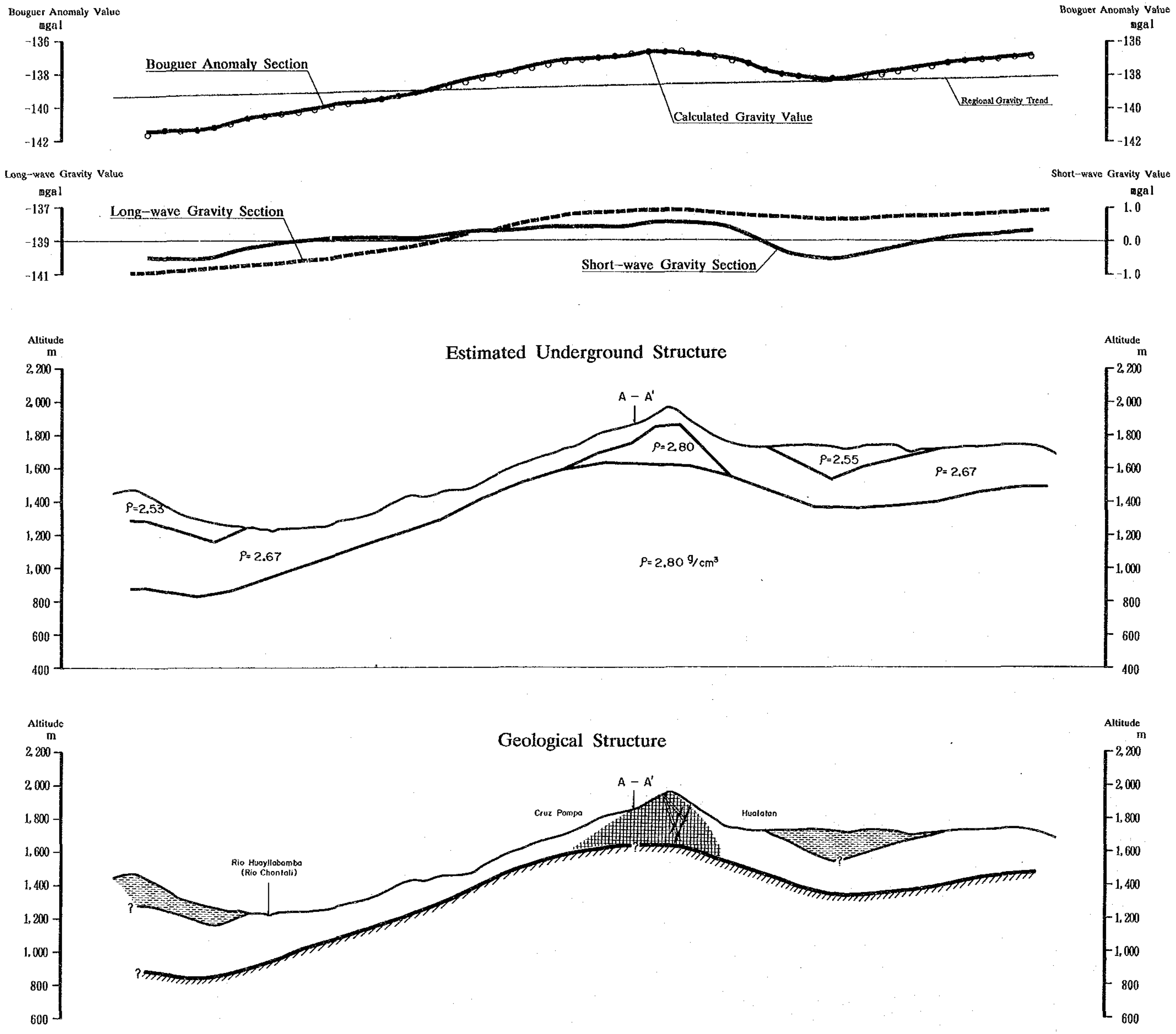


LEGEND

- Boring site
- Quartz vein
- Gravity basement
- High density zone on basement
- Low density layer

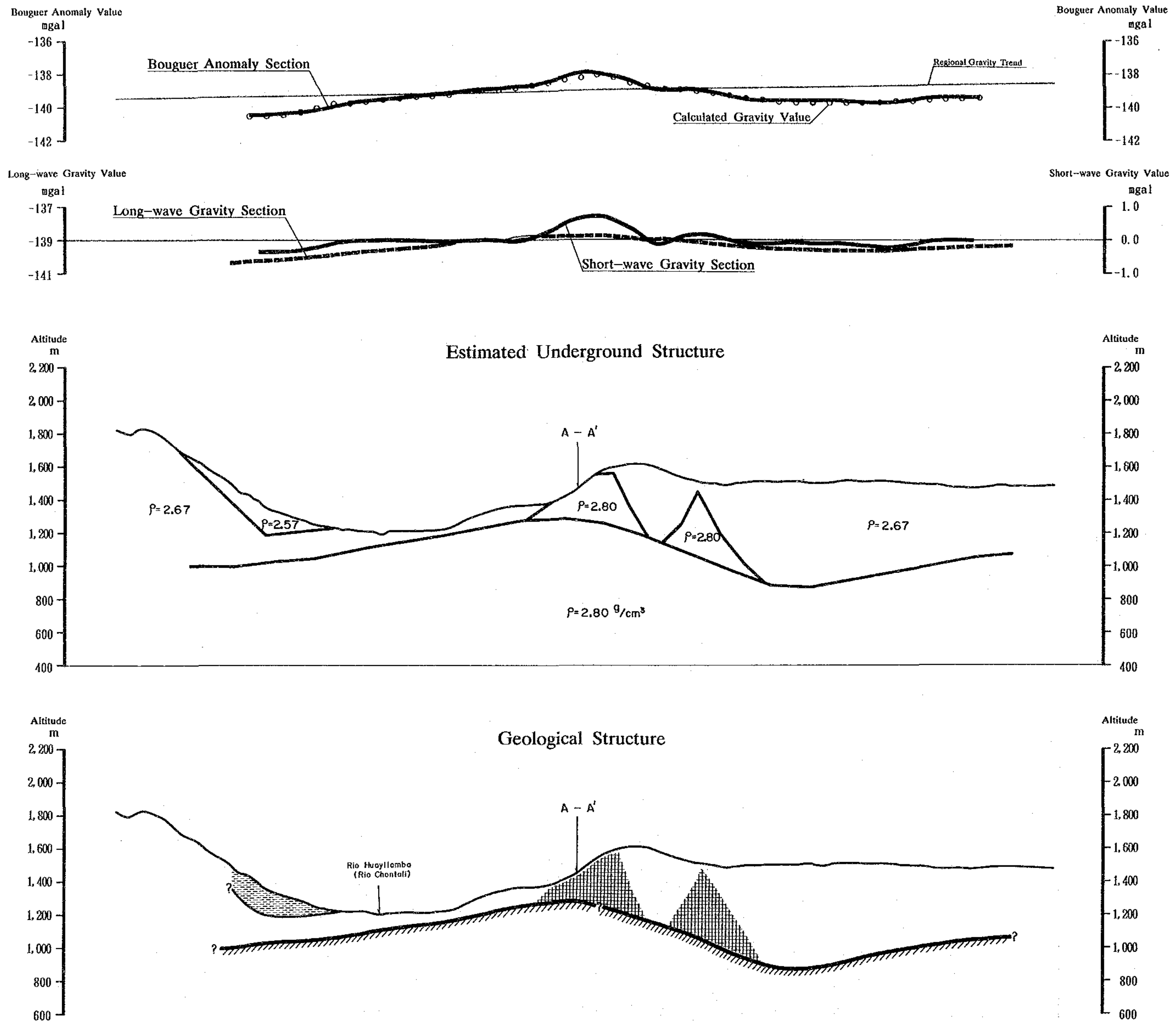
THE MINERAL EXPLORATION
IN
THE PACHAPIRIANA AREA
REPUBLIC OF PERU
(PHASE Ⅲ)

GRAVITY SURVEY

Fig. Ⅱ-10 (3)
Cross Section of C–C'

FEBRUARY 1991

0 500 1000 m



LEGEND

Gravity basement

High density zone on basement

Low density layer

THE MINERAL EXPLORATION IN THE PACHAPIRIANA AREA REPUBLIC OF PERU (PHASE Ⅲ)

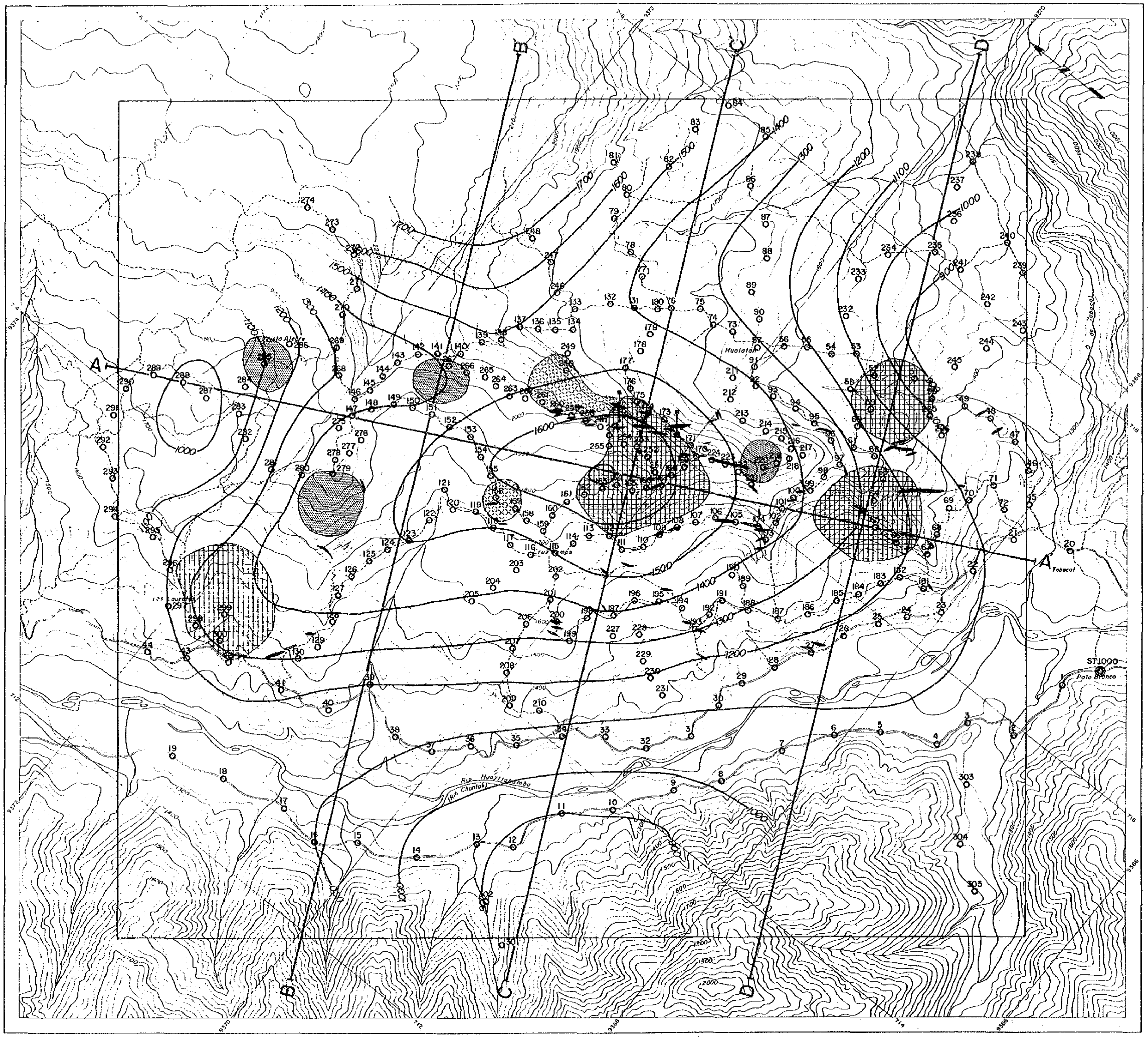
GRAVITY SURVEY

Fig. Ⅱ−10 (4)

Cross Section of D−D'

FEBRUARY 1991

0 500 1000 m



LEGEND

- A—A' Cross section
- Boring site
- Quartz vein
- Contour of basement depth
- 100m interval
- High density zone on basement
- Assumed High density zone on basement
- Low resistivity zone (<20 m)
- High resistivity zone (>1000 m)

THE MINERAL EXPLORATION
IN
THE PACHAPIRIANA AREA
REPUBLIC OF PERU
(PHASE Ⅲ)

GRAVITY SURVEY

Fig. Ⅱ-11

Geophysical Interpretation Map

FEBRUARY 1991

0 500 1000 m

dome midway between Hualatan and Tabacal. These anomalies can be correlated with anomalously high short-wave gravity, Fig. II-9(2). It is reasonable to assume that a shallow high density zone of limited extent would cause a high in the short-wave gravitational field and the possibility exists that high density anomalies exist near other short-wave gravity highs such as the major short-wave high south-east of Los Laureles.

A high resistivity zone was mapped by CSAMT on the ridge in the middle of the survey area in a zone of dense quartz vein occurrence. The peak of the resistivity basement is in this high resistivity zone at the peak of the gravity basement.

Four low resistivity CSAMT anomalies were mapped in the survey area. The northernmost of these anomalies is located at Vista Alegre, two more lie half way between Vista Alegre and Cruz Pampa and the fourth is just south-east of the apex of the basement dome. All of these anomalies, while shifted to somewhat to the south, can be correlated with short-wave gravity lows.

6) Conclusions

In conclusion, from the results of gravity and CSAMT geophysical surveys;

i) The center of a dome in the gravity basement is located in middle of the survey area west of Hualatan.

ii) Shallow high density zones exist near the apex of the dome and on the south-eastern flank of the dome midway between Hualatan and Tabacal. In these zones there is a high occurrence of quartz veins.

iii) The high resistivity zone mapped on the north side of the gravity basement dome is located in a zone of dense quartz vein occurrence. A small low resistivity zone was found on the south-eastern slope of the dome and three more occur on the north-western flank of the dome.

iv) A dome structure like this may indicate the uplift of the basement rocks by the formation of a magma chamber beneath the unit. Intrusion of the overlying units has resulted in fracturing and the formation of quartz veins.

As compared with the distribution of resistivity basement in the center of area, gravity basement is about 100m shallower.

1-2 Drilling Survey

1-2-1 Purpose of the survey

The Chontali area concerns the zones where anomalies were extracted through geochemical survey using the stream sediments by INGEMMET as a part of the "Proyecto Integral Chinchipe". Through the first year semi-detailed geological survey and second year detailed geological survey, numerous quartz veins with gold were extracted in mineralized alteration zones overlapping gold and silver anomalies.

The analyzed results by homogenization temperature for auriferous quartz veins suggest that the formation temperature is lower than that adequate for gold mineralization ranging from 180° to 230°C. Therefore, it has been expected that there exists a zone most adequate for the gold mineralization in the deep underground.

During the third year phase, in order to verify the expected gold mineralization conditions and the change of mineralization temperature in the deep underground, the drilling survey was conducted by vertically fan-shaped method, in which two holes were drilled at each of three sites.

Outline of the surveyed mineralization veins in each drilling hole at three sites is as follows.

MJPC-1 and -2: width at outcrop; 5m, confirmed length; 50m
average grade; 3.15g/ton Au and 12g/ton Ag
MJPC-3 and -4: width at outcrop; 3m, confirmed length; 80m
average grade; 12.95g/ton Au and 18g/ton Ag
MJPC-5 and -6: width at outcrop; 3m, confirmed length; 110m
average grade; 3.55g/ton Au and 13g/ton Ag

1-2-2 Method of the survey

1) Outline of the survey

Drilling was performed taking the local drilling company into employment, under the direction of the drilling engineer, who as a rule stayed during the operation. Drilling was conducted at six holes using two set of rigs, model L-44 with maximum capacity of up to 1200m deep(BQ) and model L-38 with maximum capacity of up to 725m deep(BQ), to gain total hole length of 1332.51m.

Operations were conducted in three shifts of 8 hours each under the direction of a site overseer from the company. A party of each shift is constituted by one local foreman and five operators. The wire-line method was adopted as well as using a bit at least larger than NX to get high core recovery and high operation efficiency.

Drilling covers 138 days, from July 16 to November 30, 1990 and content of the drilling at each hole is as follows:

Drilling hole	Hole length(m)	Core length(m)	Core recovery(%)
MJPC-1	150.0	141.95	94.6
MJPC-2	250.0	248.1	99.2
MJPC-3	221.16	220.2	99.6
MJPC-4	310.0	309.05	99.7
MJPC-5	170.5	165.65	97.2
MJPC-6	230.85	229.35	99.4

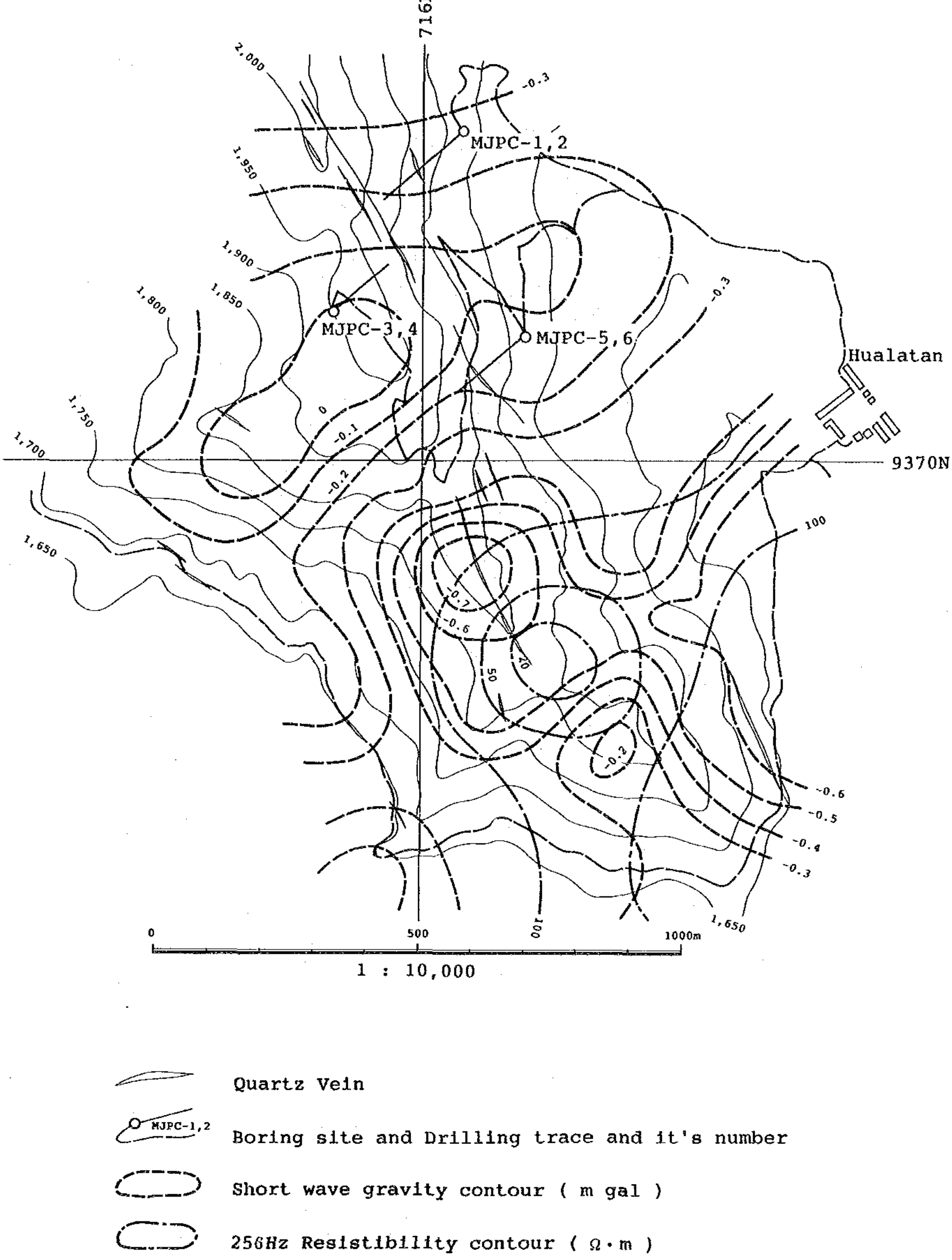


Fig.Ⅱ-12 Location of the Drilling with showing Geophysical Survey results in the Chontali Area

2) Drilling procedure

(1) Transportation of rigs and materials

Drilling rigs and materials were transported from Lima to Puente Blanca by big trucks, from Puente Blanca to Las Pinas by medium-sized trucks, from Las Pinas to Hualatan by small trucks and four-wheels driving mini-trucks, and from Hualatan to the drilling sites by horses and by human power.

(2) Construction of routes, heliport and land adjustment around each site

Construction of routes and land adjustment around each site was performed by human power.

(3) Setting up

Setting up of rigs and drilling operations was made in the following order of hole number, MJPC-5,-6(L-44), MJPC-3,-4(L-44), and MJPC-1,-2(L-38).

(4) Water transportation

For MJPC-1, -2 and MJPC-5, -6, water was transported from a stream, north of Hualatan, to each site using hoses of 1 inch in diameter and pumps.

For MJPC-3, -4, water sprung out from MJPC-5, -6 site was once deposited and transported using hoses of 1 inch in diameter and pumped.

(5) Drilling operation(Apx.15-1(1),(2),(3))

(i) MJPC-1 direction 230° inclination -15°

period	from October 14 to November 3, 1990
hole length	150.0 m
core length	141.95 m
core recovery	94.6 %

0.00-76.65 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 76.65m. At 6.5m, 13.6m and 24.45m, all muddy water was lost, and HQ diamond bit was used to extend the hole and HW casing pipe was set. At 66m, all muddy water was lost, failed to stop the lost, and the drilling was continued after injecting grease. After reaching 76.65m, NW casing pipe was set. The rock is altered tuff. Quartz veins were extracted in 42.65-43.85m, 52.45-72.6m and 94.25-94.5m.

76.65-150.0 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 76.65m. Until reaching the bottom, loss of muddy water was not stopped and the drilling was continued after injecting grease. The rock is altered tuff. Quartz veins were confirmed in 100.3-100.75m, 103.05-104.2m, 117.55-118.65m, 129.7-134.4m and 146.4-149.55m.

(ii) MJPC-2 direction 230° inclination -40°

period from November 6 to November 22, 1990
hole length 250.0 m
core length 248.1 m
core recovery 99.2 %

0.00-100.0 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 100m. Between 3 to 11m, rocks were so fractured that muddy water was lost and rocks were broken loose, and HW casing shoe was used to extend the hole and HW casing pipe was set until 15.05m. At 30m, all muddy water was lost, failed to stop the lost, and the drilling was continued after injecting grease. After reaching 100m, NW casing pipe was set. The rock is lapilli tuff. Quartz vein was confirmed between 57.95 and 58.3m.

100-250.0 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. Until reaching the bottom, loss of muddy water was not stopped and the drilling was continued after injecting grease. The rock is altered tuff breccia. Quartz veins were confirmed in 100.0-100.8m, 178.15-180.9m, 183.65-184.0m, 186.8-187.8m, 188.2-189.0m, 208.5-209.0m, 242.2-243.15m and 244.0-244.9 m.

(iii) MJPC-3 direction 50° inclination -50°

period from October 13 to November 2, 1990
hole length 221.16 m
core length 220.2 m
core recovery 99.6 %

0.00-100.0 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 100m. Between 0 to 14.5m, rocks were so fractured that rocks were broken loose, and NW casing shoe was used to extend the hole and HW casing pipe was set. At 30m and 64m, 50% and 70% of muddy water were lost, respectively, then sawdust was added but failed to stop the lost, and the drilling was continued after injecting grease and NW casing pipe was set. The rock is altered lapilli tuff. Quartz veins were confirmed in 41.1-42.4m, 43.6-43.95m, 44.85-45.1m, 63.3-64.1m and 79.7-91.2 m.

100-221.16 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water until. At 120m, all muddy water was lost, failed to stop the lost, and the drilling was continued after injecting grease. The rock is altered lapilli tuff. Quartz veins were confirmed in 133.0-133.5m, 148.75-150.0m, 172.4-172.65m, 184.25-184.5m, 203.5-207.2m and 219.95-221.1m.

(iv) MJPC-4 direction 50° inclination -70°

period from November 3 to November 30, 1990
hole length 310.0 m

core length 309.05 m
core recovery 99.7 %

0.00-100.0 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 100m. Between 0 to 14.5m, rocks were so fractured that rocks were broken loose, and NW casing shoe was used to extend the hole and HW casing pipe was set. At 30m and 64 m, 50% and 70% of muddy water were lost, respectively, then sawdust was added but failed to stop the lost, and the drilling was continued after injecting grease and NW casing pipe was set. The rock is altered lapilli tuff. Quartz veins were confirmed in 41.1-42.4m, 43.6-43.95m, 44.85-45.1m, 63.3-64.1m and 79.7-91.2m.

106.0-310.0 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water. At 141m, 60% of muddy water was lost, failed to stop the lost, and the drilling was continued after injecting grease. The rock is altered lapilli tuff and tuff breccia sometimes intercalated with fault breccia zones. Quartz veins were confirmed in 128.3-128.5m, 243.85-244.8m and 278.7-278.95m.

(v) MJPC-5 direction 230° inclination -15°
period from August 6 to September 12, 1990
hole length 170.5 m
core length 165.65 m
core recovery 97.2 %

0.00-80.5 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 80.5m. Between 0 to 19.0m, rocks were fractured and destroyed and water appeared, then HW casing shoe was used to extend the hole and HW casing pipe was set. At 27m, water appeared again and no dust was withdrawn to suggest that muddy water was lost, then the drilling was continued after increasing water pressure. The rock is altered lapilli tuff. Quartz vein was confirmed in 4.15-6.3m, 19.4-19.6m, 31.75-32.4m, 46.8-47.05m, 51.0-51.2m, 69.6-70.15m and 74.4-74.7m.

80.5-170.5 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. Water still appeared and no dust was withdrawn to suggest that muddy water was lost, then the drilling was continued after increasing water pressure. The rock is altered lapilli tuff sometimes intercalated with andesite and fault breccia. Quartz vein was confirmed between 121.45 to 123.75 m.

(vi) MJPC-6 direction 230° inclination -40°
period from September 14 to September 29, 1990
hole length 230.85 m
core length 229.35 m

core recovery 99.4 %

0.00-160.15 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 160.15m. Between 0 to 11.0m, rocks were destroyed by water appeared, then HW casing shoe was used to extend the hole and HW casing pipe was set. At 16m and 53m, water appeared again and no dust was withdrawn to suggest that muddy water was lost, then the drilling was continued after increasing water pressure and injecting grease as well as NW casing pipe was set. The rock is altered lapilli tuff sometimes intercalated with fault breccia zone. Quartz vein was confirmed in 23.8-24.36m, 53.25-53.8m, 70.3-71.0m, 91.2-91.4m, 97.05-97.32m, 127.1-127.82m, 136.4-136.6m and 156.35-160.85m.

160.15-230.85 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. Water still appeared and it is suggested muddy water was lost, then the drilling was continued after injecting grease. The rock is altered lapilli tuff intercalated with tuff breccia, sometimes fault breccia zone appearing. Quartz vein was confirmed between 210.3-210.6m.

(6) Transportation between each site and withdrawing

(i) Transportation

From site to site, drilling rigs were transported using their own mechanical power, and other materials by human power.

(ii) Withdrawing

It is left to the employed drilling company.

3) Core observation and sampling

Through the observation of drilling cores, the character and intensity of mineralization and alteration were focused. As for the mineralization, relative abundance of such visible minerals inferred to be primary as pyrite, sphalerite, galena, chalcopyrite and tetrahedrite were confirmed combined with the geological horizons. As for the alteration, the intensity mainly of silicification, argillization and chloritization was described combined with the geological horizons. The relative intensity (frequency of occurrence) of capillarity veinlets and fractures, which are too small to show on the columnar section, was described combined with the geological horizons. Samples for chemical analyses from quartz veins and capillarity quartz veinlets in fracture zones, which have more than 20cm thick, were selected and split by core spliter.

After the sampling, cores were deposited in a leased private house. It will be needed to built a deposit cottage for exclusive use.

1-2-3 Survey results

1) MJPC-1 (Location 9'370,609N, 716,071E: altitude 1822.55 m)

i) Geology and alteration

The constituent rock in this hole is Oyotun Volcanics, composed mainly of dacitic lapilli tuff.

0.00- 28.65m	weathered lapilli tuff with limonite
28.65- 42.65	medium to intensely silicified lapilli tuff
42.65- 43.85	quartz veins with limonite
43.85- 46.70	medium to intensely silicified lapilli tuff with quartz veinlets network
46.70- 52.45	medium to intensely silicified lapilli tuff
52.45- 52.70	quartz vein
52.70- 72.60	medium to intensely silicified lapilli tuff with quartz veinlets and white clay veinlets
72.60- 72.85	quartz veinlets
72.85- 77.20	lapilli tuff silicified in medium grade
77.20- 77.90	intensely silicified lapilli tuff with abundant quartz veinlets
77.90- 90.65	lapilli tuff silicified in medium grade
90.65- 94.25	fault breccia zone with quartz breccia, distinct argillization
94.25- 94.50	quartz vein
94.50- 94.80	silicified fault breccia zone
94.80-100.30	silicified lapilli tuff
100.30-100.75	quartz vein mineralized by chalcopyrite
100.75-103.05	silicified lapilli tuff
103.05-104.20	quartz vein weakly mineralized by chalcopyrite, tetrahedrite, sphalerite and galena
104.20-117.55	silicified lapilli tuff with weak chloritization
117.55-118.65	concentration of quartz vein and veinlets, weakly mineralized by tetrahedrite
118.65-129.70	silicified lapilli tuff
129.70-134.40	quartz vein weakly mineralized by tetrahedrite and sphalerite
134.40-146.40	silicified or intensely silicified lapilli tuff
146.40-149.55m	concentration of quartz vein and veinlets
149.55-150.00	fault breccia

Throughout the core in this hole, relatively intense silicification is observed. Argillization is also observed throughout the core, though relatively weak except for in fault breccia zone. Weak chloritization is observed intermittently in deeper than 60.4m.

Under the microscope, specimens have undergone intense sericitization and carbonatization (Apx.1,2;c-1, 85.05, 108.55). Two types of carbonate minerals were discriminated depending on the difference of refractive indices (C-1, 85.05). By taking into due consideration the X-ray diffractive analysis (Apx.4,5; C-1, 85.05), it is inferred that there exists ankerite and siderite. Although the original rock structure was perfectly destroyed by alteration mentioned above, relics of rock fragments were discriminated by the difference of assemblage of alteration minerals and it is inferred that the rocks were originated from lapilli tuff and tuff breccia.

It has been inferred through the X-ray diffractive analysis (Apx.4,5; C-1, 146.4) that Quartz veins were composed mainly of quartz associated with kaolinite and smectite-sericite mixed layer clay minerals, having been undergone mineralization of pyrite.

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals except for weathered leached zone (0-28.65m). Visible sulfide minerals are composed mainly of pyrite, sphalerite, galena, chalcopyrite and tetrahedrite. Among them, pyrite is observed throughout the core, and others only in quartz veins. Under the microscope, sulfide minerals in quartz veins (Apx.5, 6) are composed mainly of pyrite, with subordinate tetrahedrite, chalcopyrite, sphalerite and galena.

A specimen (C-1, 52.60) native gold is confirmed to occur associated with pyrite and chalcopyrite.

Results of chemical analysis of ore samples are as follows:

Depth		Core length	Au	Ag	Remarks
m	m	m	g/t	g/t	
28.65-	29.90	1.25	0.75	4.5	silicified lapilli tuff
33.40-	34.15	0.75	0.65	3.5	sil-arg lapilli tuff
42.65-	46.70	4.05	0.18	4.2	qz v sil-arg lp tuff
52.45-	52.70	0.25	3.65	11.5	quartz vein
72.60-	72.85	0.25	0.05	3.0	quartz vein
77.20-	77.90	0.7	0.10	5.5	silicified lapilli tuff
94.25-	94.50	0.25	0.30	4.5	quartz vein
100.30-	100.75	0.45	0.90	7.5	quartz vein
102.85-	104.20	1.35	2.05	13.5	quartz vein
117.55-	118.65	1.10	1.46	22.1	qz v-vlet network zone
128.95-	134.40	5.45	1.15	18.2	qz v bearing sil lp tuff
146.40-	149.55	3.15	0.79	22.1	qz v-vlet network zone

2) MJPC-2 (Location 9'370,610N, 716,073E: altitude 1822.11 m)

i) Geology and alteration

The constituent rock in this hole is Oyotun Volcanics, composed mainly of dacitic lapilli tuff intercalated with tuff breccia.

0.00- 23.45m	weathered lapilli tuff with limonite
23.45- 56.40	silicified lapilli tuff
56.40- 57.95	intensely silicified lapilli tuff with quartz veinlets network
57.95- 58.30	quartz vein
58.30- 61.50	intensely silicified lapilli tuff with abundant quartz veinlets network
61.50-100.00	silicified lapilli tuff
100.00-100.80	quartz vein
100.80-101.50	silicified lapilli tuff
101.50-101.80	quartz vein
101.80-116.30	silicified lapilli tuff
116.30-117.35	silicified breccia with quartz vein network
117.35-120.10	fault breccia
120.10-123.30	weakly silicified lapilli tuff
123.30-155.30	weakly silicified lapilli tuff
155.30-175.60	silicified lapilli tuff
175.60-176.45	intensely silicified lapilli tuff with abundant quartz veinlets network
176.45-178.15	silicified lapilli tuff
178.15-180.90	quartz vein and quartz veinlets network
180.90-183.65	silicified lapilli tuff
183.65-184.00	quartz vein
184.00-186.80	silicified lapilli tuff
186.80-187.80	quartz vein
187.80-188.20	silicified lapilli tuff
188.20-189.00	quartz vein
189.00-193.50	intensely silicified lapilli tuff with abundant quartz veinlets network
193.50-194.80	quartz vein
194.80-203.80	silicified to intensely silicified tuff breccia with quartz veinlets network fault breccia zone
203.80-208.50	silicified lapilli tuff
208.50-209.00	quartz vein
209.00-210.40	silicified lapilli tuff
210.40-228.00	weakly silicified tuff breccia
228.00-242.50	weakly silicified to silicified lapilli tuff, partly brecciated
242.50-243.15	quartz vein and quartz veinlets network
243.15-244.00	silicified lapilli tuff
244.00-244.90	quartz vein and quartz veinlets network
244.90-246.00	silicified to intensely silicified lapilli tuff
246.00-250.00	chloritized lapilli tuff

Throughout the core in this hole, relatively intense silicification is observed. Argillization is also observed throughout the core, though relatively weak except for in fault breccia zone. Chloritization is observed between 81.8 to 169.9m and deeper than 210.4m, the deeper the grade becoming higher.

Under the microscope, specimens have undergone silicification and sericitization as well as intense carbonatization. Two (Apx. 1; C-2, 198.10) to three types (Apx.1; C-2, 212.40) of carbonate minerals were microscopically discriminated. By taking into due consideration the X-ray diffractive analysis (Apx.4,5), it is inferred that there exists ankerite and siderite with lesser amount of calcite. Specimen C-2, 198.10 is silicified breccia with quartz veinlets network, in which quartz grains show distinct undulatory extinction to suggest that the specimen has undergone tectonic movement.

ii) Mineralization

The core of this hole, including deep part (14.25-23.45m) of weathered leached zone, underwent mineralization of sulfide minerals. Visible sulfide minerals are composed mainly of pyrite, sphalerite, chalcopyrite and tetrahedrite. Among them, pyrite is observed throughout the core, and others only in quartz veins. Under the microscope (Apx.5,6; C-2, 194.50), galena is observed as sulfide other than the above-shown minerals.

Results of chemical analysis of ore samples are as follows:

Depth m m	Core length m	Au g/t	Ag g/t	Remarks
56.40- 57.95	1.55	0.52	2.2	silicified-argillized lapilli tuff
57.95- 58.30	0.35	5.75	4.5	quartz vein
58.30- 61.50	3.20	1.41	6.1	silicified-argillized lapilli tuff
100.00-101.80	1.80	1.42	3.2	quartz veinlets network zone (breccia zone)
116.30-117.35	1.05	1.05	9.5	quartz veinlets network zone
175.60-176.45	0.85	0.25	4.5	quartz veinlets network zone
178.15-180.90	2.75	0.43	3.0	quartz veinlets network zone
183.60-184.05	0.35	0.15	2.5	quartz vein
186.80-189.00	2.20	0.45	3.0	quartz vein and veinlets network
189.00-193.50	4.50	0.21	5.3	silicified-argillized lapilli tuff
193.50-194.80	1.3	1.38	38.3	quartz vein
194.80-196.60	1.8	0.3	6.3	silicified-argillized tuff breccia
208.65-209.00	0.35	0.45	14.5	quartz vein
230.80-233.50	2.7	0.18	4.0	silicified-argillized lapilli tuff (partly brecciated)
242.50-244.90	2.4	0.36	12.9	quartz vein and veinlets network
244.90-246.00	1.1	0.25	5.5	silicified-argillized lapilli tuff

3) MJPC-3 (Location 9'370,278N, 715.829E: altitude 1947.36 m)

i) Geology and alteration

The constituent rock in this hole is Oyotun Volcanics, composed mainly of dacitic lapilli tuff, partly intercalated with tuff breccia and intruded by andesite dyke.

0.00- 29.80m	weathered lapilli tuff with limonite
29.80- 41.10	silicified lapilli tuff
41.10- 42.40	quartz vein
42.40- 43.60	silicified-argillized lapilli tuff

43.60- 43.90m	quartz vein
43.95- 44.80	argillized lapilli tuff
44.85- 45.10	quartz vein
45.10- 59.55	silicified lapilli tuff
59.55- 60.30	intensely silicified breccia
60.30- 63.30	silicified lapilli tuff
63.30- 64.10	quartz vein
64.10- 70.15	silicified to weakly silicified lapilli tuff
70.15- 71.50	andesite
71.50- 73.40	chloritized lapilli tuff
73.40- 79.70	chloritized tuff breccia
79.70- 91.20	chloritized lapilli tuff
91.20- 91.65	quartz vein and quartz veinlets network
91.65-133.00	weakly silicified and chloritized lapilli tuff
133.00-133.50	quartz vein
133.50-136.70	silicified lapilli tuff
136.70-143.25	chloritized lapilli tuff
143.25-146.25	silicified tuff breccia
146.25-148.75	silicified lapilli tuff
148.75-150.00	quartz vein
150.00-153.00	silicified to intensely silicified tuff breccia
153.00-167.80	silicified lapilli tuff
167.80-171.00	intensely silicified breccia
171.00-172.40	silicified lapilli tuff
172.40-172.65	quartz vein
172.65-180.10	silicified to intensely silicified tuff breccia
180.10-180.80	intensely silicified breccia
180.80-184.25	silicified lapilli tuff
184.25-184.50	quartz vein
184.50-199.70	silicified tuff breccia
199.70-203.50	intensely silicified breccia
203.50-207.20	quartz vein
207.20-209.10	intensely silicified lapilli tuff
209.10-209.30	fault breccia
209.30-219.10	silicified to intensely silicified lapilli tuff
219.10-219.95	argillized lapilli tuff
219.95-221.10	quartz vein
221.10-221.16	clay zone

Throughout the core in this hole, silicification is observed, relatively weak between 66.85 to 133.0m. Chloritization is distinct where silicification is weak, and the deeper it becomes weaker. Argillization is also observed throughout the core, though relatively distinct in the shallower.

By taking into due consideration the X-ray diffractive analysis (Apx.4,5), specimens in this hole have also undergone silicification and sericitization as well as intense carbonatization. It is inferred that there exists ankerite and siderite. A small amount of dolomite, which does not occur except for in this hole, is observed in a specimen (C-3, 219.95) taken from just attached to quartz vein.

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals except for weathered leached zone. Visible sulfide minerals are composed mainly of pyrite, chalcopyrite, tetrahedrite and galena. Among them, pyrite is observed throughout the core, and others only in quartz veins.

Under the microscope, sphalerite is observed as sulfide other than the above-mentioned minerals, but no arsenopyrite is observed. Sphalerite sometimes includes a large amount of very fine grained chalcopyrite, whose diameter is about 1 micronmeter.

Results of chemical analysis of ore samples are as follows:

Depth		Core length	Au	Ag	Remarks
m	m	m	g/t	g/t	
41.10~	42.40	1.3	0.7	14.0	quartz vein
42.40~	43.60	1.2	0.4	4.5	silicified-argillized lapilli tuff
43.06~	43.95	0.35	3.0	2.5	quartz veinlets network zone
43.95~	44.85	0.9	0.65	9.0	argillized lapilli tuff
44.85~	45.10	0.25	2.4	22.0	quartz vein
59.55~	60.30	0.75	0.65	9.0	intensely silicified lapilli tuff
63.30~	64.10	0.8	2.4	22.0	quartz vein
91.20~	91.65	0.45	0.95	10.5	quartz vein
133.00~	133.50	0.5	0.3	20.5	quartz vein
148.75~	150.00	1.25	1.2	37.0	quartz vein,
150.00~	153.00	3.0	0.87	8.5	silicified tuff breccia
167.80~	171.00	3.2	0.48	5.5	silicified breccia
171.00~	172.40	1.4	0.25	3.0	silicified-argillized tuff breccia
172.40~	173.05	0.65	0.35	4.5	quartz vein
180.10~	180.80	0.7	0.95	4.0	intensely silicified breccia
184.25~	184.50	0.25	0.55	6.0	quartz vein
199.70~	203.50	3.8	0.66	3.3	intensely silicified breccia
203.50~	207.20	3.7	1.47	50.0	quartz vein
207.20~	209.30	2.1	0.12	2.5	silicified lapilli tuff including fault breccia zone
219.95~	221.00	1.15	1.35	35.5	quartz vein

4) MJPC-4 (Location 9'370,277N, 715.828E: altitude 1947.26 m)

i) Geology and alteration

The constituent rock in this hole is Oyotun Volcanics, composed mainly of dacitic lapilli tuff, partly intercalated with tuff breccia and intruded by andesite dyke.

0.00~	41.20m	weathered lapilli tuff with limonite
41.20~	58.20	silicified to weakly silicified lapilli tuff
58.20~	58.90	quartz vein
58.90~	60.35	silicified lapilli tuff
60.35~	66.23	silicified lapilli tuff

66.23- 67.15m	fault breccia zone with quartz breccia
67.15- 85.40	weakly silicified to silicified lapilli tuff
85.40- 89.10	andesite
89.10- 91.30	silicified tuff breccia
91.30- 92.65	quartz vein and quartz veinlets network zone
92.65- 95.55	silicified tuff breccia
95.55-124.85	chloritized tuff breccia
124.85-126.90	silicified tuff breccia
126.90-127.15	quartz vein
127.15-128.30	silicified tuff breccia
128.30-128.50	quartz vein
128.50-138.85	weakly silicified to silicified tuff breccia
138.85-144.40	weakly silicified to silicified lapilli tuff
144.40-171.75	silicified tuff breccia
171.75-176.60	weakly silicified lapilli tuff
176.60-181.40	weakly silicified tuff breccia
181.40-194.85	weakly silicified lapilli tuff
194.85-200.60	silicified tuff breccia
200.60-201.10	quartz vein network (brecciated zone ?)
201.10-201.95	silicified lapilli tuff
201.95-202.90	quartz vein network (brecciated zone ?)
202.90-214.40	silicified tuff breccia
214.40-231.60	weakly silicified lapilli tuff
231.60-243.85	silicified tuff breccia
243.85-244.80	quartz vein
244.80-250.35	silicified tuff breccia
250.35-252.20	silicified lapilli tuff
252.20-253.15	quartz vein network (brecciated zone ?)
253.15-261.70	silicified lapilli tuff
261.70-270.85	fault breccia zone
270.85-274.40	silicified lapilli tuff
274.40-274.80	quartz vein
274.80-278.70	silicified lapilli tuff
278.70-278.95	quartz vein
278.95-295.00	weakly silicified tuff breccia
295.00-302.65	fault breccia zone
302.65-310.00	weakly silicified to silicified tuff breccia

Throughout the core in the hole, silicification is observed, rather distinct as it becomes deeper. Argillization is also observed throughout the core, and relatively weak except near fault zone. Chloritization is weak and intermittent. Under the microscope, specimens have undergone silicification, argillization, chloritization as well as carbonatization. All grains of quartz in fault brecciated zone (C-4, 66.53, 268.25) show distinct undulatory extinction to suggest that the specimen has undergone tectonic movement as faulting. Moreover,specimens of lapilli tuff and tuff breccia (C-4, 181.58,196.3) contain quartz grains showing undulatory extinction to suggest that the area has undergone regional tectonic movement. It is inferred that andesite is dyke rock as lath-shaped plagioclase in matrix becomes finer and arranged to parallel to the margin.

2) Mineralization

The core of this hole underwent mineralization of sulfide minerals except for weathered leached zone (0-41.2m). Visible sulfide minerals are composed mainly of pyrite, chalcopyrite and tetrahedrite. Among them, pyrite is observed throughout the core, and others only in quartz veins and veinlets network zone.

Under the microscope, galena and sphalerite is observed as sulfide other than above-shown minerals. In specimen C-4, 244.64 hematite and limonite are observed as alteration from siderite.

Results of chemical analysis of ore samples are as follows:

Depth		Core length	Au	Ag	Remarks
m	m	m	g/t	g/t	
58.20-	58.90	0.70	0.1	14.5	quartz vein
58.90-	60.35	1.45	1.0	13.5	sil-arg lapilli tuff
65.23-	67.15	1.92	tr	5.0	fault breccia
82.70-	83.15	0.45	0.3	10.5	quartz veinlets network zone
91.30-	92.65	1.35	0.53	10.9	quartz vein to veinlets network
126.90-	127.15	0.25	0.9	29.0	quartz-calcite vein
128.30-	128.50	0.2	0.5	16.5	calcite-quartz vein
200.60-	202.90	2.3	0.66	10.3	quartz vein with sil-arg lp tuff
242.55-	246.40	3.85	0.2	5.1	sil-arg tuff br with quartz vein
252.20-	253.15	0.95	0.25	10.0	quartz veinlets network zone (brecciated zone)
261.70-	270.85	9.15	0.17	3.0	fault breccia zone
274.40-	274.80	0.4	0.2	10.0	quartz vein
278.70-	278.93	0.23	0.1	8.0	quartz vein

5) MJPC-5 (Location 9'370,233N, 716.190E: altitude 1774.53 m)

i) Geology and alteration

The constituent rock in this hole is Oyotun Volcanics, composed mainly of dacitic lapilli tuff, partly intercalated with tuff and intruded by andesite dyke.

0.00-	2.75m	weathered lapilli tuff with limonite
2.75-	4.15	silicified to weakly silicified lapilli tuff
4.15-	6.30	quartz vein
6.30-	19.40	silicified lapilli tuff
19.40-	19.60	quartz vein
19.60-	31.75	silicified lapilli tuff
31.75-	32.40	quartz vein
32.40-	46.80	silicified lapilli tuff
46.80-	47.05	quartz vein
47.05-	51.00	silicified lapilli tuff
51.00-	51.20	quartz vein
51.20-	69.60	silicified lapilli tuff
69.60-	70.15	quartz vein
70.15-	74.40	silicified lapilli tuff

74.40- 74.70m	quartz vein
74.70- 76.90	silicified lapilli tuff
80.45- 90.75	silicified lapilli tuff
90.75- 91.30	fault breccia zone with gray clay
91.30-100.35	silicified lapilli tuff
100.35-102.25	andesite
102.25-121.45	silicified lapilli tuff intercalated with tuff
121.45-123.45	quartz vein
123.75-135.40	intensely silicified and silicified lapilli tuff
135.40-163.60	chloritized lapilli tuff
163.60-170.50	silicified lapilli tuff

Throughout the core in this hole, relatively intense silicification is observed. Argillization is also observed throughout the core. Chloritization is intermittent and weak except for around quartz veins.

Under the microscope, specimens have undergone silicification, argillization, chloritization as well as rather intense carbonatization.

By taking into due consideration the X-ray diffractive analysis, it is inferred that ankerite occur as carbonate and kaolinite as clay minerals (Apx.1,4; C-5, 74.5).

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals except for weathered leached zone (0 -2.75m). Visible sulfide minerals are composed mainly of pyrite, tetrahedrite, sphalerite and galena. Among them, pyrite is observed throughout the core, and others only in quartz veins and veinlets network zone.

Under the microscope, chalcopyrite is observed as sulfide other than above-shown minerals (Apx.5,6).

Results of chemical analysis of ore samples are as follows:

Depth		Core length	Au	Ag	Remarks
m	m	m	g/t	g/t	
4.15-	5.30	1.15	1.15	9.5	quartz vein
19.40-	19.60	0.2	1.05	22.5	quartz vein
31.75-	32.40	0.65	0.9	35.5	quartz vein
46.80-	47.05	0.25	1.35	8.0	quartz vein
51.00-	51.20	0.2	0.25	9.0	quartz vein
69.60-	70.15	0.55	0.18	6.0	quartz vein
74.40-	74.70	0.3	2.3	7.5	quartz vein
76.90-	80.45	3.55	0.51	7.0	silicified lp tf with quartz v.
121.45-	123.75	2.3	1.65	53.5	quartz vein
123.75-	125.30	1.55	0.85	4.5	quartz veinlets network zone

6) MJPC-6 (Location 9'370,234N, 716.191E: altitude 1773.60 m)

i) Geology and alteration

The constituent rock in this hole is Oyotun Volcanics, composed mainly of dacitic lapilli tuff, partly intercalated with tuff breccia and intruded by andesite dyke.

0.00- 3.00m	weathered lapilli tuff with limonite
3.00- 23.80	silicified lapilli tuff
23.80- 24.36	quartz vein
24.36- 53.25	silicified lapilli tuff
53.25- 53.80	quartz vein
53.80- 61.90	silicified lapilli tuff
61.90- 66.20	silicified breccia with quartz veinlets network
66.20- 70.30	silicified lapilli tuff
70.30- 71.00	quartz vein
71.00- 91.20	silicified lapilli tuff
91.20- 91.40	quartz vein
91.40- 97.05	silicified lapilli tuff
97.05- 97.32	quartz vein
97.32- 97.75	fault breccia zone
97.75-119.10	silicified lapilli tuff
119.10-119.50	quartz veinlets network
119.50-120.80	silicified lapilli tuff
120.80-122.00	quartz vein network (brecciated zone)
122.00-127.10	silicified lapilli tuff
127.10-127.82	quartz vein
127.82-129.42	silicified lapilli tuff
129.42-129.67	brecciated quartz vein
129.67-136.40	silicified lapilli tuff
136.40-136.60	quartz vein
136.60-146.10	silicified lapilli tuff
146.10-147.30	andesite
147.30-148.40	silicified lapilli tuff
148.40-149.20	andesite
149.20-156.35	silicified lapilli tuff
156.35-160.85	quartz vein, at hanging side of 0.7m brecciated
160.85-205.85	silicified lapilli tuff
205.85-210.30	silicified tuff breccia
210.30-210.60	quartz vein
210.60-211.50	silicified breccia with quartz veinlets network
211.50-213.95	silicified tuff breccia
213.95-214.90	silicified breccia with quartz veinlets network
214.90-230.85	silicified tuff breccia

Throughout the core in this hole, relatively intense silicification is observed. Argillization is also observed through-out the core and seems to be weak as it becomes deeper. Chloritization is weak and localized.

Under the microscope, specimens have undergone silicification, argillization, chloritization as well as rather intense carbonatization.

All grains of quartz in silicified breccia (Apx.1; C-6, 62.2) and brecciated zone with quartz vein (C-6, 156.6) show distinct undulatory extinction to suggest that specimens have undergone tectonic movement. Moreover, although it has undergone intense recrystallization to loose the original rock structure, the latter specimen is composed mainly of fine-grained (20 micronmeter) equigranular quartz grains to suggest it can be derived from quartzite of Goyllarisquizga Group.

Andesite is equigranular and porphyritic, similar to C-4, 85.4 but rather finer. It is rather fresh and has undergone weak sericitization, chloritization as well as carbonatization. It is an intrusive rock.

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals except for weathered leached zone (0-3.0m). Visible sulfide minerals are composed mainly of pyrite, sphalerite, chalcopyrite and tetrahedrite. Among them, pyrite is observed throughout the core, and others only in quartz veins and veinlets network zone.

Under the microscope, galena is observed as sulfide other than above-shown minerals. In specimen C-6,97.2, sphalerite includes a large amount of fine-grained pyrite as small as 2 micronmeter.

Results of chemical analysis of ore samples are as follows:

Depth	Core length	Au	Ag	Remarks
m m	m	g/t	g/t	
23.80- 24.36	0.56	3.45	26.0	quartz vein
53.25- 53.80	0.55	0.70	6.5	quartz vein
61.90- 66.20	4.30	0.41	7.2	silicified breccia
70.30- 71.00	0.70	0.55	22.5	quartz vein
91.20- 91.40	0.20	0.20	12.5	quartz vein
97.05- 97.32	0.27	0.40	12.5	quartz vein
119.10-119.50	0.40	0.10	2.5	quartz network vein
120.80-122.00	1.20	0.55	5.0	quartz network vein (brecciated)
127.10-127.82	0.72	0.70	6.5	quartz vein
129.42-129.67	0.25	0.25	2.0	brecciated quartz vein
136.30-136.60	0.30	0.20	14.5	quartz vein
156.35-160.85	4.50	0.99	29.1	quartz vein
210.30-211.50	1.20	0.66	18.9	quartz v to vlet network zone
211.50-213.95	2.45	0.10	2.5	silicified tuff breccia
213.95-214.90	0.95	0.30	4.0	quartz veinlets network

1-3 Consideration

This survey area consists of the Oyotun Volcanics. Silicified and combined silicified-argillized zones are widely developed in the Oyotun Volcanics, and among them those closely connected with geochemical anomaly are found at Hualatan west.

In the central part of the alteration zone there exists a rise of resistivity basement extracted as high resistivity zones. It is suggested that the rise can reflect the intrusion structure of these intrusive rocks of granites or diorite-granodiorite in the western part of the survey area.

It is clarified, through the gravity prospecting that the gravity basement has the density of 2.8g/cm3. The value is rather higher (4.5%) than observed density (2.68g/cm3) of granitic rocks which is inferred to constitute the basement. Meanwhile, as shown in Table II-3, the arithmetic mean of density (2.71: 3 specimens) of drilling core is 5.9% higher than that (2.56:12 specimens) of the specimen taken from surface. It has been clarified through this year survey that drilling cores have undergone distinct carbonatization rich in Mn, Fe and Mg and it may make the density higher. Basement granitic rocks may also undergo regional carbonatization to make the density higher. In this case, the density can be as high as 2.84g/cm3 (2.68 X 1.059). The area extracted as high density almost coincides with the area extracted as concentration of quartz veins last year, and with the area confirmed as highly carbonatized through this year survey.

As the result of the drilling survey, it has been clarified that quartz vein exposed on the surface continues to the underground as deep as 200m, as large-scaled tectonic zone with quartz vein or its concentration. Due to the thick covering by plants, to confirm on the surface for the extension of the large-scaled tectonic zone extracted by drilling core observation has been difficult and left for further survey.

Though the drilling survey was conducted to confirm the mineralization zone just beneath the outcrop, the feature of quartz veins on MJPJ-1,2 and MJPJ-3,4 sections (Fig.II-13), suggest that they tend to plunge. If it is the case, the mineralization zone could also plunge but the direction of the plunge is difficult to be estimated for lack of adequate data.

As ore minerals, tetrahedrite, sphalerite, pyrite, chalcopyrite and native gold were observed. The former four were closely associated with each other, thus they were deposited contemporaneously in a short time as xenothermal deposit.

The analyzed results by homogenization temperature for quartz veins ranged from 102° to 194° C, and rather lower values are predominant (Apx.3). The temperature distribution on geological sections (Fig.II-15) show that higher and lower temperature zones develop western and eastern parts of survey area, respectively. It supports the conclusion of last year that granitic rocks in the west part of the survey area plays the important role as a heat source. Temperature values on each geological section are different as shown below. On MJPC-5, 6th section, it is the highest ranged from 111 to 194° C, and decrease to MJPC-1, 2nd section (102° -168° C) and then to MJPC-3,4th section (102° -144° C). As compared with the distribution of short-wave length anomaly

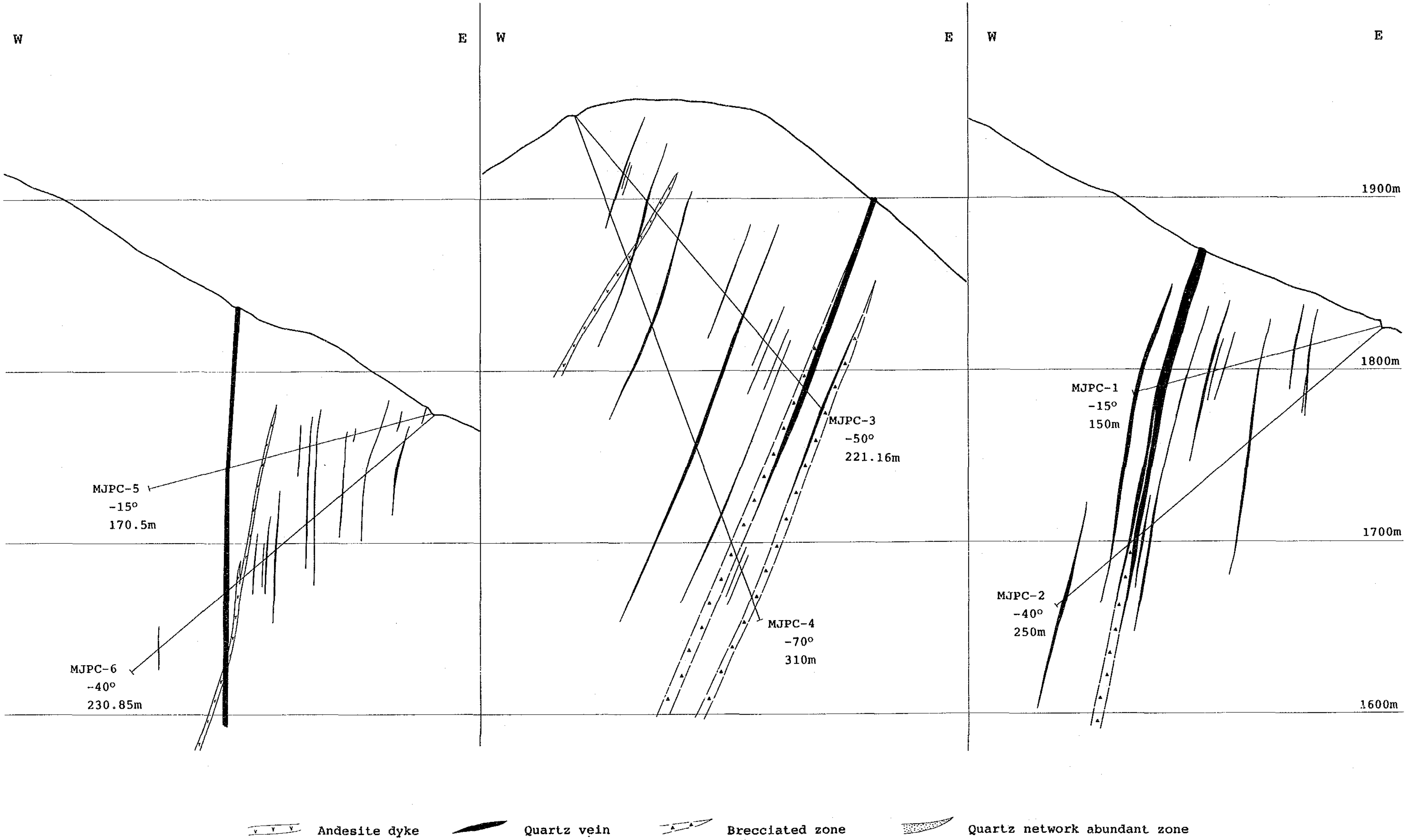


Fig. II-13 Interpretative Profiles of the Drillings in the Chontali Area

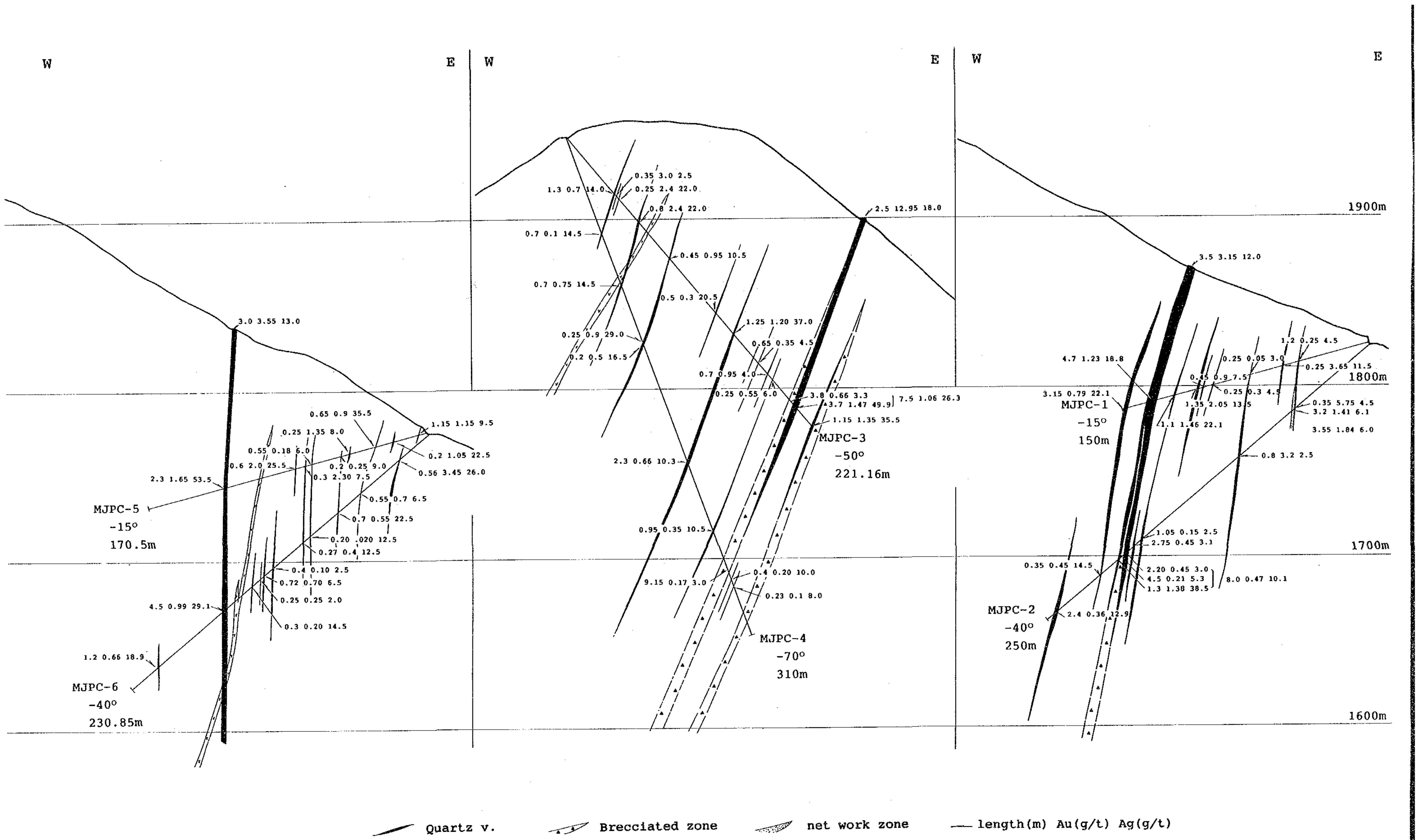


Fig. II -14

Assay Results on the Profiles of the Drillings in the Chontali Area

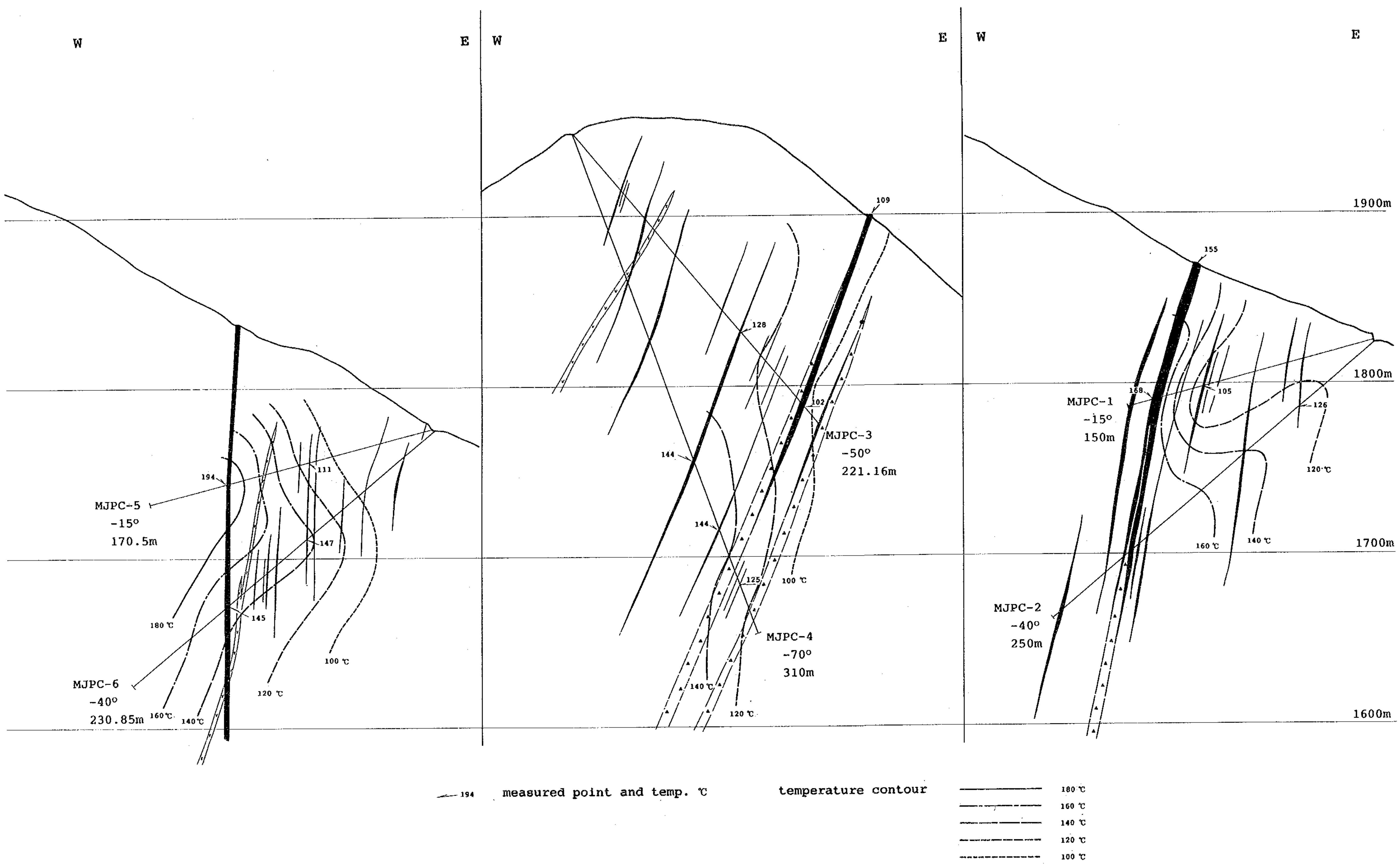


Fig. Ⅱ -15 Distribution of Fluid Inclusion Homogenization Temperature in the Chontali Area

extracted through the gravity prospecting, MJPC-3,4th section of the lowest temperature is situated in high density anomaly part, while the remaining either two on the slope of the high density anomaly part. The short-wave high density anomaly coincides with aforementioned high density zone. If the high density zone is formed by carbonatization, the zone could not be directly related with the gold mineralization, but to the distribution of residue left after the mineralization.

CHAPTER 2 JEHUAMARCA AREA

2-1 Geological Survey and Geochemical Survey

2-1-1 Purpose and method of the survey

The Jehuamarca area includes the mineralized zone extracted by the follow-up study for the anomalies found out by geochemical prospecting in the "Proyecto Geoquimico del Norte". The study was advanced by INGEMMET up to the phase of detailed geological survey on a scale of 1/2500. The first year survey was carried out by adopting a detailed geological survey with the geochemical survey of rock samples to re-evaluate the results obtained by INGEMMET. Moreover geophysical survey using the CSAMT method was conducted to clarify resistivity structure deep underground and the possibility that silicified alteration zone, which was closely related with the mineralization as concluded from the geological survey, exists with a mushroomed structure.

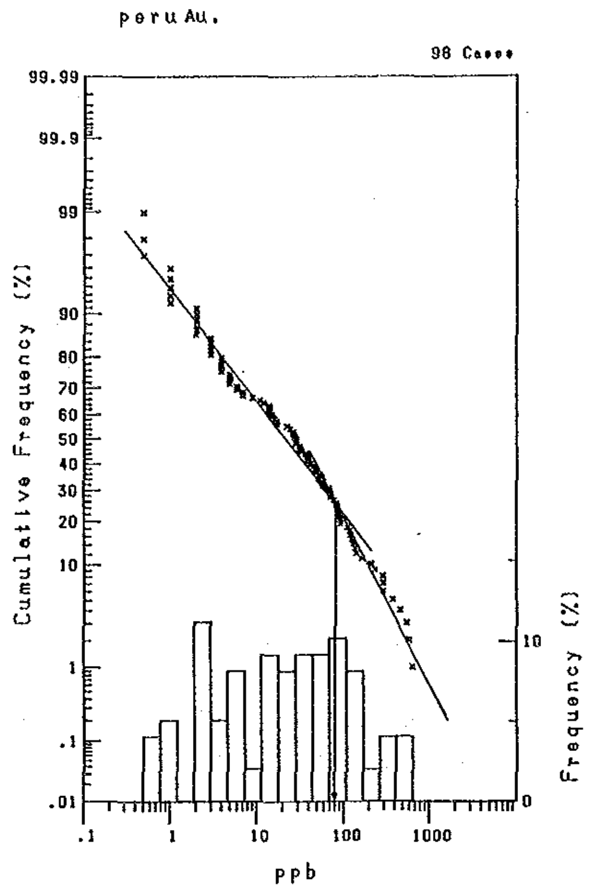
During the second year survey, drilling survey was performed to verify the mineralized conditions in underground silicified mineralization zone with a mushroomed structure and in the silicified breccia with highest anomalous value in the survey area and the existence of three types of mineralization zones as follows:

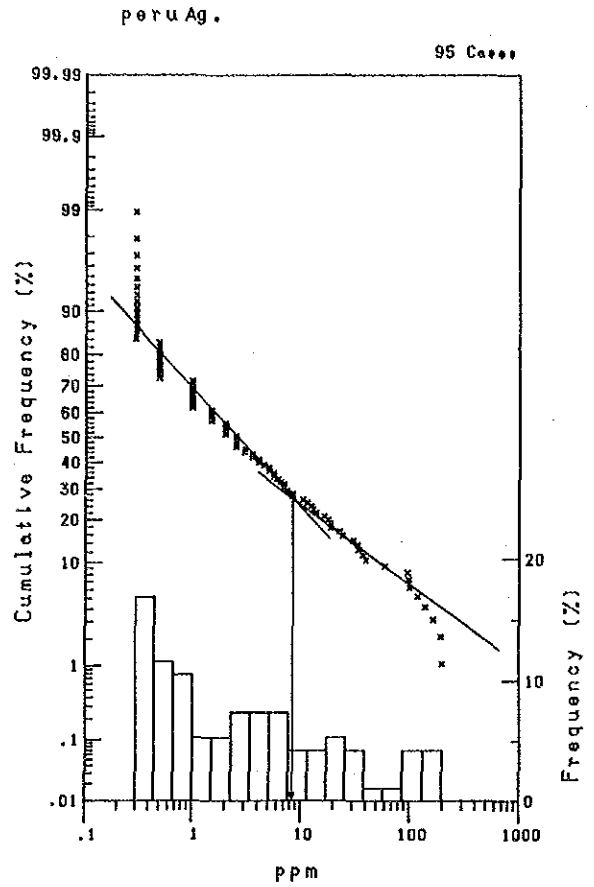
1)Silicified zone can be characterized by a mushroomed structure as interpreted and are associated with low grade base metal disseminated mineralization.
2)In the silicified zone, layered quartz zone exists with high grade base metal mineralization.
3)In the silicified breccia, existence of high grade gold and silver mineralization zone is confirmed.

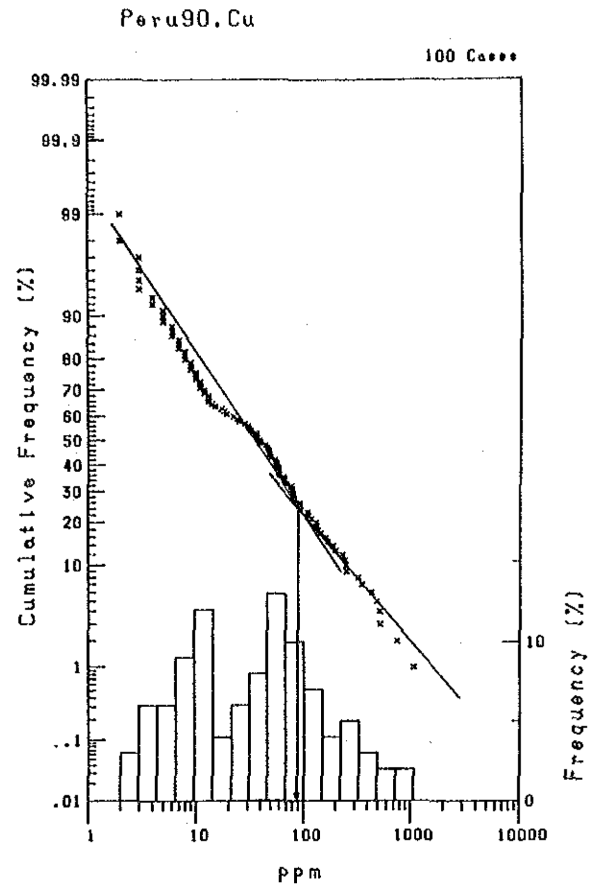
As the surveyed geological map is with a scale of 1/10,000, which has low accuracy if compared with that of drilling survey results, it is inadequate for geological analysis. During third year phase, route maps on the scale of 1/2,000 were made and compiled into a detailed geological map on the scale of 1/2,500.

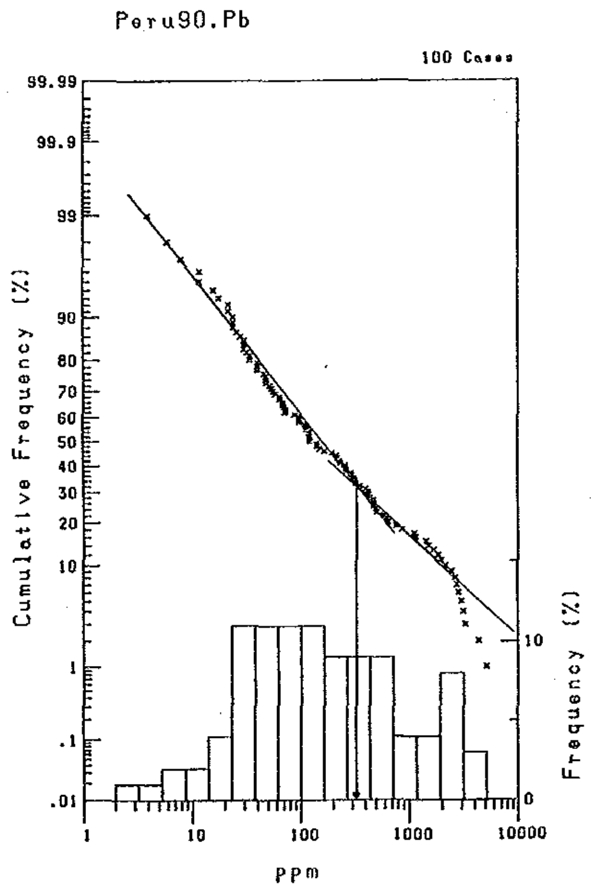
Trench survey was also performed to confirm the mode of occurrence of silicified zone and silicified breccia.

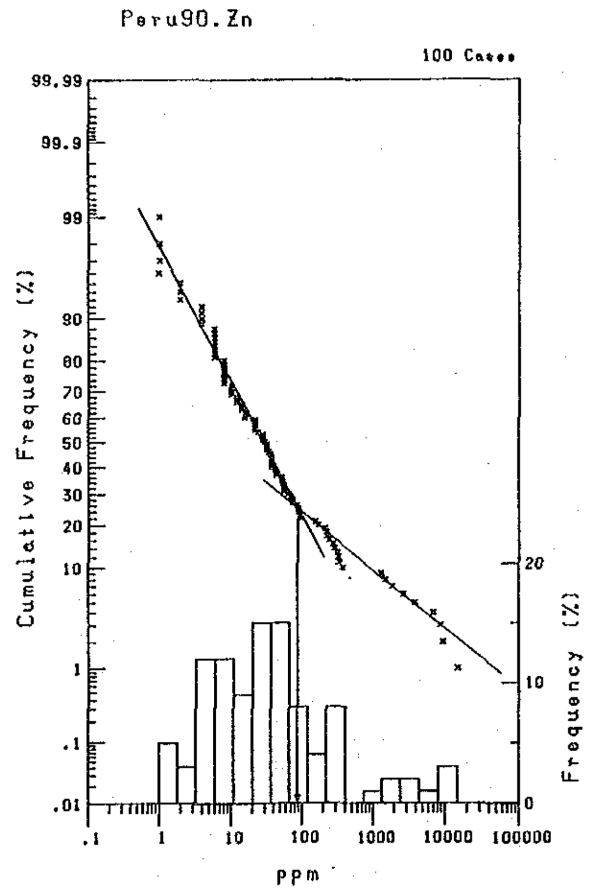
A triangulation map on a scale of 1/2,500 measured by INGEMMET was used as the base map for the survey. The survey was carried out along measuring lines, which were drawn using string measures (100m) and pocketcompasses to make a geological description. Measuring lines were closed with each other, except for in some part of marginal survey area. The revision of error of closure was made in terms of horizontal distance. The altitude was measured based on the that of altitude of 3230.0m at triangulation station J-2 (closest to the point MJPJ-3) confirmed by INGEMMET. The revision of error of closure was made in terms of relative height. As the altitude of MJPJ-1,3 was revised only in











Statistic Element	Au (ppb)		Ag (ppm)		Cu (ppm)	Pb (ppm)	Zn (ppm)
	Whole Sample	Selectsd Sample	Whole Sample	Selectsd Sample	Whole Sample	Whole Sample	Whole Sample
Number of Sample	100	98	100	95	100	100	100
Mean	21.82	19.83	3.656	2.905	33.22	157.0	34.95
Standard Deviation	6.813	6.227	8.330	6.745	4.468	5.502	8.058
Threshold		80		8.5	90	310	90

Fig. II -16 Histogram and Cumulative Frequency Diagram of Geochemical Data in the Jehuamarca Area

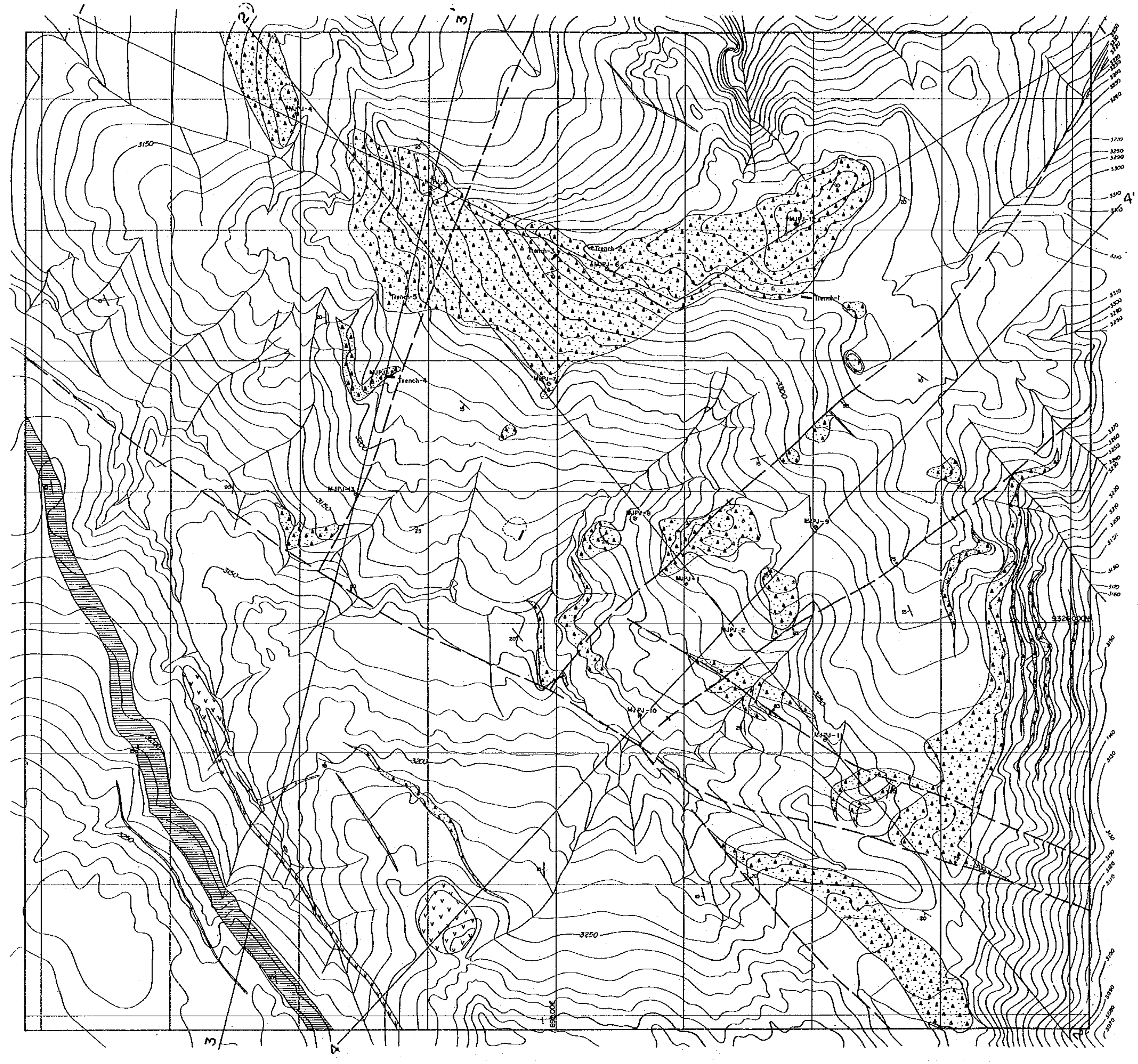
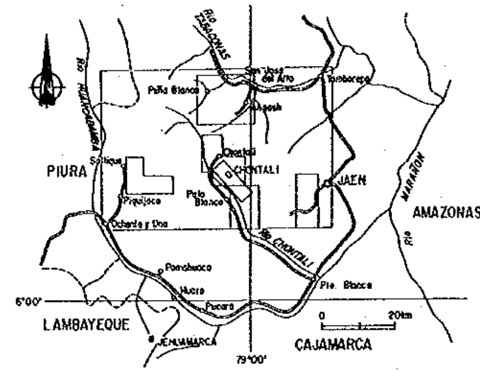


Fig II-17

THE MINERAL EXPLORATION
IN
THE PACHAPIRIANA AREA, REPUBLIC OF PERU
(PHASE Ⅲ)

Geological Map of the Jehuamarca Area



JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN
FEBRUARY 1991
prepared by MINDECO

0 100 200 250m

LEGEND

- Pyroclastics
- Silicified Breccia
- Shale and Tuffaceous Shale
- Andesite
- Rhyolite
- Bedding Plane
- Fault
- Drilling Site in 1989
- Drilling Site in 1990
- Trenching Site

terms of horizontal distance during second year phase, it is revised further in terms of relative height.

2-1-2 Analytical method

The survey results were compiled as a detailed geological map on the scale of 1/2,500, which supplement itself by and to the geological section based on the drilling results of the first and second year phases.

The geochemical samples and ore samples were sent for assay to Chemex Labs Ltd., Canada and to C.H. Plenge & Cia, S.A., Peru, respectively.

The analytical data were statistically processed in a batch for the entire survey area, the cumulative frequency distribution was plotted on normal probability graphs, and the relevant threshold value was extracted as bending point of the cumulative frequency distribution curve, which would discriminate between the background and anomaly values (Fig.II-16). Geochemical anomaly distribution map was prepared for each element. In calculation, as the values above 1 g/ton Au and 200g/ton Ag, which can be deemed as obvious anomaly values responding to the ore grade, the relevant elements were excluded from the statistical processing as in the second year survey. Threshold values used for analysis and the statistical data obtained from the calculation using them are shown in Table II-4.

Table II-4 Geochemical Statistics for the Jehuamarca Area

Statistic	Au(ppb)		Ag(ppm)		Cu(ppm)	Pb(ppm)	Zn(ppm)
Element	W.S.	S.S.	W.S.	S.S.	W.S.	W.S.	W.S.
No Sample	100	98	100	95	100	100	100
Mean	21.82	19.83	3.656	2.905	33.22	157.0	34.95
S.D.	6.813	6.227	8.330	6.745	4.468	5.502	8.085
Threshold		80		8.5	90	310	90

W.S. ; whole sample : S.S. ; selected sample

2-1-3 Geology

Regionally, the survey area consists of the Oyotun Volcanics as basement and Porculla Volcanics unconformably covering it (Wilson, 1984). The area is characterized by the development of pyroclastic rocks composed mainly of andesitic to dacitic tuff breccia and lapilli tuff, intercalated with tuff, welded tuff, tuffaceous sale or tuffaceous silt. These pyroclastic rocks have the gently waved structure but generally trend in NW-SE direction, showing a homoclinal structure dipping gently toward southwest.

The distinct fault fissure system trends NE-SW with dipping steeply and is intersecting perpendicular with geological structure. Additionally, minor branched fissures trending NNW-SSE to NW-SE are also observed, bridging between the main NE-SW system. These fissure systems scarcely disturb the geological structure, therefore, they are concluded to be the secondary systems.

Alteration in this area may have developed taking the said fissures as passage. The central part concentrated by fissures are surrounded by the following zonal alteration zones: silicification-argillization, argillization and/or propylization from center outward. In the flange of the alteration zone, a small scale silicification zone in harmony with the bedding plane was often observed in the argillization zone, suggesting that these alteration zones would have developed preferentially in the specific horizons.

Judged from the results of geochemical survey, the mineralization in this area developed through the NE-SW fissures as the passage and especially occur in a significant scale in the silicification stage and Au mineralization is the representative one.

2-1-4 Survey result

1) Geological survey

This survey area consists of dacitic pyroclastic intercalated with tuffaceous shale beds, and andesitic and rhyolitic dykes intrude them.

Based upon the foregoing surveys, the pyroclastic is correlatable with Porculla Volcanics, composed mainly of dacitic lapilli tuff intercalated with tuff and rarely with tuff breccia. As described in the first year survey, tuffaceous shale develops continuously in the southwestern part of the area. Tuff is extracted in the drilling core, but its continuity is not so good, changing its thickness laterally. The occurrence of tuff breccia is localized. Microscopically, lapilli tuff shows such variable texture as relatively coarse-grained clastic one (R72505) or vitric fluidal one (R102902), all of which have undergone intense sericitization and silicification.

Andesite occurs as sheeted dyke in the southwestern part of the area. Under the microscope, it (R82802) is holocrystalline porphyritic with phenocrysts of plagioclase, skeleton hornblende replaced perfectly by sericite and chlorite, and sometimes biotite. The groundmass is composed of lath-shaped euhedral plagioclase, opaque minerals, apatite and such secondary minerals as chlorite and sericite. Rhyolite occurs as small-scaled dyke or sheet in the northeastern and southwestern part of the area. Under the microscope, it is cryptocrystalline, showing flow and banded structures with 0.1-0.3mm interval.

The fault fissure system trends NW-SE and NE-SW. The displacement along the system is as small as a couple of to 10m. The continuity of the system is not so good. These fissure systems, therefore, are inferred to be the secondary or third systems branched from major one which controls the geologic structure, as

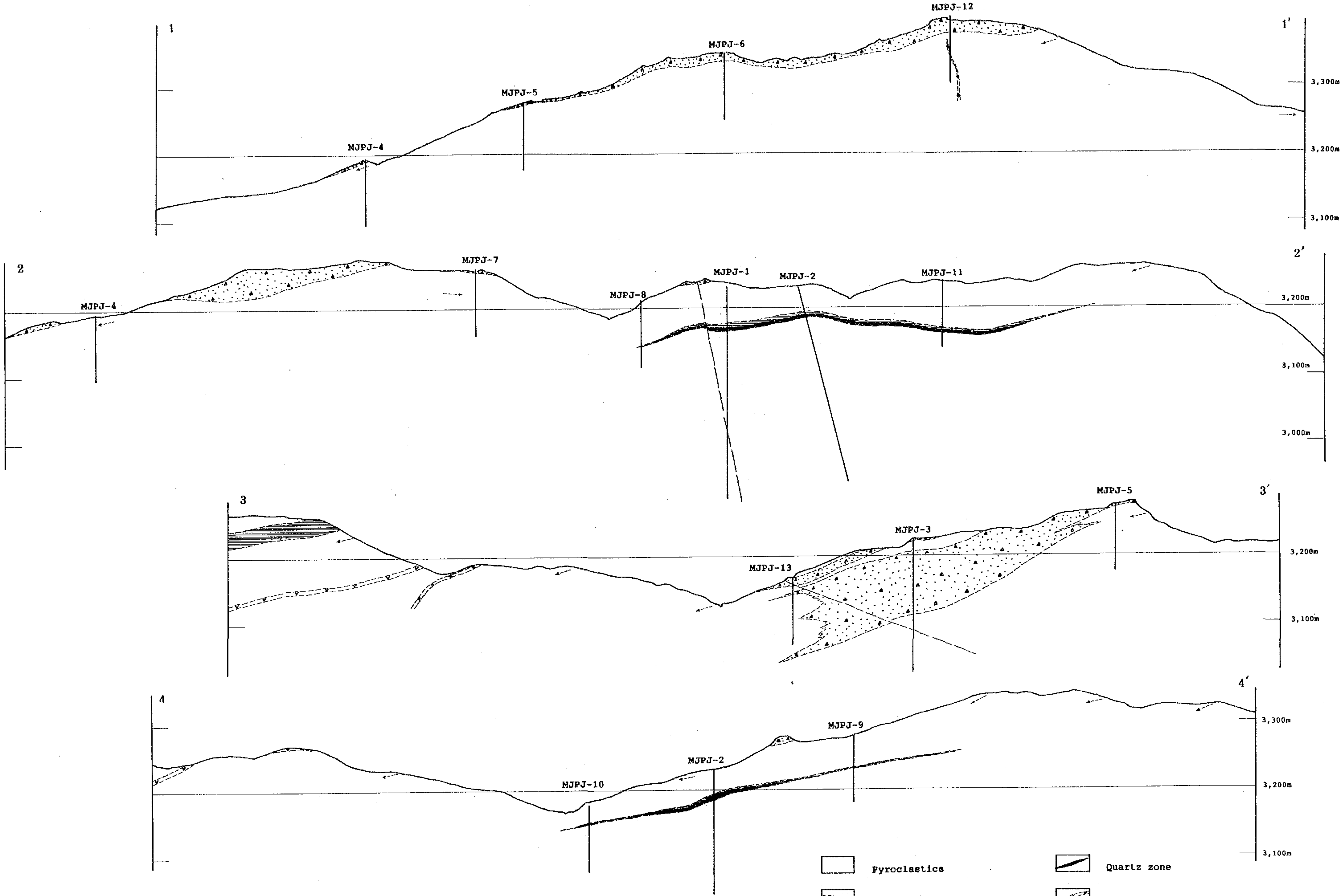


Fig. II -18 Geological Profiles of the Jehuamarca Area

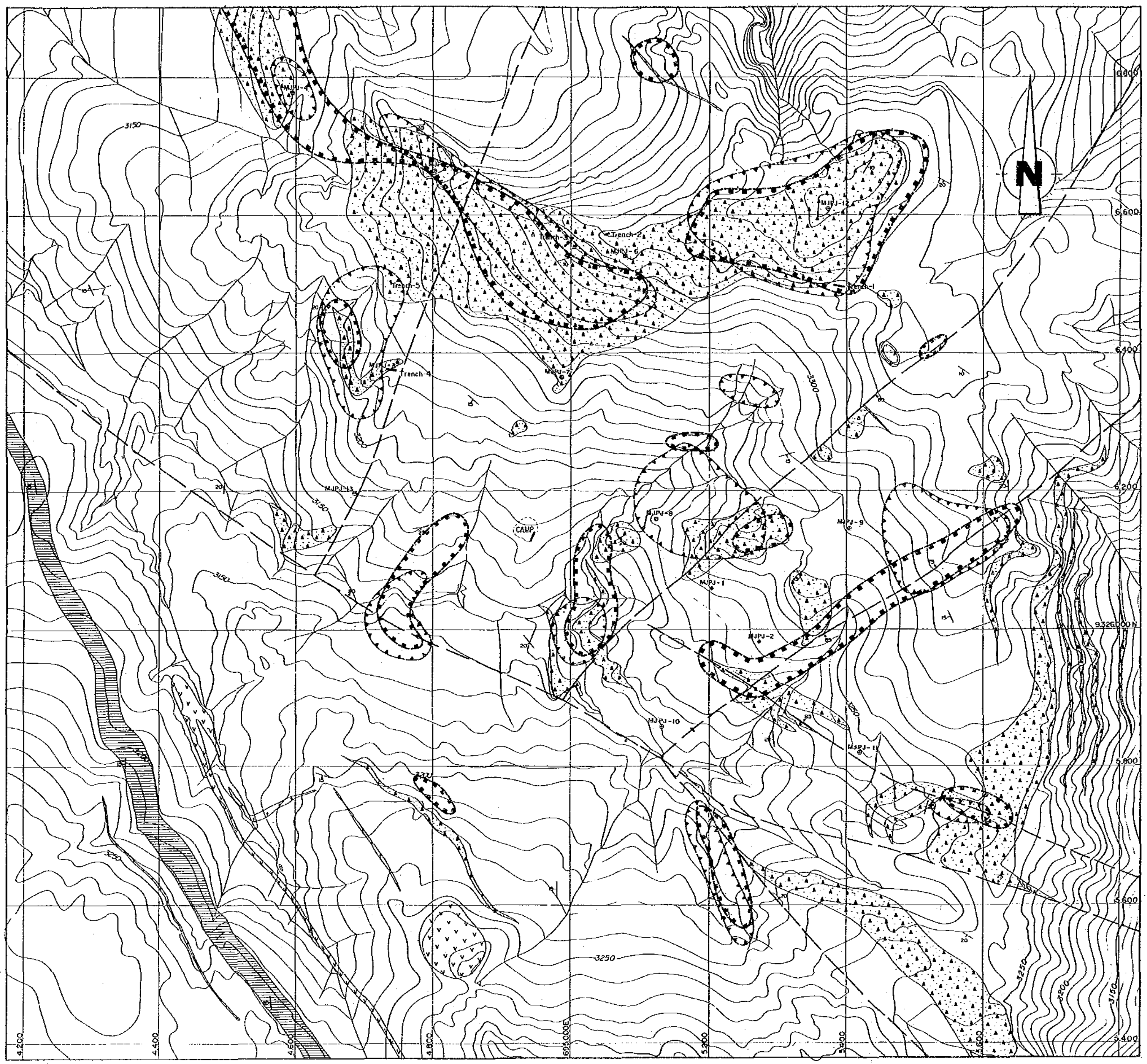
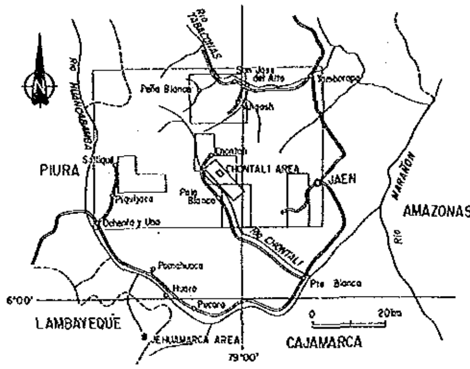


Fig II-19(1)

THE MINERAL EXPLORATION
IN
THE PACHAPIRIANA AREA, REPUBLIC OF PERU
(PHASE III)

Distribution of Geochemical Anomary in the Jehuamarca Area (Au, Ag)



JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN
FEBRUARY 1991
prepared by MINDECO

0 100 200 250m

LEGEND

Au anomaly

Ag anomaly

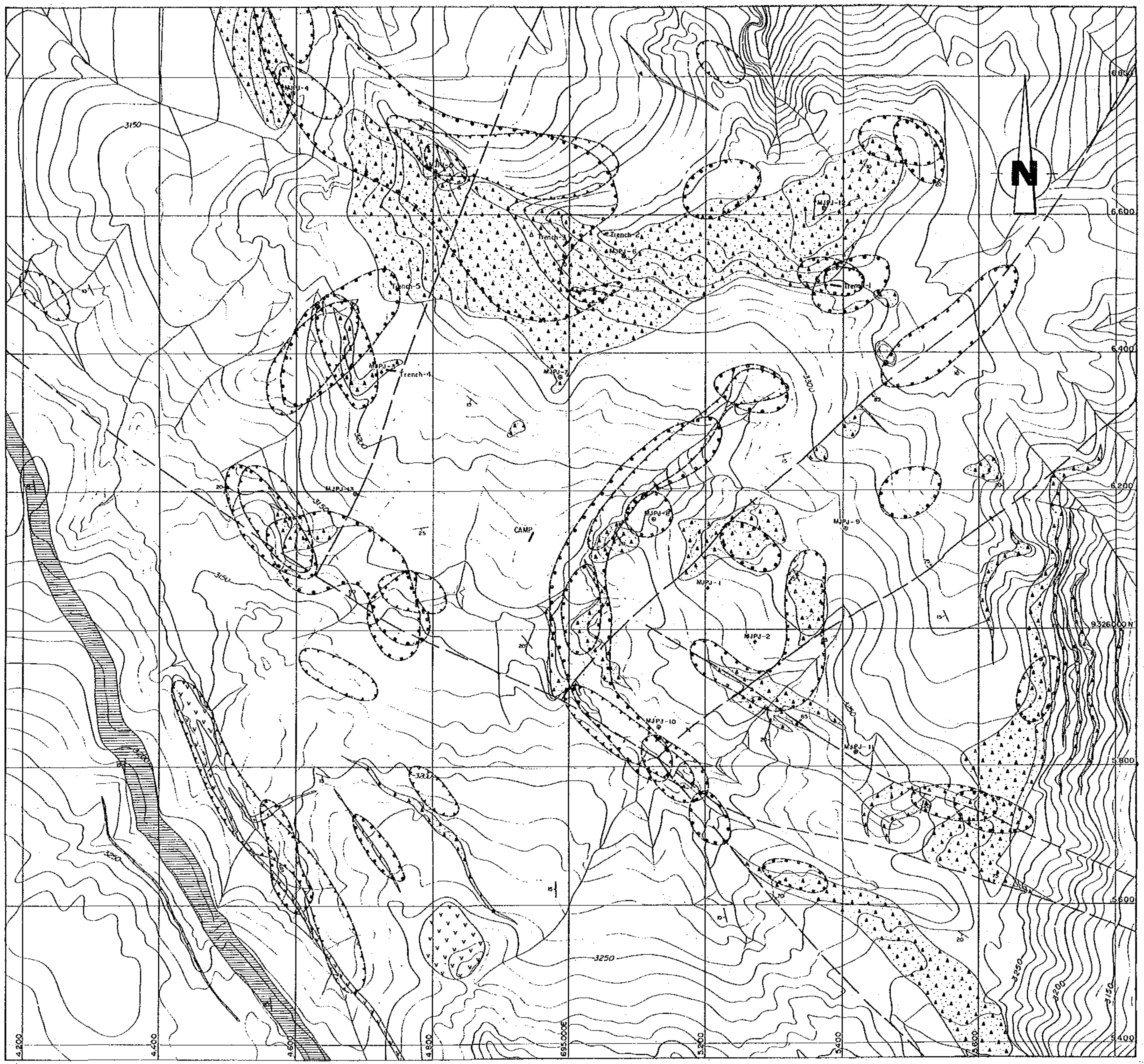
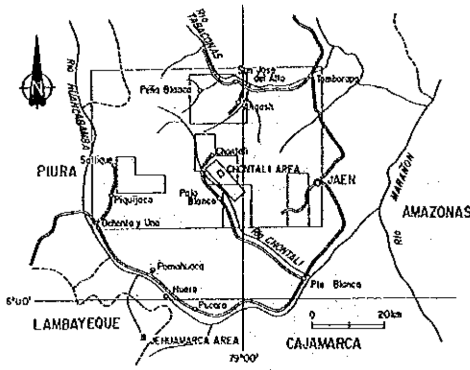


Fig II-19(2)

THE MINERAL EXPLORATION
IN
THE PACHAPIRIANA AREA, REPUBLIC OF PERU
(PHASE III)

Distribution of Geochemical Anomary in the Jehuamarca Area (Pb,Zn,Cu)



JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN
FEBRUARY 1991
prepared by MINDECO

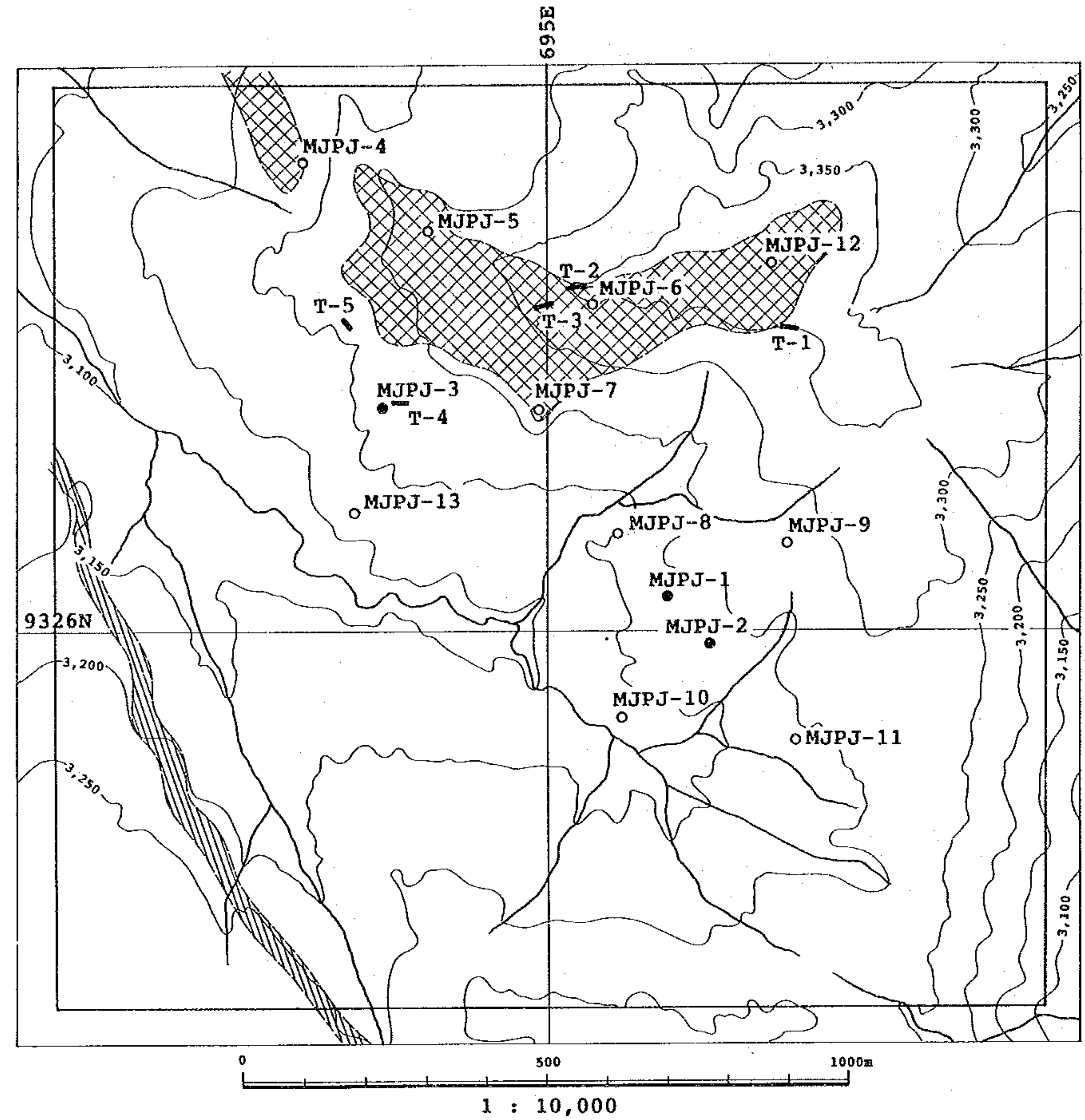
0 100 200 250m

LEGEND

Pb anomaly

Zn anomaly

Cu anomaly



● Drilling Hole in 1989 (MJPJ-1 - MJPJ-3, 3 holes total length 816.25m)

○ Drilling Hole in 1990 (MJPJ-4 - MJPJ-13, 10 holes total length 1,001.55m)

▬ Trenching in 1990 (T-1 - T-5, 5 trenches total length 73.6m)

Silicified Breccia

Tuff and tuffaceous shale alternation zone

Fig. II-20 Location of the Drilling and Trenching sites in the Jehuamarca Area concluded in the first year phase.

The Porculla volcanics, though being slightly displaced and undulated by the said fault system, mainly trend NW-SE with gently dipping toward the southwest as homoclinic (Fig.II-17,18).

Throughout the survey area, rocks have undergone such alteration as silicification, argillization and carbonatization. Silicification affected the central to northern and eastern part, chloritization the southwestern and northeastern parts, while argillization the whole area. By X-ray diffractive analysis, sericite-smectite mixed layer is mainly detected as clay mineral except for R82401, in which sericite is found. Halotrichite is detected from six specimens. These argillized specimens have been taken from fissures close to silicified breccia or quartz vein bearing ones. Therefore, it is suggested that silicified breccia and quartz vein have been formed under relatively low-temperature acidic condition.

During the third phase, trench survey was performed for the purpose of confirming the occurrence of silicified breccia mentioned-above. The locality of trench site and sketch are shown in Fig.II-20 and Apx.14, respectively. At first, silicified breccia was considered to be intrusive breccia by INGEMMET and it was concluded to develop preferentially in the specific horizons by the first year survey. It is clarified, however, that at least a part of it could be tectonic origin by the second year survey. As shown in the sketch based on the results of surface and trench surveys of this year, silicified breccia is confirmed to occur concordantly to the structure of country rock. Moreover, at trench No.1 a high grade lead-zinc ore body (assumed thickness 4m, confirmed length 10m, Au 0.83g/t, Ag 483.9g/t, Cu 0.41%, Pb 0.77%, Zn 9.85%) is affirmed to occur concordantly to the structure of country rock. The occurrence of the ore body is similar to that of quartz zone with high grade base metal mineralization extracted by second year survey.

2) Geochemical survey

The comparison of the geochemical data for Jehuamarca area with mean for whole area of the second year survey is shown in the following (analyses were made in the same laboratory and the values above 1g/ton Au and 200g/ton Ag, which can be deemed as obvious anomaly values responding to the ore grade were excluded).

	Au(ppb)	Ag(ppm)	Pb(ppm)	Zn(ppm)	Cu(ppm)
Mean for Jehuamarca	19.83	2.905	157.0	34.95	33.22
Mean of the second year survey	21.34	0.47	47.88	107.91	53.86

In the comparison of mean for Jehuamarca with that for whole area, Au is similar, while Ag and Pb higher and Zn and Cu lower.

As geochemical survey in the second year phase was conducted in the area including Chontali, where a high possibility of an existence of high grade gold mineralization has been suggested, Au value of the second year survey seems to be too high to use it as mean value for the whole area. Au value for Jehuamarca is higher than that for Pena Blanca(Au: 9.26ppb).

As shown in the distribution of geochemical anomaly (Fig.II-19), gold anomaly tends to be concentrated along silicified breccia or fissures with quartz vein in central to northern and eastern parts of survey area. Silver anomaly tends to be distributed overlapping to the zone of Au anomaly, but the effect by fissures is intense. Lead anomaly tends to be distributed overlapping to the former two anomalies but less continuous, shifting slightly outward. Zinc anomaly tends to be distributed overlapping to lead anomaly and shifting outward furthermore. Zinc anomaly in the southwestern part of the area could be associated with the andesite sheet intrusion. Copper anomaly sometimes tends to be distributed overlapping the other anomalies, but sporadic.

2-2 Drilling Survey

2-2-1 Purpose of the survey

As shown in the foregoing section, three types of mineralization zone has been confirmed in this area. Among them, *low grade base metal disseminated mineralization zone along the* silicified zone seems to be in large scale but less profitable, even if its scale merit is considered. During the third year phase, therefore, drilling survey was conducted in order to verify the extension of high grade base metal mineralization in quartz vein and gold and silver mineralization in silicified breccia.

The surveyed mineralization types in each drilling hole is as follows;

Gold and silver mineralization zone in silicified breccia;
MJPJ-4, 5, 6, 7, 12 and 13

High grade base metal mineralization zone in quartz zone;
MJPJ-8, 9, 10 and 11

2-2-2 Method of the survey

1) Outline of the survey

Drilling was performed taking the local drilling company into employment, under the direction of the drilling engineer, who as a rule stayed during the operation. Drilling was conducted using model L-38 with maximum capacity of up to 725m deep(BQ), to gain total hole length of 1001.55m at ten sites.

Operations were conducted in three shifts of 8 hours each under the direction of a site overseer from the company. Each shift is constituted by one local foreman and five operators. The wireline method was adopted as well as using a bit at least larger than NX to get high core recovery and high operation efficiency, except for MJPJ-11.

Drilling covers 120 days, from July 14 to November 10, 1990 and content of the drilling at each hole is as follows (Apx.15):

Drilling hole	Hole length(m)	Core length(m)	Core recovery(%)
MJPJ- 4	100.0	98.65	98.7
MJPJ- 5	100.5	99.05	98.6
MJPJ- 6	100.0	97.5	97.5
MJPJ- 7	100.0	98.9	98.9
MJPJ- 8	100.0	99.35	99.4
MJPJ- 9	100.0	100.0	100.0
MJPJ-10	100.5	99.65	99.2
MJPJ-11	100.0	95.2	95.2
MJPJ-12	100.15	98.65	98.5
MJPJ-13	100.4	96.75	96.4

2) Drilling procedure

(1) Transportation of rigs and materials

Drilling rigs and materials were transported from Lima to Pucara by trucks, from Pucara to Jehuamarca by helicopter, ending on July 27. Fuel oil and mud were transported from Pucara to the drilling sites by horses in two days.

(2) Construction of routes, heliport and land levelling each site

Construction of routes, heliport and levelling around each site was performed by human power.

(3) Setting up

Setting up of rigs and drilling operations was made in the following order of hole number, MJPJ-7, MJPJ-4, MJPJ-5, MJPJ-6, MJPJ-9, MJPJ-8, MJPJ-11, MJPJ-10, MJPJ-12 and MJPJ-13.

(4) Water transportation

Water was transported from a stream, downward from the base camp, to each site using hoses of 1 inch in diameter and pumped.

(5) Drilling operation (Apx.15-1(4)--15-1(8))

i) MJPJ-4 inclination -90°

period	from August 10 to October 14, 1990
hole length	100.0 m
core length	98.65 m
core recovery	98.7 %

0.00-20.25 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 20.25m. At 9m and 20m, all muddy water was lost, failed to stop the lost, and the drilling was continued after injecting grease. After reaching 20.25m, NW casing pipe was set. The rock is weathered lapilli tuff.

20.25-100.0 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. At 32m, 63m and 72m, all muddy water was lost, failed to stop the lost, and the drilling was continued after injecting grease. The rock is alternation of altered lapilli tuff and tuff. Quartz vein was confirmed in 77.8-78.0m.

ii) MJPJ-5 inclination -90°

period	from August 23 to August 28, 1990
hole length	100.5 m
core length	99.05 m
core recovery	98.6 %

0.00-16.25 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 16.25m and NW casing pipe was set. The rock is changed from silicified breccia near the ground surface to weathered tuffaceous rock.

16.25-100.5 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. The rock is altered lapilli tuff. High grade quartz vein was confirmed in 90.6-90.8m.

iii) MJPJ-6 inclination -90°

period	from August 7 to August 11, 1990
hole length	100.0 m
core length	97.5 m
core recovery	97.5 %

0.00-20.45 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 20.45m and NW casing pipe was set. The rock is changed from silicified breccia near the ground surface to weathered tuffaceous rock.

20.45-100.0 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. The rock is altered tuffaceous rock.

iv) MJPC-7 inclination -90°

period	from July 30 to August 3, 1990
hole length	100.0 m
core length	98.9 m
core recovery	98.9 %

0.00-30.8 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 30.8m. At 1m and 2m, all muddy water was lost, then HW casing shoe was used to extend the hole until 4m and NW casing pipe was set. At 15m, water was lost, failed to stop the lost, then the drilling was continued after injecting grease. The rock is weathered lapilli tuff.

30.8-100.0 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. At 60.1m all muddy water was lost, failed to stop the lost, then the drilling was continued after injecting grease. The rock is lapilli tuff with intercalation of altered tuff. Quartz vein was confirmed between 83.05-83.7m.

v) MJPC-8 inclination -90°

period	from October 3 to October 6, 1990
hole length	100.0 m
core length	99.35 m
core recovery	99.4 %

0.00-20.8 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 20.8m and NW casing pipe was set. The rock is weathered tuffaceous rock.

20.8-100.0 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. At 30m all muddy water was lost and rocks were destroyed, then the drilling was continued using NW casing shoe to extend the hole until 31.5m, and NW casing pipe was set. At 50.0m all muddy water was lost, failed to stop the lost, then the drilling was continued after injecting grease. The rock is alternation of altered lapilli tuff, tuff and tuff breccia. Quartz vein was confirmed between in 68.1-68.4m.

vi) MJPC-9 inclination -90°

period	from September 18 to September 21, 1990
hole length	100.0 m
core length	100.0 m
core recovery	100.0 %

0.00-22.0 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 22.0m and NW casing pipe was set. The rock is weathered tuff.

22.0-100.0 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. At 89m muddy water was lost, then the drilling was continued after injecting grease. The rock is lapilli tuff with intercalation of shale and tuff.

vii) MJPC-10 inclination -90°

period from October 10 to October 17, 1990
hole length 100.5 m
core length 99.65 m
core recovery 99.2 %

0.00-20.5 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 20.5m. At 18m, 80% of water was lost, then stopping the lost and NW casing pipe was set. The rock is weathered tuffaceous rock.

20.5-100.0 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. At 25m, 50m, 60m and 75.3m, all muddy water was lost, then the drilling was continued after injecting grease. The rock is altered lapilli tuff with intercalation of fault breccia. Oxidized quartz vein was confirmed between in 25.4-27.2 m.

viii) MJPC-11 inclination -90°

period from September 24 to September 29, 1990
hole length 100.0 m
core length 95.2 m
core recovery 95.2 %

0.00-21.0 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 21.0m and NW casing pipe was set. The rock is weathered tuff breccia.

21.0-71.65 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water until 71.65m. At 30.0m, muddy water was lost, failed to stop the lost, then the drilling was continued after injecting grease and BW casing pipe was set. The rock is altered lapilli tuff with intercalation of tuff, tuff breccia and shale.

71.65-100.0 m

Drilling was performed using BX-WL diamond bit with bentonite muddy water. The rock is altered lapilli tuff. Oxidized quartz vein was confirmed between in 71.6-76.15m.

ix) MJPC-12 inclination -90°

period from October 24 to October 28, 1990
hole length 100.15 m
core length 98.65 m
core recovery 98.5 %

0.00-29.10 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water until 29.1m. Until 3m all muddy water was lost and rocks were destroyed, then the drilling was continued using HW casing shoe to extend the hole until 3.1m, and HW casing pipe was set. At 19.0m all muddy water was lost again, failed to stop the lost, then the drilling was continued after injecting grease and NW casing pipe was set. The rock is silicified breccia with intercalation of altered tuffaceous rock.

29.1-100.0 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. At 35m, 70m and 90m muddy water was lost by 50%, 65% and 70%, respectively. Stopping the lost, the drilling was continued after injecting grease. The rock is altered lapilli tuff sometimes intruded by rhyolitic dyke.

x) MJPC-13 inclination -90°

period	from November 4 to November 7, 1990
hole length	100.4 m
core length	96.75 m
core recovery	96.4 %

0.00-22.05 m

Drilling was performed using NC-WL diamond bit with bentonite muddy water and NW casing pipe was set. The rock is silicified breccia near surface and altered lapilli tuff in the deeper.

22.05-100.4 m

Drilling was performed using NX-WL diamond bit with bentonite muddy water. The rock is altered lapilli tuff with sporadic intercalation of fault breccia.

(6) Transportation between each site and withdrawing

(i) Transportation
From site to site, drilling rigs were transported using their own mechanical power, and other materials by human power.

(ii) Withdrawing
It is left to the employed drilling company.

3) Core observation and sampling

Through the observation of drilling cores, the character and intensity of mineralization and alteration were focused. As for the mineralization, relative abundance of such visible minerals inferred to be primary as pyrite, sphalerite, galena, chalcopyrite and tetrahedrite were confirmed combined with the geological horizons. As for the alteration, the intensity mainly of silicification, argillization and chloritization was described combined with the geological horizons. The relative intensity (frequency of occurrence) of capillarity veinlets, which are too small to show on the columnar section, was described combined with the geological horizons.

In the case of the survey area where the low graded mineralization has undergone, it is desirable to get samples systematically from the whole core, however, samples only for all core of silicified breccia and quartz zone, as well as samples which seems to contain more than 1% of Cu, Pb and Zn from different horizons are selected and split by core spliter.

After the sampling, cores were preserved at the temporary warehouse in Jehuamarca.

2-2-3 Survey result

1) MJPJ-4 (Location 9'326,776N, 694,594E: altitude 3195.28 m)

i) Geology and alteration

The constituent rock in this hole is Porculla Volcanics, composed mainly of lapilli tuff intercalated with tuff.

0.0 - 17.80m	weathered lapilli tuff tinted by limonite
17.8 - 28.0	intensely silicified lapilli tuff with relatively weak limonitization
28.0 - 48.15	intensely silicified lapilli tuff with yellowish-brown tinted by limonite
48.15- 66.25	silicified to strongly silicified lp tuff tinted by limonite
66.25- 72.9	weakly to intensely silicified tuff tinted by limonite
72.90- 77.7	silicified lapilli tuff
77.07- 78.0	compact quartz zone
78.00- 81.6	silicified tuff
81.60-100.0	silicified lapilli tuff

Throughout the core in this hole, relatively intense silicification is observed except for weathered zone on the surface. Argillization is relatively intense in the shallower part, which is is inferred not to be primary alteration but weathering by meteoric water. It is intense in the below-mentioned leached zone. Chloritization is relatively intense in shallower part.

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals, except for the oxidized leached zone of 0-72.9m. The sulfide minerals are composed mainly of pyrite, associated with chalcocite just below the leached zone and with sphalerite in quartz vein and veinlets, and in calcite-rhodochrosite veinlets.

Results of chemical analysis of ore samples are as follows:

Depth	Core length	Au	Ag	Cu	Pb	Zn	Remarks
m	m	g/t	g/t	%	%	%	
77.7-78.0	0.3	0.35	14.0	tr	0.21	0.55	quartz zone

78.0-81.6	3.6	0.47	6.0	tr	0.21	0.32 silicified tuff

2) MJPJ-5 (Location 9'326,663N, 694,804E: altitude 3274.87 m)

i) Geology and alteration

The constituent rock in this hole is Porculla Volcanics, composed mainly of lapilli tuff intercalated with tuff.

0.0 - 4.05m	weathered breccia with yellow brown tint colored by weak limonitization
4.05- 10.05	silicified tuff with yellow brown tinted by limonite
10.05- 21.8	argillized lapilli tuff
21.80- 37.35	chloritized lapilli tuff
37.35- 83.45	silicified lapilli tuff, partly welding
83.45- 87.90	chloritized lapilli tuff
87.90- 90.60	silicified tuff
90.60- 90.80	quartz zone
90.80- 91.30	silicified tuff
91.30- 96.25	chloritized tuff
96.25-100.50	silicified tuff

Relatively intense silicification is observed in the shallower and deeper parts of this hole. Argillization is relatively intense in the shallower part. Chloritization is observed through-out the hole and relatively intense in the middle part.

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals, except for the oxidized leached zone of 0-3.15m. Visible sulfide minerals are composed mainly of pyrite, associated with sphalerite just on the base of silicified breccia (3.15-4.05m), and with a small amount of sphalerite and galena in silicified altered zone.

Under the microscope, silicified breccia (J-5, 3.15) is composed mainly of sphalerite, pyrite, pyrrhotite and galena. Sphalerite sometimes includes very fine grained chalcopyrite (1-2 micronmeter).

Results of chemical analysis of ore samples are as follows:

Depth	Core length	Au	Ag	Cu	Pb	Zn	Remarks
m m	m	g/t	g/t	%	%	%	
0.0 - 4.05	4.05	0.46	13.7	0.01	0.36	0.78	silicified breccia
7.85-11.05	3.55	0.54	19.1	0.02	0.28	0.46	silicified tuff
87.90-96.25	8.35	0.18	27.8	tr	0.11	0.41	sil and chl tuff with quartz zone

3) MJPJ-6 (Location 9'326,540N, 695,080E: altitude 3351.21 m)

i) Geology and alteration

The constituent rock in this hole is Porculla Volcanics, composed mainly of lapilli tuff intercalated with tuff.

0.0 - 12.85m	silicified breccia tinted by limonite
12.85- 25.05	chloritized lapilli tuff
25.05- 34.00	silicified-intensely silicified lapilli tuff
34.00- 34.45	fault breccia and clay zone
34.45-100.00	silicified lapilli tuff

Silicification is intense except for a part of shallower part. Argillization is ubiquitously developed and relatively intense in the shallower part. In the part deeper than silicified breccia, chloritization is observed to be relatively intense in the shallower part.

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals, except for the oxidized leached zone of 0-12.85m. Visible sulfide minerals are composed mainly of pyrite and sphalerite associated with chalcocite and bornite just below the leached zone and with galena in quartz veinlets. Relatively intense mineralization of sulfide is observed in the shallower part of this hole.

Under the microscope, silicified breccia (J-6,1.55) contains rhyolitic rock fragment (Apx.1,2). Mineralization shown below develops along the flow structure in the rhyolitic fragment. In specimen J-6,14.85, silicified-sericitized tuff is intruded by sphalerite bearing quartz vein, which suggests that country rocks were mineralized by the quartz vein.

Results of chemical analysis of ore samples are as follows:

Depth	Core length	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Remarks
0.0 - 6.10	6.10	0.29	6.9	0.01	0.03	0.01	silicified breccia
6.1 -12.85	6.75	1.81	73.7	0.05	0.07	0.02	silicified breccia
12.85-20.45	7.60	0.22	17.1	0.03	0.64	1.02	chloritized lapilli tuff

4) MJPJ-7 (Location 9'326,364N, 694,987E: altitude 3259.87 m)

i) Geology and alteration

The constituent rock in this hole is Porculla Volcanics, composed mainly of lapilli tuff intercalated with tuff.

0.0 - 1.25m	silicified breccia
1.25- 23.20	weathered lapilli tuff tinted by limonite

23.20- 62.30m	silicified lapilli tuff
62.30- 79.80	alternation of chloritized lapilli tuff and tuff
79.80- 83.05	silicified tuff
83.05- 83.70	quartz zone
83.70- 84.40	fault breccia and clay zone
84.40-100.00	silicified lapilli tuff

Silicification is relatively intense except for weathered zone in a shallower part. Argillization is ubiquitously developed and relatively intense in the deeper part. Chloritization is observed to be relatively intense in the shallower part but discontinuous.

ii) Mineralization

The core of this hole underwent relatively intense mineralization of sulfide minerals, except for the oxidized leached zone of 0-23.2m. Visible sulfide minerals are composed mainly of pyrite and sphalerite associated with galena, tetrahedrite and chalcocite. Chalcocite occurs as crust coating pyrite just below the oxidized leached zone, while tetrahedrite sporadically occurs and galena is relatively abundant in the deeper part of this hole.

Under the microscope, sulfide minerals are sphalerite, pyrite, tetrahedrite and galena (J-7, 87.4). Sphalerite includes a large quantity of very fine grained chalcopyrite (2-3 micronmeter) and sometimes galena (20-30 micronmeter).

Results of chemical analysis of ore samples are as follows:

Depth	Core length	Au	Ag	Cu	Pb	Zn	Remarks
m m	m	g/t	g/t	%	%	%	
0.0 - 1.25	1.25	0.05	4.5	0.01	0.25	0.01	silicified breccia
79.80- 81.75	1.95	0.17	25.7	tr	0.12	0.53	silicified tuff
81.75- 85.60	3.85	0.65	222.3	0.05	0.13	0.30	silicified zone with quartz zone and fault breccia
85.60-100.00	14.40	0.18	23.3	0.01	0.30	0.79	silicified lapilli tuff

5) MJPJ-8 (Location 9'326,159N, 695,124E: altitude 3211.70 m)

i) Geology and alteration

The constituent rock in this hole is Porculla Volcanics, composed mainly of lapilli tuff intercalated with tuff and tuff breccia.

0.0 - 18.90m	alternation of weathered lapilli tuff and tuff with colored by limonite
18.90- 28.90	silicified lapilli tuff partly intercalated with chloritized zone chloritized zone
28.90- 29.65	silicified breccia

29.65- 30.75m	alternation of silicified lapilli tuff and tuff
30.75- 36.80	silicified tuff breccia
36.80- 68.10	silicified lapilli tuff with silicified tuff
68.10- 68.40	quartz zone
68.40-100.00	silicified lapilli tuff partly chloritized

Throughout the hole, silicification is relatively intense. Argillization is ubiquitously developed and relatively weak. Chloritization is observed from shallower to the deeper, but localized.

By X-ray diffractive analysis, it is clarified that sericite exists in silicified tuff breccia just below the silicified breccia. Its polytype is inferred to be 2M1. It is also clarified that mineralized zone in quartz zone (J-8, 68.4) contains sericite-smectite mixed layer.

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals including the oxidized leached zone of 0-18.9m. Visible sulfide minerals are composed mainly of pyrite associated with sphalerite, chalcocite and tetrahedrite. Relatively intense mineralization of sphalerite is observed in the deeper part of this hole. Chalcocite is observed just below the oxidized leached zone and tetrahedrite locally.

Under the microscope, it is confirmed that chalcocite and covelline occur as mantle coating tetrahedrite in secondary enriched zone just below the oxidized leached zone (J-8, 31.05). Mineralized zone in quartz zone is composed mainly of tetrahedrite associated with sphalerite and galena (J-8, 68.4).

Results of chemical analysis of ore samples are as follows:

Depth m	Core length m	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Remarks
28.90- 29.65	0.75	0.75	23.5	1.23	0.11	0.44	silicified breccia
29.65- 36.80	7.15	0.96	24.1	0.18	0.41	0.76	silicified lp tuff
65.65- 68.10	2.45	0.25	24.7	0.03	0.10	1.06	silicified lp tuff
68.10- 68.40	0.3	2.8	1065.0	5.11	0.99	9.22	quartz zone
68.40- 69.25	0.85	0.9	264.0	1.67	0.17	1.15	silicified lp tuff
96.60-100.0	3.4	0.12	6.7	0.01	0.05	0.13	silicified lp tuff

6) MJPJ-9 (Location 9'326,146N, 695,406E: altitude 3280.40 m)

i) Geology and alteration

The constituent rock in this hole is Porculla Volcanics, composed mainly of lapilli tuff intercalated with tuff, tuffaceous shale and tuff breccia.

0.0 - 7.65m	weathered lapilli tuff colored by limonite
7.65- 21.10	chloritized lapilli tuff, intercalated with tuffaceous shale and lapilli tuff
21.10- 28.30	silicified lapilli tuff
28.30- 33.80	alternation of chloritized lapilli tuff and tuff
33.80- 37.10	weakly silicified tuffaceous shale
37.10- 43.70	alternation of chloritized lapilli tuff and tuff
43.70- 49.10	weakly argillized tuffaceous shale
49.10- 86.95	alternation of chloritized lapilli tuff, tuff breccia and tuff
86.95- 96.05	alternation of weakly silicified tuffaceous shale and tuff, intercalated with tuff breccia
96.05-100.0	weakly silicified lapilli tuff

Silicification and argillization is ubiquitously developed and relatively weak. Chloritization is observed to be relatively weak in the deeper part, and intense in the middle part.

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals, except for the oxidized leached zone of 0-7.65m. Visible sulfide minerals are composed mainly of pyrite, associated with sphalerite, chalcocite, galena and tetrahedrite.

Chalcocite is observed in the lower part of the oxidized leached zone and tetrahedrite and galena rarely occurs and in local.

Results of chemical analysis of ore samples are as follows:

Depth	Core length	Au	Ag	Cu	Pb	Zn	Remarks
m	m	g/t	g/t	%	%	%	
21.1-28.3	7.2	0.36	11.6	tr	0.41	1.03	silicified lapilli tuff
92.9-97.1	4.2	0.04	6.9	tr	0.27	1.11	silicified lapilli tuff

7) MJPJ-10 (Location 9'325,858N, 695,132E: altitude 3178.62 m)

i) Geology and alteration

The constituent rock in this hole is Porculla Volcanics, composed mainly of lapilli tuff intercalated with tuff and tuff breccia.

0.0- 7.6m	lapilli tuff with intercalation of weathered tuff breccia with colored by limonite
7.6- 25.4	alternation of weakly silicified-silicified lapilli tuff and tuff breccia
25.4- 37.2	quartz zone
37.2-100.5	silicified to intensely silicified lapilli tuff with intercalation of tuff and tuff breccia

Silicification is relatively intense except throughout the hole. Argillization is ubiquitously developed and relatively weak in the deeper part. Chloritization is observed to be rare and localized.

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals, including in the lower part of the oxidized leached zone of 0-16.3m. Visible sulfide minerals are composed mainly of pyrite and sphalerite.

Chalcocite is observed below the oxidized leached zone and galena rarely occurs and in local.

Results of chemical analysis of ore samples are as follows:

Depth	Core length	Au	Ag	Cu	Pb	Zn	Remarks
m m	m	g/t	g/t	%	%	%	
25.40-27.20	1.8	0.09	62.0	0.03	0.06	0.03	quartz zone
27.20-29.95	2.75	0.36	20.3	0.39	0.03	0.36	sil-arg tuff breccia
29.95-47.20	17.25	0.12	5.3	0.05	0.30	2.45	sil lapilli tuff

8) MJPJ-11 (Location 9'325,820N, 695,420E: altitude 3239.81 m)

i) Geology and alteration

The constituent rock in this hole is Porculla Volcanics, composed mainly of lapilli tuff intercalated with tuff breccia, tuff and tuffaceous shale.

0.0 - 5.6m	alternation of weathered lapilli tuff and tuff breccia with colored by limonite
5.6 - 20.0	tuff breccia argillized lapilli tuff
20.0 - 57.6	silicified lapilli tuff with tuff and tuff breccia
57.6 - 71.6	tuffaceous shale intercalated with silicified tuff and tuff breccia
71.6 - 76.15	quartz zone
76.15-100.0	silicified lapilli tuff

Throughout the hole, silicification and argillization are ubiquitously developed and intense. Chloritization is observed in the shallower part.

Under the microscope, though tuffaceous shale (J-11, 71.6) is replaced mainly by sericite, quartz, chlorite and other clay minerals, alternation of tuffaceous and argillaceous parts is easily discriminated.

ii) Mineralization

The core of this hole underwent mineralization of sulfide minerals, except for the oxidized leached zone of 0-5.6m. Visible sulfide minerals are composed mainly of pyrite associated with sphalerite, chalcocite and tetrahedrite. Relatively intense mineralization of sphalerite is observed in the middle part of this hole. Chalcocite is not observed just below but under the oxidized leached zone, as mantle coating pyrite. Tetrahedrite occurs rarely and in local.

Results of chemical analysis of ore samples are as follows:

Depth	Core length	Au	Ag	Cu	Pb	Zn	Remarks
m m	m	g/t	g/t	%	%	%	
29.15-30.4	1.25	0.45	15.0	0.01	0.25	0.70	silicified tuff
65.7 -68.35	2.65	0.39	26.8	0.07	0.19	1.65	silicified lp tuff
71.6 -76.15	4.55	0.42	57.4	0.19	0.05	0.11	quartz zone

9) MJPJ-12 (Location 9'326,608N, 695.172E: altitude 3402.11 m)

i) Geology and alteration

The constituent rock in this hole is Porculla Volcanics, composed mainly of lapilli tuff and rhyolitic dykes intrude.

0.0 - 24.45m	silicified breccia with weathered lp tuff colored by limonite
24.45- 25.30	weathered lapilli tuff with yellow brown tint colored by limonite
25.30- 44.90	silicified lapilli tuff intercalated with weakly silicified zone
44.90- 96.25	chloritized lapilli tuff,rhyorite dykes intrude at 55.35,56.5,58.0-58.7, 60.0-61.9, 66.45-66.6 m
96.25- 97.05	fault breccia with clay zone
97.05-100.0	weakly silicified lapilli tuff

Throughout the hole, silicification is ubiquitously developed and intense in the shallower part. Argillization is also ubiquitous and relatively weak except for the fault zone. Chloritization is commonly observed in the deeper part.

Under the microscope, the boundary between lapilli tuff and rhyolite is distinct (Apx.2; J-12, 58.8), the latter showing chilled margin texture. Both rocks have undergone intense sericitization.

ii) Mineralization

The core of this hole underwent relatively weak mineralization of sulfide minerals, except for the oxidized leached zone of 0-25.3m. Visible sulfide minerals are composed mainly of pyrite rarely associated with sphalerite and chalcocite.

Results of chemical analysis of ore samples are as follows:

Depth		Core length	Au	Ag	Cu	Pb	Zn	Remarks
m	m	m	g/t	g/t	%	%	%	
1.0-	2.5	1.5	0.95	8.0	0.01	0.04	0.01	weathered lp tuff
2.5-	17.2	14.7	0.46	45.9	0.01	0.37	0.01	silicified breccia
19.0-	24.45	4.65	0.88	27.2	0.01	0.47	0.01	silicified breccia

10) MJPJ-13 (Location 9'326,196N, 694.687E: altitude 3167.56 m)

i) Geology and alteration

The constituent rock in this hole is Porculla Volcanics, composed mainly of lapilli tuff with intercalation of tuff and tuff breccia.

0.0 - 12.30m	weathered silicified breccia
12.3 - 23.25	alternation of sil tuff and tuff breccia
23.25- 25.4	silicified breccia
25.4 - 60.9	silicified lapilli tuff intercalated with tuff
60.9 - 61.5	fault breccia with clay zone
61.5 -100.4	silicified lapilli tuff intercalated with thin bed of tuff breccia

Throughout the hole, silicification and argillization are ubiquitously developed. The former is relatively intense in the shallower part. Argillization is relatively weak except for the fault zone. Chloritization is commonly observed in the deeper part.

By X-ray diffractive analysis, it is clarified that sericite of 1M polytype exists in tuff breccia, which could be fault zone (18.35m).

ii) Mineralization

The core of this hole has underwent relatively intense mineralization of sulfide minerals including the oxidized leached zone of 0-17.2m. Visible sulfide minerals are composed mainly of pyrite and sphalerite associated with chalcocite and tetrahedrite. Chalcocite is observed in the middle and under the oxidized leached zone. Tetrahedrite occurs in silicified breccia of the shallower part.

Under the microscope, it is confirmed that pyrite, tetrahedrite, sphalerite, galena and chalcopyrite occur in the above-mentioned specimen (J-13, 18.35). Secondary chalcocite replaces the cavity within tetrahedrite.

Results of chemical analysis of ore samples are as follows:

Depth	Core length	Au	Ag	Cu	Pb	Zn	Remarks
m	m	g/t	g/t	%	%	%	
1.8 - 9.4	7.6	0.34	84.0	0.04	0.12	0.03	silicified breccia
9.95-12.3	2.35	0.25	98.6	0.05	0.09	0.02	silicified breccia
17.2 -20.0	2.8	0.27	109.2	0.19	0.08	0.05	silicified lp tuff
37.3 -44.8	7.5	0.39	18.7	0.01	0.41	1.34	silicified lp tuff
49.9 -55.9	6.0	0.35	14.2	0/01	0.26	0.86	silicified lp tuff

2-3 Consideration

The Porculla volcanic rocks in this survey area have the gently waved structure, though being slightly displaced and undulated by the fissure systems, and mainly trend NW-SE with gently dipping toward the southwest as homoclinic (Fig.II-18). It is rare to recognize on the drilling core the underground continuity of fissure systems confirmed on the surface. It is not also the case to recognize the continuity on the surface the underground fault breccia zone confirmed in the drilling core. The fissure systems, therefore, must be the secondary one branched from regional fault systems as concluded until the last year.

As the whole survey area is considered to be the silicification-argillization zone, further regional survey is needed to clarify the lateral distribution pattern of the alteration zone. The vertical distribution has not also been confirmed because drilling holes of this year survey were too short to reach to propylite zone under the "mushroom-like" underground structure as inferred to exist by the surveys until last year.

Through this year survey of surface geology, the genetic environment of the silicified rocks was tried to be clarified by X-ray diffractive analyses mainly for silicified rocks. As a result of the analyses it is clarified that clay minerals associated with silicified rocks are composed mainly of sericite -smectite mixed layer and that halotrichite occurs close to the silicified breccia and in fissures with quartz veins. These facts suggest that silicified breccia and quartz zones were formed under rather low temperature and acidic environment. Meanwhile, it was concluded by the first year survey that the alteration environment is relatively neutral to alkaline, because the polytype of sericite is only of 1M. Through the last year survey, diaspore and pyrophyllite were found in the silicified rock near the bottom of MJPJ-1 to suggest the environment could be rather high temperature and acidic. Moreover, high-temperature 2M1 polytype was found from the base of silicified breccia in MJPJ-3 and it was concluded that mineralized-alteration could been progressed through the base of the breccia as passage of fluid.

All things considered, it can be inferred that at first argillization was progressed under neutral to alkaline environment, then acidic mineralization fluid ascended mainly around MJPJ-1 through the fault-fissure system or the bedding boundary to mineralize and silicify the surroundings. This leads to a better understanding of the concentration of geochemical anomalies for gold, silver, lead and partly zinc to the silicified rocks and along the fissures. The anomalies for copper and a part of zinc cannot be attributed to the above-shown model and left for further investigation.

Quartz zone expected to associate high-grade base metal mineralization is confirmed to occur as a layer, but it is discontinuous and changes its thickness and grade frequently. Therefore, there is a small possibility that it develops to a large scale high-grade ore body.

Silicified breccia expected to associate high-grade gold and silver mineralization is confirmed to occur also as a layer, but it is lower grade than expected, therefore seems not to be profitable as affairs now stand.

Following is mean thickness and mean grade of confirmed silicified breccia and quartz zone.

	thickness	average grade				
		Au	Ag	Cu	Pb	Zn
	m	g/t	g/t	%	%	%
silicified breccia	4.31	0.58	38.0	0.04	0.34	0.10
quartz zone	1.70	0.97	160.7	0.72	0.83	2.54

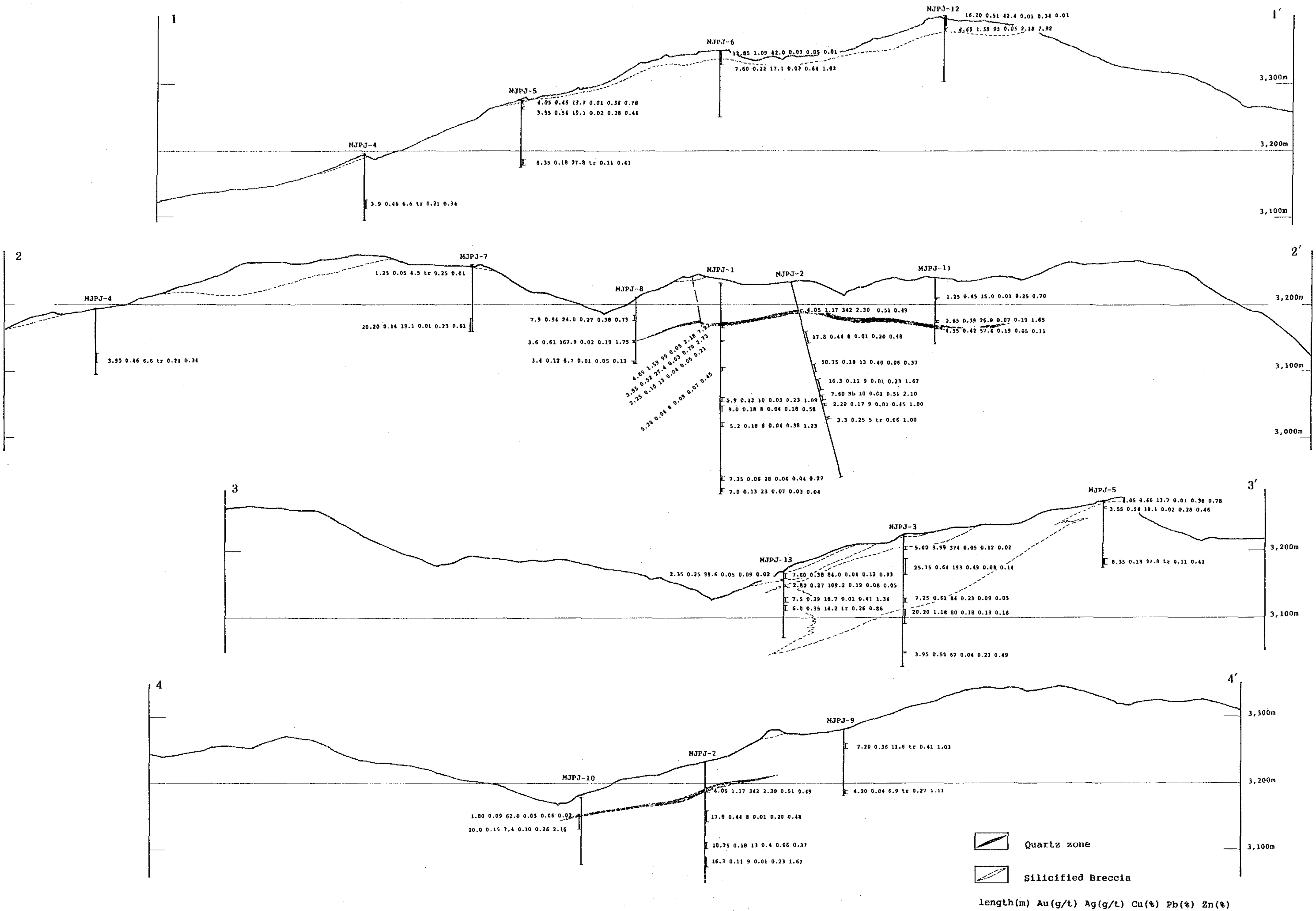


Fig. II -21 Assay Results on the Profiles of the Drillings in the Jehuamarca Area

PART III CONCLUSION AND RECOMMENDATION

CHAPTER 1 CONCLUSION

It is clarified, through this year survey in Chontali and Jehuamarca areas, that secondary fissure systems trending NE-SW and NW-SE develop branched from regional fault system in acidic pyroclastic rocks, the ages of which are different between both areas. Mineralization is concluded to progress through the fissure systems.

1-1 Chontali Area

It is concluded that alteration-mineralization occurs along the relatively large-scaled NW-SE fissure zone developed between the regional NE-SW fault system in Oyotun Volcanics correlatable to Jurassic. The fissure zone, although unclear on the surface, is extracted as distinct breccia zone in drilling cores and quartz grain in it microscopically shows distinct undulatory extinction.

The basement structure inferred by the resistivity survey last year is clarified, through the gravity prospecting that the gravity basement has higher density of 2.8g/cm3. The value is higher than that of inferred basement granitic rocks. It, therefore, may well be said that basement granitic rocks have undergone carbonatization rich in heavy metal to make the density higher, which is extracted in drilling cores. It is inferred that gravity basement high suggest the existence of underground carbonatized alteration zone.

Native gold grains are confirmed by microscopic observation and ore minerals containing such metals as silver, zinc, lead and copper are closely associated with each other, thus the mineralization environment is assumed to be xenothermal.

The analyzed results by homogenization temperature for quartz veins ranged from 102° to 194° C, and rather lower values ranged from 102° to 168° C are predominant, except for a specimen which gives the temperature within the range most adequate for gold mineralization (180° to 230° C). It is inferred that a zone most adequate for gold mineralization can exist deeper than the depth of altitude 1700m, until which this year survey has reached.

The temperature distribution on any geological drilling sections show that higher and lower temperature zones develop western and eastern parts of survey area, respectively. It supports the conclusion of last year that granitic rocks in the west part of the survey area plays the important role as a heat source. Among the aforementioned high density zones, the northernmost zone, where drilling survey was carried out, shows the lower homogenization temperature in the central (MJPC-3,4 section), the value increasing toward the north and the south (MJPC-1,2 and MJPC-5,6 sections respectively). If the high density zone is formed by carbonatization, the zone could not be directly related to the gold mineralization but to the distribution of residue left after the mineralization.

1-2 Jehuamarca Area

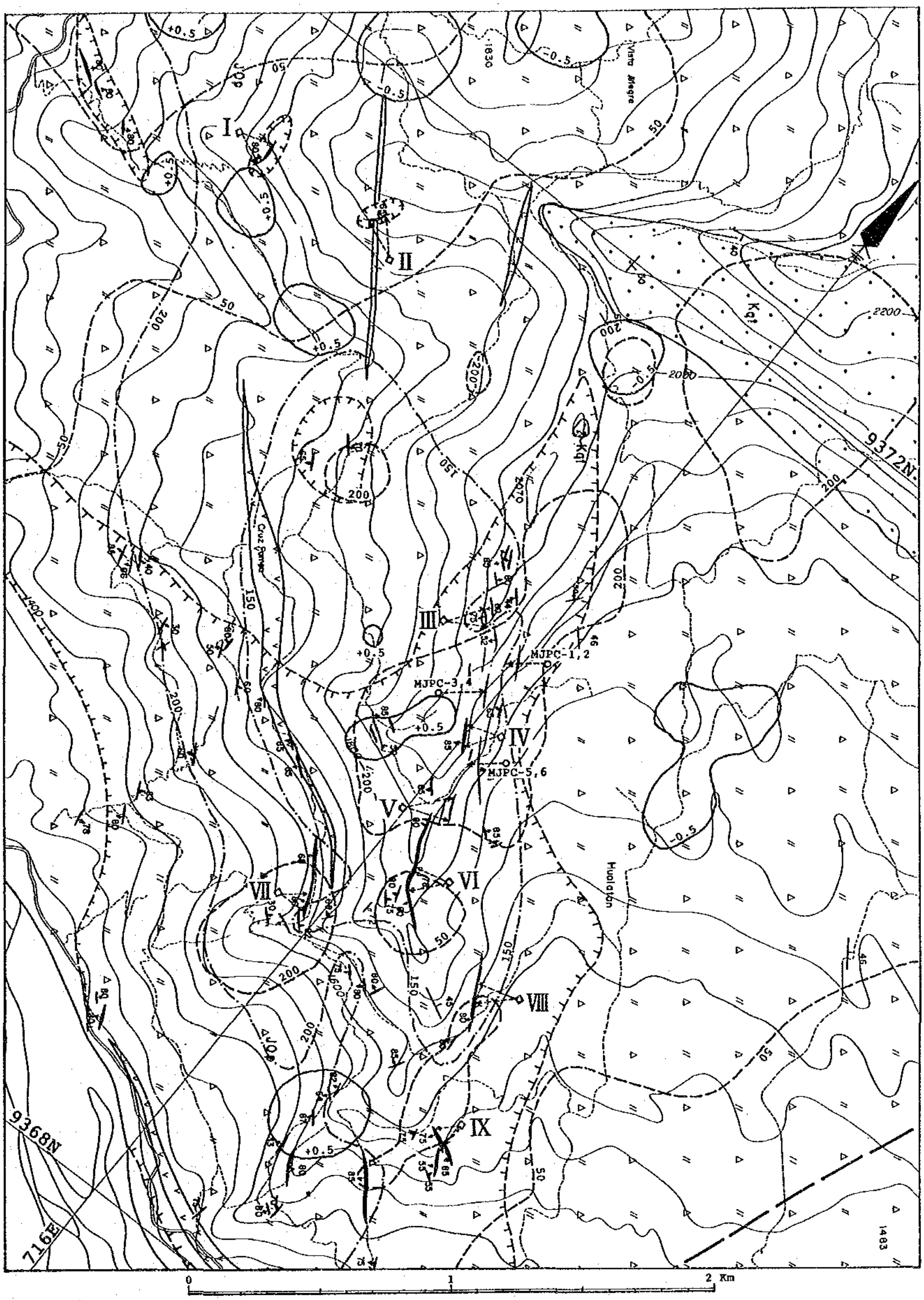
It is concluded that alteration and mineralization develop along NW-SE and NE-SW fissure systems and along the specific bedding boundary in Porculla Volcanics correlatable to Tertiary.

It is inferred that argillization under neutral to alkaline environment has progressed, and then followed by silicification with mineralization under acidic environment.

A layered quartz zone associating high-grade base metal mineralization is discontinuous and changes its thickness and grade frequently, therefore there is a small possibility that it develops to a large scale high-grade ore body. Average grade of quartz zone is Au 0.97g/t, Ag 160.7g/t, Cu 0.72%, Pb 0.83% and Zn 2.54%. Average thickness is 1.7m.

Silicified breccia associating gold and silver mineralization is confirmed to occur widely near the summit, but the grade changes frequently, therefore it seems not to be profitable as affairs now stand.

Mean grade of silicified breccia extracted by drilling cores is Au 0.58g/t and Ag 0.38g/t.



Drilling Site and Target Vein

III Drilling Site Number

Silicification zone

150 Homogenization Temp. ℃

50 Resistibility 256 Hz (Ωm)

0.5 Short-wave Gravity (m.gal)

Fig. III-1 Location of the Recommended Drilling Sites in the Chontali Area

Table Ⅲ-1 Recommended Drilling Sites in the Chontali Area

Drilling Site	Outcrop Scale			Outcrop Grade			Homogenization Temperature		Resistibility		Short Wave Gravity		Ranking	
	length (m)	max. width (m)	Rank	Au (g/t)	Ag (g/t)	Rank	(℃)	Rank	256Hz (Ωm)	Rank	(m.gal)	Rank	point	final
Ⅰ	100	5	4	4.15	5	3	N.D. (ab 190)	2	L (30)	3	H (+0.4)	8	20	3
Ⅱ	60	2	5	16.15	11	1	190	1	L (21)	2	M (0)	5	14	1
Ⅲ	20	1	9	7.45	4	2	160	4	H (172)	4	L (0)	3	22	4
Ⅳ	140	5.5	2	2.60	5	4	N.D. (ab 120)	9	H (330)	8	H (+0.4)	9	32	7
Ⅴ	50	1.2	8	1.50	4	8	Not Examined (ab 130)	8	H (205)	5	H-M(+0.1)	7	36	9
Ⅵ	110	8	1	2.35	6	5	146	6	L (17)	1	M-L(-0.1)	1	14	1
Ⅶ	30	3	7	1.60	32	6	Not Examined (ab 150)	5	H (429)	9	M (+0.1)	6	33	8
Ⅷ	220	2.5	3	1.50	11	7	144	7	H (226)	6	M-L(-0.1)	2	25	5
Ⅸ	60	1.9	6	1.15	7	9	Not Examined (ab 170)	3	H (258)	7	L (0)	4	29	6
MJPC-1,2	50	5		3.15	12		155		H (330)		H-M(+0.2)			
MJPC-3,4	80	3		12.95	18		109		H (330)		H (+0.4)			
MJPC-5,6	110	3		3.55	13		N.D. (ab 120)		H (330)		H (+0.3)			

CHAPTER 2 RECOMMENDATION FOR THE FOURTH YEAR SURVEY

The drilling survey in Chontali is proposed to be continued and concentrated for the fourth year survey based on the results obtained in the third year. Fig.III-1 shows the proposed drilling sites are extracted by the conditions, are more than 1m in width and 1g/t Au at the outcrops. Priorities of these drilling sites are shown in Table III-1. The following points must be noted for the drilling survey.

1) To confirm the plunge of quartz vein and mineralization zone;

At first fixing the target of altitude, then drilling survey must be conducted at more than two holes in each drilling site to confirm the horizontal development.

2) To make detailed geological map for the assistance of interpretative analyses of drilling data;

It will be needed to clarify the structure and locality of quartz veins and fracture zones based upon route map with a scale of 1/2,000 to 1/1,000, as well as mapping and systematic sampling of quartz vein out crops with a scale of 1/200 to 1/100.

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APPENDIXES

Apx. 1 Microscopic Observations of Thin Sections

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Sample No.	Rock Name	Geol. unit	Texture	Grain/Phenocryst/Main component mineral: Rock fragment	Quartz	Plagio-clase	Biotite	Horn-blende	Matrix/Groundmass/Accessory mineral: Quartz	Plagio-clase	Apatite	Anatase	Ziron	Glass	Sphale-rite	Opaque mineral	Secondary mineral: Quartz	Chlorite	Sericite	Epidote	Clay mineral	Carbo-nate	Opaque mineral	Remarks	
Chontali Area Drilling Core Samples																									
C-1 85.05	tf	Oy	not clear (altered)	? Ser, Cab							0.03 *	0.05×0.1				0.2 * E~A	○	*	△			◎ An Si			X
C-1 108.55	tf w/QV	Oy	〃	? Ser, Sil					0.15×0.07 △ W Ex		0.05×0.1 *					0.3×0.4 △ E~S	△		◎			○ An		Quartz in vein mainly occurs as lathy aggregate.	
C-2 198.10	tf w/QV	Oy	〃		0.2×0.6 in V W Ex											0.3 * E~S	◎		△			◎ An Si	*	Storongly wavy extinction of quartz is observed. Recrystalized quartz is remarkeble	X
C-2 212.40	tf w/QV	Oy	〃									0.02×0.05 *				0.7 * S	○		○		*	◎ An Si Ca	*	Original texture is broken by brecciation. Fragments are tinted by hematite.	X
C-4 66.53	tf	Oy	〃	? Sil, Ser, Cab	1.1 * S, C, W Ex						0.05×0.7 *	0.08×0.09 *				0.09×0.2 * S~A	◎		△			△ An Si		Surrounding quartz phenocryst occurs microcrystal-line rim.	X
C-4 85.40	tf and andesit	Oy	ho porphyritic			0.9×1.5 ◎ E, Z, T		△R Cab, Chl, Ser		0.03×0.17 ◎ E Z T		0.02×0.04 *				0.2×0.3 * A	*	○	*		*	△ An Si		Andesite boundary shows chilled margin texture.	
C-4 156.70	tf	Oy	not clear (altered)	○ Ser, Cab				0.7~0.9 *R Chl	0.4×0.6 *		0.03×0.05 *	0.09×0.1 *				0.16×0.17 *	◎	*	○			△ Ca			X
C-4 181.58	tf	Oy	〃		* W Ex	0.9×1.4 △ E, Z, T	0.6×0.7	0.6×1.3 *R Chl, Op, Cab								0.2×0.3 * E~S	◎	○	△			* Ca		Relic of plagioclase shows twinning and zoning.	X
C-4 196.30	tf w/QV	Oy	〃		in V W Ex						0.02×0.07 *	0.25×0.4 *				0.3 * E~S	◎	*	○			△ Ca An Si		Quartz in vein mainly occurs as lathy aggregate.	X
C-4 268.25	tf w/QV	Oy	〃	○ Sil, Ser	0.1×0.4 in V W Ex	0.9×1.6 * Ser, Cab					0.007×0.05 *		0.05×0.1 *			0.4×0.5 * E~S	◎		○			○ An		*Quartz in vein occurs as lathy aggregate and is cut* by carbonate veinlet.	X
C-5 74.50	tf w/QV	Oy	〃		0.6 C 1.2×3.5 in V, W Ex						0.06×0.1 △					0.2×0.3 △ E~S	○	*	○		*	△ An	*		F/I, P
C-6 62.20	tf	Oy	〃	2.1×2.5 ○ Cab, Ser, Sil	0.8×1.2 W Ex	* Ser, Cab									0.12×0.19 * A	* E~S	◎		○			△ An	*	Sphalerite occurs in quartz vein.	X
C-6 146.30	andesite	Oy	ho porphyritic		0.2×0.6 * C, (W Ex)	0.6×1.0 △E, Z, T Ser, Cab	Chl	0.8×1.4 * R Ser, Chl		0.01×0.1 ○ E T	0.02×0.03 *					0.4×0.5 * A~S	*	△	○			△ An	*		
C-6 156 60	quartzite w/QV	Oy	ho equigr fluidal		0.05×0.1 in V W Ex						0.05 *					0.05×0.1 △ E~A	○		◎				○	Quartzite fragment in brecciated zone.	P, X
C-6 201.90	tf	Oy	(fluidal)	Ser, Sil	1.0×1.0 * S, Ro						0.06×0.08 * Rounded	0.4 *				0.09×0.1 * S~A	○		◎			△ An Si		Carbonate occurs as like phenocryst. Groundmass foliated by sericite.	X
C-6 222.06	tf	Oy	not clear (altered)			1.2×1.6 * R E, Z, T			○ W Ex		0.2×0.2 *	0.1×0.15 *				0.4×0.5 * S~A	△		◎			△ Ca An Si			
Jehuamarca Area Drilling Core Samples																									
J-6 1.55	rhyolite	Po	fluidal						◎								△		△				○ Lm	Rhyolite fragment in the silicified breccia zone.	
J-6 14.85	tf	Po	hy clastic	5×7 ○	0.8×1.0 * (W Ex)										0.4×1.2 * A Ag	0.2×0.3 * E~A	◎		○					Sphalerite mainly occurs in quartz vein.	
J-11 71.60	tf-sh alt	Po	cyclic													0.1 *	○	*	◎	*					
J-12 58.80	rhyolite and tf	Po	not clear (altered)		0.1×0.2 * S, C									○ Ser		*	△		◎					Rhyolite boundary shows chilled margin texture.	
Jehuamarca Area Geological Survey Surface Samples																									
R-72505	tf	Po	hy clastic	5×10 ◎	0.5×0.1 △	3×4 ○ R			△	○		0.05 *	0.02×0.04 *	◎		0.2×1 * E~S	○	*	◎						X
R-72605	rhyolite	Po	m fluidal						◎							*	◎(?)	*	○					Along a fluidal texture sericite occurs abundantly.	
R-82302	rhyolite	Po	m fluidal						◎				0.007×0.01 *			*	◎(?)	*	△				* Lm Hm		X
R-82802	Bi-Hb andesite	Po	ho porphyritic			0.5×2.0 ◎ E, Z, T	0.8×0.6 * R, E	1.1×2.0 ○ R, E		0.1×0.3 ◎ E						0.2×0.3 * A(Hm)	*	*	○	*			*		
R-102902	tf	Po	hy clastic		1×2 * A, C									○		0.01×0.1 * E~A			◎		*			Sericitized elongated fragments are obserbed frequ-ently.	X

◎:abundant ○:common △:few *:rare

Abbreiviations A:anhedral, Ag:aggrefate, alt:alteration, An:ankerite, Bi:biotite, C:coroded, Cab:carbonate, Chl:chlorite, E:euhedral, equigr:equigranular, Ex:extinction, Hb:hornblende, Hm:hematite, ho:holocrystalline, hy:hypocrystalline, Lm:limonite m:microcrystalline, Op:opaque minerals, Oy:Oyotun formation, Po:Porculla formation, QV:quartz vein, R:relic, Ro:rounded, S:subhedral, Ser:sericite, sh:shale, Si:siderite, Sil:silicified T:twin, tf:tuff, V:vein, W:wavy, w/:with, Z:zoning

F/I:fluid inclusion examined, P:polished section observed, X:x-ray diffraction examined