CHAPTER 2 RESULTS OF THE SURVEY

2 - 1 Geology and Mineralization of the Drill Cores

2 - 1 - 1 Outline of Geology

The horizons confirmed by this drilling are from Loralai Member Unit-I to Anjira Member Unit-II. The rocks of these units are basically limestone and shale. Marly shale forms alternations with the above two rocks and these are divided lithologically into alternation A and B. There are no significant differences between the lithology of the units in Surmai-I and III. Same results were obtained during the second phase. The characteristics of the above four lithologic units are described below and sketches of core are shown in Figures II -2-1.

The samples for microscopic studies were collected from the zone between West and East Deposits where drilling (MJP-14,15) was conducted for the first time in the third phase. The results of these studies (Table II -2-1) do not differ significantly from those of previous work in Surmai Area. The limestone was grouped by Folk's classification (1959). The columar sections (Scale 1:200) of each drill core are shown in Appendix-8.

(1) Limestone: Usually grey, in same cases pale grey or dark grey. Compact and hard. Mostly micric and biomicritic and locally oomicritic. Generally contains irregular 2～10 cm patches of shale～marly shale. The boundary between the patches and the limestone is clear for shale and gradual in case of marly shale. These patches selectively become reddish brown to orange by hematitization between the surface and 100 m depth. Also calcite veinlets occur through the limestone.

A photograph of a typical sample (DH14-BB) is shown in Photo.-2. This sample is biomicrite and the orthochem consists of micrite and allochem of bioclasts. Of the allochem, the round grains at the central-right part of the photograph are algae, the tubular material traversing the photograph and the comma-shaped material at the far right are probably molluscs, but they have all changed to calcite spar and it is difficult to identify the bioclast species.

(2) Shale: Dark grey to black, weakly argillic and soft. Lamination is developed with 0.5～1 mm thick laminae and is fissile. Partly marly, massive and grey to dark grey. Generally contains powdery or nodular (1 mm diameter) pyrite which is considered to be of primary origin. The nodules are concentration of powdery material. Often flat limestone nodules with 1～3 cm diameter (limestone nodules) and trails of tubular creatures 1～3 mm wide (tubular trails) occur in the shale immediately below the boundary with limestone.

A photograph of a typical sample (DH14-CC) is shown in Photo-3. This sample is biomicrite and the orthochem consists of micrite, quartz and clay minerals and the allochems of bioclasts and calcite spar. The semi-circular material in the upper left is probably mollusc replaced by calcite spar. Fine grains of opaque minerals, probably pyrite, are scattered throughout and a concentration of these grains or a large grain occur in the lower right. Foliation is observed accross the image from upper left to lower right. The lineation diagonally accros the image is sparitic calcite filling the bedding planes. These were recorded as calcite films during core observation by the unaided eyes.

(3) Alternation A (AA): Regular alternation of shale and marly shale, individual beds are 0.5～3 mm thick. The shale is dark grey to black and the marly shale grey to dark grey.

(4) Alternation B (AB): Alternation of limestone and marly shale with limestone predominant. Individual beds are 5～10 mm thick, marly shales are 1～2 mm. Limestone is grey and marly limestone dark grey.

2 - 1 - 2 Stratigraphy

The strata investigated by drilling are correlated to the lower Loralai Unit-I to the upper Anjira Unit-II. The stratigraphic correlation chart of the drill holes are shown in Figure II-2-2. In correlating the strata, the lithology, thickness, the angle between the bedding and the drill cores (cross angle), distribution of limestone nodules, tubular trails and other factors were considered. The stratigraphic correlation of the surface and of the drill holes was carried out and geologic cross sections (scale 1:1,000) were prepared (PL.II-2-1～4). Then these were somewhat simplified to scale 1:2,000 cross sections (Figs.II-2-3～6). Also the geologic cross sections (scale 1:2,000) of the zone between Northern Orebody of Surmai-III West Deposit and East Deposit is laid out in Figure II-2-7～8.

The characteristics of the horizons identified from the work of the first and the present phases are as follows.

(1) Loralai Unit-I: 120～150 m thick. Alternation of limestone with AA or AB or shale. Limestone predominant in the upper and middle parts, AA predominant in lower part. Thicknesses of individual beds are; limestone 1～7 m, AA 1～10 m, AB and shale 1～2 m. They tend to become sandy in the lower parts.

(2) Loralai Unit-II: 100～120 m thick. Limestone and shale alternation with limestone predominant in the upper part, thicknesses of individual beds are; limestone 1～15 m and shale 0.5～1 m. Alternation of limestone and AA with AA predominant in the lower part, thicknesses are; limestone 1～2 m, AA 1～10 m.

(3) Loralai Unit-III: 100～150 m thick, alternation of limestone and shale with shale predominant. Thicknesses of individual beds are; limestone 0.5～2 m, shale 1～7 m.

(4) Loralai Unit-IV: 100～130 m thick, alternation of limestone and

shale, upper part limestone predominant, lower part shale. Thickness of individual beds for both limestone and shale is 1～5 m.

(5) Anjira Unit-I: 50 m thick, limestone with minor shale intercalation. Limestone beds are 1～2 m thick.

(6) Anjira Unit-II: 100～180 m thick, regular alternation of limestone and shale. Individual beds of both limestone and shale are 0.2～1 m thick.

2-1-3 Geology and Mineralization of the Drill Holes

The geology and mineralization of the drill holes are described below. In describing the mineralization, only the concentrated parts are mentioned regarding calcite and pyrite. The true thickness is mentioned in this report considering the cross angle of the beds.

(1) MJP-7

【Geology】

0～2.1 m: Gravel.

2.1～51.4 m: Correlated to Loralai Member Unit-III, alternation of limestone and shale, shale predominant between 27.8～41.7 m. Individual beds, limestone 0.5～5m thick, shale 0.2～2.5 m thick. Hematitization observed in limestone from 0～42m. Cross angles show 70°～80° degree.

51.4～150.5 m: Correlated to Loralai Member Unit-II, thick limestone with shale intercalation, almost totally limestone at 51.4～89.2 m and 102.0～120.1 m. Individual beds, limestone 1～20 m thick, shale 0.2～1 m thick. Limestone contains fossils of bivalves and gastropods, and is partly oolitic.

【Mineralization】

Limonitized zone associated with powder to dissemination of sphalerite and galena occur from the lowermost part of Loralai Member Unit-III to the upper part of Unit-II. This mineralized zone occurs at 44.2～54.0 m and 64.1～79.7 m, both including non-mineralized parts 0.5～1.5 m thick. Calcite veinlets occur through the zone. Mineralization is not observed in the intercalated shale.

(2) MJP-8

【Geology】

0~9.1 m: Gravel.

9.1~54.9 m: Correlated to Anjira Member Unit-II, alternation of limestone and shale. Individual beds, 0.2~1.5 m thick for both limestone and shale.

54.9~138.5 m: Correlated to Anjira Member Unit-I, alternation of limestone and shale, Shale predominant to 90.8 m and individual beds are limestone 0.2~1 m thick and shale 0.2~7 m thick. Below 90.8 m, limestone predominant and individual beds are limestone 0.2~5 m thick, shale 0.2~0.5 m thick. Hematitization observed in limestone at 110~135 m.

138.5~330.5 m: Correlated to Loralai Member Unit-IV, alternation of limestone and shale with shale predominant. Individual beds limestone 0.2~6 m thick, shale 0.2~3 m thick. Fossils generally abundant with bivalves and gastropods in limestone and 5~10 cm thick coquina beds of bivalves are distributed in shale. Limestone nodules and tubular trails often occur in the uppermost parts of the shale beds. Shale is often fractured and argillized.

330.5~401.0 m: Correlated to Loralai Member Unit-II, alternation of limestone and shale at 330.5~337.4 m with thickness of individual beds 0.2~0.5 m. 337.4~401.0 m consists of AA, AB and shale with AA predominant.

【Mineralization】

Mineralized zone containing lead-zinc sulfides distributed at 331.2~337.4 m. Mineralization consists of dissemination of sphalerite and galena in limestone and shale and of siderite, calcite veinlets cutting through the host rock and dissemination.

(3) MJP-9

【Geology】

0~11.5 m: Gravel.

11.5~51.1 m: Correlated to Anjira Member Unit-II, alternation of limestone and shale, thickness of individual beds is 0.2~1.5 m for both limestone and shale.

51.1~112.8 m: Correlated to Anjira Member Unit-I, alternation of limestone and shale at 51.1~72.0 m with shale predominant. Individual beds limestone 0.2 m thick and shale 0.5～7 m thick. Alternation of limestone and shale at 72.0～112.8 m with limestone predominant and thickness of individual bed 1～7 m for limestone and 0.2 m for shale.

112.8～265.8 m: Correlated to Loralai Member Unit-Ⅳ, alternation of limestone and shale with shale predominant. Individual beds, limestone 0.2～6 m thick and shale 0.2～5 m thick. Fossils are generally abundant with bi-valves and gastropods in limestone and coquina beds of bivalves 5～10 cm thick occur in shale. Limestone nodules and tubular traces often occur in uppermost parts of the shale beds. Shale is often fractured and argillized.

265.8～301.0 m: Correlated to Loralai Member Unit-Ⅱ. At 265.8～292.0 m, alternation of limestone and shale with part intercalate of AA. Individual beds, limestone 0.2～4 m thick, shale 0.1～1.5 m thick. At 292.0～301.0 m: alternation of limestone, AB and shale, individual beds AB 0.5～2 m thick, both limestone and shale 0.5～1 m thick.

【Mineralization】

Mineralized zone containing lead-zinc sulfide minerals occur at 265.8～282.5 m. The zone consists of sphalerite and minor galena disseminated in limestone together with siderite and calcite veinlets cutting through the dissemination.

(4) MJP-10

【Geology】

0～7.8 m: Gravel.

7.8～59.0 m: Correlated to Anjira Member Unit-Ⅱ, alternation of limestone and shale. Individual beds, limestone 0.2～1.5 m thick, shale 0.2～0.5 m thick. Hematitization observed throughout the section.

59.0～193.2 m: Correlated to Anjira Member Unit-Ⅰ, alternation of limestone and shale and shale predominant to 98 m. Individual beds, both limestone and shale 0.2～1 m thick. Below 98 m, limestone predominant and the thickness of individual beds are 1～3 m for limestone and 0.2 m for shale.

193.2～500.3 m: Correlated to Loralai Member Unit-Ⅳ, alternation of limestone and shale with shale predominant. Individual beds, limestone 0.2～6 m thick and shale 0.2～5 m thick. Fossil generally abundant, bivalves and gastropods found in limestone and 5～10 cm thick bivalve coquina beds distributed in shale. Limestone nodules and tubular traces often occur in the uppermost parts of shale beds. Also the shale is often fractured and argillized.

【Mineralization】

Lead-zinc mineralization nor siderite occurrence were not observed in this drill hole. At 210～320 m, however, limestone is fractured associated with many calcite veins.

(5) MJP-11

【Geology】

0～1.1 m: Gravel.

1.1～49.5 m: Correlated to Loralai Member Unit-Ⅲ, alternation of limestone and shale. Individual beds, both limestone and shale 0.2～3 m thick.

49.5～210.0 m: Correlated to Loralai Member Unit-Ⅱ. At 49.5～150.2 m, alternation of limestone and shale with limestone predominant, and the thickness of individual beds is limestone 0.5～20 m, shale 0.2～1 m. At 150.2～210.0 m, alternation of limestone, shale, AA and AB with AA predominant and the thickness of individual beds is AA 1～7.5 m and others 0.2～2 m.

210.0～251.0 m: Correlated to Loralai Member Unit-Ⅰ, alternation of limestone, shale, AA and AB with limestone predominant. Individual beds, limestone 0.5～12 m thick and others 0.2～1 m thick.

【Mineralization】

Mineralized zone with lead-zinc sulfide minerals occur at 53.5～77.0m. The mineralization consists of dissemination of small amount of sphalerite and galena in the host rock and siderite and calcite veins cutting through. Limonite is associated at 136.3～138.0 m. Aside from above, dissemination of sphalerite and galena is observed in limestone at, 44.6～46.6 m, 88.0～88.9 m, 98.0～100.0 m and 136.3～138.0 m.

(6) MJP-12

【Geology】

0～1.1 m: Gravel.

1.1～43.6 m: Correlated to Loralai Member Unit-Ⅲ, alternation of limestone and shale with limestone predominant. Individual beds, limestone 0.5～5 m thick and shale 0.2～1 m thick.

43.6～151.0 m: Correlated to Loralai Member Unit-II, alternation of limestone and shale with limestone predominant. Individual beds, limestone 1～10 m thick, shale 0.2～1.5 m thick. Bivalves and gastropods fossils occur in the limestone.

【Mineralization】

Mineralized zone with lead-zinc sulfide minerals occurs at 46.6～71.3 m. The mineralization consists of dissemination of small amount of sphalerite and galena in the host rock together with siderite and calcite veinlets cutting through. Limonite is associated at 52.0～56.3 m. Aside from above, sphalerite and galena dissemination is observed at 40.4～43.6 m and 78.7～80.4 m.

(7) MJP-13

【Geology】

0～2.7 m: Gravel.

2.7～116.1 m: Correlated to Loralai Member Unit-III, alternation of limestone and shale. At 2.7～69.3 m, shale is predominant and the thickness of individual beds is limestone 0.2～1 m and shale 0.2～4.5 m. At 69.3～116.1 m, limestone is predominant and the thickness is limestone 0.5～3.5m.

116.1～351.0 m: Correlated to Loralai Member Unit-II. At 116.1～322.8 m, lithology is alternation of limestone and shale with limestone predominant, and the thickness of individual beds is limestone 1～10 m and shale 0.2～1 m. At 322.8～351 m, lithology is alternation of limestone, shale and AA, the thickness of individual beds is limestone and shale 1 m and AA 1.5～3 m.

【Mineralization】

Mineralized zone with lead-zinc sulfide minerals occurs in the limestone at 132.2～181.8 m. The mineralization consists of sphalerite and galena dissemination in the host rocks together with siderite and calcite veins cutting through.

(8) MJP-14

【Geology】

0～4.1 m: Gravel.

4.1～123.2 m: Correlated to Loralai Member Unit-III, alternation of limestone and shale with shale predominant. Individual beds, limestone 0.2～4.5 m thick, shale 0.2～2.5 m thick. At 109.5～123.2 m, shale is intensely fractured and argillized and the possibility of faults passing through this zone is high.

123.2～184.1 m: Correlated to Loralai Member Unit-II, alternation of limestone and shale. Individual beds, limestone 1～2 m thick, shale 0.2～7 m thick. At 123.2～168.0 m, shale is intensely fractured and argillized and the possibility of faults passing through this zone is high.

184.1～286.5 m: Correlated to Loralai Member Unit-III, alternation of limestone and shale. Individual beds, limestone 0.2～4.5 m thick, shale 0.2～4 m thick.

286.5～351.0 m: Correlated to Loralai Member Unit-II, thick limestone with local intercalation of thin shale. Individual beds, limestone 1～15 m thick, shale 0.2～1 m thick.

【Mineralization】

Mineralized zones, 0.5～3 m thick, consisting of lead-zinc sulfide minerals occur at 16 points. An unmineralized zone exists at 288.6～347.3 m. The mineralization consists of sphalerite and galena dissemination in the host rock together with siderite and calcite veinlets cutting through.

(9) MJP-15

【Geology】

0～3.1 m: Gravel.

3.1～128.0 m: Correlated to Loralai Member Unit-III, alternation of limestone and shale with shale predominant. Individual beds, both limestone and shale 0.2～5.5 m thick. Shale is generally intensely fractured and argillized.

128.0～154.8 m: Correlated to Loralai Member Unit-IV, alternation of limestone, shale and AB with shale predominant. Individual beds, limestone and AB 0.2～1 m thick, shale 0.2～6 m thick. Shale is generally intensely fractured and argillized.

154.8～207.8 m: Correlated to Loralai Member Unit-III, alternation of limestone and shale. Individual beds limestone and shale both 0.2～4.5 m thick. Shale at 154.8～173.2 m is intensely argillized and fractured.

207.8～300.2 m: Correlated to Loralai Member Unit-II, thick limestone with locally intercalated thin shale. Individual beds, limestone 1～15 cm thick, shale 0.2～1 m thick.

【Mineralization】

Mineralized zones with lead-zinc sulfide minerals occur at 239.4～258.1 m and 277.1～300.2 m. Similar mineralized zones with thickness of 0.3～1 m occur at seven depths with unmineralized zone at 200.8～237.1 m. The mineralization consists of sphalerite and galena dissemination in the host rock together with siderite and calcite veinlets cutting through.

2 - 1 - 4 Geologic Structure

2 - 1 - 4 - 1 Surmai-I

(1) Vicinity of Main Orebody

The results of the drilling conducted during the third phase and the surface survey revealed the geologic structure of this zone to be as follows.

a. MJP-7,13 Section (Fig.II-2-3, Pl.II-2-1)

Units II and III of Loralai Member are distributed in this section. These dip westward at approximately 70° and are gently folded. The cross angles of both MJP-7 and 13 are very stable and the stratigraphic correlation between the two drill holes is very clear. Thus the geologic structure of this zone is not disturbed. There is a normal fault which dips steeply westward with displacement of 300～400 m at 25 m west of the drill site and the above beds are all intersected by this fault. This is the same fault as the one identified by MJP-2 and 3 located approximately 150 m south of the present section. Units III and IV of Loralai Member situated above the fault dips eastward at the surface but gradually inclines westward in the deeper parts.

The Pb-Zn mineralized zone is 30～35 m thick and it occurs in the lower part of Unit Ⅲ to the upper part of Unit Ⅱ of Loralai Member on the surface while in the deeper parts it is distributed in the upper part of Unit Ⅱ. The ground water table estimated from the hematitization is approximately 120 m below the surface. The mineralized zone confirmed in MJP-7 consists mostly of limonite associated with lead-zinc sulfides while that in MJP-13 consists solely of sulfides. Therefore, the zone in MJP-7 is considered to be the transition zone from oxidized zone to the sulfide zone.

The geologic structure of this area is inferred to be as follows from the study of the sections MJP-1～3 (Fig.Ⅱ-2-9) and MJP-1, 4 (Fig.Ⅱ-2-10) as well as the above.

In this zone, Units Ⅱ-Ⅳ of Loralai Member are distributed and they strike N30°E, and dip 70°W. There is a normal fault which strikes N5°E and dips 80°W with displacement of 300～400 m in the western part. This fault intersects the above units.

The lead-zinc mineralized zone is 400 m long in strike direction and 30～35 m thick. It is emplaced more or less parallel to the bedding in the lower part of Unit Ⅲ and the upper part of Unit Ⅱ. This mineralized zone is intersected at the depth of 150 m in MJP-1～3 section and at 200 m depth in MJP-7,13 by the above fault. The mineralized zone was not located above the fault. The transition from the surface oxidized zone to the *deeper sulfide zone is believed to be near 50 m below the surface.*

2 - 1 - 4 - 2 Surmai-Ⅲ

(1) Vicinity of Northern Orebody

The geologic structure of this zone inferred from the results of five drill conducted in the third phase as well as the surface survey and the past drilling work is as follows.

a. MJP-8～10 section (Fig.Ⅱ-2-4 and Pl.Ⅱ-2-2)

Unit Ⅱ of Loralai Member and Unit Ⅱ of Anjira Member is distributed in this section and they dip westward at approximately 55° with gentle folding. There is a normal fault at the eastern edge which steeply dips westward with displacement of 300～400 m. This fault was identified by drilling MJP-5 and 6 during the second phase. It is inferred that intense folding occur below this fault because of the variation of cross angles and here only the Unit Ⅱ of Loralai Member occurs. The existense of another fault with westward dip is inferred to occur in Unit-Ⅳ of Loralai Member and another with similar dip in Unit-Ⅰ of Anjira Member from the local abrupt change of the cross angles, the lack of beds when correlating the bore holes and also the intense fractures and argillization.

Lead-zinc mineralized zone is cut by the fault at the eastern edge of the section and is distributed in a narrow zone in Unit-Ⅱ of Loralai Member. The ground water table inferred from the distribution of the hematitized zone is approximately 100 m below the surface.

b. MJP-11,12 section (Fig.Ⅱ-2-5 and Pl.Ⅱ-2-3)

This section forms the western limb of the anticline extending in N-S direction and Units Ⅰ～Ⅲ of Loralai Member are distributed with 30° westward dip and gentle folding. The cross angles are very stable and the stratigraphic correlation between the two bore holes are clear, thus the geologic structure is inferred to be little disturbed.

Lead-zinc mineralized zone is 25～30 m thick and lies within the Unit-Ⅱ of Loralai Member at the surface, but the mineralized horizon changes to the lower part of Unit-Ⅲ and upper part of Unit-Ⅱ of Loralai Member in the deeper zones. The depth of ground water table inferred from hematitization is approximately 50 m. The mineralized zone consists mainly of lead-zinc sulphides partly accompanied by limonite. Thus the mineralized part hit by the MJP-11 and 12 (approximately 50 m deep) is considered to be the transitional zone from oxidized to sulfide zone.

The geologic structure of this area is inferred to be as follows from the study of the section MJP-5～6 (Fig.Ⅱ-2-11) as well as the above.

Unit-Ⅰ of Loralai Member to Unit-Ⅱ of Anjira Member is distributed in this district. There is a normal fault at the western part with N-S strike, 8°W dip and 300～400 m displacement and it intersects the above beds. The beds above Unit-Ⅳ of Loralai Member occur in the hanging wall side of the fault with N5～10°E strike and 45°～70°W dip. Units Ⅰ～Ⅲ of Loralai Member occur in the foot wall side of the fault with N45°～70°E strike and 55°W dip which decreases to 30°W in the north.

Lead-zinc mineralized zone occur in the lower part of Unit-Ⅲ to the lower part of Unit-Ⅱ of Loralai Member along the bedding. The zone is 350 m long in strike direction, 50 m thick in the central part and 25～30 m in the north. It wedges out in the northern margin and is cut by the fault in the south. This zone is cut by the fault at 400 m below the surface near the MJP-8, 9, 10 section and at 200 m depth near the MJP-5～6 section. Near the MJP-11～12 section, however, the extension below 80 m is not clear. The mineralized zone could not be located above the fault. The transition between the oxidized and the deeper sulfide zones is inferred to occur near 50 m below the surface.

(2) Intermediate zone between the West and East Deposit

The geologic structure of this zone inferred from the results of the two drilling conducted during the third phase together with the surface survey and the past drilling is as follows.

a. MJP-14～15 Section (Fig.Ⅱ-2-6 and Pl.Ⅱ-2-4)

The general structure of this section is a northward plunging syncline with N-S trending axis. This syncline lies within a series of anticlines which opens northward in a horse-shoe manner. The deposits of Surmai-Ⅲ which is originally of a continuous nature, crops out on the surface along this anticlinal structure (Fig.Ⅰ-3-6～7: Surmai-Ⅲ geological map, cross section and Fig.Ⅱ-2-8～9: drilling section). This section cuts through this synclinal structure along the axis in N-S direction.

The beds of Unit-Ⅱ～Ⅳ of Loralai Member confirmed by MJP-14 and 15 dips gently at horizontal to 20° with gentle folding near the drilling site, but the dip become steeper southward and is 70° where the South Orebody of the West Deposit is exposed on the surface. Five faults are inferred to be distributed in this section from the abrupt local changes of cross angles, the lack of some beds in stratigraphic correlation between the two bore holes and the occurrence of many fractured and argillized zones. The beds near the drilling site are cut into many blocks by N-S faults parallel to the section and also by E-W faults which, transect the section. Also the vertical relation of these beds are disturbed. The zone shallower than 18.4 m of MJP-14 and that above 128 m of MJP-15 are intensely fractured and argillized and the cross angles are small and unstable, thus it appears that the fractured zone or its vicinity was drilled.

The lead-zinc mineralized zone occurs along the bedding in the lower part of Unit-Ⅲ to the upper part of Unit-Ⅱ of Loralai Member. The mineralization at 288.6～347.3 m of MJP-14 and 200.8～300.2 m of MJP-15 is, although dissected by three E-W faults, continuous to the surface exposure of the Southern Orebody of the West Deposit shown at the southern end of the section. The three mineralized zones confirmed at 126.2～151.5 m of MJP-14 all consist of mineralized and fractured boulders of limestone, and intensely fractured and argillized shale occur in the vicinity. Thus they are considered to be boulders of the fault zone. The ground water table depth is inferred to be approximately 100 m from the distribution of hematitized zone. The transition from oxidized zone to the deeper sulphide zone is considered to have occured near 50 m depth.

Geological cross section through West Deposit～the present zone～East Deposit is shown in Figure Ⅱ-2-8～9. It is seen that the beds of the Shirinab Formation form, from west eastward, anticline ～ syncline ～ anticline structure with intense local folding. The mineralized zone of the West Deposit～East Deposit is originally continuous and is distributed concordantly with the above structure in the lowermost part of Unit-Ⅲ to middle of Unit-II of Loralai Member. The occurrence of the mineralized zone continuing from 288.6~347.3 m of MJP-14 to 200.8~300.2 m of MJP-15 is limited in E-W direction by faults.

2 - 1 - 5 Mineralization

(1) Nature of Mineralization

Significant difference is not recognized between the nature of mineralization at Surmai-I and at Surmai-III. Mineralization consists mainly of disseminated powdery to granular sphalerite (ZnS_2) and galena (PbS) replacing limestone with siderite ($FeCO_3$) and calcite veins and veinlets intersecting the above mineralized zone. Also small amount of pyrite (FeS_2), chalcopyrite ($CuFeS_2$) and weak silicification are associated with the activity. Sphalerite and galena often occur separately. The veins mentioned above sometimes contain medium to large crystals of sphalerite and galena which were probably formed at a late stage. Lead-zinc mineralization in shale is rare. The sphalerite is brown and it is believed that its Fe content is larger than those in most Mississippi Valley type lead-zinc deposits. Siderite and calcite often occur in the same vein and the calcite is in the central part while siderite occur in the marginal (near the host rock) part of the veins. Siderite, therefore, crystallized before calcite. In intensely mineralized parts, the host limestone is often fractured. These characteristics of the mineralization are similar to the results of the second phase survey. A sketch of a typical mineralized part of the core is laid out in Figure II-2-1. Limonite and lead and zinc sulphides occur together in the mineralized zone encountered in MJP-7, 11 and 12, this is believed to be the transitional zones between the upper oxidized and lower sulfide zones.

Polished sections of 30 samples from the mineralized zone of the drill cores were studied microscopically. Also eight samples from the above were studied by X-ray powder diffraction in order to identify carbonate minerals. The results of microscopic observation are shown in Table II-2-2.

Sphalerite is usually subrounded with 0.05~ 2 mm diameter and occurs in mainly limestone matrix as scattered spots or in concentrated parts. The grain boundary with the matrix is irregualr (Photo-3: DH 11-B). Galena is euhedral with diameter in the order of 1 mm. It is rare to find sphalerite and galena occuring together or these minerals with inclusion of other minerals. In many samples the transition of these two sulphides to carbonates - smithonite and cerussite - was observed (Photo-4). Pyrite and chalcopyrite occur widely, but they are of minute grain size and of small amount and they occur mostly in veins.

It is noteworthy that, although in small amount, electrum was identified in 15 samples and mineral grains which were inferred to be electrum were found in six samples and in one of these samples gold grains were identified. These are usually 2~ 20 μm (maximum 40 μm) in diameter and occur mainly with the gangue minerals. In many cases the identifi-cation is difficult because pyrite and chalcopyrite have the same occurrence, the grain size is small and there are only 1 to 4 grains in one sample. Photograph-5 shows sample DH12-A which contain mineral grains inferred to be electrum. Photograph-6 shows sample DH15-A containing gold grains.

Although definite identification was difficult because of the minute grain size, Ag-Pb-Bi minerals were inferred to occur in five samples and in one of these samples (DH14-A), minerals inferred to be of Ag-Pb-Sb system and tennantite were found. DH14-A contains the highest Ag grade(670g/t)(Photo-7).

In the transition zone from oxidized to sulfide, there were samples with sphalerite and galena changing to carbonates and further with goethite on the margin of the grains (Photo-8).

Assays were done on 141 samples collected from the mineralized parts. A quarter of the core was sampled, crushed, quatered to 100g, ground to under 80 mesh and 20 g were used for the assay. The elements analysed are Pb, Zn, Ba and Ag. The prepared samples were sent to Chemex Labs Ltd. and AAS was used. The results are laid out in Table II-2-3.

(2) Mineralized horizons

The surface survey and drilling revealed that the major part of the mineralization is controled stratigraphically and occurs in Loralai Member. The results of the drilling carried out during the second and third phases are correlated in Figure II-2-2. It is seen that the lead-zinc mineralized horizons are in Unit II-III of Loralai Member and they have been named A, B and C horizons from the upper horizon downward. The mineralized parts of the drill holes were numbered in accordance with the holes such as A-3, B-2, C-2. The A-Horizon is situated at the lowest part of Unit-III to middle of Unit-II of Loralai Member, B-Horizon is at middle to the lower part of Unit-II and C-Horizon in the lower part. The thickness of the horizons are 100 m for A, 6~7 m for B and 10~15 m for C. The mineralization is distributed in these zones with varying vertical locations.

These three horizons are clearly correlated and it is established that they are distributed continuously.

(3) Dimensions and grade of the mineralized zones

The depth, average and maximum grade, and the promising zone each hole drilled during the third phase are as follows. The criteria for defining the promising zones are the same as for the previous phase, namely over 2.5 m wide and over 5 % Pb+Zn content.

The characteristics of the mineralized zones are; although locally high, the Pb+Zn grade is generally low and there are not many promising zones, Ba content is generally very low, Ag content on the other hand is higher than most Mississippi Valley type lead-zinc deposits. This is similar to the characteristics of the mineralization investigated last year. The highest contents of the metals are, Pb 43.3 % at A-14-1, Zn 18.00 % at A-7-1, Ba 0.14 % at B-8 and Ag 670 g/t at A-14-1.

a. Surmai-I

At Surmai-I, mineralization was confirmed in the A-Horizon at MJP-7 and 13. The depth of B-Horizon was not reached at MJP-7 and C-Horizon not reached at MJP-13. The mineralization (A-7) in A-Horizon at MJP-7 is divided into three parts, A-7-1, A-7-2, A-7-3 as shown in the following table.

Position		Depth (m)	Width(m)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)
A-7-1	Average	44.2~ 54.0	9.8	0.52	3.40	< 0.01	6.8
	Maximum	45.8~ 46.8	1.0	0.83	18.00	< 0.01	6.5
	P.Z.M.	44.3~ 46.8	2.5	0.55	10.42	0.03	4.3
A-7-2	Av.& Max	57.7~ 58.3	0.6	0.27	0.10	< 0.01	2.5
A-7-3	Average	64.1~ 79.7	15.6	0.77	2.49	< 0.01	14.4
	Maximum	76.6~ 79.7	3.1	2.50	7.65	< 0.01	53.0
	P.Z.M.	76.6~ 79.7	3.1	2.50	7.65	< 0.01	53.0

[Abbreviation] P.Z.M.: Promising Zone for Mining

Av.& Max.: Average & Maximum

The details of the mineralization in A-Horizon at MJP-13 are as follows.

Position		Depth (m)	Width(m)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)
A-13	Average	131.3~181.8	50.5	0.54	1.10	< 0.01	7.3
	Maximum	155.9~157.4	1.5	6.85	0.21	< 0.01	96.0
	P.Z.M.	155.9~158.4	2.5	4.36	0.21	< 0.01	61.4

Mineralization was confimed only in A-Horizon at Surmai-I as shown above during the third phase drilling. Also the existence of mineralized zone in the lower part of Unit-Ⅲ of Loralai Member was confirmed at MJP-7. During the previous phases, mineralization was not found in the lower part of Loralai Member. The new finding agrees with the distribution of mineralization on the surface. Grade locally reaches Pb+Zn 10 %, but generally it is low with relatively high Ag content.

b. Surmai-Ⅲ

In Surmai-Ⅲ, mineralized parts were confirmed in A-Horizon of MJP-9, 11, 12, 14 and 15 and in the B-Horizon of MJP-8 and 9. Depth of A-Horizon is not reached in MJP-10, of B-Horizon not reached in MJP-14, 15 and C-Horizon not attained in MJP-8, 9.

The details of the mineralized part in A-Horizon of MJP-9 are as follows.

Position		Depth (m)	Width(m)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)
A-9	Average	265.8~267.9	2.1	1.19	4.24	0.09	11.0
	Maximum	265.8~266.4	0.6	2.60	7.67	0.19	24.5
	P.Z.M.	265.8~268.3	2.5	0.94	3.56	0.08	9.4

The details of the five mineralized parts A-11-1~5 in the A-Horizon (A-11) of MJP-11 are as follows.

Position		Depth (m)	Width(m)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)
A-11-1	Av.& Max.	44.6~ 46.6	2.0	0.22	0.08	< 0.01	1.8
A-11-2	Average	53.5~ 77.0	23.5	0.52	1.84	< 0.01	5.5
	Maximum	53.4~ 58.9	5.4	0.62	3.68	< 0.01	8.5
A-11-3	Av.& Max.	88.0~ 88.9	0.9	3.70	9.64	< 0.02	62.0
	P.Z.M.	88.0~ 90.5	2.5	1.33	3.47	< 0.02	22.3
A-11-4	Av.& Max.	98.0~100.0	2.0	1.18	3.51	< 0.01	12.5
A-11-5	Av.& Max.	136.3~138.0	1.7	4.99	0.06	< 0.01	30.5

The details of the three mineralized parts A-12-1~3 in A-Horizon (A-12) of MJP-12 are as follows.

Position		Depth (m)	Width(m)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)
A-12-1	Average	40.4~ 43.6	3.2	1.05	4.29	0.04	9.1
	Maximum	40.4~ 42.4	2.0	1.12	5.70	0.04	11.0
	P.Z.M.	40.4~ 42.9	2.5	1.08	4.95	0.04	10.0
A-12-2	Average	46.6~ 71.3	24.7	0.61	3.52	0.02	7.9
	Maximum	54.4~ 56.3	1.9	3.22	9.22	< 0.01	35.5
	P.Z.M.	54.4~ 59.0	4.6	1.68	5.27	0.02	21.3
A-12-3	Av.& Max.	78.7~ 80.4	1.7	0.19	3.06	< 0.01	3.0

The details of the three mineralized parts A-14-1～3 in the A-Horizon (A-14) of MJP-14 are shown in the following table. For A-14-3 with thickness of 58.7 m, the assay was carried out for samples from 12 points where lead-zinc sulphides were observed by the unaided eyes. Total thickness of the assayed part is 22.6 m. The average grade of the above is Pb: 0.44 %, Zn: 0.50 %, Ba: <0.01 %, Ag: 4.7g/t, and a value of 1/5 of this was used for the unassayed parts, 36.1 m thick, in calculating the average of the total A-14-3.

Position		Depth (m)	Width(m)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)
A-14-1	Average	126.2～133.2	7.0	7.26	2.48	< 0.04	110.8
	Maximum	126.2～127.3	1.1	43.3	1.30	< 0.01	670
	P.Z.M.	126.2～133.2	7.0	7.26	2.48	< 0.04	110.8
A-14-2	Av.& Max.	149.2～151.5	2.3	3.21	< 0.01	< 0.01	30.5
A-14-3	Average	288.6～347.3	58.7	0.22	0.25	< 0.01	2.4
	Maximum	312.9～313.7	0.8	1.21	2.68	< 0.01	12.0

The details of the five mineralized parts A-15-1～5 of the A-Horizon (A-15) of MJP-15.

Position		Depth (m)	Width(m)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)
A-15-1	Av.& Max.	200.8～201.5	0.7	0.20	0.04	< 0.01	2.5
A-15-2	Average	211.5～214.5	3.0	0.57	0.79	< 0.01	6.7
	Maximum	212.1～212.6	0.5	0.15	4.42	< 0.01	7.5
A-15-3	Average	216.4～221.9	5.5	0.20	0.16	< 0.01	2.1
	Maximum	221.2～221.9	0.7	0.79	0.87	< 0.01	8.0
A-15-4	Average	238.8～258.7	19.9	1.04	2.15	< 0.01	10.9
	Maximum	245.9～246.7	0.8	0.66	15.90	< 0.01	7.2
	P.Z.M.	241.5～246.7	5.2	1.77	6.51	< 0.01	16.5
A-15-5	Average	277.1～300.2	23.1	1.30	4.03	< 0.02	14.0
	Maximum	288.8～295.1	6.3	3.54	10.10	< 0.01	37.2
	P.Z.M.	288.8～298.1	9.3	3.01	9.03	< 0.01	32.1

The details of the mineralization in MJP-8, 9 are as follows.

Position		Depth (m)	Width(m)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)
B-8	Average	331.2~337.4	6.2	1.60	2.03	0.01	16.2
	Maximum	335.1~336.5	1.4	5.79	7.35	< 0.01	58.0
	P.Z.M.	334.9~337.4	2.5	3.61	4.59	< 0.01	9.5
B-9	Average	272.6~283.2	10.6	0.59	0.77	0.04	3.5
	Maximum	275.5~276.1	0.6	0.17	5.40	< 0.01	3.0

As seen from above, mineralization was confirmed by the third phase drilling at A and B-Horizons at Surmai-Ⅲ. Also the mineralization in the lower part of Unit-Ⅲ of Loralai Member was confirmed for the first time. This agrees with the distribution of mineralization on the surface.

c. Details of the mineralized zone confirmed by the second phase drilling

The details of the mineralized zone confirmed by the second phase drilling are as follows. This will be the basis for reserve calculation.

Area	Drill No.	Position		Depth (m)	Width (m)	Pb (%)	Zn (%)	Ba (%)	Ag (g/t)
Surmai-I	MJP-3	A-3-1	Average	169.1~172.9	3.8	0.38	4.73	< 0.01	7.6
			Maximum	171.9~172.9	1.0	1.17	7.68	< 0.01	17.0
			P.Z.M.	169.1~172.9	3.8	0.38	4.73	< 0.01	7.6
		A-3-2	Average	176.3~191.7	15.4	0.25	0.80	< 0.01	4.9
			Maximum	176.3~177.1	0.8	0.20	8.86	< 0.01	15.2
		A-3-3	Av.& Max.	210.1~211.8	1.7	0.54	2.02	< 0.01	5.7
	MJP-2	B-2	Average	288.2~292.3	4.1	0.04	0.89	< 0.01	1.0
			Maximum	290.4~291.0	0.6	0.23	5.74	< 0.01	3.9
		C-2	Average	323.2~328.6	5.4	0.03	1.00	< 0.01	0.6
			Maximum	326.0~328.6	2.6	0.06	1.54	< 0.01	0.8
	MJP-4	B-4	Average	283.4~290.1	6.7	0.33	0.62	< 0.01	3.3
			Maximum	289.0~289.6	0.6	0.16	4.11	< 0.01	2.8
		C-4-1	Average	308.5~310.4	1.9	0.01	0.03	< 0.01	< 0.5
			Maximum	308.5~309.6	1.1	0.01	0.03	< 0.01	< 0.5
		C-4-2	Average	316.2~320.4	4.2	0.04	1.11	< 0.01	0.9
			Maximum	319.9~320.2	0.3	0.06	11.10	< 0.01	5.6
Surmai-III	MJP-6	A-6-1	Average	168.5~182.4	13.9	0.66	3.25	< 0.01	6.0
			Maximum	170.3~172.4	2.1	1.81	13.90	< 0.01	16.8
			P.Z.M.	170.3~172.8	2.5	1.68	11.77	< 0.01	15.3
			P.Z.M.	168.5~172.4	3.9	1.01	8.59	< 0.01	9.7
		A-6-2	Average	185.6~190.3	4.7	0.51	3.66	< 0.01	5.5
			Maximum	186.0~186.6	0.6	0.34	20.90	< 0.01	8.5
			P.Z.M.	185.6~188.1	2.5	0.23	6.64	< 0.01	3.6
		A-6-3	Average	191.8~197.9	6.1	0.24	0.64	< 0.01	0.7
			Maximum	191.8~193.8	2.0	0.10	1.59	< 0.01	0.8
		A-6-4	Av.& Max.	199.3~199.7	0.4	< 0.01	4.79	< 0.01	< 0.5
	MJP-5	B-5	Average	215.0~216.8	1.8	0.19	0.85	< 0.01	1.8
			Maximum	215.2~215.8	0.6	0.39	1.89	< 0.01	3.7

Table Ⅱ-2-1 Description of Microscopic Observation of Thin Sections

Sample No.	Drill. No. Position	Rock		Allochems	Orthochems	Member & Unit
		Name	Facies			
DH14-AA	MJP-14 33.0m	Sh	Biomicrite	Bioclasts, Q.	Micrite, Q, Clay mineral.	Lo-Ⅲ
DH14-BB	MJP-14 39.5m	Ls	Biomicrite	Bioclasts, sparry Ca.	Micrite.	Lo-Ⅲ
DH14-CC	MJP-14 67.8m	Sh	Biomicrite	Bioclasts, Q, sparry Ca.	Micrite, Q, Clay mineral.	Lo-Ⅲ
DH14-DD	MJP-14 131.4m	Ls	Sparite	Ca-Q-Cn-Wo vein, Siderite.	Micrite < Sparite.	Lo-Ⅱ
DH14-EE	MJP-14 238.2m	Ls	Biomicrite	Bioclasts, Ca vein.	Micrite > Sparite	Lo-Ⅲ
DH14-FF	MJP-14 240.3m	Sh, limy	Biomicrite	Bioclasts, sparry Ca, Ca vein.	Micrite>>Sparite Clay mineral.	Lo-Ⅲ
DH14-GG	MJP-14 317.8m	Ls	Micrite	Sparry Ca, Ca vein, (bioclasts, Q)	Micrite > Sparite	Lo-Ⅱ
DH14-HH	MJP-14 322.4m	Sh	Micrite	Opaque mineral, Q, (Bioclasts).	Micrite, Q, Clay mineral.	Lo-Ⅱ
DH15-AA	MJP-15 214.9m	Ls	Pelsparite	Sparrry Ca, Bioclasts, Peloids.	Sparite > Micrite	Lo-Ⅱ
DH15-BB	MJP-15 216.7m	Ls	Biomicrite	Sparrry Ca, Bioclast, opaque mineral, Ca vn.	Sparite > micrite	Lo-Ⅱ

Legend

Ls : Limestone
Sh : Shale
Lo : Loralai Member

Ca : Calcite
Q : Quartz
Cn : Chalcedony
Wo : Wollastonite

Table II-2-2 Description of Microscopic Observation of Polished Sections

Sample No.	Position(m)	Minerals																		Remarks
		Sp	Ga	Py	Cp	Li	He	Ce	Sm	Tn	El	Ma	Si	Ca	Mc	Do	Q	Ab	Au	
DH7- A	49.8		○	•		◎	△	△						•		•	△			※
DH7- B	51.9	△	•	•	•	◎	•	•			•		•	•	•		△			※
DH7- C	53.9	◎	•	△	•	•			△											
DH7- D	58.0		◎	△	•	•		•			•′									
DH7- E	67.0			•	•	◎					•									
DH7- F	70.6			•		◎	△				•′									
DH7- G	72.7	△		•		◎	•		△		•									
DH7- H	79.6	△	○	•		○		•	△		•			•			•			※
DH8- A	335.4	◎	○	△	•							•								
DH9- A	266.3	◎	△	•					△		•									
DH9- B	267.6	◎	○	△	△						•									
DH9- C	275.9	◎	•	○	•															
DH9- D	281.5	◎	△	•	•				•											
DH11- A	56.5	◎		•	•						•′		◎	△	•		△			※
DH11- B	74.5	◎		•					△		•		•	◎			•	•′		※
DH11- C	88.3	◎	○	•					•											
DH12- A	58.6	○	△	•	•			•	•		•′		○		•		△			※
DH12- B	68.5		△	•							•		○							
DH13- A	140.7	◎	○									○	○		△		△			※
DH13- B	148.1	△	◎	•	•													•′		
DH13- C	162.6	◎	△	•	•				•		•									
DH13- D	172.5	◎		•	•				•		•									
DH14- A	126.4	◎	◎	•	△					•								•′		
DH14- B	131.0	◎	△	•	△				•		•′		•							
DH14- C	289.3		△	•				△			•									
DH14- D	313.2	◎	△	•	•						•							•′		
DH15- A	245.3	○	△	•	•						•′								•	
DH15- B	246.5	◎	△	•							•							•′		
DH15- C	295.2	◎	△						•		•									
DH15- D	297.5	○	△	•	•				•		•		○		•		△			※

Legend ◎: abundant ○: common △: a little • : rare ′: uncertain

Sp: Sphalerite Ga: Galena Py: Pyrite Cp: Chalcopyrite Li: Limonite(Goethite)

Ma: Marcasite He: Hematite Ce: Cerussite Sm: Smithsonite Si: Siderite

Tn: Tennantite El: Electrum Ca: Calcite Si: Siderite Do: Dolomite

Q : Quartz Mc: High Mg Calcite Ab: Ag-Pb-Bi, Ag-Pb-Sb Mineral

Au: Gold ※: Supported by X-ray Detection Analysis

Table Ⅱ-2-3 Chemical Analyses of Ores (1)

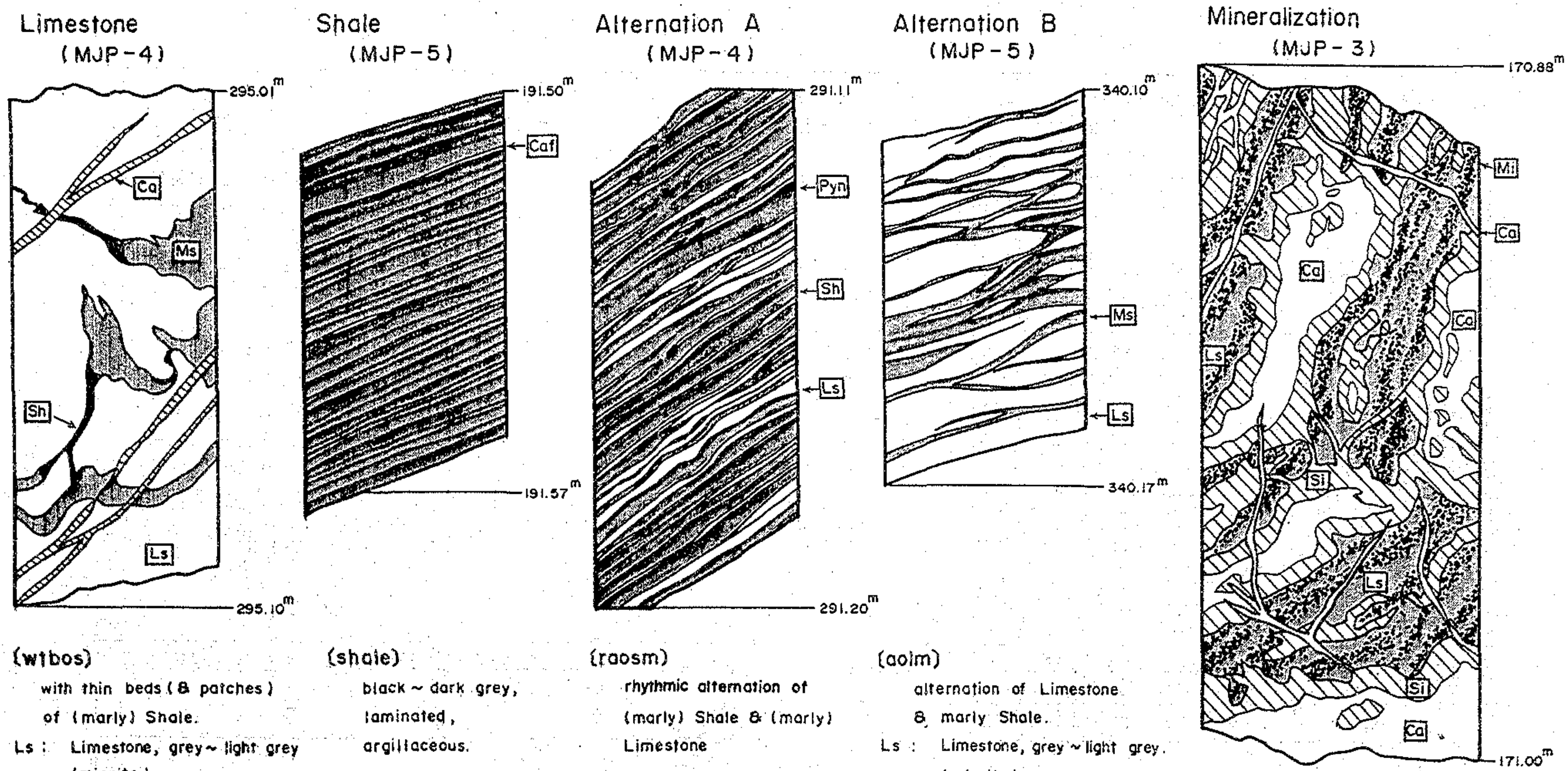
Drill No.	Position	Sample No.	Depth (m)	Width (m)	Grade Pb %	Zn %	Ba %	Ag g/t
MJP-7	A-7-1	DH7-1	44.2～ 45.1	0.9	0.09	1.04	< 0.01	2.5
		-2	～ 45.8	0.7	0.69	10.30	0.12	3.3
		-3	～ 46.8	1.0	0.83	18.00	< 0.01	6.5
		-4	～ 47.8	1.0	0.02	0.32	< 0.01	1.0
		-5	～ 48.3	0.5	0.20	0.81	< 0.01	1.5
		-6	～ 49.2	0.9	0.15	0.09	< 0.01	3.3
		-7	～ 50.0	0.8	3.48	1.49	< 0.01	50.0
		-8	～ 51.4	1.4	0.05	0.08	0.12	1.0
		-9	～ 53.0	1.6	0.21	0.94	< 0.01	3.3
		-10	～ 53.4	0.4	0.56	0.90	< 0.01	6.0
		-11	～ 54.0	0.6	0.04	5.30	< 0.01	2.8
			44.2～ 54.0	9.8	0.52	3.40	0.03	6.8
	A-7-2	-12	57.7～ 58.3	0.6	0.27	0.10	< 0.01	2.5
	A-7-3	-13	64.1～ 65.1	1.0	1.84	0.94	< 0.01	29.0
		-14	～ 65.7	0.6	0.05	0.27	< 0.01	0.8
		-15	～ 65.9	0.2	0.04	11.40	< 0.01	8.0
		-16	～ 66.8	0.9	0.08	0.36	< 0.01	2.3
		-17	～ 68.0	1.2	0.57	1.64	< 0.01	9.5
		-18	～ 68.5	0.5	< 0.01	0.07	< 0.01	< 0.5
		-19	～ 68.8	0.3	0.86	0.31	< 0.01	8.5
		-20	～ 70.0	1.2	0.01	0.02	< 0.01	< 0.5
		-21	～ 71.6	1.6	0.24	1.84	< 0.01	2.8
		-22	～ 72.5	0.9	< 0.01	0.01	< 0.01	< 0.5
		-23	～ 74.9	2.4	0.42	2.60	< 0.01	3.8
		-24	～ 76.6	1.7	< 0.01	0.03	< 0.01	< 0.5
		-25	～ 79.7	3.1	2.50	7.65	< 0.01	53.0
			64.1～ 79.7	15.6	0.77	2.49	< 0.01	14.4
MJP-13	A-13	DH13-1	131.3～132.2	0.9	0.02	0.18	0.05	0.5
		-2	～132.7	0.5	0.96	5.09	0.02	6.0
		-3	～133.6	0.9	0.31	1.76	< 0.01	2.5
		-4	～136.0	2.4	0.05	0.10	< 0.01	1.5
		-5	～140.1	4.1	0.15	1.73	< 0.01	1.5
		-6	～140.5	0.4	0.07	0.03	< 0.01	1.3
		-7	～141.2	0.7	0.77	9.33	< 0.01	6.0
		-8	～141.6	0.4	< 0.01	< 0.01	< 0.01	< 0.5
		-9	～147.0	5.4	0.15	1.01	< 0.01	1.3
		-10	～148.0	1.0	0.06	0.02	< 0.01	1.3
		-11	～151.5	3.5	2.68	1.91	< 0.01	32.0
		-12	～152.4	0.9	0.96	0.12	0.13	12.0
		-13	～154.0	1.6	0.27	5.53	< 0.01	4.0
		-14	～155.5	1.5	0.21	0.34	< 0.01	2.3
		-15	～155.9	0.4	0.41	0.03	< 0.01	7.5
		-16	～157.4	1.5	6.85	0.21	< 0.01	96.0
		-17	～160.8	3.4	0.62	0.20	< 0.01	9.5
		-18	～162.5	1.7	0.02	0.02	0.02	0.8
		-19	～164.6	2.1	0.12	5.37	< 0.01	7.0
		-20	～168.6	4.0	0.11	0.07	< 0.01	1.3
		-21	～170.1	1.5	0.06	0.02	< 0.01	1.0
		-22	～171.4	1.3	< 0.01	0.02	< 0.01	0.5
		-23	～172.4	1.0	0.06	0.02	< 0.01	0.8
		-24	～173.0	0.6	0.06	4.71	< 0.01	3.0
		-25	～174.6	1.6	< 0.01	< 0.01	< 0.01	< 0.5
		-26	～177.1	2.5	< 0.01	< 0.01	< 0.01	0.5
		-27	～178.9	1.8	< 0.01	0.20	< 0.01	< 0.5
		-28	～180.1	1.2	< 0.01	< 0.01	< 0.01	< 0.5
		-29	～181.2	1.1	0.01	< 0.01	< 0.01	< 0.5
		-30	～181.8	0.6	0.05	< 0.01	< 0.01	< 0.5
			131.3～181.8	50.5	0.54	1.10	< 0.01	7.3

Table II-2-3 Chemical Analyses of Ores (2)

Drill No.	Horizon	Sample No.	Depth (m)	Width (m)	Grade Pb %	Zn %	Ba %	Ag g/t
MJP-8	B-8	DH8-1	331.2~331.4	0.2	0.23	0.06	0.14	2.5
		-2	~332.0	0.6	1.00	1.77	0.02	11.0
		-3	~332.7	0.7	0.02	< 0.01	< 0.01	< 0.5
		-4	~333.6	0.9	0.11	0.02	0.01	1.5
		-5	~334.1	0.5	0.09	0.02	< 0.01	1.0
		-6	~335.1	1.0	0.08	0.02	0.04	1.5
		-7	~336.5	1.4	5.79	7.35	< 0.01	58.0
		-8	~337.4	0.9	1.00	1.32	< 0.01	9.5
			331.2~337.4	6.2	1.60	2.03	0.01	16.2
MJP-9	A-9	DH9-1	265.8~266.4	0.6	2.60	7.67	0.19	24.5
		-2	~267.2	0.8	0.26	4.42	0.06	4.0
		-3	~267.9	0.7	0.83	1.09	0.04	7.5
			265.8~267.9	2.1	1.19	4.24	0.09	11.0
		-4	267.9~269.3	1.4	< 0.01	< 0.01	< 0.01	0.8
		-5	~270.4	1.1	0.02	< 0.01	< 0.01	< 0.5
		-6	~272.6	2.2	0.09	0.05	< 0.01	1.3
			267.9~272.6	4.7	0.05	0.02	< 0.01	0.8
	B-9	-7	272.6~275.5	2.9	0.01	0.01	0.14	< 0.5
		-8	~276.1	0.6	0.17	5.40	< 0.01	3.0
		-9	~276.5	0.4	0.39	0.01	< 0.01	3.0
		-10	~277.2	0.7	0.15	< 0.01	< 0.01	1.5
		-11	~277.5	0.3	0.95	0.01	< 0.01	6.0
		-12	~278.7	1.2	0.42	0.34	< 0.01	4.0
		-13	~279.8	1.1	0.14	< 0.01	< 0.01	2.0
		-14	~282.5	2.7	1.42	1.59	< 0.01	8.5
		-15	~283.2	0.7	0.04	0.20	< 0.01	1.3
			272.6~283.2	10.6	0.59	0.77	0.04	3.5
			265.8~283.2	17.4	0.45	0.98	0.03	3.7
MJP-11	A-11-1	DH11-1	44.6~46.6	2.0	0.22	0.08	< 0.01	1.8
	A-11-2	DH11-2	53.5~58.9	5.4	0.62	3.68	< 0.01	8.5
		-3	~63.3	4.4	0.70	1.99	< 0.01	6.5
		-4	~66.5	3.2	0.24	1.61	< 0.01	2.8
		-5	~69.0	2.5	0.15	0.62	< 0.01	1.0
		-6	~74.6	5.6	0.55	1.32	< 0.01	5.5
		-7	~77.0	2.4	0.62	0.17	< 0.01	5.5
			53.5~77.0	23.5	0.52	1.84	< 0.01	5.5
	A-11-3	DH11-8	88.0~88.9	0.9	3.70	9.64	< 0.02	62.0
	A-11-4	DH11-9	98.0~100.0	2.0	1.18	3.51	< 0.01	12.5
	A-11-5	DH11-10	136.3~138.0	1.7	4.99	0.06	< 0.01	30.5
MJP-12	A-12-1	DH12-1	40.4~42.4	2.0	1.12	5.70	0.04	11.0
		-2	~43.6	1.2	0.93	1.95	0.04	6.0
			40.4~43.6	3.2	1.05	4.29	0.04	9.1
	A-12-2	DH12-3	46.6~52.0	5.4	0.49	1.61	0.06	5.5
		-4	~54.4	2.4	0.94	2.98	0.07	10.0
		-5	~56.3	1.9	3.22	9.22	< 0.01	35.5
		-6	~58.3	2.0	0.40	0.23	0.05	11.0
		-7	~59.0	0.7	1.14	8.93	< 0.01	12.0
		-8	~71.3	12.3	0.19	3.82	< 0.01	3.5
			46.6~71.3	24.7	0.61	3.52	0.02	7.9
	A-12-3	DH12-9	78.7~80.4	1.7	0.19	3.06	< 0.01	3.0

Table Ⅱ-2-3 Chemical Analyses of Ores (3)

Drill No.	Position	Sample No.	Depth (m)	Width (m)	Grade Pb %	Zn %	Ba %	Ag g/t
MJP-14	A-14-1	DH14-1	126.2~127.3	1.1	43.3	1.30	< 0.03	670
		-2	~129.6	2.3	1.00	2.72	< 0.04	12.0
		-3	~133.2	3.6	0.24	2.68	< 0.04	3.0
			126.2~133.2	7.0	7.26	2.48	< 0.04	110.8
	A-14-2	DH14-4	149.2~151.5	2.3	3.21	< 0.01	< 0.01	30.5
	A-14-3	DH14-5	288.6~289.4	0.8	0.91	2.08	< 0.01	14.0
		DH14-6	290.3~291.1	0.8	0.10	0.03	< 0.01	1.5
		DH14-7	295.7~296.9	1.2	0.27	0.38	< 0.01	2.8
		DH14-8	303.5~305.0	1.5	0.50	1.04	< 0.01	4.8
		DH14-9	307.2~308.7	1.5	0.25	0.72	< 0.01	2.8
		DH14-10	310.0~312.0	2.0	0.29	0.10	< 0.01	2.5
		DH14-11	312.9~313.7	0.8	1.21	2.68	< 0.01	12.0
		DH14-12	314.6~317.3	2.7	0.10	0.36	< 0.01	1.3
		DH14-13	317.8~318.2	0.4	0.23	0.59	< 0.01	2.3
		DH14-14	319.0~326.4	7.4	0.66	0.20	< 0.01	7.0
		DH14-15	338.0~341.0	3.0	0.28	0.18	< 0.01	3.0
		DH14-16	346.8~347.3	0.5	< 0.01	1.69	< 0.02	< 0.5
MJP-15	A-15-1	DH15-1	200.8~201.5	0.7	0.20	0.04	< 0.01	2.5
	A-15-2	DH15-2	211.5~212.1	0.6	0.61	0.25	< 0.01	8.0
		-3	~212.6	0.5	0.15	4.42	< 0.01	7.5
		-4	~213.8	1.2	0.05	< 0.01	< 0.01	0.5
		-5	~214.5	0.7	1.71	0.01	< 0.01	15.5
			211.5~214.5	3.0	0.57	0.79	< 0.01	6.7
	A-15-3	DH15-6	216.4~217.0	0.6	0.18	0.43	< 0.01	1.8
		-7	~218.0	1.0	0.02	0.02	< 0.01	< 0.5
		-8	~221.2	3.2	0.13	< 0.01	< 0.01	1.5
		-9	~221.9	0.7	0.79	0.87	< 0.01	8.0
			216.4~221.9	5.5	0.20	0.16	< 0.01	2.1
	A-15-4	DH15-10	238.8~239.4	0.6	0.03	0.01	< 0.01	< 0.5
		-11	~241.5	2.1	0.15	0.07	< 0.01	1.0
		-12	~244.4	2.9	2.25	1.77	< 0.01	20.2
		-13	~245.5	1.1	1.52	13.90	< 0.01	16.2
		-14	~245.9	0.4	1.26	1.77	< 0.01	9.2
		-15	~246.7	0.8	0.66	15.90	< 0.01	7.2
		-16	~251.2	4.5	0.94	1.13	< 0.01	9.5
		-17	~251.8	0.6	0.16	0.13	< 0.01	1.5
		-18	~255.3	3.5	1.15	0.21	< 0.01	15.5
		-19	~258.4	3.1	0.83	0.75	< 0.01	9.2
		-20	~258.7	0.3	0.48	1.54	< 0.01	6.5
			238.8~258.7	19.9	1.04	2.15	< 0.01	10.9
	A-15-5	DH15-21	277.1~284.1	7.0	0.05	0.38	< 0.02	0.8
		-22	~285.6	1.5	0.09	0.02	< 0.01	1.3
		-23	~288.8	3.2	0.44	1.96	< 0.02	4.8
		-24	~295.1	6.3	3.54	10.10	< 0.01	37.2
		-25	~296.2	1.1	2.47	8.50	< 0.02	27.2
		-26	~297.3	1.1	0.34	5.55	< 0.01	5.7
		-27	~298.1	0.8	3.24	6.14	< 0.02	34.7
		-28	~300.2	2.1	0.03	0.10	< 0.01	0.5
			277.1~300.2	23.1	1.30	4.03	< 0.02	14.0



(wtbos)
with thin beds (& patches) of (marly) Shale.
Ls : Limestone, grey ~ light grey (micrite)
Ms : Marly Shale, grey.
Sh : Shale, black.
Ca : Calcite veinlet.

(shale)
black ~ dark grey, laminated, argillaceous.
Caf : Calcite film

(raosm)
rhythmic alternation of (marly) Shale & (marly) Limestone
Sh : Shale (marly)
Ls : Limestone (marly)
Pyn : Pyrite nodule

(aolm)
alternation of Limestone & marly Shale.
Ls : Limestone, grey ~ light grey. (micrite)
Ms : marly Shale, grey.

Mi : Sphalerite dissemination
Si : Siderite
Ca : Calcite
Ls : Limestone

Fig. II-2-1 Sketch of Drilling Cores

Scale 1 : 1

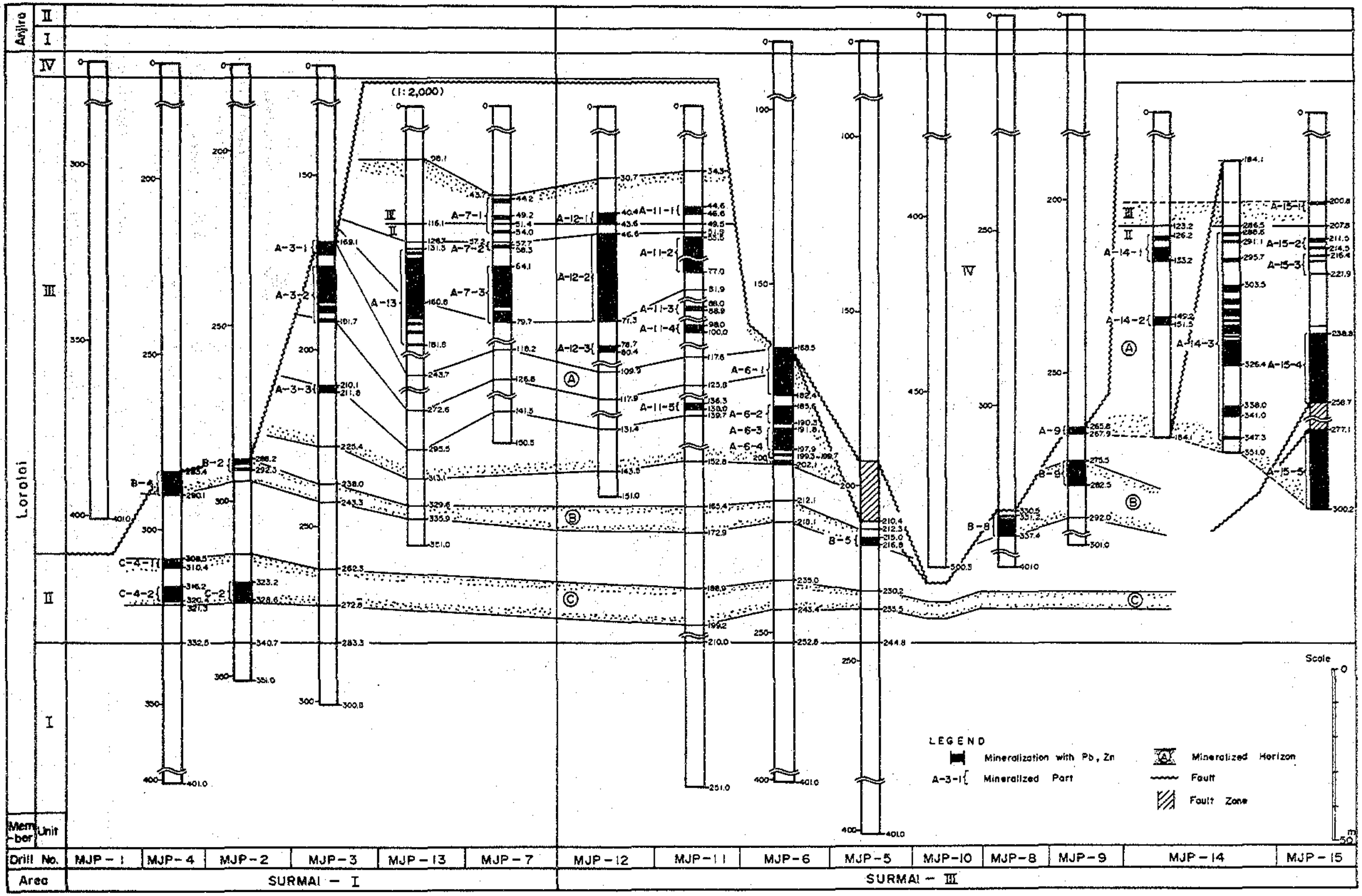


Fig. II-2-2 Geological Correlation Column by Drill Records at the Surmai Area

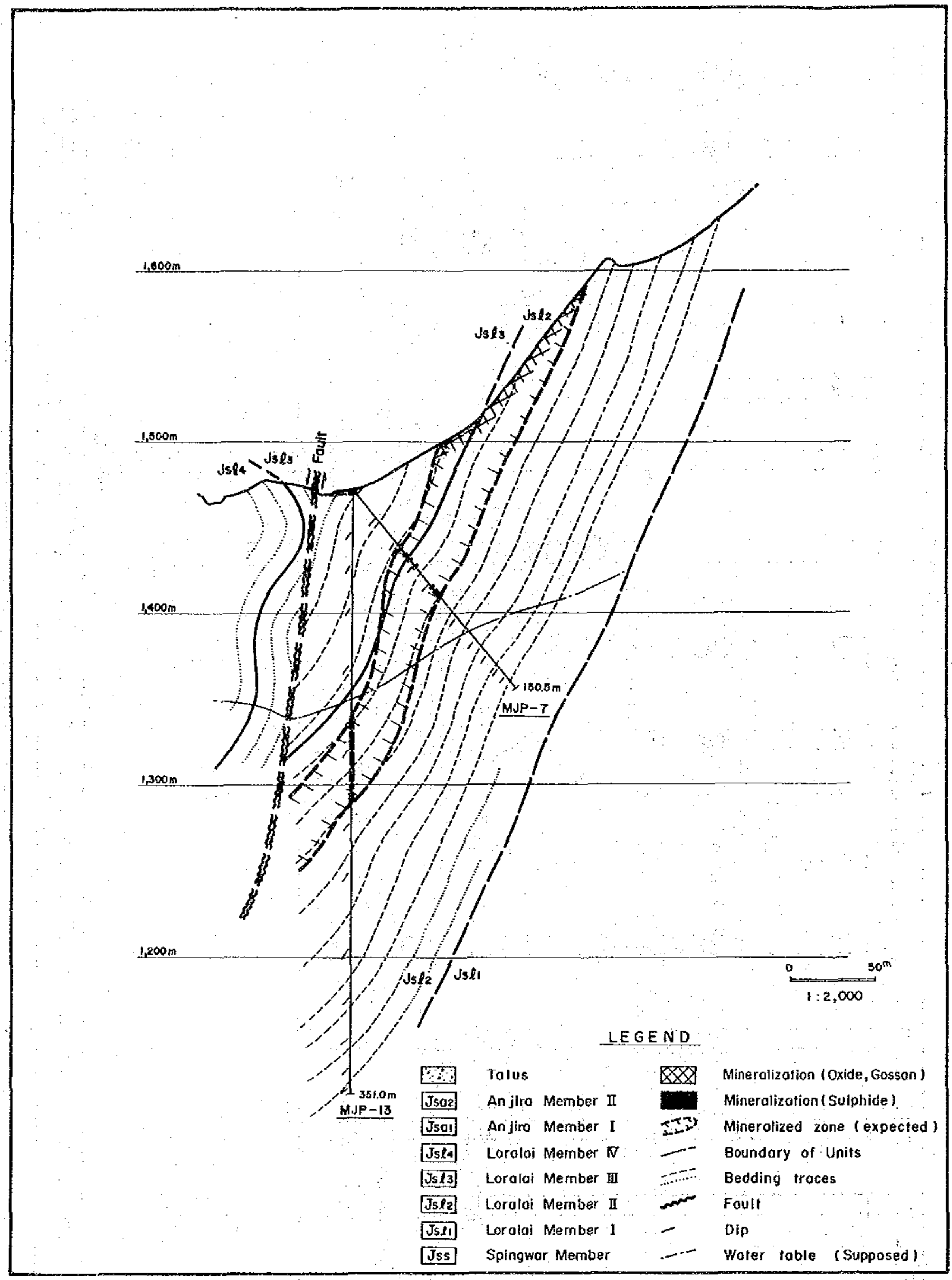


Fig. II-2-3 Geological Profile of Surmai-I (MJP-7, MJP-13)

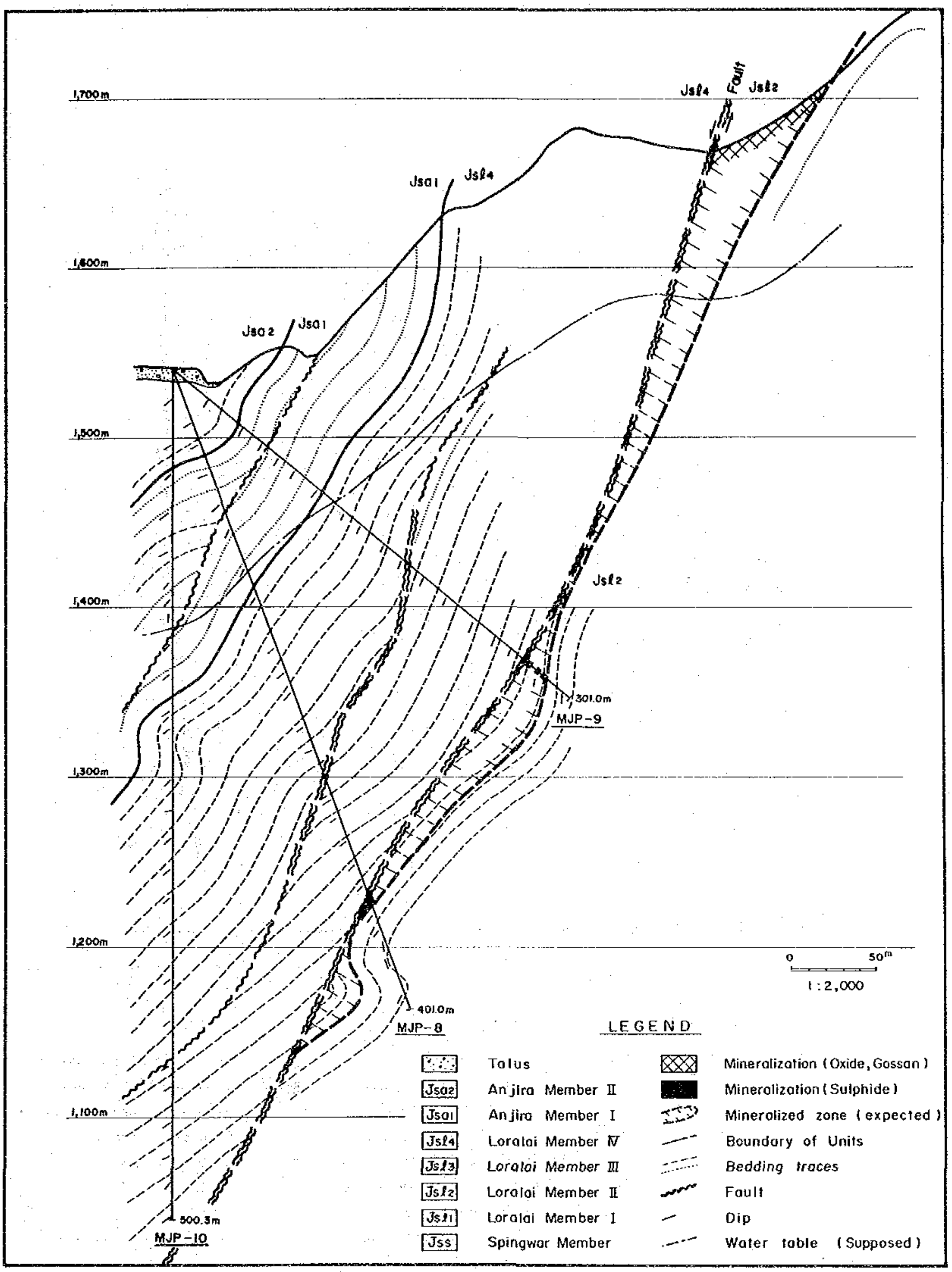


Fig. II-2-4 Geological Profile of Surmai-III (MJP-8, 9, 10)

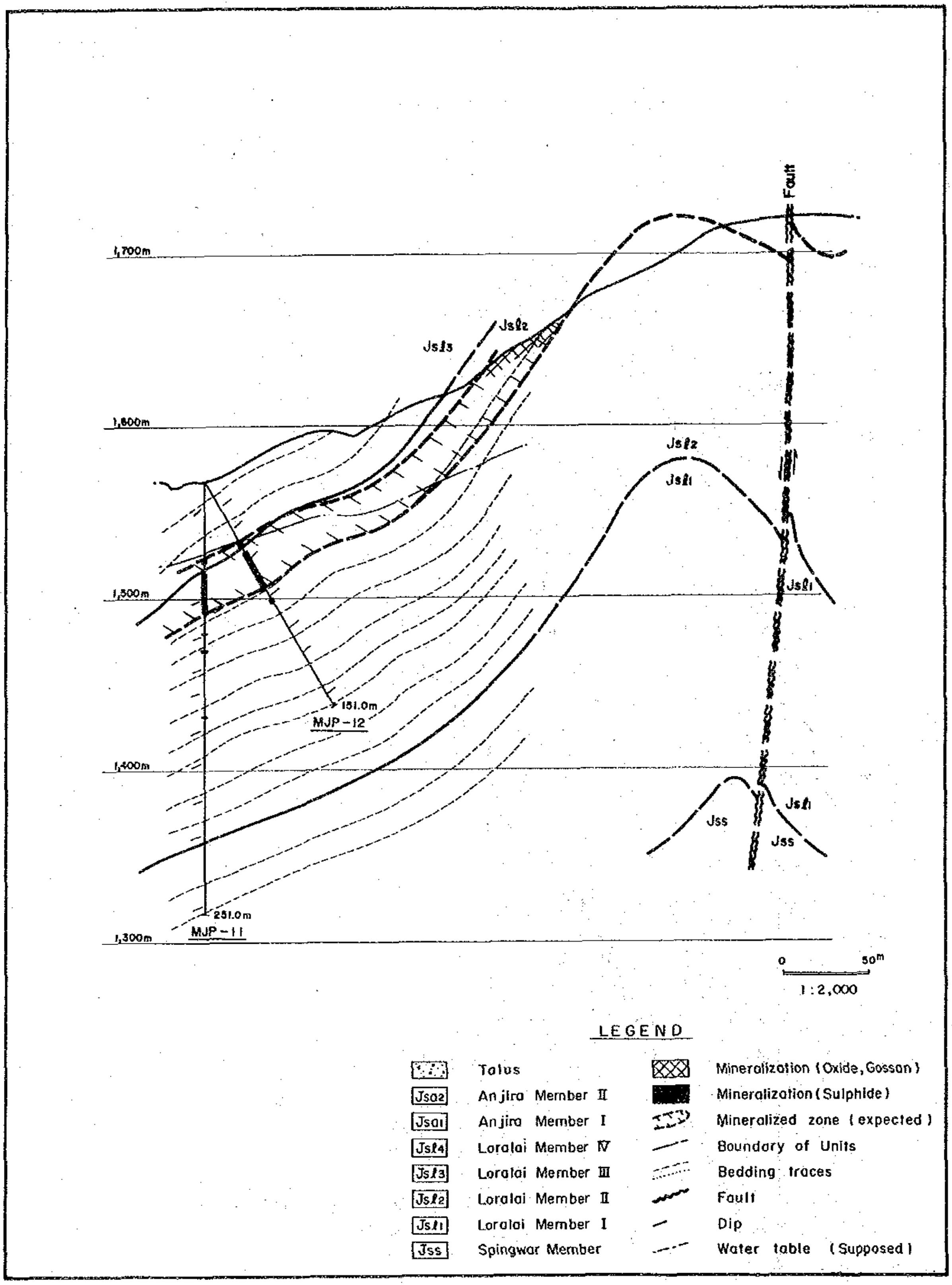


Fig. II-2-5 Geological Profile of Surmai-III (MJP-11, 12)

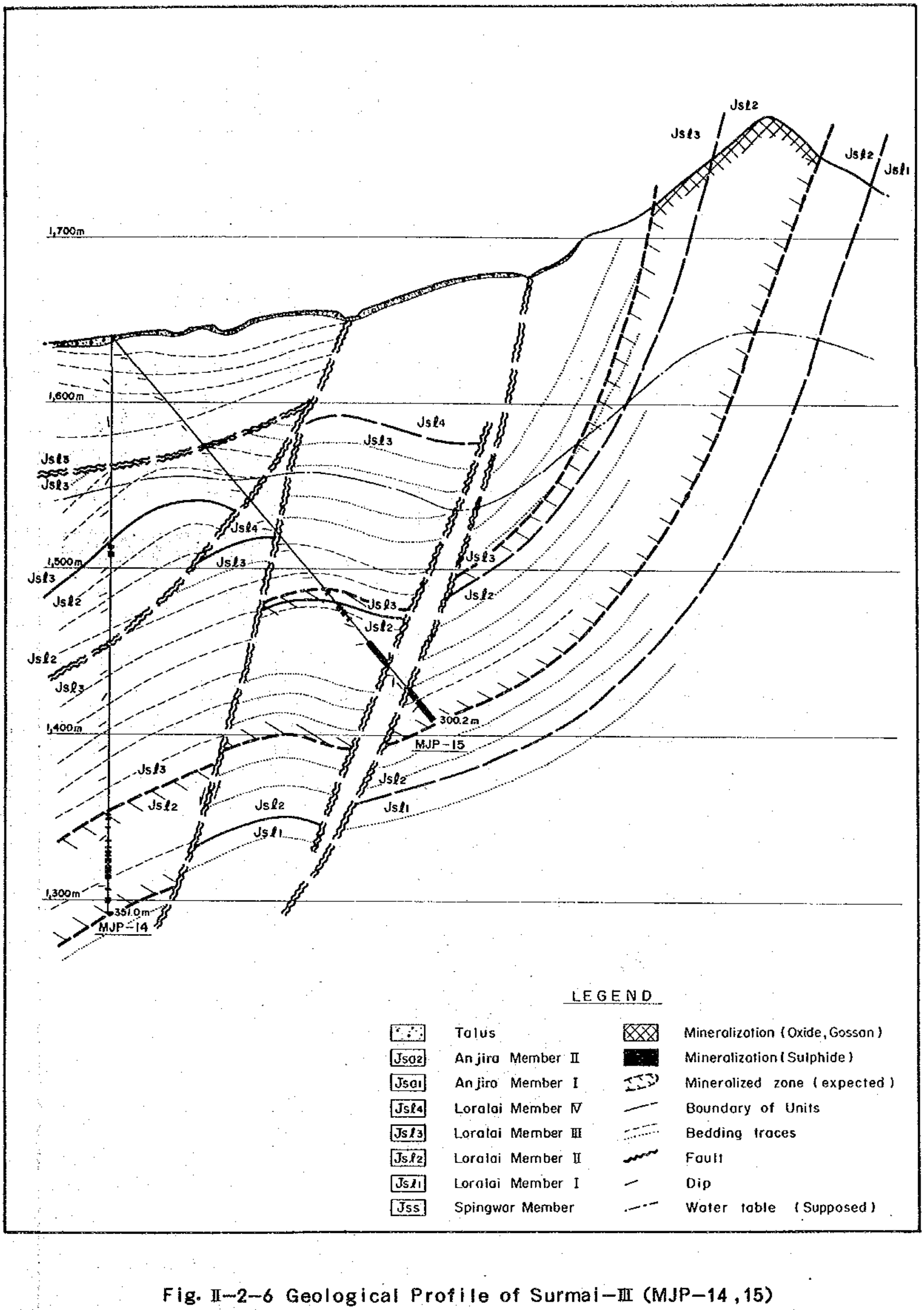


Fig. II-2-6 Geological Profile of Surmai-III (MJP-14, 15)

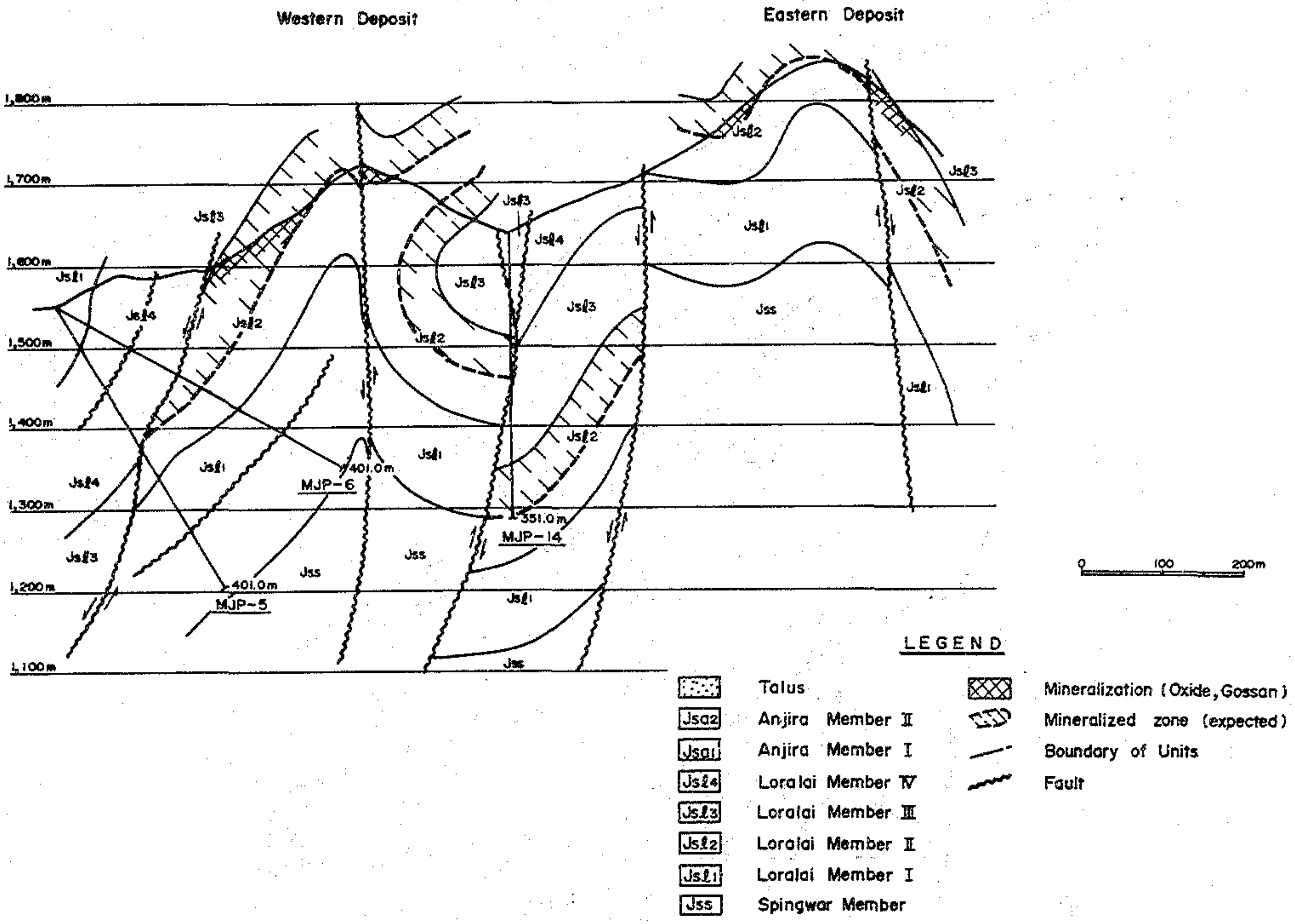


Fig. II-2-7 Geological Profile of Surmai-III (MJP-5, 6, 14)

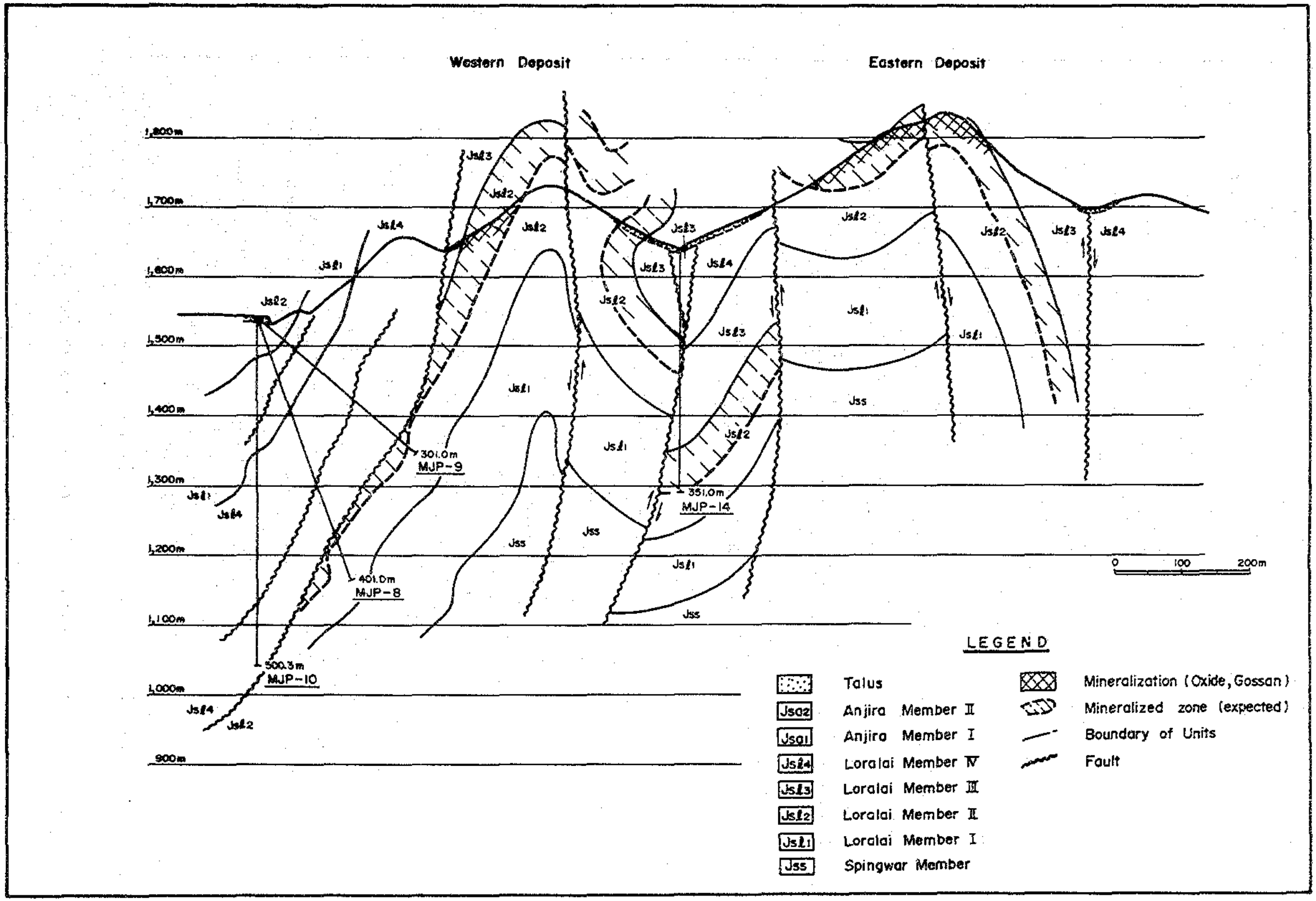


Fig. II-2-8 Geological Profile of Surmai-III (MJP-8, 9, 10, 14)

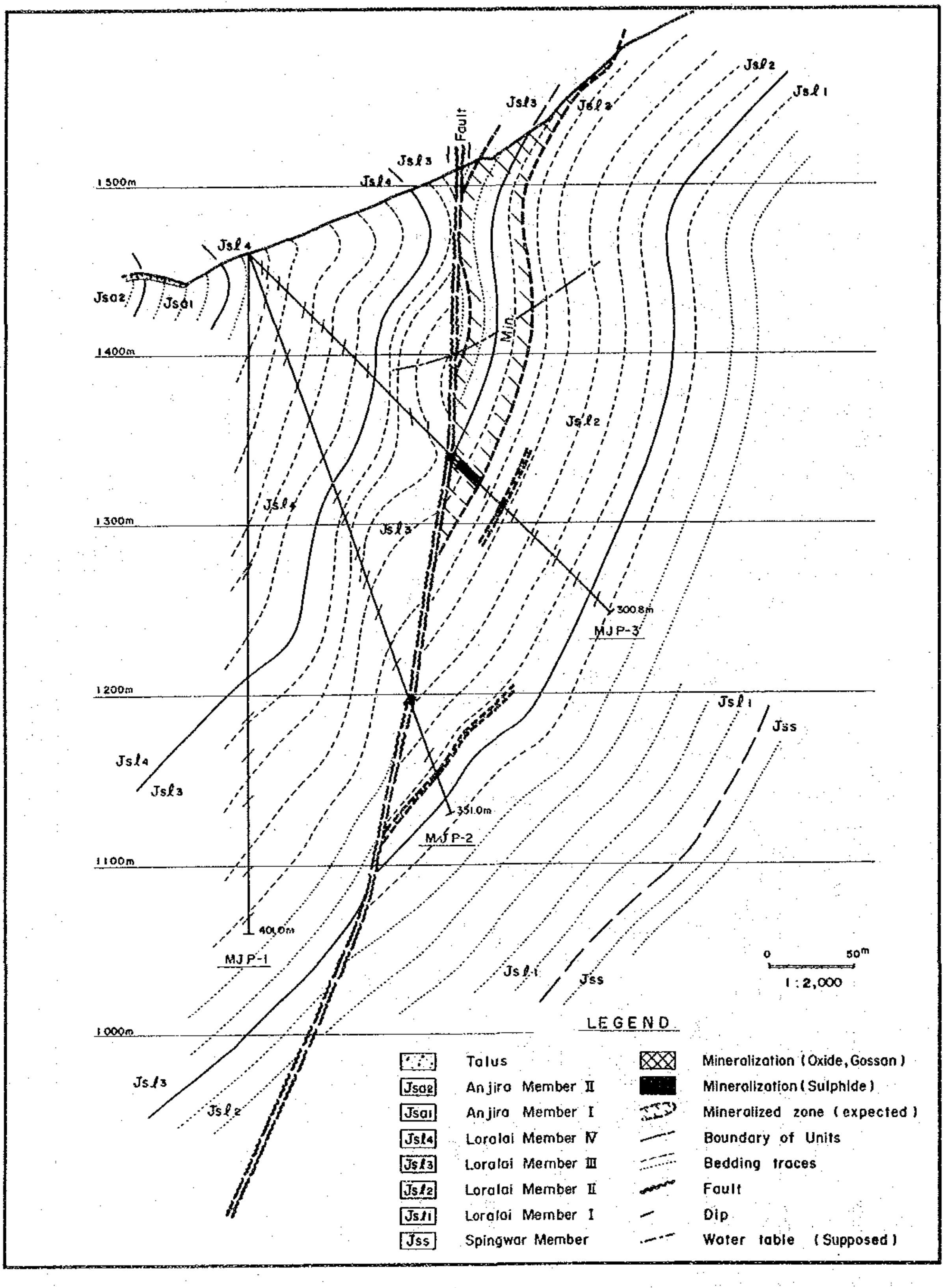


Fig. II-2-9 Geological Profile of Surmai-I (MJP-1, 2, 3)

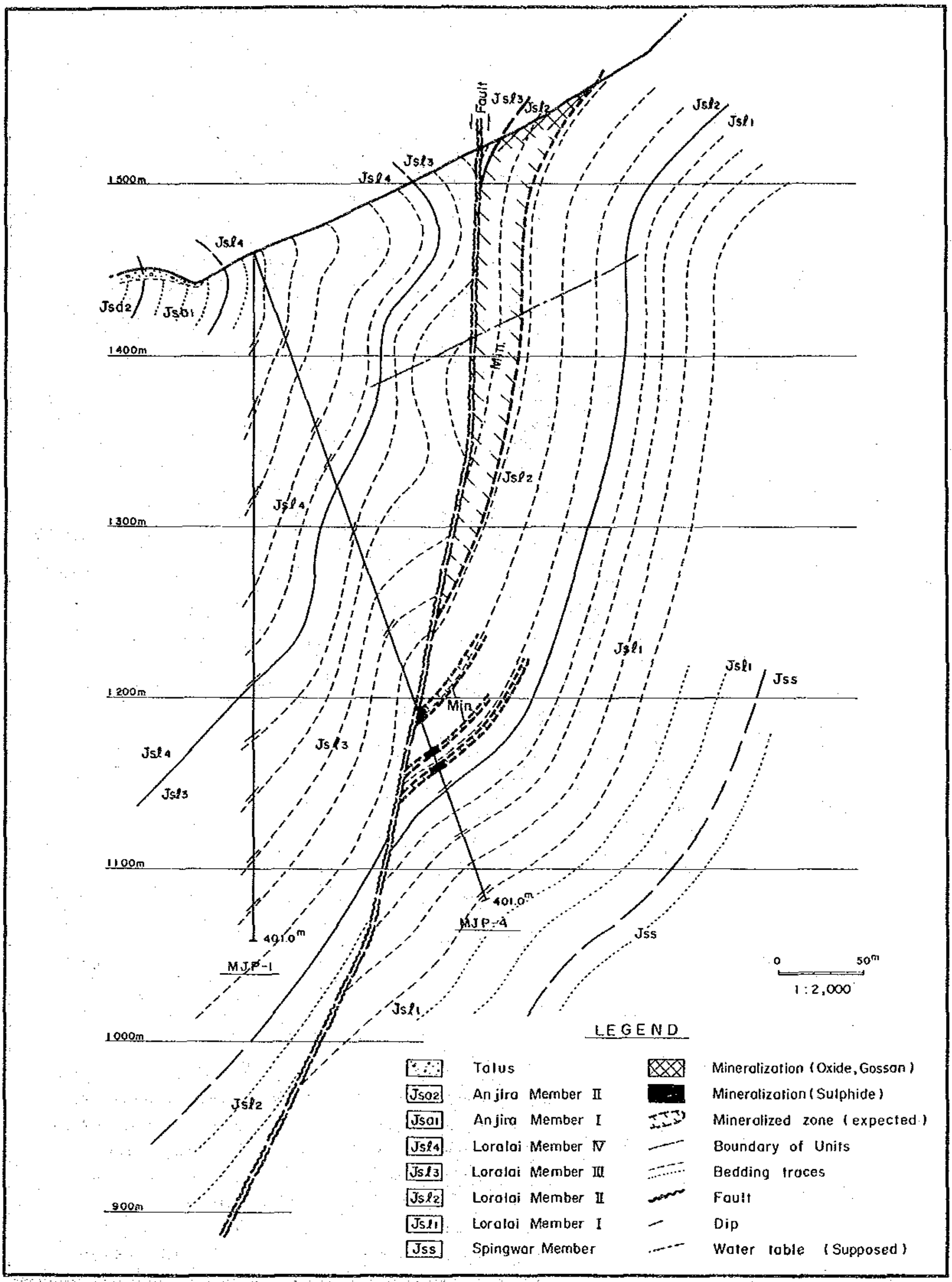


Fig. II-2-10 Geological Profile of Surmai-I (MJP-1,4)

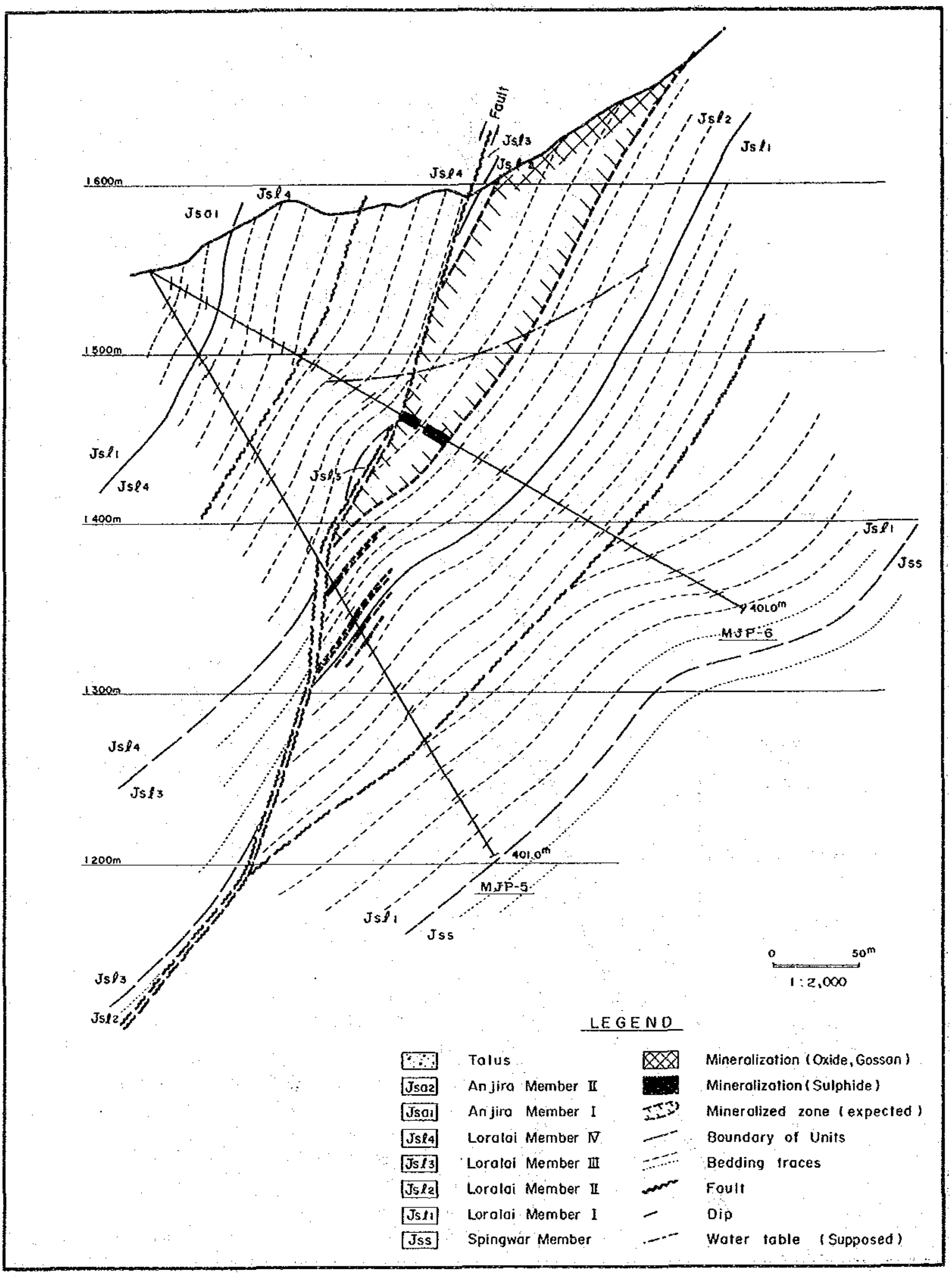


Fig. II-2-11 Geological profile of Surmai-III(MJP-5,6)

2 - 1 - 6 Reserve Calculation

Ore reserves were calculated for Main Orebody of Surmai-I , Northern Orebody and the orebody between the West and East Deposits of Surmai-III . The basic data for these orebodies were obtained by drilling. The existence ratio for the calculation was assumed to be 100 %. The orebodies were divided into large blocks which included the larger area for which the continuity of the mineralization was considered certain and small blocks which were established around the high-grade portion (PZM) within the large blocks. The large blocks were further divided into the sulphide zone and the oxide zone (shallower than 50 m depth) while the small blocks were all in the sulphide zone. The results of drilling were the sole source for the basis of calculation. These figures are in the possible reserve category.

Regarding the specific gravity of the ores, 2.7 was used for both sulphide and oxide ores. Since there are no specific gravity measurements of the ores or limestone of the Surmai District, this figure was arrived at by considering the following values and the compact nature of the limestone in the area.

Specific gravity of minerals* = calcite: 2.7, galena: 7.6,
sphalerite: 4.0, siderite: 4.0
Specific gavity of rocks** = average of Mesozoic to Paleozoic limestone
of Soviet Union: 2.35
average of marble in Soviet Union: 2.71
Specific gravity of ore containing 5 % Pb as galena with limestone density of 2.5*** = 2.6

Note: * Chronological Scientific Tables (Japanese),
** Geological Glossary (Japanese), *** Calculation

2 - 1 - 6 - 1 Surmai-I

(1) Main Orebody

a. Large block

The area and the block number is shown in Figure II-2-12. The total orebody is indicated by I ML (Surmai-I Main, Large) and it is divided into three blocks, namely I M-1, 2, 3 and these are further divided into sulphide (-Su) and oxide (-Ox) blocks. The reserves calculated for the blocks are listed below. I M-1 is wedge-shaped with the calculated area of MJP-7, 13 section as the base with the point to the north. I M-3 is core-shaped with the calculated area of MJP-1, 2, 3 section as the base with the point to the south.

Block No.		Area on Section		Length	Volume	Tonnage
		Section	Area (m^2)	(m)	(m^3)	(1,000t)
I ML-1-Su		MJP-7,13	7,060	145	511,850	1,382
I ML-1	I ML-1-Ox	MJP-7,13	3,300	145	239,250	646
I ML-2	I ML-2-Su	MJP-7,13	7,060			
I ML-2	I ML-2-Su	MJP-1,2,3	5,280	145	894,650	2,416
I ML-2	I ML-2-Ox	MJP-7,13	3,300			
I ML-2	I ML-2-Ox	MJP-1,2,3	2,200	145	398,750	1,077
I ML-3	I ML-3-Su	MJP-1,2,3	5,280	150	264,000	713
I ML-3	I ML-3-Ox	MJP-1,2,3	2,200	150	110,000	297
I ML	I ML-Su					4,511
I ML	I ML-Ox					2,020
I ML	Total			440		6,531

The calculated area of each drilled section and the average grade are as follows.

MJP-7, 13 section :

Drill. No.	Mineralized Position		Width (m)		Grade			
	Name	Depth (m)	Drill	True	Pb %	Zn %	Ba %	Ag g/t
MJP-7	A-7-1	44.2~ 54.0	9.8		0.52	3.40	0.03	6.8
		54.0~ 57.7	3.7		-	-	-	-
	A-7-2	57.7~ 58.3	0.6		0.27	0.10	< 0.01	2.5
		58.3~ 64.1	5.8		-	-	-	-
	A-7-3	64.1~ 79.7	15.6		0.77	2.49	< 0.01	14.4
	Average	44.2~ 79.7	35.5	32.2	0.49	2.03	< 0.01	8.2
MJP-13	A-13-1	131.3~181.8	50.5	25.0	0.54	1.10	< 0.01	7.3
	Grand Average			28.6	0.51	1.62	< 0.01	7.8

MJP-1, 2, 3 section :

Drill. No.	Mineralized Position		Width (m)		Grade			
	Name	Depth (m)	Drill	True	Pb %	Zn %	Ba %	Ag g/t
MJP-3	A-3-1	169.1~172.9	3.8		0.38	4.73	< 0.01	7.6
		172.9~176.3	3.4		-	-	-	-
	A-3-2	176.3~191.7	15.4		0.25	0.80	< 0.01	4.9
	Average	169.1~191.7	22.6		0.23	1.34	< 0.01	4.6

The grade of the blocks was calculated on the basis of weighted averages of the areas in the sections as follows.

Block No.	Area on Section		Grade			
	Section	Area (m^2)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)
I ML-1	MJP-7,13	10,360	0.51	1.62	< 0.01	7.8
I ML-2	MJP-7,13	10,360	0.51	1.62	< 0.01	7.8
	MJP-1,2,3	7,480	0.23	1.34	< 0.01	4.6
	Average	17,840	0.39	1.50	< 0.01	6.5
I ML-3	MJP-1,2,3	7,480	0.23	1.34	< 0.01	4.6

The results of the evaluation of the large block of Surmai-I Main Body are summarized as follows.

Block No.			Tonnage (1,000t)	Grade Pb(%)	Zn(%)	Ba(%)	Ag(g/t)	Remarks
Large Block	I ML-1	Su	1,382	0.51	1.62	< 0.01	7.8	
		Ox	646	0.51	1.62	< 0.01	7.8	
	I ML-2	Su	2,416	0.39	1.50	< 0.01	6.5	
		Ox	1,077	0.39	1.50	< 0.01	6.5	
	I ML-3	Su	713	0.23	1.34	< 0.01	4.6	
		Ox	297	0.23	1.34	< 0.01	4.6	
Total	I ML	Su	4,511	0.40	1.51	< 0.01	6.6	
		Ox	2,020	0.40	1.51	< 0.01	6.6	
			6,531	0.40	1.51	< 0.01	6.6	

b. Small blocks

Four promising zones for mining (PZM) were confirmed by three drilling for this orebody as listed below. But these zones are all in different horizons. Also they are not thick and their continuity to the adjacent drill hole is not certain. Thus circular blocks were established with a radius of 50 m (7,854 m^2) along the ore-bearing horizon with the drill hole as the centre. The block numbers are I MS (Surmai-I Main, Small)-1~4. I MS-1, however is located at the marginal part of the orebody and the diameter of half of the above was used. The grades of PZM were used for the calculation.

Block No.	Position Drill.No.	Position	Depth(m)	Width (m)	Volume (m^3)	Tonnage (1,000t)
I MS-1	MJP-3	A-3-1	169.1~172.9	3.8	14,923	40
I MS-2	MJP-7	A-7-1	44.3~ 46.8	2.5	19,635	53
I MS-3	MJP-7	A-7-3	76.6~ 79.7	3.1	24,347	66
I MS-4	MJP-13	A-13	155.9~158.4	2.5	19,635	53

The reserves of I MS are as follows.

Block No.		Tonnage (1,000t)	Grade Pb(%)	Zn(%)	Ba(%)	Ag(g/t)	Remarks
Small Block	I MS-1	40	0.38	4.73	< 0.01	7.6	
	I MS-2	53	0.55	10.42	0.03	4.3	
	I MS-3	66	2.50	7.65	< 0.01	53.0	
	I MS-4	53	4.36	0.21	< 0.01	61.4	
Total		212	2.08	5.93	< 0.01	34.4	

c. Summation

The reserves of Surmai-I Main Orebody are summed as follows.

Block No.			Tonnage (1,000t)	Grade Pb(%)	Zn(%)	Ba(%)	Ag(g/t)	Remarks
Large Block	I ML	Su	4,511	0.40	1.51	< 0.01	6.6	
		Ox	2,020	0.40	1.51	< 0.01	6.6	
	Total		6,531	0.40	1.51	< 0.01	6.6	
Small Block	I MS-1～4 Total		212	2.08	5.93	< 0.01	34.4	

2 - 1 - 6 - 2 Surmai-Ⅲ

(1) Northern Orebody

a. Large block

The areas and the block numbers for reserve calculation are shown in Figure Ⅱ-2-13. The block numbers are; the whole orebody, ⅢNL (Surmai-Ⅲ, Northern, Large) and this was further divided into ⅢNL-1, 2, 3, 4 and then they were divided into sulphide (-Su) and oxide (-Ox) blocks. The result of the calculation for each block is shown below. ⅢNL-1 is wedge-shaped with the calculated area of MJP-11, 12 section as the base and the points at 100 m from the drilling sit for the northern and eastern parts. ⅢNL-4 is core-shaped with the calculated area of MJP-8, 9, 10 section as the base and the point at the southern part.

Block No.		Area on Section		Length	Volume	Tonnage
		Section	Area (m^2)	(m)	(m^3)	(1,000t)
ⅢNL-1	ⅢNL-1-Su	MJP-11, 12	3,800	100	190,000	513
	ⅢNL-1-Ox	MJP-11, 12	2,320	100	116,000	313
ⅢNL-2	ⅢNL-2-Su	MJP-11, 12	3,800	300	1,260,000	3,402
		MJP-5, 6	4,600			
	ⅢNL-2-Ox	MJP-11, 12	2,320	300	877,500	2,369
		MJP-5, 6	3,530			
ⅢNL-3	ⅢNL-3-Su	MJP-5, 6	4,600	100	400,000	1,080
		MJP-8, 9, 10	3,400			
	ⅢNL-3-Ox	MJP-5, 6	3,530	100	308,500	833
		MJP-8, 9, 10	2,640			
ⅢNL-4	ⅢNL-4-Su	MJP-8, 9, 10	3,400	120	136,000	367
	ⅢNL-4-Ox	MJP-8, 9, 10	2,640	120	105,600	285
ⅢNL	ⅢNL-Su					5,362
	ⅢNL-Ox					3,800
	Total			620		9,162

The calculated areas and the average grade of each drilling section are as follows.

MJP-5, 6 section :

Drill. No.	Mineralized Position		Width (m)		Grade			
	Name	Depth (m)	Drill	True	Pb %	Zn %	Ba %	Ag g/t
MJP-6	A-6-1	168.5~182.4	13.9		0.66	3.25	< 0.01	6.0
		182.4~184.8	2.4		0.02	0.04	< 0.01	< 0.05
		184.8~185.6	0.8		0.02	0.02	< 0.01	< 0.05
	A-6-2	185.6~190.3	4.7		0.51	3.66	< 0.01	5.5
	Average	168.5~190.3	21.8		0.53	2.87	< 0.01	5.0

MJP-8, 9, 10 section :

Drill. No.	Mineralized Position		Width (m)		Grade			
	Name	Depth (m)	Drill	True	Pb %	Zn %	Ba %	Ag g/t
MJP-9	A-9	265.8~267.9	2.1		1.19	4.24	0.09	11.0

MJP-11, 12 section :

Drill. No.	Mineralized Position		Width (m)		Grade			
	Name	Depth (m)	Drill	True	Pb %	Zn %	Ba %	Ag g/t
MJP-11	A-11-2	53.5~ 77.0	23.5	21.3	0.52	1.84	< 0.01	5.5
MJP-12	A-12-2	46.6~ 71.3	24.7	24.7	0.61	3.52	0.02	7.9
	Grand Average			23.0	0.57	2.74	0.01	6.8

The grade for each block was calculated on the basis of weighted averages of the areas in the section as follows.

Block No.	Area on Section		Grade			
	Section	Area (m^2)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)
ⅢNL-1	MJP-11, 12	6,120	0.57	2.74	0.01	6.8
ⅢNL-2	MJP-11, 12	6,120	0.57	2.74	0.01	6.8
	MJP-5, 6	8,130	0.53	2.87	< 0.01	5.0
	Average	14,250	0.55	2.81	< 0.01	5.8
ⅢNL-3	MJP-5, 6	8,130	0.53	2.87	< 0.01	5.0
	MJP-8, 9, 10	6,040	1.19	4.24	0.09	11.0
	Average	14,170	0.81	3.45	0.04	7.6
ⅢNL-4	MJP-8, 9, 10	6,040	1.19	4.24	0.09	11.0

The reserves of the large block of Surmai-Ⅲ North orebody are summarized as follows.

Block No.			Tonnage (1,000t)	Grade Pb(%)	Zn(%)	Ba(%)	Ag(g/t)	Remarks
Large Block	ⅢNL-1	Su	513	0.57	2.74	0.01	6.8	
		Ox	313	0.57	2.74	0.01	6.8	
	ⅢNL-2	Su	3,402	0.55	2.81	< 0.01	5.8	
		Ox	2,369	0.55	2.81	< 0.01	5.8	
	ⅢNL-3	Su	1,080	0.81	3.45	0.04	7.6	
		Ox	833	0.81	3.45	0.04	7.6	
	ⅢNL-4	Su	367	1.19	4.24	0.09	11.0	
		Ox	285	1.19	4.24	0.09	11.0	
Total	ⅢNL	Su	5,362	0.65	3.03	0.02	6.6	
		Ox	3,800	0.66	3.05	0.02	6.7	
			9,162	0.65	3.04	0.02	6.6	

b. Small blocks

Six PZM were confirmed by four drilling for this orebody as listed below. But these zones are in different horizons or thin with no certainly of continuity to the adjacent drill hole. Thus circular blocks were established with a radius of 50 m (7,854 m^2) along the horizon with the centre at the drill hole. The block numbers are ⅢNS (Surmai-Ⅲ, North, Small)-1～6, ⅢNS-1, however, is located at the marginal part of the orebody and the diameter of half of the above was used. ⅢNS-3, 4, 6 are located outside of the large block while others are located within. The grade of PZM were used for the calculation. The results of the calculation are listed below.

Block No.	Position Drill.No.	Position	Depth(m)	Width (m)	Volume (m^3)	Tonnage (1,000t)
ⅢNS-1	MJP-6	A-6-1	168.5～172.4	3.9	15,315	41
ⅢNS-2	MJP-6	A-6-2	185.6～188.1	2.5	19,635	53
ⅢNS-3	MJP-11	A-11-3	88.0～90.5	2.5	19,635	53
ⅢNS-4	MJP-12	A-12-1	40.4～42.9	2.5	19,635	53
ⅢNS-5	MJP-12	A-12-2	54.4～59.0	4.6	36,128	98
ⅢNS-6	MJP-8	B-8	334.9～337.4	2.5	19,635	53

The reserves calculated for the small blocks are shown below.

Block No.		Tonnage	Grade				Remarks
		(1,000t)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)	
Small Block	ⅢNS-1	41	1.01	8.59	< 0.01	9.7	A-6-1
	ⅢNS-2	53	0.23	6.64	< 0.01	3.6	A-6-2
	ⅢNS-3	53	1.33	3.47	< 0.02	22.3	A-11-3
	ⅢNS-4	53	1.08	4.95	0.04	10.0	A-12-1
	ⅢNS-5	98	1.68	5.27	0.02	21.3	A-12-2
	ⅢNS-6	53	3.61	4.59	< 0.01	9.5	B-8
Total		351	1.53	5.44	0.01	13.9	

c. Summation

The reserves of Surmai-Ⅲ Northern Orebody are summed as follows.

Block No.			Tonnage	Grade				Remarks
			(1,000t)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)	
Large Block	ⅢNL	Su	5,362	0.65	3.03	0.02	6.6	
		Ox	3,800	0.66	3.05	0.02	6.7	
	Total		9,162	0.65	3.04	0.02	6.6	
Small Block	ⅢNS-1～6 Total		351	1.53	5.44	0.01	13.9	

(2) Intermediate Orebody between West and East Deposits

a. Large block

The areas and the block numbers for reserve calculation are shown in Figure Ⅱ-2-14. The block number is ⅢWEL (Surmai-Ⅲ, West Deposit～East Deposit, Large) and this was further divided into sulphide block (-Su) and oxide block (-Ox). Regarding the mineralized zone confirmed by MJP-14, A-14-1, 2 are considered to be in a fault zone containing ore pebbles, and A-14-3 is of low grade and thus these were omitted from the reserve calculation. This block extends 75 m on both sides of the MJP-14, 15 section and is bounded to the north by a fault in between MJP-14 and 15. Also the unmineralized part between the two faults in the central part of the mineralized zone is also omitted from the calculation. The result of the evaluation is shown below.

Block No.		Area on Section		Length	Volume	Tonnage
		Section	Area (m^2)	(m)	(m^3)	(1,000t)
Ⅲ WEL	Ⅲ WE-Su	MJP-14, 15	31,280	150	4,692,000	12,668
	Ⅲ WE-Ox	MJP-14, 15	4,920	150	738,000	1,993
	Total					14,661

The calculated areas and the average grade of MJP-15 are as follows.

Drill. No.	Mineralized Position		Width (m)		Grade			
	Name	Depth (m)	Drill	True	Pb %	Zn %	Ba %	Ag g/t
MJP-15	A-15-2	211.5～214.5	3.0		0.57	0.79	< 0.01	6.7
		214.5～216.4	1.9					
	A-15-3	216.4～221.9	5.5		0.20	0.16	< 0.01	2.1
		221.9～238.8	16.9					
	A-15-4	238.8～258.7	19.9		1.04	2.15	< 0.01	10.9
	A-15-5	277.1～300.2	23.1		1.30	4.03	< 0.02	14.0
	Average	211.5～300.2 (except:258.7～277.1)	70.3	75.0	0.76	1.98	< 0.01	8.1

The reserves of the large block are summarized as follows.

Block No.			Tonnage	Grade				Remarks
			(1,000t)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)	
Large Block	Ⅲ WEL	Su	12,668	0.76	1.98	< 0.01	8.1	
		Ox	1,993	0.76	1.98	< 0.01	8.1	
	Total		14,661	0.76	1.98	< 0.01	8.1	

b. Small block

Two PZM were confirmed by MJP-15 for this orebody. These can not be considered geologically to extend in large areas and thus circular blocks were established with a radius of 50 m (7,854 m^2) along the ore-bearing horizon with the centre at the drill hole. The block numbers are Ⅲ WES (Surmai-Ⅲ, West Deposit～East Deposit, Small)-1～2. The grade of PZM were used for the calculation.

Block	Position			Width	Volume	Tonnage
No.	Drill. No.	Position	Depth(m)	(m)	(m^3)	(1,000t)
Ⅲ WES-1	MJP-15	A-15-4	241.5～246.7	5.2	40,841	110
Ⅲ WES-2	MJP-15	A-15-5	288.8～298.1	9.3	73,042	197

The reserves calculated for the small blocks are listed below.

Block No.		Tonnage	Grade				Remarks
		(1,000t)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)	
Small Block	Ⅲ WES-1	110	1.77	6.51	< 0.01	16.5	
	Ⅲ WES-2	197	3.01	9.03	< 0.01	32.1	
	Total	307	2.57	8.13	< 0.01	26.5	

c. Summation

The reserves of Surmai-Ⅲ Intermediate Orebody between West and East Deposits are summed as follows.

Block No.			Tonnage	Grade				Remarks
			(1,000t)	Pb(%)	Zn(%)	Ba(%)	Ag(g/t)	
Large Block	Ⅲ WEL	Su	12,668	0.76	1.98	< 0.01	8.1	
		Ox	1,993	0.76	1.98	< 0.01	8.1	
	Total		14,661	0.76	1.98	< 0.01	8.1	
Small Block	Ⅲ WES-1～2 Total		307	2.57	8.13	< 0.01	26.5	

2 - 1 - 6 - 3 Total reserves

The total reserves of the Surmai-I and III Area are shown in Table II-2-4.

Fig. II-2-4 Total Ammount of Ore Reserves

Area	Body	Block			Tonnage (1,000t)	Grade Pb(%)	Grade Zn(%)	Grade Ba(%)	Grade Ag(g/t)
Surmai-I	Main Ore Body	Large Block	I ML	Su	4,511	0.40	1.51	< 0.01	6.6
Surmai-I	Main Ore Body	Large Block	I ML	Ox	2,020	0.40	1.51	< 0.01	6.6
Surmai-I	Main Ore Body	Large Block	Total		6,531	0.40	1.51	< 0.01	6.6
Surmai-I	Main Ore Body	Small Block	IMS-1~4 Total		212	2.08	5.93	< 0.01	34.4
Surmai-III	Northern Ore Body	Large Block	III NL	Su	5,362	0.65	3.03	0.02	6.6
Surmai-III	Northern Ore Body	Large Block	III NL	Ox	3,800	0.66	3.05	0.02	6.7
Surmai-III	Northern Ore Body	Large Block	Total		9,162	0.65	3.04	0.02	6.6
Surmai-III	Northern Ore Body	Small Block	IIINS-1~6 Total		351	1.53	5.44	0.01	13.9
Surmai-III	E~W Deposit Ore Body	Large Block	III EWL	Su	12,668	0.76	1.98	< 0.01	8.1
Surmai-III	E~W Deposit Ore Body	Large Block	III EWL	Ox	1,993	0.76	1.98	< 0.01	8.1
Surmai-III	E~W Deposit Ore Body	Large Block	Total		14,661	0.76	1.98	< 0.01	8.1
Surmai-III	E~W Deposit Ore Body	Small Block	IIIEWS-1~2 Total		307	2.57	8.13	< 0.01	26.5
Surmai-III	Total	Large Block	Su		18,030	0.73	2.29	< 0.01	7.7
Surmai-III	Total	Large Block	Ox		5,793	0.69	2.68	0.01	7.2
Surmai-III	Total	Large Block	Total		23,823	0.72	2.38	< 0.01	7.6
Surmai-III	Total	Small Block	IIIEWS-1~2 Total		658	2.02	6.70	< 0.01	19.8
Grand Total		Large Block	Su		22,541	0.66	2.13	< 0.01	7.5
Grand Total		Large Block	Ox		7,813	0.62	2.38	< 0.01	7.0
Grand Total		Large Block	Total		30,354	0.65	2.19	< 0.01	7.4
Grand Total		Small Block	Total		870	2.03	6.51	< 0.01	23.4

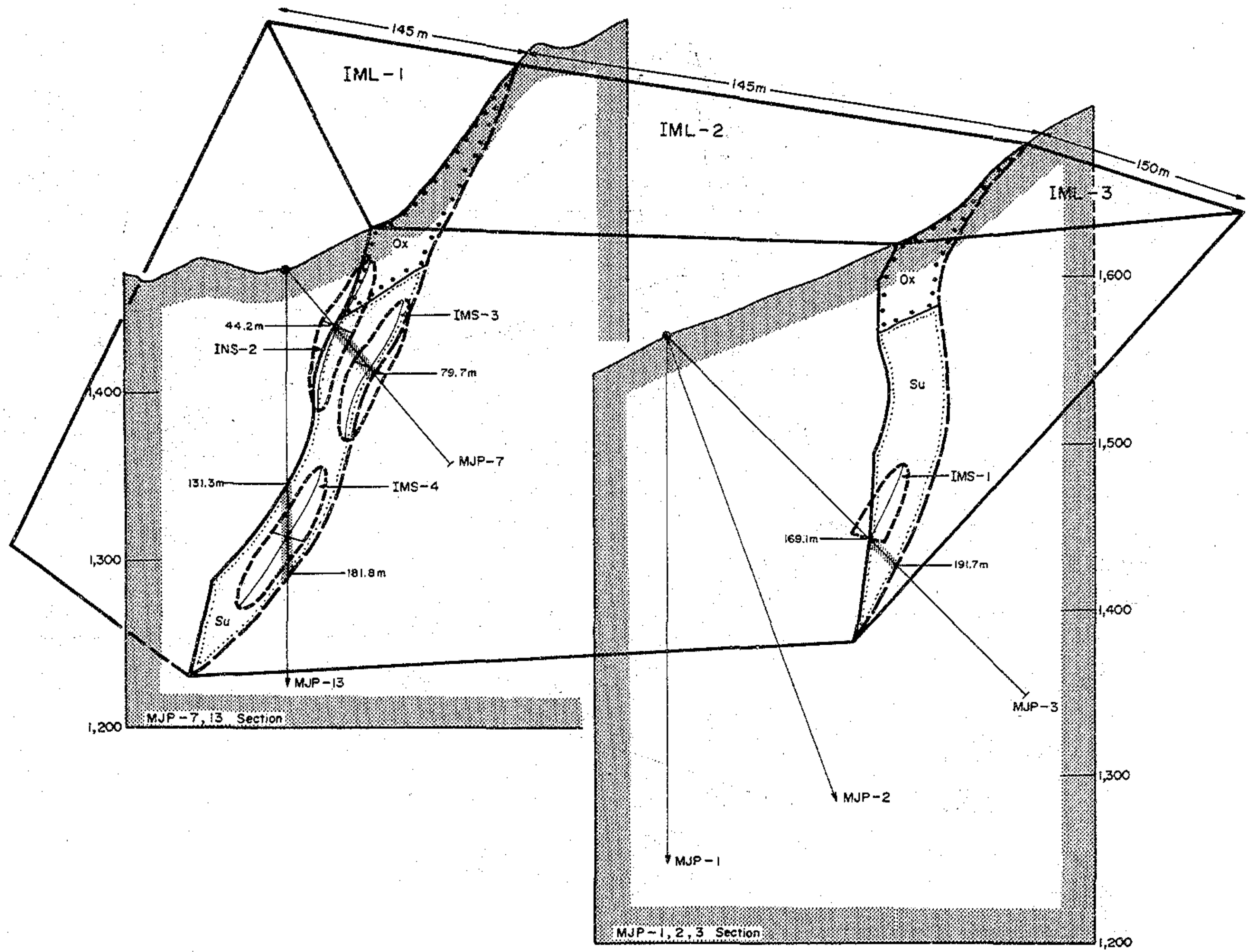


Fig. II-2-12 Schematic Illustration of Mining Blocks of Surmai-I Main Orebody

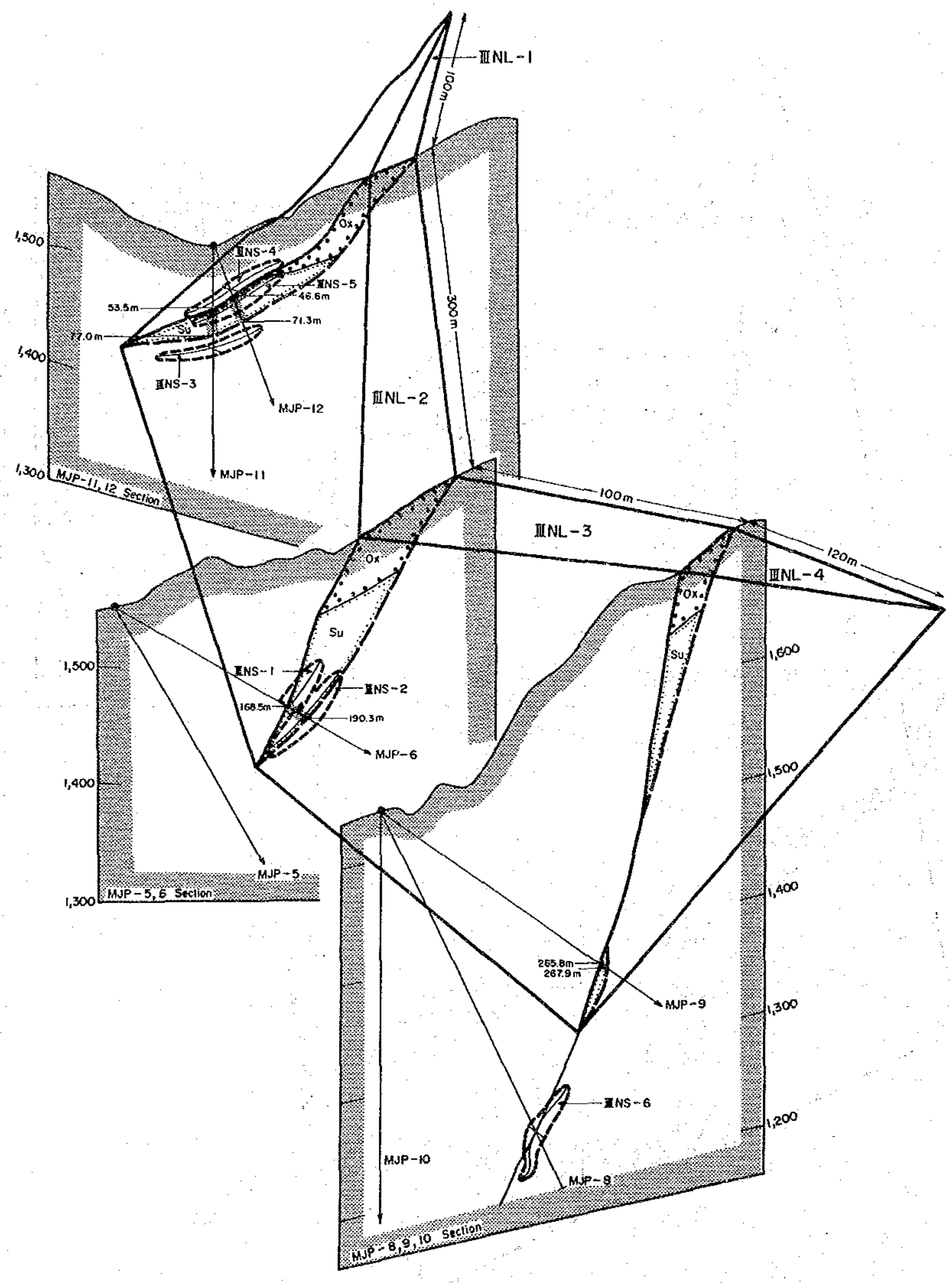


Fig. Ⅱ-2-13 Schematic Illustration of Mining Blocks of Surmai-Ⅲ Northern Orebody

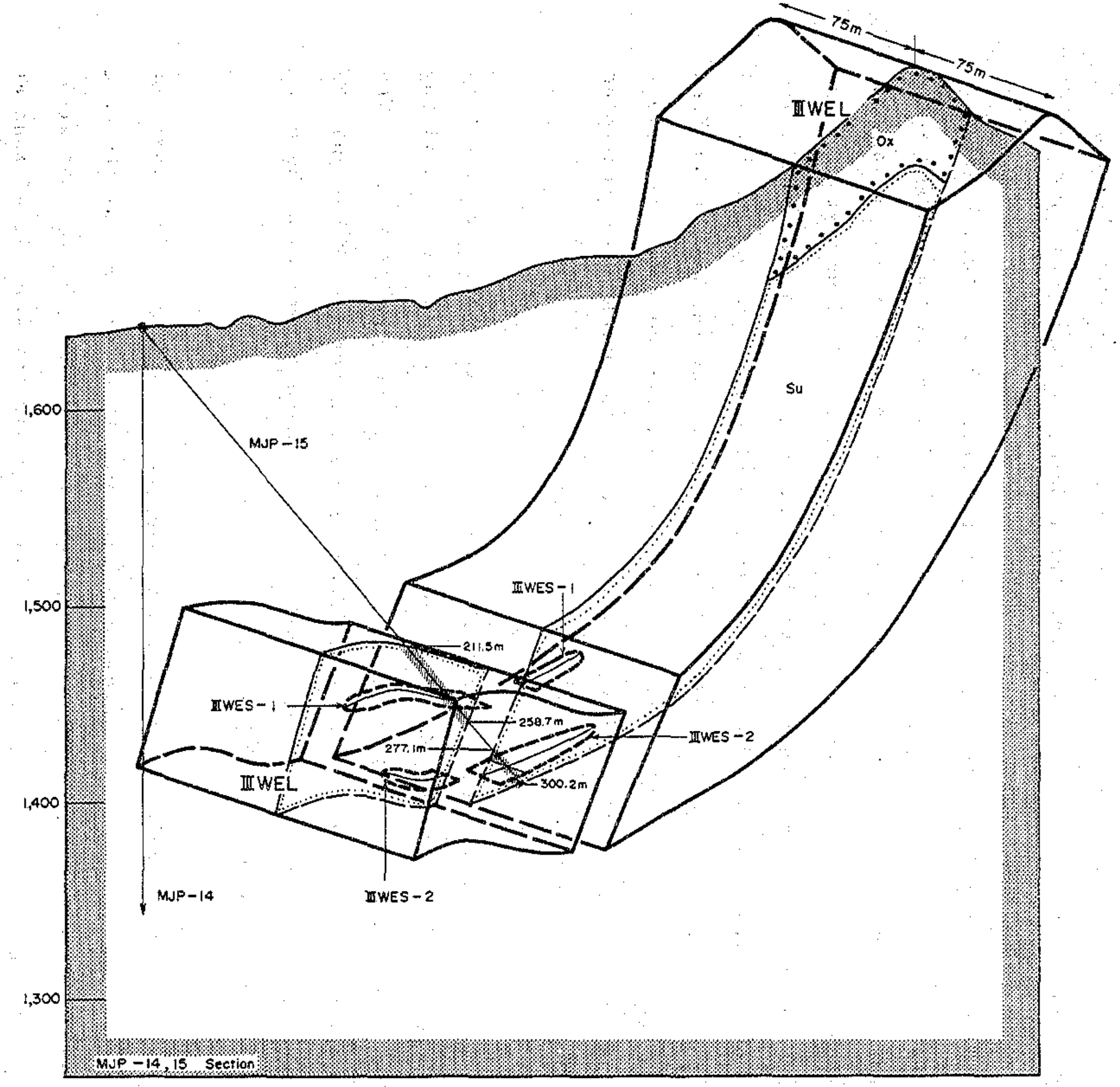


Fig. Ⅱ−2−14 Schematic Illustration of Mining Blocks of Surmai−Ⅲ W~E Deposit Area Orebody

CHAPTER 3 DISCUSSIONS

3 - 1 Characteristics of the Geologic Structure and Mineralization and Factor which Control Mineralization

It was clarified by the first phase survey that the mineralization of the Surmai district occurred along the bedding replacing the host rocks and also filling the faults and fractures. It was also revealed that the mineralization which was considered to be promising for both continuity and grade formed bedded deposits. And the bedded deposits of larger scale were developed in Units II ~ III of Loralai Member of Surmai-I and III showings and were accompanied by samller fissure filling types. The mineralized horizons confirmed by drilling during the second and third phases largely corresponded with the horizon of the surface gossan derived from the bedded deposits. Thus it is concluded that the assumption from the results of the first phase that the gossan distributed on the surface was derived from the primary sulphide deposits which were controled stratigraphically during their formation.

It is inferred that the ground water table of the Surmai district is approximately 100 m deep from the zone of lost circulation during drilling and also from the distribution of hematitization of limestone. The transition from oxidized to sulphide zone was confirmed by MJP-7 and the boundary between the two zones is believed to be shallower than the water table at approximately 50 m below the surface.

A normal fault with westward dip and 300~400 m displacement intersects the whole area in N-S direction at the central part of the area and it cuts through the mineralized horizon. The drilling for Surmai-I Main Orebody and Surmai-III North Orebody confirmed the mineralized zone at the footwall side of the fault while the deepest drilling MJP-10 (-90°, 500 m) into the hanging wall side of the fault did not encounter the mineralized zone. In the intermediate zone between the West and East Deposits, the mineralized zone is cut and separated by several faults with

N-S and E-W trends.

Thus the distribution of the mineralized zone is controled stratigraphically and bounded by the faults.

The nature of the lead-zinc mineralization of the Surmai district generally correspond to that of the Mississippi Valley type deposits. The main deviation of this mineralization from that of the general Mississippi Valley type is the relatively higher Fe content of sphalerite judged from the colour of the mineral and particularly the higher Ag content. The average Ag content of the total reserve calculation is 7.4 g/t, that for small blocks is 23.4 g/t and the highest assay value is 670 g/t, while that of most Mississippi Valley type deposits is 1～3 g/t. Detailed microscopic study of 30 polished sections of drill core samples revealed the existence of electrum in 21 samples of which one contained gold grains. Also Ag minerals of Pb-Bi, Pb-Sb series were inferred to exist in five samples. It is therefore, concluded that most of the silver associated with the lead-zinc mineralization of this district occurs as electrum and the possibility of containing gold is high for these ores. The gold-silver ratio of the electrum is estimated from the colour to be 1:5～10.

The Mississippi Valley type deposits in North America are generally mined by large scale underground mining method (Room and Pillar) with high efficiency of 30～50 t/man•shift and the crude ore grade is Pb+Zn: 10 %. The evaluation of the reserves and grade of deposits is carried out on the basis of a cut-off grade which is decided by considering various factors such as the planned operational mode of the mine, the price of the metals and others. The cut-off grade of the deposits at Surmai district has not been calculated and thus accurate estimation cannot be made, but it is considered that the economic feasibility of developing these ores at the present knowledge of the deposits and the current metal markets, however, is concluded to be low. The present knowledge of the deposits, as mentioned above, is grand total reserves of 30,513,000 t at the average grade of Pb: 0.66 %, Zn: 2.13 %, Ag: 7.4 g/t of which higher grade small mining blocks contain a total of 870,000 t of at the average grade of Pb: 2.03 %, Zn: 6.51 %, Ag: 23.4 g/t.

The large blocks were set for larger areas with emphasis on the continuity of the mineralization and thus the lower grade parts were included. Future drilling between the present drill holes would clarify the continuity of the high grade parts and will enable more accurate reserve evaluation. Also increase of drilling would add more small blocks and will provide data for more accurate calculation.

3 - 2 Geophysical Anomalies and Mineralization

The location of the geophysical (IP/SIP) anomalies measured during the first phase survey and the location of the mineralized zones confirmed by the drilling of the third phase agrees relatively well as shown below. It is expected that the accuracy of the geophysical work will increase significantly if re-analysis of the model simulation using the physical data measured from the drill cores would be carried out. And thus IP/SIP is a very effective method for prospecting for Mississippi Valley type lead-zinc deposits.

(1) Surmai-I

The two drill holes (MJP-7, 13) of this district are located between the No.10 station of B profile line and No.10 station of C profile line. The direction of MJP-7 intersects the direction of the two lines at an acute angle (Fig.II-1-1: Drilling site map). The location of the lead-zinc mineralized zone (A-7-1～3, A-13-1) confirmed by the two drill holes (Fig.II-2-13) agrees with the weak anomaly of 1.7～1.9 % which continues westward at steep dip downward from Nos.11～12 stations on the FPE section of C profile (Fig.III-3-19, Report first phase) and also with the weak anomalous zone which continues from the shallow zone of Nos.12～13 stations westward to the deep zones of FPE section (Fig.III-3-19, Report first phase). Also the location agrees with the anomaly source (apparent resistivity at the surface: 10 ohm-m, PFE: 5 % apparent resistivity in the deeper zone: 100 ohm-m, PFE: 10 %) confirmed by model simulation of Profile C (Fig.Ⅲ-3-42, Report first phase). It is believed that the weak anomalous zone of over 1.5 % identified in the north central part in the PFE plan (Fig.Ⅲ-3-18(3), Report first phase) expresses the mineralized zone.

(2) Surmai-Ⅲ

a. *Northern Orebody*

Three holes were drilled (MJP-8, 9, 10) for the southern extension and two (MJP-11, 12) for the northern extension of the North Orebody. MJP-8～10 were drilled in SE direction which is the same as the Profile R between No.1.5 station of Profile I and No.1.5 of J(Fig.Ⅲ-3-3, Report first phase), and MJP-11, 12 in Surmai direction at 50 m south of No.5.5 of Profile I. I and J are at right angles to each other.

(MJP-8, 9, 10(Fig.Ⅱ-2-11))

MJP-8 and 9 were drilled for the PFE anomaly (1.8 %) at the deeper part of No.3, R and PFE (3.2 %) detected in the deeper part of No.3, 5, J(Fig.Ⅲ-2-23, Report first phase). Although the whole PFE anomalous zone is not clarified by these two drill holes due to the depth and the location at the end of the profile, the model simulation (Fig.Ⅲ-3-44, Report first phase) of J indicate it as the source of the anomaly of apparent resistivity 10 ohm-m, PFE 8 %. The location of mineralized zone (A-9, B-9, B-8) agrees with that of the above PFE anomalies.

(MJP-11, 12 (Fig.Ⅱ-2-14))

The site of these two holes are 50 m south of L and MJP-11 was drilled southward at -90° and MJP-12 at 60°. Thus PFE value near No.5.5 of I was considered for these two holes. Mineralized zone (A-11-1, A-12-1～2) were identified at 45～80 m depth by drilling. On the other hand, the PFE of Profile I is distributed in the shallow parts of Nos.4～10 stations in bedded form as negative 0～-0.8 % value, (Fig.Ⅲ-3-23(1), Report first phase), but anomalies are not detected in the mineralized zone confirmed by drilling. This is probably due to the fact that the electrode interval is 100 m for the IP/SIP prospecting and the data for zones deeper than 100 m were lacking. It is inferred that the northern extension of the North Orebody submerges below the Profile I (approximately 100 m deep) at a gentle angle and the negative PFE anomaly mentioned above is considered to be due to the difference of resistivity of the mineralized zone and the limestone below.

b. Intermediate zone between West and East Deposits

Two holes (MJP-14 and 15) were drilled at No.7 station of Profile R, one vertically and the other at -50°. Geophysical work detected a negative anomaly of PFE -0.4 % below the No.7 station of Profile R and to the northwest weak positive anomaly with PFE increasing downward (Fig.Ⅲ-3-23(1), Report first phase). It is believed that this combination of the negative and PFE weak positive anomaly reflects the three mineralized zones, namely A-14-1 and 2 near 150 m depth and A-14-3 at 300 m depth.

MJP-15 was drilled toward below No.6.5 station of Profile K. In this profile negative anomaly is detected through the whole section and the PFE pattern is different from other sections (Fig.Ⅲ-3-23(1), Report first phase). As described in the report of the first phase, negative PFE anomalies are often detected at the contact of a high resistivity body and a lower one. The existence of several faults some of which are parallel to and some intersect at acute angles to Profile K is expected from the results of drilling and the above negative anomalies are believed to be caused by the change of resistivity at the faults.

3 - 3 Resource Potential

Of the three zones drilled, the mineralization of Surmai-Ⅰ Main Orebody is limited by faults to the west and east and thus the possibility of its extension outside of the block established for evaluation is small. Regarding Surmai-Ⅲ North Orebody, there is a possibility of the deposit extending northward at a gentle dip and the wide area east of Surmai-Ⅱ showing can be identified as a target for further prospecting Unit-Ⅲ of Loralai Member is distributed in this area. Also this is outside of the geophysically prospected area of the first phase. Regarding the Surmai-Ⅲ West-East Deposit area, the deposit could be cut by faults, but the grade is relatively high and the concentration of the ores is not bad. Therefore, together with the fact that there are wide areas outside of the blocks set for evaluation, this is considered as a promising zone for further prospecting.

The three zones with high potential for locating mineralization by future prospecting are, vicinity of East Deposit, Surmai-Ⅲ ; between West and East Deposit, Surmai-Ⅲ ; and east of Surmai-Ⅱ .

PART III

CONCLUSIONS

AND

RECOMMENDATIONS

PART III
CONCLUSIONS AND RECOMMENDATIONS

During the third phase, drilling was conducted for Surmai-I Main Orebody, North Orebody of Surmai-III Deposit, and the zone between West and East Deposits of Surmai-III Deposit. The objective of the drilling was to ascertain the mechanism of ore concentration and to clarify the mode of occurrence of the mineralized zone. The results of the above work and recommendations for future work are laid out below.

CHAPTER 1 CONCLUSIONS

(1) The Geological beds clarified by the third phase drilling range from Unit-I of Loralai Member in the lower part and Unit-II of Anjira Member in the upper part. The lithology is mostly limestone, shale and alternation of the two with marly shale. These four rocks alternate with the thickness of the individual beds at 0.2~10 m. The general strike is N-S and folds with axes of the same trend and faults occur in the area.

(2) Of the nine holes drilled this year, eight encountered lead-zinc ores. The mineralized horizons are divided into three, A, B, C in descending order and all occur in Units II~III of Loralai Member. Mineralized zones are distributed within these horizons with varying vertical positions. The mineralized zones considered to be promising in size, continuity and grade occur in the A Horizon.

(3) The mineralization consists of dissemination of powdery to granular sphalerite and galena replacing mainly limestone host rock wich siderite and calcite veins containing pyrite and minor amount of chalcopyrite. These intersect the dissemination zones. The microscopic study of these ores revealed the occurrence of lead-zinc carbonate minerals and electrum and, although the minute grain size prohibited definite identification, it was believed that Pb-Bi-Ag and Pb-Sb-Ag minerals also occur.

(4) The ground water table of Surmai district is believed to be approximately 100 m below the surface from the depth of circulation loss and the distribution of hematitized zones in the limestone. The transition from the oxidized to sulphide zone below was confirmed by MJP-7, and it is concluded that it is shallower than the water table at 50 m below the surface.

(5) The locations of the mineralized zones confirmed by the drilling this year (third phase) agree with those of the PFE anomalies detected by the geophysical prospecting (IP,SIP) conducted during the first phase. The exceptions are places where the electrode interval was too long. Thus this method is concluded to be effective for locating lead-zinc deposits of Mississippi Valley type.

(6) The reserves of Surmai-I Main Orebody, Northern Orebody of Surmai-Ⅲ West Deposit and the Intermediate Orebody between West and East Deposits were calculated. For this evaluation, all the results of this project were used and two types of ore blocks were established. Large blocks were drawn with emphasis on the continuity of the mineralization and small blocks centred on the mineralized zone in drill holes were set with emphasis on the grade. These reserves are in the possible category. The obtained reserves are; total 30,513,000 t (Pb: 0.66 %, Zn: 2.13 %,Ag: 7.4 g/t) of which sulphide ores 22,700,000 t, oxide ores 7,813,000 t and the reserves (sulfide) in the smaller blocks are 870,000 t (Pb: 2.03 %, Zn: 6.51 %, Ag: 23.4 g/t). These reserves and grades are considered to be insufficient for commercial development at current world metal markets.

(7) The zones with high potential for locating economic deposits are; vicinity of East Deposit of Surmai-Ⅲ, zone between West～East Deposits of Surmai-Ⅲ, and east of Surumai-Ⅱ.

CHAPTER 2 RECOMMENDATIONS

(1) The economic feasibility of the reserves calculated on the basis of the work of the past three years, is cosidered to be low at present, but there are possibilities of more high grade ores being found by future prospecting. Therefore, it is desirable that drilling be continued in the mining blocks in order to ascertain the shape, grade, continuity and spatial extension of the mineralized zones. Three zones; namely the vicinity of East Deposit of Surmai-Ⅲ, zone between West and East Deposits of Surmai-Ⅲ, and the zone east of Surmai-Ⅱ were delineated as promising for future prospecting. It is recommended that prospecting with emphasis on drilling be conducted in these zones.

(2) It was shown that the deposits of the Surmai district contained higher amount of silver compared to the general Mississippi Valley type ores. The silver is concluded to occur mostly as electrum and thus there is a good possibility of gold occurrence in these ores. It is recommended that gold be included in the future investigation of these deposits.

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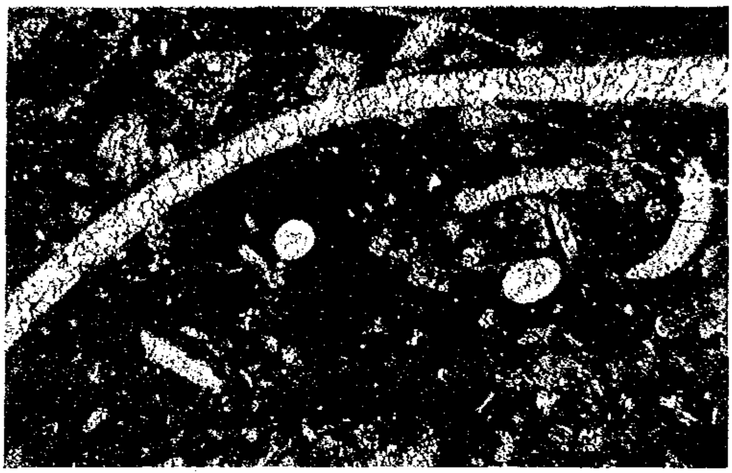
GSJ : Geological Survey of Japan
GSP : Geological Survey of Pakistan
JICA : Japan International Coperation Agency
MMAJ : Metal Mining Agency of Japan
OTCA : Overseas Technical Cooperation Agency
TAGCJ: The Association for the Geological Collaboration in Japan
TAO : Tokyo Astoronomical Observatory
USGS : United States Geological Survey

PHOTOGRAPHS

Photographs

LEGEND

Sp : Sphalerite	Sm : Smithsonite
Si : Siderite	El : Electrum
Gg : Gangue mineral	Ga : Galena
Cp : Chalcopyrite	Li : Limonite
Ce : Cerussite	Ab : Ag-Pb-Bi, Ag-Pb-Sb mineral
Au : Gold	Gg : Gangue mineral



0 0.5 mm

Phot. -2

Thin Section
(Parallel nicol)

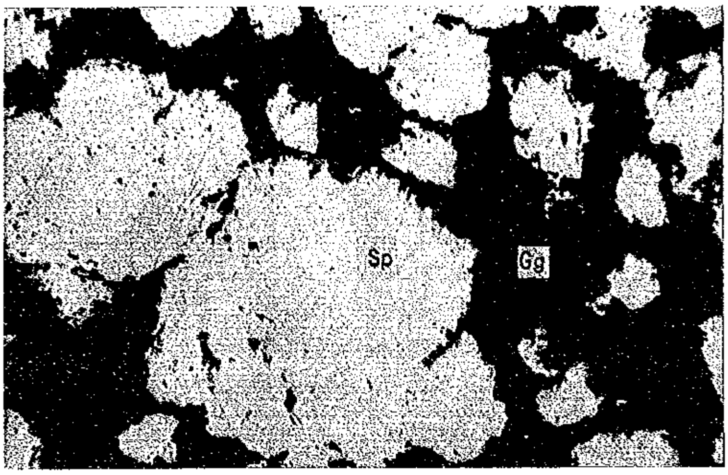
Sample No. : DH14-BB
Drill No. : MJP-14
Position : 39.5m
Rock Name : Limestone
Allochems : Bioclasts
Orthochems: Micrite

0 0.5 mm

Phot. -3

Thin Section
(Parallel nicol)

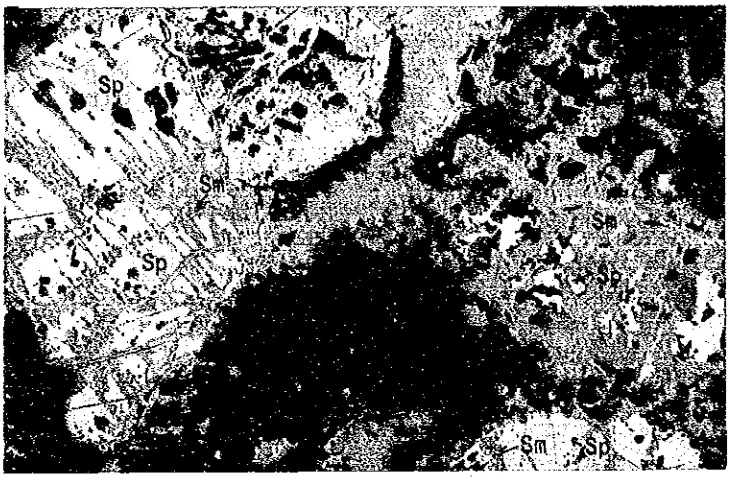
Sample No. : DH14-CC
Drill No. : MJP-14
Position : 67.8m
Rock Name : Shale
Allochems : Bioclasts, Quartz
Orthochems: Micrite



Phot. -4
Polished Section
(Parallel nicol)

Sample No. : DH11-B
Drill No. : MJP-11
Position : 74.5m

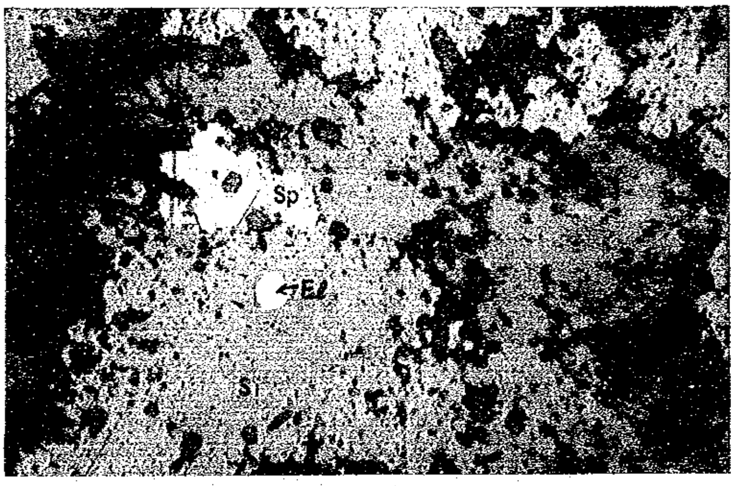
0 0.4 mm



Phot. -5
Polished Section
(Parallel nicol)

Sample No. : DH7-H
Drill No. : MJP-7
Position : 79.6m

0 0.4 mm



Phot. -6
Polished Section
(Parallel nicol)

Sample No. : DH12-A
Drill No. : MJP-12
Position : 58.6m

0 0.2 mm

Phot. -7

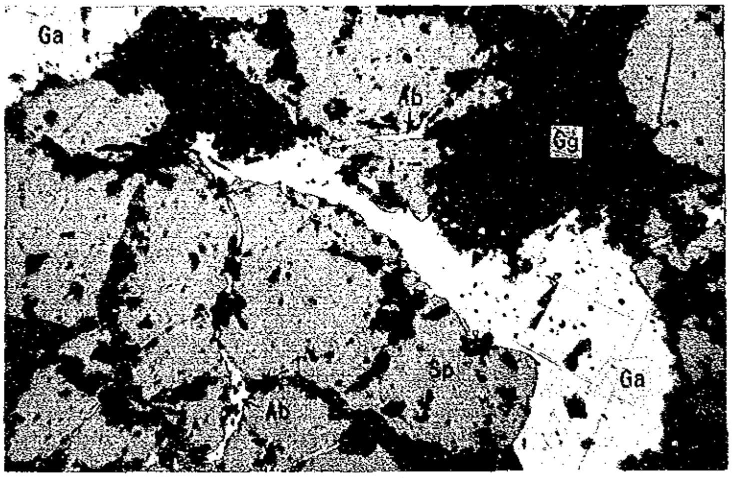
Polished Section
(Parallel nicol)

Sample No. : DH15-A
Drill No. : MJP-15
Position : 245.3m

0 0.1 mm

Phot. -8

Polished Section
(Parallel nicol)

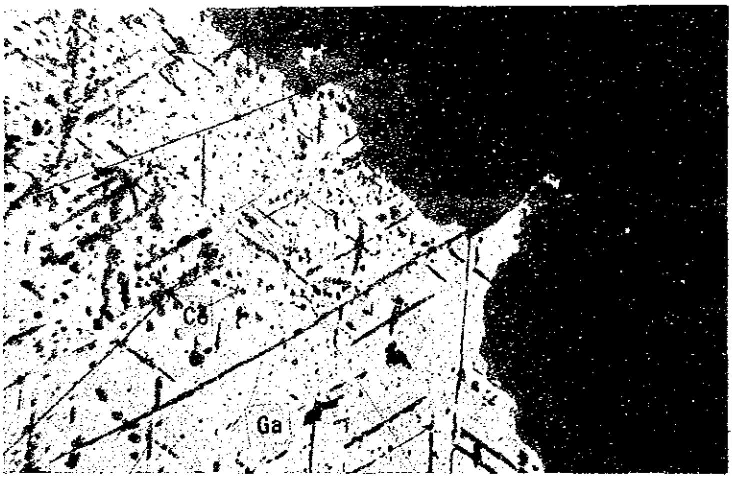


Sample No. : DH14-A
Drill No. : MJP-14
Position : 126.4m

0 0.2 mm

Phot. -9

Polished Section
(Parallel nicol)



Sample No. : DH7-A
Drill No. : MJP-7
Position : 49.8m

0 0.2 mm

APPENDICES

App. 1 Drilling Machine and Equipment Used

Drilling Machine Model "L-38"	1 set
Specifications:	
Capacity	700m (BQ-WL)
Dimensions L × W × H	2,150mm×1,170mm×1,450mm
Hoisting capacity	4,000kg
Spindle speed	Forward 211,438,803,1,000rpm
Engine Model "F3L912"	41ps/1,800rpm
Drilling Pump Model "WLNG-15h"	1 set
Specifications:	
Piston diameter	68mm
Stroke	100mm
Capacity	discharge capacity 100ℓ/min
Dimensions L × W × H	2,350mm×720mm×1,120mm
Engine Model "NS-130C"	13ps/2,200rpm
Wire line Hoist Model "SK-1-110"	1 set
Specifications:	
Rope capacity	500m
Hoisting speed	8~105m/min
Engine Model "NF-110"	11ps/2,200rpm
Mud mixer Model "HM-250"	1 set
Specifications:	
Capacity	200ℓ/600rpm
Engine Model "NS-65C"	7ps/2,400rpm
Generator Model "YSG-10E"	1 set
Specifications:	
Capacity	10KVA 8KW 100~200V
Engine Model "NS-130C"	13ps/2,200rpm
Generator Model "YDG3000S"	1 set
Specifications:	
Capacity	2.7KVA 100V
Generator Model "YSG2000B"	1 set
Specifications:	
Capacity	1.7KVA 100V
Water supply pump Model "U-40KI"	2 set
Specifications:	
Capacity	discharge capacity 300ℓ/min
Yanmar set Pump Model "PA25-35L	1 set
Capacity	discharge capacity 180ℓ/min
Derrick	1 set
Specifications:	
Height	9.5m
Max load capacity	4,000Kg
Drilling tools	
Drilling rod	NQ-WL 3m 100 pcs
	BQ-WL 3m 167 pcs
Casing pipe	HX 1m 10 pc
	NX 1m 2 pcs
	NX 3m 21 pcs
	BX 3m 85 pcs

App. 2 Drilling Meterage of Diamond Bit Used

Item	Size	Bit No.	Drilling Meterage by Unit:Meter									Total
			MJP-7	MJP-8	MJP-9	MJP-10	MJP-11	MJP-12	MJP-13	MJP-14	MJP-15	(m)
Diamond bit	HX-SW	NXBP-1	3.10	9.10	12.00				4.10			28.30
		NXBP-2				10.10	4.10	3.10		6.10	4.00	27.40
			3.10	9.10	12.00	10.10	4.10	3.10	4.10	6.10	4.00	55.70
		Total	Drilling length /bit (55.70 / 2)									27.85
	NQ-WL	NNP-11			87.10							87.10
		NNP-12		76.20								76.20
		NNP-13		77.00								77.00
		NNP-14		78.10								78.10
		NNP-15	77.90									77.90
		NNP-16	69.50									69.50
		NNP-17							115.70			115.70
		NNP-18							43.70			43.70
		NNP-19							46.90			46.90
		NNP-20									68.30	68.30
		NNP-21									58.60	58.60
		NNP-22									49.20	49.20
		NNP-23								73.90		73.90
		NNP-24								70.10		70.10
		NNP-25								60.30		60.30
		NNP-26						51.20				51.20
		NNP-27						96.70				96.70
		NNP-28					69.50					69.50
		181886					76.50					76.50
		181887				74.40						74.40
		181888				71.10						71.10
		181889				83.90						83.90
		181890				58.50						58.50
			147.40	231.30	87.10	287.90	146.00	147.90	206.30	204.30	176.10	1,634.30
		Total	Drilling length/bit (1,634.30/23)									71.05
	BQ-WL	NBP- 5			60.30							60.30
		NBP- 6			71.40							71.40
		NBP- 7			70.20							70.20
		NBP- 8		76.70								76.70
		NBP- 9		83.90								83.90
		NBP-10							87.50			87.50
		NBC-10							53.10			53.10
		NBC-11									55.70	55.70
		NBC-12									64.40	64.40
		NBC-13								68.00		68.00
		NBC-14								72.60		72.60
		NBC-15					100.90					100.90
		NBC-16				69.30						69.30
		NBC-17				71.10						71.10
		NBC-18				61.90						61.90
			-	160.60	201.90	202.30	100.90	-	140.60	140.60	120.10	1,067.00
		Total	Drilling length/bit (1,067.00/15)									71.13
Casing shoe	N X	NNCS-1	37.00	32.00	12.10							81.10
		181662							60.00			60.00
		181663								31.00	40.50	71.50
		181664				39.00	21.00	25.50				85.50
			37.00	32.00	12.10	39.00	21.00	25.50	60.00	31.00	40.50	298.10
		Total	Reaming length/bit (298.10/4)									74.52
	B X	177497			12.00						24.00	36.00
		177498									49.90	49.90
			-	-	12.00	-	-	-	-	-	73.90	85.90
		Total	Reaming length/bit (85.90/2)									42.95

App. 3 Consumables Used

Description	pecifications	Unit	Quantity									Total
			MJP-7	MJP-8	MJP-9	MJP-10	MJP-11	MJP-12	MJP-13	MJP-14	MJP-15	
Light oil		ℓ	940	2,620	2,250	4,060	1,530	840	2,590	2,730	3,870	21,430
Petrol		ℓ	80	420	380	230	110	70	380	360	280	2,310
Hydraulic oil		ℓ	8	12	36	18	10	-	12	8	10	114
Engine oil		ℓ	6	12	30	40	12	14	16	26	28	184
Gear oil		ℓ	-	6	10	8	4	-	8	4	6	46
Greas		kg	5	8	10	15	6	5	10	10	15	84
Bentonite	25kg/bag	bag	28	58	58	86	22	13	64	53	80	468
C M C		kg	16	24	33	53	13	8	38	35	53	253
Tel-stop (G)		kg	10	30	40	50	30	20	46	38	87	351
Tel-stop (P)		kg	2	8	8	35	15	2	12	12	20	114
Multi seal		kg	5	13	10	20	10	2	10	10	20	100
Mud oil		ℓ	72	144	90	144	52	40	174	144	204	1,064
Cement		kg	700	900	1,200	900	350	650	1,550	450	2,900	9,600
Diamond bit	HX-SW	pc	(1)	(1)	1	(1)	(1)	(1)	(1)	1	(1)	2
Diamond bit	NQ-WL	pc	2	3	1	4	2	2	3	3	3	23
Diamond bit	BQ-WL	pc	-	2	3	3	1	-	2	2	2	15
Diamond reamer	NQ-WL	pc	1	2	1	2	2	1	2	2	2	15
Diamond reamer	BQ-WL	pc	-	2	2	2	1	-	1	1	1	10
Casing diamond shoe	NX	pc	(1)	(1)	1	1	(1)	(1)	1	(1)	1	4
Casing diamond sHoe	BX	pc	-	-	1	-	-	-	-	-	1	2
Casing metal shoe	HX	pc	1	1	1	1	1	1	1	1	1	9
Casing metal shoe	NX	pc	1	1	1	1	1	1	1	1	1	9
Casing metal shoe	BX	pc	-	1	1	1	1	-	1	1	1	7
Core barrel Ass'y	NQ-WL	set	-	-	1	-	-	1	-	1	1	4
Core barrel Ass'y	BQ-WL	set	-	-	1	1	-	-	-	1	1	4
Outer tube	NQ-WL	pc	1	1	-	1	-	1	-	-	1	5
Outer tube	BQ-WL	pc	-	1	-	-	-	-	-	-	1	3
Inner tube	NQ-WL	pc	1	-	1	2	1	2	-	-	1	8
Inner tube	BQ-WL	pc	-	-	1	2	1	2	-	-	1	7
Core lifter case	NQ-WL	pc	2	2	2	4	2	2	2	4	4	24
Core lifter case	BQ-WL	pc	-	2	2	4	2	-	2	4	2	18
Core lifter	NQ-WL	pc	2	4	2	6	2	2	4	2	4	28
Core lifter	BQ-WL	pc	-	2	2	6	2	-	2	2	4	20
Stop ring	NQ-WL	pc	2	2	2	2	2	2	2	2	2	18
Stop ring	BQ-WL	pc	-	2	2	2	2	-	2	2	2	14
Thrust ball bearing	NQ-WL	pc	4	2	4	6	4	4	2	4	4	34
Thrust ball bearing	BQ-WL	pc	-	4	4	2	2	4	2	4	4	26
Innertube stabilizer	NQ-WL	pc	1	2	1	2	2	1	2	2	2	15
Innertube stabilizer	BQ-WL	pc	-	2	2	2	1	-	1	1	1	10
Latch	NQ-WL	set	1	-	-	2	-	1	-	-	1	5
Latch	NQ-WL	set	-	-	-	1	-	-	1	-	1	3
Chack piece	NX	set	-	-	1	1	-	-	1	-	1	4
Chack piece	NQ-WL	set	1	-	1	1	-	-	-	1	1	5
Chack piece	BQ-WL	set	-	1	-	1	-	-	1	-	1	4
Chack screw		set	-	-	-	1	-	1	-	-	1	3
Chack bushing		set	-	-	-	1	-	1	-	-	1	3
Cylinder liner	MG-15h 68mm	pc	-	-	-	2	-	2	2	-	-	6
Piston rod	MG-15h	pc	-	2	-	2	-	-	2	2	2	10
Piston rubber	MG-15h 68mm	pc	-	4	-	4	4	-	4	4	4	24
V-packing	MG-15h	pc	-	14	-	14	-	-	14	14	14	70
Valve seat	MG-15h	pc	-	-	-	8	-	-	-	-	8	16
Valve insert	MG-15h	pc	-	8	-	8	-	8	8	-	8	40
Waste		kg	10	15	15	25	10	10	15	10	20	130
Wire rope	6mm X 500m	roll	-	-	1	1	-	-	-	-	1	3
Core box	NQ-WL	pc	22	43	18	44	22	25	32	31	26	263
Core box	BQ-WL	pc	-	18	36	21	14	-	15	15	13	132

App. 4 Working Time Analysis of the Drilling Operation

Hole No.	Drilling			Shift		Working man		Working Time							
	Bit siz	Drilling length (m)	Core length (m)	Drill-ing (shift)	Total (shift)	Engin-eer (man)	Worker (man)	Drilling (h)	Other working (h)	Recove-ring (h)	Total (h)	Removing (h)	Water transpor-tation (h)	Road con-struction and others (h)	G.Total (h)
MJP- 7	HX	3.10	0.20	1	5	18	53	1°00′	1°40′	-	2°40′	36°00′		-	38°40′
	NQ	147.40	145.90	14	16	22	67	82°00′	41°30′	3°20′	126°50′	5°00′		-	131°50′
	Total	150.50	146.10	15	21	40	120	83°00′	43°10′	3°20′	129°30′	41°00′	(66°00′)		170°30′
MJP- 8	HX	9.10	0	3	4	11	32	3°10′	13°30′	-	16°40′	13°00′		-	29°40′
	NQ	231.30	228.80	32	32	43	129	145°00′	85°50′	29°30′	260°20′	-		-	260°20′
	BQ	160.60	160.00	17	18	26	79	95°40′	44°50′	-	140°30′	4°30′		-	145°00′
	Total	401.00	388.80	52	54	80	240	243°50′	144°10′	29°30′	417°30′	17°30′	(189°00′)	-	435°00′
MJP- 9	HX	12.00	0.30	1	6	24	72	5°00′	4°00′	-	9°00′	45°00′		-	54°00′
	NQ	87.10	84.90	11	15	30	87	36°50′	41°30′	38°00′	116°20′	-		-	116°20′
	BQ	201.90	201.10	28	30	42	130	126°10′	78°10′	34°50′	239°10′	5°30′		-	244°40′
	Total	301.00	286.30	40	51	96	289	168°00′	123°40′	72°50′	364°30′	50°30′	(189°00′)	(56°00′)	415°00′
MJP-10	HX	10.10	0.60	1	5	18	65	4°20′	3°40′	-	8°00′	38°00′		-	46°00′
	NQ	287.90	280.90	38	39	52	156	180°10′	85°50′	46°00′	312°00′	-		-	312°00′
	BQ	202.30	202.10	24	26	38	115	133°50′	65°30′	40′	200°00′	9°00′		(126°00′)	209°00′
	Total	500.30	483.60	63	70	108	336	318°20′	155°00′	46°40′	520°00′	47°00′	(160°00′)	(126°00′)	567°00′
MJP-11	HX	4.10	1.20	1	2	4	10	2°10′	1°20′	-	3°30′	7°00′		-	10°30′
	NQ	146.00	140.30	17	17	22	67	89°30′	37°50′	13°10′	140°30′	-		-	140°30′
	BQ	100.90	100.50	9	10	15	45	53°20′	17°10′	1°30′	72°00′	8°00′		-	80°00′
	Total	251.00	242.00	27	29	41	122	145°00′	56°20′	14°40′	216°00′	15°00′	(53°00′)	-	231°00′
MJP-12	HX	3.10	1.00	1	5	18	65	2°20′	2°40′	-	5°00′	39°00′		-	44°00′
	NQ	147.90	141.40	14	17	24	72	71°50′	55°10′	4°00′	131°00′	4°00′		-	135°00′
	Total	151.40	142.40	15	22	42	137	74°10′	57°50′	4°00′	136°00′	43°00′	(28°00°)	-	179°00′
MJP-13	HX	4.10	1.00	1	3	10	29	2°20′	1°40′	-	4°00′	20°00′		-	24°00′
	NQ	206.30	201.90	27	28	37	111	137°10′	82°40′	-	219°50′	-		-	219°50′
	BQ	140.60	140.60	15	17	25	77	78°10′	43°50′	14°10′	136°10′	8°00′		-	144°10′
	Total	351.00	343.50	43	48	72	217	217°40′	128°10′	14°10′	360°00′	28°00′	(168°00′)	-	388°00′
MJP-14	HX	6.10	0.20	1	3	8	23	3°50′	4°10′	-	8°00′	14°00′		-	22°00′
	NQ	204.30	197.00	28	29	38	115	142°20′	77°10′	12°30′	232°00′	-		-	232°00′
	BQ	140.60	140.40	21	24	36	108	95°20′	72°20′	22°20′	190°00′	6°00′		-	196°00′
	Total	351.00	337.60	50	56	82	246	241°30′	153°40′	34°50′	430°00′	20°00′	(191°00′)	-	450°00′
MJP-15	HX	4.00	0.50	1	7	26	109	2°00′	1°30′	-	3°30′	57°00′		-	60°30′
	NQ	176.10	170.30	23	24	32	96	106°40′	71°50′	18°00′	196°30′	-		-	196°30′
	BQ	120.10	118.30	18	49	68	201	65°00′	76°50′	242°10′	384°00′	4°00′		-	388°00′
	Total	300.20	289.10	42	80	126	406	173°40′	150°10′	260°10′	584°00′	61°00′	(410°00′)	-	645°00′
Grand Total		2,575.00	2,659.40	347	431	687	2,113	1,665°10′	1.012°10′	480°10′	3.157°30′	323°00′	(1.454°00′)	(182°00′)	3.480°30′

App. 5-1 Record of the Drilling Operation on MJP-7

	Drilling length			Total		Shift		Working man	
	shift 1	shift 2	shift 3	Drilling	length	Core Drilling	Total	Engineer	Worker
	m	m	m	m	m	shift	shift	man	man
March									
9	Tra-Reas								
10	Tra-Reas								
11	Tra-Reas					—	3	12	36
12	Reassemb								
13	6.20	6.80	10.00	23.00	19.60				
14	5.00	12.20	Reaming	17.20	17.00				
15	14.00	13.50	13.30	40.80	40.20				
16	12.00	10.50	11.20	33.70	33.50				
17	10.40	10.10	7.90	28.40	28.40				
18	7.40	Dismant		7.40	7.40	15	18	28	84
Total	55.00	53.10	42.40	150.50	146.10	15	21	40	120

Abbreviation

Pbs : Preparation for drilling sit
Trans : Transportation
Tra-Reas : Transportation and Reassemblage
Reassemb : Reassemblage
Dismant : Dismantlement

Ins-C.P : Inserting casing pipe
Out-C.P : Taking out casing pipe
Reaming : Reaming for casing
Stopping : Stopping for water leakage
Recover : Recovering works

App. 5-2 Record of the Drilling Operation on MJP-8

	Drilling length			Total		Shift		Working man	
	shift 1	shift 2	shift 3	Drilling	length	Core Drilling	Total	Engineer	Worker
	m	m	m	m	m	shift	shift	man	man
February									
17	Reassemb								
18	3.50			3.50	-	1	2	8	24
19	2.60	4.60	6.10	13.30	7.30				
20	4.40	6.30	5.80	16.50	16.10				
21	3.60	8.20	3.10	14.90	14.50				
22	9.30	9.30	8.80	27.40	27.40				
23	9.70	7.00	7.10	23.80	23.60				
24	4.20	6.80	4.20	15.20	14.90				
25	4.10	10.90	9.50	24.50	24.10	21	21	28	84
26	8.30	8.10	6.80	23.20	23.00				
27	9.20	9.20	8.80	27.20	27.10				
28	10.20	5.10	6.10	21.40	21.40				
March 1	6.40	10.00	10.80	27.20	27.10				
2	2.30	1.50	7.50	11.30	11.00				
3	10.10	7.90	9.30	27.30	27.10				
4	8.80	7.90	11.30	28.00	28.00	21	21	28	84
5	12.40	10.40	11.80	34.60	34.50				
6	12.10	10.70	11.20	34.00	34.00				
7	12.40	9.30	6.00	27.70	27.70				
8	Dismant					9	10	16	48
Total	133.60	133.20	134.20	401.00	388.80	52	54	80	240

App. 5-3 Record of the Drilling Operation on MJP−9

	Drilling length			Total		Shift		Working man	
	shift 1	shift 2	shift 3	Drilling	Core length	Drilling	Total	Engineer	Worker
	m	m	m	m	m	shift	shift	man	man
January									
23	Pds								
24	Tra-Reas								
25	Tra-Reas								
26	Tra-Reas								
27	Tra-Reas								
28	12.00			12.00	0.30	1	6	24	78
29	5.30	1.70		7.00	6.30				
30	4.40	1.50		5.90	5.80				
31	13.60			13.60	13.00				
February									
1	11.50			11.50	11.20				
2	6.60	16.80		23.40	22.90				
3	Holi day								
4	14.00	4.20	Stoping	18.20	18.20	10	11	24	70
5	Stoping	Stoping	Stoping						
6	7.50	8.20	0.40	16.10	16.10				
7	0.70	Reaming	3.30	4.00	4.00				
8	1.30	11.50	8.50	21.30	21.30				
9	7.80	9.30	9.30	26.40	26.40				
10	4.30	7.60	4.70	16.60	16.60				
11	10.40	11.00	5.60	27.00	26.70	17	21	28	84
12	6.30	9.40	12.10	27.80	27.70				
13	9.60	10.50	11.10	31.20	30.80				
14	3.30	5.80	8.10	17.20	17.20				
15	9.70	9.00	3.10	21.80	21.80				
16	Dismant					12	13	20	57
Total	128.30	106.50	66.20	301.00	286.30	40	51	96	289

App. 5-4 Record of the Drilling Operation on MJP-10

	Drilling length			Total		Shift		Working man	
	shift 1	shift 2	shift 3	Drilling	Core length	Drilling	Total	Engineer	Worker
June	m	m	m	m	m	shift	shift	man	man
23	Tra-Reas								
24	Tra-Reas					-	2	8	30
25	Tra-Reas								
26	Tra-Reas								
27	8.00	7.10	7.20	22.30	9.80				
28	8.30	8.50	3.00	19.80	18.80				
29	6.00	7.60	10.00	23.60	23.60				
30	6.00	12.80	12.30	31.10	30.70				
July 1	11.00	11.70	13.80	36.50	36.50	15	17	28	90
2	8.40	7.50	6.40	22.30	22.30				
3	8.80	7.10	4.90	20.80	20.60				
4	5.50	6.00	6.50	18.00	17.10				
5	6.60	8.50	8.90	24.00	23.80				
6	7.10	6.00	8.00	21.10	20.80				
7	6.90	8.00	7.50	22.40	22.00				
8	1.40	6.40	8.30	16.10	15.60	21	21	28	84
9	7.70	7.10	5.20	20.00	19.90				
10	Ins-C.P	4.10	10.20	14.30	14.30				
11	9.10	10.40	8.90	28.40	28.40				
12	9.60	9.00	8.00	26.60	26.40				
13	9.70	8.00	3.00	20.70	20.70				
14	Holi day								
15	5.20	10.40	7.90	23.50	23.50	17	18	24	72
16	10.20	8.50	8.20	26.90	26.90				
17	8.40	7.80	10.50	26.70	26.70				
18	9.30	9.50	9.10	27.90	27.90				
19	7.30	Out-C.P		7.30	7.30				
20	Dismant					10	12	20	60
Total	160.50	172.00	167.80	500.30	483.60	63	70	108	336

App. 5-5 Record of the Drilling Operation on MJP—11

	Drilling length			Total		Shift		Working man	
	shift 1	shift 2	shift 3	Drilling	Core length	Drilling	Total	Engineer	Worker
June	m	m	m	m	m	shift	shift	man	man
12	Reassemb								
13	7.70	8.30	8.10	24.10	18.50				
14	9.80	9.90	9.00	28.70	26.80				
15	10.40	6.30	4.10	20.80	20.70				
16	8.40	9.50	10.20	28.10	27.60				
17	10.70	9.90	8.50	29.10	28.80	15	16	22	65
18	6.90	9.30	3.10	19.30	19.10				
19	7.40	9.30	14.20	30.90	30.60				
20	13.00	12.00	13.60	38.60	38.50				
21	11.70	14.40	5.30	31.40	31.40				
22	Dismant					12	13	19	57
Total	86.00	88.90	76.10	251.00	242.00	27	29	41	122

App. 5-6 Record of the Drilling Operation on MJP—12

	Drilling length			Total		Shift		Working man	
	shift 1	shift 2	shift 3	Drilling	Core length	Drilling	Total	Engineer	Worker
	m	m	m	m	m	shift	shift	man	man
June 2	Tra-Reas								
3	Tra-Reas					--	2	8	30
4	Reassemb								
5	Reassemb								
6	7.70	7.60	10.70	26.00	19.70				
7	8.60	4.50	Dismant	13.10	12.00				
8	Reassemb	5.90	5.90	5.80					
9	9.30	13.90	11.70	34.90	34.50				
10	12.10	13.40	14.40	39.90	39.80	12	16	28	90
11	13.20	10.50	7.50	31.20	30.60				
12	Dismant					3	4	6	17
Total	50.90	49.90	50.20	151.00	142.40	15	22	42	137

App. 5-7 Record of the Drilling Operation on MJP-13

	Drilling length			Total		Shift		Working man	
	shift 1	shift 2	shift 3	Drilling	Core length	Drilling	Total	Engineer	Worker
	m	m	m	m	m	shift	shift	man	man
March									
19	Reassemb								
20	Reassemb								
21	9.30	6.40	7.50	23.20	19.60				
22	7.30	6.50	10.20	24.00	23.20				
23	6.90	Reaming	7.30	14.20	13.30				
24	2.10	9.80	11.60	23.50	23.40				
25	12.00	12.40	10.50	34.90	34.90	14	17	28	84
26	4.40	6.00	10.60	21.00	20.50				
27	10.10	6.20	6.40	22.70	21.40				
28	7.70	7.20	6.00	20.90	20.60				
29	5.40	6.60	5.70	17.70	17.70				
30	7.20	1.10	4.80	13.10	13.10				
31	9.90	7.00	8.30	25.20	25.20				
April 1	9.80	10.20	7.30	27.30	27.30	21	21	28	84
2	9.10	10.90	10.20	30.20	30.20				
3	12.60	10.00	12.90	35.50	35.50				
4	11.80	5.80	Out-C.P	17.60	17.60				
5	Dismant					8	10	16	49
Total	125.60	106.10	119.30	351.00	343.50	43	48	72	217

App. 5-8 Record of the Drilling Operation on MJP-14

	Drilling length			Total		Shift		Working ma	
	shift 1	shift 2	shift 3	Drilling	Core length	Drilling	Total	Engineer	Worker
	m	m	m	m	m	shift	shift	man	man
May									
12	Reassemb								
13	Reassemb					—	2	6	18
14	6.70	7.10	4.30	18.10	9.40				
15	6.00	6.20	4.50	16.70	16.30				
16	4.10	6.40	9.90	20.40	20.40				
17	6.40	10.00	8.40	24.80	24.20				
18	7.40	9.50	7.30	24.20	22.40				
19	8.80	8.60	8.00	25.40	24.80				
20	7.60	6.00	6.90	20.50	19.50	21	21	28	84
21	8.40	8.90	7.10	24.40	24.40				
22	7.50	7.50	8.40	23.40	23.30				
23	8.10	4.40	Int-C.P	12.50	12.50				
24	1.60	6.50	7.30	15.40	15.40				
25	7.40	7.20	6.20	20.80	20.80				
26	9.50	7.80	7.20	24.50	24.40				
27	7.30	7.40	12.00	26.70	26.60	20	21	28	84
28	5.70	4.60	4.10	14.40	14.40				
29	4.90	6.30	9.40	20.60	20.60				
30	7.60	5.80	4.80	18.20	18.20				
31	Out-C.P	Out-C.P							
June 1	Dismant					9	12	20	60
Total	115.00	120.20	115.80	351.00	337.60	50	56	82	246

App. 5-9 Record of the Drilling Operation on MJP—15

	Drilling length			Total		Shift		Working man	
	shift 1	shift 2	shift 3	Drilling	Core length	Drilling	Total	Engineer	Worker
	m	m	m	m	m	shift	shift	man	man
April 6	Trans								
7	Trans								
8	Trans					—	3	12	60
9	Tra-Reas								
10	Tra-Reas								
11	Reassemb								
12	7.90	7.20	6.10	21.20	15.60				
13	5.50	6.80	6.20	18.50	16.80				
14	6.30	7.40	6.90	20.60	19.90				
15	6.10	5.90	9.20	21.20	20.80	12	15	28	92
16	7.10	6.60	10.40	24.10	23.80				
17	9.20	6.70	9.40	25.30	25.30				
18	7.80	8.70	9.10	25.60	25.40				
19	7.20	8.80	7.60	23.60	23.20				
20	Int-C.P	5.70	12.70	18.40	18.40				
21	11.70	10.40	10.30	32.40	32.20				
22	2.50	0.30	0.40	3.20	3.20	20	21	28	84
23	Stopping	0.60	Stopping	0.60	0.40				
24	Stopping	Stopping	Stopping						
25	Stopping	1.10	Stopping	1.10	1.10				
26	Stopping	Stopping	Stopping						
27	10.70	8.80	0.80	20.30	19.70				
28	Recover	Recover	Recover						
29	Recover	Recover	Recover			5	21	28	84
30	Recover	Recover	Recover						
May 1	Recover	Recover	Recover						
2	Recover	Recover	Recover						
3	Recover	1.90	10.30	12.20	12.20				
4	7.00	9.60	8.30	24.90	24.70				
5	5.10	1.90	Out-C.P	7.00	6.40				
6	Out-C.P					7	19	28	80
7	Holi day								
8	Holi day								
9	Holi day								
10	Holi day								
11	Holi day								
12	Dismant					—	1	2	6
Total	94.10	98.40	107.70	300.20	289.10	44	80	126	406

App. 6－1 Summary of the Drilling Operation on MJP－7

	Survey Period: Period	Survey Period: Days	Survey Period: Work day	Survey Period: Off day	Total man day: Engineer	Total man day: Worker
Operation			days	days	man	man
Preparation	9.3.1989 ～ 12.3.1989	4	4	0	16	48
Drilling	13.3.1989 ～ 18.3.1989	5.5	Drilling 5.5	0	22	66
			Recovering			
Removing	18.3.1989 ～ 18.3.1989	0.5	0.5	0	2	6
Total	9.3.1989 ～ 18.3.1989	10	10	0	40	120

Drilling length			
Length planed	150.00 m	Overburden	2.10m
Increase or Decrease in length	―	Core length	146.10m
Length drilled	150.50 m	Core recovery	% 98.4

Core recovery of 100 m hole

Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0 ～ 100	97.6	97.6
100 ～ 150.5	100	98.4
～		
～		

Working hours	h	%	%
Drilling	83°00′	64.1	48.7
Other working	43°10′	33.3	25.3
Recovering	3°20′	2.6	2.0
Total	129°30′	100	76.0
Reassemblage	36°00′		21.1
Dismantlement	5°00″		2.9
Water transportation	(66°00′)		
Road construction and others			
G.Total	170°30′		100

Efficiency of Drilling

Total m/work period(m/day)	150.50 m/ 6 days (25.08 m/day)
Total m/total shift (m/shift)	150.50 m/15 shifts (10.03 m/shift)

Drilling length/bit(each sized bit)

Bit size	HX	NQ	BQ
Drilled length	3.10m	147.40m	
Core length	0.20m	145.90m	

Casing pipe inserted

Size	Meterage (m)	Meterage / drilling length × 100 (%)	Recovery (%)
H X	3.10	2.1	100
N X	40.10	26.6	100

App. 6-2 Summary of the Drilling Operation on MJP—8

	Survey Period				Total man day	
	Period	Days	Work day	Off day	Engineer	Worker
Operation			days	days	man	man
Preparation	17.2.1989 ～ 18.2.1989	1.5	1.5	0	6	18
Drilling	18.2.1989 ～ 7.3.1989	17.5	Drilling 17.5	0	70	210
			Recovering			
Removing	8.3.1989 ～ 8.3.1989	1	1	0	4	12
Total	17.2.1989 ～ 8.3.1989	20	20	0	80	240

Drilling length			
Length planed	350.00 m	Overburden	9.10m
Increase or Decrease in length	50.00 m	Core length	388.80m
Length drilled	401.00 m	Core recovery	99.2 %

Core recovery of 100 m hole

Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0 ～ 100	98.4	98.4
100 ～ 200	99.0	98.7
200 ～ 300	99.4	98.9
300 ～ 401	99.9	99.2

Working hours	h	%	%
Drilling	243°50′	58.4	56.1
Other working	144°10′	34.5	33.1
Recovering	29°30′	7.1	6.8
Total	417°30′	100	96.0
Reassemblage	13°00′		3.0
Dismantlement	4°30°		1.0
Water transportation	(189°00′)		
Road construction and others			
G.Total	435°00′		100

Efficiency of Drilling

Total m/work period(m/day)	401.00 m/17.5 days (22.91m/day)
Total m/total shift (m/shift)	401.00 m/52 shifts (7.71 m/shift)

Drilling length/bit(each sized bit)

Bit size	HX	NQ	BQ
Drilled length	9.10m	231.30m	160.60
Core length	0.00m	228.80m	160.00

Casing pipe inserted

Size	Meterage (m)	Meterage / drilling length × 100 (%)	Recovery (%)
H X	6.10	1.5	100
N X	38.10	9.5	100
B X	240.40	60.0	100

App. 6-3 Summary of the Drilling Operation on MJP−9

	Survey Period				Total man day	
	Period	Days	Work day	Off day	Engineer	Worker
Operation			days	days	man	man
Preparation	23.1.1989 ～ 27.1.1989	5	5	0	20	66
Drilling	28.1.1989 ～ 15.1.1989	19	Drilling 17	1	68	202
			Recovering 1	0	4	12
Removing	16.2.1989 ～ 16.2.1989	1	1	0	4	9
Total	23.1.1989 ～ 16.2.1989	25	24	1	96	289

Drilling length			
Length planed	250.00 m	Overburden	11.50m
Increase or Decrease in length	50.00 m	Core length	286.30m
Length drilled	301.00 m	Core recovery	% 98.8

Core recovery of 100 m hole

Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0 ～ 100	97.2	97.2
100 ～ 200	99.7	98.5
200 ～ 301	99.5	98.8
～		

Working hours	h	%	%
Drilling	168°00′	46.1	40.5
Other working	123°40′	33.9	29.8
Recovering	72°50′	20.0	17.6
Total	364°30′	100	87.9
Reassemblage	45°00′		10.8
Dismantlement	5°30′		1.3
Water transportation	(189°00′)		
Road construction and others	(56°00′)		
G.Total	415°00′		100

Efficiency of Drilling

Total m/work period(m/day)	301.00 m/17 days (17.70m/day)
Total m/total shift (m/shift)	301.00 m/40 shifts (7.52m/shift)

Drilling length/bit(each sized bit)

Bit size	HX	NQ	BQ
Drilled length	12.00m	87.10m	201.90
Core length	0.30m	84.90m	201.10

Casing pipe inserted

Size	Meterage (m)	Meterage / drilling length × 100 (%)	Recovery (%)
H X	10.00	3.3	100
N X	24.10	8.0	100
B X	111.10	37.0	100

App. 6-4 Summary of the Drilling Operation on MJP−10

	Survey Period				Total man day	
	Period	Days	Work day	Off day	Engineer	Worker
Operation			days	days	man	man
Preparation	23.6.1989 ~ 26.6.1989	4	4	0	16	60
Drilling	27.6.1989 ~ 19.7.1989	23	Drilling 22	1	88	264
			Recovering			
Removing	20.7.1989 ~ 20.7.1989	1	1	0	4	12
Total	23.6.1989 ~ 20.7.1989	28	27	1	108	336

Drilling length			
Length planed	500.00 m	Overburden	7.80m
Increase or Decrease in length	−	Core length	483.60m
Length drilled	500.30 m	Core recovery	% 98.1

Core recovery of 100 m hole		
Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0 ~ 100	93.3	93.3
100 ~ 200	98.7	96.1
200 ~ 300	98.7	97.0
300 ~ 400	99.8	97.7
400 ~ 500.3	100	98.1

Working hours	h	%	%
Drilling	318°20′	61.2	56.2
Other working	155°00′	29.8	27.3
Recovering	46°40′	9.0	8.2
Total	520°00′	100	91.7
Reassemblage	38°00′		6.7
Dismantlement	9°00′		1.6
Water transportation	(160°00′)		
Road construction and others	(126°00′)		
G.Total	567°00′		100

Efficiency of Drilling	
Total m/work period(m/day)	500.30 m/22 days (22.74m/day)
Total m/total shift (m/shift)	500.30 m/63 shifts (7.94m/shift)

Drilling length/bit(each sized bit)			
Bit size	HX	NQ	BQ
Drilled length	10.10m	287.90m	202.30
Core length	0.60m	280.90m	202.10

Casing pipe inserted			
Size	Meterage (m)	Meterage / drilling length × 100 (%)	Recovery (%)
H X	9.10	1.8	100
N X	48.10	9.6	100
B X	298.00	59.6	100

App. 6-5 Summary of the Drilling Operation on MJP—11

	Survey Period				Total man day	
	Period	Days	Work day	Off day	Engineer	Worker
Operation			days	days	man	man
Preparation	12.6.1989 ～ 12.6.1989	0.5	0.5	0	2	5
Drilling	13.6.1989 ～ 21.6.1989	9	Drilling 9 Recovering	0	36	108
Removing	22.6.1989 ～ 22.6.1989	1	1	0	3	9
Total	12.6.1989 ～ 22.6.1989	10.5	10.5	0	41	122

Drilling length			
Length planed	250.00 m	Overburden	1.10m
Increase or Decrease in length	—	Core length	242.0m
Length drilled	251.00 m	Core recovery	% 96.8

Core recovery of 100 m hole

Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0 ～ 100	92.9	92.9
100 ～ 200	99.2	96.0
200 ～ 251	99.8	96.8
～		

Working hours	h	%	%
Drilling	145°00′	67.1	62.8
Other working	56°20′	26.1	24.4
Recovering	14°40′	6.8	6.3
Total	216°00′	100	93.5
Reassemblage	7°00′		3.0
Dismantlement	8°00°		3.5
Water transportation	(53°00′)		
Road construction and others			
G.Total	231°00′		100

Efficiency of Drilling

Total m/work period(m/day)	251.00 m/ 9 days (27.88m/day)
Total m/total shift (m/shift)	251.00 m/27 shifts (9.29m/shift)

Drilling length/bit(each sized bit)

Bit size	HX	NQ	BQ
Drilled length	4.10m	146.00m	100.90
Core length	1.20m	140.30m	100.50

Casing pipe inserted

Size	Meterage (m)	Meterage / drilling length × 100 (%)	Recovery (%)
H X	3.10	1.2	100
N X	24.10	9.6	100
B X	150.10	60.0	100

App. 6-6 Summary of the Drilling Operation on MJP－12

	Survey Period: Period	Days	Work day	Off day	Total man day: Engineer	Worker
Operation			days	days	man	man
Preparation	2.6.1989 ～ 5.6.1989	4	4	0	16	60
Drilling	6.6.1989 ～ 11.6.1989	6	Drilling 6	0	24	72
			Recovering			
Removing	12.6.1989 ～ 12.6.1989	0.5	0.5	0	2	5
Total	2.6.1989 ～ 12.6.1989	10.5	10.5	0	42	137

Drilling length			
Length planed	150.00 m	Overburden	1.60m
Increase or Decrease in length	－	Core length	142.40m
Length drilled	151.00 m	Core recovery	% 95.3

Core recovery of 100 m hole

Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0 ～ 100	93.4	93.4
100 ～ 151	98.8	95.3
～		
～		

Working hours	h	%	%
Drilling	74°10′	54.5	41.5
Other working	57°50′	42.5	32.3
Recovering	4°00′	3.0	2.2
Total	136°00′	100	76.0
Reassemblage	39°00′		21.8
Dismantlement	4°00°		2.2
Water transportation	(28°00′)		
Road construction and others			
G.Total	179°00′		100

Efficiency of Drilling

Total m/work period(m/day)	151.00 m/ 6 days (25.16m/day)
Total m/total shift (m/shift)	151.00 m/15 shifts (10.06m/shift)

Drilling length/bit(each sized bit)

Bit size	HX	NQ	BQ
Drilled length	3.10m	147.90m	
Core length	1.00m	141.40m	

Casing pipe inserted

Size	Meterage (m)	Meterage / drilling length × 100 (%)	Recovery (%)
H X	1.60	1.1	100
N X	27.10	18.1	100