Chapter 3 Drillling Survey

3-1 Survey Method

1 Outline

A total of 6 drilling surveys (2 surveys each in the section shown in Fig. 2-3-1) were conducted with the aim of determining the geology and the mineralization and alteration of the Santiago Salinas, Capire, and La Campana districts. A new road was constructed in Santiago Salinas because there was no access road for bringing in the material and equipment required to the planned drilling site.

MJZC-4 was originally planned at a drilling depth of 300 m near a stream (400 m upstream from the mineral showing) where the mineralization and alternation zones at the east end of the Santiago Salinas district exist. Judging from the geological condition, the drilling depth was changed to 201.5 m and a vertical well was bored.

MJZC-5 is situated at a mountain ridge about 300 m away to the southwest from MJZC-4. An alteration zone indicating 1.01% of Ba is found in a stream situated to the west-northwest of MJZC-5. MJZC-5 was originally planned at a drilling depth of 300 m, but the depth was changed to 264 m like MJZC-4 and a vertical well was bored.

At the main road along a mountain ridge in the northeaster part of the Capire district, 2 boreholes (MJZC-6 and MJZC-7) were planned. They are vertical wells at a depth of 300 m each. The purpose of these boreholes was to determine the extension of the mineralization and alteration zone in Tlanilpa recognized in the western part. Both boreholes are about 550 m apart from each other NNE and SSW.

Along the road from the northern part to the northwestern part of Mt. La Campana, 2 boreholes (MJZC-8 and MJZC-9) were planned in the La Campana district. The 2 vertical wells were bored at a depth of 200 m each, in the hope that an ore body would occur in these places, judging from the alternation zone and geochemical anomaly recognized in the northern part to the western part of the district. Both boreholes between which the La Campana prospect is situated are about 600 m apart from each other almost east and west.

The drilling work was carried out by Asesoría y Servicios de Perforación, a local drilling contractor. The collected cores were observed and summarized in a 1:200

geologic column. At the same time, previous cores were photographed in color and some samples to be subjected to a laboratory test were collected. All the collected cores were temporarily stored in the COREMI office in Teloloapan. In the end, they were kept in COREMI's Moleria office.

2 Method and Drilling Equipment

The drilling work was carried out by the wire line method with two Long Year 44 and one Long Year 38. A casing was inserted near the mouth as necessary, and polymer and other materials were used during excavation to protect the borehole walls, depending on the internal condition of the boreholes.

Main equipment, materials, and consumables used for the survey are listed in Figs. 2-3-1 and 2-3-2.

3 Working Condition

The drilling team consisted of one or two drilling engineers and two or three workers. The team performed sending-in, setup, and removal without a shift and carried out drilling work, as a general rule, 12 hours in two shifts. However, the team had a spell of bad weather at night and worked 14 hours in effect without a shift at MJZC-5. The group leased a private house near the drilling site as a base during the work. It took 2 to 2.5 hours to go to Teloloapan by car for the procurement of goods required for the survey.

4 Mobilization, Rig Up, Tear Down

Some vehicles including 20-ton, 7-ton, and 3.5-ton trucks were used to bring in, move, and remove the equipment and materials. A bulldozer was used to repair many cave-ins on the road caused by bad weather. In particular, the road was blocked by rain during the drilling of MJZC-4 and 5. Necessary goods and cores were transported by horses and donkeys to a place accessible by car. Site preparation work for the base and roads was performed as little as possible in consideration of the environmental protection. The drilling sites have been back to the original state after moved out, and

the drill hole have been covered by cement being recorded the hole number and depth according to the COREMI's custom.

5 Drilling Water

Stream water near the drilling site at MJZC-4 and 5 was collected in a 9-m^3 pit by pumping up or natural flow for use. There was a water shortage at MJZC-6 through MJZC-9 because the drilling point was on the mountain ridge. A water-supply truck was rented to secure water.

6 Road Construction, Preparation

In the Santiago Salinas district, a new 1.5km road to each drilling site from private houses to which an existing road leads was prepared from July 29 through August 25 with a bulldozer. The bulldozer was also used to move some of the equipment and materials from MJZC-5 to MJZC-4 and remove them after the drilling was completed as well as to repair existing roads and the new road.

7 Progress of Drilling

The position of each borehole is shown in Figs. 2-3-2, 2-3-6, and 2-3-10, and the drilling performance and process chart are listed in Tables 2-3-3 and 2-3-4.

(1) MJZC-4

The drilling was executed from September 19 through 29. An NW casing was installed from the surface to a depth of 15 meter and the drilling was carried out to the bottom of the hole with an NQ wire line. The drilling machine and pump broke down midway through drilling, but the drilling was successful to a depth of 201.5 m.

(2) MJZC-5

The drilling was executed from August 28 through September 11. An NW casing was installed from the surface to a depth of 30.3 meter and the drilling was carried out to the bottom of the hole with an NQ wire line. The wire line and pump

broke down midway through drilling, but the drilling was successful to a depth of 264 m. With the achievement of the object of recognizing the horizon, the drilling was terminated.

(3) MJZC-6

The drilling was executed from October 17 through November 3. An NW casing was installed from the surface to a depth of 12.0 meter and the drilling was carried out to the bottom of the hole with an NQ wire line. The drilling machines were clogged with cores, resulting in a decrease in drilling efficiency, because andesite at shallow depths has many sharp-angled cracks, but afterwards the drilling went smoothly. With the achievement of a scheduled depth of 300.0 m, the drilling was terminated.

(4) MJZC-7

The drilling was executed from October 9 through November 2. An NW casing was installed from the surface to a depth of 24.0 meter and the drilling was carried out to the bottom of the hole with an NQ wire line. The drilling machines were clogged with cores, resulting in a decrease in drilling efficiency, because andesite at shallow depths has many sharp-angled cracks as in the case of MJZC-6, but afterwards the drilling went almost satisfactorily. With the achievement of a scheduled depth of 300.0 m, the drilling was terminated.

(5) MJZC-8

The drilling was executed from October 30 through November 11. An NW casing was installed from the surface to a depth of 9.0 meter and the drilling was carried out to the bottom of the hole with an NQ wire line. It took a long time to adjust the drilling machines at the beginning, resulting in a decrease in drilling efficiency. After the recovery, the drilling went smoothly without much trouble. With the achievement of a scheduled depth of 200.0 m, the drilling was terminated.

(6) MJZC-9

The drilling was executed from November 4 through 9. An NW casing was installed from the surface to a depth of 9.0 meter and the drilling was carried out to the bottom of the hole with an NQ wire line. The drilling of this hole went smoothly from beginning to end. With the achievement of a scheduled depth of 200.0 m, the drilling was terminated.

3-2 Survey Result

Figures 2-3-3 ～ Figurers 2-3-16 show the geological columner sections, geological sections, and Tables 2-3-5 ～2-3-9 show the assay result and laboratory test result.

1 Santiago Salinas District

Geological units of Santiago Salinas are reestablished, constituents are andesitic rocks (lava, tuff, hyaloclastite), dacitic tuff of lower volcanic rocks, sedimentary rocks (calcareous slate, limestone), upper volcanic rocks (dacitic tuff, andesitic tuff, andesite with slate), and calcareous slate of Pachivia Formation. The continuation of mineralization zones that found phase Ⅱ survey, is the target for the drilling survey.

(1) MJZC-4

a) Geology

The geologic unit of this hole consists of Villa Ayala Formation, from surface to depth, dacitic tuff of upper volcanic rocks, sedimentary rocks and dacitic tuff and andesitic rocks of lower volcanic rocks.

0-12m : Weathered dacitic tuff.

From surface to 1-2m depth, overburden sediments were cored. Core recovery was low due to brecciation. Between 11.5m to 12m, core was fractured by 70 ° joints.

12-33.5m : Lapilli bearing dacitic tuff, gray to grayish green in color.

The matrix contains approximately 5-10vol% of plagioclase and accidental fragments such as gray pyritized and silicified rock, black slate, porphyritic andesite, which size is mm-3cm order. Glassy essential fragments increase to the depth. Cleavage plane shows about 10 ° .

33.5-49.2m : Grayish green lapilli bearing tuff.

Black and flat slate chip and the other fragments increase to the depth. It contains small to medium amount of glass lens and plagioclase that is less

than the overlain tuffs. Microscopic observation reveals that the tuff contains about 10% euhedral to subhedral plagioclase and accidental fragments set in the glassy matrix. Dominant alteration minerals are quartz and sericite with minor chlorite and calcite. Coarse sandy tuff is intersected between 40.3-40.5m. This unit gradual change to the underling slate unit, and contact shows about 10 ° .

49.2-50.6m : Black slate with white siliceous mineral band.

Cleavage plane shows 20 ° dip.

50.6-51.7m : Black to dark gray muddy limestone.

Argillized shear zone is cored at near 51.6m depth showing 30 ° dip.

51.7-55.6m : Sandy limestone, gray to dark gray in color.

It partly intercalated with thin layers (2-3cm) of black slate. It shows gradual contact with upper and lower unit. Calcite veinlets mostly occurred parallel to the cleavage plane. Bedding plane(cleavage) shows 20-30 ° dip. This unit contains 3-5vol% of very fine pyrite disseminated fragments (mm size in diam.)

55.6-95.5m : Intercalation of dark gray muddy limestone and gray limestone, in mm to cm size.

Microscopically it consists of abundant calcite, graphite, clay minerals with minor quartz. Bedding plane shows mostly 20-30 ° , partly steep dipping (40-70 °). Axial plane cleavage dipping 10-30 ° is observed. This unit partly contains dissemination (1-3%) and fine band (1-3mm) of very fine pyrite.

95.5-97.8m : Dark gray calcareous slate with gray thin limestone bed.

Bedding plane shows 30-40 ° dip. It shows gradual contact with upper and lower unit.

97.8-99.5m : Dark gray muddy limestone with very fine pyritic band.

99.5-107.3m : Gray to dark gray foliated sandy limestone～calcareous slate with calcite veinlets.

This unit contains some amount of lens of grayish yellow fine tuff with dissemination of fine pyrite.

107.3-108.2m : Black slate with a layered pyrite bed and thin band of pyrite.

Microscopically it consists of fine clay minerals, sericite, graphite, chlorite, pyrite and small amount of plagioclase. This unit shows concordant contact dipping 20 ° with lower pyrite bed.

108.2-108.4m : Fine pyrite bed with small amount of silica mineral.

Pyrite dissemination decreases to the lower part of this unit. It gradually changes to dacitic tuff unit.

108.4-113.8m : Grayish dacitic tuff, rich in plagioclase.

Intense dissemination of pyrite and small amount of quartz-calcite veinlets occurred in this unit.

113.8-116.75m : Alternation of sandy tuff, lapilli tuff and siliceous mudstone～siltstone.

Very fine grained pyrite impregnated in this unit. Microscopically, lapilli tuff consists of mainly fragments of aphyric dacite and andesite in a glassy matrix which contains crystals of plagioclase, quartz and secondary sericite, quartz and pyrite. Bedding shows 10-20 ° dip.

116.75-148.2m : Dacitic tuff, dark gray to greenish gray in color.

It contains relatively abundant plagioclase crystals in glassy matrix with small amount of accidental fragments such as siliceous rock and porphyritic rock. Lower part of this unit becomes lapilli tuff including essential aphyric lens and green glass chips. Dissemination of pyrite decreases to the depth.

148.2-169.3m : Greenish to grayish green glassy tuff with a little fine plagioclase.

It is silicified breccia or hyaloclastic rock and contains a few fragments of silicified rock. Microscopically it is small plagioclase bearing glassy tuff with abundant micro silica minerals. Bedding plane shows 30-40 ° dip. From 167.7m to 168.9m depth, a fault shearzone with clay is intersected.

169.3-173.9m : Mix zone of glassy tuff and plagioclase rich tuff.

This unit may be a transitional zone from upper unit to lower unit.

173.9-175.4m : Grayish green dacitic glassy tuff rich in plagioclase crystal.

It consists of green glass chips and a few mineralized fragments and gradually

changes lower lapilli tuff.

175.4-180.75m : Grayish green dacitic lapilli tuff.

The matrix contains abundant plagioclase, green glass and fragments such as fine silicified rock, pyritic porphyritic rock, gray plagio-porphyritic rock, those size vary from mm to 3cm in diameter. Quartz and calcite vein occurred in the contact plane of lower unit.

180.75-191.0m : Fine plagioclase bearing glassy tuff, green to grayish green in color.

It contains abundant essential deep green glass and minor accidental fragment of siliceous rock. Cleavage plane shows about 30 ° .Solid fault shear zone of 20cm width is intersected at 187.1m. Contact plane with the lower unit is brecciated core, showing 20-30 ° dip.

191.0-201.5m : Andesitic hyaloclastite, green to grayish green in color.

It consists of massive to autobrecciated lava, sandy～lapilli tuff, thin bed of siliceous slate and those intercalations. Massive part contains medium amount of plagioclase and minor mafic (pyroxene) mineral. Sandy～lapilli tuff part shows week stratification and small amount of accidental fragments such as pyritic tuff, slate and plagio-porphyritic rock. From 199.2 to 199.9m depth is a alternation of pyritic siliceous slate and tuff showing 30 ° dip. Microscopically, tuffaceous part consists of abundant volcanic glass with plagioclase and andesite fragment, slate part consists of mainly fine graphite and clay minerals and alteration minerals such as calcite, sericite, pyrite and quartz.

b) Mineralization and Alteration

The remarkable mineralization is mainly composed of bedded pyrite that can be observed in the depth between 108.2 and 180.4 meters of the uppermost layer of dacite under the lower sedimentary rocks. Although there are the marked dissemination and the argillization zones continuing in the lower layer, the both dissemination and alteration gradually become indistinct toward the lower horizon. It shows massive sulfide type mineralization in spite of no indication of marked Pb and

Zn mineralization. Weak mineralization can be observed in the lower part of the sedimentary rocks and in the alternation of slate and tuff. The very weak dissemination type pyrite mineralization also can be recognized in the sedimentary rocks within andesite.

Except in the other part, since chloritization is the major alteration, it is difficult to distinguish from regional metamorphism or not.

The result of chemical analysis of six samples of ore minerals is as follows:

Au: 2 to 9 ppb, Ag: 0.1 to 0.8 ppb,. Cu : 10 to 19 ppm, Pb : 2 to 7 ppm, Zn : 53 to 330 ppm, Ba : 218 to 1,590 ppm, Fe : 1.52 to 5.20 %, S : 0.86 to 4.54 %.

The tendency of comparatively high contents of Zn and Ba is recognized in the pyrite dissemination zone directly under the sedimentary rocks. From the observation result of the polished samples, only pyrite is observed and colloform texture is observed in some pyrite samples.

From the result of X-ray diffraction analysis, small amounts of chlorite and sericite are successively detected. Besides the above observation, a small amount of paragonite (Na- mica) was detected in dacitic tuff.

c) Result of Geochemical Analysis

The geochemical analysis were carried out for the following six samples; those were dacitic tuff of the upper volcanic rocks, calcareous slate of sedimentary rocks and, sandy tuff, vitric tuff, dacitic tuff and andesitic hyaloclastite of the lower volcanic rocks.

All the alteration indices show less than 50. As regards the trace elements, the tendency of relatively high contents of As and Cu + Pb +Zn is recognized in sandy tuff directly below the sedimentary rocks. The Co content is considered to change according to the above two kinds of contents.

(2) MJZC-5

a) Geology

This hole is composed of rocks of Villa Ayala Formation, including dacitic tuff of

upper volcanic rocks, sedimentary rocks and dacitic tuff, andesitic rocks of lower volcanic rocks.

0-8.0m : Surface soil and weathered sediments of dacitic tuff.

8.0-58.8m : Lapilli bearing dark gray dacitic tuff.

It contains accidental clasts of fine silicified rock, pyritic rock and black slate in a glassy matrix with small amounts of plagioclase. Microscopically porphyritic dacite and plagioclase are observed in a glassy matrix accompanying abundant alteration minerals such as micro silica and sricite. Intense pyritized fragments are found at 34m, 35m, 47m, 52.5m depth. Cleavage plane shows 10 ° dip.

58.5-59.8m : Weakly brecciated fine glassy tuff, dark green to gray in color.

It contains fine plagioclase in a glassy matrix accompanying silicification and fine dissemination of pyrite.

59.8-93.2m : Accidental lapilli bearing dacitic tuff, grayish green in color.

It contains essential fine glassy lens and small amounts of accidental fragments such as slate and fine pyritic siliceous rock. The lower part of this unit changes dark gray part of pyrite dissemination. Microscopically, euhedral plagioclase (10vol%) set in the very fine silica matrix. Alteration minerals are abundant sericite and minor chlorite, calcite and pyrite. This unit grade into lower sedimentary rocks, its contact shows 5-10 ° dip.

93.2-95.5m : Gray calcareous slate with thin black slate.

The upper part includes thin bed of pyrite. Fine graphite, quartz with minor sericite, calcite, opaque mineral and well developed foliation plane are microscopically observed.

95.5-97.75m : Fine alternation of dark gray calcareous slate and black slate.

Bedding and cleavage plane show 5-10 ° dip.

97.75-110.1m : Dark gray calcareous slate with fine band of gray limestone.

Dissemination and bands of pyrite are observed in part.

110.1-122.3m : Sandy, brecciated to granule conglomeratic limestone, gray in color.

Black slate fragments are involved, and black slate layers dominate in part.

Microscopically it is muddy limestone consists of very fine calcite with subordinate graphite, quartz and pyrite.

122.3-133.6m : Dark gray calcareous slate～gray muddy limestone accompanying thin black slate.

Cleavage and bedding plane shows 10 ° in most part. Between 127.5 to 128.6m depth, steeply dipping minor folding was observed.

133.6-164.1m : Accidental lapilli bearing, dark gray～greenish gray dacitic tuff, rich in plagioclase.

The accidental fragments are porphyritic andesite～dacite, silicified rock, black slate. Aphyric essential lens increases with depth. Microscopically, it contains coarse crystals of quartz and plagioclase and abundant sericite, quartz, pyrite and chlorite occurred in the matrix. Fine tuff is intersected between 158.5-158.8m depth. The massive pyrite bed is hosted in the upper part of this unit and accompanying intense pyrite dissemination below the massive pyrite, grade into week dissemination with depth.

164.1-173.5m : Grayish green lithic lapilli tuff.

It contains fragments of gray fine silicified rock, pyritic ore and subordinate black slate. Green volcanic glass chip and essential dacitic lens increase at lower part. Microscopically, it contains about 40 vol. % of dacitic fragment (partly hornblende bearing dacite) and plagioclase in the fine glassy matrix and alteration minerals such as sericite, very fine silica minerals, subordinate chlorite and pyrite are observed.

173.5-178.8m : Brecciated dacitic rock(probably hyaloclastic origin), gray～greenish gray in color.

It consists of gray aphyric fragments (1-5cm in size) and glassy matrix accompanying pyrite dissemination and network.

178.8-195.7m : Dacitic tuff, greenish gray in color.

It contains some amounts of green volcanic glass. Microscopically, it is composed of fine glassy matrix and clasts of pumice, subordinate siliceous fragment, and alteration minerals such as fine silica, sericite, minor chlorite

and pyrite. The inclination of glass chip (parallel with cleavage plane) shows max. 40 ° dip.

195.7-204.0m : Dacitic tuff, greenish gray～green in color.

This rock is composed of mainly glassy matrix with small amounts of fine plagioclase. Banded stratification of green glassy part and gray aphyric part are commonly observed. Microscopically, this rock consists of chlorite replaced abundant glass and a few siliceous fragments. The contact part with underlying andesite is not clear due to brecciated core.

204.0-207.5m : Gray braccia with porphyritic plagioclase.

Pyrite dissemination and veinlets occurred in dark gray matrix part. This unit gradual changes to andesitic hyaloclastite.

207.5-264.0m : Andesitic hyaloclastite and autobrecciated lava, green～pale bluish green in color.

This unit is composed of small and medium amounts of plagioclase and subordinate chloritized pyroxene, green volcanic glass and accidental fragments such as gray fine silicified rock, sandstone, black glassy rock and accessory porphyritic dark gray rock. Weak foliation is visible. Microscopically, it is hornblende bearing augite andesite that is composed of 20 vol. % of plagioclase and pilotaxitic groundmass with brecciation texture. Alteration minerals are mainly chlorite, subordinate epidote, sericite and calcite.

b) Mineralization and Alteration

The most remarkable mineralization and alteration can be intensively observed in the boundary part of sedimentary rocks and dacitic tuff as same as the case of MJZC-4. There are marked pyrite mineralization particularly in the upper most part of dacite in the depth of 133.6 to 134.2 meters with the dissemination zones of the lower horizon. The mineralization is gradually indistinct toward the lower part with partly marked dissemination and stockwork zones. It is accompanied the fine-grained and band shaped pyrite dissemination layers (several centimeters in thickness) within the sedimentary rocks in the depth of 129.4 to 129.7 meters. The alteration that is

mainly composed of chlorite is widely observed within dacitic tuff and andesite (hyaloclastite). Chloritization with blue green color is remarkable in andesite. However, it is difficult to define by mineralization or regional metamorphism.

The result of analysis of nine samples in the representative mineralization zones is as follows:

Au : 3 to 8 ppb, Ag : 0.1 to 1.90 ppm, Cu : 3 to 30 ppm, Pb : 6 to 88 ppm, Zn : 21 to 164 ppm, Ba : 217.2 to 2,470 ppm, Fe : 1.61 to 18.20 %, S : 1.48 to 20.53 %.

Though the grades of the samples are generally low, the tendency of high Ba content is observed in the mineralization zone within dacite of the lower volcanic rocks.

From the observation of the polished samples, only pyrite is observed as same as the case of MJZC-4 and pyrite with colloform texure is included as the characteristic.

From X-ray diffraction, small to very small amount of sericite is successively observed except in limestone. Very small amount of paragonite (Na-mica) is also observed in dacitic tuff of the volcanic rocks of the upper and lower horizons. Slate in the depth of 95 meters is accompanied by 3T type sericite.

c) Result of Geochemical Analysis

The geochemical analysis were carried out for the following nine samples; those were dacitic tuff of the upper volcanic rocks (two samples), sedimentary rocks (slate and limestone), and dacitic tuff (four samples) and andesite of the lower volcanic rocks.

The alteration indices generally show comparatively low except 76 of vitric andesite of the lower volcanic rocks in the depth of 193.1 meters.

As regards the trace elements, the tendency of relatively high contents of As is recognized in the sedimentary rocks and the dacitic tuff that is lower horizon of the former. The Mo content shows a little high value in the same dacitic tuff that already described.

2 Capire District

(1) MJZC-6

a) Geology

The geological unit of this hole includes upper volcanic rocks(andesitic rocks(Va-2), daitic tuff(Vdt)), sedimentary rocks(Ms, ML, Mts) and lower volcanic rocks (andesite(Vab), Dacitic tuff(Dc-1)).

0-1.5m : Surface soil, rock fragment.

1.5-41.2m : Grayish green andesite.

Autobrecciated lava or tuff contains abundant plagioclase phenocrysts and aphyric essential fragment (several cm in size). Under the microscopic observation of tuff, it consists about 20% of plagioclase and coarse ash accompanying alteration minerals such as chlorite, sericite, calcite, pyrite. High to moderate angle joints or fractures filled with calcite, quartz or pyrite.

41.2-55.2m : Yellow greenish gray tuff.

Main constituents of this tuff is fine andesitic glassy matrix with accessory or essential lens of plagio-porphyritic andesite. The network zones or films filled with fine pyrite or silica minerals are partly observed.

55.2-82.0m : Gray to greenish gray andesitic tuff.

Fine glassy matrix increase, but andesite fragments decrease compare to the upper unit. Small amounts of silicified and pyritized slate clasts are included. Pyrite network zones are commonly observed. This unit gradually changes to the underlying unit.

82.0-94.8m : Weak brecciated grayish andesite.

It contains medium amounts of plagioclase phenocrysts, small veinlets of quartz- pyrite and network of pyrite in part.

94.8-106.0m : Dacitic lapilli bearing foliated tuff, greenish green in color.

The upper part of this unit contains abundant volcanic glass, but the lower part increases plagioclase crystals. Under the microscopic observation of glassy tuff, it consists of mainly volcanic glass that contains plagioclase(less than 2mm) and rare quartz, accompanying abundant sericite, subordinate chlorite and very fine pyrite. Dark gray slaty tuff is intersected at

99.65-100.05m depth, containing small amounts of fragments such as gray glassy rock, silicified pyritized rock and slate. The bedding plane shows 10 ° dip. The lower contact is brecciated core.

106.0-109.9m : Glassy andesitic tuff, grayish green in color.

Fault breccia zones with low core recovery are observed at 106.4m, 109.2-109.6m. An alternation zone of slate and tuff is present at depth with interbeds of dissemination pyrite. Bedding plane show 20-40 ° dip.

109.9-115.4m : Well foliated black slate.

It contains thin bed of tuff at upper part and intercalated with sandy limestone at depth. Bedding plane crossed the cleavage plane.

115.4-121.6m : Foliated sandy gray limestone.

Black slate flat chips are partly involved. Microscopically it consists of mainly very fine calcite and subordinates chlorite, pyrite and graphite. Cleavage plane shows 30-80 ° dip.

121.6-136.4m : Alternation of gray calcareous slate and minor black slate, sandy limestone.

Cleavage pane shows 10-30 ° dip, minor folding and kink folding are occasionally observed. Thin pyritic beds are partly contained.

136.4-145.4m : Alternation zone of limestone conglomerate, sandy limestone and calcareous slate.

The conglomerate has gray fossilferous slaty matrix accompanying small amounts of slate fragments. Cleavage plane shows about 30 ° dip.

145.4-170.9m : Well foliated gray to dark gray calcareous mudstone.

It is partly alternate with black slate and sandy limestone. Calcite veinlets are commonly present. Under the microscopic observation of calcareous mudstone, abundant very fine grained calcite, small amounts of pyrite and quartz are observed. Brecciated and porous part is observed at 155.0-155.4m depth. The inclination of cleavage plane indicates 20-30 ° . Thin pyrite bed interbeded at contact zone with lower unit.

170.9-175.2m : Well foliated black slate.

White alteration minerals (calcite, quartz) are commonly occurred as intercalation form and cut by cleavage. Bedding plane shows 20-50 ° dip.

175.2-189.2m : Dark gray laminated calcareous slate.

Well developed cleavage plane shows 20-40 ° dip, but bedding plane usually more steeply dipping. Minor folding is partly observed.

189.2-194.9m : Several mm order of alternation zone of black slate and calcareous slate.

It contains boudinage form of white vein. Well developed cleavage plane shows10-20 °

194.9-195.9m : Alternation zone of black slate and plagioclase crystal rich tuff.

Fine grained sedimentary pyrite beds are contained parallel to the bedding plane which shows 10-20 ° dip. Tuffaceous parts increase to the depth and gradually change to the lower unit.

195.9-248.4m : Dacitic tuff, grayish green to green in color.

It mainly consists of green glassy matrix with plagioclase (10vol%, diam 0.5-2mm), and accompanying small amounts of accidental lapilli such as aphyric to fine siliceous rocks, dark gray mineralized chip and andesite. Abundant sericite and subordinate chlorite and silica minerals are observed by the microscopic observation. Slightly intense dissemination zone of fine pyrite occurred in the top 40cm of this unit. Pyrite dissemination decreases to the depth. Inclination of glass chips indicate cleavage plane and showing 20 ° dip. This unit gradually changes to the underlying unit.

248.4-276.8m : Andesitic lapilli tuff～tuff breccia or hyaloclastic autobrecciated lava.

It contains abundant essential to accessory fragments, small amounts of green glass, altered rock and fine grained matrix. Plagioclase occurred in green glass chips (probably dacitic) that locally show planar arrangement on the cleavage plane, with inclination of 20-30 ° . This unit gradually changes to the underlying unit.

276.8-300.0m : Andesitic autobrecciated lava (hyaloclastite).

It includes altered tuffaceous part. Lava part is consists of coarse altered plagioclase and small amounts of pyroxene replaced by chlorite. The

alteration by pyrite and quartz veins increases to the depth.

b) Mineralization and Alteration

Fine pyrite dissemination as powder, film and fine network vein with parallel to schistose structure can be partly observed in the depth of 0 to 109.9 meters in the upper volcanic rocks of Villa Ayala Formation. Ore minerals except pyrite cannot be observed by naked eye.

Banded thin layers of fine grained pyrite (mm) are accompanied with in the sedimentary rocks of the middle layer. The pyrite layer of sedimentary origin with several centimeters in thickness was confirmed in the alternation of tuff of the lower horizon.

The mineralization of Pb and Zn could not be observed in the lowest formation in spite of the existence of distinct pyrite dissemination zone in the uppermost part of the lower layer. Quartz-pyrite vein with steep angle can be observed within the andesite near the bottom of drilling hole. Since the vein was not affected by deformation, it was possibly formed by hydrothermal activity after regional metamorphism.

The result of chemical analysis of four samples in the representative mineralization zones is as follows:

Au : 4 to 18 ppb, Ag : 0.35 to 0.80 ppm, Cu : 3 to 100 ppm, Pb : 5 to 25 ppm, Zn : 28 to 83 ppm, Ba : 240 to 864 ppm, Fe : 1.93 to 10.60 %, S : 0.68 to 11.70 %.

Though the grades of the samples are generally low, the Cu content of pyrite network near the bottom of drilling hole is comparatively high.

Almost all the polished samples are mainly composed of pyrite. By the observation of the polished samples, a small amount of sphalerite is observed in the sedimentary origin ore layer of pyrite in the depth of 194.6 meters.

By X-ray diffraction, small to very small amounts of chlorite, sericite and calcite are generally detected. Besides the former minerals, small to very small amounts of potassium feldspar, pyrite and epidote are often detected.

Very small amount of paragonite is also observed in dacitic tuff of the volcanic

rocks of the upper and lower horizons. Slate in the depth of 95 meters accompanies 3T type sericite.

c) Result of Geochemical Analysis

The analysis was carried out for the following six samples; those were andesitic tuff and vitric tuff of the upper volcanic rocks, alternation of calcareous slate and tuff of the sedimentary rocks, and dacitic tuff and andesite of the lower volcanic rocks.

The alteration indices are generally low. 54 of dacitic tuff of the lowest volcanic rocks was the highest value

The anomalous value that indicates the mineralization could not be detected. Cu + Pb + Zn, As and Ba are recognized to change with mutual relationship. Co content as with Cr and Ni contents shows a little high value in andesite of the lower volcanic rocks.

(2) MJZC-7

a) Geology

The geologic unit of this hole includes upper volcanic rocks（Va-2, Vdt, Vat）, sedimentary rocks(Mts, Ms, Ml), and lower volcanic rocks (Dc-1, Vab)of Villa Ayala Formation.

0-53.3m : Andesitic tuff or hyaloclastic rock.

Fractured and weathered cores are recovered at surface to 30m depth. This interval predominantly composed of chloritized green glassy matrix accompanying small to medium amounts of accidental fragments and thin pyrite bands～networks. Well developed cleavage is observed in fine part. Under the microscopic observation of tuff, fine grained andesitic matrix with abundant plagioclase and andesitic fragments are observed. Alteration minerals are sericite, chlorite, calcite and pyrite.

53.3-81.15m : Pyroxene andesitic brecciated lava or tuff, green～grayish green in color.

Phenocrysts of plagioclase and pyroxene (chlorite) are observed in green

glassy groundmass, showing week brecciation. Fragments of altered rock are occasionally contained. Week foliation plane shows 10-20 ° dip. The lower contact plane is concordant with lower unit, showing inclination of 20-30 ° .

81.15-87.8m : Fine grained glassy tuff, yellow grayish green～grayish green in color.

It contains interbeds of fine tuffaceous slate of dark gray in color. Cleavage plane developed parallel to the bedding plane, showing 10-20 ° dip. The fine beds of pyrite are intercalated with bedding plane. The fault with solid clay was intersected at 87.4m depth, indicating the inclination of 60 ° .

87.8-100.0m : Well foliated vitric tuff, grayish green in color.

It contains acccessory tuffaceous fragments and rare slate chips. The cleavage plane shows 10-20 ° dip. Under the microscopic observation of tuff, It consists of crystal poor fine grained matrix composed of abundant elongated glass and sericite.

100.0-107.3m : Grayish green dacitic tuff.

It contains plagioclase and small amounts of pinkish gray aphyric fragment in a vitric matrix. Alteration minerals such as abundant sericite, minor chlorite and calcite are observed in a andesitic fragment bearing vitric matrix by the microscopic observation. Well developed cleavage plane shows 5-20 ° dip. Fault clay is observed at contact plane with lower unit.

107.3-109.15 : Andesitic vitric tuff, pale grayish yellow in color.

Plagioclase content increases to the depth. The cleavage plane shows 15 ° dip. The contact part is fractured core.

109.15-115.1m : Grayish green massive andesite.

Under the microscopic observation of this andesite, considerable amounts of plagioclase and minor chlorite altered pyroxene are observed in a hyalopilitic groundmass with abundant sericite and chlorite. The most recovered cores of this unit are broken and it makes difficult to find the clear relation with lower unit.

115.1-118.2m : Well foliated vitric tuff, grayish green in color.

Thin beds of pyrite dissemination are contained. The cleavage plane shows

10-30 ° dip. This unit gradually changes to the underlying unit.

118.2-120.4m : Well foliated black slate.

White and thin bands of alteration minerals (mainly calcite) occurred parallel to the foliation plane. The contact plane with lower unit shows 40 ° .

120.4-132.9m : Grayish green silicic dacitic tuff, lapilli bearing.

It consists of mainly vitric matrix with medium amounts of plagioclase and small amounts of accidental lapilli such as black slate, gray aphyric rock and silicified-pyritized rock chips. The boundary part (60cm) between this unit and lower unit is black glassy and filled with calcite veins.

132.9-137.6m : Dark gray and well foliated calcareous slate with thin interbeds of black slte .

It contains very small amounts of pyritic band. Kink type folding occurred in some part. The cleavage plane shows 10-40 ° dip.

137.6-140.5m : Well foliated and fine grained sandy limestone.

The cleavage plane shows 10-20 ° dip.

140.5-160.4m : Dark gray, well foliated calcareous slate dominant unit accompanying thin bed of slate.

The cleavage plane shows 10-20 ° dip and intersected mineral band (bedding) obliquely. Bedding plane partly shows steep inclination (50-70 °). The framboidal pyrite bands are observed at 141.5-142m depth.

160.4-167.1m : Gray muddy to sandy foliated limestone.

Calcite veinlets occurred commonly and several thin bands of black mineral (probably Mn-oxide) are found at upper part of this unit. The cleavage plane shows 20-30 ° dip. The upper and the lower contact of this unit show brecciation that implies fault contact.

167.1-195.1m : Dark gray calcareous slate dominant unit intercalated with thin slate bed.

The small folding structure is found at 178.6-179.2m and 181.6m. The maximum inclination of bedding or mineral band is 70 ° .

195.1-207.5m : Alternation zone of pyritic sandy tuff and slate.

Maximum width of pyritic bed in tuff is 10cm and contains 15-20% of pyrite. Under the microscopic observation of tuff, fine vitric matrix replaced by sericite and pyrite is observed. The bedding plane shows about 30 ° . The boundary part between this unit and lower unit shows sharp contact (fault?), dipping 50 ° .

207.5-214.8m : Gray argillized dacitic tuff.

It consists of glassy matrix containing considerable amounts of plagioclase crystal, small amounts of aphyric rock fragments and glass clasts. The dissemination of pyrite (2-5%) occurred in the matrix. This unit gradually changes to the underlying unit.

214.8-228.1m : Dacitic lapilli tuff, lithic to the depth.

It contains abundant plagioclase crystals, aphyric fragments and small amounts of pyritized fragments. The contact plane with lower unit shows 40 ° dipping fault, and accompanying a 25cm width argillized, pyritized bed.

228.1-233.2m : Dacitic tuff with green glass.

It contains abundant plagioclase crystals in sericite altered fine grained glassy matrix and small amounts of accidental fragments of andesite, porphyrite, and altered rocks are observed by microscopic observation. The small amounts of dissemination of pyrite and vein are locally exist. The cleavage plane shows 40-50 ° dip.

233.2-243.4m : Glassy dacitic brecciated rock, dark gray to black in color.

This unit may be a marginal part of the upper dacitic tuff, gradually changes to the underlying unit.

243.4-250.5m : Silicified andesite, gray to greenish green in color.

Week brecciation and pyrite dissemination(Max:5%) are observed. Under the microscopic observation of porphyritic andesite, it contains about 20% phenocrysts of plagioclase in a hyalopilitic groundmass that consists of glass and fine plagioclase lath. The small amounts of pyroxene and Fe-oxide minerals are also observed. The contact plane with lower unit is pyrite bearing silicified zone or fault.

250.5-300.0m : Grayish green andesitic tuff or fine grained autobrecciated lava～ hyaloclastite.

It contains abundant fragments of altered aphyric rock, and undergone intense chloritization accompanying epidote, and silicification. Microscopically, abundant phenocrysts of plagioclase (40%) and subordinate pyroxene set in a hyalopilitic fine grained groundmass. Alteration minerals such as chlorite, sericite, pyrite and calcite are also observed frequently.

b) Mineralization and Alteration

Chloritization is generally developed in the upper volcanic rocks. Mineralization is indistinct and network veins of pyrite are recognized on rare occasion.

Thin veins and small amounts of dissemination of sedimentary origin pyrite are observed in the sedimentary rocks. The concentration of pyrite (several to 10 centimeters) is formed with tuff, or is formed to make alternation with sedimentary rocks to show layered feature in the lowest part (in depth of 200 meters) of alternation zone of tuff and slate. However, Pb and Zn minerals could not be observed.

Comparatively distinct dissemination and alteration by argillization of pyrite are observed in the dacitic tuff of the upper most part of the lower volcanic rocks. Alteration by argillization and silicification with pyrite dissemination exists around the boundary of rock facies in the depth of 228 or 250 meters. This is considered to reflect the hydrothermal activity that occurred along the boundary of formations. Andesites of the lower part are generally accompanied by strong chloritization and epidotization.

The result of the analysis of the eight samples in the representative mineralization zones is as follows:

Au : 2 to 4 ppb, Ag : 0.10 to 0.90 ppm, 3 Cu : 4 to 367 ppm, Pb : 5 to 13 ppm, Zn : 46 to 143 ppm, Ba : 464 to 2,000 ppm, Fe : 3.38 to 5.65 %, S : 1.32 to 4.87 %.

Though the grades of the samples are generally low, the tendency of comparatively high Ba content (1,300-2,000ppm) is recognized in the depth of 200

meters, and the same tendency of Cu content in the alteration part of the boundary of rock faces is recognized in the depth of 228 meters.

By the observation of the polished samples, all the samples are mainly composed of pyrite with colloform texture, and very small amount of chalcopyrite is observed in the depth of 200 meters. Besides them, very small amounts of chalcopyrite with calcite veins exist in the depth 250.5 meters.

By X-ray diffraction, medium to small amounts of chlorite, sericite, calcite and pyrite are generally detected. 3T type sericite detected in vitric tuff of the upper volcanic rocks and in pyritized tuff in the depth of 200 meters is. And very small amounts of mixed layer minerals of sericite and montomollironite are detected in dacitic tuff (in the depth of 220.5 meters) and black vitric tuff (in the depth of 241.2 meters) of the lower volcanic rocks.

Besides the former minerals, small to very small amounts of potassium feldspar, pyrite and epidote are often detected.

c) Result of Geochemical Analysis

The analysis was carried out for the following six samples; those were andesitic tuff and vitric tuff and dacitic tuff of the upper volcanic rocks, limestone and slate of the sedimentary rocks, and black vitric tuff of the lower volcanic rocks.

The alteration indices are generally low except dacitic tuff with the index 60. Cu + Pb + Zn and As of black vitric tuff of the lower volcanic rocks show comparatively high. Low As and Ba of sedimentary rocks are characteristic.

3 La Campana District

(1) MJZC-8

a) Geology

The geologic unit of this hole includes upper volcanic rocks (Vdt, Vat, sedimentary rocks (Mst, Mt,), and lower volcanic rocks (Qsh,Gsh) of Villa Ayala Formation.

0-6m : Non core.

6-16.2m : Brown weathered vitric tuff.

It contains small amounts of slate chips. The lower contact is not clear due to most part of cores are fractured

16.2-24.5m : Brecciated glassy tuff, grayish green～dark gray in color.

Quartz veins and silicification occurred commonly in this unit. The week foliation reflecting cleavage shows 20 ° dip. This rock microscopically contains small amounts of dacitic fragments that includes about 10% plagioclase in sericite altered matrix and minor alteration minerals of chlorite and calcite.

24.5-60.2m : Well foliated, accidental palilli bearing dacitic to rhyolitic tuff, light grayish green in color.

This tuff contains vitric matrix pale greenish in color with variable amounts of plagioclase and accidental fragments of fine black altered rock, essential to accessory gray pumice and plagio porphyritic rock. The cleavage shows 10-30 ° dip.

60.2-66.7m : Well foliated vitric tuff, pale grayish green in color.

It contains very small amounts of mineralized fragments (mm in size). The cleavage plane shows 5-30 ° dip. Segregation quartz filled with lower contact zone.

66.7-79.0m : Grayish green tuff.

Plagioclase contents decrease from top to the depth. Very small amounts of silicifid and pyritized fragments are contained. The cleavage plane shows 20 ° dip. A dissemination zone of pyrite (10%) occurred at lower contact.

79.0-83.6m : Gray to dark gray calcareous slate dominant unit with black slate interbed.

The lens structure (boudinage) is partly observed. White calcite veinlets occurred commonly. Black slate part contains thin bands of dissemination pyrite. Fine grained graphite occurred in black slate part and abundant calcite are observed in calcareous part.

83.6-96.1m : Tuffaceous slate, gray to dark gray in color.

Black slate bed and sandy tuff intercalated in this unit. Lamination or

mineral bands show 5-30 ° dip. Several thin layers of sphalerite-galena -chalcopyrite are found parallel to the lamination.

96.1-98.0m : Fine to coarse grained dacitic sandy tuff, greenish gray in color.

It contains green glass chips and mineralized fragments and coarse part composed abundant plagioclase. This unit gradually changes to upper and lower unit.

98.0-104.4m : Grayish green vitric tuff.

Alternation bands of gray fine part and coarse plagioclase dominant part formed parallel to the foliation plane, showing inclination of 20-30 ° . Sharp contact with lower unit shows 15 ° dip.

104.4-132.0m : Tuffaceous slate.

Grayish green colored part indicate dominant in tuff, but black part indicate slate dominant zone. Coarse sandy tuffaceous parts are found at 123.5-124.4m and 126.1-126.4m depth. Mineralization bands of sphalerite, galena, chalcopyrite are found at 109m, 110.6m and 116m depth. Bedding plane shows 10-30 ° dip.

132.0-137.0m : Dark gray to grayish green coarse sandy tuff , black vitric tuff and slate mix zone.

Under the microscopic observation of vitric tuff, it consists of vitric matrix that contains fragments of plagioclase and quartz, alteration minerals such as sericite, chlorite, calcite and pyrite. The bedding plane shows 0-20 ° dip. Sharp contact with lower unit shows 5-15 ° dip.

137.0-164.5m : Altered tuff, dark gray in color.

Intense pyritization (5-10%) occurred in this unit. Microscopically, intense pyritization and sericitization occurred in vitric matrix accompanying small amounts of fragments of dacite and plagioclase. Black glassy tuffaceous part containing elongated essential pale fragments intersected at 140.5-155.5m depth. The cleavage plane shows 5-20 ° dip and this unit gradually changes to the lower unit.

164.5-172.8m : Black vitric tuff.

Fine grained pyritization and network of pyrite occurred frequently in this unit. Grayish tuffaceous fragments are contained at both upper and lower parts of this unit.

172.8-178.8m : Altered tuff.

This unit shows same lithology as tuff observed at 137.0-164.5m depth. Intense pyritization and sericitiation occurred commonly. The cleavage plane shows 20 ° dip.

178.8-183.8m : Gray sandy tuff weak foliated.

It contains medium amounts of coarse plagioclase and has undergone intense alteration of pyrite and sericite. This unit gradually changes to upper and lower unit.

183.8-200.0m : Altered tuff.

This unit shows same lithology as tuff described above. The thin bed (20cm) of sandy tuff interbedded at 195.5m depth and the lenticular to elongated brecciation is observed at 196.5m depth. The breccias have undergone white silicification and sericitization.

b) Mineralization and Alteration

Although alteration by chloritization is generally observed in the upper volcanic rocks, distinct mineralization cannot be observed. Pyrite dissemination that is composed of very fine particles is always observed. It partly shows bedded feature. Although thin vein to bands that are composed of pyrite, sphalerite, galena and chalcopyrite with parallel to schistose structure is observed in the depth of 84, 86, 109, 110.6 and 116 meters, respectively, all of them are dispersed distribution.

Strong pyrite dissemination and sericitization partly with silicification are generally developed in foliated tuff of the lower volcanic rocks. Colloform like textures are observed in a part of banded pyrite by naked eye.

By the observation of the polished samples, medium amount of pyrite and medium to small amounts of sphalerite, galena and pyrite are identified in the samples from the depth of 83.7, 86, and 115.7 meters. Chalcopyrite diseas in sphalerite is

observed in depth of 115.6 meters. In the sample from the depth of 141.0 meters, pyrite with framboidal texture is identified in addition to pyrite with colloform texture. In the depth of 168.6 meters, medium amounts of pyrite and small amounts of sphalerite is identified.

The result of analysis of ore minerals of each mineralization zone is as follows:

In the depth of 83.7 m (10 cm)

Au(ppb)	Ag(ppm)	Cu(%)	Pb(%)	Zn(%)	Ba(ppm)	Fe(%)	S(%)
26	11.7	0.268	1.69	3.94	1,920	3.65	6.28

In the depth of 86.0 m (10 cm)

Au(ppb)	Ag(ppm)	Cu(ppm)	Pb(ppm)	Zn(ppm)	Ba(ppm)	Fe(%)	S(%)
9	1.15	70	728	16	660	3.08	1.71

In the depth of 115.7 to 116 meters (30cm)

Au(ppb)	Ag(ppm)	Cu(%)	Pb(ppm)	Zn(ppm)	Ba(ppm)	Fe(%)	S(%)
176	47.5	0.231	1.28	1.33	44	8.20	10.26

In the depth of 141.0 meters (20 cm)

Au(ppb)	Ag(ppm)	Cu(ppm)	Pb(ppm)	Zn(ppm)	Ba(ppm)	Fe(%)	S(%)
22	9.85	18	37	461	2,270	11.1	12.8

In the depth of 168.6 meters (20 cm)

Au(ppb)	Ag(ppm)	Cu(ppm)	Pb(ppm)	Zn(ppm)	Ba(ppm)	Fe(%)	S(%)
15	7.65	20	17	455	4,460	4.26	4.64

By X-ray diffraction, sericite, calcite and pyrite are detected in all the samples. Comparatively large amounts of chlorite are detected except the depth of 168.6 meters. Almost all sericites are 3T type except in dacitic tuff (in the depth of 28.1 meters) of the upper volcanic rocks. In the above depth, sericite is accompanied by palagonite (Na-mica).

c) Result of Geochemical Analysis

The analysis was carried out for the following four samples; those were dacitic tuff of the upper volcanic rocks, calcareous slate and black slate of the sedimentary rocks, and vitric altered tuff of the lower volcanic rocks.

All the alteration indices show low values. Although the vitric altered tuff of the lower volcanic rocks were obviously influenced by alteration in these samples, the reason of low alteration index is considered due to strong calcitizaion under the high Ca content of 11 %.

Black slate is accompanied by bands of pyrite and it's Au, As, Sb and Cu + Pb + Zn contents are high that show the influence of mineralization. Vitric tuff of the lower volcanic rocks shows the same tendency. But, Ba contents of the both rocks are low.

(2) MJZC-9

a) Geology

The geologic unit of this hole includes sedimentary rocks (Mst) and lower volcanic rocks (Qsh,Gsh) of Villa Ayala Formation.

0-10.2m : Weathered brown surface sediment, soil.

10.2-28.8m : Sandy tuff to lapilli tuff, gray in color.

It contains small amounts of plagioclase, green glass chips and small amounts of black slate chips and mineralized fragments, mm in size. Microscopically, it consists of volcanic ash matrix containing 20% plagioclase and small amounts of andesite, dacite, sercite, calcite and chlorite. This unit gradually changes to the lower unit forming alternation.

28.8-31.4m : Dark gray tuffaceous slate.

Thin beds or laminas of grayish fine grained tuff interbedded with this unit. Thin beds or laminas show 10 ° dip. This unit gradually changes to the lower unit.

31.4-36.8m : Gray coarse sandy tuff, accidental lapilli bearing.

This unit shows almost same lithology as above tuff at 10.2-28.8m depth. Weak pyritizaion (1-2%) is observed in general. This unit gradually changes to the lower unit.

36.8-40.3m : Black slate.

The sandy tuffaceous part increase to the depth and the lithology changes to an alternation zone of slate and tuff. The core recovery is low due to brecciation.

40.3-46.1m : Greenish gray coarse sandy tuff～lapilli tuff.

Foliation becomes clear to the depth. The constituents of this rock are small

amounts of accidental fragments such as slate, altered rock, essential fragments and vitric matrix containing small amounts of plagioclase. This unit concordantly overlay the lower unit.

46.1-61.1m : Gray to dark gray tuffaceous slate dominant.

Fine grained tuffaceous part is dominant from top of this unit to 52.1m depth. Well foliated bedding plane or cleavage plane show 0～10 °. Thin beds of disseminated pyrite are rarely observed. The lower contact is not clear due to most part of cores are fractured.

61.1-144.9m : Gray intense altered tuff.

It consists of mainly glassy matrix, pertly contains pumiceous fragments. Pyrite dissemination (5-10%) occurred in general accompanying sericitization and partial silicification. Chlorite dominant andesitic tuff is observed at 126m, 130.8-133.8m. The cleavage plane shows 0-40 ° dip.

144.9-165.6m : Fine grained green andesitic tuff.

It consists of glassy, crystal poor matrix and occasionally contains fragments or thin interbed of altered gray tuff. Abundant grayish lapilli are contained at 151.7-153.6m depth. The cleavage plane shows10-30 ° dip.

165.6-174.2m : Foliated and brecciated tuff, gray to greenish gray in color.

This unit has undergone silicification and weak pyritization. Thin veinlets (1-2cm) of pyrite-calcite-quartz occasionally occurred parallel with cleavage plane. Segregation veins of quartz and calcite filled with contact zone with the lower unit.

174.2-200.0m : Weak foliated fine andesite, green in color.

Quartz and calcite veins accompanying pyrite, occurred crosscutting foliation or cleavage palne. Microscopically, fine plagioclase crystals lie in a groundmass of fluidal and porphyritic texture. Abundant alteration minerals such as chlorite, sericite and pyrite are commonly observed.

b) Mineralization and Alteration

Weak chloritization and sericitization with very small amounts of pyrite

dissemination are observed in tuffaceous slate of the sedimentary rocks. Sometimes thin bands of pyrite dissemination are accompanied within slate.

Relatively strong sericitization and pyrite dissemination (maximum 15 %) partly with silicification are recognized in foliated tuff of the lower volcanic rocks. Though chloritization is strong, amounts of sericite and pyrite are small in andesitic tuff. Since chloritization in fine-grained andesitic tuff is strong and vein like chloritization is developed to cut foliated structure, the alteration is considered to occur after deformation.

The result of the analysis of two samples from the representative mineralization zones is as follows:

Au : 18 to 21 ppb, Ag : 1.30 to 1.90 ppm, Cu : 9 to 40 ppm, Pb : 6 to 12 ppm, Zn : 48 to 56 ppm, Ba : 156 to 579 ppm, Fe : 4.51 %, S : 3.33 to 4.37 %.

By the observation of the polished samples, besides medium amounts of pyrite, small amounts of sphalerite are identified in foliated tuff with pyrite dissemination (in the depth of 91.2 meters). Very small amounts of sphalerite and chalcopyrite are identified besides medium amount of pyrite in quartz-calcite-pyrite veins.

By X-ray diffraction, small to very small amounts of sericite and pyrite are commonly detected. Chlorite and calcite are detected except the samples of the depth of 91.2 meters. In the depth of 91.2 meters, very small amounts of albite and potassium feldspar under the strong alteration, and comparatively large amounts of 3T type sericite are detected.

c) Result of Geochemical Analysis

The analysis was carried out for the following four samples; those were sandy tuff, slate, foliated tuff and andesite of Villa Ayala Formation.

Though the alteration indices of foliated tuff of the lower volcanic rocks are generally high as 69, reflecting sericitization, the indices of the other rocks are low.

The contents of As, S and Mn is higher and the contents of Cu + Pb + Zn and Ba are little lower in volcanic rocks in the relative comparison sedimentary rocks and volcanic rocks.

4 Result of Isotope Analysis

Isotopic analysis of sulfur and lead was carried out for the representative existing ore deposits and drilling cores. Sulfur isotope analysis was carried out Calgary University through ALS Chemex. The result of the analysis is shown in Table I2-3-10 and 2-3-11, and Fig.2-3-17 and 2-3-18.

(1) Sulfur Isotope ($\delta^{34}S$)

The analysis was carried out for the sulfur of the whole rocks of black ore of the existing Capire ore deposit, the Aurora 1 ore deposit and the Rey de Plata ore deposit, massive pyrite (MJZC-5) of the Santiago Salinas district, pyrite (MJZC-7) within the sedimentary rocks of the Capire district, and of pyrite (MJZC-8) within the sedimentary rocks and (MJZC-9) within tuff of the La Canpana district.

Sulfur Isotope data of the representative ore and rocks such as black ore of Japan and Guererro terrane are shown in Fig.2-3-17 as the reference.

The obtained tendency is that the ore of the existing ore deposit shows higher value than that of the Tizapa ore deposit. The massive pyrite of the Santiago Salinas region also shows plus value of ore in Tizapa ore deposit. Considering to that the sulfur of ore in Tizapa ore deposit was possibly influenced by the sedimentary origin schist that lies under the ore deposit (Yamamoto, Nedachi, 1998), the sulfur of the existing ore deposits was derived from the sulfur in the environment that was superior to volcanic rocks.

On the other hand, the sulfur in MJZC-7 (195.1 m) that is superior to slate shows –44.7 %. This fact suggests that the sulfur was derived from bacteria origin sulfur. The sulfur of pyrite within the other sedimentary rocks shows the minus value and the sulfur isotope ratio varied. Those phenomena suggest it is due to the ratio of the content of bacteria origin sulfur.

(2)Lead Isotope

The analysis was carried out for samples of the Capire (3 samples) and the Aurora ore deposits (1 sample), the black ore of the Rey de Plata (2 samples).

The result of the analysis is shown in Fig.2-3-18 together with the values of existing ocean floor basalt, deep-sea sediments, Kuroko deposit of Japan and the large-scale lead ore deposits.

The result of Pb analysis shows comparatively similar values. The fact suggests that the origin of leads of the ore of existing Rey de Plata ore deposit and Capire ore deposit, Aurora1 ore deposit is similar. A little unevenness of the values suggests there are two kinds of ores are derived from pyrite and siliceous. On the other hand, there is the tendency that values were plotted comparatively clustered area along the lead growth curve, and that partially overlap the area of that of deep-sea sediments.

By the analysis of the lead isotope of volcanic rocks of the Villa Ayala Formation and Tejupilco schist, some relationship between the result of the analysis and the ore minerals may obtain.

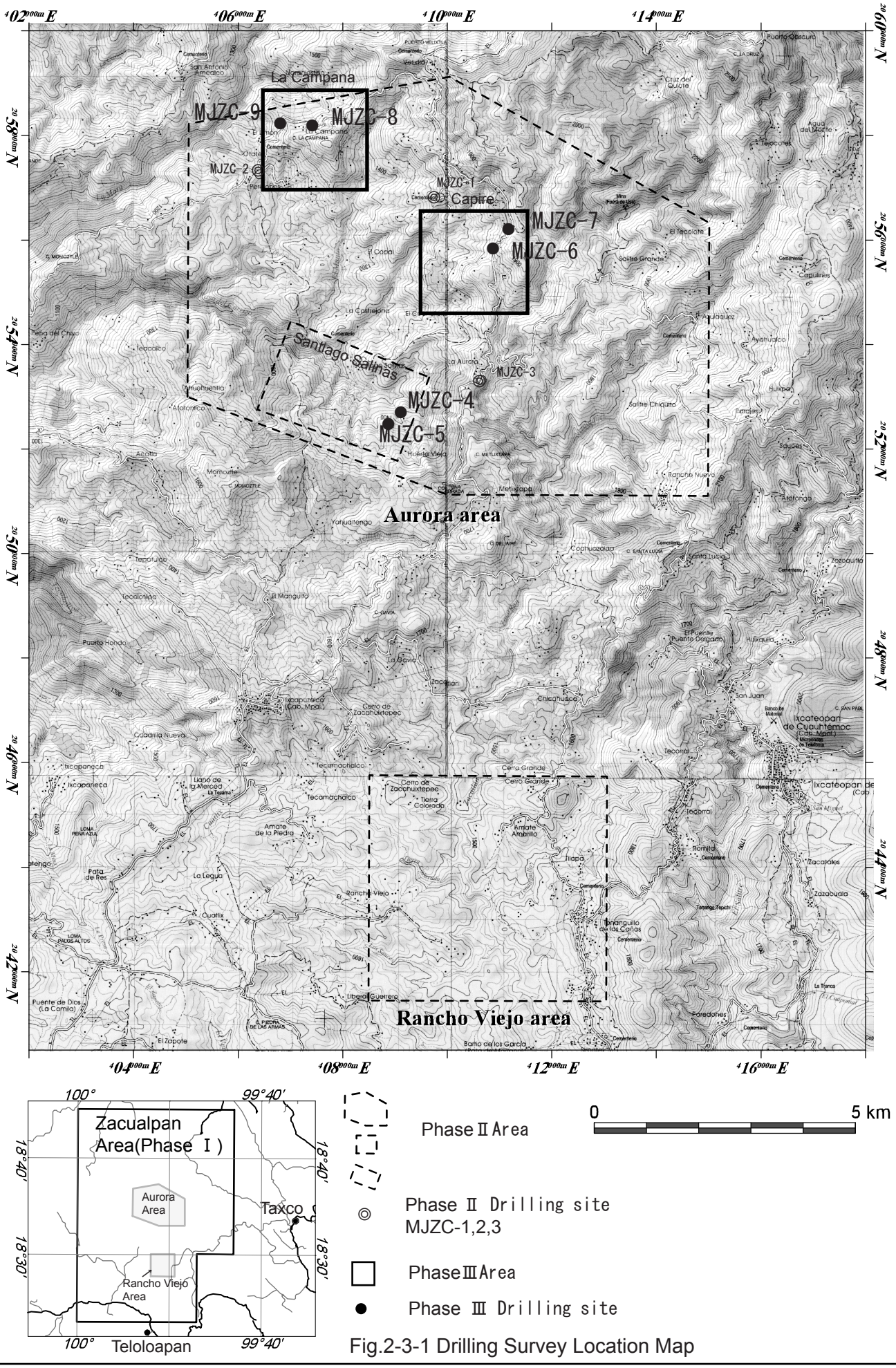

Fig.2-3-1 Drilling Survey Location Map

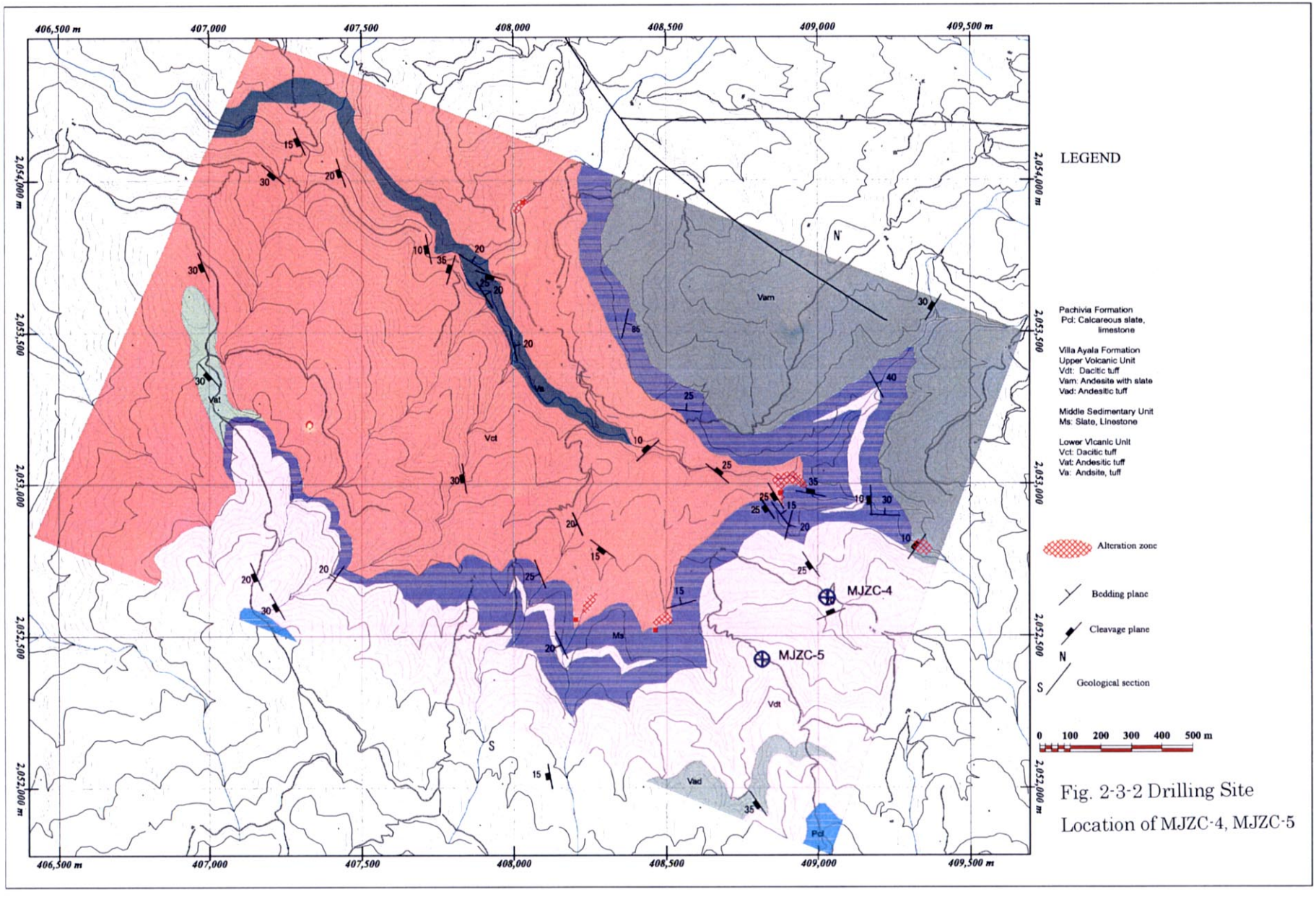

Fig. 2-3-2 Drilling Site Location of MJZC-4, MJZC-5

MJZC-4(1)

0m－100m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	CHEMICAL ANALYSIS Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
			weathered dacite fragments low coar recovery	8,7m py-net3cm											
5			oxide brown plagio-dacite tuff												
			8-14m;gray to brown mix color dacite lapilli bearing tuff												
10			11.5-12m;fractured coar,with 70 dip frac, quartz vein												
			fragment:black glassy altered rock, pl-dot dacite, py-ore	14.1m py ore chip 1x3cm											
15		Dacite tuff	14m-;gray silisified?dacite tuff, lapilli bearing												
			foliation pane=10												
20			gray aphyiric dc lens, cm cont												
			gradual change to greenish color												
25				matrix;py poor											
			30.6m;black slate chip												
30			32.9m;quartz vein,5cm,with black breccia												
			33.5-35.0m:gray sandy tuff, pl-poor	chlorite, silicification?											
35			grayish pale green dacitic lapilli bearing tuff, plagio:5-7%, siliceous aphyric dc or tuff lens cont												
			40.3-40.5m:fine to coarse tuff												
40			accidental fragment slitly increas black slate chip, siliceous rock, black glassy rock, cm	45.5m vf-py ore chip 3x5cm											
45															
		49.2	gradual chang dip 10												
50		Slate	49.2-50.6m;black slate, mm siliceus band	mm py band chip cont.											
			50.6-51.7m;black calcareous mud												
		calcareous slate	51.7-55.6m;gray to dark gray sandy calcaeous slate, bed:dip 20-30												
55		55.6													
			black slate>>gray fine calcareous part	very fine py diss, sil+py band(mm)											
60			60.4-60.7m:siliceous mm band, dip:40-70												
			61m:pyrite band (mm) rich zone, dip 10												
65			64.5-66m;minor folding,fold axis=S2 cleavage plane(10-20), bed=40-50												
		slate													
			black to dark gray slate with calcareous fine band	pyrite diss:2-3 %											
70															
			78.3m;3cm calcite vein, dip10												
75			drag fold, foliation plane:dip 30°												
80															
			85-85.15m:shear zone?												
85															
			86.5-87.2m:calcareous band rich zone cleavage:dip10° , bed:dip10-30°												
90			90.4-90.8m;folding, bed:dip 30-80°	calcite vein rich zone											
95		95.5	95.5-97.8m;black slate,with siliceous, calc, mm band,bed:30-40												
		97.8													
		99.5	97.8-99.5m:very fine calc. mud	99.4m, pyrite mm band rich											
100															

Fig.2-3-3(1) Geological Columnar Section (MJZC-4)

MJZC-4(2)

100m－200m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DETH (m)	SAMPLE WIDTH (cm)	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
105		Limestone	gray sandy foliated linestone, calc. slate 104.6-107.3m:olive yellow gray vary fine tuff, cm bed-lens cont, with py dissemination.	107.65-107.75 py beded ore	1 2 3 4 5	105.5 106.45 107.75 108.2 108.4	10 15 10 20 10	2 2 31 30 9	0.80 0.10 1.30 0.65 0.35	11 19 28 13 10	5 2 9 92 7	53 112 17 38 330	218 599 13 23 1590	1.52 2.72 20.40 29.6 5.20	1.51 1.19 23.40 30.08 4.54
110		Dacite 113.8	107.3-108.2m:black slate, with py band contact:20° dip gray plagio rich dacitic tuff, matrix glassy	108.2-108.4m massive py ore											
115		Tuff/slate 116.75	gray sandy tuff, siliceous fine breccia, siliceous mud alternaion(very fine pyrite) bed=10-20° dip	intens diss of pyrite10-15%											
120		Dacitic tuff	dark gray to pale greenish gray glassy dacitic tuff, plagioclase 1-2mm, 10% essential aphyric-small plagio porphyritic lens-band, 2-10cm cont.	pyrite 2-3% decreas to down											
125				py less than 1%											
130			greenish gray glassy plagio rich tuff, foliation=20° accidental siliceous ,porphyritic rock fragment bearing(dia:5-15mm)												
135															
140			green fine glass chip rich essentail? green aphyric glass fragment 10cm cont												
145			accidental lapilli and green glass chip increas, plagio decreas, gradually chang to greenish gray glassy crystal poor tuff												
150		Glassy tuff 148.2	151.3m:quartz vein, 3cm with, 40 ° dip												
155			grassy to silicified tuff, dacite-ryhiolittic? very fine plagioclase bearing sheard or fractured(hyaloclastic?) accidental altered(py+sil)fragment cont. foliation=30°												
160			160-161.2m:yellow aphyric fragment-lens rich zone,foliation=40°												
165			167.7m, 168.9m:shear zone,clay												
170		Dacitic tuff/ breccia? 173.9	glassy tuff and plagioclase crystal rich tuff mix zone												
175		Dacitic tuff 175.4	graysh green plagio crysytal rich tuff contact:30° dip												
180		Lapilli tuff 180.75	lithic lapill tuff ,plagio rich in matrix accidental fragment:sil+py ore,sil-dcaite gray porphyry, glass chip,5-20mm gradual change,contact quartz band zne												
185		Tuff	deep green glassy tuff(andesitic-dacitic) small plagio crystal bearing 187.1m:solid shesr fault zone 20cm												
190			pale green and deep green glassy band												
195		Andesitic hyaloclastite 191.0	grayish green lpillitic hyaloclastite, partly slate bed or fragnent cont. 199.2-199.9m:darkgray siliceous mud-slate breccia intercaration, dip30°	very fine pyrite in slate bed											
200			201.5m:End of hole		6	199.9	10	2	0.35	16	4	73	277	2.76	0.862

Fig.2-3-3(2) Geological Columnat Section(MJZC-4)

MJZC-5(1)

0m－100m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
5		overbarden weathered dacite, 8.0	yellow brown soil and weathered dacite fragments												
10		Dacite tuff	olive yellow brown to graysh breown weathered dacite tuff lapilli bearing plagio max 2mm, 5-10%, essential glass film, and sil+py ore fragments(15.1m, m, etc) mm-cm in size fractured(disking)	overall:very fine py dissemination 0.5-1%?											
15															
20															
25			gradual chang in color												
30			deep - dark gray lapilli bearing dacite tuff, plagio max:2mm, 5-10% lappili:light gray siliceous rock, sil+ py ore , and mm size black slate chip, foliation pl=10°												
35															
40		Dacite tuff	36.2-43.65m:fractured core ore fragments, chuip:34.15m, 35m 47.1m, 50m, 52.4m, 52.6m etc												
45					7	46.9	5	6	1.90	17	88	164	551	7.36	8.68
50			52.8-54.0m:fracture zone												
55			55-57m:milky quartz veinlets 1/10cm. 3-10mm width												
60		58.8 59.8	dark gray hard fine siliceous breccia bed or fragment?	very fine py 10-15% diss-film	8	59.5	10 6	0.25	0.25	4	12	35	45	1.61	1.48
65			61-63m:fractured core												
70		dacite tuff	65m-:olive graysh green plagio rich lapilli bearing dacite tuff plagio dot essential glass lens,	bluish green chloritic alt											
75			pyrite ore - film:2-3cm(67.9m) 69.6m:very fine py ore fragment (2-4cm)												
80			77.6m:black slate fragment with py dissemination												
85			dark gray -black color												
90		93.2	bedding:5-10°												
95		95.5	gray calcareous slate>>black slate black slate//calcareous slate mm altarnation	pyrite film mm											
100		97.75 Calcareous slate													

Fig.2-3-4(1) Geological Columner Section (MJZC-5)

MJZC-5 (2)

100m－200m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
105		calcareous slate	dark gray to black calcareous mud ～slate weak startification with very fine pyrite bed, dissemination												
			gradual change dip 10°												
110		110.1	110.1-111.6m:gray folded limestone												
			111.6-112.1m:black muddy part												
		113.6	112.1-113.6m: gray sheard limestone foliated, dip=20°												
115		114.5	113.6-114.5m:sandy gray limestone												
		limestone	114.5-122.0m:fine fragmented to sheard calcareous slate ～limestone												
120		122.0	116.7-117.4m, 119.5-119.6m:fine slate, sandy calcareous slate												
125		calcareous slate	dark gray calcareouse slate dominant, minor black graphytic slate	129.4-129.7m very fine py sulfide diss-emination bed	9	129.5	10	3	0.60	30	6	95	905	3.08	3.23
			partly well folded, foliation pl:10-20°		10	133.1	10	5	0.70	20	16	51	2470	5.25	5.74
130			124.5-124.9m:alternation of black slate calcareouse slate	133.6-134.2m massive py + siliceous ore	11	133.6	10	8	0.10	7	9	15	1040	18.20	20.53
		133.6			12	133.8	20	4	0.35	9	16	21	971	11.70	12.40
135			dark gray plagio crystal rich(10-20%) dacitic tuff, lapilli bearing matrix:glassy, pale olive gray glass film-patch(flat), lapilli:porphyritic dc-ad, siliceous rock with py diss., rare,black slate, mostly mm to 4cm in size, subrounded	overall pyrite content=5-10 %											
140		Dacite tuff		138.5m:very fine py film zone											
145			144m:10cm siliceous fine dacite fragment	147.8-148.8m: partly dens py diss-film zone											
			145.9-151.1m:silicified porphyritic dacite or tuff,		13	147.9	10	6	0.60	6	15	32	271	10.1	10.84
150			155.2-155.6m:quartz-calcite veinlets 1-5mm, dip:20-50	151.75m: pyrite net	14	148.3	10	4	0.35	4	16	25	1242	7.55	7.22
155			156m:greenish essential lens-patch rich												
			158.5-158.8m:fine part?												
160			gradual change												
		164.1													
165		Lapilli tuff	garyish green lithic lappli tuff or lapilli stone matrix poor, fragment:siliceous pyrite ore, aphyric dacite green glass, rare black slate, mm-cm in size, subanguler-rounded												
170			gradual change												
		173.5	grayish green, fine aphyric, dacitic hyaloclastic breccia, 1-5cm in size intens pyrite network	pyrite network silicification	15	173.7	10	5	0.35	3	22	23	1070	4.09	3.10
175		Dacite breccia	gradual change												
		178.8													
180			gree essential glass patch lapilli bearing dacitic tuff, crystal poor lapilli: gray siliceous dacite? glass patch:dip 40°												
185		Dacitic tuff	186.9m:very fine siliceous pyritized fragments rich zone												
190			gradual change												
195		195.7	greenish gray foliated fine glassy dacite tuff pale green glass weak band siliceouse fragment bearing	very fine py diss weak											
200		Dacite tuff													

Fig.2-3-4(2) Geological Columnar Section (MJZC-5)

MJZC-5(3)

200m－300m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	CHEMICAL ANALYSIS Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
			fractured coare	silicification, py											
		204.0	204.0-207.5m black glassy matrix, plagio porphyritic rock(Ad-Dc)												
205			207.5-264.0m:grayish green gradually decreas glassy net (py, sil alteration)												
210			essential breccia part: pl 1-2mm, glass chip(green bluish green) pyx?(chloritized), plago porphyry 1-10cm	chlorite, minor pyrite											
215		Andesite (hyaloclastic)	accdental fragment: gray siliseous altered rock, sandstone black glassy rock, mm-cm	220.3m, 220.8m py-net											
220			223m:fine lapillitic hyaloclastite												
225			coarese plagioclase dominat ,2-3mm												
230			dark gray porphyritic fragment increas max;15cm												
235			, partly auto brecciated												
240			243.7m:2cm quartz vein dip:75												
245			246.8m;2-3cm calcite vein dip 80												
250			246.5-247.5m:lithic laplli - hyaloclastite buish green glass film, chip cont. weak foliated	chlorite, minor py net											
255			10cm breccia: plagio porpyritic auto breccia lava												
260			pl:1-2mm with siliceous black fragment mm-cm												
		264.0m	End of hole												
265															
270															
275															
280															
285															
290															
295															
300															

Fig.2-3-4(3) Geological Columnar Section (MJZC-5)

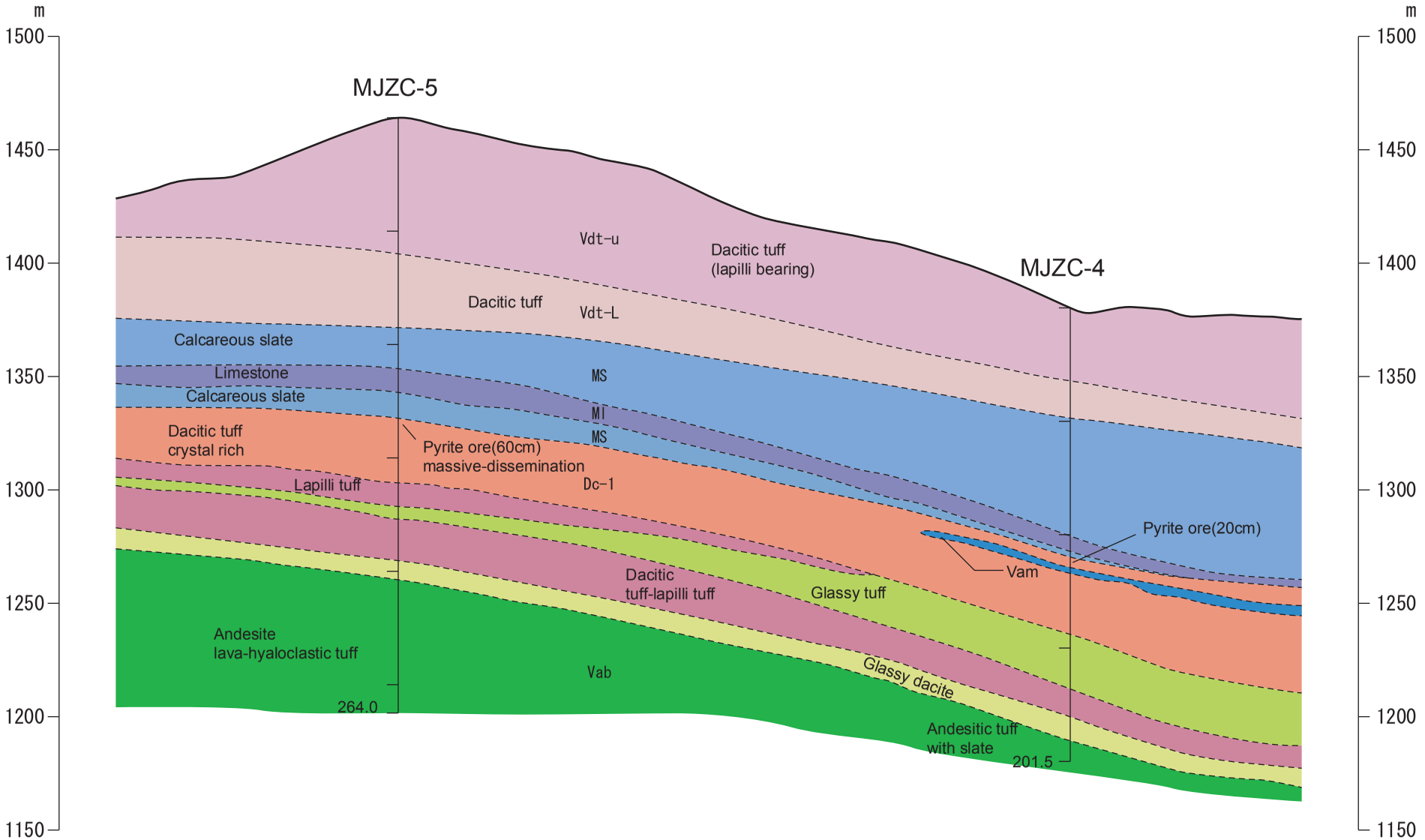

Fig. 2-3-5 Geological Section of Drilling Survey (Santiago Salinas District)

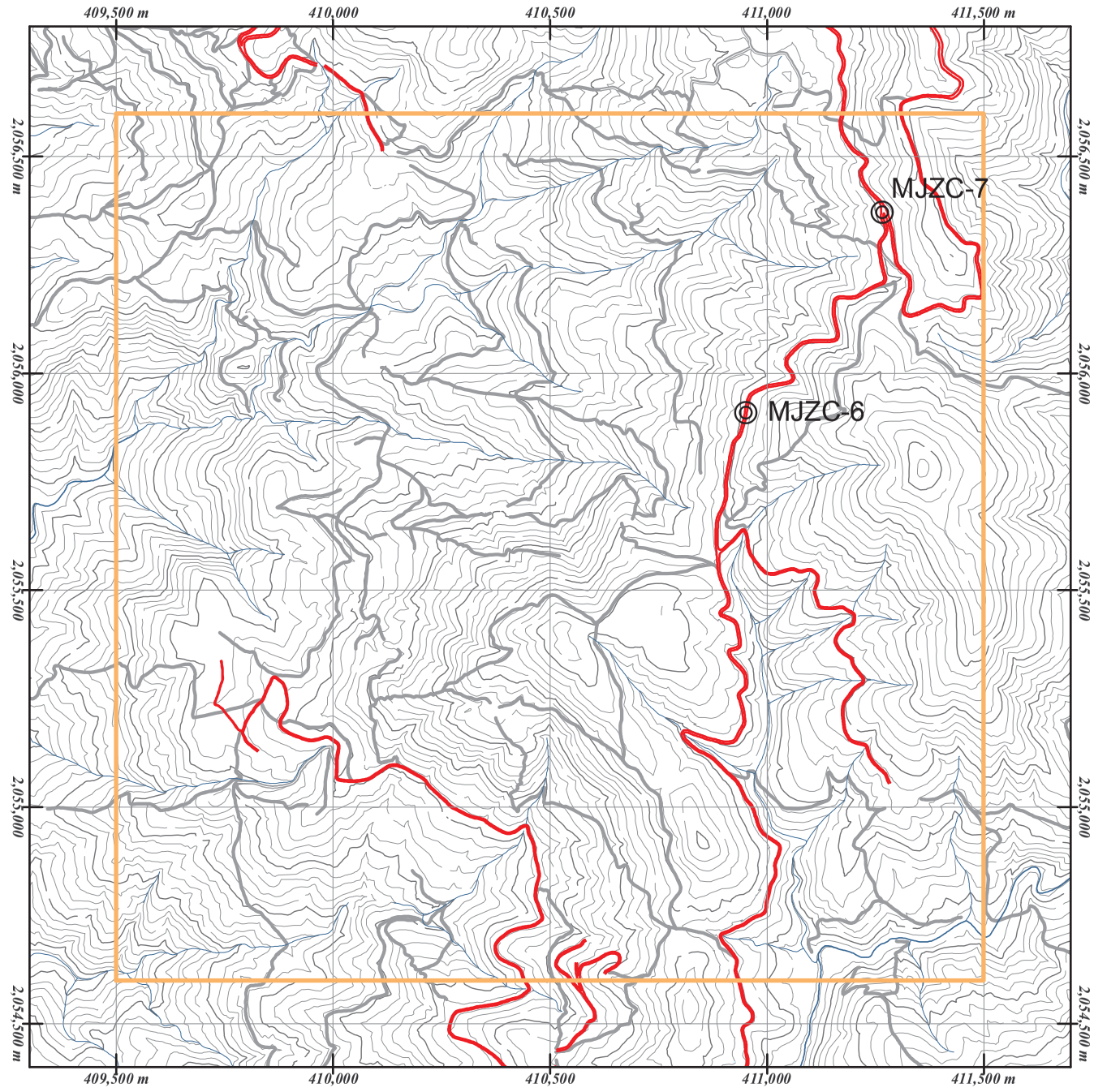

Fig.2-3-6 Drilling Site Location
of MJZC-6,MJZC-7

MJZC-6(1)

0m－100m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	CHEMICAL ANALYSIS Au (ppb)	Ag (ppm)	Cu (ppb)	Pb (ppb)	Zn (ppb)	Ba (ppb)	Fe (%)	S (%)
			0-1.5m:soil and rock fragmnet												
			1,5-15.5m:fractured core, brown oxide fracture surface	pyrite net weak											
5															
			grayish green compact andesite lava, partly autobrecciated, plagio porphyritic(max 3mm), minor minor pyroxene phenocryst cont.												
10															
15			grayish green compact, coarse plagio-crystal rich andesite												
20				20-24m:qz+ca vein rich											
25		Andesite	25-26m:fine part with pyrite net												
			27-28m:fractured core												
			fine greenish lens or fragment(cm order) cont. up to 42.1m												
30				ca+qz vein rich zone dip50-70,											
			33.3-33.8m:fracture zone, core lost												
35															
40		41.2													
			gradual change to fine olive green to gray green andesitic tuff? with plagio dot lens	43-45m:ca vein rich pyrite+sil net fine											
45		Andesitic tuff	fine olive greenish gray matrix>plagio dot andesitic fragment,	48.3-48.5m: dark gray net with pyrite											
50															
55		55.2													
			gray to grayish green fine mafic tuff with plagio dot andesitic(essential) fragment small glass chip cont												
60															
		Andesitic tuff?		66.4-65m,py film rich											
			63.8m:lapillitic essential lens(plagio dot) and accidental black pyritized slate bearing	65.4-65.7m, py net-film rich zone	16	67	5	35	0.75	34	33	55	163	6.34	4.98
65			67.1m:py very fine band,1cm, 20 dip accompanied 10cm py net												
70															
			71-74m:grayish green mafic fine tuff	py film-net rich											
75															
			pale olive yellow green massive tuff with glass chip and porphyritic altered rock fragment												
80		82.0	81.3m:70° fault clay												
			gradual change												
85		Andesite	coarse plagio rich, weak brecciated andesite lava	87.4m, 87.7m py net rich											
90															
			gradually change to deep green fine mafic tuff?												
		94.8	pale grayish green lapilli bearing tuff	pyrite film											
95		Dactic tuff	white fine rock fragment(pumic?) cm plagio dot fragment												
			99.65-100.05m:dark gray slaty tuff,bed =10dip	pyrite dot band											
100															

Fig.2-3-7 Geological Columnar Section (MJZC-6)

MJZC-6 (2)

100m－200m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	CHEMICAL ANALYSIS Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
105			pale green dacitic lapilli bearing tuff essential plagio-dot fragment, green glass chip, and accidenal black slate(rare) increas reddish rock, aphyric rock,silaltered rock etc.												
		106.0	foliation=30-40												
		Andesitic tuff	103.4m:shear zone, core lost												
110		109.9	106.0-109.9m:fractured, olive green fine to coarse andesitic glass tuff	very fine py diss-band 2-3%											
		Calcareous slate/tuff/slate	109.2-109.6m:fault shear zone with clay												
115		115.4	109.9-115.4m:calcareous slate>slate, tuff intercalation,bed=10, cleavage=30												
		Sandy limestone	gray well foliated sandy, conglotic breccia partly rich in black slate chip foliation or bedding=30-40(Max80)												
120		121.6													
125		Calcareous slate	dark gray calcareous slate, minor black slate, sandy limestone bed, partly py+silica band (mm) bearing foliation =10-30	py+silica mm band											
130			130.5-133m:kink folded sandy limestone well foliated												
135		136.4													
140		Limestone conglo,ss	gray to light gray conglomeratic limestone sandstone, well foliated matrix:black calcareous slate fragment, light gray limestone, elongated mostly pebble size foliation =30												
145		145.4													
150		Muddy limestone	dark gray calcareous mud dominant, well foliated, partly intercalated blak slate, sandy limestone foliation=20-30, partly folded and neary vertical												
155															
160			160.4-160.85m:black slate rich												
165															
170		170.9	168.9-169.2m:altarnation of black slate/ calcareous slate	170.9m: pyrite band zone											
		Slate	foliated black slate>siliceous mm band foliation=60-90												
175		175.2	shear contact												
180		Calcareous slate	dark gray fine muddy, well foliated												
			182.5m:folded fold axis=foliation plane (30-40), bed=50												
185		189.2													
190		Slate and Calcareous slate	folded and foliated black slate, calc. slate, with siliceous band foliation =10-20												
		194.9	194.9-195.9m:black slate and plagio dot glassy tuff, mix zone with very fine py bed	pyrite bed	17	195.3	10	7	0.60	16	25	28	864	10.6	12.2
195		195.9			18	196.4	10	7	0.55	7	17	68	103	5.78	4.86
		Dacite	plagio crystal rich, essential lens tuff upper part is fine	intens py-dissemination											
200															

Fig.2-3-7(2) Geological Columnar Section (MJZC-6)

MJZC-6 (3)

200m－300m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
205			grayish brawn to greenish gray, plagio-crystal rich lapilli bearing tuff,	pyrite film,diss 2-3%	19	202.2	10	4	0.35	3	5	82	368	1.93	0.68
			accidental siliceous alterd rock, light gray aphyric rock, black siliceous rock matrix:glassy, green chip,plagio=0.5-2mm 7-10% vol,												
210															
		Dacite													
215			glass patches show foliation=20												
220			222.9-223.1m:pagio poor, fine part												
			224.2-224.7m:plagio poor and glass chp cont.												
225															
230			glass chip, patch gradually increase												
235		235.7		pyrite<0.5%											
			green ahyric-fine porphyritic lens, gray fine rock lapilli tuff												
240			deep green glass patch rich, foliation 20												
245															
		248.8													
250			olive grayish green, lithic lapilli-tuff breccia or hyaloclastite												
255		Andesitic breccia													
			matrix:green glass chip, plagio, sil-ser alt ball-chip fragment:gray porphyritic rock. altered rock,												
260															
265			264.5-lapilli and autobreccia lens alternation												
270															
275		276.8													
			coarse plagio, green glass dot massive to autobreccia?	pyrite film dot, vein											
280															
285		Andesite													
290			gark gray fine sel+sil alterd tuff? pyrite film-net , vein cont												
				chlorite											
295			green fine-porphyritic rock	fine pyrite net	20	298.9	10	18	0.80	100	14	63	240	10.6	11.7
300															

Fig.2-3-7(3) Geological Colomnar Section (MJZC-6)

MJZC-7(1)

0m－100m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	CHEMICAL ANALYSIS Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
5			low core recovery, intens fracturing weatherd graysh brown fine andesitic or dacitic tuff?												
10			low core recovery, intens fracturing brown oxide fracture surface up to 28m												
15															
20			graysh green to weatheard brownish gray fine fractured (with high angle fracture) fine to coarse plagio-dot andesitic tuff? calcite and quartz vein fracture filling?												
25															
30		Andesitic hayaloclastic tuff-lapilli tuff	28-30m:grayish green andestic lapilli-or hyaloclastic tuff, glassy, pale yllow gray fragment(glass), pyritized chip cont												
35			31-34m:grayish green glassy matrix, andesitic lapilli tuff-hyaloclastite with black slate(max2X4cm), siliceous slate? and essential fragment, breccia, green glass chip(mm) foliation plane:dip10-15	35.3m:py-net											
40			35-:pale yellow gray fragment bearing andesitic glassy lapilli - hyaloclastite matrix:plagioclase(2mm), pyroxne(1mm) glass chip	blue-green chlorite											
45			37.8-46.5m:fractured core, high angle sharp joint												
50			49.5-52.1m:deep green glass film-chip (plagio bearing), lapilli tuff andesitic? foliation plane: dip 10												
53.3															
55			autobreccia lava, hyaloclastic tuff												
60		Andesite	greenish glass chip andesitic rock(tuff) partly porphyritic, coarse plagio rich, deep gray - black silicelos, glassy lamina or film bearing												
65															
70															
75															
80															
81.15															
85		Tuff//Slate	olive gray fine glassy tuff>black slate(cm) intercalation bedding plane10-20° 87.4m:fault,60 dip, solid clay	very fine py 1-2% diss											
87.8															
90			gradual contact, 50-55 dip, folding												
95		Tuff	olive gray fine tuff, glass rich, partly black slate film cont.and pale pumiceous patch band, dip 20°												
100			well foliated essental glass patch increas contact:30°												
100.0															

Fig.2-3-8(1)Geological Columnar Section (MJZC-7)

MJZC-7(2)

100m－200m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	CHEMICAL ANALYSIS Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
105		Dacitc tuff	100.0-102.2m:graysh green partly reddish pl dot, glassy fine tuff, green glass chip cont 102.2-107.3m:lapilli bearing pagido dot glassy tuff, foliation=5-20												
		107.3m	fault contact with clay?												
		Tuff	107.3-109.15m:olive green fine foliated tuff												
110		109. 15 Andesite	graysh green massive porhyritic andesite upper part is brecciated												
115		115.1													
		Tuff 118.2	siliceous gray to grayish green foliated andesitic tuff, glassy, foliation=10-30												
120		Slate	black slate>siliceous band well foliated,lower contact dip=20												
		120.4													
125		Dacitic tuff	olive-pale grayish green glassy lapilli bearing tuff, fragment:siliceous py ore, aphyric gray rock, black slate, mm-cm in size, foliation=40-50 essential plagio rich elongated fragment												
130		132.9	132.5-132.9m:marginal black grass part calcite vein filled with contact												
135		Calcareous slate 137.6	gray to dark gray calcareous slate>black slate, with pyrite fine band, kink folding foliation plane=10-40												
140		Sandy limestone	gray foliated, black thin slate intercalated												
		140.5	fine framboidal pyrite+silica band mm (140.5m, 171.7m, 141.8m etc)	pyrite band mm											
145			dark gray fine cacareous slate>black slate well foliated, foliation plane=10-30	pyrite diss. 1-2% in slate											
			145.8-147.5m:black slate dominant												
150		Calcareous slate													
155															
160		160.4													
		Limestone	black mm Mn band? gray fine muddy-sandy partly brecciated calcite veinlets rich												
165			bed or foliation=20-30												
		167.1	fault contact, 2cm clay												
170			dark gray muddy to sandy calcareous slate>black slate, well foliated and laminated												
175		Calcareous slate	171-173m:folding, foliation or bed=50-55												
			178.6-179.2m:shear and boudinage												
180			181.6m:folding,overturned												
185			siliceous mm band increas foliation or bed =30-70												
190															
					21	195.1	10	3	0.35	15	7	87	897	4.24	2.83
195		195.1	zigzag boundary dip=15												
		slate//sandy tuff	intercalation of pyritic sandy tuff and slate with pyrite bed	pyrite bed	22	198.5	10	3	0.10	21	13	84	1300	4.25	4.87
200															

Fig.2-3-8(2) Geological Columnar Section (MJZC-7)

MJZC-7 (3)

200m－300m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	CHEMICAL ANALYSIS Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
205		Tuff//slate	pyritic tuff, calcareous slate, intercalation bed=10-30 dip	pyrite band diss	23	203.0	10	4	0.7	18	13	98	1480	4.51	4.85
					24	204.1	10	2	0.35	15	12	55	1880	4.7	4.83
			205.2m, black slate, calcareous slate mix		25	205.8	10	3	0.90	24	8	46	2000	3.8	3.88
			207.2-207.5m:shear fault contact												
210		207.5 Dacite(tuff)	gray pyrite+clay altered plagio rich dacitic tuff ,glassy matrix	pyrite, caicite, clay mineral(ser)	26	207.9	10	2	0.35	4	6	59	967	3.38	1.86
			green glass chip cont.												
		214.8	gradual change												
215															
220		Dacitic lapilli tuff	pale grayish green lapilli tuff, matrix=green glass chip(5-20mm) cont. fragment=gray aphyric to fine rock,py diss siliceous rock, foliation 10-20												
225			fragment increas(lapilli stone?)												
		228.1	pyrite band zone fault shear boundary:dip 40	227.85-228.0 py band zone	27	228.0	10	3	0.60	367	12	143	484	5.65	2.89
230		Dacite	deep green glassy plagio dacite,lapilli bearing												
		233.2													
235		Dacite Braccia	black glassy brecciated rock or hyalo-clastite? with white to pale gray aphyric fragment	very fine py diss											
240															
		243.4	gradual change to aphyric grayish andesite												
245		Andesite	fine aphyric andesite, gray to pale green altered	silicification py diss(max 5%)											
250		250.5	silicified boundary with pyrite		28	250.5	10	3	0.35	13	5	75	464	4.84	1.32
255		Andesitic tuff	greenish coarse andesite, matrix contain coarse plagioclase(cal or epidote altered), siliceous fragment ball? minor pyroxene(chl)	chlorite,epidote											
260			262.3m:60 dip shear fault												
265															
270			pale brown fine to very fine sil-ser alterd fragment(very fine pyrite cont) in matrix green glass chip, coarse plagio dot.												
275				silicification pyrite, chl-ep?											
280			278.5-282m:green fine part, tuff or aphyric lava fragment												
285															
290			289-295m:autobreccia, pyroxene porhyritic or fine aphyric breccia in glassy grandmass												
295															
300															

Fig.2-3-8(3) Geological Columnar Section (MJZC-7)

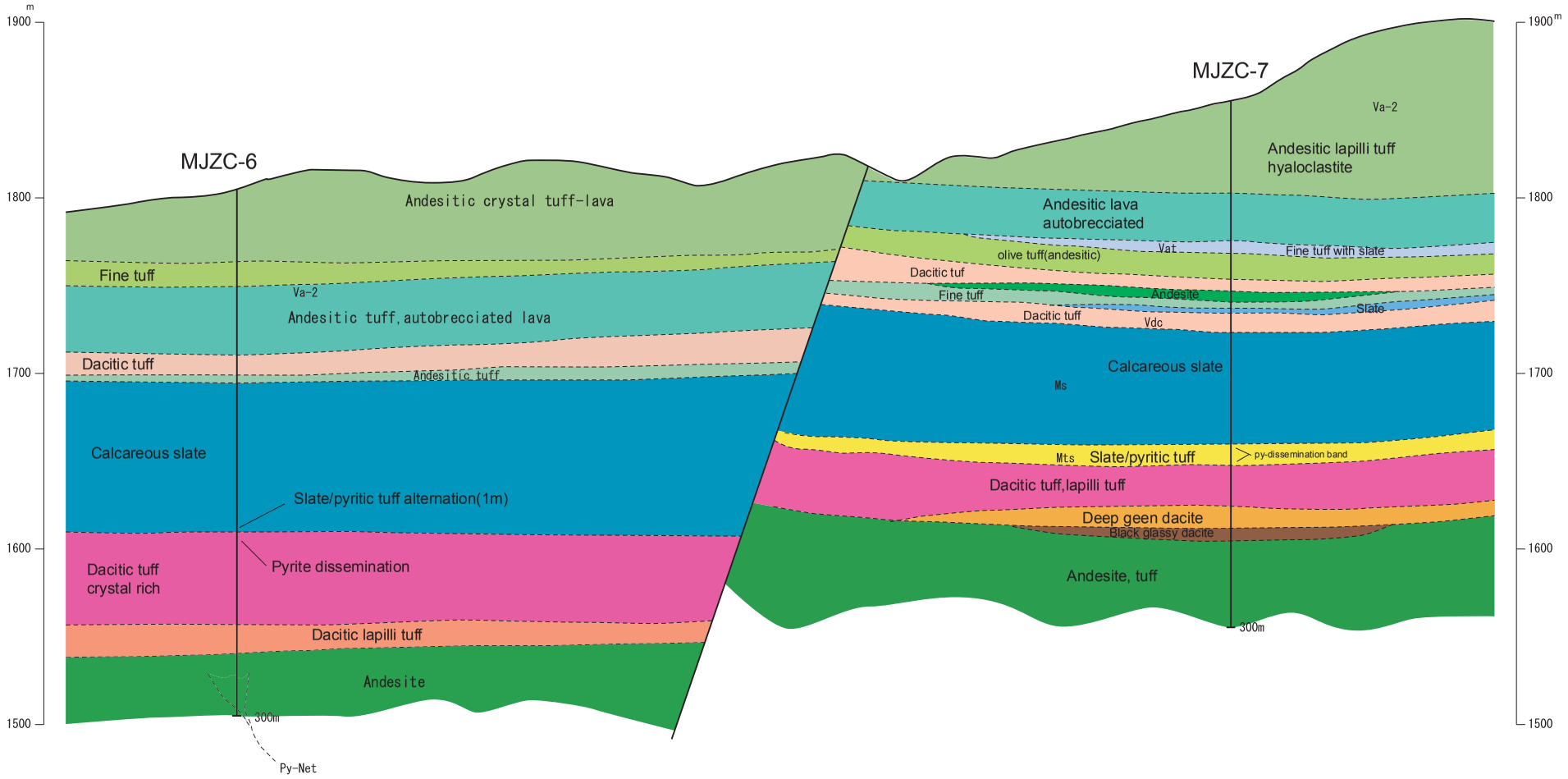

Fig.2-3-9 Geological Section of Drilling Survey(Capire Disrtict)

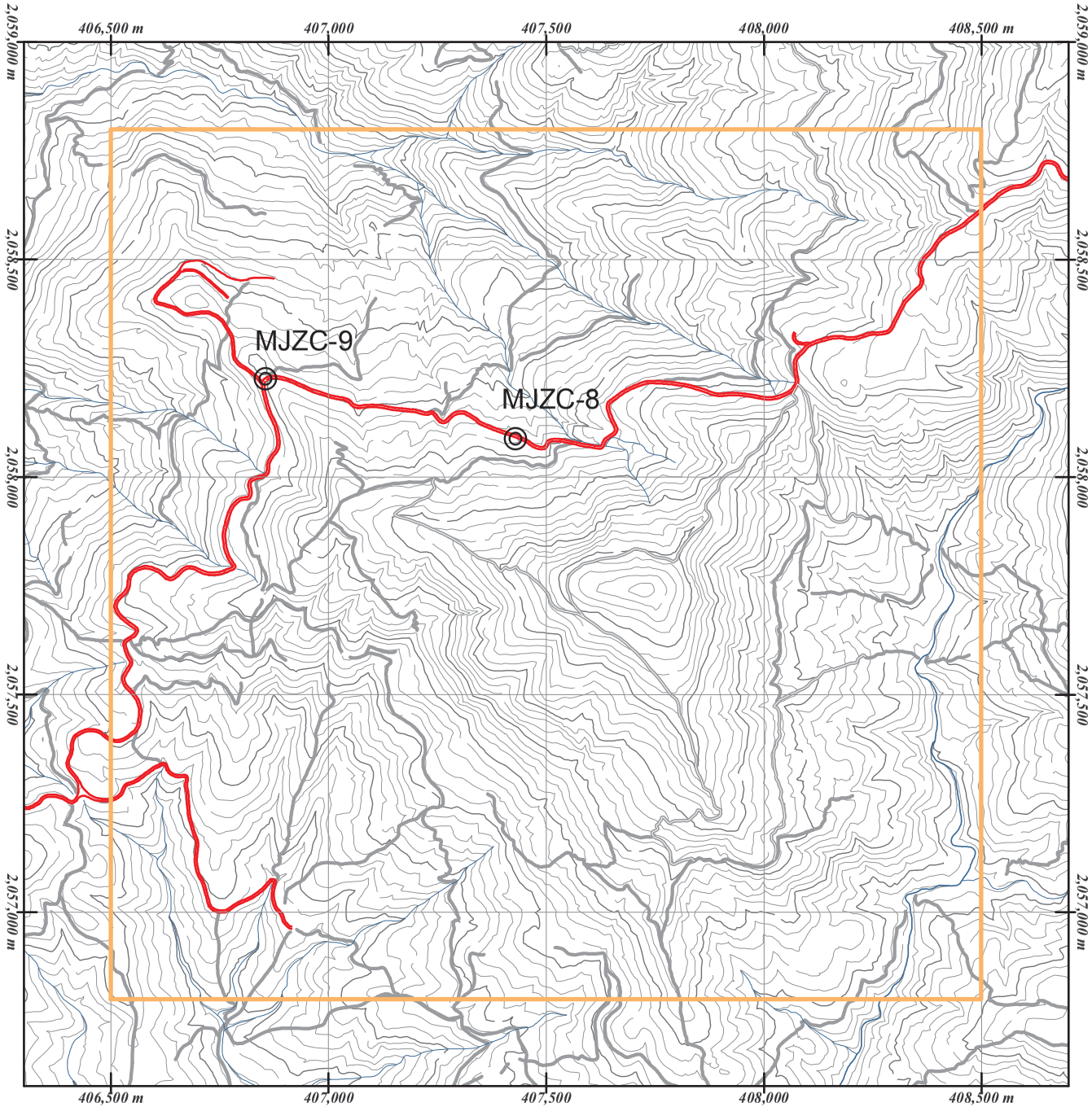

Fig.2-3-10 Drilling Site Location
of MJZC-8, MJZC-9

MJZC-8(1)

0m－100m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
5			0-6m:no core												
10	〃 〃 〃 〃 〃	Tuff	weathered oxide and fractured core,fine green tuff with slate												
15	〃 〃 〃 〃 〃	16.2													
20	△ △ △ △	Breccia	dark gray glassy tuffaceous breccia? altered(py disseminate) frgament bearing matrix=black glassy, light gray aphyric fragment dominat												
25	△ △ △ △	24.5	weak foliation=20°												
30		Dacitic tuff	gradual change plae green plagio dot, glassy tuff dacitic to rhyolitic with altered rock, essential and accidental fragment bearing												
35			foliation=20-30°												
40															
45			46.4-47.5m:reddish brown hematite band and plagio crystal increas foliation plane=30°												
50															
55			flat essential lass or lens(neary aphyric), partly black accidental fragment(1-3cm) bearing												
60		60.2													
65		Tuff	olive green laminated, foliated glass tuff pyritic ore fragment bearing foliation=5-30°												
70		66.7 Dacitic tuff	66.7-67.3m:contact,segrigation quartz zone grayish green glassy tuff, foliated and partly small kink folded plagioclase 0.5-2mm(5-10%), accidental gray, black fragment bearing												
75		77.5	gradual change												
80		Tuff 79.0	gray to olive gray foliatete pyritic tuf (py=max10%)												
85		83.6 Tuffaceous slate	gray calcareous slate>black slate(79-79.4m, 80.5-80.9m, with py band) dark gray fine, tuffaceous partly sandy, and well foliated, pyrtic tuff bed cont	83.7-84m: py+sph+gn+cp sil band mm 84.6m:py diss 5-10%(10cm)	29 30	83.7 86.0	10 10	26 9	11.7 1.15	0.268 (%) 70	1.69 (%) 728	3.94 (%) 16	1920 660	3.65 3.08	6.28 1.71
90			foliation(cleavage)plae=5-30° 90.1-92.2m:plagio rich sandy tuff with fine pyrite dissemination	85.8-86m: py+sph+gn+cp sil band mm											
95		96.1	gradual change												
		Sandy tuff 98.0	grayish green coarse to lapili bearing sandy tuff, essential lens, plagio rich												
100		Dacitic tuff	gradual change												

Fig.2-3-11(1) Geological Columnar Section (MJZC-8)

MJZC-8(2)

100m－200m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
		Dacitic tuff	plagio dot glassy, foliation=20-30°												
		104.4	contact 15° sharp												
105			black slate>pyritic olive tuff, well foliated and folded												
			msall kink fold(111.8m 113.7m etc)	108.8, 109.0m 2-3cm py+sph band											
110			very fine gray tuffaceous lamina												
			coare separated or fracured along cleavage plane	110.2m(10cm) py band	31	115.7	30	176	47.5	0.23 (%)	1.28 (%)	1.33 (%)	44	8.2	10.26
115				110.6m(5cm) py band+sph											
		Slate	sandy tuff part(23.5-124.4m, 126.1-126.m) bed//foliation=10°												
120				116-116.2m py band with sph, gn,											
125			black slate dominant partly sandy bed or fragment, py bed(130.3m)												
130															
		132.0	boundary is fractured with calcite vein												
		Sandy tuff	coarse plagio cont, sandy tuff intercalated black glassy tuff, slate bed												
135		137.0	sharp cntact 5-10°												
			olive gray fine pyritic foliated tuff, black glassy part intercalated		32	141	50	22	9.85	18	37	461	2270	11.1	12.8
140															
			140.5-155.5m:black glassy slaty?part dominant, accompanied with py bed (colloform texture) and flat light gray glass essential fragment	pyrite dissemination 5-10%											
145															
		Tuff													
150			foliation=5-20°												
155			below 162m:black glassy part increas												
160															
		164.5													
165		Black glassy tuff	olive gray tuff fragment bearing fine dissemination py net-film rich	py:5-15%	33	168.6	10	15	7.65	20	17	455	4460	4.26	4.64
		172.8	gradual change												
170		Altered tuff	well foliated gray to yellow tuff?sandy olive glass fragment, chip , shear lens foliation=20°	dissemination pyrite 5-10% (framboidal py cont.)											
		178.8	gradual chang												
175		Sandy tuff	gray plagio crystal rich sandy tuff, less foliated with quartz vein												
		183.8													
180			olive gray to gray sandy, glassy foliated tuff												
185															
		Altered tuff													
190															
195			195.7m(20cm):fine to lapillitic(sheared) tuff, normal grading?												
			well shear flat banded												
200			end of hole(200.1m)												

Fig.2-3-11(2) Geological Columnar Section (MJZC-8)

MJZC-9(1)

0m－100m

DEPTH (m)	GEOLOGICAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALIZATION	SAMPLE No.	SAMPLE DEPTH (m)	SAMPLE WIDTH (cm)	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
5		overbarden	reddish brawn soil and weatherd fuff fragment												
10		10.2													
15		Sandy tuff	gray to greenish gray coarse-lapilli bearing plagioclase, glass chip and accidental altered rock, slate ,pyrite dissemination fragment												
20															
25			27-28m:grading, sandy to glassy tuff												
30		28.9 Slaty tuff	28.9-31.4m:black fine slate-tuff lamination												
35		31.4 Sandy tuff 36.8	plagioclas and glass dominant, coarse to lapilli(siliceous aphyric) bearing tuff	py-diss, 1-2%											
40		Slate 40.3	black slate, partly sandy fractured coare, low core recovery												
45		Sandy tuff 46.1	coarse-lapilli bearing,py ore, slate chip, well foliated(foliation=10)												
50		Tuff/slate 52.2	dark gray tuffaceus, well foliated	py dot, band											
55		Slate	below 52.2:black slate ,sandy tuff altarnation, bedding plane=5-10°												
60		61.1	sheared contact												
65		Altered tuff	olive gray fine glassy, foliated dacitic? ser+qz+py altered												
70			quartz vein rich zone 70.0-30cm:green glass mm chip bearing tuff zone	py diss 5-10%											
75			75-78m:shear or fragmented tuff, well foliated and altered												
80			foliation=10-40°												
85			82-83.1m:quartz vein rich												
90			86-90m:white altered glass patch(pumice?) well banded,and foliated												
95			94.5-95.3m:fine green tuff, weak pyritization		34	91.2	10	21	1.30	9	6	48	579	4.51	4.37
100			99.5-100m:grayish green fine tuff												

Fig.2-3-12(1) Geological Colomnar Sction (MJZC-9)

MJZC-9 (2)

100m－200m

DEPTH (m)	GEOLOGI-CAL COLUM	ROCK NAME	DESCRIPTION	ALTERATION and MINERALI-ZATION	SAMPLE			CHEMICAL ANALYSIS							
					No.	DEPTH (m)	WIDTH (cm)	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Fe (%)	S (%)
105			gray siliceous, sericite, pyrite altered partly brecciated, and accidental rock fragment bearing 100-105m:lapillitic breciated(gray essential breccia)												
110		Tuff													
115			weak to moderate bracciated foliated tuffaceous rock foliation plane=0-40°	pyrite,silicification											
120															
125			125.5-126.5m:greenish chloritic fine andesitic tuff, sharp lower contact indicate fragment?												
130		130.8													
		Andesitic tuff	deep green andesitic glassy, py - diss week												
135		133.8													
		Tuff	gray tuff and green chloritic tuff mix, olive glass cont. well foliated(0-20°) partly lapillitic brecciated												
140															
145		144.9													
			deep greenish, fie glassy andesitic? partly brecciated, chl+py>ser altered	146.3-146.6m pyrite quartz vein - net											
150			151.7-153.6m:gray aphyric fragmented breccia zone												
155				py band											
		Andesitic tuff	well foliated green tuff and gray altered part mix, foliation=10-20°												
160															
165		165.6													
		Andesitic breccia	well foliared, banded, gray aphyric breccia, fragment and fine matrix	168.6m, pyrite band 5mm											
170															
175		174.2	calcite and quartz segrigation filled with contact zone												
		Andesite	greebish fine-porphyritic, chl-altered lava, qz+ca+py veinlet cut foliation plane and high angle												
180															
185					35	186.4	10	18	1.90	40	12	56	156	4.51	3.33
190															
195															
200															

Fig.2-3-12(2)　Geological Colomnar Section(MJZC-9)

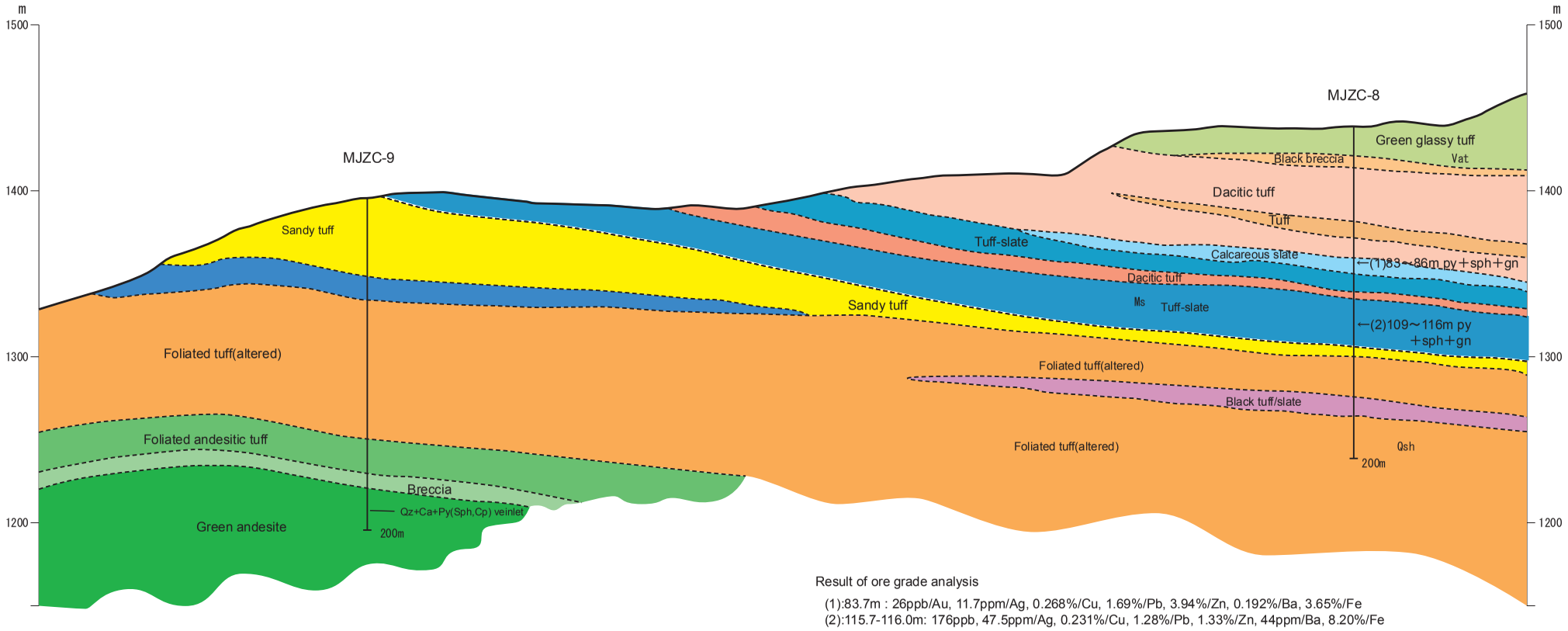

Fig.2-3-13 Geological Section of Drillig Survey(La Campana District)

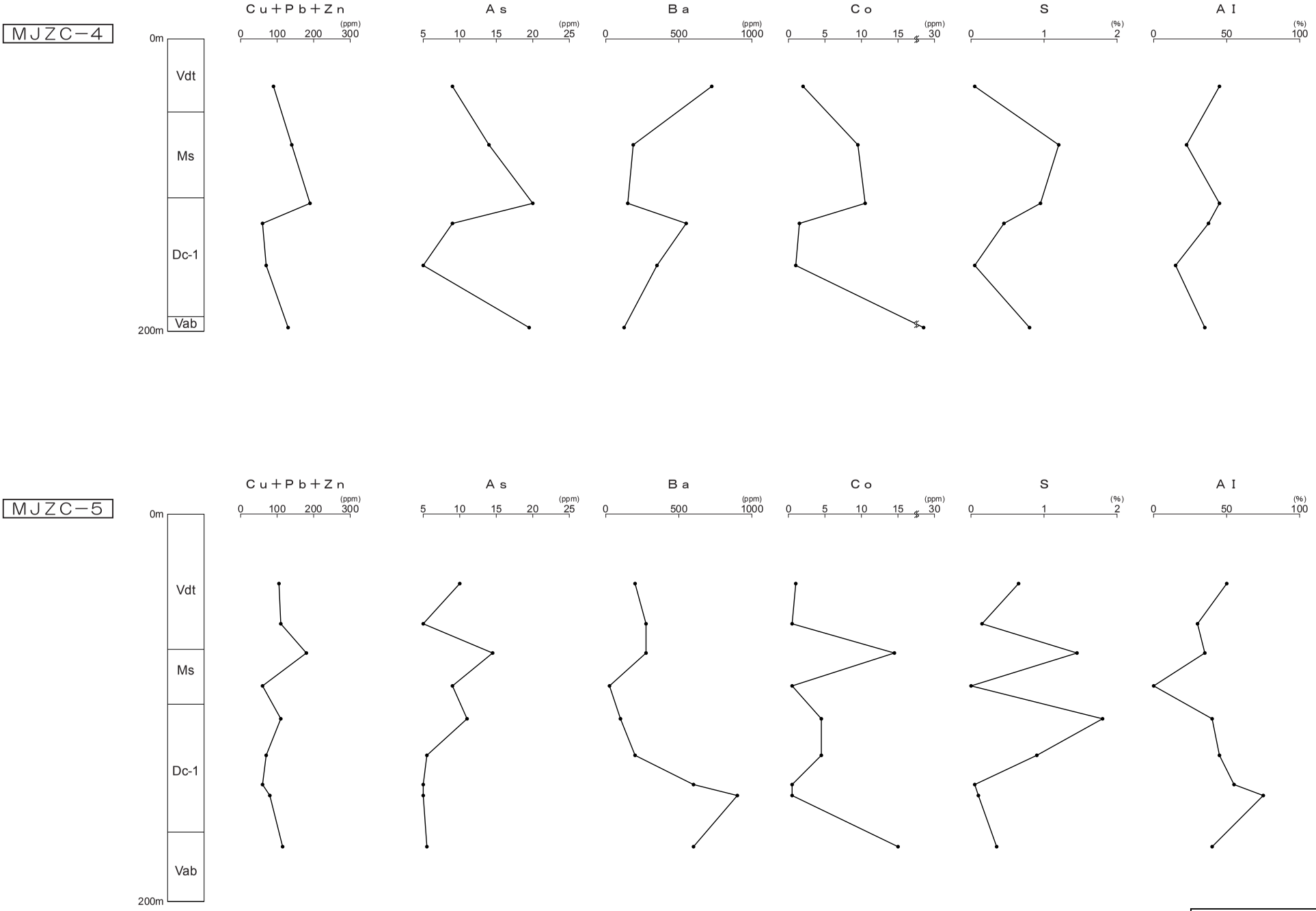

Fig.2-3-14 Result of Geochemical Analysis of MJZC-4, MJZC-5

Vdt :Dacitic tuff
Ms :Calcareous slate,limestone
Dc-1:dacitic tuff
Vab :Andesitic tuff lava

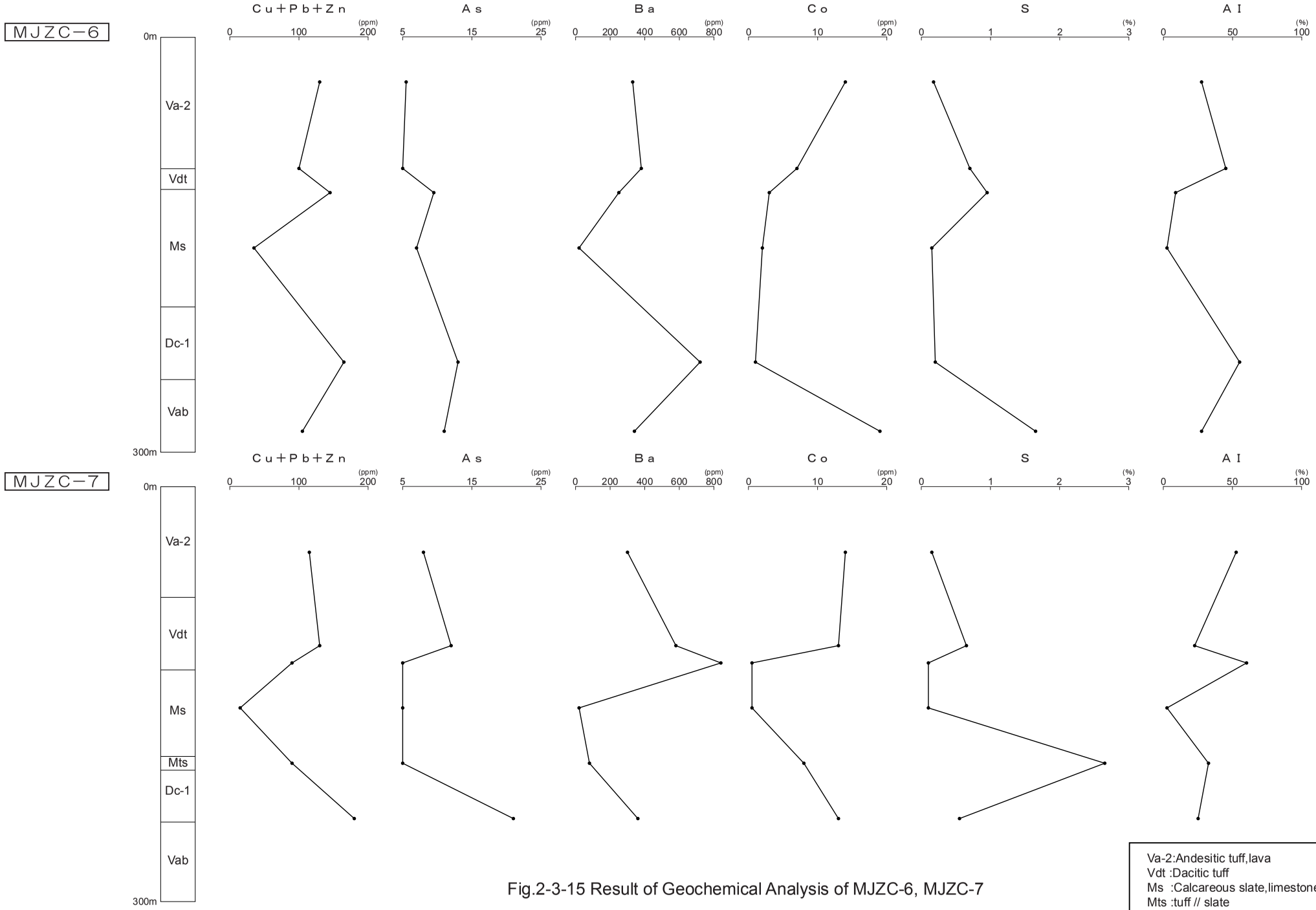

Fig.2-3-15 Result of Geochemical Analysis of MJZC-6, MJZC-7

Va-2:Andesitic tuff,lava
Vdt :Dacitic tuff
Ms :Calcareous slate,limestone
Mts :tuff // slate
Dc-1:Dacitic tuff
Vab:Andesitic tuff lava

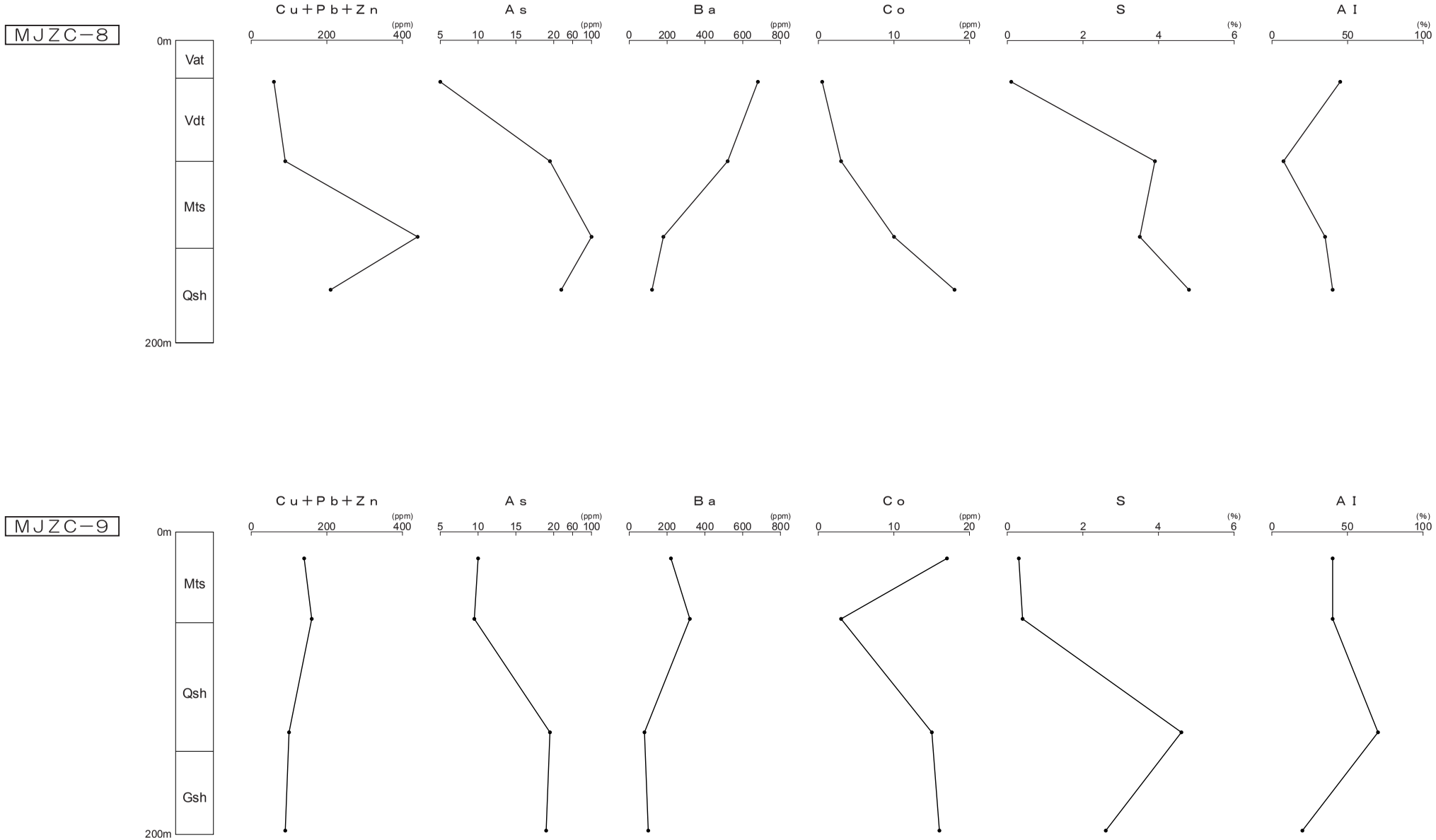

Fig.2-3-16 Result of Geochemical Analysis of MJZC-8, MJZC-9

Vat :Glassy tuff
Ms :Dacitic tuff
Mts :tuff // slate
Qsh :Foliated tuff
Gsh :Foliated andesite,tuff

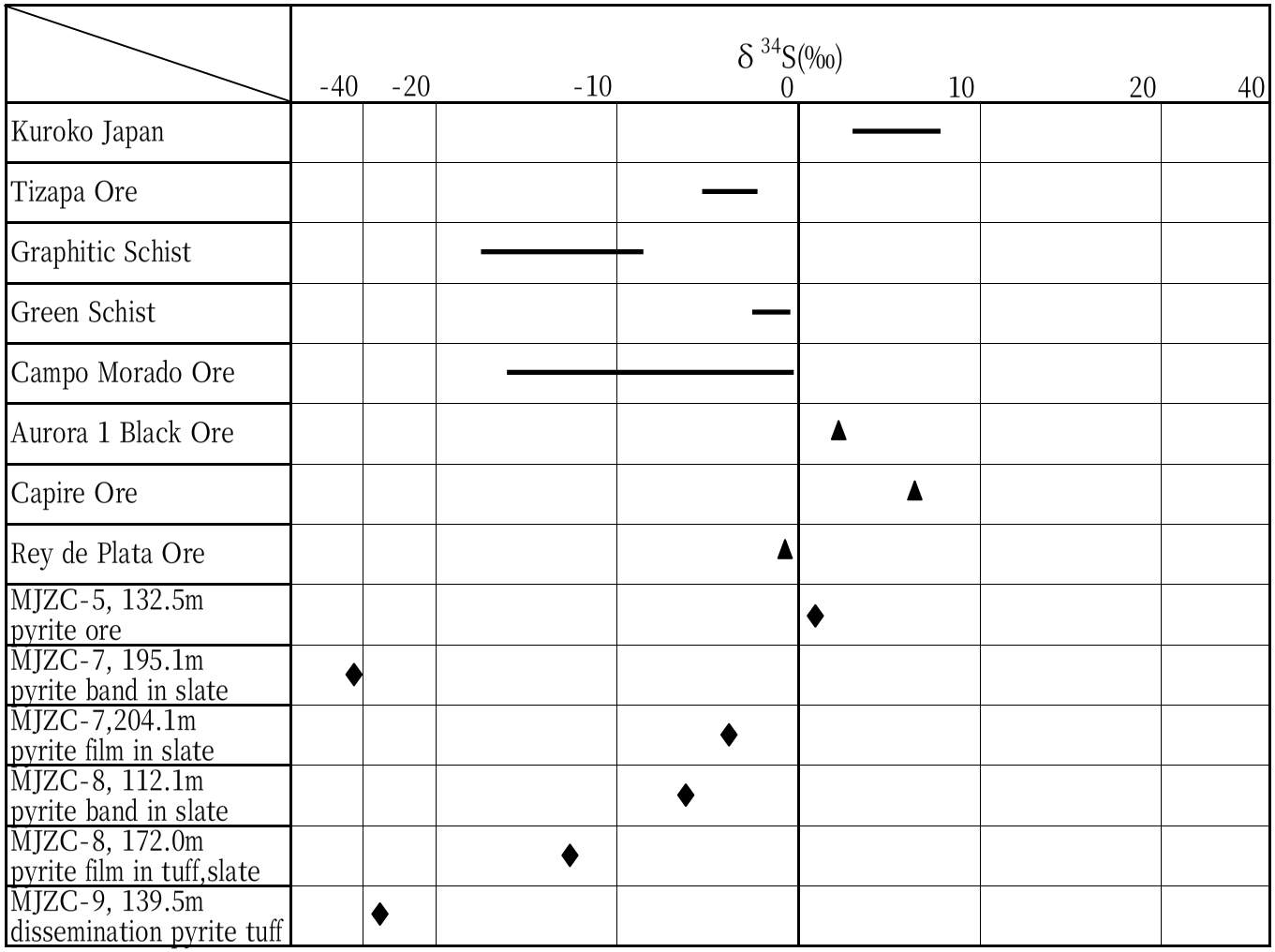

Fig2-3-17 Result of S Isotope Analysis

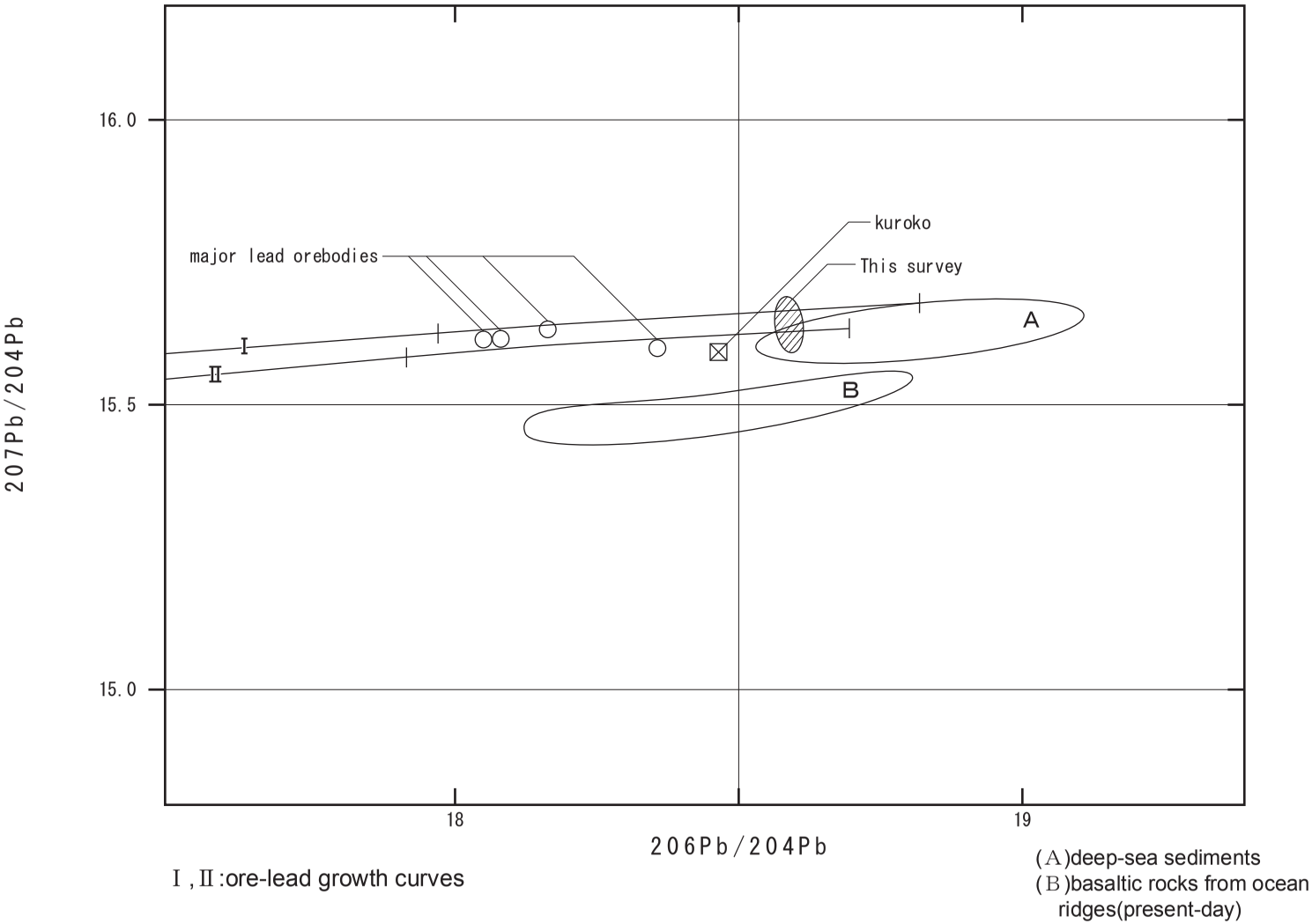

Fig.2-3-18 Result of Pb Isotope Analysis