.80	185.00	176.50	747.29	16128.81	-11648.00
				712.80	16128.08	-11647.96
585.00	-86.20	140.00	131.50	612.85	16126.00	-11645.61
				515.41	16105.87	-11635.57
785.00	-75.40	48.00	39.50	456.95	16119.32	-11624.49
				432.51	16124.94	-11619.85
885.00	-71.00	174.00	165.50	295.65	16119.94	-11615.34
				280.82	16114.26	-11614.04
				251.59	16105.26	-11611.54
				332.80	16099.33	-11610.15
				325.02	16099.40	-11609.79
985.00	-70.80	34.00	25.50	312.32	16100.39	-11607.34
				309.51	16101.27	-11608.92
				304.70	16102.78	-11608.29
				296.11	16104.86	-11605.21
				296.60	16105.33	-11604.99
				277.61	16111.24	-11602.17

MJZC--9

Locality: Chambishi Southeast

Survey Data		Hole depth for calc	Elevation	Coordinates		Geologic boundary
Dip angle (α)	Mag. angle (β)			Northing	Easting	
0.00	-90.00	8.50	0.00	1240.60	16100.60	-12600.30
60.00	-84.67	182.00	178.50	1210.00	16100.60	-12600.30
120.00	-86.33	0.00	351.50	1150.85	16095.05	-12579.67
180.00	-84.33	260.00	191.50	1090.98	16098.85	-12580.24
240.00	-77.00	30.00	21.50	1031.28	16093.05	-12581.42
300.00	-71.50	36.00	27.50	972.81	16105.61	-12576.47
360.00	-71.00	36.00	27.50	960.20	16109.35	-12574.52
				939.00	16122.49	-12567.88
420.00	-70.67	37.00	28.50	899.00	16139.82	-12558.68
480.00	-70.50	118.00	118.50	802.37	16157.26	-12549.16
540.00	-70.20	38.00	29.50	746.01	16147.72	-12531.58
600.00	-69.50	41.00	32.50	735.95	16150.91	-12529.76
660.00	-68.50	42.00	33.50	689.63	16165.68	-12521.47
720.00	-67.00	42.00	33.50	639.43	16183.30	-12510.18
780.00	-66.00	41.00	32.50	577.60	16201.64	-12498.05
840.00	-65.50	145.00	136.50	522.37	16221.19	-12485.11
900.00	-67.50	36.00	25.50	457.96	16241.77	-12472.00
960.00	-61.50	33.00	24.50	413.86	16222.35	-12455.57
1020.00	-50.67	164.00	159.50	389.00	16251.20	-12439.14
				369.20	16273.41	-12429.06
				316.51	16294.74	-12423.90
				316.30	16295.19	-12423.69
				286.91	16282.63	-12415.28
				278.56	16256.22	-12412.68
				209.69	16249.57	-12410.38
1080.00	-47.50	221.00	212.50	1969.60	16238.40	-12417.49
				1079.50	16248.14	-12421.08
				1065.68	16229.24	-12423.23
				1068.26	16241.59	-12424.25
				1108.36	16216.32	-12431.56
				1110.00	16215.36	-12432.16
1140.00	-43.00	28.00	19.50	1112.20	16216.90	-12431.62
				1114.26	16212.75	-12431.12
				1144.20	16239.26	-12423.67

MJZC-10

Locality: Chambishi Southeast

Survey Data		Hole depth for calc	Elevation	Coordinates		Geologic boundary
Dip angle (α)	Mag. angle (β)			Northing	Easting	
0.00	-90.00	8.50	0.00	1268.36	15906.91	-11824.75
120.00	-86.40	345.00	335.50	1168.58	15906.91	-11824.75
220.00	-84.60	65.00	56.50	1153.69	15910.06	-11826.13
320.00	-82.60	50.00	41.50	1078.80	15913.26	-11827.50
				979.24	15918.44	-11819.68
				932.13	15922.88	-11815.60
				888.11	15927.51	-11811.61
				885.23	15927.59	-11811.57
				882.06	15927.90	-11811.29
				880.07	15928.59	-11811.12
420.00	-82.00	48.00	39.50	790.29	15937.78	-11803.14
520.00	-81.20	37.00	28.50	470.00	15938.83	-11802.27
620.00	-81.00	60.00	51.50	691.97	15960.75	-11795.79
720.00	-81.00	12.00	39.50	670.09	15958.34	-11796.26
820.00	-81.70	15.00	33.50	779.00	15968.45	-11790.04
920.00	-83.70	-15.00	33.50	854.55	15976.97	-11793.74
				870.00	15978.52	-11794.41
				879.00	15979.43	-11794.81
				916.00	15983.15	-11796.43
				927.70	15984.33	-11796.94
				957.90	15987.37	-11798.26
				960.00	15987.58	-11798.35
1000.00	-83.00	-12.00	339.50	961.30	15987.71	-11798.40
				969.40	15990.35	-11799.28
				988.40	15990.40	-11799.63
				995.20	15991.14	-11799.88
				1007.80	15992.41	-11800.16
				1009.80	15992.62	-11800.24

tite disseminated zone with minor amounts of chalcopyrite, which is continued from the above Ore Shale Horizon, is in micaceous quartzites at 937.40 to 938.60m. Poorly disseminated pyrite zone occurs from 938.60m downward, and anhydritization (patch and dissemination) is observed.

"Ore Shale Horizon": 919.40 to 937.40m. Dark gray to gray argillites chiefly composed this unit are generally sandy or silty, and is micaceous or dolomitic in part. The basal part of the unit is intercalated with dolomites. Convolute lamination is developed in argillites and dolomitic rocks in part. Intervals of 919.40 to 925.40m, 925.40 to 927.60m, 927.60 to 930.60m, 930.60 to 931.50m and 931.50 to 937.40m are a disseminated pyrite zone, disseminated pyrrhotite-pyrite zone, disseminated pyrrhotite-pyrite zone with minor amounts of chalcopyrite, comparative ore shoot composed of pyrrhotite-chalcopyrite-pyrite-dolomite thin lenses and disseminated pyrrhotite-pyrite zone with minor amounts of chalcopyrite, respectively. From this phenomenon, presence of ore arrangement with vertical symmetric is apparent. Dolomite concretions fringed with pyrite and mica occur relatively in the upper part. Also quartz veins with pyrrhotite and chalcopyrite are dispersed. Results of ore assay are shown in Table 2-5-1.

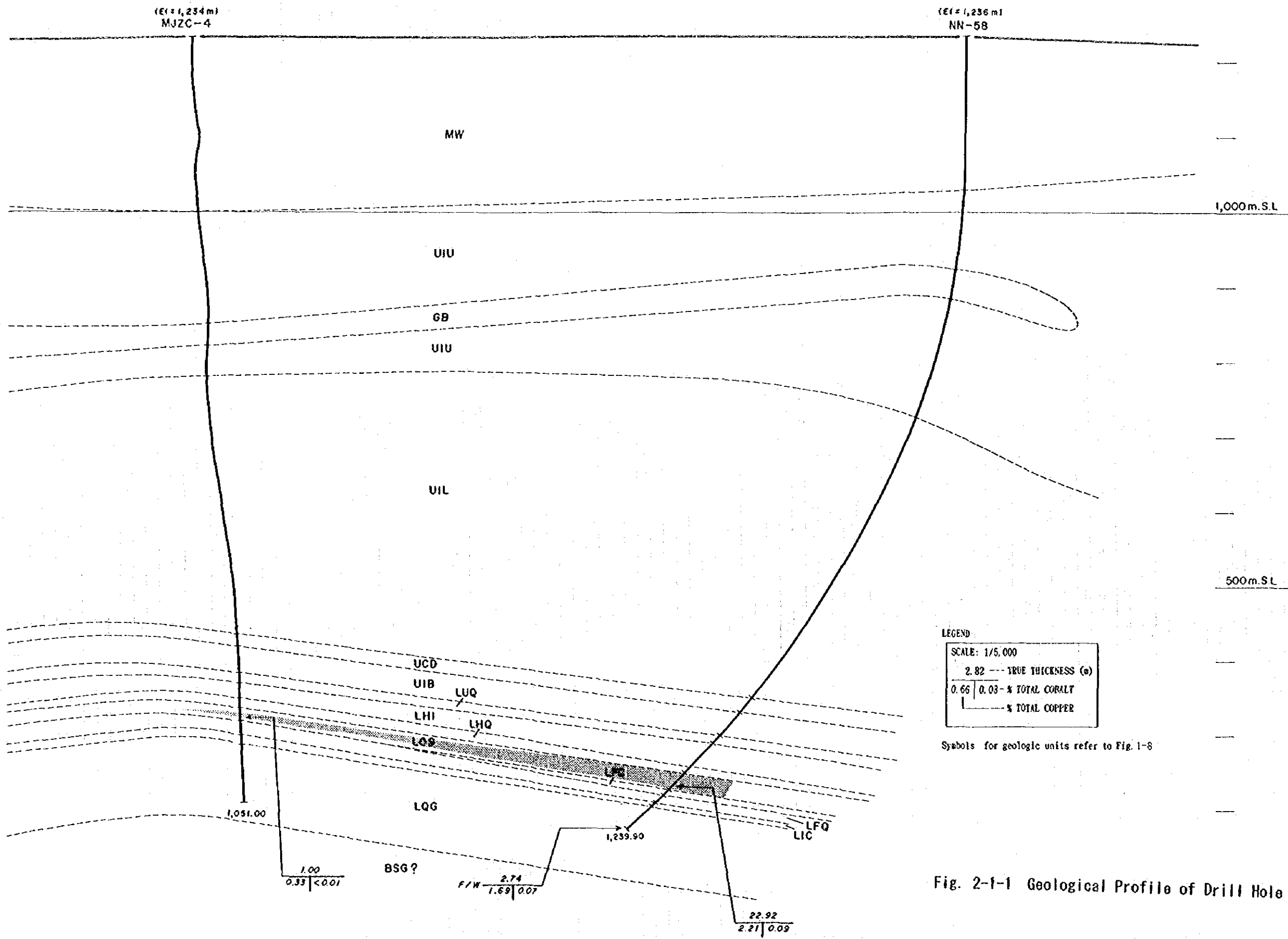
"Hangingwall Quartzite and Argillite: 903.10 to 919.40m. It consists of gray and green pelitic and micaceous quartzites with many amounts of pelitic bands. The lower part is intercalated with granule conglomerates and dark gray shales. Anhydritization (lens, veinlet and dissemination) is observed.

"Interbedded Argillite and Quartzite: 884.00 to 903.70m. It is mainly composed of dark gray to dark green pelitic, micaceous and dolomitic sandstone and quartzites with intercalations of dolomite and argillite. Anhydritization (lens and patch) is observed.

"Upper Quartzite": 869.00 to 884.00m. It is composed chiefly of white quartzites with subordinate micaceous parts and minor amounts of pelitic band. Poorly disseminated pyrite is observed.

Upper Roan Group

"Interbedded Argillite, Dolomite and Quartzite": 833.70 to 869.00m. This unit is divided to upper and lower parts. The



LEGEND
 SCALE: 1/5,000
 2.82 --- TRUE THICKNESS (m)
 0.66 | 0.03 - % TOTAL COBALT
 | - % TOTAL COPPER

Symbols for geologic units refer to Fig. 1-8

Fig. 2-1-1 Geological Profile of Drill Hole (MJZC-4)

former is of dark gray pelitic, micaceous and dolomitic sandstones and quartzites with intercalated silica lenses, dolomites and argillites. The latter is of an alternation of dark gray shale, grayish white sandy and micaceous dolomite and dolomitic sandstone.

"Cherty Dolomite: 816.20 to 833.70m. It chiefly consists of massive, white slightly siliceous dolomitic with intercalations of massive dark green argillite (Marker Shale), and dark gray pelitic bands and silica lenses at the upper and lower parts, respectively. Generally, lens and patch-shaped anhydrite are contained, and very fine grained chalcopyrites and pyrites are disseminated at 826.50 to 832.20m.

"Arenite, Argillite and Dolomite with Anhydrite": 466.50 to 816.20m. This unit is divided to upper and lower parts. The former is of green to gray argillites with many intercalations of dolomite. The argillites are sandy, dolomitic and micaceous in part. The latter is of dark gray to dark green pelitic and micaceous sandstone and green sandy argillites with minor amounts of dolomite thin layer. The argillites at the lower part are intercalated with many sandstone and quartzites, and show a thin alternation in part. Pillar structures are observed in this alternation. While, in the some thin layers of pelitic dolomite at the upper part, pelitic lamina broken by liquefaction are observed. At 674.20 to 689.70m, a few dolomites contain hornblende, and show hybrid rock-like lithofacies. Strong anhydritization (patch, veinlet and lens) and veinlets formed by dolomite and mica are observed at depths from about 468 m downward and from about 700m upward, respectively. Chalcopyrite-pyrite-mica-dolomite-quartz veinlets and disseminations, siliceous concretions with chalcopyrite in black shales, and intense silicification-disseminated pyrite zone are observed at 588.40 to 599.30m, 598.00 to 599.00m and 598.00 to 600.70m, respectively.

"Interbedded Argillite and Dolomite with Tectono-Breccias": 236.00 to 466.50m. This unit is divided to upper and lower parts. The former is of white and gray dolomites, and the latter of gray and greenish gray greywackes. There is no alternation of argillite and dolomite, so the lithofacies of this formation caught by MJZC-4 is distinct from that of the typical formation. In the upper dolomites, development of silica concretions and stylolites is observed. Small vugs with

quartz-carbonate minerals are partly present in dolomitic. The lower sandstone contain pelitic bands, and show quartzite-like in part. At 442.60 to 451.80m, the sandstone are intercalated with pink and dark yellow conglomerates. The conglomerates consist of quartzite and dolomitic pebbles and micaceous matrix. Venlets, stockworks formed by quartz, carbonate minerals and mica, silicified zones and shears are developed in this formation.

"Mwashia Groups: 12.00 to 236.00m. It consists of grayish white dolomitic, black shales, greenish gray calcareous to dolomitic argillites, white quartzites and sandstones. In the black shales, pyrite or silica bands parallel to bedding planes are developed in part, showing boudinage structure. Dolomites are pelitic and siliceous in part, and small vugs are locally present in dolomite. At 175.80 to 181.80m, dolomites contain hornblende, and show hybrid rock-like lithofacies.

"Gabbro": 386.50 to 419.40m. The gabbro is black, massive, altered, and biotite and scapolite-dominant one. In this gabbro, dolomite-mica-pyrite stockworks are developed.

1-2-2 MJZC-5

The geology of this borehole compared to that of the survey area described in 3-2 of PART I, lacks the "Footwall Conglomerate" immediately below the "ore shale horizon", but otherwise it agrees well. Description of the borehole is as follows.

Lower Roan Group

"Feldspathic Quartzite and Grit": 1,065.20 to 1,100.15m. This unit is composed of dark grey pelitic pebbly conglomerate and pinkish grey pebbly quartzite with intercalation of argillite lamination. The pebbles are all granite. Biotite and anhydrite occur in the quartzite.

"Intermediate Conglomerate": 1,037.60 to 1,065.20m. The upper part is composed of pebbles and lower part of cobbles to boulders. It contains pebbly quartzite. The nature of pebbles, cobbles and boulders are; biotite schist, granite and micaceous argillite while the matrix includes anhydrite, biotite and dolomite.

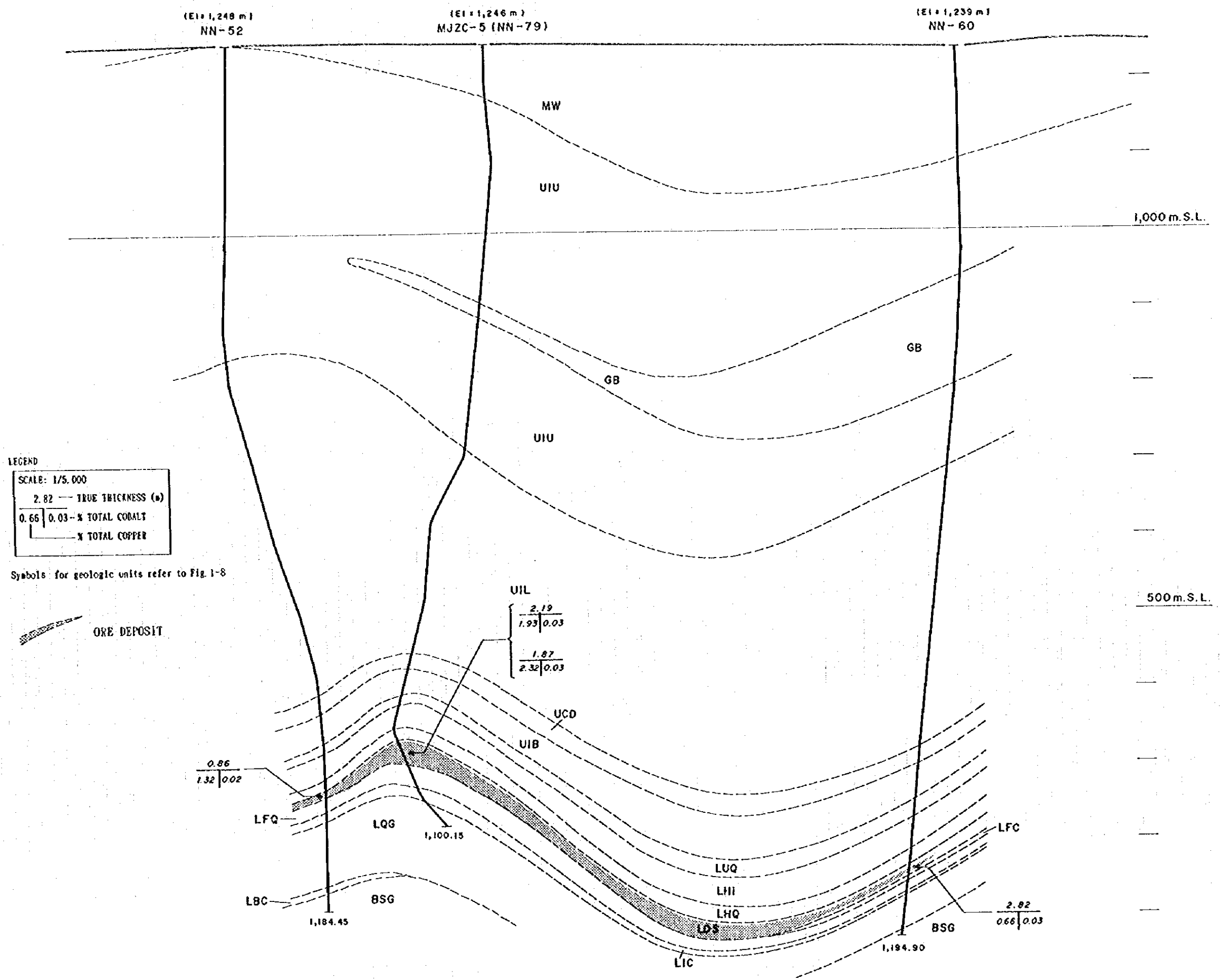


Fig. 2-1-2 Geological Profile of Drill Hole (MJZC-5)

"Footwall Quartzite": 1,005.10 to 1,037.60m. The upper part consists of white grey massive quartzite partly containing anhydrite, dolomite or biotite. The lower part is composed of dark grey pelitic and dolomitic quartzite with grit. Anhydrite is developed at the boundary with the footwall.

"Ore Shale Horizon": 967.00 to 1,005.10m. It mainly consists of sandy and dolomitic argillites with very thin layers of dark grey lamination. There is dolomite intercalation in the basal part. The interval of 967.00 to 972.20m is a pyritized zone and 972.20 to 1,005.10m is a chalcopyrite-pyrrhotite-pyrite zone. The ores of the shoot occur as; thin lenses to laminations of chalcopyrite-pyrrhotite-dolomite, dissemination of fine-grained chalcopyrite and chalcopyrite along the rim of dolomite lenses. Results of ore assay are shown in Table 2-5-1. The cobalt mineral of this borehole was identified to be cobalt pentlandite (Appendices).

"Hangingwall Quartzite and Argillite": 949.60 to 967.00m. It consists mainly of grey pelitic, dolomitic and quartzitic sandstone with thin dolomite and argillite band intercalation. Fine conglomerate and thin quartzite occur in the lowermost part. Also patches of anhydrite are observed.

"Interbedded Argillite and Quartzite": 914.10 to 949.60m. It is mainly composed of dark grey to dark green dolomitic sandstone and grey argillitic quartzite with intercalations of thin dolomite and argillitic rocks.

"Upper Quartzite": 898.60 to 914.10m. It is composed of greyish white coarse quartzite with pelitic and biotite bands. Pyrite dissemination is observed.

Upper Roan Group

"Interbedded Argillite, Dolomite and Quartzite": 860.10 to 898.60m. The upper part is composed of dark grey pelitic quartzite and grey dolomitic sandstone with intercalation of thin dolomite layers and argillite bands. Pyrite dissemination is observed in the lower parts.

"Cherty Dolomite": 838.30 to 860.10m. It mainly consists of massive white dolomite and with local silicified parts and silica lenses. In the upper part, dark green to grey sandy argillite (Marker Shale) is intercalated. Generally, patches

and lenses of anhydrite occur in this unit and weak dissemination of minute chalcopyrite-pyrite is observed at 851.5-859.3m.

"Arenite, Argillite and Dolomite with Anhydrite": 538.20 to 838.30m. The upper part is composed mainly of pale green to purple anhydritic dolomite with intercalation of thin argillite. The middle part is an alternating zone of dark green to grey gritty argillite and dolomite. The lower part consists of dark green to grey sandy to gritty argillite with lenses of quartzite. This unit has been strongly anhydritized (veinlets, patches, lenses) as a whole.

"Interbedded Argillite and Dolomite with Teotono-Breccias": 71.00 to 343.70m, 362.50 to 538.20m. The upper part is composed mainly of dolomite with thin argillites, the middle part of alternation of argillite and dolomite with altered conglomerate, the lower part of argillite with thin dolomite. Pyrite dissemination is frequently observed between 136.0 and 366m, and pyrrhotite dissemination with minor chalcopyrite content occur between 273.6 and 285.3m. Silicification is observed frequently at 322.2 to 501.0m and the silicified rocks at 472.0 to 501.0m are strongly brecciated. Limonitization probably by weathering occurs in zones shallower than 157m and at 373.0 to 532.8m. Sheared zones are developed between 362.50 and 373.90m and also 510.50 and 524.60m.

"Mwashia Group": 12.00 to 71.00m. It consists of black shale and grey silt. The shale is calcareous and accompanied by pyrite dissemination.

"Gabbro": 374.70 to 362.50m. The bodies are dark green massive and is strongly argillized, carbonatized and biotized.

1-2-3 MJZC-6

The geology of this borehole compared to that of the survey area described in 3-2 of PART I, lacks the "Footwall Conglomerate", "Intermediate Conglomerate", "Feldspathic Quartzite and Grit" and "Basal Conglomerate" but otherwise it agrees well. Description of the borehole is as follows.

"Basement": 1,006.60 to 1,014.96m. The rock is grey granite. The major components of this rock are; quartz, potash feldspar,

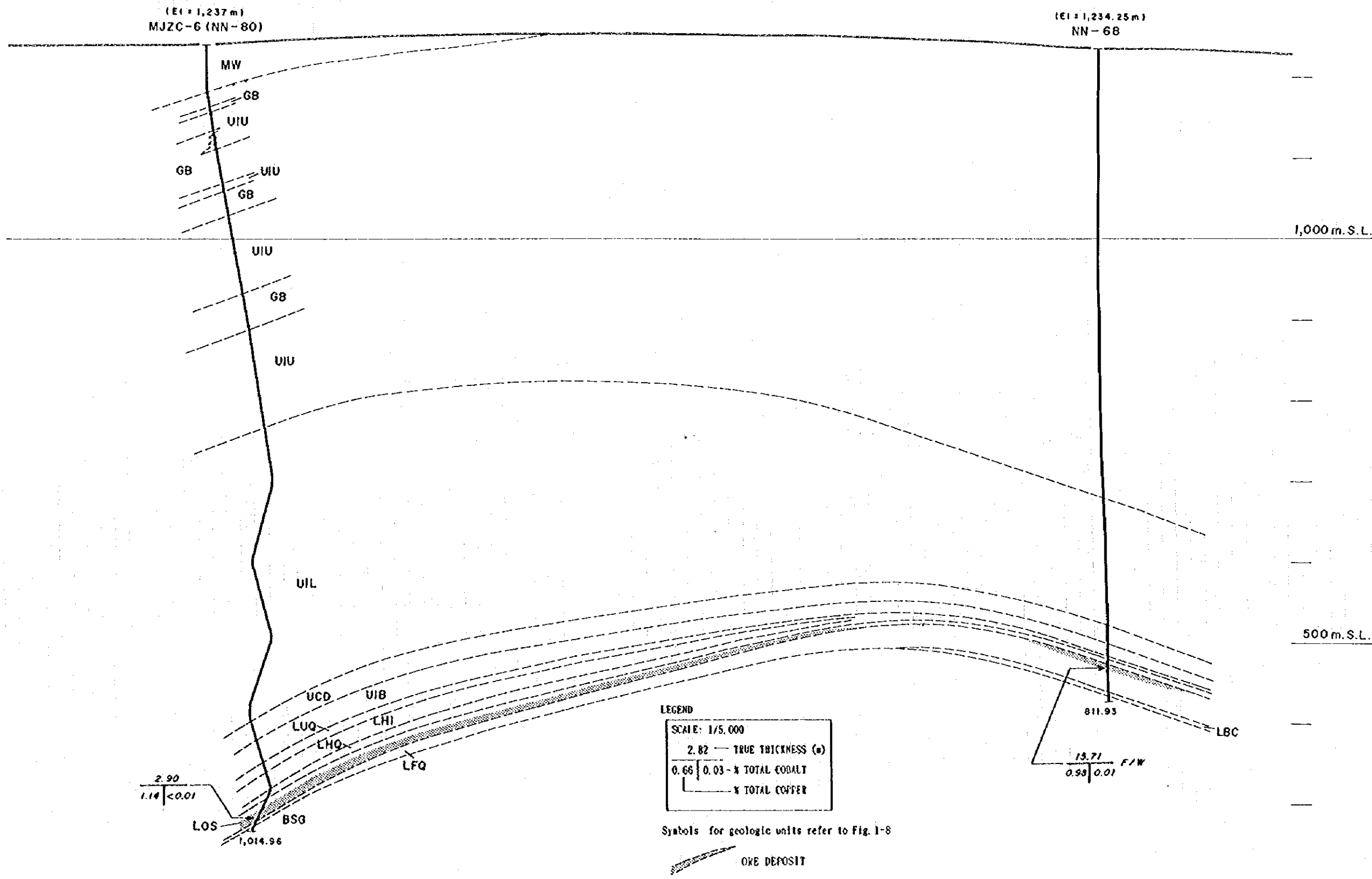


Fig. 2-1-3 Geological Profile of Drill Hole (MJZC-6)

plagioclase, biotite and muscovite, and the accessory components are; sphene, opaque minerals, apatite and zircon. Also carbonate minerals, epidote and chlorite occur as altered products.

Lower Roan Group

"Footwall Quartzite": 1,002.90 to 1,006.60m. This is composed of grey pelitic quartzite and white quartzite with intercalation of pelitic bands. Chalcopyrite-bornite dissemination is observed in this unit.

"Ore Shale Horizon": 969.50 to 1,002.90m. It mainly consists of white dolomite and grey dolomitic sandstone with thin layers of dark grey sandy argillite lamination. Chalcopyrite-bornite dissemination is observed at 974.80 to 995.20m. Results of ore assay are shown in Table 2-5-1. The cobalt mineral of this borehole was identified to be cobalt pentlandite (Appendices).

"Hangingwall Quartzite and Argillite": 956.30 to 969.50m. This is grey pelitic to micaceous quartzite with argillite bands. The lower part consists of dolomitic rocks. Quartz veinlets occur scattered throughout the unit.

"Interbedded Argillite and Quartzite": 933.90 to 956.30m. It is mainly composed of grey micaceous to dolomitic sandstone with intercalation of thin quartzite and dolomite.

"Upper Quartzite": 922.10 to 933.90m. This unit consists of greyish white pelitic and micaceous quartzite with pelitic bands.

Upper Roan Group

"Interbedded Argillite, Dolomite and Quartzite": 888.90 to 922.10m. The upper part is composed mainly of dark grey gritty and dolomitic sandstone and the lower part of thin alternation of dark grey sandy argillite·white micaceous dolomite·pelitic and micaceous sandstone·pelitic quartzite. Weak chalcopyrite dissemination is observed in the argillite of the lower part.

"Cherty Dolomite": 816.20 to 888.90m. It mainly consists of massive white dolomite. In the upper part, dark green to grey sandy argillite (Marker Shale) is intercalated. Generally, patches and lenses of anhydrite occur locally in this unit. Chalcopyrite-bornite dissemination occurs at 874.20-875.60m

and dissemination of minute chalcopyrite grains at 884.50-887.20m.

"Arenite, Argillite and Dolomite with Anhydrite": 480.10 to 816.20m. The upper part is composed mainly of alternation of green to grey micaceous to dolomitic argillite and dolomite with intercalation of sandy to quartzitic lenses. The lower part consists of dark green to grey sandy to gritty argillite. There are thin laminated dolomite layers considered to be stromatolite (758.05-759.25, 764.70-766.00, 774.90-777.40m). This unit has been anhydritized (veinlets, patches, lenses) as a whole. Weak pyrite dissemination is observed frequently in the upper part.

"Interbedded Argillite and Dolomite with Tectono-Breccias": 55.00 to 77.00, 85.00 to 128.00, 171.00 to 182.00, 213.40 to 310.40, 355.70 to 480.10m. The upper part is composed mainly of alternation of dark grey dolomitic argillite and dolomite, the middle part of pale green argillized conglomerate and silicified breccia with thin dolomite layers, the lower part of alternation of dark green to dark grey argillite and dolomite and the upper part of argillite is strongly fractured. There are several layers of gabbroic bodies. Limonitization probably by weathering occurs in zones shallower than 309m.

"Mwashia Group": 12.00 to 55.00m. The major rocks of this group are grey phyllitic to shaly argillite.

"Gabbro": 77.00 to 85.00, 128.00 to 171.00, 182.00 to 213.40, 310.40 to 355.70m. The bodies are dark green to black, altered, coarse-grained, crystalline and massive and contains biotite. Dolomite veinlets are developed.

1-2-4 MJZC-7

The geology of this borehole compared to that of the survey area described in 3-2 of PART I, lacks the "Footwall Quartzite", "Intermediate Conglomerate", "Feldspathic Quartzite and Grit" and "Basal Conglomerate" below the ore horizon, but otherwise it agrees well. Description of the borehole is as follows.

"Basement": 965.10 to 985.00m. The rock is white to grey

granite rich in quartz and biotite. There are many small shear fractures in this rock and biotite bands are formed along these fractures.

Lower Roan Group

"Footwall Conglomerate": 963.50 to 965.10m. Greyish white conglomerate. The pebbles are quartz and anhydrite and the matrix is rich in biotite.

"Ore Shale Horizon": 923.80 to 963.50m. The unit consists of alternation of dark grey dolomitic argillite and dolomite. Chalcopyrite dissemination is observed at 923.80-927.40, 940.60-945.10, 948.00-956.90, 957.40-960.60, 961.80-963.50 m; and bornite occur disseminated at 959.20-963.50m. Results of ore assay are shown in Table 2-5-1.

"Hangingwall Quartzite and Argillite": 906.90 to 923.80m. This is composed of grey quartzite, dark grey dolomitic sandstone and white coarse-grained quartzite. Chalcopyrite dissemination occurs below 922.50m.

"Interbedded Argillite and Quartzite": 876.20 to 906.90m. It is composed of grey pelitic and dolomitic sandstone and quartzitic sandstone with intercalation of thin dolomite, quartzite and pelitic bands. Patches and lenses of anhydrite occur in sandstone and dolomite.

"Upper Quartzite": 860.30 to 876.20m. This unit consists of greyish white quartzite. The upper part is coarse crystalline and the lower part contains pelitic bands.

Upper Roan Group

"Interbedded Argillite, Dolomite and Quartzite": 821.50 to 860.30m. The upper part is composed of grey dolomitic sandstone, pelitic dolomite and sandy argillite and the lower part of thin alternation of white micaceous dolomite·dark grey dolomitic sandstone·dark grey sandy argillite·greyish white quartzite. Weak pyrite dissemination and quartz-anhydrite veinlets are observed locally.

"Cherty Dolomite": 796.00 to 821.50m. The main component of this units is white massive dolomite and the upper part contains grey pelitic argillite (Marker Shale). Patches of anhydrite occur locally.

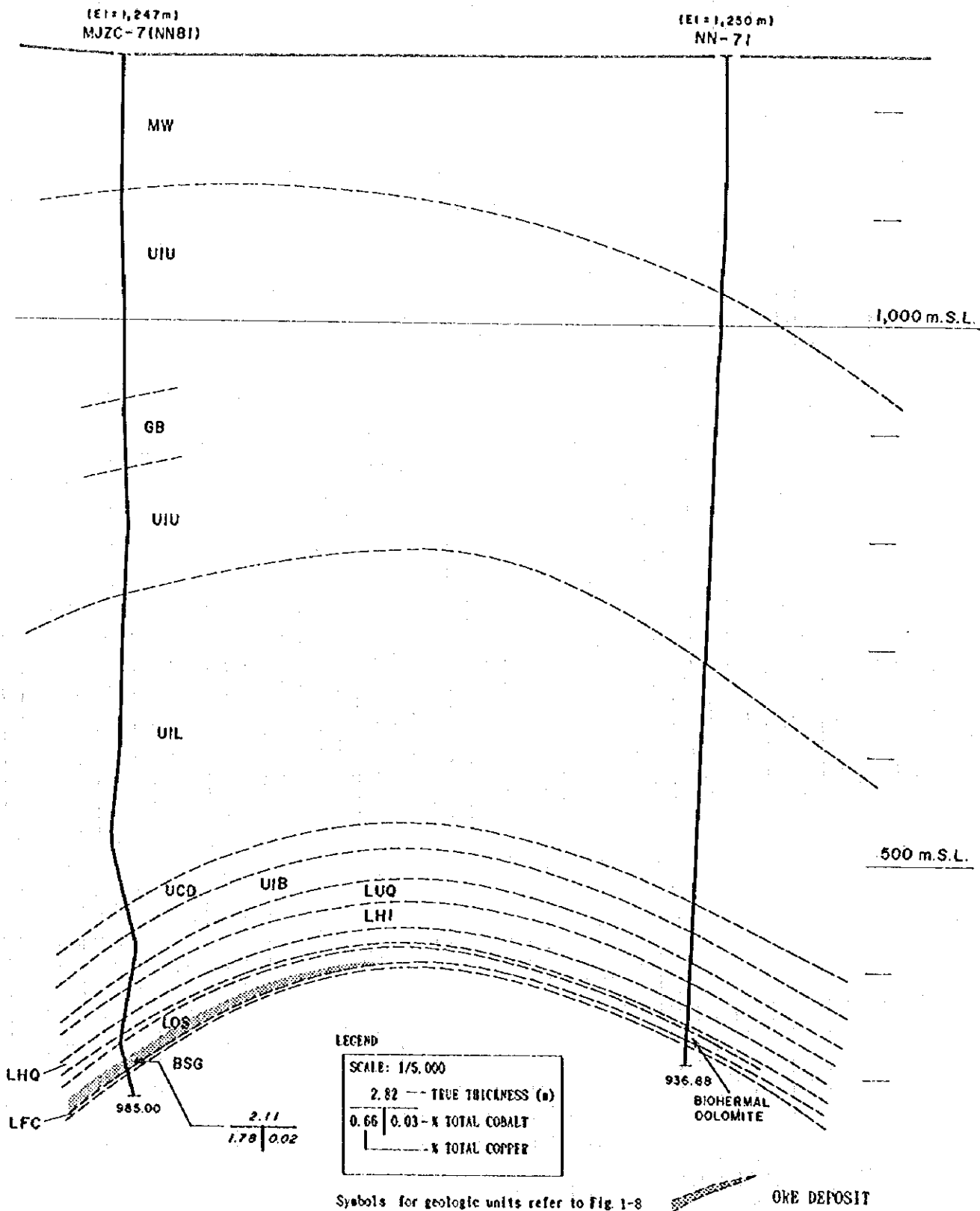


Fig. 2-1-4 Geological Profile of Drill Hole (MJZC-7)

"Arenite, Argillite and Dolomite with Anhydrite": 500.50 to 796.00m. The upper part is composed mainly of alternation of greenish grey to dark grey sandy to micaceous argillite and dolomite with intercalation of grit to quartzite lenses in argillite. The lower part consists of greenish grey to dark grey sandy to gritty argillite with small amount of thin dolomite and quartzite layers. Anhydritized patches, veinlets and lenses occur throughout the unit. A large amount of muscovite and anhydrite occur in the upper dolomite. Also dissemination of pyrite occur scattered in the upper part.

"Interbedded Argillite and Dolomite with Tectono-Breccias": 126.00 to 318.70, 382.90 to 5000.50m. The upper part is composed mainly of alternation of dark grey dolomitic argillite and dolomite with intercalation of black shale, the middle part of alternation of white conglomerate dolomite dark grey to black argillite greyish white quartzite, and the lower part of grey argillite with dolomite intercalation. The argillite in the lower part contains sandy to quartzitic parts irregularly and is silicified and fractured. In the upper part, pyrite dissemination and veinlets, anhydrite veinlets and bands, and quartz veinlets occur locally. Small groups of faults are developed at 206.00-226.00m. Gabbroic bodies occur in this unit. Weak limonitization probably by weathering occurs locally in zones shallower than 300m.

"Mwashia Group": 27.00 to 126.00m. The major rocks of this group are phyllitic black shale with dolomitic shale in the lower parts.

"Gabbro (Amphibolite)": 318.70 to 382.90m. The bodies are dark green to black, altered, coarse-grained, crystalline and massive. They are rich in amphibole, plagioclase and biotite. Veinlets of calcite-quartz-biotite-chalcopyrite-pyrite are developed in these bodies.

1-2-5 MJZC-9

The geology of this borehole compared to that of the survey area described in 3-2 of PART I, lacks the "Footwall Conglomerate" immediately below the "Ore Shale Horizon", but otherwise it agrees well. Geological description of the borehole is as

follows.

Lower Roan Group

"Footwall Quartzite": 1,112.20 to 1,144.76m. It mainly consists of quartzite and sandstone with intercalation of biotite-anhydrite rock and thin conglomerate. The upper pebbly quartzite and coarse quartzite partly contain pelitic parts. Anhydrite, biotite and dolomite occur in the lower quartzite. The conglomerates are composed of quartz, altered granite and biotite schist pebbles and biotite matrix. Dissemination of minute chalcopyrite is observed at 1,112.20-1,121.40m.

"Ore Shale Horizon": 1,079.50 to 1,112.20m. It mainly consists of dolomitic argillites with grey thinly laminated layers. The basal part of this formation is made up of schistose argillite. The interval of 1,080.20 to 1112.20m is the sulfide mineralized zone composed of chalcopyrite and pyrite, partly rich in chalcopyrite. The sulfides occur as dissemination in the bedding planes and dissemination in silica concretion or dolomite veinlet. Results of ore assay are shown in Table 2-5-1. The cobalt mineral of this borehole was identified to be cattierite and carrollite (Appendices).

"Hangingwall Quartzite and Argillite": 1,069.60 to 1079.50m. It mainly consists of grey quartzites. In the upper part, pelitic bands are intercalated. The lowest part is composed of thin alternation of pelitic beds and sandy beds.

"Interbedded Argillite and Quartzite": 1,038.80 to 1,069.60m. It is mainly composed of dark grey pelitic to dolomitic sandstone with intercalation of thin argillite, dolomite and quartzite. The lower part is composed of quartzitic sandstone. Lenses of anhydrites are observed frequently.

"Upper Quartzite": 1,028.00 to 1,038.80m. It is composed of grayish white coarse quartzite with minor amounts of pelitic bands and thin dolomitic sandstone beds.

Upper Roan Group

"Interbedded Argillite, Dolomite and Quartzite": 989.20 to 1,028.00m. The upper part consists mainly of pelitic sandstone with intercalation of thin argillite and dolomite beds. The lower part consists of thin-bedded alternation of dolomite, argillite and sandstone with quartzite lenses.

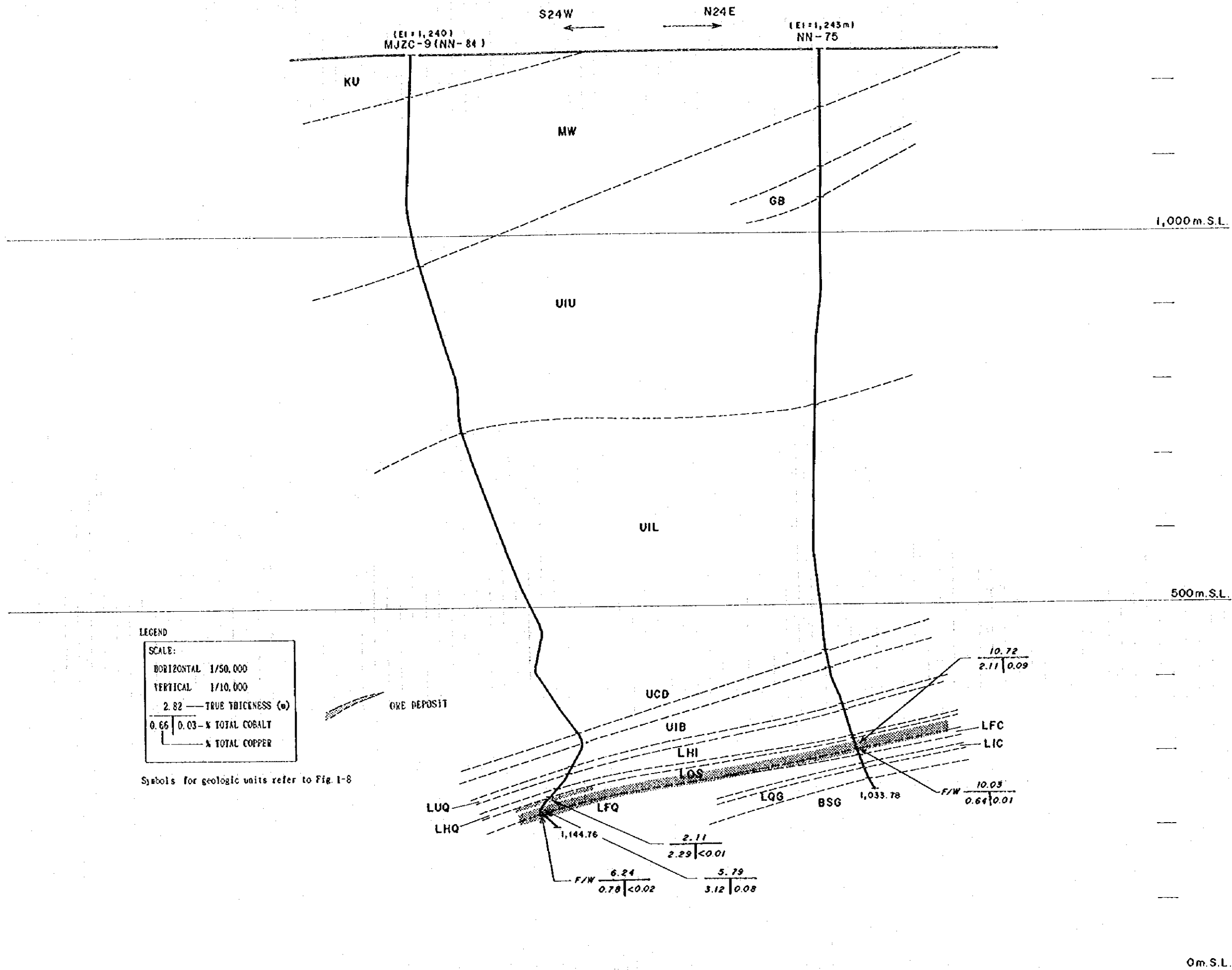


Fig. 2-1-5 Geological Profile
 of Drill Hole (MJZC-9)
 -- 75 -- 76 --

"Cherty Dolomite": 969.20 to 989.20m. It mainly consists of massive white dolomite with silica lenses. In the upper part, grey argillite (Marker Shale) is intercalated. Very fine-grained chalcopyrite and pyrite are disseminated between 984.60 and 987.70m.

"Arenite, Argillite and Dolomite with Anhydrite": 520.70 to 969.20m. It mainly consists of sandy argillite, dolomite and pelitic sandstone. The upper part, the middle part and the lower part are rich in pelitic sandstone, dolomite and sandy argillite, respectively. There are many lenses or patches or veinlets of anhydrite in this formation.

"Interbedded Argillite and Dolomite with Tectono-Breccias": 283.30 to 520.70m. The upper part consists of an alternation of dolomite, argillite and conglomerate, the middle part of alternation of sandy rock, dolomite and argillite, the lower part of alternation of dolomite and argillite. The conglomerate is composed of dolomite pebbles of irregular shape, and is argillized. Contemporaneous brecciations are developed in the argillite and sandstone, and many fractures are filled with dolomite or quartz. Minor amounts of gypsum bands and patches of anhydrite or disseminations of pyrite are partly observed in the upper part and the middle to lower part, respectively.

"Mwashia Group": 60.00 to 283.30m. The upper part is composed of pelitic dolomite. The lower part is composed mainly of argillite. The argillite is rich in shaly part with sandy or dolomitic intercalation.

1-2-6 MJZC-10

The geology of this borehole compared to that of the survey area described in 3-2 of PART I, lacks the "Intermediate Conglomerate", "Feldspathic Quartzite and Grit" and "Basal Conglomerate" of the Footwall Formation, but otherwise it agrees well. Geological description of the borehole is as follows.

"Basement": 1,007.80 to 1,009.86m. The rock is altered coarse-crystalline granite. Strong biotitization and argillization of feldspar are observed in this rock. Also, weak dissemination of minute pyrite grains occurs.

Lower Roan Group

"Footwall Quartzite": 988.40 to 1,007.80m. It mainly consists of gray argillaceous quartzite and greywacke with pelitic parts irregularly. Anhydrite-biotite rock and thin bed of biotite rock occur in the basal part of this formation. Dissemination of chalcopyrite is observed at 988.40-995.20m.

"Footwall Conglomerate": 987.40 to 988.40m. It is composed of conglomerate and pebbly dolomitic sandstone. The conglomerate consists of quartz and feldspar granules. Pyrite dissemination is observed in this formation.

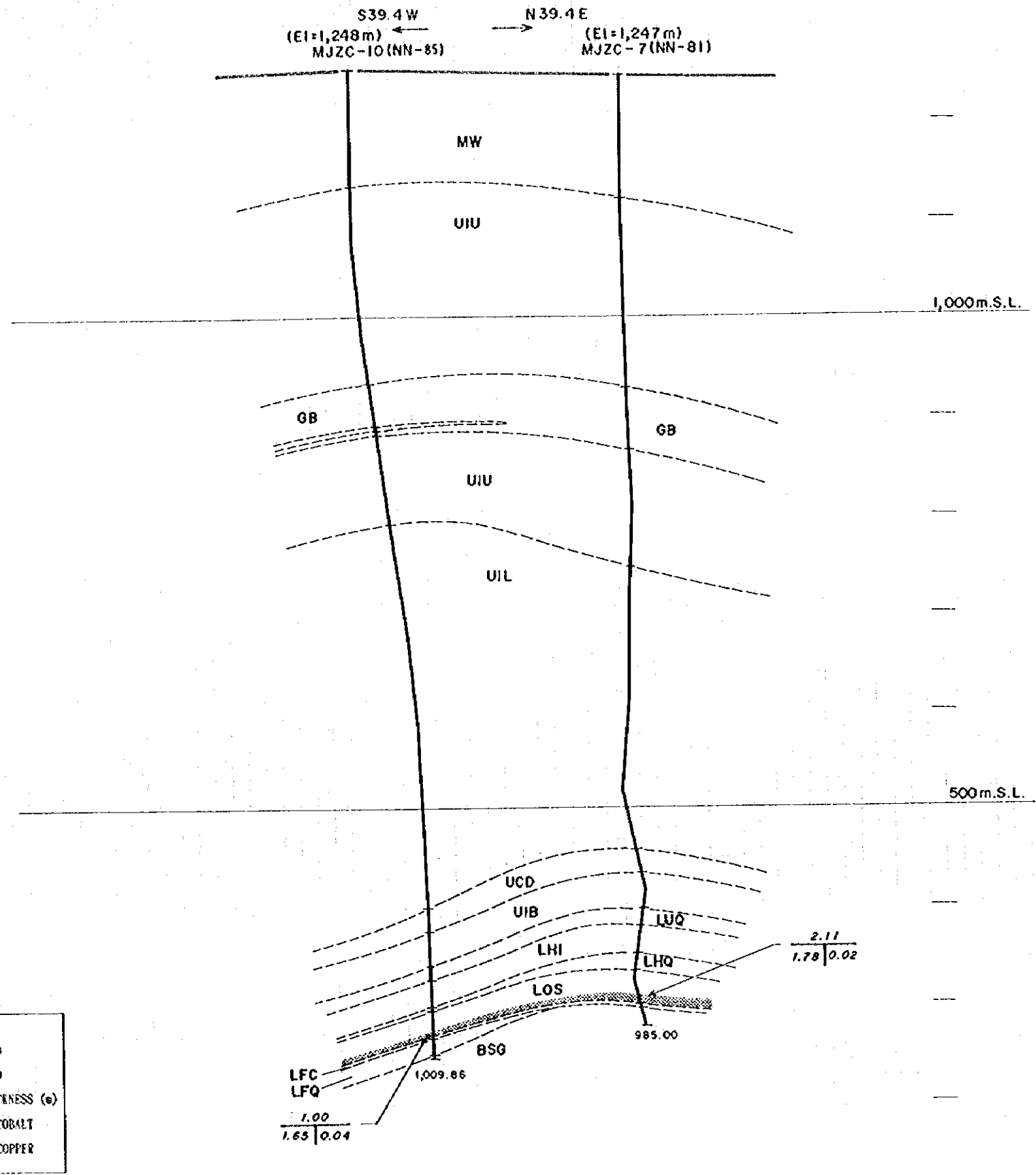
"Ore Shale Horizon": 961.30 to 987.40m. The upper part mainly consists of black sandy argillite with thin lamination. The lower part is made up of gray to black dolomitic argillite, and rich in biotite. The interval of 961.30 to 971.50m is the pyritized zone and 971.50 to 974.90m is pyrite-pyrrhotite zone and 974.90 to 979.80m is pyrite-pyrrhotite-chalcopyrite zone and 979.80 to 982.50m is pyrrhotite-chalcopyrite zone and 982.50 to 987.40m is chalcopyrite-pyrite zone. The sulfides occur as dissemination at the bedding planes, the rim of dolomite concretions and patches or lenses of irregular shape. Results of ore assay are shown in Table 2-5-1. The cobalt mineral of this borehole was identified to be cobalt pentlandite (Appendices).

"Hangingwall Quartzite and Argillite": 957.90 to 961.30m. It mainly consists of siliceous greywacke, siliceous granule conglomerate, quartzite and pebbly argillite. Local weak dissemination of pyrite is observed.

"Interbedded Argillite and Quartzite": 927.70 to 957.90m. It is composed mainly of pelitic and dolomitic sandstone to greywacke with intercalation of thin dolomite, argillite and quartzitic lenses. Pyrite dissemination is observed in pelitic parts, and also, local anhydritization (lenses, patches) is observed.

"Upper Quartzite": 916.00 to 927.70m. It is composed of grayish white quartzite with pelitic bands. Pyrite dissemination is observed in the pelitic bands.

Upper Roan Group



LEGEND
 SCALE:
 HORIZONTAL 1/50,000
 VERTICAL 1/10,000
 2.82 — TRUE THICKNESS (m)
 0.66 | 0.03 — % TOTAL COBALT
 — % TOTAL COPPER

Symbols for geologic units refer to Fig 1-8
 ORE DEPOSIT

Fig. 2-1-6 Geological Profile of Drill Hole (MJZC-10)

"Interbedded Argillite, Dolomite and Quartzite": 879.00 to 916.00m. This is composed of thin-bedded alternation of pelitic sandstone, dolomite and argillite. The upper part is rich in sandstone, and the lower part is rich in dolomite and argillite.

Pyrite dissemination and silicification are locally observed in the basal part.

"Cherty Dolomite": 854.55 to 879.00m. It mainly consists of dolomite with anhydrite. In the upper part, dark green sandy argillite (Marker Shale) is intercalated. Weak dissemination of minute chalcopyrite-pyrite grains is observed between 869.70 and 878.00m.

"Arenite, Argillite and Dolomite with Anhydrite": 460.20 to 854.55m. The upper part mainly consists of dark gray thinly laminated argillite with small amount of thin local intercalation of dolomite and sandstone. The middle part mainly consists of an alternation zone of green to gray massive argillite and dolomite with small amount of thin quartzitic sandstone intercalation. The lower part is composed mainly of dark gray to black micaceous and sandy argillite with small amount of thin dolomite bed, thin sandstone bed, quartzite lens and grit. Contemporaneous brecciation and sheared zone are developed in the above argillite, and many fractures are filled with dolomite or quartz or green clay. The middle and lower part have been anhydritized (veinlets, patches, lenses) as a whole. Pyrite dissemination is observed frequently in the middle part.

"Interbedded Argillite and Dolomite with Tectono-Breccias": 115.00 to 316.50m, 361.90 to 364.80m, 368.00 to 460.20m. The upper part mainly consists of an alternation of dolomite and argillite with thin intercalation of sandy rock and conglomerate. The conglomerate is composed of dolomite and argillite pebbles. The lower part mainly consists of quartzite with local pebbles of pelitic sandstone. Weak pyrite dissemination is observed frequently in the upper part.

"Mwashia Group": 7.00 to 115.00m. It mainly consists of gray micaceous to dolomitic argillite and black dolomitic shale with intercalation of dolomite and thin sandstone bed. Dissemination and lenses to laminae of pyrite-pyrrhotite are observed in the black shale.

"Gabbro (Amphibolite)" 316.50 to 361.90m, 364.80 to 368.00m. The bodies are dark gray altered and massive and strongly carbonatized and biotized.

1-3 Discussions

MJZC-4 and MJZC-5 are located in the anticlinal structure which is distributed in the southwestern side of the Northern Area Shoot as seen in the cross section (Fig.1-9, 2-1-1, 2-1-2).

The mineralized zone confirmed in MJZC-4 belongs to the chalcopyrite-pyrrhotite zone, and it is rich in pyrrhotite with low copper grade. It is therefore, inferred that this site was offshore at a distance from the coast during the formation of the ore deposit and is inferred to have been unfavorable for copper precipitation.

The mineralized zone confirmed by MJZC-5 has relatively high grade (i. width 3.10m T-Cu 1.93% T-Co 0.03%; ii. width 2.64m T-Cu 2.32% T-Co 0.03%). It has been clarified by NN-55 and NN-48 that the southwestern part of Northern Area Shoot is situated in the anticlinal part, and it is inferred that the ores of this hole is in the same structural position as in the previous two holes.

The ores of the above three boreholes (NN-55, NN-48, MJZC-5) belong to the chalcopyrite-pyrrhotite-pyrite zone and the grade appears to be somewhat lower than that of the central part of the Northern Area Shoot.

MJZC-6 and MJZC-7 are located on the limb of the rise of the basement (Figs. 1-9, 2-1-3, 2-1-4). As the "Ore Shale horizon" is dolomitic and the "Footwall Formation" is very thin in the both hole, it is inferred that the basement of these parts were palaeo-basement high at the time of ore deposition.

Although the copper grade of the deposit confirmed by MJZC-6 is relatively low (width 3.35m T-Cu 1.14%, T-Co<0.01%) the mineralization most probably belongs to the bornite zone of the zonal distribution of sulfides (Fig. 1-11), the deposit is concluded to have formed near the shore.

Although the copper content of the deposit confirmed by MJZC-7 is relatively low (width 2.98m T-Cu 1.78%, T-Co 0.02%) and the deposit is believed to belong to the chalcopyrite zone of the sulfide zonal distribution (Fig. 1-11), the deposit is concluded to have formed relatively close to the shore because of the occurrence of bornite.

Chalcopyrite veinlets are strongly developed in the gabbro (amphibolite) encountered in this hole (321-366m). The source of this copper is not clear, but it is possible that they were regenerated by the concentration of copper migrated from the "Ore Shale horizon". Very fine-grained chalcopyrite lamina which is considered to be primary, occur in the "Ore Shale" of the area. The high grade part, however, consists of lenses, veins and concretions of chalcopyrite assemblage, therefore, it is believed that migration and recrystallization of copper metal during diagenesis and metamorphism played important roles in the formation of the ore shoot. If the copper in these veinlets were derived from the "Ore Shale horizon", it would indicate the relatively high concentration of the metal in this horizon.

MJZC-9 confirmed the existence of high-grade ores (i. width 5.90m, grade T-Cu 3.12%, T-Co 0.08%; ii. width 2.58m, grade T-Cu 2.29%, T-Co <0.01%). NN-75 is located to the north of the present site in question. This NN-75 confirmed the occurrence of a high-grade copper deposit. The mineralization encountered in both holes is developed from the "Ore Shale" to the footwall and belongs to the chalcopyrite zone. The geology of MJZC-9 is shown in the cross section (Figs. 1-9, 2-1-5). The "Ore Shale" is thicker in this borehole than in NN-75. In NN-75, the ore shoot occurs as one unit in "Ore Shale", whereas in this hole, the shoot is separated into two within the "Ore Shale" and the lower one continues into the footwall quartzite. The highest grade of copper and cobalt in both holes occurs in the lower part of the shoot, and it is possible that they are continuous.

Basement depth contour of the area was prepared from three holes (MJZC-6, 7, 10) drilled in the vicinity of MJZC-9 and NN-75 (Fig. 1-12). And it is inferred that both MJZC-9 and NN-75 are located over a basement depression which extends in the NE-SW direction. MJZC-6, -7, -10 are located on or near palaeo-basement highs at the time of ore deposition. From the similarity of mineralization encountered at MJZC-9 and NN-75 and the

geologic structure of the area, the ore shoot confirmed by the two boreholes is concluded to be a continuous ore deposit emplaced over a basement depression which extend in approximately NE-SW . And this depression was formed on a limb of the palaeo-basement high at the time of ore deposition.

MJZC-10 is located on a limb of a basement high (Figs. 1-9, 2-1-6). It is inferred that this hole is located in the vicinity of palaeo-basement high at the start of "Ore Shale" deposition. The mineralized zone of this hole is developed from the "Ore Shale" horizon toward the footwall, and zonal distribution of sulfide minerals are observed. This is interpreted to indicate that; in this area, the sea rapidly became deeper after the start of the deposition of the "Ore Shale" and consequently the environment became chemically reducing. Therefore, it is considered that the oreshoot was formed in this area because of the formation of a deep local depression in a relatively short period of time after the start of "Ore Shale" deposition on the limb of a palaeo-basement high. Ore shoots were not encountered in this hole, but the existence of rich ore in the vicinity is a possibility.

MJZC-4

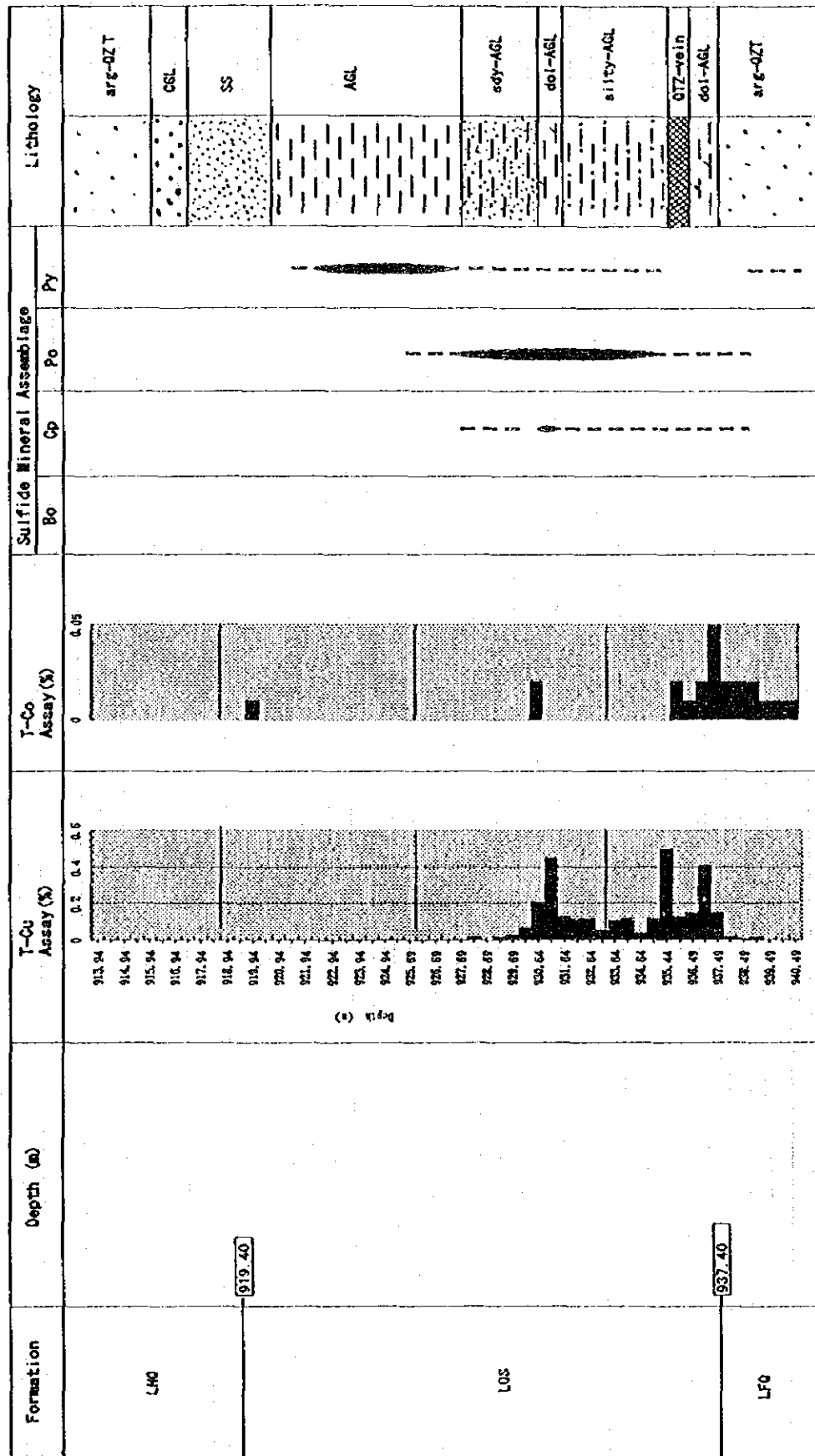


Fig. 2-1-7 Ore Assaying, Assemblage of Ore Minerals and Lithology

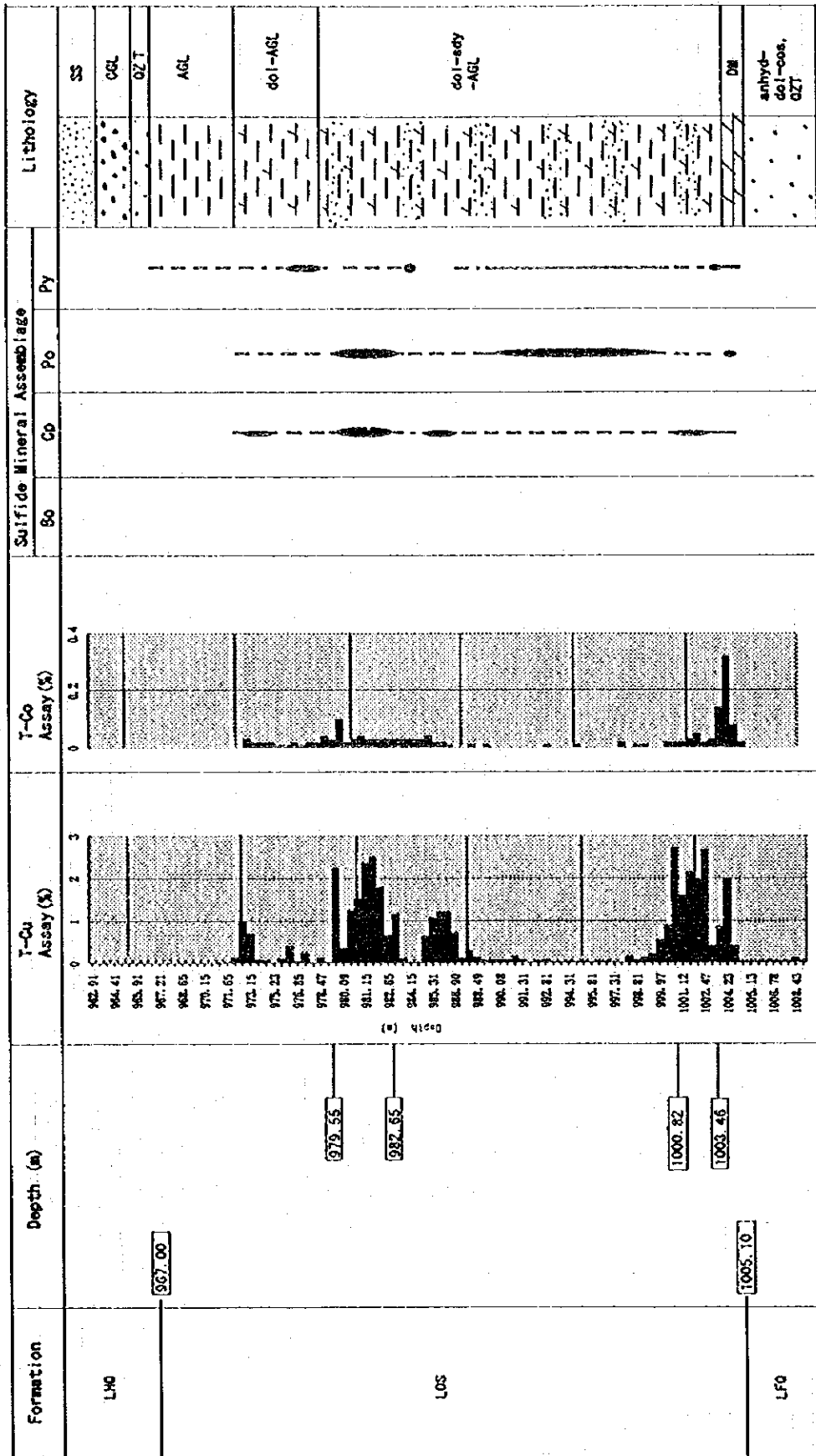


Fig. 2-1-8 Ore Assaying, Assemblage of Ore Minerals and Lithology

MJZC-6

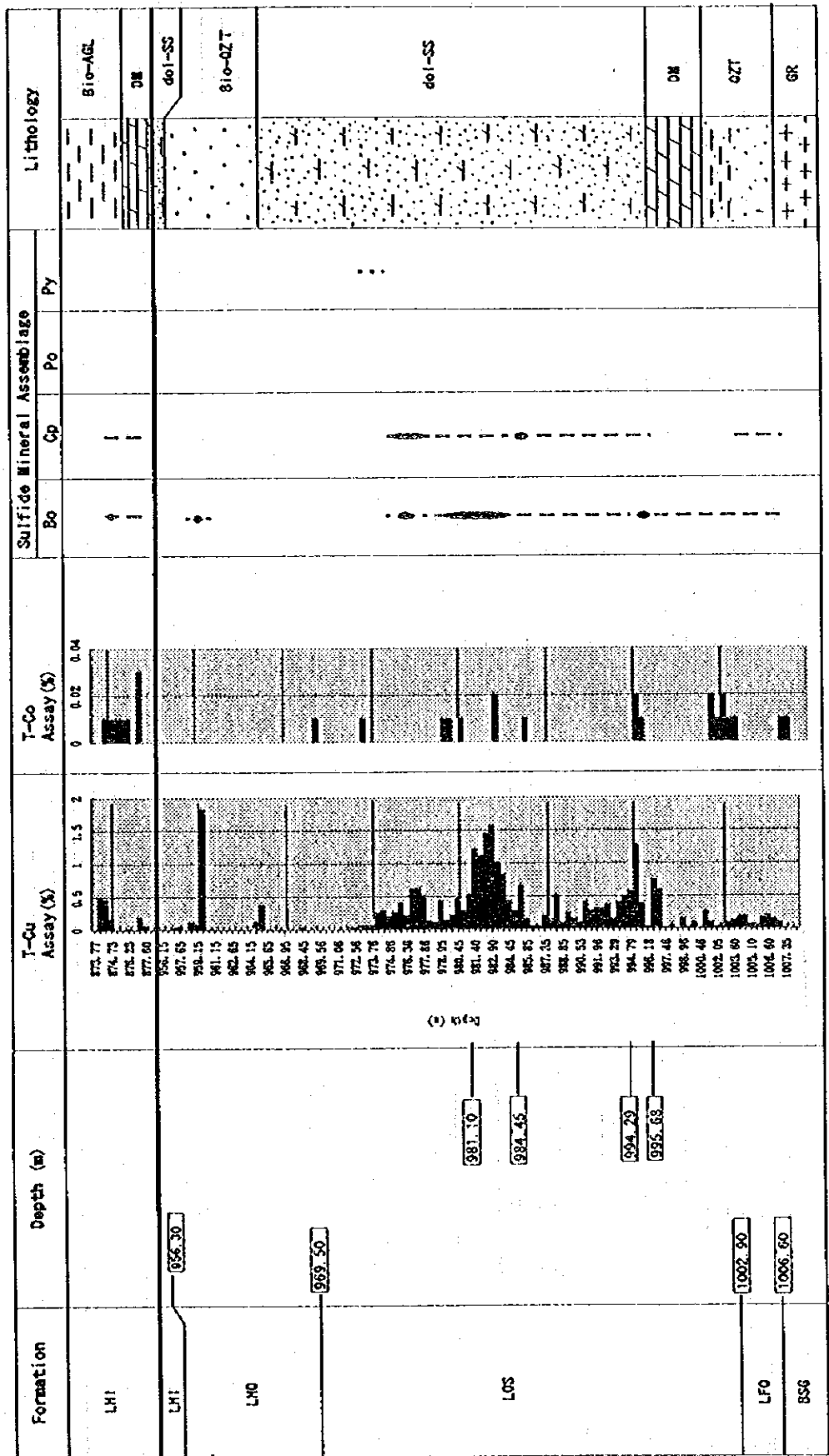


Fig. 2-1-9 Ore Assaying, Assemblage of Ore Minerals and Lithology

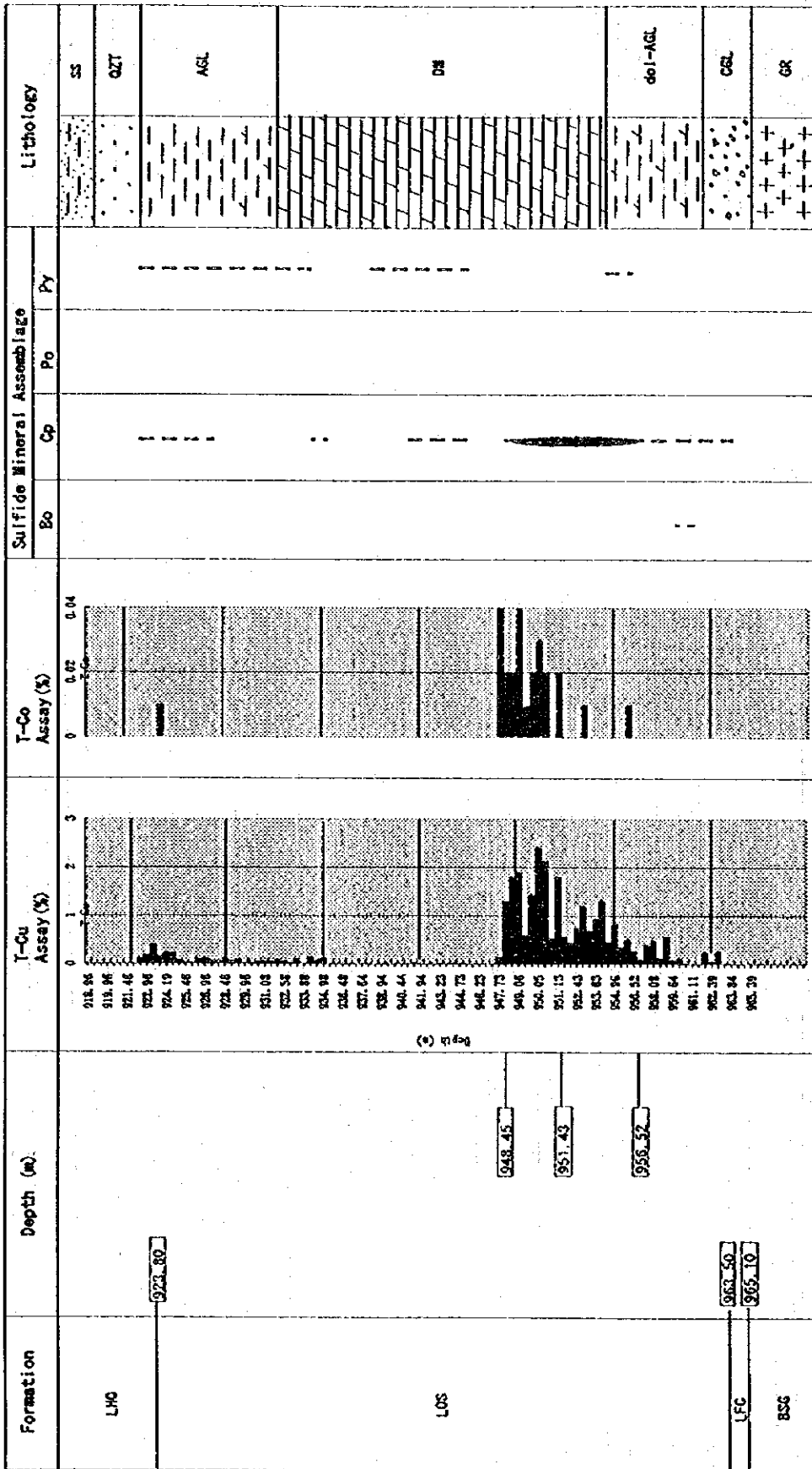


Fig. 2-1-10 Ore Assaying, Assemblage of Ore Minerals and Lithology

MJZC-9

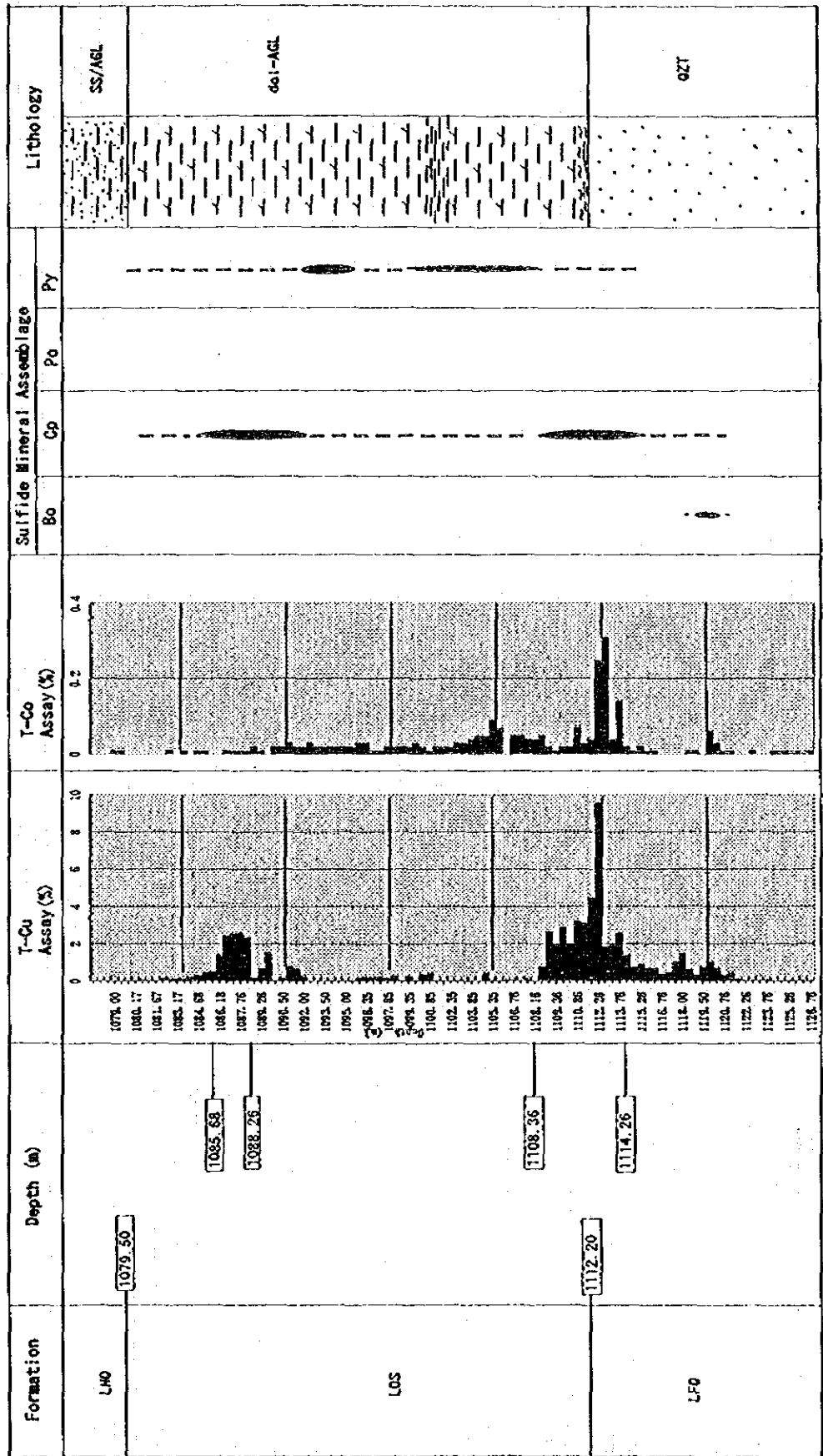


Fig. 2-1-11 Ore Assaying. Assemblage of Ore Minerals and Lithology

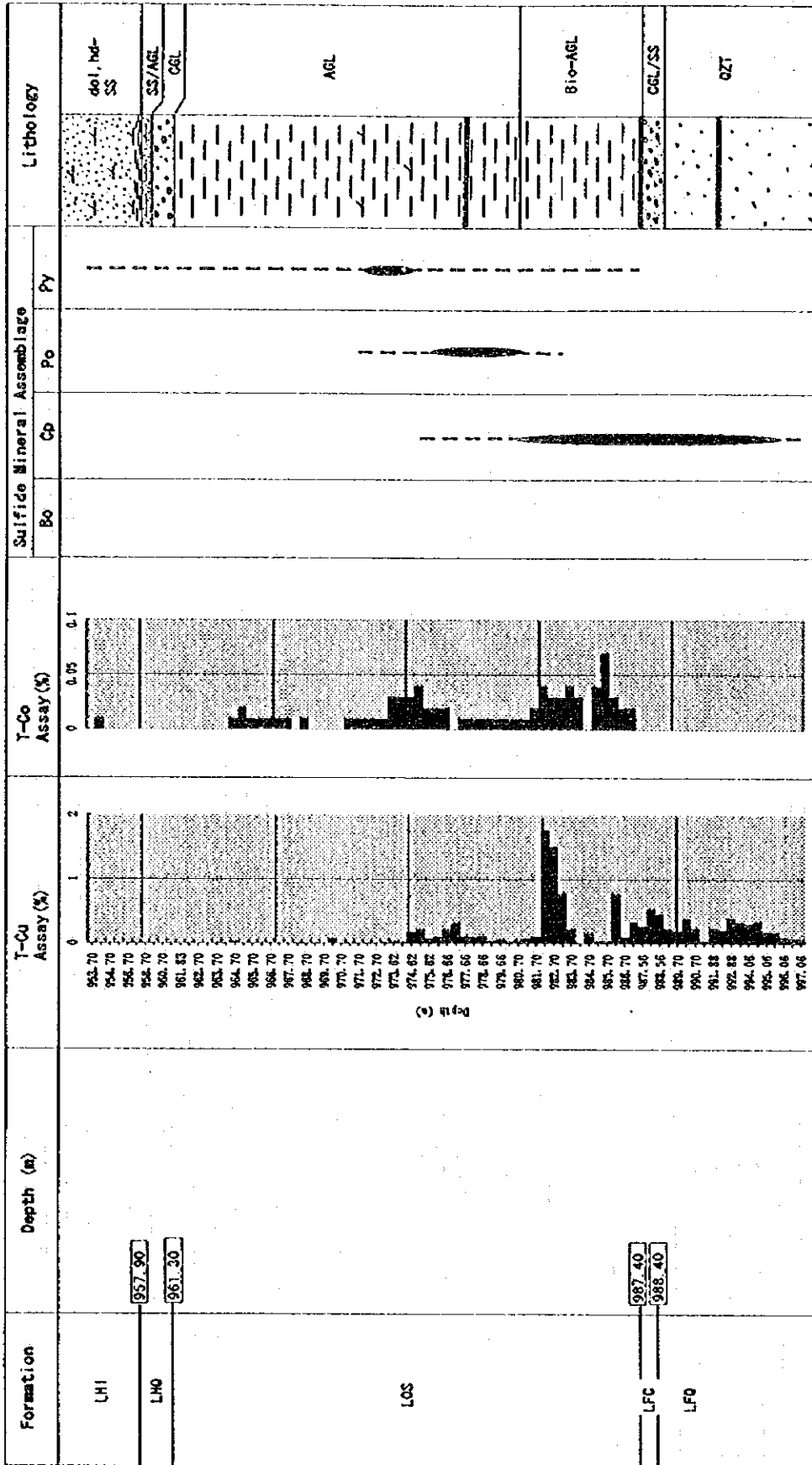


Fig. 2-1-12 Ore Assaying, Assemblage of Ore Minerals and Lithology

NN-75

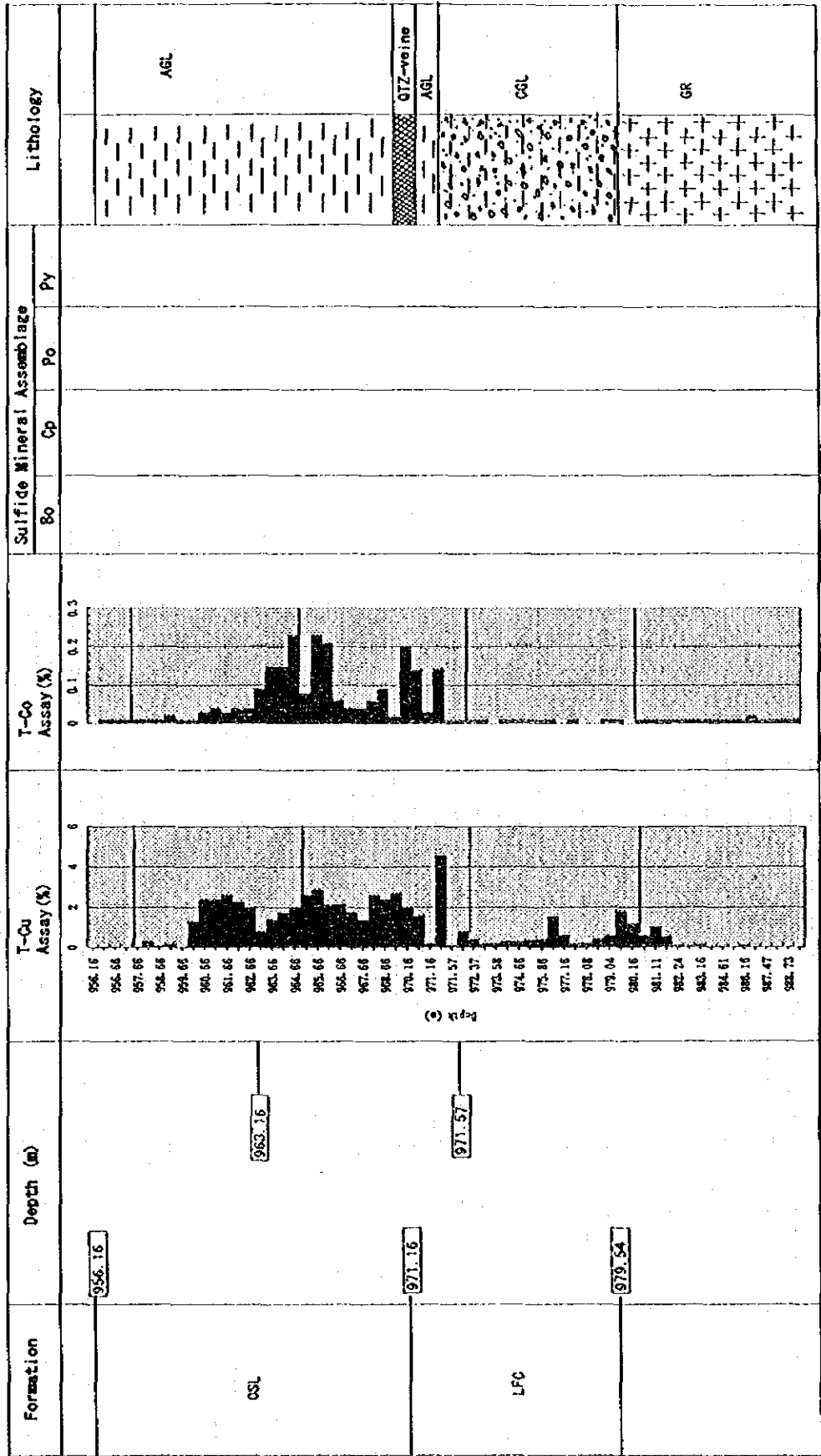


Fig. 2-1-13 Ore Assaying, Assemblage of Ore Minerals and Lithology

Chapter 2 Central Area

2-1 Objectives, Localities of Holes and Geologic Boundaries

The Objectives of the drilling was to confirm the periphery of the southeastern part of Northern Area Shoot.

The location and the collar elevation of hole and geologic boundaries are shown in Table 2-2-1, and summary of the drilling is appended.

2-2 Geology and Mineralization

2-2-1 MJZC-8

The geology of this borehole compared to that of the survey area described in 3-2 of PART I, lacks the "Footwall Conglomerate", "Feldspathic Quartzite and Grit" and "Basal Conglomerate" below the ore horizon, but otherwise it agrees well. But the units between the "Cherty Dolomite" and the basement are very thin and the differentiation of the geologic units are not very clear. Description of the borehole is as follows.

"Basement": 486.40 to 490.26m. The rock is greyish white silicified granite. The rock is rich in quartz and biotite with weak pyrite-chalcopyrite dissemination.

Lower Roan Group

"Intermediate Conglomerate": 486.10 to 486.40m. Conglomerate with pebbles of grey silicified rocks with veinlets of dolomite-(anhydrite).

"Footwall Quartzite": 482.50 to 486.10m. It is composed mainly of greyish white quartzite with thin dolomite intercalation. Argillite with biotite bands occur in the basal part.

"Ore Shale Horizon": 480.90 to 482.50m. The unit consists mainly of alternation of argillite and dolomite. Biotite bands occur locally in the dolomite. Very weak dissemination of bornite-chalcopyrite is observed.

"Hangingwall Quartzite and Argillite": 479.10 to 480.90m.

Table 2-2-1 Location of Hole and Geologic Boundaries (Central Area)

MJZC-8

Locality: Chambishi Southeast
 Direction of Cross Section: N82° W

Survey Data			Eleva- tion (m)	Coordinates	Geologic boundary		
Hole depth (m)	Dip angle (°)	Bng (mag)				Northing	Easting
0.00	-90.00	8.50	0.00	1210.03	14484.18	-8833.52	
90.00	-87.80	-56.00	295.50	45.00	1165.02	14484.18	-8833.52
190.00	-86.80	-60.00	291.50	140.00	1070.10	14485.75	-8836.81
290.00	-85.20	-70.00	281.50	240.00	970.26	14487.79	-8842.01
390.00	-85.80	-75.00	276.50	340.00	870.61	14489.46	-8850.21
490.00	-84.80	248.00	239.50	386.60	824.13	14489.85	-8852.60
				440.00	770.88	14490.29	-8857.48
				476.90	734.13	14488.59	-8860.36
				477.40	733.69	14491.75	-8861.47
				478.80	732.30	14491.78	-8861.59
				479.10	732.00	14491.78	-8861.61
				480.90	730.20	14491.81	-8861.76
				482.50	728.61	14491.84	-8861.89
				486.10	725.02	14491.90	-8862.19
				486.40	724.72	14491.90	-8862.21
				490.26	720.83	14487.98	-8861.41

This is composed of dark grey pelitic quartzite with pelitic bands. Biotite and pyrite dissemination is observed.

"Interbedded Argillite and Quartzite": 478.80 to 479.10m. It is thin alternation of dolomite and argillite with lenses of anhydrite.

"Upper Quartzite": 477.40 to 478.80m. This unit consists of grey quartzite with pelitic bands and anhydrite lenses.

Upper Roan Group

"Interbedded Argillite, Dolomite and Quartzite": 476.90 to 477.40m. It consists of grey dolomitic quartzite and dolomite with pelitic bands. Weak pyrite dissemination is observed.

"Cherty Dolomite": 454.50 to 476.90m. The main component of this units is white massive dolomite with pelitic dolomite, mica bands, pelitic bands and anhydrite. There are many quartz veins and also weak pyrite-chalcopyrite dissemination is observed.

"Arenite, Argillite and Dolomite with Anhydrite": 386.60 to 454.50m. The upper part is composed mainly of green micaceous to dolomitic argillite with intercalation of thin dolomite layers. The lower part consists of greenish grey argillite with sandstone lenses and grit. Anhydritized patches, veinlets and lenses occur throughout the unit. In the lower part of this unit, weak pyrite-chalcopyrite dissemination is observed at 439.3-442,6m and 443.8-445.0m.

"Interbedded Argillite and Dolomite with Tectono-Breccias": 59.00 to 386.60m. The upper part is composed mainly of greyish white dolomite with considerable amount of conglomerate and small amount of thin argillite layers. The conglomerate is composed of dolomitic argillite and dolomite pebbles and biotitic pelitic matrix. The lower part is composed of green argillite and dolomite alternation with local intercalation of clayey argillite and sandy rocks. The upper part is locally strongly silicified and weakly pyritized. Limonitization by weathering is observed throughout the unit and gossan occurs in some localities.

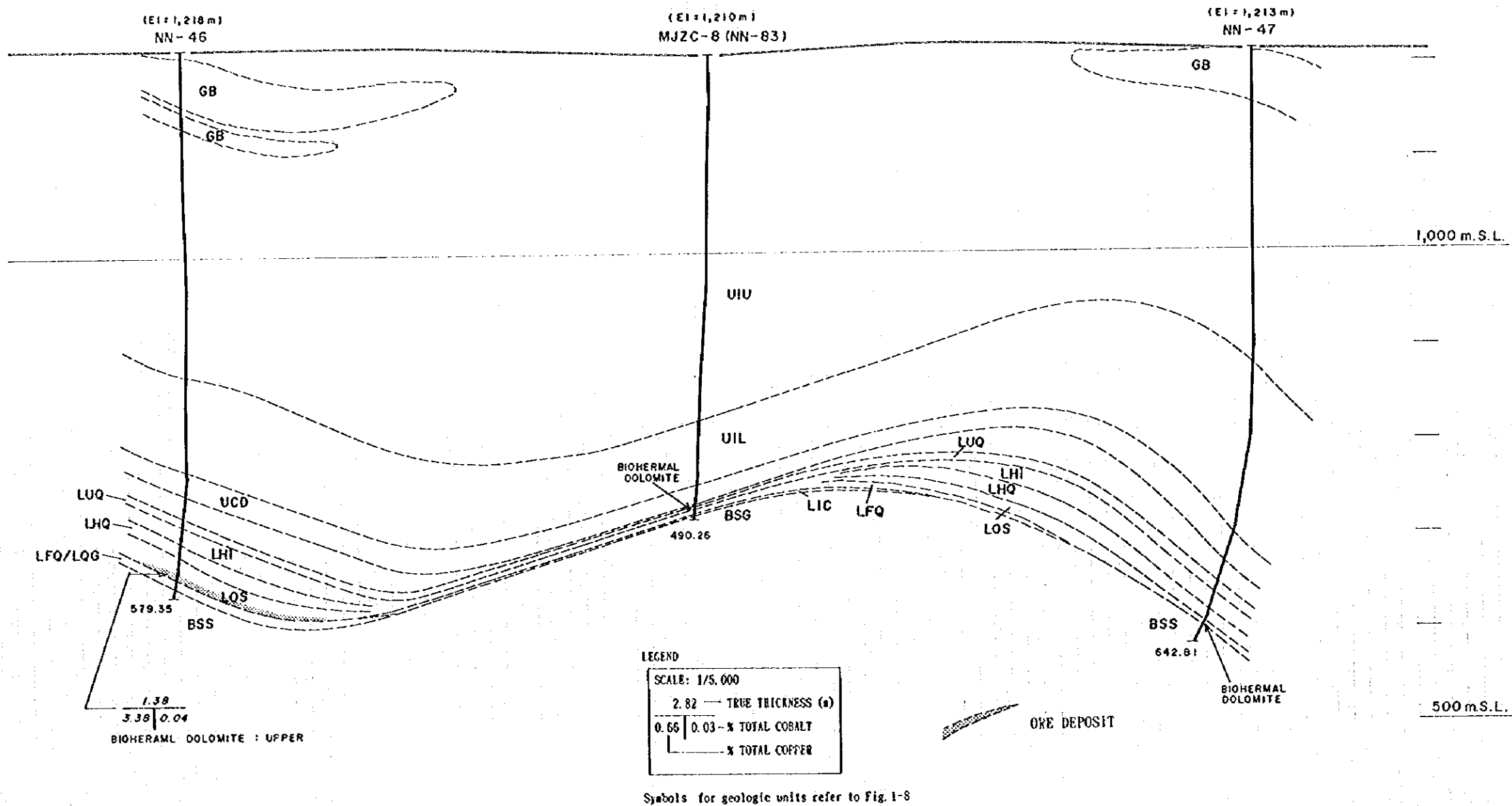


Fig. 2-2-1 Geological Profile of Drill Hole (MJZC-8)

2-3 Discussions

This borehole is located on the near crest of the rise of the basement (Figs. 1-9, 2-2-1).

As the "Ore Shale horizon" is dolomitic and the "Footwall Formation" is very thin, it is inferred that the basement of this part was palaeo-basement high at the time of ore deposition. Although the deposit is believed to belong to the bornite zone of the zonal distribution of sulfides (Fig. 1-11), the deposit is underdeveloped and it is concluded to have formed very close to the shore.

It is seen from the geologic profile (Fig. 1-9) that the formations higher than the "Ore Shale Horizon" is folded harmoniously with the basement. Thus the present topography of the basement is strongly affected by folding after the deposition of the "Upper Roan Group".

Chapter 3 Southern Area

3-1 Objectives, Localities of Holes and Geologic Boundaries

The Objectives of the drilling was to discover new ore deposits at the south of Southern Area Shoot-I.

The location and the collar elevation of holes and geologic boundaries are shown in Table 2-3-1, and summary of the drilling is appended.

3-2 Geology and Mineralization

3-2-1 MJZC-1

"Basal Conglomerate" is not developed immediately over the basement rocks at this hole. But the geology of the borehole is similar to that of the survey area, which is described in 3-2 of PART I. Geological description of the borehole is as follows.

Basement: 622.50 to 650.85 m. White to grey granite constitutes the basement and the upper part (622.50-643.10m) is fractured. The main component minerals are quartz, potash feldspar, plagioclase, biotite and muscovite, and the accessory minerals are sphene, opaque minerals, carbonates, apatite and zircon. It also contains epidote and chlorite as the altered minerals. Bleached alteration zones occur in parts of the basement and also anhydrite veinlets are dispersed. A thin amphibolite intercalation occurs immediately below the upper fractured zone. This amphibolite is considered to be a mafic igneous intrusion. Coarse crystalline quartz veins are developed at the lower boundary of the amphibolite.

Lower Roan Group

"Feldspathic Quartzite and Grit": 556.00 to 622.50m. The upper part is composed of dark grey to pinkish grey pebbly quartzite with pelitic bands. The middle part is composed of conglomerate consisting of granite pebbles. The lower part is composed of pelitic rocks locally containing granite pebbles. Gypsum and anhydrite veinlets occur scattered throughout upper to middle part and in the lower part quartz and dolomite vein-

Table 2-3-1 Location of Holes and Geologic Boundaries (Southern Area-1)

MJZC-1
Locality: Chambishi Southeast

Survey Data			Coordinates		Geologic boundary
Hole depth (m)	Dip angle (°)	Grid (m)	Elevation (m)	Northing/Easting	
0.00	-80.00	8.50	0.00	1188.50/12653.60	9549.30
50.00	-80.50	35.00	26.50	1173.50/12650.00	9549.90
150.00	-88.50	10.00	1.50	1094.50/12651.19	9549.61
250.00	-88.00	20.00	11.50	998.54/12653.80	9549.54
300.00	-88.00	20.00	11.50	965.56/12654.93	9549.31
350.00	-88.20	22.00	22.00	898.60/12657.22	9549.84
400.00	-79.20	54.00	29.50	872.03/12659.55	9550.21
450.00	-79.20	54.00	29.50	798.11/12663.93	9553.97
500.00	-75.80	55.00	29.50	767.99/12664.72	9559.34
550.00	-75.80	55.00	29.50	732.09/12670.15	9562.08
600.00	-75.80	55.00	29.50	730.69/12672.07	9563.77
650.00	-75.80	55.00	29.50	721.17/12672.93	9567.41
700.00	-75.80	55.00	29.50	710.96/12675.84	9569.17
750.00	-75.80	55.00	29.50	700.95/12674.74	9570.90
800.00	-75.80	55.00	29.50	686.97/12675.19	9571.60
850.00	-75.80	55.00	29.50	680.69/12677.03	9575.49
900.00	-75.80	55.00	29.50	678.17/12677.31	9576.08
950.00	-75.80	55.00	29.50	666.05/12678.58	9578.60
1000.00	-75.80	55.00	29.50	646.66/12680.87	9583.19
1050.00	-75.80	55.00	29.50	604.00/12683.99	9592.85
1100.00	-75.80	55.00	29.50	583.11/12677.44	9594.23
1150.00	-75.80	55.00	29.50	559.53/12668.14	9596.79
1200.00	-75.80	55.00	29.50	596.75/12687.06	9595.97

MJZC-2
Locality: Chambishi Southeast

Survey Data			Coordinates		Geologic boundary
Hole depth (m)	Dip angle (°)	Grid (m)	Elevation (m)	Northing/Easting	
0.00	-80.00	8.50	0.00	1212.57/12198.51	8775.17
100.00	-82.00	-10.00	34.50	1192.57/12199.51	8775.17
200.00	-82.00	-15.00	33.50	1060.28/12209.14	8778.39
300.00	-82.00	-15.00	33.50	1033.54/12212.71	8779.58
400.00	-82.00	-15.00	33.50	1024.14/12213.92	8780.11
500.00	-82.00	-15.00	33.50	1010.37/12215.69	8780.88
600.00	-82.00	-15.00	33.50	997.89/12217.30	8781.58
700.00	-82.00	-15.00	33.50	964.22/12221.64	8783.47
800.00	-82.00	-15.00	33.50	885.10/12231.84	8787.90
900.00	-82.00	-15.00	33.50	860.25/12235.04	8789.30
1000.00	-76.00	-40.00	311.50	763.22/12291.07	8807.42
1100.00	-72.00	-45.00	305.50	703.59/12282.32	8823.19
1200.00	-68.00	-50.00	301.50	672.87/12288.12	8831.32
1300.00	-68.00	-50.00	301.50	671.01/12288.51	8831.98
1400.00	-68.00	-50.00	301.50	637.91/12279.50	8843.38
1500.00	-68.00	-50.00	301.50	624.37/12278.35	8846.02
1600.00	-68.00	-50.00	301.50	614.90/12280.82	8852.05
1700.00	-68.00	-50.00	301.50	591.99/12285.38	8859.49
1800.00	-68.00	-50.00	301.50	560.15/12287.69	8865.28
1900.00	-68.00	-50.00	301.50	578.50/12286.97	8864.35
2000.00	-68.00	-50.00	301.50	575.60/12286.38	8865.24
2100.00	-68.00	-50.00	301.50	572.07/12286.07	8865.71
2200.00	-68.00	-50.00	301.50	570.09/12285.67	8866.31
2300.00	-68.00	-50.00	301.50	555.43/12282.73	8870.76
2400.00	-68.00	-50.00	301.50	535.04/12278.63	8876.95
2500.00	-68.00	-50.00	301.50	481.46/12287.87	8883.20
2600.00	-70.00	221.00	212.50	447.58/12297.48	8899.84
2700.00	-70.00	221.00	212.50	429.80/12292.01	8903.31

MJZC-3
Locality: Chambishi Southeast

Survey Data			Coordinates		Geologic boundary
Hole depth (m)	Dip angle (°)	Grid (m)	Elevation (m)	Northing/Easting	
0.00	-80.00	8.50	0.00	1313.20/11850.15	8249.40
100.00	-82.00	2.00	303.50	1453.20/11850.15	8249.40
200.00	-72.00	4.00	305.50	1044.14/11854.82	8251.93
300.00	-72.00	4.00	305.50	1042.90/11864.82	8251.06
400.00	-72.00	4.00	305.50	998.11/11875.97	8252.25
500.00	-72.00	4.00	305.50	968.15/11889.03	8252.96
600.00	-72.00	4.00	305.50	965.71/11889.80	8253.02
700.00	-72.00	4.00	305.50	962.26/11890.94	8253.11
800.00	-72.00	4.00	305.50	949.04/11895.22	8253.45
900.00	-72.00	4.00	305.50	934.77/11899.85	8253.57
1000.00	-72.00	4.00	305.50	930.30/11901.31	8253.61
1100.00	-72.00	4.00	305.50	853.44/11923.02	8254.18
1200.00	-72.00	4.00	305.50	784.76/11937.00	8258.32
1300.00	-68.00	340.00	351.50	761.67/11941.11	8259.53
1400.00	-68.00	340.00	351.50	683.98/11958.70	8274.51
1500.00	-68.00	340.00	351.50	664.78/11975.51	8278.21
1600.00	-68.00	340.00	351.50	652.78/11978.33	8278.88
1700.00	-68.00	340.00	351.50	648.30/11982.08	8283.44
1800.00	-68.00	340.00	351.50	635.83/11987.08	8287.40
1900.00	-68.00	340.00	351.50	616.58/11994.73	8293.50
2000.00	-68.00	340.00	351.50	607.40/11998.39	8296.41
2100.00	-68.00	340.00	351.50	596.79/12002.62	8299.78
2200.00	-68.00	340.00	351.50	595.77/12003.63	8300.74
2300.00	-68.00	340.00	351.50	591.99/12004.54	8301.30
2400.00	-68.00	340.00	351.50	591.86/12004.59	8301.34
2500.00	-68.00	340.00	351.50	589.85/12005.39	8301.94
2600.00	-68.00	340.00	351.50	587.71/12005.24	8302.68
2700.00	-68.00	340.00	351.50	585.30/12010.95	8305.45
2800.00	-68.00	340.00	351.50	542.09/12074.93	8316.49
2900.00	-68.00	340.00	351.50	502.62/12041.10	8328.45
3000.00	-68.00	340.00	351.50	454.02/12061.04	8347.38

Table 2-3-1 Location of Holes and Geologic Boundaries (Southern Area-2)

MJZC-11
Locality: Chambishi, Southeast

Survey Data			Coordinates		Hole depth for sonic	Elevation (m)	Dip angle (°)	Geologic boundary
Hole depth (m)	Dip angle (°)	Northing	Easting					
5.00	-90.00	1210.47	9259.56	35.00	1210.47	9259.56		
70.00	-86.00	1204.50	9259.86	35.00	1175.47	9259.86		
190.00	-75.67	1204.50	9259.86	35.00	1175.47	9259.86		
310.00	-73.33	1204.50	9259.86	35.00	1175.47	9259.86		
430.00	-72.00	1204.50	9259.86	35.00	1175.47	9259.86		
550.00	-69.33	1204.50	9259.86	35.00	1175.47	9259.86		
670.00	-66.33	1204.50	9259.86	35.00	1175.47	9259.86		
790.00	-63.00	1204.50	9259.86	35.00	1175.47	9259.86		
910.00	-60.00	1204.50	9259.86	35.00	1175.47	9259.86		
1030.00	-56.17	1204.50	9259.86	35.00	1175.47	9259.86		
1150.00	-53.00	1204.50	9259.86	35.00	1175.47	9259.86		
1270.00	-50.00	1204.50	9259.86	35.00	1175.47	9259.86		
1390.00	-46.67	1204.50	9259.86	35.00	1175.47	9259.86		
1510.00	-43.33	1204.50	9259.86	35.00	1175.47	9259.86		
1630.00	-40.00	1204.50	9259.86	35.00	1175.47	9259.86		
1750.00	-36.67	1204.50	9259.86	35.00	1175.47	9259.86		
1870.00	-33.33	1204.50	9259.86	35.00	1175.47	9259.86		
1990.00	-30.00	1204.50	9259.86	35.00	1175.47	9259.86		
2110.00	-26.67	1204.50	9259.86	35.00	1175.47	9259.86		
2230.00	-23.33	1204.50	9259.86	35.00	1175.47	9259.86		
2350.00	-20.00	1204.50	9259.86	35.00	1175.47	9259.86		
2470.00	-16.67	1204.50	9259.86	35.00	1175.47	9259.86		
2590.00	-13.33	1204.50	9259.86	35.00	1175.47	9259.86		
2710.00	-10.00	1204.50	9259.86	35.00	1175.47	9259.86		
2830.00	-6.67	1204.50	9259.86	35.00	1175.47	9259.86		
2950.00	-3.33	1204.50	9259.86	35.00	1175.47	9259.86		
3070.00	0.00	1204.50	9259.86	35.00	1175.47	9259.86		

MJZC-12
Locality: Chambishi, Southeast

Survey Data			Coordinates		Hole depth for sonic	Dip angle (°)	Geologic boundary
Hole depth (m)	Dip angle (°)	Northing	Easting				
5.00	-90.00	11649.50	9900.80	95.00	11649.50	9900.80	
170.00	-81.00	11649.50	9900.80	95.00	11649.50	9900.80	
327.00	-77.00	11649.50	9900.80	95.00	11649.50	9900.80	
474.00	-76.50	11649.50	9900.80	95.00	11649.50	9900.80	
621.00	-77.00	11649.50	9900.80	95.00	11649.50	9900.80	
768.00	-74.67	11649.50	9900.80	95.00	11649.50	9900.80	
915.00	-72.00	11649.50	9900.80	95.00	11649.50	9900.80	
1062.00	-68.00	11649.50	9900.80	95.00	11649.50	9900.80	
1209.00	-65.00	11649.50	9900.80	95.00	11649.50	9900.80	
1356.00	-62.00	11649.50	9900.80	95.00	11649.50	9900.80	
1503.00	-58.00	11649.50	9900.80	95.00	11649.50	9900.80	
1650.00	-55.00	11649.50	9900.80	95.00	11649.50	9900.80	
1797.00	-52.00	11649.50	9900.80	95.00	11649.50	9900.80	
1944.00	-48.00	11649.50	9900.80	95.00	11649.50	9900.80	
2091.00	-45.00	11649.50	9900.80	95.00	11649.50	9900.80	
2238.00	-42.00	11649.50	9900.80	95.00	11649.50	9900.80	
2385.00	-38.00	11649.50	9900.80	95.00	11649.50	9900.80	
2532.00	-35.00	11649.50	9900.80	95.00	11649.50	9900.80	
2679.00	-32.00	11649.50	9900.80	95.00	11649.50	9900.80	
2826.00	-28.00	11649.50	9900.80	95.00	11649.50	9900.80	
2973.00	-25.00	11649.50	9900.80	95.00	11649.50	9900.80	
3120.00	-22.00	11649.50	9900.80	95.00	11649.50	9900.80	
3267.00	-18.00	11649.50	9900.80	95.00	11649.50	9900.80	
3414.00	-15.00	11649.50	9900.80	95.00	11649.50	9900.80	
3561.00	-12.00	11649.50	9900.80	95.00	11649.50	9900.80	
3708.00	-9.00	11649.50	9900.80	95.00	11649.50	9900.80	
3855.00	-6.00	11649.50	9900.80	95.00	11649.50	9900.80	
4002.00	-3.00	11649.50	9900.80	95.00	11649.50	9900.80	
4149.00	0.00	11649.50	9900.80	95.00	11649.50	9900.80	

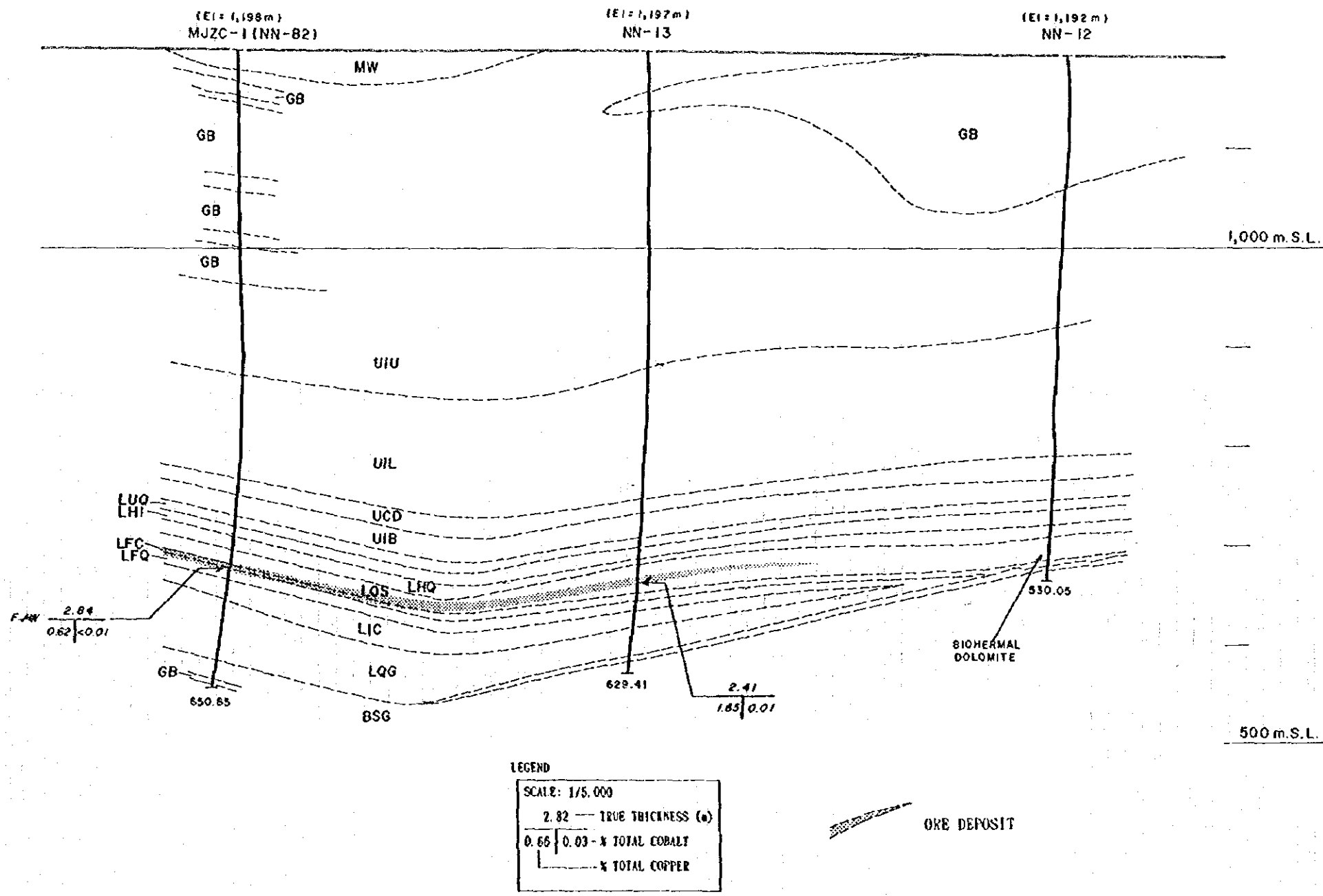


Fig. 2-3-1 Geological Profile of Drill Hole (MJZC-1)

lets are observed.

"Intermediate Conglomerate": 536.00 to 556.00m. The conglomerate is black and contains various types of pebbles such as quartzite, biotite schist, chert, granite, gneiss, sandstone and pelitic rocks.

"Footwall Quartzite": 523.50 to 536.00m. The upper part is white pebbly quartzite with granite pebbles. The middle to lower part is dark gray pelitic quartzite rich in biotite with many intercalations of thin argillite. Chalcopyrite dissemination is observed between 523.50 - 530.60m.

"Footwall Conglomerate": 520.90 to 523.50m. This consist of gray conglomerate with quartzite, black schist and pelitic pebbles. Chalcopyrite dissemination is observed.

"Ore Shale Horizon": 504.10 to 520.90m. It consists mainly of dolomitic argillites with grey and black thinly laminated layers. The basal part of this formation is made up of pelitic dolomites. The interval of 508.30 to 520.90m is the sulfide mineralized zone rich in pyrrhotite with minor amount of chalcopyrite and pyrite. The sulfides occur in thin lenses parallel to the bedding planes, irregular veinlets and as dissemination in the rims of dolomitic concretions. Results of ore assay are shown in Table 2-5-1.

"Hangingwall Quartzite and Argillite": 489.80 to 504.10m. The upper part consists of mainly grey to white pelitic quartzites with many thin argillite beds and thin pelitic dolomite beds. The lower part consists of pelitic and dolomitic sandstone with intercalation of thin pelitic dolomite beds.

"Interbedded Argillite and Quartzite": 479.40 to 489.80m. It is mainly composed of dark grey pelitic to dolomitic sandstone with intercalation of thin argillite, anhydritic dolomite and quartzite. Lenses of anhydrites are observed.

"Upper Quartzite": 469.70 to 479.40m. It is composed of pink quartzite with pelitic and micaceous bands.

Upper Roan Group

"Interbedded Argillite, Dolomite and Quartzite": 447.90 to 469.70m. The upper part consists mainly of dolomitic sandstone

with intercalation of thin dolomite beds. The lower part consists of alternation of thin bedded dolomite and argillite.

"Cherty Dolomite": 431.70 to 447.90m. It mainly consists of massive white dolomite with silica lenses, anhydrite and muscovite. In the upper part, greenish grey argillite (Marker Shale) is intercalated. While, in the lower part, dark grey pelitic dolomite is intercalated. Very fine-grained chalcopyrite is disseminated between 442.50 and 443.00m.

"Arenite, Argillite and Dolomite with Anhydrite": 326.70 to 431.70m. The upper part consists of greenish grey dolomitic argillite and pelitic dolomite alternation, the middle part of grey sandy and dolomitic argillite and pelitic dolomite, the lower part of greenish grey sandy to gritty argillite with intercalation of thin dolomite and quartzite. There are many lenses of anhydrite and gypsum in this formation.

"Interbedded Argillite and Dolomite with Tectono-Breccias": 47.48 to 53.50m, 127.50 to 142.40m, 187.00 to 199.80m, 233.00 to 326.70m. The upper part consists of dolomite, greenish grey dolomitized argillite, dark green micaceous argillite, greyish white pelitic quartzite, greyish white dolomitic sandstone and grey conglomeratic silicified rock and the lower part of alternation of green micaceous to dolomitic argillite and dolomite. This formation is generally limonitized (dissemination, veinlets) and the upper part is partly silicified.

"Mwashia Group": 00.00 to 33.787 m. The surface laterite is considered to be derived from micaceous argillite and is believed to belong to Mwashia Group from the surface geology.

"Gabbro": Gabbroic bodies occur at many parts in intervals of 33.78 to 47.48m, 53.50 to 127.50m, 142.40 to 187.00m, 199.80 to 233.00m. These are dark green altered massive bodies rich in biotite accompanied by grey intensely silicified rocks. In these gabbroic bodies, calcite, biotite, silica, dolomite, veinlets are developed.

3-2-2 MJZC-2

The geology of the drill hole is similar to that of the survey area, which is described in 3-2 of PART I. Description

of the drill hole is as follows.

Basement: 797.20 to 810.00m. The upper part is white, intensely solidified rock consisting of quartz and mica, and it gradually changes to granite in the lower part. The granite is white or grey, recrystallized holocrystalline, and is composed of quartz and biotite, containing pseudomorph of feldspar replaced by quartz. Anhydride veinlets are dispersed in the granite.

Lower Roan Group

"Basal Conglomerate": 791.10 to 797.20m. It is composed of pinkish grey pebbles with granite boulders in part. The pebbles mainly consist of subangular silicified granite with minor amount of angular chert. The matrix mainly consists of biotite and quartz, containing pink and white silicified crystal fragments (feldspar?).

"Feldspathic Quartzite and Grits ": 698.00 to 791.10m. This unit is composed of grayish white and pinkish gray quartzites with intercalations of conglomerate, pebbly quartzite and pelitic lamina. These are intensely silicified in general. Anhydritization and biotitization are recognized.

"Intermediate Conglomerate": 676.30 to 698.00m. It is composed of intensely silicified gray conglomerates with anhydride patches. The conglomerates contain various types of pebbles such as chert, granite, quartzite, gneiss and biotized rock.

"Footwall quartzite: 660.10 to 676.30m. It consists of dark gray and pink pelitic quartzites with many intercalations of argillite. The quartzites are rich in biotite.

"Footwall Conglomerate": 658.60 to 660.70m. This formation is made up of biotite-rich, gray silicified conglomerates. The conglomerates are composed of chert, black sandy rock and granite pebbles and anhydrite matrix.

"Ore Shale Horizon": 638.2n to 658.60m. It mainly consists of sandy and dolomitic argillite with very thin layers of dark gray and black lamina (1 to 5mm). The basal part of this formation is made up of pelitic dolomites. A interval of 642.90 to 658.60m is a mineralized zone composed of Cu-bearing sulfide minerals. A interval of 649.20 to 658.60m of the above

interval is a Cu-high grade part at which chalcopyrite and pyrrhotite are disseminated and concentrate in thin lenses parallel to bedding planes, and irregular veinlets of quartz-chalcopyrite-pyrite-pyrrhotite occur. At a depth of 642.90 to 645.60m, small-spotted dolomitic concretions are contained, and their rims are fringed with pyrite. At 648.10 to 649.30m, chalcopyrite and pyrrhotite occur in and around concretions of siliceous dolomite. Results of ore assay are shown in Table 2-5-1.

"Hangingwall Quartzite and Argillite": 614.90 to 638.20m. It consists of dark gray pelitic quartzites with many amounts of argillite band and small amounts of anhydrite-rich dolomite and siliceous dolomite partings. Lenticular and disseminated anhydrites occur in this interval.

"Interbedded Argillite and Quartzite": 602.30 to 614.90m. It is mainly composed of green sandy argillite with intercalations of siliceous and micaceous dolomites. Disseminated, small patch and lenticular anhydrites are observed.

"Upper Quartzite: 587.70 to 602.30m. It is composed of pinkish and brownish gray quartzites with many pelitic and micaceous bands.

Upper Roan Group

"Interbedded Argillite, Dolomite and Quartzite": 552.00 to 581.10m. This unit is divided to upper and lower parts. The former is of sandy rocks such as gray quartzite and gray dolomitic quartzite with intercalations of dark yellowish gray micaceous argillite, white anhydritic dolomite, sandy dolomite, green dolomitic argillite and so on. The latter is of white micaceous and siliceous dolomites with intercalations of quartzite, sandstone, sandy argillite and so on.

"Cherty Dolomite": 517.10 to 552.00m. It mainly consists of massive white dolomites and locally with spotted silicified parts. In the upper part, a dark green micaceous and sandy argillite (Maker Shale) is intercalated. While, in the lower part, dark gray pelitic dolomite and micaceous argillite are intercalated. Generally, spotted anhydrite are contained. A copper mineralization is recognized at 539.80 to 541.10m, where very fine-grained chalcopyrite are disseminated in the anhydrites and dolomites.

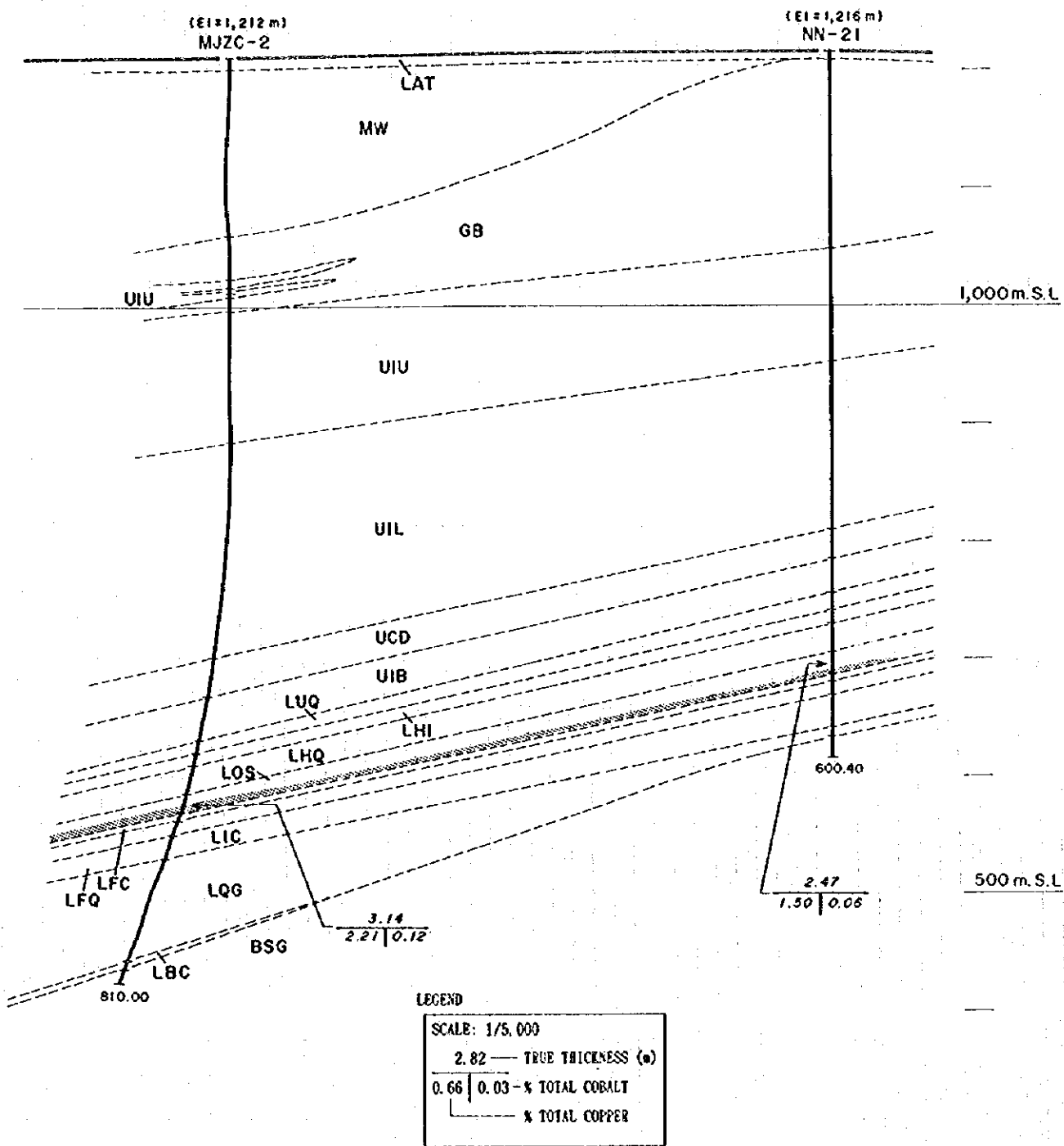


Fig. 2-3-2 Geological Profile of Drill Hole (MJZC-2)

"Arenite, Argillite and Dolomite with Anhydride": 329.90 to 517.70m. This unit is divided to upper and lower parts. The former is of green and dark yellow micaceous and silty argillite with many thin dolomite partings and the latter of green sandy argillite and alternations of thin argillite and sandstone with thin quartzite partings. In the alternations of argillite and thin sandstone dish structure, pillar structure, sandstone dike formed by liquefaction and convolute lamination are developed. From about 333m downward, intense anhydritization (lens, veinlet and spot) is generally observed, and quartz veinlets are dispersed at 453 to 500m.

"Interbedded Argillite and Dolomite with Tectono-Breccias: 189.50 to 329.90m. This unit is divided to upper, middle and lower parts. The upper part is of silicified, dolomitized and micaceous breccias, the middle part of white quartzitic sandstone with intercalations of pale green argillite, dark gray siliceous shale and white dolomite, and the lower part of green sandy argillites and white siliceous or micaceous dolomites. Stylolites are recognized in dolomites at 274 to 293m. Limonite are attached to vugs broadly observed in dolomites. At 225.80 to 232.20m, vuggy veinlets composed of limonite and dolomite are developed in argillites.

"Mwashia Groups: 12.00 to 153.00m. It consists of black shales with gray dolomites, dark green phyllitic argillites and arkosic sandstones. A densely disseminated pyrite zone is developed in the shales.

"Gabbro": Gabbros occur at many parts in a interval of 153.00 to 216.00m. These are dark green to gray, altered, biotite-dominant massive rocks with gray intensely silicified rocks. In these gabbroic bodies, silica-dolomite-mica stockworks are developed.

3-2-3 MJZC-3

"Basal conglomerate" is not developed immediately over the basement rock at this hole. But the geology of the drill hole is nearly similar to that of the survey area, which is described in 3-2 of PART I. Description of the drill hole is as follows.

Basement: 780.80 to 805.84m. The basement consists of pinkish gray granite. The grain size of quartz, feldspar and biotite is 3 to 5mm. Silicification and sericitization are generally recognized in granite, and veinlets of anhydrite and quartz are developed.

Lower Roan Group

"Feldspathic Quartzite and Grits": 705.70 to 180.80m. It is composed of grayish to pinkish white quartzites with intercalations of conglomerate, argillite lamina and quartzite including fragments. These are intensely silicified in general. Anhydrite and quartz veinlets are dispersed.

"Intermediate Conglomerate ": 666.30 to 705.70m. It is composed of compact gray to dark green conglomerates with intercalations of sandstone and pebbly quartzite. The conglomerates consists of granite, sandstone, quartzite, schist, chert, gneiss and argillite pebbles. Anhydrite and quartz veinlets are dispersed.

"Footwall Quartzite": 652.10 to 664.80m. It consists of pinkish gray micaceous quartzites with intercalations of argillite. Quartz veins are developed near the unit boundary.

"Footwall Conglomerate": 649.70 to 651.30m. It is composed of compact gray conglomerates with dolomitic sandstone at the upper part. The conglomerates consists of granite, chert, schist, sandstone and quartzite pebbles, however, the detailed lithology is not clear because of intense silicification. A dish structure is observed in pyrite-disseminated sandstone of the upper part.

"Ore Shale Horizon": 632.40 to 649.10m. It consists of sandy and dolomitic argillites with dark gray indistinct lamina. A mineralized zone which is composed of Cu-bearing sulfide minerals, is developed at 635.10 to 649.70m, and the Cu-high grade part is at 644.70 to 649.10m. Chalcopyrite is concentrated parallel to the bedding planes into thin lenses, and irregular veinlets of quartz, chalcopyrite, pyrite and pyrrhotite occur in the high grade part. At 636.00 to 636.70m, chalcopyrite lamina which very fine-grained chalcopyrite concentrates at bedding planes are formed. At 636.70 to 644.70m, spotted small dolomitic concretions are fringed with chalcopyrite and pyrite

assemblages. Chalcopyrite is contained in concretions composed of siliceous dolomites near 649m. Results of ore assay are shown in Table 2-5-1.

"Hangingwall Quartzite and Argillite": 622.10 to 632.40m. It consists of dark gray pelitic and dolomitic quartzites with many pelitic bands.

"Interbedded Argillite and Quartzite": 600.50 to 622.10m. It is composed of dark gray pelitic, dolomitic, micaceous sandstone and grayish white dolomitic quartzites with intercalations of dolomite and argillite.

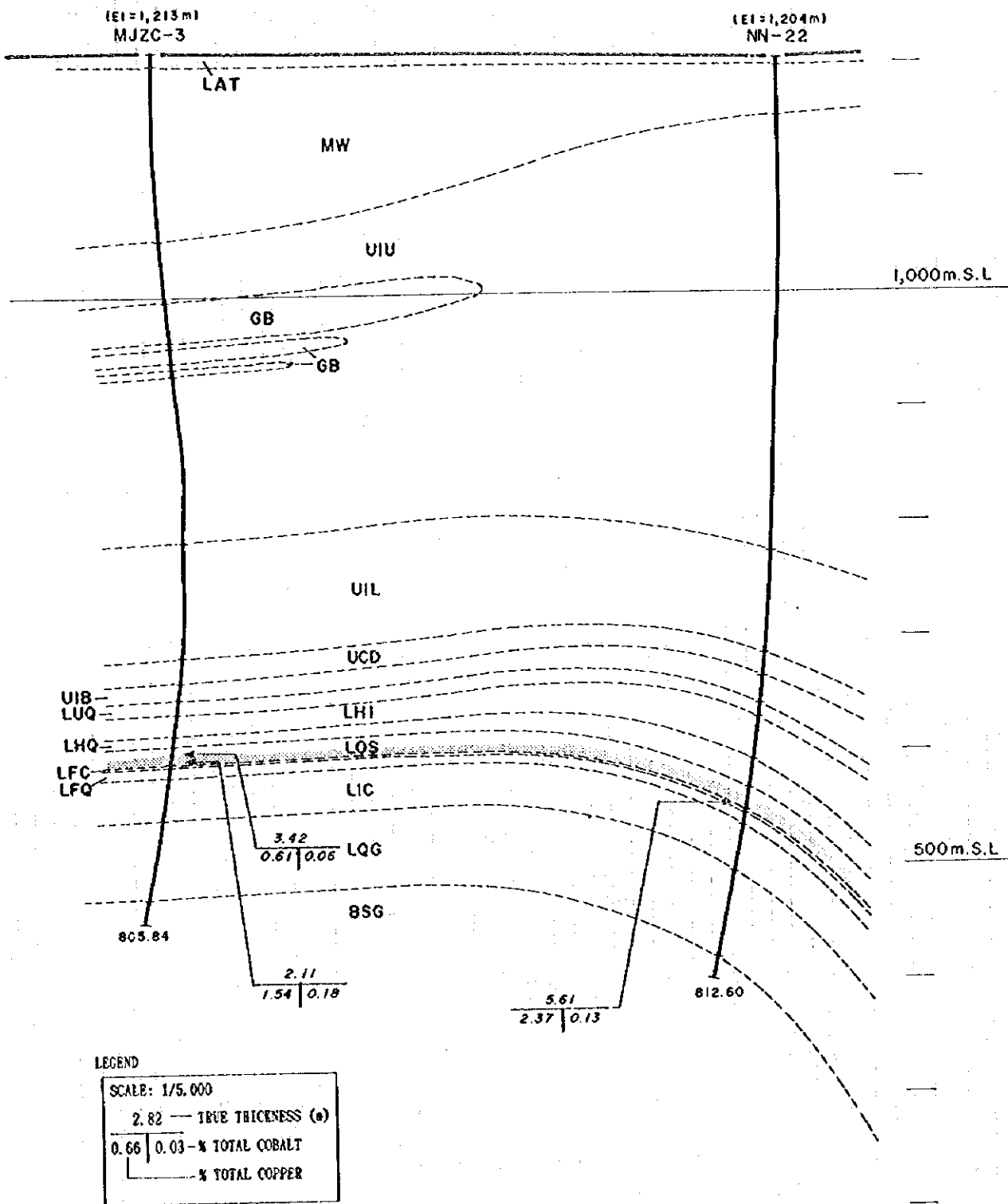
"Upper Quartzite": 586.50 to 600.50 m. It is composed of pinkish to brownish white dolomitic quartzites with many pelitic bands.

Upper Roan Group

"Interbedded Argillite, Dolomite and Quartzite": 570.30 to 586.50m. This unit is divided to upper and lower parts. The former is of dark gray dolomitic, micaceous and quartzite sandstones with intercalations of dolomite and argillite, and the latter of alternation of dark gray pelitic dolomites and thin argillites.

"Cherty Dolomite": 547.30 to 570.30m. It mainly consists of massive white dolomitic and locally with silicified parts. A massive green argillite (Marker Shale) is intercalated in the upper part. While, the lower part consists of dark gray pelitic dolomites and alternations of dolomite and micaceous argillite. Generally, lenses and patches of anhydrite are contained. A copper mineralization is observed at 556.80 to 562.60m, where flat and small concentrations of chalcopyrite are dispersed in silicified parts, dolomites and anhydrite. Also chalcopyrite-bearing quartz veins occur at these depths.

"Arenite, Argillite and Dolomite with Anhydrite": 440.00 to 547.30m. This unit is divided to upper and lower parts. The former is of green dolomitic and micaceous argillites intercalated with thin dolomites, and the latter of green argillites and alternations of argillite and thin sandstone in which dish structures, pillar structures and sandstone dikes formed by liquefaction are developed. From about 475m down to the bottom



Symbols for geologic units refer to Fig. 1-8

Fig. 2-3-3 Geological Profile of Drill Hole (MJZC-3)

depth of the unit, strong anhydritization (lens, veinlet and patch) is generally observed.

"Interbedded Argillite and Dolomite with Tectono-Breccias: 171.30 to 440.00m. It consists of white to gray dolomitic with intercalations of green argillite. Limestones are developed at the upper part, and thin layers and lenses of cherry rocks are intercalated in carbonate rocks and argillites. Pebbly conglomerates and argillites brecciated by shear forces are distributed at 289.70 to 290.50m and about 323.70m, respectively. Fractures and stylolites are developed in dolomites at 290.50 to 342m and 350 to 422m, respectively. Limonites are attached to vugs, and fractures broadly observed in dolomites. Transparent quartz veins occur near the uppermost part.

"Mwashia Groups: 12.00 to 166.00m. It consists of black shales, grayish white dolomites, dark green calcareous and dolomitic argillites, arkosic sandstones and olive gray argillites. Black shales are carbonaceous, and pyrite bands with thickness of 0.5 to 1cm, which is accompanied by quartz, hematite and dolomite, are well developed parallel to bedding planes in the shales, showing boudinage structure. Venlets branch out from the bands in some parts.

"Gabbro": Massive, dark green and white altered rocks mainly consisting of plagioclase, biotite, hornblende and carbonate minerals occur at 179.00 to 179.70m, 220.50 to 249.90m, 252.40 to 256.10m and 285.00 to 289.70m. Also, dark green pelitic altered rocks occur at 263.30 to 283.60m. These rocks are intensely carbonatized and white argillized, therefore, their lithologies are not clear.

3-2-4 MJZC-11

The geology of this borehole compared to that of the survey area described in 3-2 of PART I, lacks the "Basal Conglomerate" of the Footwall Formation, but otherwise it agrees well. Geological description of the borehole is as follows.

"Basement": 785.70 to 852.87m. The rock is altered granite. Strong silicification or bleaching occur locally. Thin amphibolites are intercalated frequently in this rock. This amphibolite seems to be mafic intrusive rock.

Lower Roan Group

"Feldspathic Quartzite and Grit": 697.00 to 771.60m, 782.10 to 785.70m. It mainly consists of white to gray quartzite. Pebbly quartzite and thin conglomerate bed are intercalated in the middle part. Thin beds of gritty and pelitic sandstone are intercalated in the lower part. The quartzite contains bands or dissemination of biotite. Also, amphibolite supposed to be mafic intrusive rock occurs in the lower part.

"Intermediate Conglomerate": 672.70 to 697.00m. It mainly consists of conglomerate with intercalation of small amount of thin quartzite bed in the lower part. The conglomerate contains various types of pebbles of rounded to subangular shape such as quartzite, sandstone, biotized argillite, chert, quartz, potash feldspar, granite and schist.

"Footwall Quartzite": 658.70 to 672.70m. It mainly consists of argillaceous to biotized quartzite and pelitic sandstone with many pelitic bands. Dissemination of chalcopyrite-bornite is observed in this formation.

"Footwall Conglomerate": 656.60 to 658.70m. It is composed of conglomerate with rounded to subangular pebbles. The nature of pebbles are quartzite, argillite, sandstone and small amount of granite.

"Ore Shale Horizon": 637.20 to 656.60m. It mainly consists of gray dolomitic argillite with intercalation of carbonaceous argillite in the lower part. Also, thin bed of dolomite and sandstone occurs in the basal part. The interval of 637.2 to 642.6m is the pyritized zone and 642.6 to 656.4m is pyrite-pyrrhotite-chalcopyrite zone. The sulfides occur as dissemination at the bedding planes, the rim of dolomite concretions, patches or lenses and veinlets. Results of ore assay are shown in Table 2-5-1. The cobalt mineral of this borehole was identified to be cobalt pentlandite (Appendices).

"Hangingwall Quartzite and Argillite": 636.80 to 637.20m. It consists of white quartzitic sandstone with pelitic bands.

"Interbedded Argillite and Quartzite": 606.80 to 636.80m. The major rock of this unit is dolomitic or pelitic sandstone with many thin intercalations of dolomite and argillite. The sandstone is locally quartzitic. This formation contains patch-

es to lenses of anhydrite.

"Upper Quartzite": 594.20 to 606.80m. This unit consists of pinkish gray quartzite with pelitic to micaceous bands.

Upper Roan Group

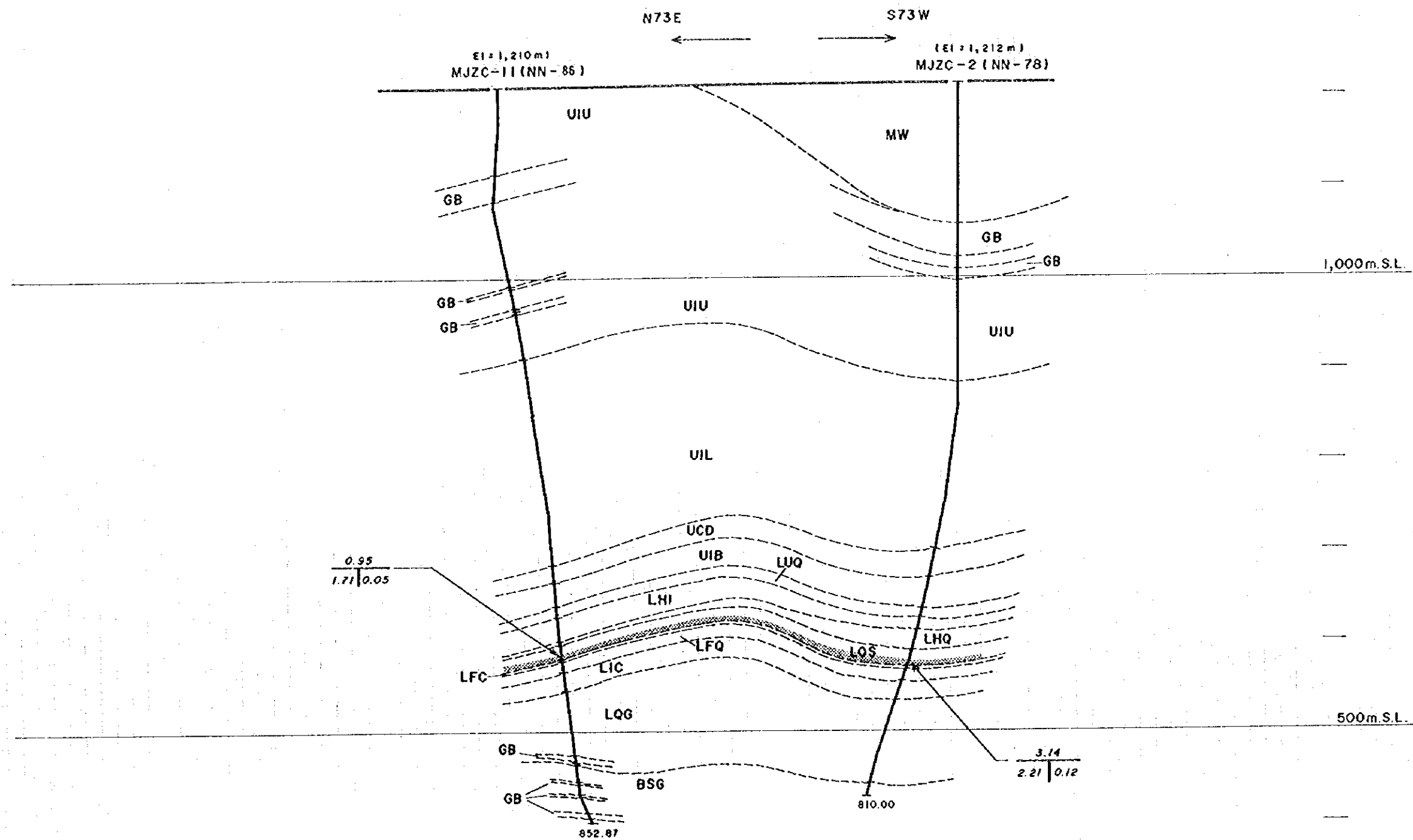
"Interbedded Argillite, Dolomite and Quartzite": 566.70 to 594.20m. The upper part is composed mainly an alternation of dolomite and pelitic sandstone with intercalation of small amount of pelitic bands and thin quartzite beds. The lower part is composed of an alternation of dolomite and sandy argillite.

"Cherty Dolomite": 545.30 to 566.70m. The main component of this unit is white massive dolomite and green sandy argillite (Marker Shale) is intercalated in the upper part. This unit contains anhydrite patches. Also, minute chalcopyrite-pyrite grains is faintly disseminated in th lower part.

"Arenite, Argillite and Dolomite with Anhydrite": 306.70 to 545.30m. The upper part mainly consists of an alternation of micaceous dolomite and micaceous to dolomitic argillite with thin intercalation of sandstone to quartzite. The lower part is composed of argillite with grit. Anhydritization (patches, veinlets, lenses) occurs throughout the unit and limonitization by weathering is commonly observed in cavity of dolomite in the upper part.

"Interbedded Argillite and Dolomite with Tectono-Breccias": 6.00 to 96.00m, 126.00 to 222.70m, 224.50 to 247.60m, 254.30 to 306.70m. The upper part consists of micaceous or shaly or dolomitic argillite, limestone and dolomite. Lamina to dissemination is observed in a part of the shale. The major component of the lower part is quartzite with intercalation of dolomite and conglomeratic rocks in some localities. The conglomeratic rock consists of dolomite, quartzite and micaceous argillite pebbles of subrounded shape. Some gabbro bodies occur in this unit. Also, limonitization by weathering occur frequently in this unit, and limonite-dolomite-quartz veinlets which filled fractures of quartzite are considerably developed in the lower part.

"Gabbro (Amphibolite)" 96.00 to 126.00m, 222.70 to 224.50m, 247.60 to 254.30m. The bodies are dark green altered with platy cleavages developed and strongly carbonatized and biotized.



LEGEND

SCALE:	
HORIZONTAL	1/50,000
VERTICAL	1/10,000
2.82	--- TRUE THICKNESS (m)
0.66	0.03 --% TOTAL COBALT
	% TOTAL COPPER

Symbols for geologic units refer to Fig. 1-8

ORE DEPOSIT

Fig. 2-3-4 Geological Profile of Drill Hole (MJZC-11)

Also, in the lower part of this hole, thin amphibolites similar to this rock are developed in the "Feldspathic Quartzite and Grit" of Lower Roan Group and basement granite.

3-2-5 MJZC-12

The geology of this borehole compared to that of the survey area described in 3-2 of PART I, it agrees well. Geological description of the borehole is as follows.

"Basement": 769.60 to 782.28m. The rock is coarse-crystalline granite and rich in secondary quartz and biotite. Strong silicification and a large amount of mica occur in the top part. Thin mafic rocks occur in this rock.

Lower Roan Group

"Basal Conglomerate": 768.70 to 769.60m. Conglomerate with boulders of granite and fragments of potash feldspar.

"Feldspathic Quartzite and Grit": 743.70 to 768.70m. It is composed of pinkish grey quartzite with local pebbly quartzite, and contains bands or patches of biotite.

"Intermediate Conglomerate": 692.00 to 743.70m. It mainly consists of conglomerate with subangular pebbles, and contains locally granule conglomerate or pebbly quartzite. The nature of pebbles are rich in quartzite, chert, argillite, granite, quartz, schist and potash feldspar in the upper part, and rich in biotite schist, spotted mica schist and quartzite in the lower part.

"Footwall Quartzite": 675.50 to 692.00m. It mainly consists of pebbly sandstone, pebbly quartzite and pelitic sandstone, and many pelitic bands are intercalated in a state of thin-bedded alternation in the sandstone.

"Footwall Conglomerate": 674.10 to 675.50m. It is composed of conglomerate with subangular to rounded pebbles. The most abundant pebbles are granite, followed by quartzite and biotite schist.

"Ore Shale Horizon": 655.40 to 674.10m. It mainly consists of black to gray sandy argillite with local dolomitic argil-

lite. Also, thin bed of pelitic sandstone occurs in the basal part. The interval of 655.4 to 661.4m is the pyritized zone and 661.4 to 672.1m is pyrite-pyrrhotite-chalcocopyrite zone and 672.1 to 674.0m is bornite-chalcocopyrite zone. The sulfides occur as dissemination to lamination at the bedding planes, patches to lenses of irregular shape. Results of ore assay are shown in Table 2-5-1. The cobalt minerals of this borehole were identified to be cobalt pentlandite and carrollite (Appendices).

"Hangingwall Quartzite and Argillite": 654.00 to 655.40m. It consists of pink to white quartzite with pelitic bands.

"Interbedded Argillite and Quartzite": 624.00 to 654.00m. It is composed mainly of an alternation of pelitic sandstone, quartzite and argillite, and thin beds of dolomite are intercalated in this unit. Anhydrite lenses occur commonly in this unit.

"Upper Quartzite": 612.20 to 624.00m. This unit consists of white to pink quartzite with pelitic and micaceous bands.

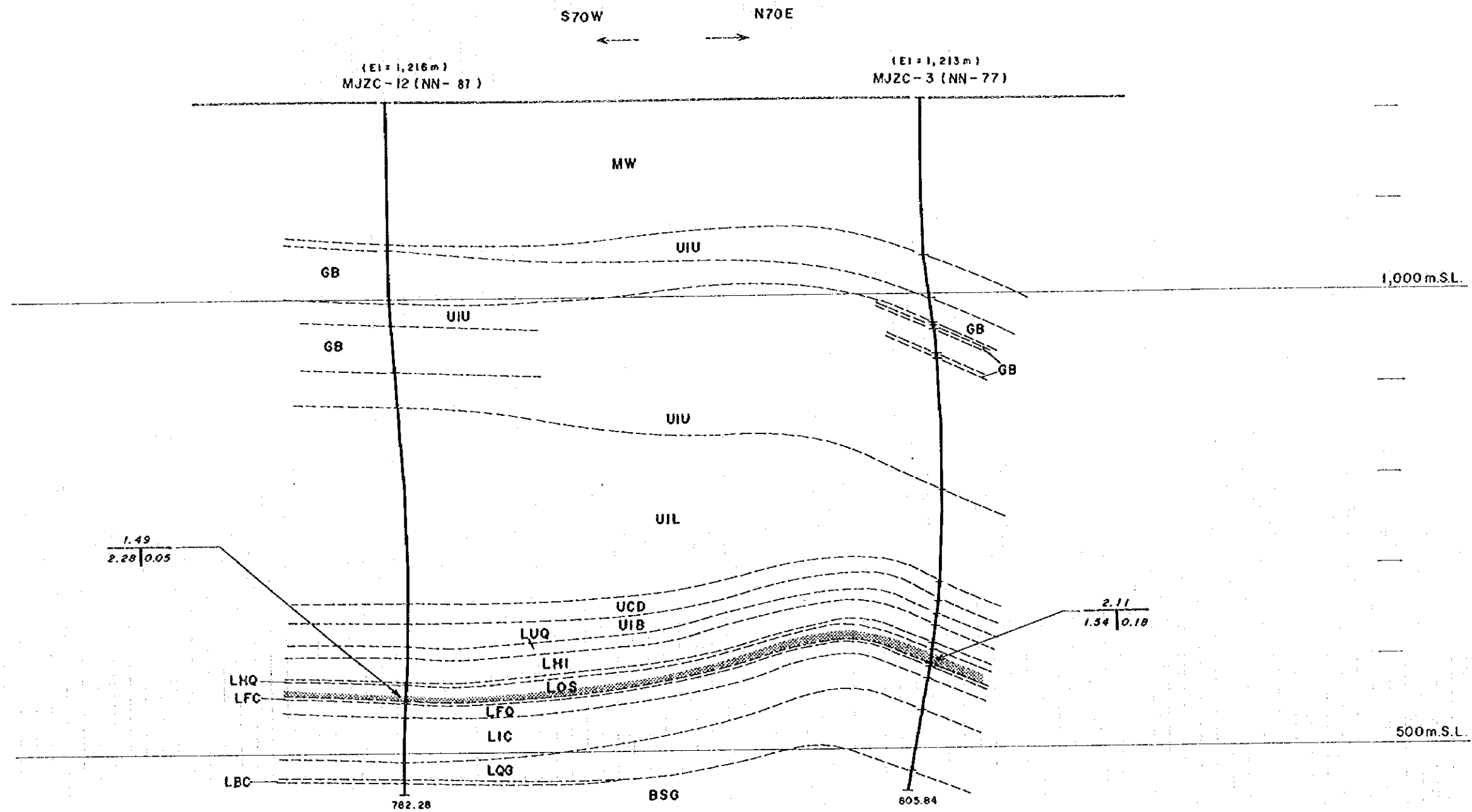
Upper Roan Group

"Interbedded Argillite, Dolomite and Quartzite": 584.70 to 612.20m. This unit is composed of thin-bedded alternation of dolomite, argillite, pelitic sandstone and quartzite.

"Cherty Dolomite": 562.70 to 584.70m. The main component of this unit is white massive dolomite with anhydrite. Micaceous and dolomitic argillite (Marker Shale) is intercalated in the upper part.

"Arenite, Argillite and Dolomite with Anhydrite": 339.00 to 562.70m. The upper part mainly consists of an alternation of dolomite and greenish grey argillite, and contains locally intercalations of pelitic sandstone. The lower part is composed mainly of green sandy to gritty argillite with thin intercalations of small amount of dolomite and sandstone. Anhydritization (patches, veinlets, lenses) occurs throughout the unit and limonitization by weathering is observed in the upper part.

"Interbedded Argillite and Dolomite with Tectono-Breccias": 157.00 to 164.50m, 220.50 to 247.60m, 300.20 to 339.00m. The upper part consists of an alternation of dolomite and argil-



LEGEND

SCALE:	
HORIZONTAL	1/50,000
VERTICAL	1/10,000
2.82	— TRUE THICKNESS (a)
0.65	0.03 — X TOTAL COBALT
	— X TOTAL COPPER

ORE DEPOSIT

Symbols for geologic units refer to Fig. 1-8

Fig. 2-3-5 Geological Profile of Drill Hole (MJZC-12)

lite, and contains intercalations of sandstone. The lower part is composed mainly of an alternation of quartzite and dolomite, and contains intercalation of conglomerate. The conglomerate consists of pebbles of dolomite and argillite. Some gabbro bodies occur in this unit. Also, limonitization by weathering occur generally this unit.

"Mwashia Group": 29.00 to 157.00m. It is composed mainly of dark grey to black shaly argillite with intercalation of dolomite. Dissemination of pyrite is observed locally in the argillite.

"Gabbro (Amphibolite)" 164.50 to 220.50m, 247.60 to 300.20m. The bodies are dark green to black altered, massive. Generally, strong biotitization and carbonatization occur and silicification is observed locally.

3-3 Discussions

It is seen from the cross sections (Figs. 1-9, 2-3-1) that MJZC-1 differs from NN-13 and NN-12 to the northeast in that dolomite is not developed in the "Ore Shale horizon". It is, therefore, considered that this site was offshore at a distance from the coast during the formation of the ore deposit.

The mineralization of the "Ore Shale" of MJZC-1 belongs to the chalcopyrite-pyrrhotite zone, but the copper grade is low with high pyrrhotite content and thus it is believed that the hole is relatively close to the pyrite-pyrrhotite zone considered to occur to the southwest of this site. Also there is a chalcopyrite mineralized zone (width 2.85m T-Cu 0.62% T-Co <0.01%) in the "Footwall Formation" immediately below the "Ore Shale" mentioned above. The mineralization of the upper part of the "Footwall Formation" and that of the "Ore Shale" is believed to be of the same series and the difference between the two probably is the result of the different depositional environment of the two formations. Namely, the "Ore Shale" of this site was too strongly reducing for copper deposition because of the rapid deepening of the sea at the time of deposition. During the later part of the "Footwall Formation" deposition to that of the "Ore Shale", relatively large amount of copper probably was brought to the vicinity of this borehole site and the precipitation of copper minerals is believed to

have been controlled by the sea bottom topography of that time.

The mineralization of MJZC-2 belongs to the chalcopyrite-pyrrhotite-pyrite zone, but the copper grade is relatively high (width 3.14m T-Cu 2.21% T-Co 0.21%). This indicates the possibility of a new ore shoot in this area.

The mineralized zone of MJZC-3 is located over a basement high. The mineralization belongs to the chalcopyrite-pyrrhotite-pyrite zone, and contains the relatively high grade of cobalt, but the copper grade is relatively low (width 2.11m T-Cu 1.54% T-Co 0.18%). It is generally believed that ore deposits of the Copperbelt occur on depressions of the basements, and those on basement highs are barren or low-grade. Therefore, the conditions of this hole are harmonious with the general trend. However, there are exceptions such as that recognized at NN-23 located in the Southern Area Shoot-I (Fig. 1-9, K-K' Section). Here, the western half of the Shoot occurs at higher horizon than the top of the basement rise and below thin gabbro. Now, if the western extension of Southern Area Shoot-II was formed by the same process as Southern Area Shoot-I, the high grade part would continue southwestward along the rim of the gabbroic body and the basement limb to the south of this hole (Fig. 1-12 and 1-13).

The mineralized zone occurs in the "Ore Shale" horizon in MJZC-11. The ores belong to the pyrite-pyrrhotite-chalcopyrite zone and pyrite zone, but the ore grade is low. Thus the location of this borehole was offshore far from the coast at the time of ore deposition and is inferred to have been unfavorable for copper precipitation.

Existence of a basement high is inferred to the west of MJZC-11 from the basement surface contour map (Fig. 1-12), but it is believed that this basement high was formed by folding after the deposition of the "Upper Roan Group" because all the beds of the "Lower and Upper Roan Groups" occur in harmony with the basement (Fig. 1-9; I-I', L-L', M-M').

The mineralized zone occurs in the "Ore Shale" of MJZC-12 and vertical zoning of sulfide minerals is observed. In the "Ore Shale" horizon, bornite-chalcopyrite zone occurs at the bottom and the mineral assemblage changes upwards through pyrite-pyrrhotite-chalcopyrite zone to pyrite zone. This fact

indicates that this site was located in the vicinity of the palaeo-basement high at the beginning of "Ore Shale" deposition. But subsequently the sea rapidly became deeper and the environment became chemically reducing and thus unfavorable for copper precipitation.

Although MJZC-12 is inferred to be located over a basement high from the basement surface contour map (Fig. 1-12), the units of the "Lower and Upper Roan" Groups occur in harmony with the basement complex (Fig. 1-9; M-M'). Thus this basement high is considered to have formed by folding after the deposition of the "Upper Roan Group". The occurrence of palaeo-basement high in this basement high became a possibility as above mentioned. If, therefore, deep depressions were formed locally on the limb of the palaeo-basement high during the beginning of "Ore Shale" deposition, ore shoots could have been formed.

MJZC-1

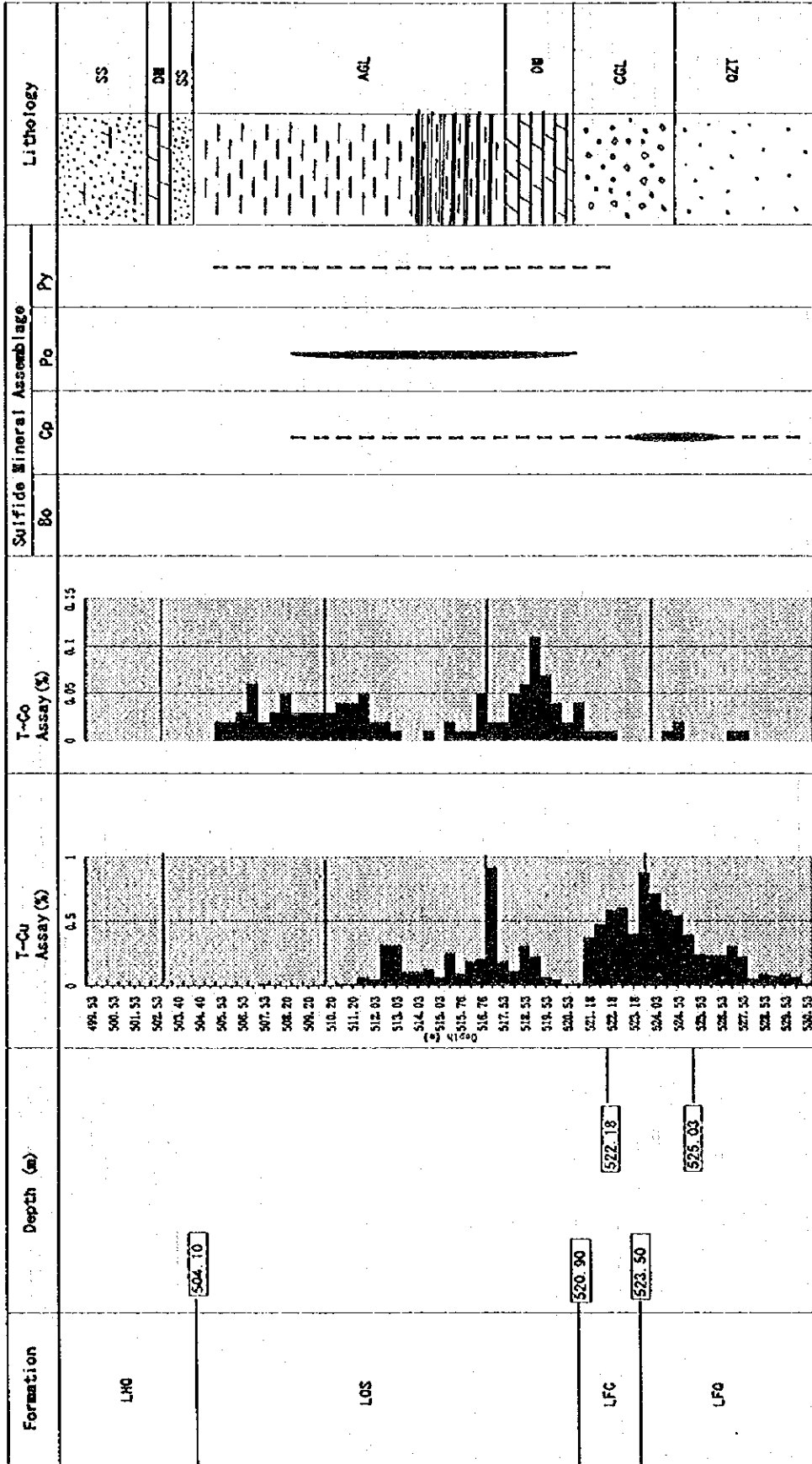


Fig. 2-3-6 Ore Assaying, Assemblage of Ore Minerals and Lithology

MJZC-2

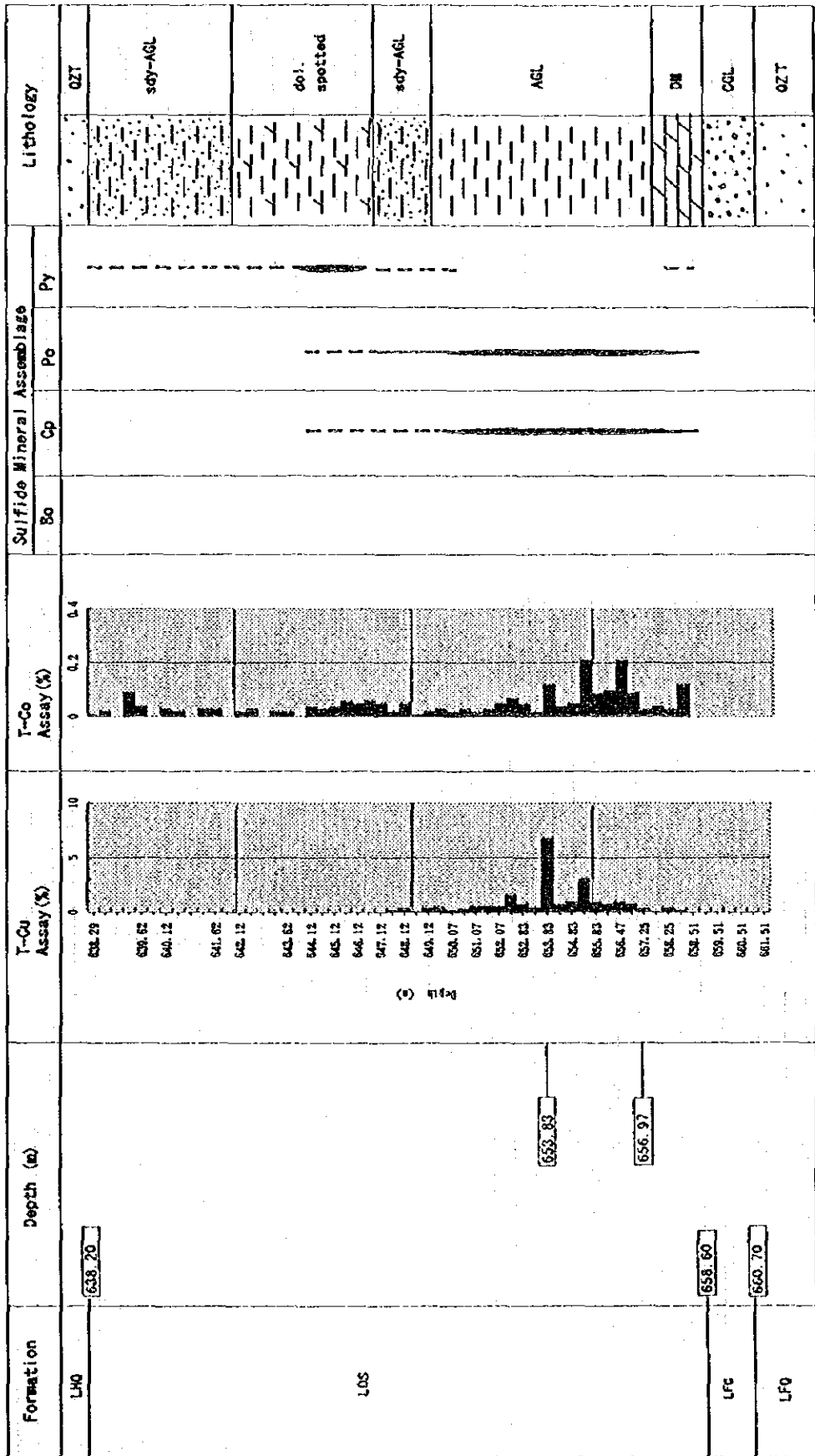


Fig. 2-3-7 Ore Assaying, Assemblage of Ore Minerals and Lithology

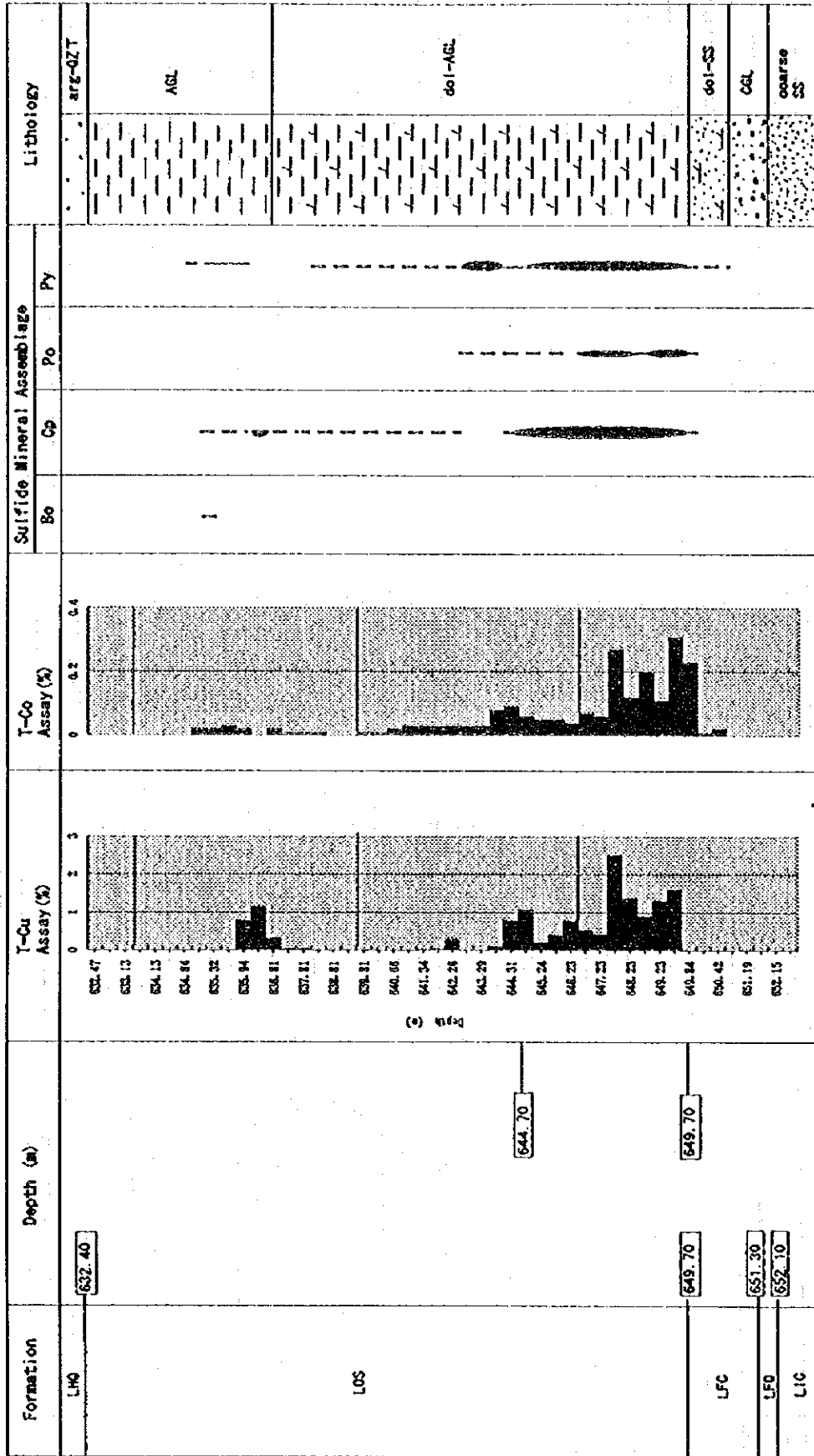


Fig. 2-3-8 Ore Assaying, Assemblage of Ore Minerals and Lithology

MJZC-11

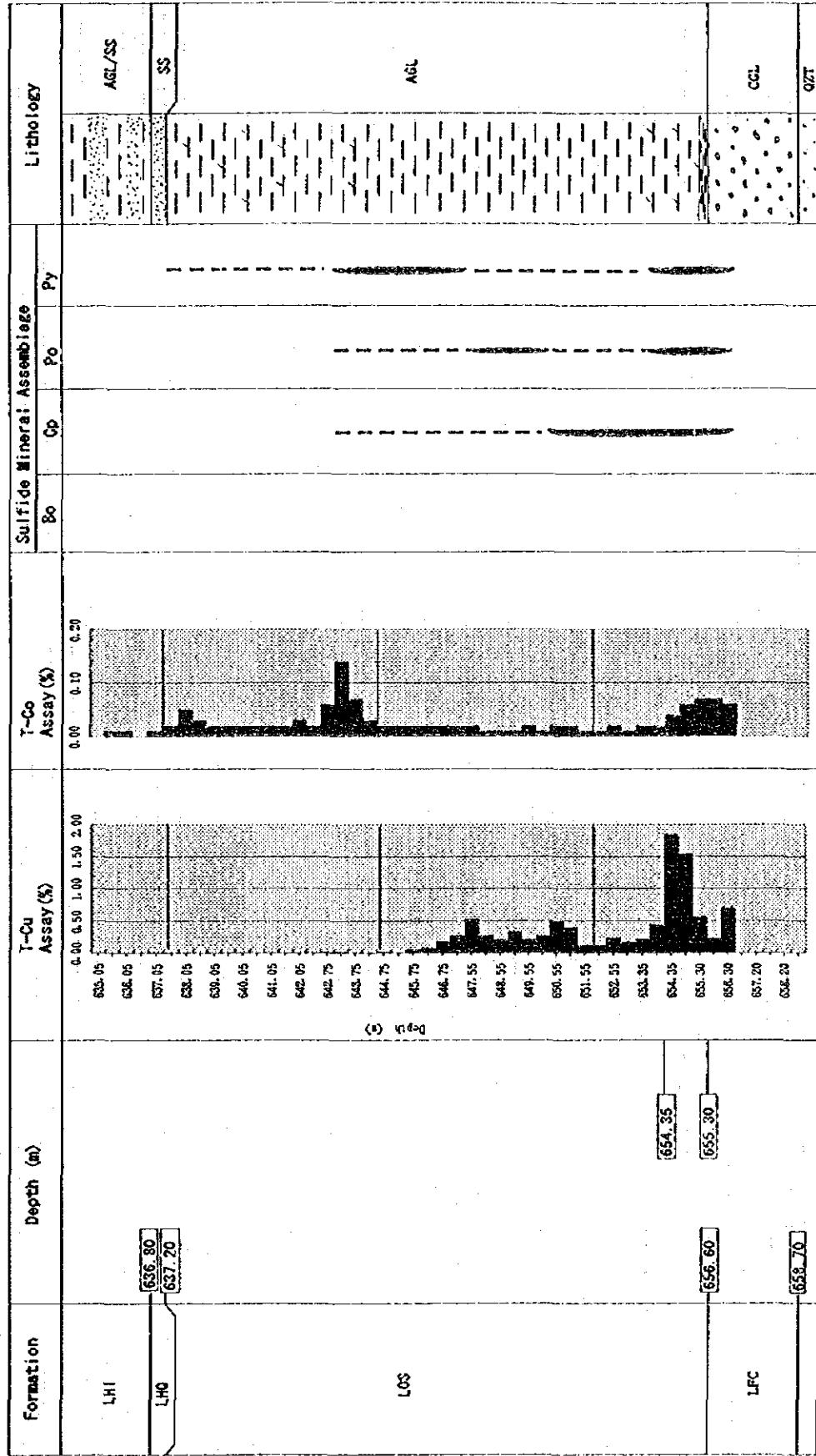


Fig. 2-3-9 Ore Assaying, Assemblage of Ore Minerals and Lithology

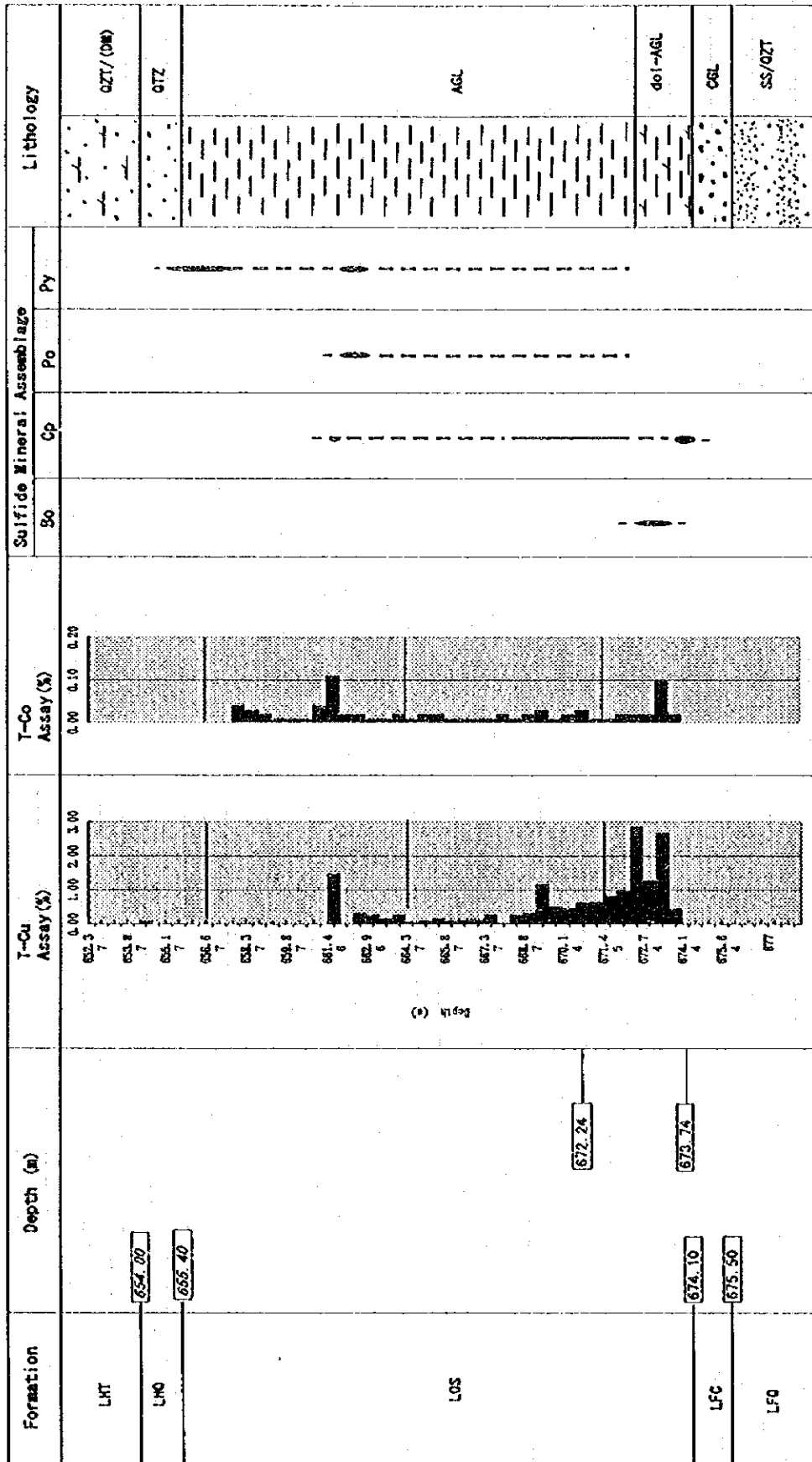


Fig. 2-3-10 Ore Assaying, Assemblage of Ore Minerals and Lithology