Chapter 3 Drilling survey

3-1 Objective

The main objective of this survey is to clarify geology and mineralization, and discover a profitable ore deposits in Marrakech Tekna area in the Kingdom of Morocco, through drilling survey, and also to pursue technology transfer to the Moroccan counterpart personnel.

3-2 Survey area and members

The Marrakech Tekna area is located in the central part of the Kingdom of Morocco (Fig.1). It is approximately 330km south of Rabat (capital city), north of the Anti Atlas Mountains, and also southwest of Marrakech. The survey area extends from 31° 19' to 31° 38' latitude north and from 8° 01' to 8° 24' longitude west.(Fig.II-3-1 Locality map of survey area and Fig.II-3-2 Location of drilling sites)

Quantity of the survey is shown in the following table.

Specification of survey

1. Drilling survey

Number	Inclination	Direction	Length (m)
MJTK-1	-90°	--	592. 70m
MJTK-2	-70°	90°	253. 20m
(Total)			845. 90m

2. Laboratory Tests.

Items	Quantity
(1) Microscopic observation (thin section)	20
(2) Microscopic observation (polished section)	22
(3) Chemical analysis (Ore) Au,Ag,Cu,Pb,Zn,Fe,Ba,S	22
(4) X-ray diffraction analysis	23
(5) ICP analysis (27 elements + Au)	22
(6) Standard sample	1
(7) Resistivity and Chargeability	20
(8) Isotope ($^{34}S/^{32}S$)	10
(9) Isotope ($^{208}Pb/^{204}Pb$, $^{206}Pb/^{204}Pb$ etc.)	5

The terms of period are as follows.

Local stay period: From December 16, 2003 to February 13, 2004

Grilling period: From December 24, 2003 to January 28, 2004

Observation of rock core: From December 29, 2003 to February 12, 2004

3-3 Method and Content of Survey

3-3-1 Outlines

The drilling operation was carried out by Bureau de Recherches et de Participations Minieres (BRPM), and drilling machines, parts and other materials were owned by BRPM.

1/200 columnar figure was arranged about the cores recovered. Colored photographs of all drilling cores were taken. Geological survey around drilling points was executed for the correlation with geology of the hole and integrated evaluation. Chemical analysis, the observation of thin sections and polished sections were executed, and observed a microscope representation. And X-ray diffraction test was executed in order to know the alteration of rocks.

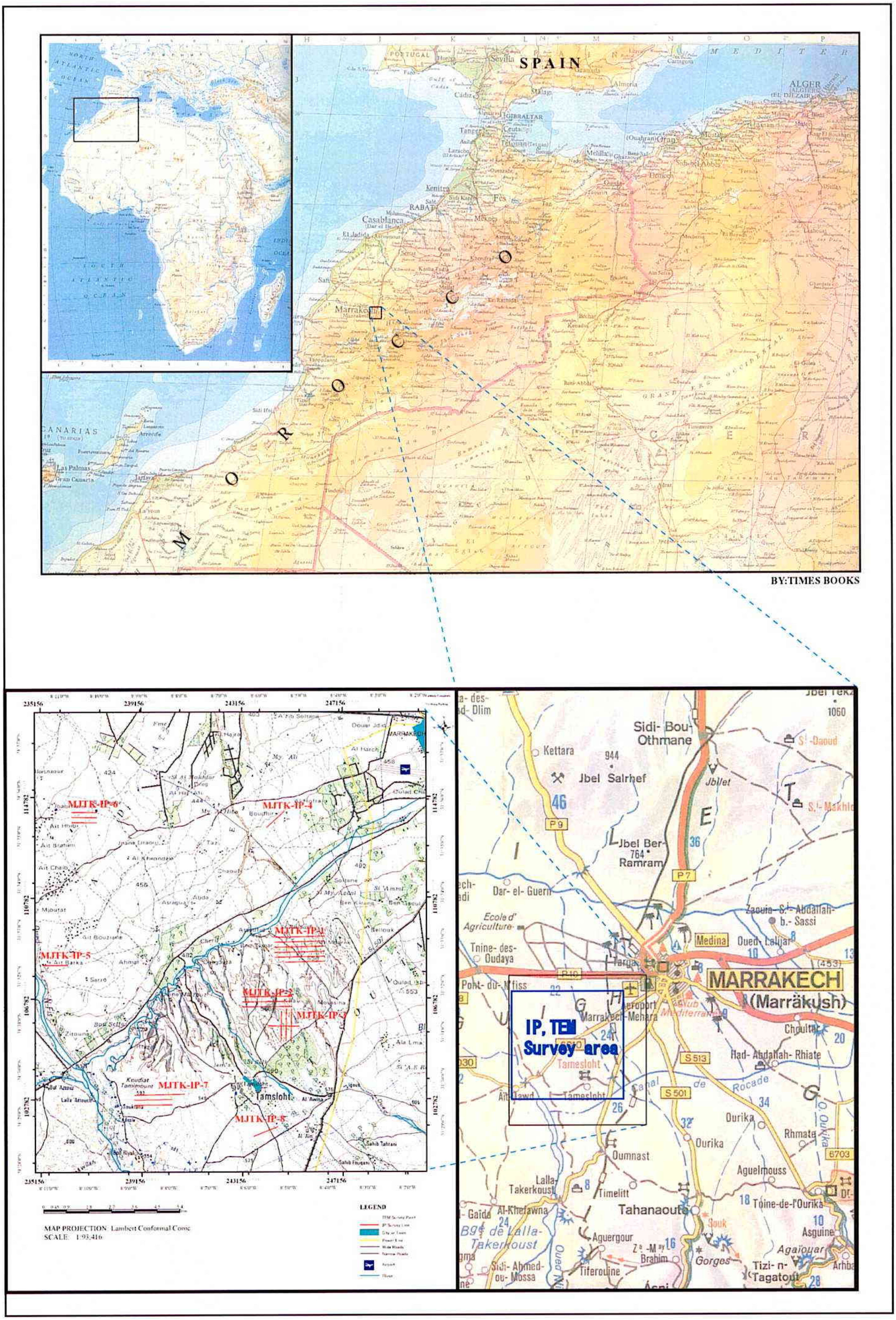

Fig.II-3-1 Locality map of survey are

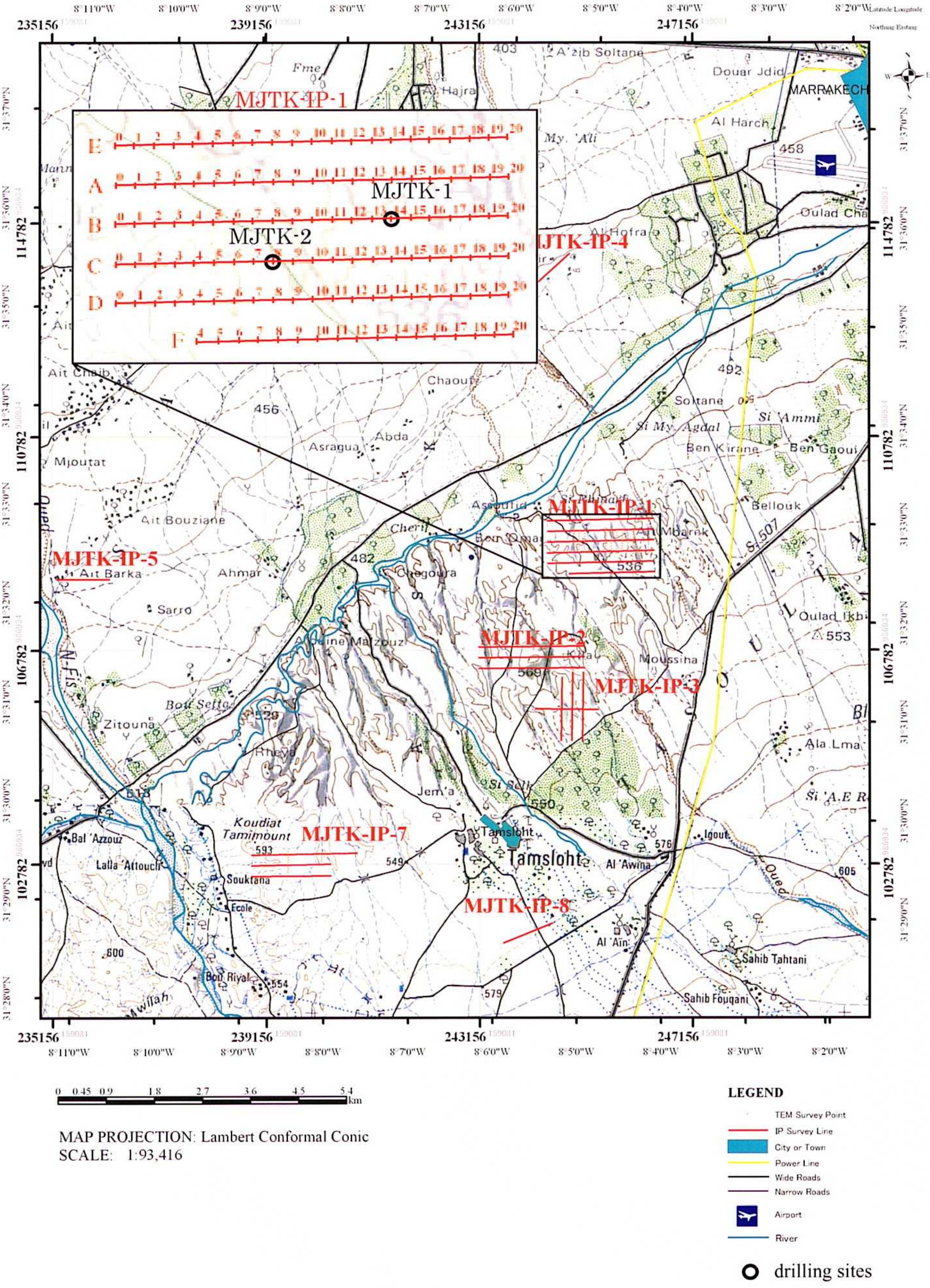

Fig.II-3-2 Location of drilling sites

3-3-2 Method and Equipments

The drillings were executed by wire-line method, and casings were inserted as responding the geologic situation. The holes were drilled protecting the walls by regulating the concentration of mud water.

Principal equipment, materials, supplies, diamond bits and reamers were listed on Table II-3-3. The operated rigs were L44n°7 and L44n°8 were belonged to BRPM.

3-3-3 Survey Team

The drilling work was taken turns at 8-hours shifts, 3-shifts per day. 1 shift is organized of 18 Moroccan BRPM engineers and 8 workers. And Japanese engineer usually directed them about general instruction. The base camp of drilling workers had stayed in Marrakech or near this area. And they commuted to the drilling sites by car.

3-3-4 Mobilization and Preparation

The equipments and materials for drilling survey were carried by truck from Rabat, to the drilling sites. Some machines were taken from the Draa Sfar mine.

3-3-5 Demobilization

After the finish of the survey, equipments and materials owned by BRPM were taken out to Rabat. Whole drilling cores were reserved at the Rabat office of BRPM.

3-3-6 Water for drilling

Drilling water was usually pumped up from an irrigation channel to the sites, through iron tubes.

3-3-7 Drilling process

The record and schedule of drilling works were shown in table II-3-1 and Table II-3-2 and ensured deviations are shown in Table II-3-4.

(1) MJTK-1 (direction: Vertical, length: 592.7m depth.)

The drilling period is from December 25 to January 28. Setting up was carried since December 20th until December 24th. Tricone drilling was started on Dec. 25th.

The bit was stucked at depth 78.0m depth, on 26th, and drilling was restarted several hours later. The rod order was changed after the hole was drill for 154m depth. on 30th. Just after the basement seemed to have approached, the core drilling started. And the geology from 167.0m depth is Cenozoic sediment pelitic schist of the Paleozoic.

Graphite became dominant from almost 250m depth. Drilling rate decreased, as rock core was apt to break along schistosity and blocked up in the core tube. The drilling rate decreased more in the parts with many cracks.

Psamitic schist (a sandstone) was dominant from 384.10m depth, and drilling rate was improved. However, pelitic schist reduced the drilling rate from 554.1m depth, again.

The rod order was changed for NQ drilling after the hole was drilled to 446.44m depth on January 20.

MJTK-1 was drilled deeper than the original planed length 400m depth in order to confirm the situation of the ore horizon and lower rocks (footwall), because it was thought that the upper zone (hanging wall) of the massive sulfide deposit was drilled and mineralization was shown (a small vein including sphalerite).

The drilling was stopped at 592.7m depth, because the dip became steeper (about 45 ° → 65 °) and to make difficult to encounter the footwall, and It was more reasonable to drill another point.

(2) MJTK-2 (direction: S,70° dip, length: 253.2m depth.)

The drilling period is from December 24th to January 6th. Setting up was carried since December 20th until December 23rd. Tricone drilling was started on Dec. 24th.

As it was indicated that the bit arrived at base rock at 83m depth, Rod order was changed on 27th. And core drilling started.

The geology is the Cenozoic sediment from the surface to depth 83.0m depth.

And it was micro-gabbro with magnetism, from 219.2m depth.

The drilling advanced smoothly. And it was stopped at 253.2m depth., because it was made clear that the magnetic anomaly of this place were caused by the gabbro.

Table II-3-1 Drilling schedule

ITEM		DECEMBER	JANUARY	FEBRUARY
Mobilization to the sites		19 -20		
MJTK-1	Rig up	20-24		
	Drilling	25 ———	——— 28	
	Tear down			20-24
MJTK-2	Rig up	20-23		
	Drilling	24 ———	——— 6	
	Tear down			20-24

Table II-3-2 Drilling summary (MJTK-1)

WORKING PERIOD

CLASS	WORKING PERIOD	DAY BREAK DOWN			WORKERS
	PERIOD	TOTAL DAYS	ACTUAL WORKING	DAY OFF	
RIG UP	2003/12/20 - 2003/12/24	5 days	5 days	0 days	64 workers
DRILLING	2003/12/25 - 2004/1/28	35	DRILLING 33	2	536
			REPAIR etc. 0	0	0
TEAR DOWN	2004/2/20 - 2004/2/24	5	5	0	24
TOTAL	H15/10/28 - H15/11/21	45	43	2	624

DRILLING DEPTH etc.

PLOPOSED DEPTH	400.00 m	OVERBURDEN	167.0 m
ADDITIONAL DEPTH	192.70 m	CORE LENGTH	417.84 m
INSPECTED DEPTH	592.70 m	RECOVERY	98.15 %

TIME ANALYSIS

CATEGORY	(hr.)	(%)	(%)
DRILLING	630	75.0	63.0
TRIP, CORE RECOVER, CASING, etc	198	23.6	19.8
REPAIR, FISHING	12	1.4	1.2
SUB TOTAL	840	100.0	-
RIG UP	80		8.0
TEAR DOWN	80		8.0
TOTAL	1000		100.0

CASING

SIZE	SET DEPTH (m)	B/A X 100 (%)	RECOVERY (%)
HW	171.00	28.85	100
NW	446.45	75.32	100

CORE RECOVERY PER EACH 100m

DEPTH (m)	CORE LENGTH (m)	CORE RECOVERY(%) SECTION	CORE RECOVERY(%) CUMULATIVE
0 - 100.00	0.00		
100.00 - 200.00	30.00	33.00	90.91
200.00 - 300.00	100.00	100.00	97.74
300.00 - 400.00	100.00	100.00	98.71
400.00 - 500.00	100	100.00	99.10
500.00 - 592.70	88.84	92.70	98.39

TOTAL DEPTH/TOTAL WORKING DAYS	13.17 m/day
TOTAL DEPTH/ACTUAL WORKING DAYS	13.78 m/day
TOTAL DEPTH/ACTUAL DRILLING DAYS	17.96 m/day
ACTUAL DRILLING WORKERS/TOTAL DEPT	0.90 worker/m

REMARKS

A: TOTAL DEPTH

B: SET DEPTH

WORKING PERIOD

CLASS	WORKING PERIOD PERIOD	DAY BREAK DOWN TOTAL DAYS	ACTUAL WORKING	DAY OFF	WORKERS
RIG UP	2003/12/20 - 2003/12/23	4 days	4 days	0 days	64 workers
DRILLING	2003/12/25 - 2004/1/6	13	DRILLING 12	1	536
			REPAIR etc. 0	0	0
TEAR DOWN	2004/2/20 - 2004/2/24	5	5	0	24
TOTAL	H15/10/28 - H15/11/21	22	21	1	624

DRILLING DEPTH etc.

PLOPOSED DEPTH	400.00 m	OVERBURDEN	83.0 m
ADDITIONAL DEPTH	-146.80 m	CORE LENGTH	170.2 m
INSPECTED DEPTH	253.20 m	RECOVERY	100.00 %

CORE RECOVERY PER EACH 100m

DEPTH (m)	CORE LENGTH (m)	CORE RECOVERY(%) SECTION	CUMULATIVE
0 - 100.00	17.00	17.0	17.0
100.00 - 200.00	100.00	100.0	100.00
200.00 - 253.20	53.20	53.2	100.00

TIME ANALYSIS

CATEGORY	(hr.)	(%)	(%)
DRILLING	252	65.6	47.7
TRIP, CORE RECOVER, CASING, etc	120	31.3	22.7
REPAIR, FISHING	12	3.1	2.3
SUB TOTAL	384	100.0	-
RIG UP	64		12.1
TEAR DOWN	80		15.2
TOTAL	528		100.0

TOTAL DEPTH/TOTAL WORKING DAYS	11.51 m/day
TOTAL DEPTH/ACTUAL WORKING DAYS	12.06 m/day
TOTAL DEPTH/ACTUAL DRILLING DAYS	21.10 m/day
ACTUAL DRILLING WORKERS/TOTAL DEPT	2.12 worker/m

CASING

SIZE	SET DEPTH (m)	B/A X 100 (%)	RECOVERY (%)
HW	83.00	253.20	100
NW	0.00	0.00	100

REMARKS

A: TOTAL DEPTH

B: SET DEPTH

Table II-3-3 List of drilling equipment and consumption goods

Item	Specifications	Quantity		Unit
		MJTK-1	MJTK-2	
Drilling Machine	L44n°7	1		
	L44n°8		1	
Drilling rod HQ	3.04m	150	85	u
Drilling rod NQ	3.04m	200	-	u
Swivel head	25 / 8	1	1	
Core barrel	HQ	1	1	
Core bit	HQ	3	1	
Reaming Shell	HQ	1	1	
Outer tube	HQ	1		
Inner tube	HQ	1		
Core barrel	NQ			
Core bit	NQ	2		
Reaming Shell.	NQ	1		
Inner/tube	NQ	1		
Inner tube head	HQ			
Inner tube head	NQ			
Inner tube head	BQ			
Overshot	HQ	1		
Overshot	NQ	1		
Wireline rope	Diameter: 6mm	700	600	m
Casing pipe (HW)	3.04m	60	30	u
Casing pipe (NW)	3.04m	150		u
Casing pipe (BW)	3.04m	1		u
Core lifter case	HQ			
Core lifter case	NQ	1		kg
Core lifter case	BQ			
Bentonite				
Polymer		114	19	kg
Cement		200	200	kg
Diesel oil		3400	1130	ℓ
Engine oil		12	6	ℓ
Gear oil		23	2	ℓ
Hydraulic oil		40	25	ℓ
Core box	5.6-6.4m	88	39	u

Table II-3-4 Result of measurement of Hole deviation

MJTK-1

	Degree	
depth(m)	inclination	direction
50	90	
100	89.5	
150	89	
200	87	
230	87	
250	87	152
300	87	147
350	85.5	
400	84	
446	84	
500	83	
550	83	
590	82	

MJTK-2

	degree	
depth(m)	inclination	direction
50	70	180
120	70.5	186
150	72	185
200	72	186
250	72	185

3-4 Result of Drilling

3-4-1 Geology, Mineralization and Alteration

The result of this survey (MJTK-1 and MJTK-2) is as follows, with Fig.II-3-3 Geological Section, and Geological columnar figures (appendix).

(1) MJTK-1 (direction: Vertical, length: 592.7m)

The geology consists of Cenozoic gravels or conglomerate from the surface to 167.0m depth. The matrix of the conglomerate is calcareous, and the gravels consists of many kinds of a rocks (mudstone, andesite, granodiorite and so on).

The part of Cenozoic sediment was drilled by tricone, therefore the diameters of the gravels are unclear, but they are 5-20cm diameters near the surface.

The geology of the deeper part from 167.0m depth is pelitic schist or phyllite is not hornfels. These are not influenced by gabbro in MJTK-2.

Pyrite – Sphalerite - carbonate veinlets along schistsity (45°), width:3mm, are at 175.10m depth.. Galena – Sphalerite – Pyrite - carbonate irregular veinlet, width:<4mm, is at 175.40m depth.. A pyrite veinlet is along schistsity (35°) with carbonate veinlets, at 176.20m depth.

In deeper part from there, the black or dark gray pelitic schist has 40-45° schistsity, pyrite dissemination and carbonate veinlet.

Pyrite veins (width:2cm ∠45°) are 191.44m depth and 193.90m depth. They are not magnetic.

A fracture (40° .width:6cm) is filled with pyrite and clay at 195.4m depth. It is with fracture zone disseminated by pyrite. Pelitic schist contains dominant graphite.

Psamitic schist is bedded (45°) at 197.0m depth.-198.2m depth.

Pelitic schist is bedded(45°)at deeper part than 198.2m depth. Graphite is dominant there. Pyrite is disseminated along schistsity. Carbonate networks are in the schist around 199.94m depth.

Pelitic schist has psamitic and silty laminations, 45° -50°, at 211m depth. It is with pyrite dissemination and dominant graphite.

Pyrite disseminated lens is at 213.50m depth, and its width is <20mm.

Sandy-silty lamina, ∠45-50°, was observed at 217.1m depth.-221.4m depth, partly, with graphite

The schist is fragile and dominant in graphite at 221.5- width.

Porous quartz vein, width>20mm, 70° is at 254.60m depth, in the black pelitic schist. The schist is partly with Quartz and pinkish dolomite (containing Mn?) which form network. And pyrite is disseminated along schistsity there.

At 259.90m depth, the schist is very fragile with dominant graphite. The dip of the schistsity decreased from 40° to 30 °.

It seems that there is a fault at 269.40-270.00m depth, with 40° dip and a brecciated zone. The schist is fractured in the upper zone of the fault. A quartz vein is at 270.24m depth, with 25 ° dip and 70mm width.

Psamitic schist is more than 270.30m depth. - 274.4m depth, with 25° dip, and it is ∠20 - 30° laminated. Also it is with quartz network.

Pelitic schist is 274.4m - 285.0m depth.. It has sometimes silty – pelitic layers with graphite. It is partly with ∠40° lamina and pyrite dissemination. It is hard and fragile, with graphite, and also it is sheared, pyrite-disseminated, and containing dominant carbonate.

Psamitic schist (sand stone) is more at 285.0m-301.2m depth, with ∠45 - 60° dip schistsity. It is fragile with graphite.

Pelitic schist is at 301.20m depth.-384.10m depth., with dominant Graphite. A quartz vein is at 302.14m depth, with ∠40° dip, 3cm , chlorite alteration and quartz networks.

The psamitic schist with chlorite and pyrite (very fine) is silicified at more than 302.24m depth.. It Partly has pelitic schist thin layers with ∠45° dip.

Pelitic schist-psamitic schist alternation is at 305.1m depth.-344.1m depth.. It has the lamination with graphite, ∠45° dip and calcareous fossils. And it is silicified with disseminated fine pyrite and marcasite. It is partly silty, and partly with quartz-carbonate veinlets.

A pyrite-disseminated layer is at 344.1m depth-344.7m depth. with 1cm-2cm thick and ∠ 45° dip. A quartz-sphalerite-pyrite veinlet is at 356.60m depth. Sphalerite, chalcopyrite and pyrite are disseminated at 358.84m depth.. A sheared zone with carbonate network is at 375.90m depth-377.20m depth..

Silicified Psamitic schist (Sand stone) is at 384.10-554.10m depths. It is with carbonate-quartz network including sphalerite. It includes Graphite. And it is fractured with pyrite dissemination.

Quartz-carbonate-sphalerite-pyrite network at 384.84m -385.10m depth.. Sphalerite and pyrite are disseminated at 386.70m -386.84m depth. The rock is silicified with sphalerite-pyrite network at 387.00m-389.84m depths. sphalerite-quartz veinlets with ∠45° are at 390.40m, 390.44m and 392.00m depth. Sphalerite-quartz 6 veinlets (with galena?) are at 392.00m-393.00m depth. A sphalerite-quartz network is at 404.10m- 404.70m depths. a medium-coarse sandstone layer, with ∠70° (?) dip, is at 408.54m depth.-408.74m depth.. Lamination with ∠75° dip is at 410.90m depth.-412.00m depth. A quartz (-Galena-Pyrite) vein intrudes into a Chlorite vein at 412.90m depth.. The rock is sheared at 413.80m -415.10m depth.

A sphalerite-quartz veinlet with ∠70° dip, which is like a reverse fault, at 415.1m depth.. Sphalerite-quartz veinlets are in the part deeper than 426.40m depth.. The laminations with ∠ 60-65° dip and graphite at 427m depth. , 431.9m depth., 440.0m depth.-440.3m and 446.44m depth.. Graphite decreases and the rock is more silicified beneath there.

Hematite (?)-Barite veinlet with ∠20° dip is at 455.00m depth. Quartz-chlorite-Sphalerite veinlet with ∠65° dip is at 463.40m depth. Quartz network with sphalerite is in the chloritezated zone at 465.70m depth.. Quartz-Barite veinlet, which has less than 3cm width, is at 475.7m depth. Quartz network, with sphalerite and pyrite is at 477.2m depth.. Quartz-network, with sphalerite and pyrite, is 479.0m - 480.1m depth. The rock is chloritezated strongly, and partly with Pyrite – Sphalerite - Quartz veinlets (-481.7m depth.). Sphalerite - Quartz network is at 482.0m depth.. Quartz-Chlorite network with sphalerite is at 485.2m - 485.4m depth. Quartz (-sphalerite) network is with chlorite and at 489.6m depth. Fractured and hydrothermal zone is at 492.3m depth.-493.2m depth.. The rock core is porous, siliceous, and with quartz crystals there.

Quartz (-carbonate) network is at 501.7m-502.8m depth.. Coarse Sand stone layer is in Fine sandstone with ∠55° at 503.0m depth.-503.44m depth. lamina (graphite) has ∠65° dip at 515.20m depth. The fine sand stone is partly alkose and partly medium or coarse. Calcareous sandstone layer has ∠55° dip at 520.3m depth. It includes small sulfide grains and it's weakly magnetic.

Weakly magnetic coarse gentle sand dyke is at 520.9m depth.

Barite-Quartz network has less than 9mm width at 522.4m depth. Sphalerite-pyrite-quartz veinlet with ∠75° dip is at 525.0m depth. Barite (-Carbonate) veinlets, with Galena and ∠60° dip, is at 529.3m depth.-529.4m depth. The sandstone is sheared at 533.8m - 534.0m depth. Carbonate (Chlorite) network is at 535.9m depth. Sphalerite-pyrite-quartz (-carbonate) veinlets with ∠30° dip are around 536.1m depth. Graphite thin layer with ∠65° dip is at 536,84m depth. Sphalerite-Barite-Quartz veinlet with ∠ 50 ° dip at 537.34m depth. Sphalerite (-Galena)-Barite-Quartz veinlet is, with ∠ 65 ° dip and 3mm width at 537.64m depth. Sphalerite-Quartz-Barite veinlet is, with ∠ 50 ° dip, 537.8m depth. (Pyrite-Sphalerite-Galena-Barite-) Quartz veinlets are at 538.04m - 538.1m depth.,538.23m depth.,538.39m depth. The sandstone is strongly silicified and fractured at 539.10m - 541.6m depth.

Sphalerite Barite-Quartz veinlets-network is 540.4m depth. Sheared and argillizated zone is around 540.7m depth. Barite-Quartz (-Galena) network is at 541.1m - 541.2m depth. Several Quartz-Barite (-Galena) networks are more than 541.8m depth. Barite vein, with 3cm with and ∠ 60° dip and with sphalerite in edges, is at 546.1m depth.-546.3m depth. Graphite schist layers, with ∠60° dip is at 548.1m - 548.3-6m depth. Barite network is at 550.1m - 550.9m depth. Graphite is dominant at 551.8m - 552.1m depth.. The sandstone is sheared at 552.1m - 552.54m depth. Barite vein, with ∠60° dip sphalerite in edges at 552.8m depth. It is with barite-chlorite (-sphalerite) network in the lower zone.

Pelitic schist rich in graphite is at, more than 554.1m depth.., Barite(-carbonate-quartz) network with sphalerite is at 558.4m depth. Pyrrhotite is disseminated at 561.1m depth.

Barite-Carbonate network is at 561.3m - 561.4m depth. Barite-carbonate vein with 2cm width is at 566.0m depth. It is with barite-quartz network. Sphalerite is in the lower zone.

Pyrrhotite and pyrite dissemination-lens (4cm) is 566.2m depth.. it has ∠50° dip concordant with bedding(?). Barite veinlet, with chalcopyrite, is at 568.6m depth. (Sphalerite-galena-barite?) quartz veinlet is at 568.74m depth, in pelitic schist. It is massive and with graphite. Barite vein, with 8m depth width and ∠60° dip is at 584.34m depth. Pyrrhotite concentrations, like lenses (13m depth×50m depth) with 45° dip, are 587.04m depth and 587.10m depth. Barite network is at 587.30m depth. Pyrite lens, intruded by barite-sphalerite veinlet, is 589.20m depth.

Barite network is at 589.24m depth. Sphalerite-galena-barite-quartz network is at 589.6m-589.8m depth. Pyrrhotite lens (40mm×7mm) intruded by sphalerite-quartz veinlet. The dip of lamination is ∠40° - ∠65° .

(2) MJTK-2 (direction: S,70° dip, length: 253.2m)

The geology consists of Cenozoic gravels and sand or conglomerate from the surface to 83.0m depth. The matrix of the conglomerate is calcareous and the gravels consists various kinds of a rock (mudstone, schist, andesite, granodiorite and so on).

The geology of the deeper part than 83.0m depth is gabbro. It is black – dark gray, massive and partly magnetic, with carbonate veinlets-network, partly with chlorite.

A fracture filled with pyrite has ∠30 ° dip at 86.6m depth, with carbonate veinlets. Carbonate veinlets – networks are around 96.20m depth. Gabbro is dark gray, massive, magnetic with Plagioclase (2mm) pyroxene (partly chloritezated). It is massive, homogeneous and magnetic. And it is with carbonate veinlets - networks.

A fractured zone, with carbonate network, is at 104.60 – 104.84m depth. A carbonate veinlet is at 116.84m depth, with ∠15° dip. The rock core has fractures filled with carbonate at 121.65-122.10m depth. A carbonate veinlet is at 124.00-124.80m depth, with ∠70° dip. A carbonate - chlorite vein, with ∠65° dip and 3mm width, is at 125.20m depth. Carbonate – chlorite - limonite veinlet, with 7mm width and ∠75° dip, is at 133.44m depth. Carbonate veinlets and carbonate-chlorite networks are dominant around there. The rock is partly sheared at 137.5-137.9m depth. Carbonate-chlorite network is at 141.20m depth.

Carbonate-chlorite veinlets, with 3mm width, are at 145.00m and 145.08m depth. Carbonate - chlorite vein is with ∠30° dip and 3mm width at 150.90m depth. A carbonate vein is, ∠35° dip and 4mm width, at 162.80m depth. Carbonate veins is, with 1mm width, at 169.30m and 170.95m depth. Carbonate-chlorite veinlets are at 183.7m depth and 183.8m depth. Carbonate veinlet is, with ∠70° dip and 6mm width, at 186.1m depth. Carbonate-chlorite vein is at 191.80m depth, ∠70° dip and 1mm width. Chlorite network is at 196.2m depth. The gabbro is fractured at 201.0m -

202.3m depth. Carbonate - limonite network is at 203.34m depth. Chlorite-carbonate veinlets are around 206.60m depth. Carbonate veinlets are at 215.24m depth, 217.90m depth and 221.94m depth.

Micro-gabbro is at deeper part than 219.2m depth. The phenocrystal sizes of this rock are finer. It is silicified and not magnetic. The rock is fractured at 220.84m depth - 221.04m depth. Carbonate veinlet is at 222.90m depth.

It is brecciated and partly has flow structure at 227.70m and 232.00m depth.

Pyrrhotite - Chalcopyrite film is at 229.40m depth.

It is silicified and has flow structure at 230.60m - 240.00m depth, with ∠30° -50°.

The rock is fractured, with carbonate network and partly with flow structure at 233.50m depth-235.00m depth. It is brecciated at 236.30m depth-239.00m depth. And it is also Brecciated (ö=21cm) or fractured at 242.10m depth and 248.49m - 250.10m depth. Carbonate vein, with ∠40° dip and 2mm width, is at 251.70m depth.

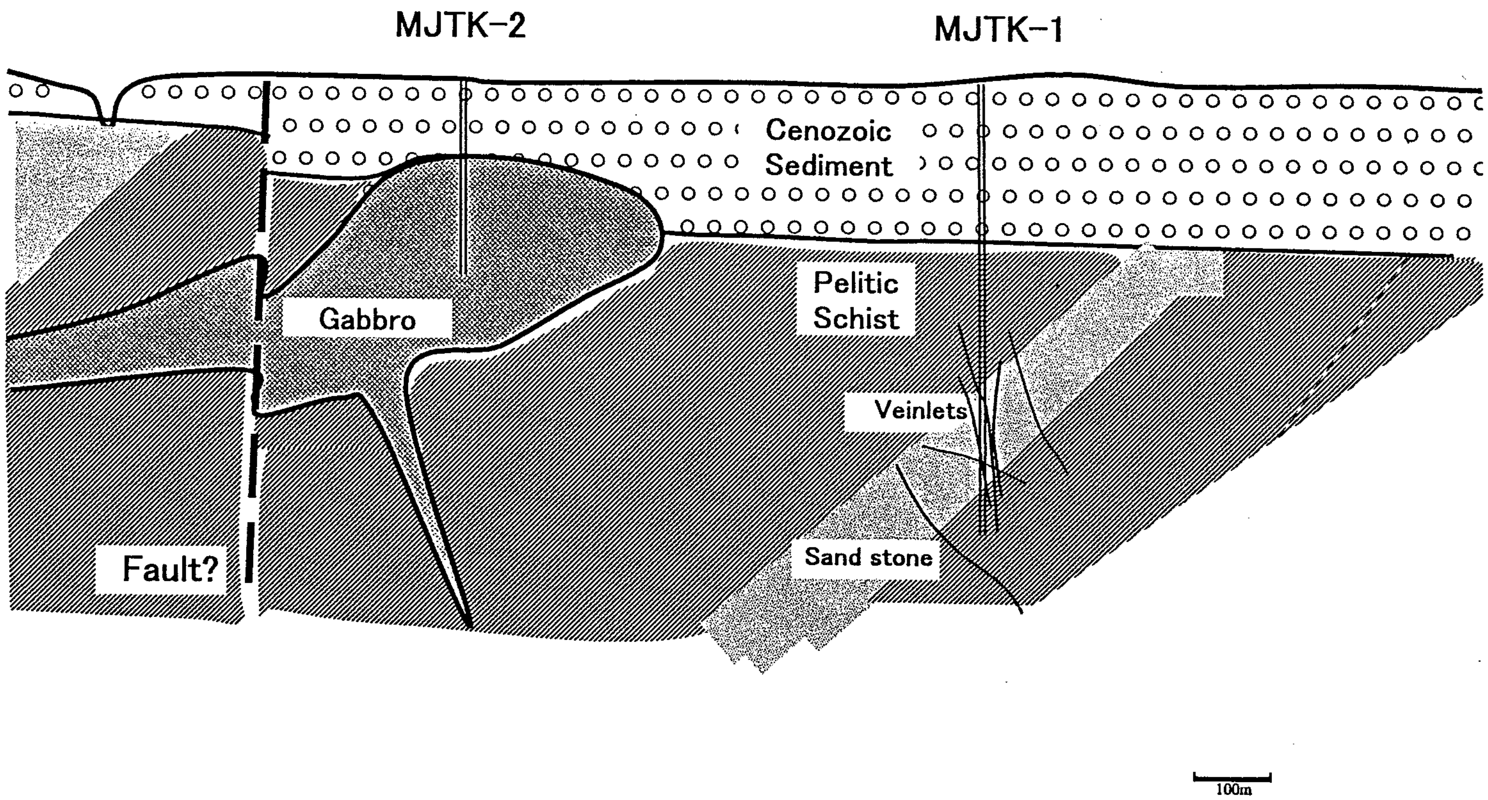

Fig.II-3-3 Geological section

3-4-2 Analyses and Tests

Laboratory tests were carried out in the consideration as follows.

1. The samples of chemical analysis (Ore), Microscopic observation (polished chip) and isotope were chosen mainly from rocks including sulfide in MJTK-1. And some pyrite - disseminated rocks in MJTK-2 were chosen for reference.
2. The samples of ICP analysis (27 elements + Au) were chosen at same intervals in general. However more samples were chosen at the part where the change of the lithofacies and the alteration at need.
3. The samples of Microscopic observation (thin section) were chosen from laminated part and so on in MJTK-1. Because it was predicted that only quartz grains would be observed in a pure pelitic rock.
4. The samples of X-ray diffraction analysis were chosen at both of typical parts and altered parts.
5. The samples of Resistivity and Chargeability were chosen to check graphite.
6. The samples were perpendicularly cut to leave half parts to BRPM.

(1) Chemical analysis (Ore)

The result of Chemical analysis (Ore) is shown in Table II-3-5. High values of Zn and Fe are shown, because the most of the samples, in MJTK-1, include veinlets and network of sphalerite and pyrite.

Some samples contain Pb more than 0.1%, as Galena is observed with the naked eye. However the contents of Au and Ag are low. Only a few samples, that conspicuously include barite, have high values of Ba.

The sample of 566.35m depth in this hole is a lens-shaped pyrrhotite concentration. It contains Fe more than 10%, and Cu and Pb are higher than Zn.

The sample of 229.4m depth in MJTK-2 is a film-like pyrrhotite disseminated part in micro-gabbro. Chalcopyrite is slightly observed with the naked eye, and the Cu content is low.

Table II-3-5 Result of Chemical analysis of ore samples

No.	試 料 名		Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Fe (ppm)	Ba (ppm)	S (ppm)
1	MJTK-1	175.60 m	3	0.50	33	29	694	36100	395	2310
2	MJTK-1	385.20 m	1	0.65	37	52	7630	23200	380	5780
3	MJTK-1	386.45 m	1	0.75	131	363	1060	23900	304	7270
4	MJTK-1	386.80 m	1	1.45	75	2180	7810	44400	12	9060
5	MJTK-1	387.75 m	1	< 0.01	3	4	620	34100	85	1140
6	MJTK-1	387.95 m	2	0.01	10	38	320	12900	172	1750
7	MJTK-1	392.20 m	1	0.04	18	125	6670	20500	83	3270
8	MJTK-1	392.85 m	4	0.01	18	4	6520	8910	77	3100
9	MJTK-1	395.90 m	< 1	0.04	14	282	7430	11400	204	5580
10	MJTK-1	397.10 m	1	0.03	17	4	6080	18500	214	3590
11	MJTK-1	397.35 m	< 1	1.25	50	1280	43300	26800	322	23200
12	MJTK-1	413.15 m	< 1	< 0.01	11	23	128	19200	161	295
13	MJTK-1	415.80 m	< 1	1.65	53	655	21200	21900	184	10300
14	MJTK-1	426.65 m	4	1.95	37	1470	5090	30400	29	4010
15	MJTK-1	444.10 m	< 1	0.30	8	5	679	15400	212	520
16	MJTK-1	465.80 m	3	0.10	10	171	33	14300	69	973
17	MJTK-1	492.90 m	1	0.20	4	14	58	15400	207	2060
18	MJTK-1	537.45 m	< 1	0.85	9	88	2260	14400	2802	1550
19	MJTK-1	540.20 m	< 1	1.55	14	162	3900	5940	586	2380
20	MJTK-1	546.60 m	3	6.30	68	4420	18100	32600	32	13800
21	MJTK-1	566.35 m	1	1.10	83	278	19	>100000	280	27500
22	MJTK-2	229.40 m	7	0.20	44	69	157	49500	513	2330

(2) ICP analysis (27 elements + Au)

The result of the ICP analysis (27 elements + Au) is shown in Table II-3-6.

Standard statistics are as follows. They were calculated after the half of the detection limits were substituted for the contents less than the detection limits.

Element	Case	Average	Min	Max	Standard Div.
Au	22	0.001568182	0.0005	0.004	0.001126472
Ag	22	0.265909091	0.25	0.6	0.074620251
Al	22	8.529545455	2.69	11.75	3.12126726
As	22	12.63636364	2.5	28	7.483604012
Ba	22	377.2727273	30	1160	285.3599534
Be	22	1.765909091	0.25	3.8	1.2759111
Bi	22	1.045454545	1	2	0.213200716
Ca	22	2.530454545	0.14	8	3.052330066
Cd	22	0.4	0.25	3.1	0.610620294
Co	22	19	6	41	11.82813434
Cr	22	101.8181818	42	238	68.33157003
Cu	22	36.13636364	8	78	22.98093507
Fe	22	3.871363636	1.55	5.92	1.374985006
K	22	1.834545455	0.11	4.14	1.448249279
Mg	22	1.976818182	0.36	5.85	2.04844049
Mn	22	771.2727273	334	1360	308.12508
Mo	22	4.045454545	0.5	11	2.764180284
Na	22	0.956363636	0.33	1.82	0.472022452
Ni	22	66.81818182	12	192	55.28595479
P	22	415	190	860	189.8307517
Pb	22	30.36363636	3	121	30.27578862
S	22	0.121136364	0.005	0.62	0.133165953
Sb	22	2.727272727	2.5	5	0.735612358
Sr	22	120.5909091	62	230	50.63751582
Ti	22	0.340909091	0.08	0.53	0.125048908
V	22	140.8181818	35	214	58.18659342
W	22	5.681818182	5	10	1.756250433
Zn	22	190.9545455	49	1285	269.1705916

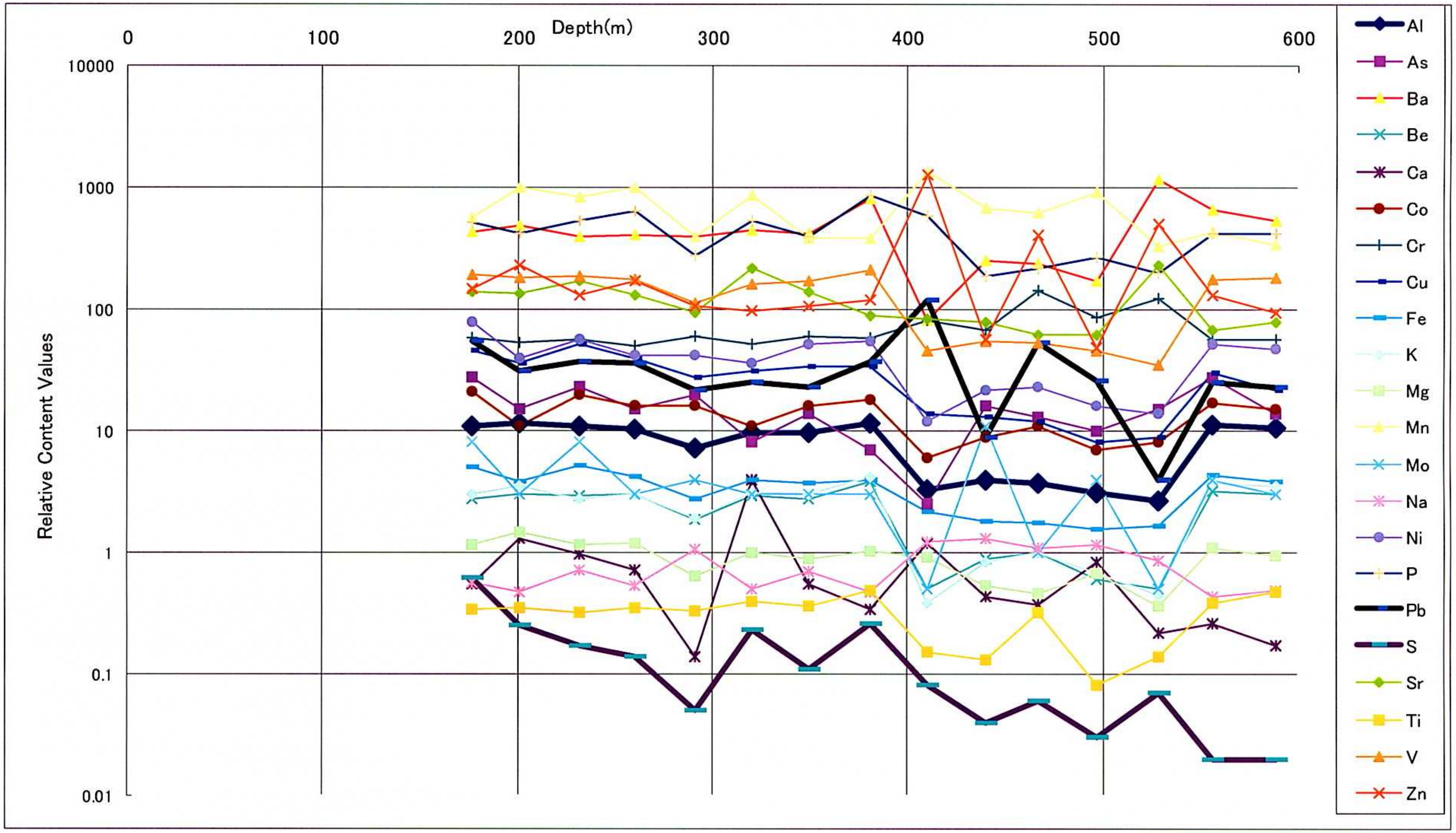

Fig.II-3-4 Depth(m) and relative content values(MJTK-1)

The following characteristics are recognized about main elements in MJTK-1.

1. The content of S tends to generally decrease into the deeper part.
2. The contents of Al, K, Fe, Ni, Mo, Ba, Cu, Mg, Ti, V, Co, P and Sr are low in the sandy rock, and high in the pelitic rock.
3. Na content tends to be higher in the sandy rock.
4. Zn content is generally high in the sandy rock, as the kind of rock is often with the mineralization.
5. Mn content is also generally high in the sandy rock. Dolomite in veinlets is a little pinkish. Mn might be concentrated with the mineralization.
6. Pb content tends to decrease in the deeper part. And it is high in mineralization zone of the sandy stone.
7. Ca content has a large dispersion.
8. Cr tends to a little increase in the deeper part.

These situations make the positive correlation among Al, K and Fe and the negative correlation between these elements and other elements (ex. Na and Zn), and that is caused by the above situation.

It is not clear if S − content changed owing to the more leaching of S by hydrothermal activity in the deeper part, or owing to the change of the biochemical situation.

The change of Na content is as that the most grains of plagioclase in the sandy rock were altered to albite.

K in pelitic rocks in MJTK-1 has generally greater quantity than the hanging wall rocks and the foot wall rocks of massive sulfide deposits around this area, and Na has similar quantity as them. That indicates the slightly stronger alteration and metamorphism pelitic rocks in MJTK-1. The various Ca quantities may indicate the transformation of the biochemical and sedimental situation.

(3) Microscopic observation (thin section)

The result of microscopic observation (thin section) is shown in Table II-3-7.

The kinds of the most rock-forming minerals are constant in the sedimentary rocks in MJTK-1. The sericite - alteration is more remarkable in the deeper part.

The phenocrysts of plagioclase and augite in MJTK-2 are slightly altered. Few parts of augite are altered to chlorite. However the grain size becomes finer in micro-gabbro in the deeper part of this hole. Furthermore, secondary quartz appears, with alteration minerals except chlorite such as clay minerals (sericite etc.) and carbonates.

Table II-3-7 Result of microscopic observation of thin section

No.	Hole	Depth (m)	Rock bame	Sedimentary Rock											Igneous & Metamorphic Rock																		alteration								Remarks
				Gravel, fragment			Matrix							Texture	Phenocryst								Matrix																		
				Type	Size(mm)	Rock name	Qz	Pl	Bi	Au	Gr	Gs	Fe		Qz	Pl	Kf	Ho	Au	Hy	Fe	Ol	Si	Pl	Au	Hy	Ol	Fe	Ho	Kf	Gs	Zr	Qz	Sm	Ch	Se	Ca	St	Fe	Ze	
1	MJTK-1	176.45	Pelitic schist	-			◎	◎			○	△	・	Foliated																			△		△	○	△		・		
2	MJTK-1	201.00	Pelitic schist				◎	◎			○	△	・	Foliated																			△		△	○	○		・		
3	MJTK-1	231.95	Pelitic schist				◎	◎			○	△	・	Foliated																			△		△	○	◎		・		
4	MJTK-1	259.95	Pelitic schist				◎	○			◎	・	・	Foliated																			△		△	○	○		・		
5	MJTK-1	290.80	Psammitic - schist				◎	◎			△	△	・	Foliated																			△		△	○	○		・		
6	MJTK-1	320.50	Pelitic - Calcareous schist				◎	○			○	△	・	Foliated																			△		△	○	◎	○	・		Micro fossil
7	MJTK-1	349.60	Pelitic schist				◎	○			◎	△	・	Foliated																			△		△	◎	◎		・		Ca veinlet
8	MJTK-1	381.00	Pelitic schist				◎	○			○	△	・	Foliated																			△		△	◎	◎		・		
9	MJTK-1	410.55	Psammitic - schist				◎	◎			△	△	・	Foliated																			△		△	○	○		・		Ca veinlets
10	MJTK-1	439.90	Psammitic - schist				◎	◎			△	△	・	Foliated																			△		△	◎	◎		・		
11	MJTK-1	467.10	Psammitic - schist				◎	△			△	△	・	Foliated																			△		△	◎	◎		・		
12	MJTK-1	497.00	Psammitic - schist				◎	○			○	△	・	Foliated																			△		△	◎	○		・		
13	MJTK-1	528.50	Psammitic - schist				◎	◎			△	△	・	Foliated																			△		△	◎	◎		・		
14	MJTK-1	555.90	Pelitic schist				◎	◎			◎	△	・	Foliated																			△		△	◎	◎		・		
15	MJTK-1	588.30	Pelitic schist				◎	◎			◎	△	・	Foliated																			△		△	◎	◎		・		
16	MJTK-2	87.40	Gabbro											holocrystal		◎			◎	○	△													・		・	△				
17	MJTK-2	121.10	Gabbro											holocrystal		◎			◎	○	△														○		△				
18	MJTK-2	152.30	Gabbro											holocrystal		◎			◎	○	△														・	・	・		・		
19	MJTK-2	181.55	Gabbro											holocrystal		◎			◎	◎	△														○						
20	MJTK-2	212.80	Gabbro											holocrystal		◎			◎	○	△													?	・	?	・				
21	MJTK-2	230.95	Micro-gabbro													○			○	△	△												◎		△	△	○		△		Silicified
22	MJTK-2	253.20	Micro-gabbro													○			○	○	△												○		◎	◎	○		△		

Alteration : Qz : Quartz Pl : Plagioclase Kf : K-ferdspar Ho : Hornblende Au : Augite Hy : Hyperthene Fe : Fe-mineral Ol : Olivine Gs : Glas Zr : Zircon Ch : Chlorite Se : Sericite
Sm : Smectite Ep : Epidote Cc : Calcite St : Smithsonite Si : Silicate Ze:Zeolite

◎:Abundant ○:Medium △:Minor ・:Rare

(4) Microscopic observation (polished section)

The result of the microscopic observation (polished section) is shown in Table III-3-8.

Table III-3-8 Result of microscopic observation of polish section

NO.	DRILLING	Depth (m)	MINERALS: Chalcopyrite	Pyrite	Galena	Sphalerite	Hematite	Pyrrhotite		Carbonate	Barite	Quartz	Remarks
1	MJTK-1	175.60		△		△				○		?	Veinlet
2	MJTK-1	385.20		△		·				?		○	network
3	MJTK-1	386.45		△		·				?		○	Veinlet, Sphalerite intrudes into pyrite
4	MJTK-1	386.80		○		△				?		◎	Network. Idiomorphic pyrite
5	MJTK-1	387.75		△		△				○		△	sulfide Veinlet
6	MJTK-1	387.95		△		◎				?		◎	Veinlet. Idiomorphic pyrite
7	MJTK-1	392.20				△				?		○	Veinlet
8	MJTK-1	392.85		△	·	△				?		○	Py->Gn->Sp
9	MJTK-1	395.90		△		○				○			Veinlet, Py->Sp
10	MJTK-1	397.10		·		○				?			network
11	MJTK-1	397.35		·		△				?	△	△	Veinlet
12	MJTK-1	413.15	·	△	·	△				?	·		Veinlet, Sp and Cp are very few.
13	MJTK-1	415.80		·	·	○				?		○	Veinlet
14	MJTK-1	426.65		△	△	○				?		◎	Veinlet. Idiomorphic sulfide. Py exdoluted in Sp
15	MJTK-1	444.10		·		·				?			Veinlet
16	MJTK-1	465.80	·	·						◎	·	○	
17	MJTK-1	537.45		·	·	◎				?		△	Veinlet
18	MJTK-1	540.20		△	·	◎				?		◎	Veinlet
19	MJTK-1	546.60		△		△				?		○	Veinlet, dissemination
20	MJTK-1	566.35	·		·	·		◎				?	Foliated pyrrhotite. Sp exdoluted in Gn
21	MJTK-2	220.95	·	·	·	·	△					○	silicified, disseminated zone
22	MJTK-2	229.40		·				○				○	dissemination

Legend
◎:Abundant ○:Medium △:Minor · :Rare

Most samples from MJTK-1 include veinlets and networks with sphalerite. Pyrite is idiomorphic to sphalerite in general. The crystallization order is regarded as pyrite → sphalerite → gangue mineral (carbonate etc.). The sample of 566.35m depth in this hole is lens-like pyrrhotite concentration in the pelitic schist, and it is foliated in the microscopic examination. The concentration includes some crystal groups of galena and chalcopyrite.

2 samples from MJTK-2 are disseminated parts in gabbro and micro-gabbro. They include pyrite, pyrrhotite, and partly chalcopyrite.

(5) X-ray diffraction analysis

The result is shown in Table II-3-9.

The rock was altered to sericite and chlorite in general, also was partly silicified in MJTK-1.

Most plagioclase is altered to albite. And disappearance of albite is hardly recognized; therefore the alteration is not so strong as the alteration beside general vein deposits. The alteration of the rock in this area is overlapped with the regional diagenesis and hydrothermal alteration. It is characteristic that the rocks in MJTK-1 include not only calcite but also dolomite.

The rocks in MJTK-2 include chlorite in general. However the alteration is not strong in the coarse gabbro, the main part of the rock body, and pyroxenes are detected. Deeper micro-gabbro was altered stronger and the alteration consists of silicification, sericitic alteration, and chloritization.

Table II-3-9 Result of mineral determination of X-ray diffraction test

Minerals / Samples				Silicate Minerals: Clay Minerals								Silicate Minerals						Sulfide Minerals				Carbonate Minerals			Ore Minerals					Primary Minerals							Remarks
No.	DRILLING No.	DEPTH(m)	type of Rock	Saponite	Smectite	Chlorite/Mont.	Sericite/Mont.	Chlorite	Sericite	Kaolin	Talc	Serpentine	Tourmaline	K-Ferdspar	Analcime	Ferrierite	Albite	Barite	Anhydrite	Alunite	Jarosite	Calcite	Dolomite	Magnesite	Pyrite	Sphalerite	Rutile	Goethite	Quartz	Orthoclase	Plagioclase	Biotite	Amphibole	Orthopyroxene	Clinopyroxene	Olivine	
1	MJTK-1	174.35	Pelitic schist					20	14																				40								
2	MJTK-1	224.45	Pelitic schist					23	13																				42								
3	MJTK-1	273.35	Psamitic schist					9	3													2	6			8			47		14						
4	MJTK-1	328.35	Pelitic schist					19	10													11							35								
5	MJTK-1	375.90	Pelitic schist					13	5								5					9	9		1				40								
6	MJTK-1	384.25	Psamitic schist					5	3								7						11						55								
7	MJTK-1	386.50	Psamitic schist					13	3								14												45								
8	MJTK-1	394.25	Psamitic schist					4	2								10					1	28		1	8			40								
9	MJTK-1	404.45	Psamitic schist					4	2								8						37		1	6			35								
10	MJTK-1	413.50	Psamitic schist					2	2														35						33		6						
11	MJTK-1	427.40	Psamitic schist					6	3								15						2						60								
12	MJTK-1	455.00	Psamitic schist					5	1								16					6	2						65								
13	MJTK-1	492.00	Psamitic schist					1									1					11	40		3				13								
14	MJTK-1	529.50	Psamitic schist					6	1								15	4				1	2						60								
15	MJTK-1	552.50	Psamitic schist					6	2								12					6	4						55								
16	MJTK-1	581.50	Pelitic schist					17	11								3						2						35								
17	MJTK-1	588.80	Pelitic schist					9	8								4						20						35								
18	MJTK-2	85.65	Gabbro		8			2								1															7			10	5		
19	MJTK-2	124.40	Gabbro				6	3									6		?			15			1												
20	MJTK-2	140.20	Gabbro					3			2				1																35			10			
21	MJTK-2	162.80	Gabbro		1			2			3																				36			12	3	7	
22	MJTK-2	203.50	Gabbro		6			6	1													2									26			4	3		
23	MJTK-2	252.70	Micro-Gabbro					18	10								25								1				35								

(6) Resistivity and Chargeability

The resistivity and chargeability of the core samples from MJTK-1 and MJTK-2 were measured. was the sample were immersed in 90 Ω・m resistivity water for 48 hours, and became filled with water. The number of the samples is 21. The resistivity and the chargeability were measured by TDIP method.

The result of the measurement is shown in Table II-3-10. And related figures are shown in Fig.II-3-5 and Fig.II-3-6.

The samples from MJTK-1 consist of pelitic schist and psamitic schist (sand stone), including much graphite. The chargeability is higher in the samples that include much graphite in general, and the maximum is 129mV/V. The samples with graphite along schistsity has higher resistivity (almost 3Ω/m. There is a negative correlation, due to the visual value of graphite, between the resistivity and the chargeability.

The samples from MJTK-2 consist of gabbro. The resistivity of the rock is from 2003Ω/m to 90,000Ω/m. The chargeability of the rock is 1-30mV /V. Altered micro-gabbro has lower resistivity and higher chargeability, than main massive gabbro.

Resistivity of pelitic schist of MJTK- 1 is less than 1,000 Ω at deeper than 240m depth. It is due to the value of graphite. The resistivity is low and the chargeability is high at approximately 200m and 430m depth.

Resistivity of gabbro from MJTK-2 is more than 40,000Ω/m near in the shallow part. Resistivity is less than 1,000Ω/m and chargeability is generally less than 10V/V at deeper than 200m depth.

The resistivity of the sample is generally high, because the samples do not have any fracture. Actual rocks in underground have many fractures or cracks. It is speculated that the general resistivity of the Paleozoic rock and gabbro in this area is approximately several 1,000Ω/m.

Table II-3-10 Result of measurement of resistivity and chargeability

Mx:450-950msec

S.No.		Depth [m]		Resistiv [Ω·m]	Mx [mV/V]	W1 [mV/V]	W2 [mV/V]	W3 [mV/V]	W4 [mV/V]	W5 [mV/V]	W6 [mV/V]	W7 [mV/V]	W8 [mV/V]	W9 [mV/V]	W10 [mV/V]	W11 [mV/V]	W12 [mV/V]	W13 [mV/V]	W14 [mV/V]
1	MJTK-1	187.2	Pelitic schist	23.1	126.81	*	*	*	267.30	249.08	230.27	209.10	187.55	165.95	145.00	124.92	106.93	90.04	75.78
2	MJTK-1	211.2	Pelitic schist	3.4	80.61	*	*	*	193.25	174.91	157.81	140.29	123.47	107.57	93.23	79.56	66.68	56.34	46.14
3	MJTK-1	241.3	Pelitic schist	994.9	9.34	*	*	*	36.61	30.56	25.70	21.30	17.47	14.21	11.45	9.09	7.16	5.55	4.31
4	MJTK-1	271.3	Pelitic schist	1776.6	40.80	*	*	*	121.91	107.04	93.54	80.38	68.42	57.65	48.24	40.01	32.94	26.94	21.93
5	MJTK-1	304.8	Pelitic schist	1914.7	5.54	*	*	*	25.23	20.51	16.79	13.55	10.87	8.64	6.81	5.37	4.17	3.20	2.49
6	MJTK-1	342.2	Pelitic schist	462.9	22.01	*	*	*	73.01	62.39	53.39	45.06	37.80	31.52	26.08	21.49	17.57	14.27	11.52
7	MJTK-1	372.0	Pelitic schist	2056.7	41.05	*	*	*	116.91	103.02	90.51	78.25	67.13	57.05	48.15	40.30	33.47	27.59	22.59
8	MJTK-1	409.7	Psammitic schis	1644.2	42.03	*	*	*	130.31	114.39	99.94	85.57	72.36	60.48	50.14	41.18	33.52	27.06	21.65
9	MJTK-1	430.4	Psammitic schis	80.6	129.77	*	*	*	279.43	257.16	235.23	211.96	189.38	167.51	146.91	127.95	111.32	96.15	82.84
10	MJTK-1	460.9	Psammitic schis	5217.5	12.54	*	*	*	38.86	33.76	29.37	25.16	21.40	17.90	14.96	12.37	10.07	8.16	6.65
11	MJTK-1	495.5	Psammitic schis	4500.3	56.35	*	*	*	141.38	127.08	113.76	100.23	87.57	75.73	65.04	55.45	47.09	39.74	33.43
12	MJTK-1	525.4	Psammitic schis	4150.9	60.17	*	*	*	147.49	133.10	119.58	105.73	92.68	80.40	69.26	59.24	50.50	42.78	36.14
13	MJTK-1	555.2	Pelitic schist	6342.6	25.73	*	*	*	77.70	68.03	59.37	51.05	43.38	36.52	30.44	25.04	20.43	16.42	13.21
14	MJTK-1	592.1	Pelitic schist	12618.4	31.99	*	*	*	135.89	113.78	94.56	76.87	61.82	49.40	39.31	31.10	24.52	19.39	15.23
15	MJTK-2	113.0	Gabbro	40843.3	12.36	*	*	*	41.74	35.08	29.85	25.20	21.11	17.61	14.70	12.08	9.93	8.10	6.59
16	MJTK-2	128.0	Gabbro	42378.8	34.25	*	*	*	102.64	89.87	78.58	67.58	57.60	48.39	40.61	33.59	27.62	22.46	18.17
17	MJTK-2	150.0	Gabbro	72077.1	5.34	*	*	*	18.92	15.68	13.24	11.10	9.25	7.67	6.34	5.20	4.25	3.44	2.77
18	MJTK-2	163.0	Gabbro	94919.8	4.80	*	*	*	18.16	14.86	12.39	10.23	8.50	7.04	5.78	4.67	3.85	3.14	2.57
19	MJTK-2	191.8	Gabbro	64006.4	14.19	*	*	*	45.36	38.87	33.51	28.53	24.11	20.17	16.86	13.88	11.41	9.29	7.53
20	MJTK-2	223.9	Micro-gabbro	1137.6	12.20	*	*	*	38.60	33.49	29.06	24.78	21.01	17.57	14.60	11.92	9.62	7.73	6.15
21	MJTK-2	251.9	Micro-gabbro	268.9	1.69	*	*	*	6.73	5.41	4.48	3.68	2.98	2.38	2.00	1.69	1.32	1.08	0.83

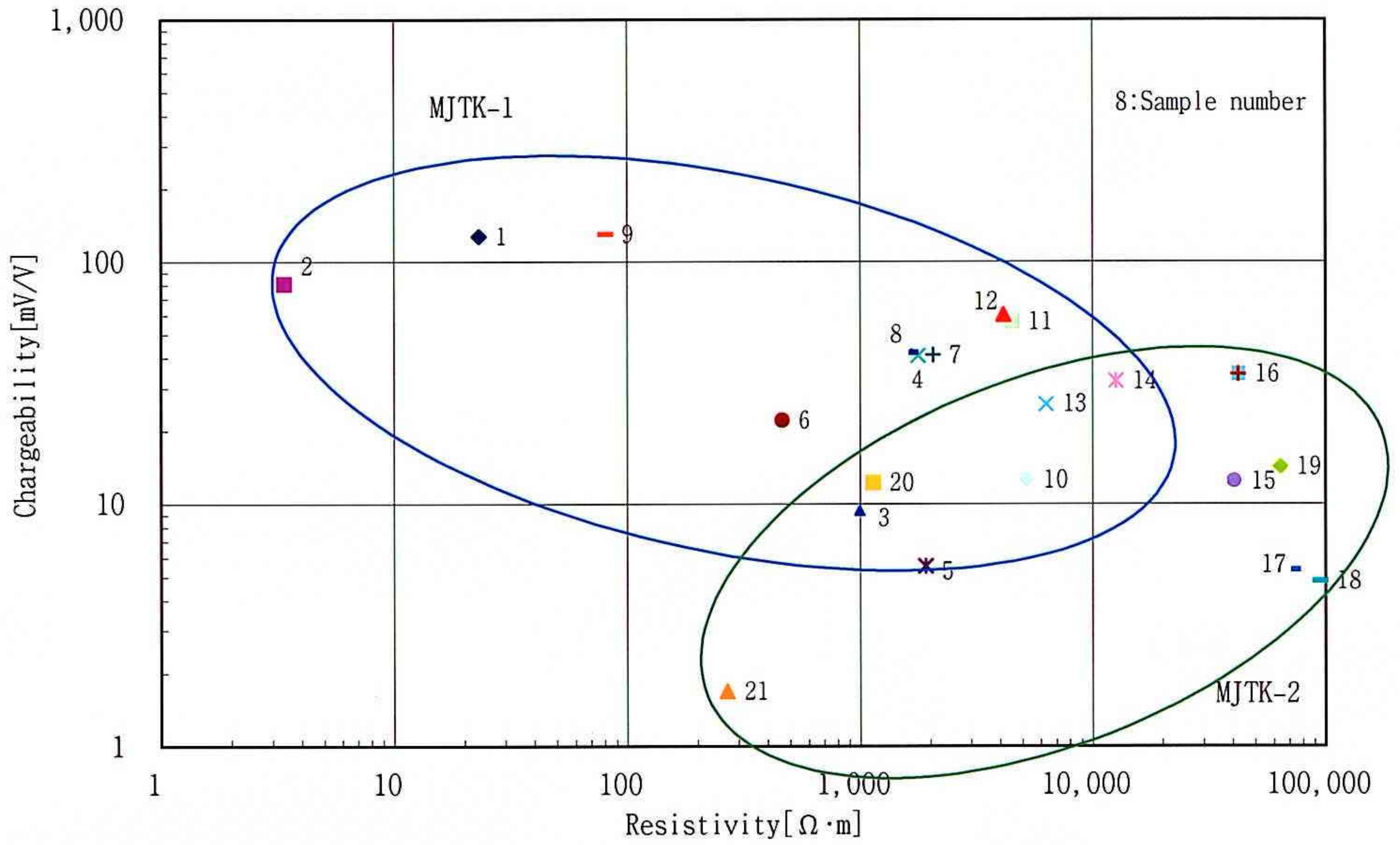

Fig.II-3-5 Resistivity and chargeability of Rock core

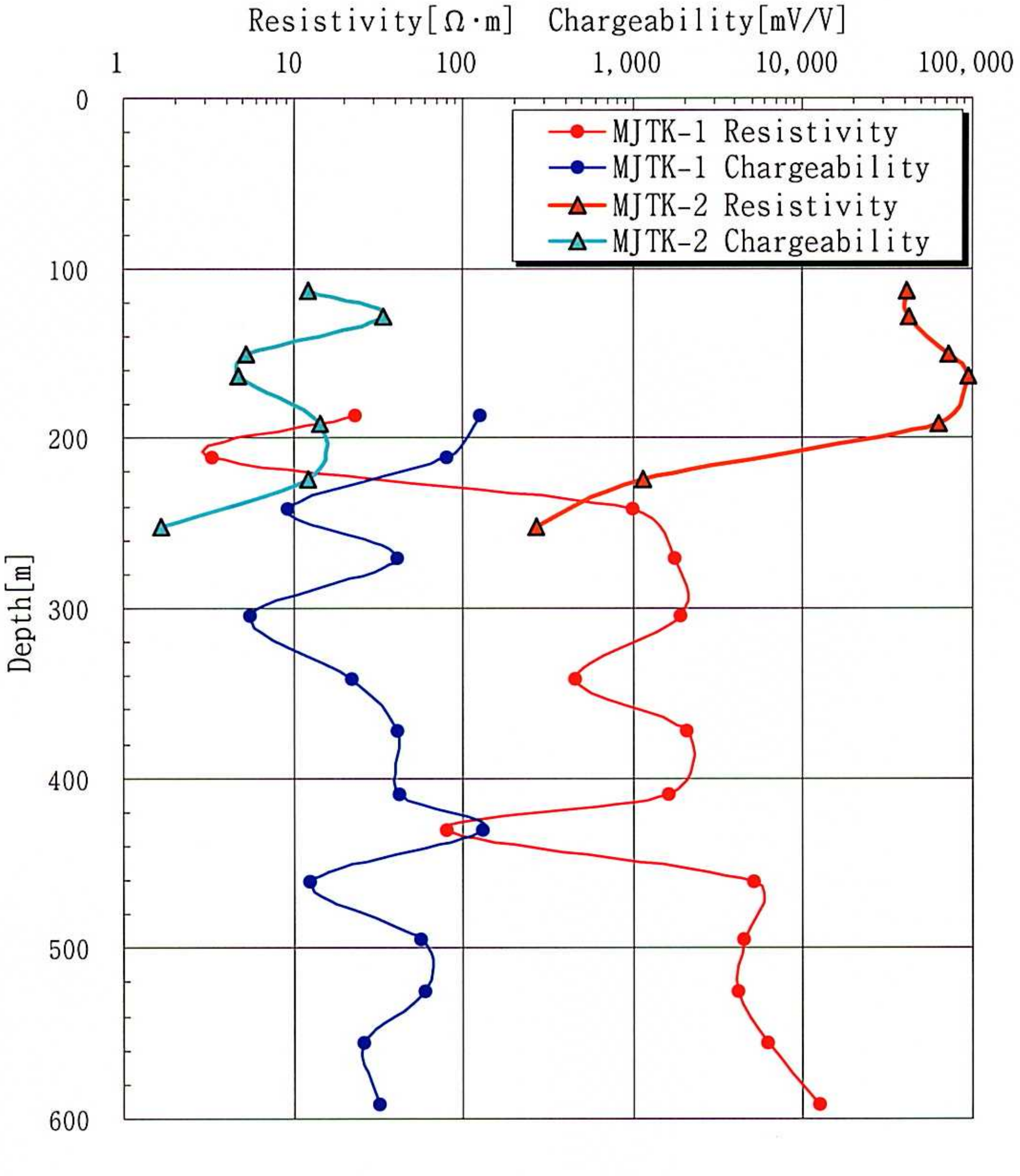

Fig.II-3-6 Columnar Figure of Resistivity and Chargeability

(7) Isotope analysis

The quantitative analysis of sulfur isotope of 10 samples, and of lead isotope of 5 samples was carried out. The result is as shown in Appendix.

3-5 Discussion

(1) Geological structure

There is an outcrop of fine sandstone at the place almost 900m southwest from MJTK-1. The strikes and dips are N37° W63° W and N43° W58° W. They are same as the outcrop of a southern mountain (in MJIP-2 area) as the western dip, however the strike is 50 ° different.

Although the direction of the bedding in the holes is unclear, because any oriented sample was not gotten, it is supposed that the direction is probably toward west. However, seismic data by ONAREP show that Paleozoic including Carboniferous has a gentle dip toward east in the eastern region from this area. It seems that an unsymmetrical anticline axis runs in the eastern region in perspective.

There may be a recumbent fold structure around MJTK-1, because sandy rock bed is between pelitic rock beds in the hole. However, any obvious and structural evidence of a recumbent fold cannot be shown. And the lower pelitic rock is different from the upper pelitic rock in the following situations.

1. The schistsity is not so obvious.
2. It sometimes includes pyrrhotite.

(2) Mineralization

It is unlikely that the veinlets in MJTK-1 are directly related with any massive sulfide deposit. However Zn should have leached, have moved from somewhere, and have been precipitated in the area. The veinlets include white quartz and carbonate, with brown or dark gray sphalerite, and sometimes with pinkish pale gray barite. The direction of the veinlets is sometimes along lamination or schistsity, sometimes crossing them. And the dip is generally steep. Most hydrothermal water seems to have moved through fractures formed by some structural or igneous activity rather than schistsity. Some fracture with mineralization is reverse fault like and small in width. Therefore they are probably formed stress rather than tension. And It the veinlets cross some chlorite veins. Therefore it is supposed that the veinlets were formed after alkali alteration of the rocks.

The hydrothermal sphalerite veinlets in MJTK-1 and gabbro in MJTK-2 indicate some past igneous activity, and suggest "bimodal" volcanism. However the rock cores that were already gotten consist of only the upper formation from the ore horizon. And there is no evidence to indicate any past rhyolitic volcanic activity at present.

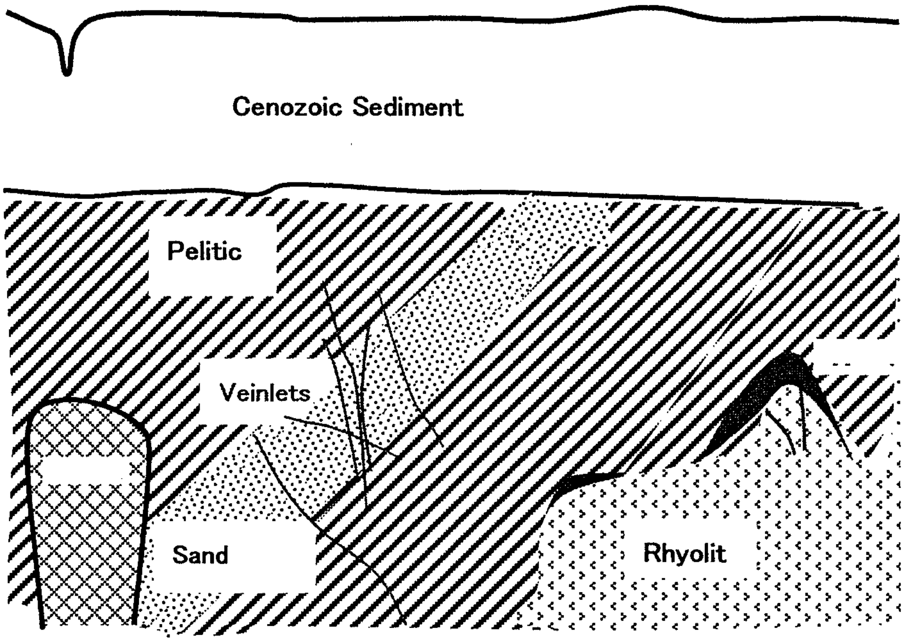

Fig.II-3-7 Model of Mineralization