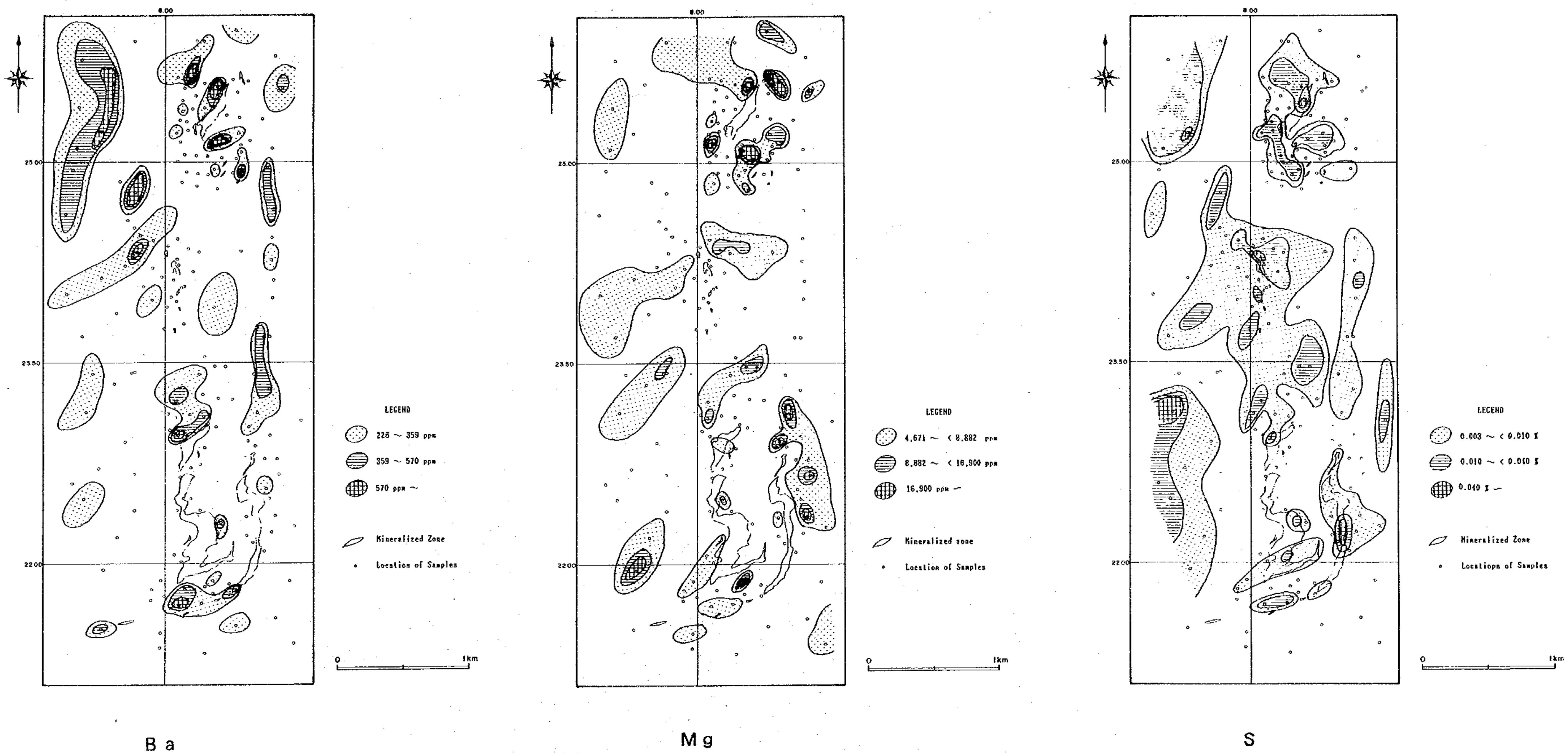



Fig. II-2-2 Distribution Map of Geochemical Elements in Surmai Area (Ba, Mg, S)

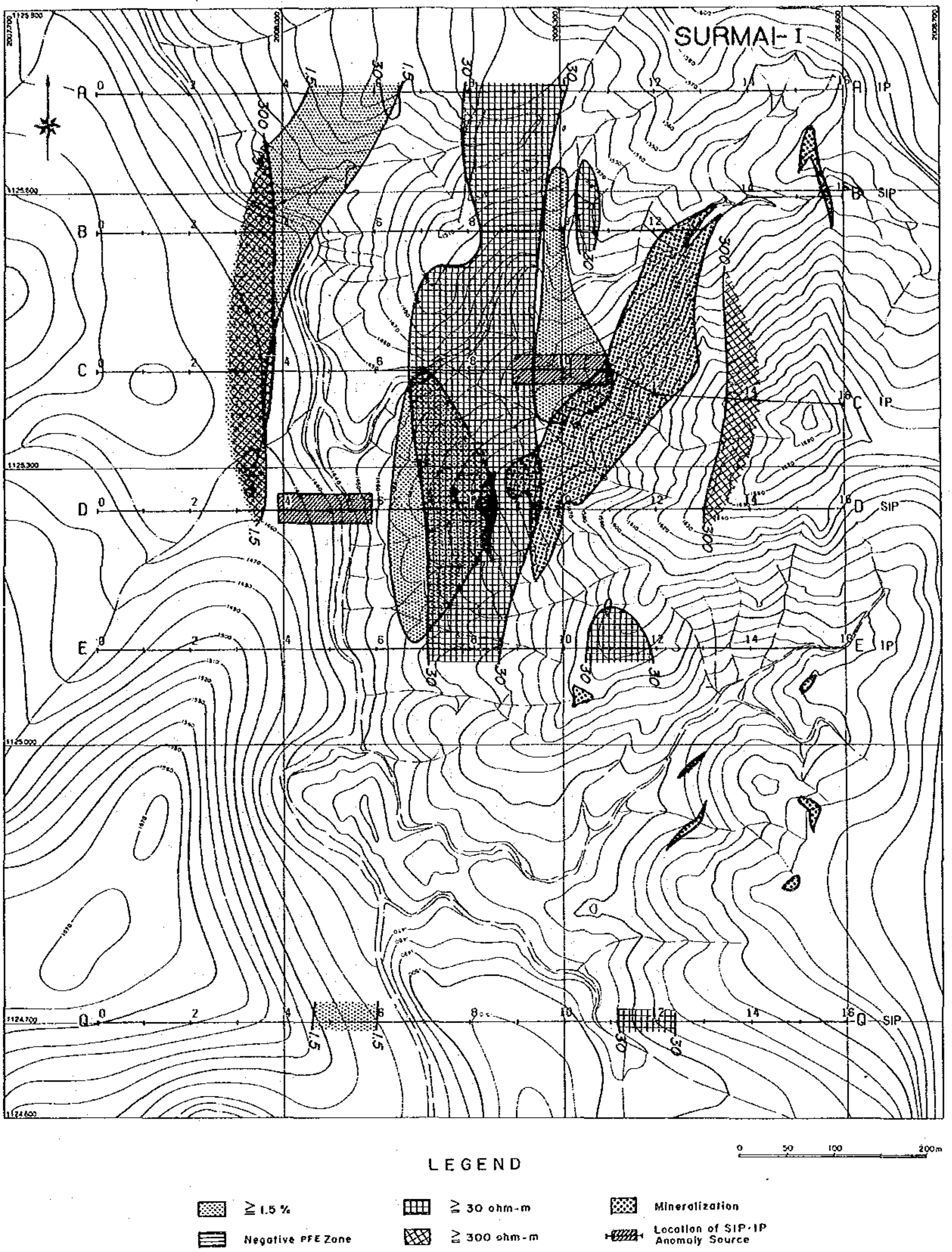
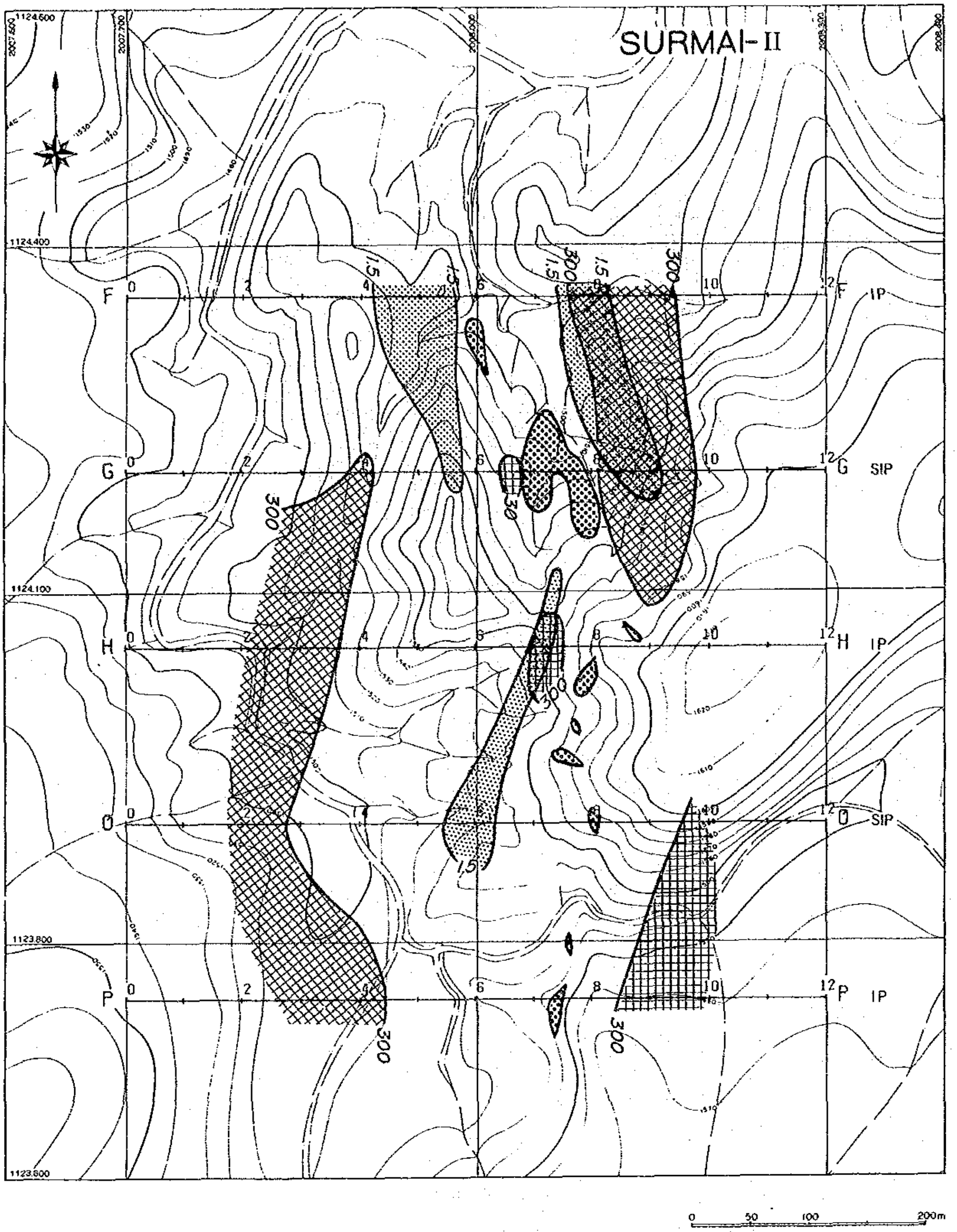


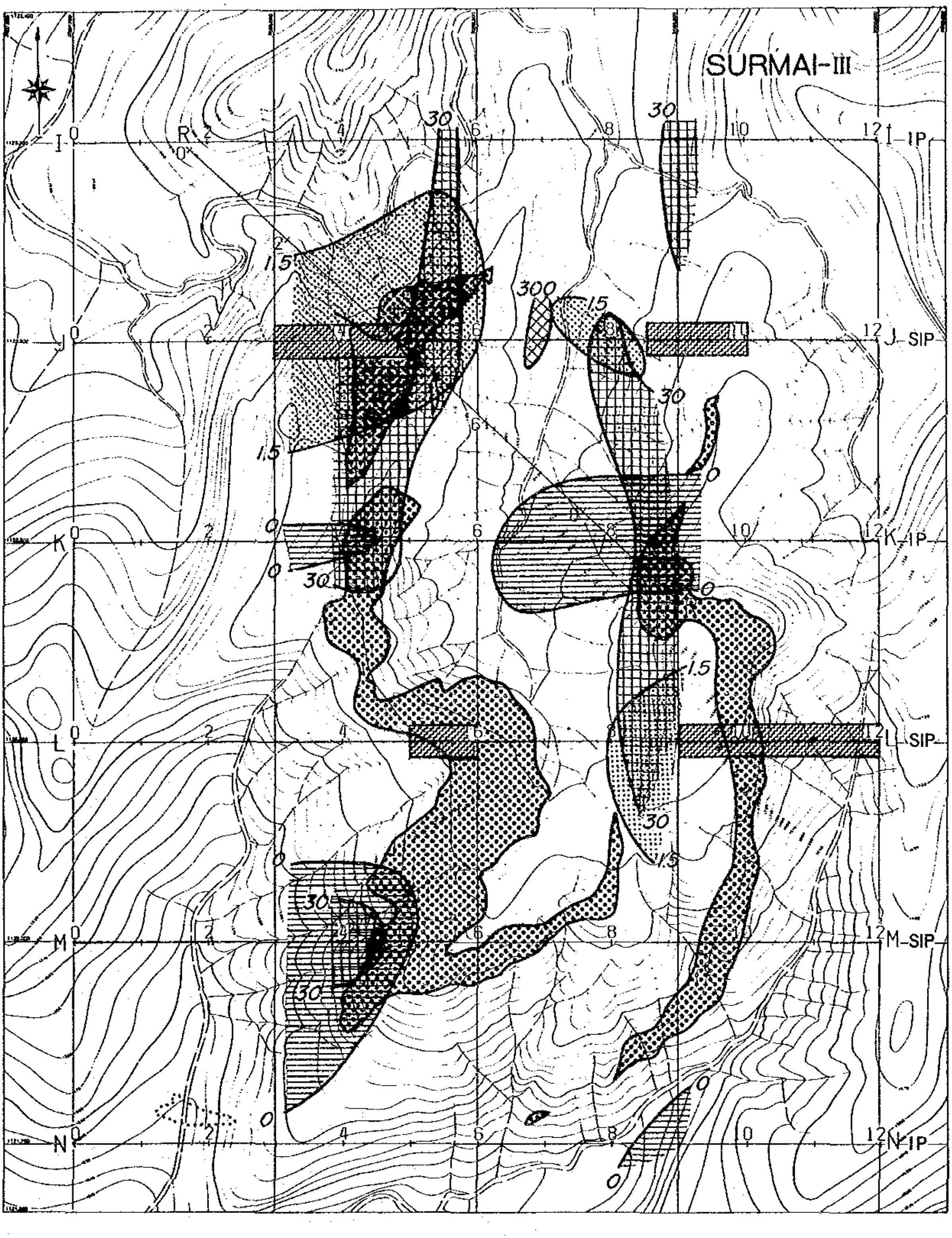

Fig. II-2-3 Interpretation Map of Geophysical Prospecting at Surmai-I Area




LEGEND

| | | | | | |
|---|---|---|---|---|---|
| | ≧ 1.5 % | | ≧ 30 ohm-m | | Mineralization |
| | Negative PFE Zone | | ≧ 300 ohm-m | | Location of SIP·IP Anomoly Source |

Fig. II-2-4 Interpretation Map of Geophysical Prospecting at Surmai-II Area




LEGEND

| | | | | | |
|---|---|---|---|---|---|
| [dotted] | ≧ 1.5 % | [grid] | ≧ 30 ohm-m | [dense dots] | Mineralization |
| [horizontal lines] | Negative PFE Zone | [cross-hatch] | ≧ 300 ohm-m | [hatched bar] | Location of SIP·IP Anomaly Source |

Fig. II-2-5 Interpretation Map of Geophysical Prospecting at Surmai-III Area

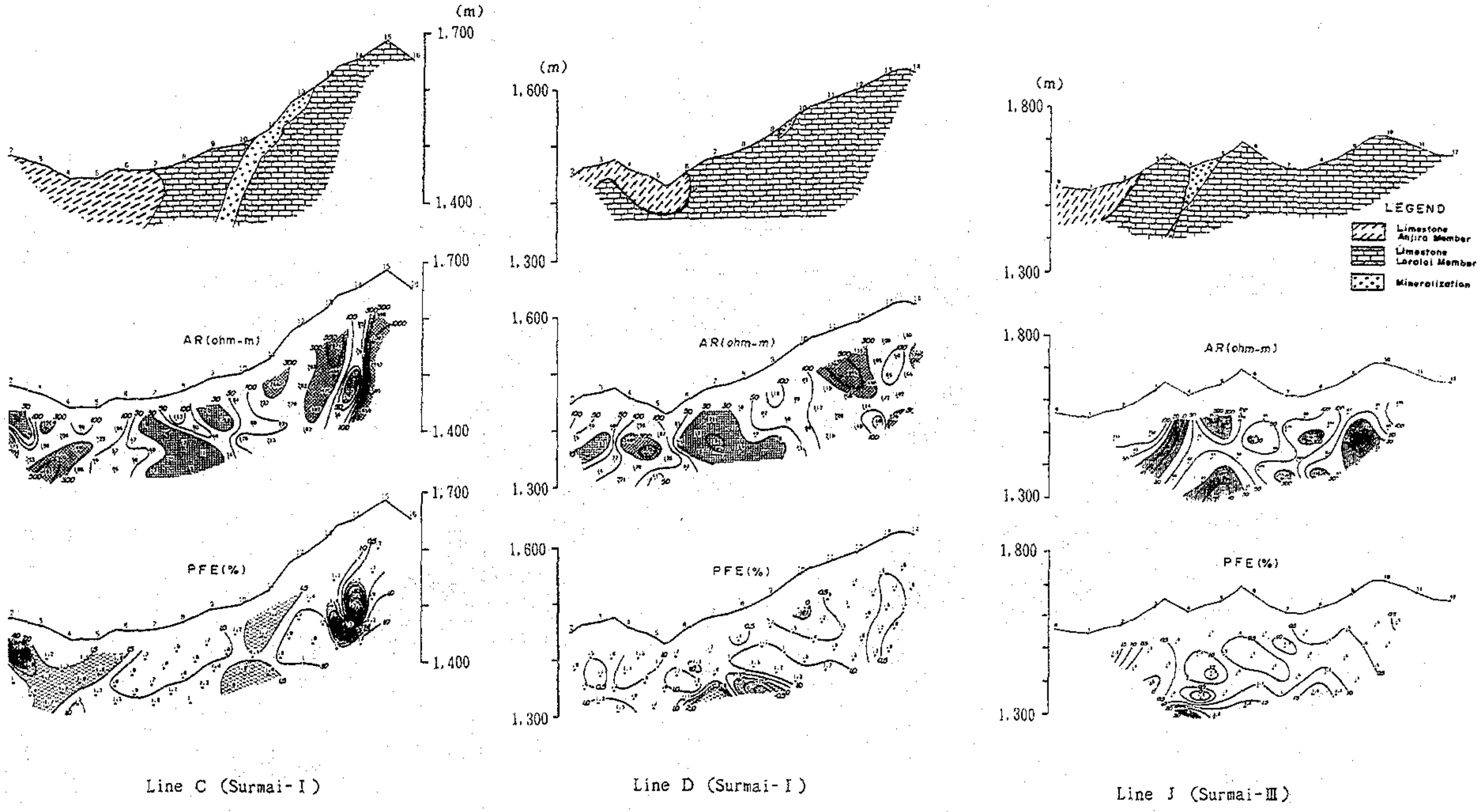
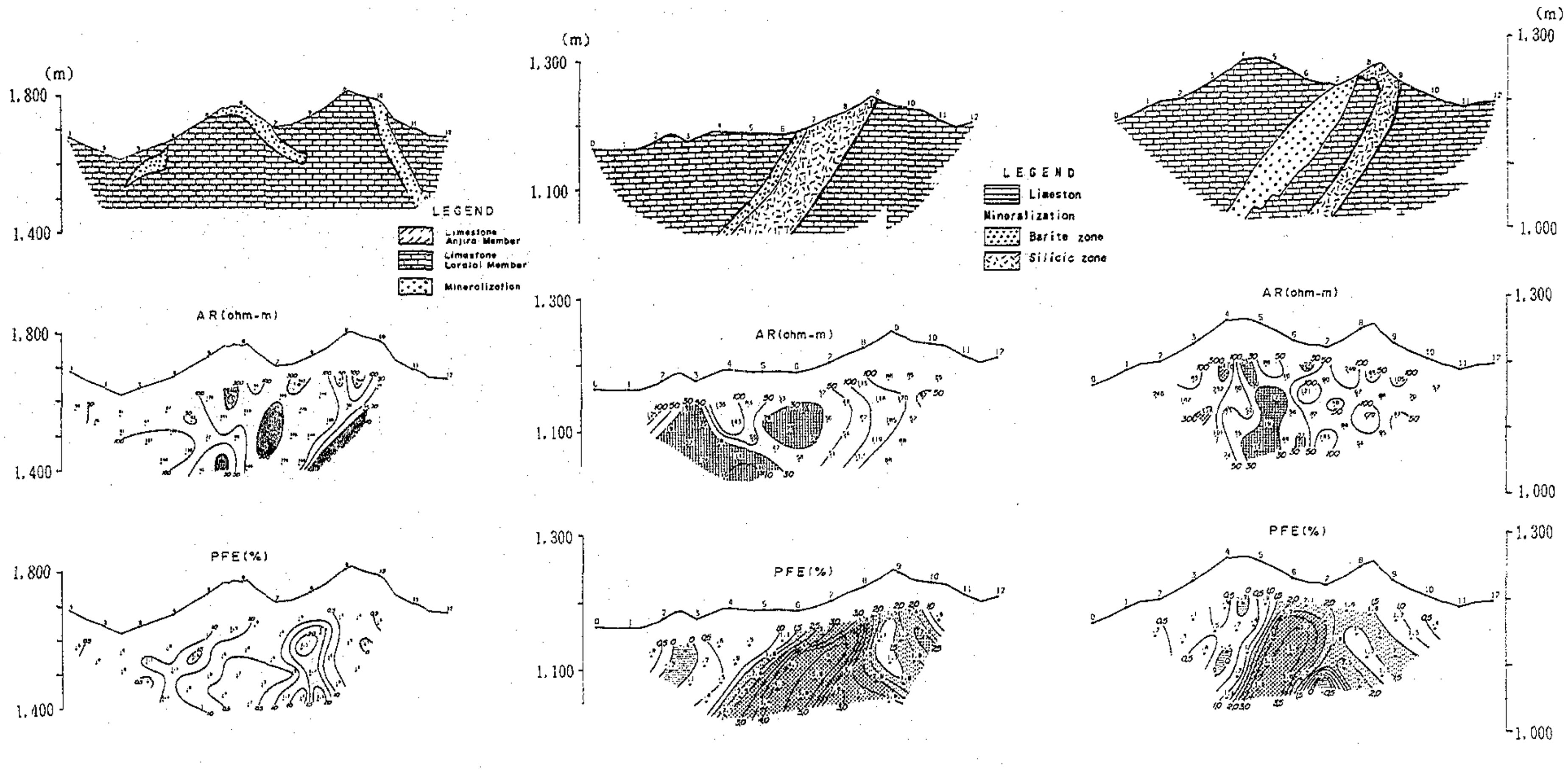



Fig. II-2-6 Interpretation Profiles of Geophysical Prospecting at Survey Line ( Line C,D,J )




Line L (Surmai-Ⅲ) Line S (Gunga) Line T (Gunga)

Fig. Ⅱ-2-7 Interpretation Profiles of Geophysical Prospecting at Survey Line ( Line L,S,T )

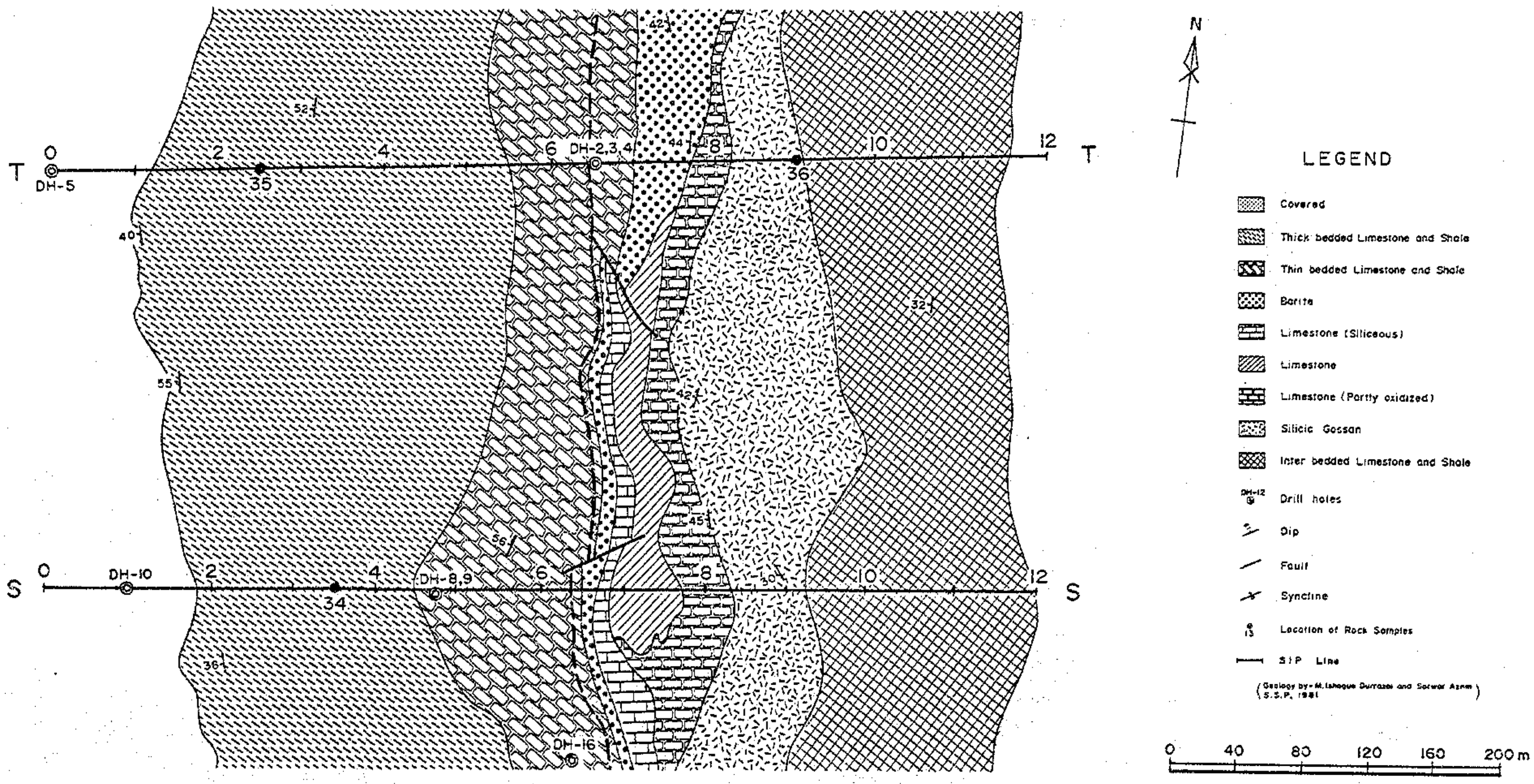



Fig. II-2-8 Location Map of Survey Lines in Gunga Mine Area

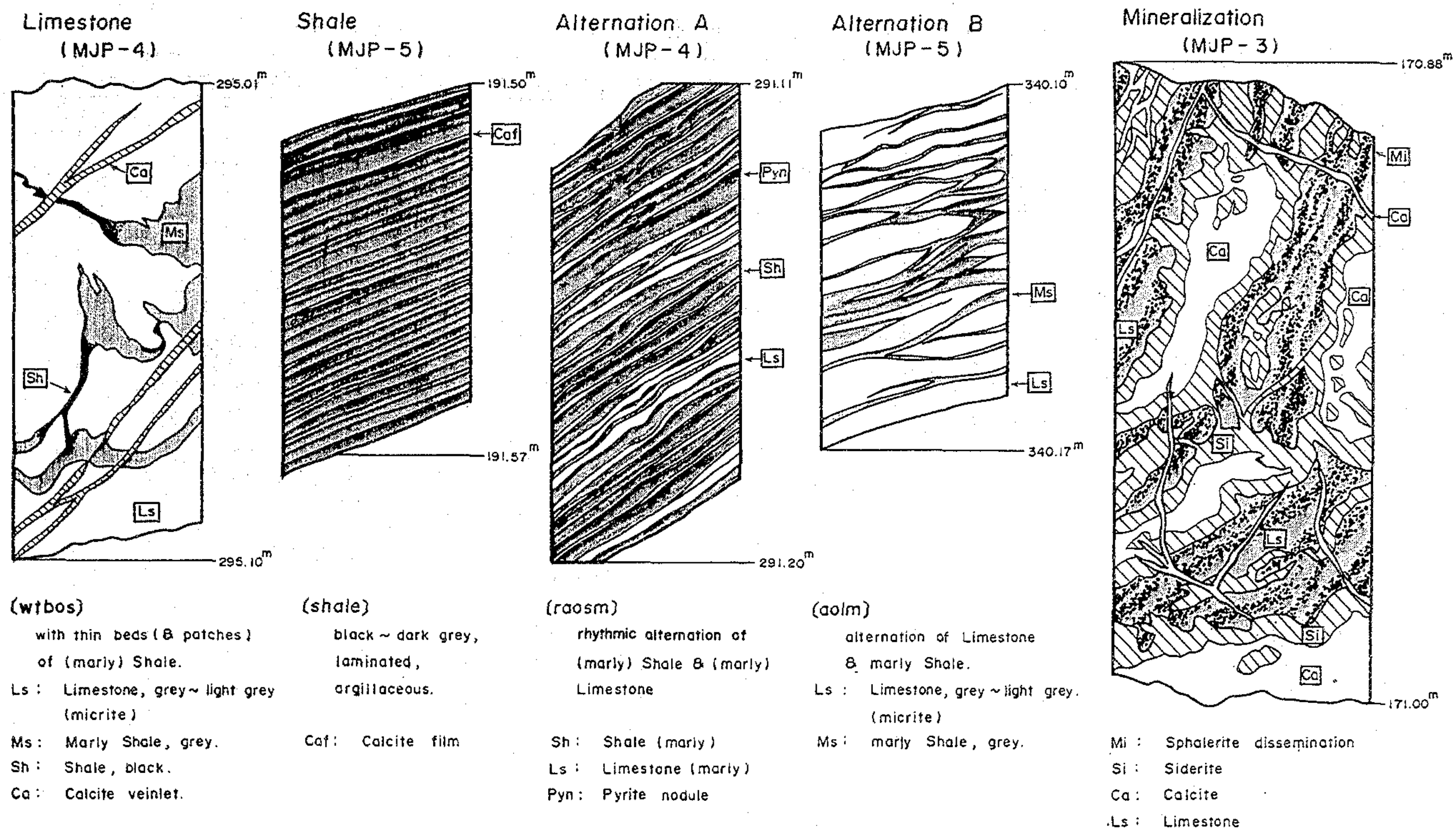



Fig. II-2-9 Sketch of Drilling Cores

Scale 1 : 1

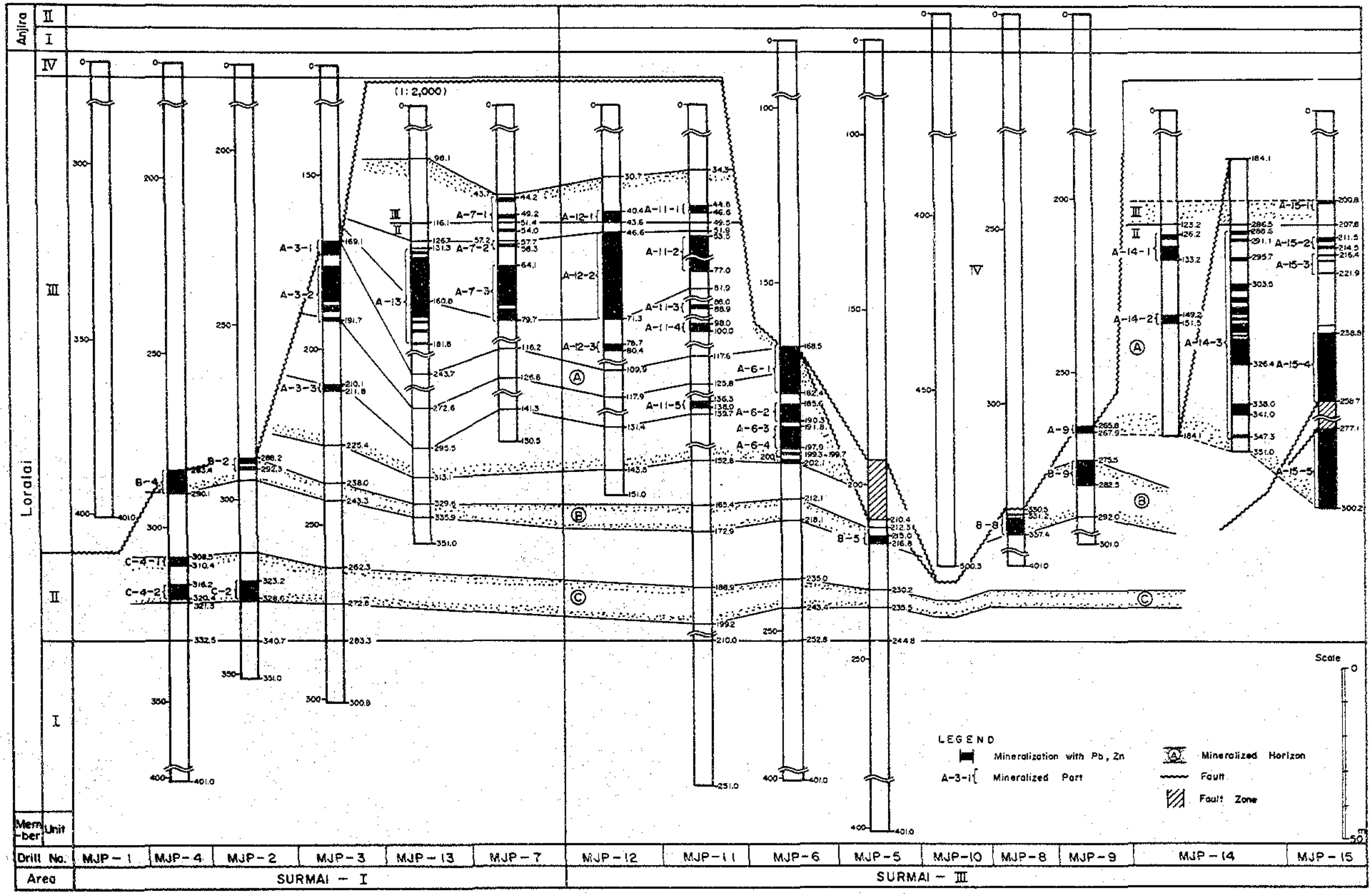



Fig. II-2-10 Geological Correlation Column by Drill Records at the Surmai Area

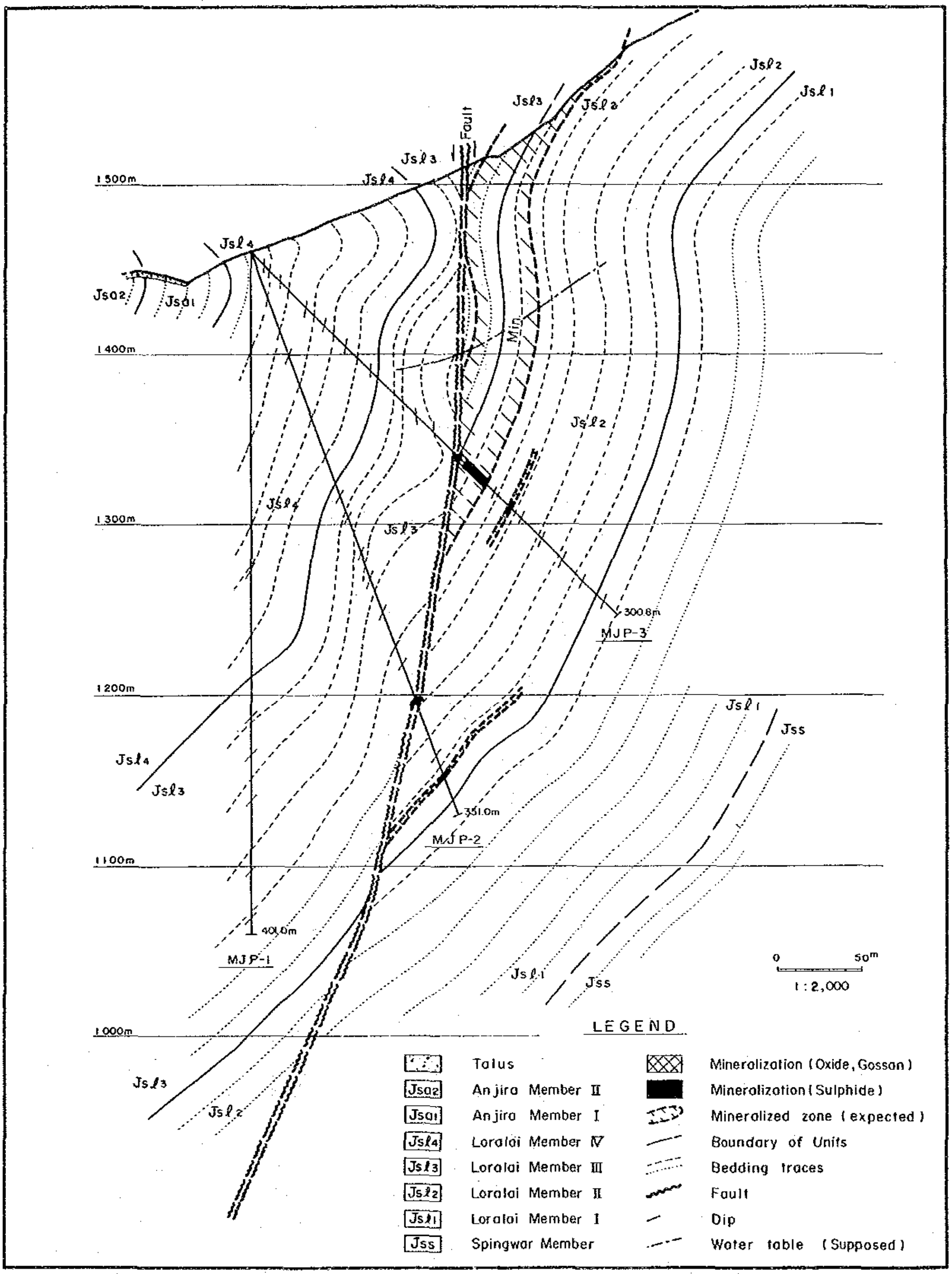



Fig. II-2-11 Geological Profile of Surmai-I (MJP-1, 2, 3)

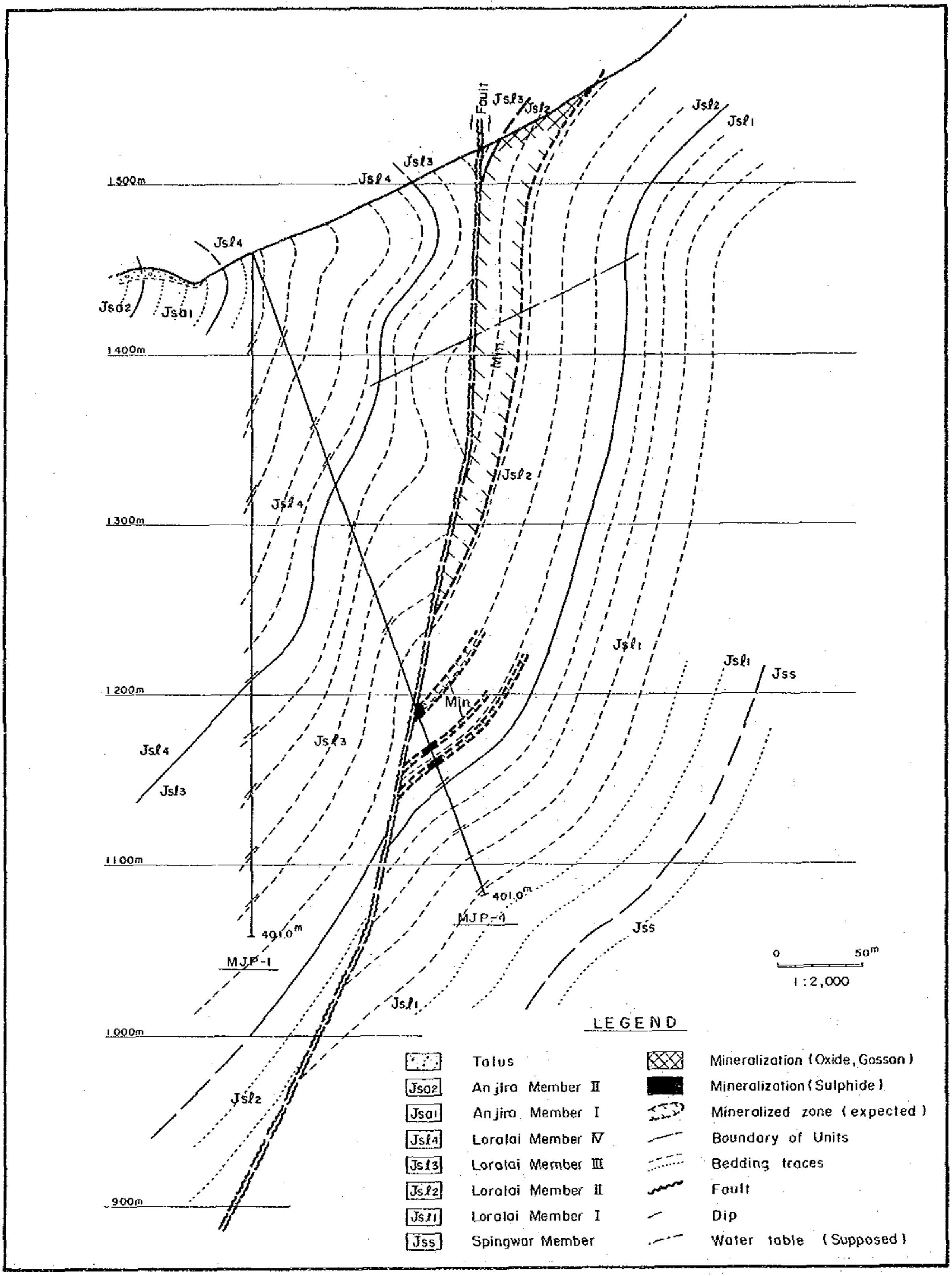



Fig. II-2-12 Geological Profile of Surmai-I (MJP-1,4)

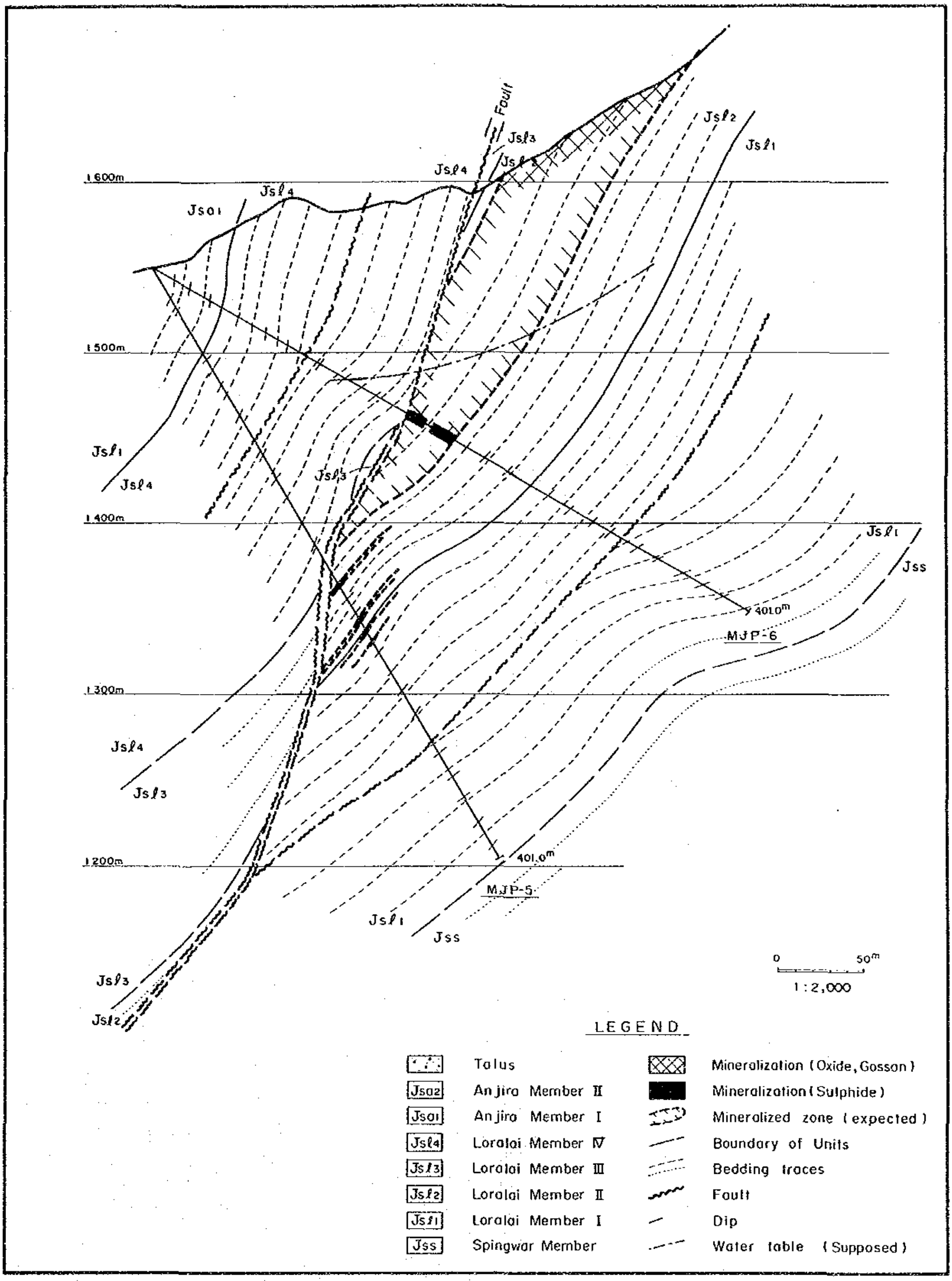



Fig. II-2-13 Geological profile of Surmai-III(MJP-5,6)

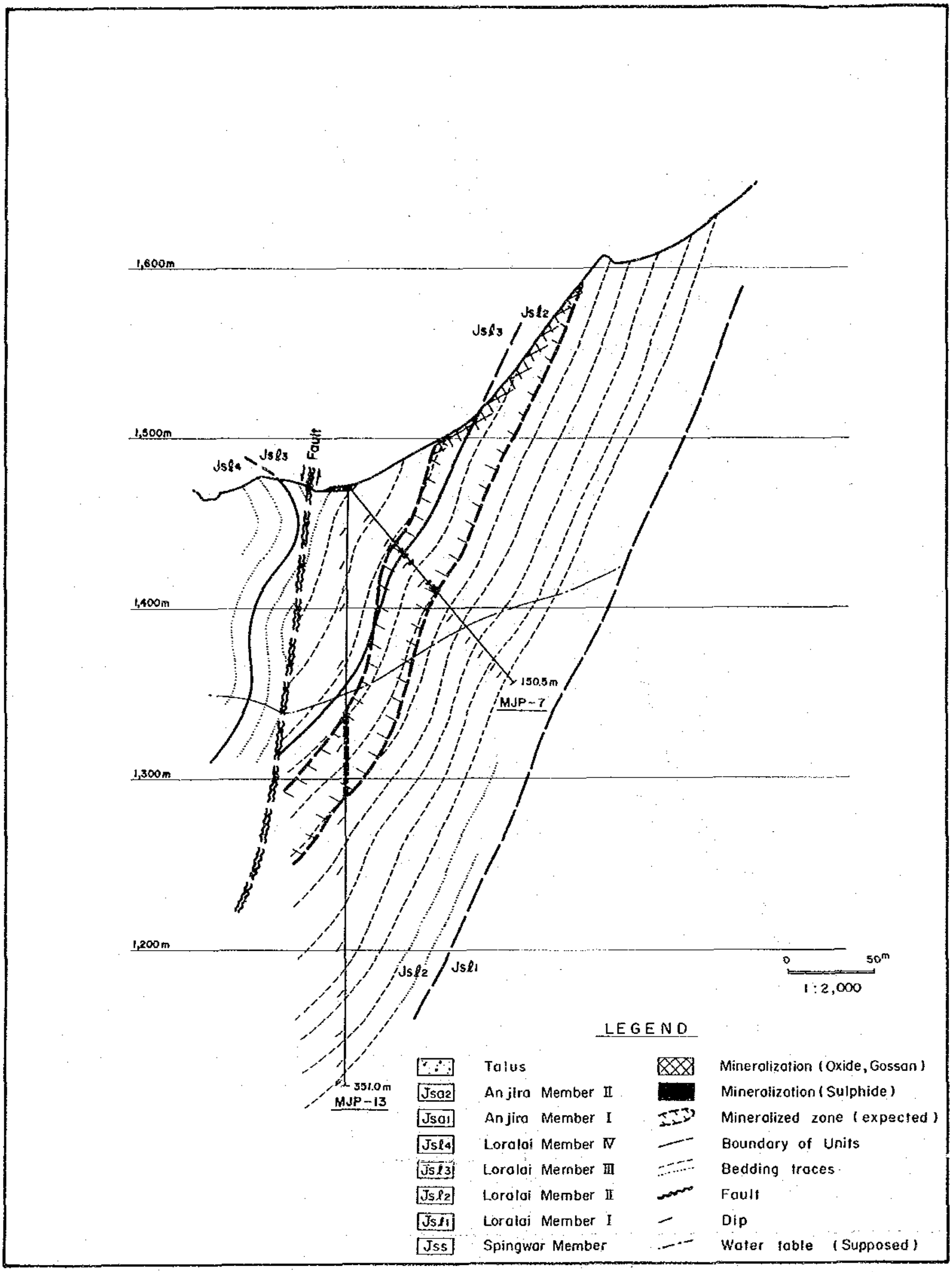



Fig. II-2-14 Geological Profile of Surmai-I (MJP-7, MJP-13)

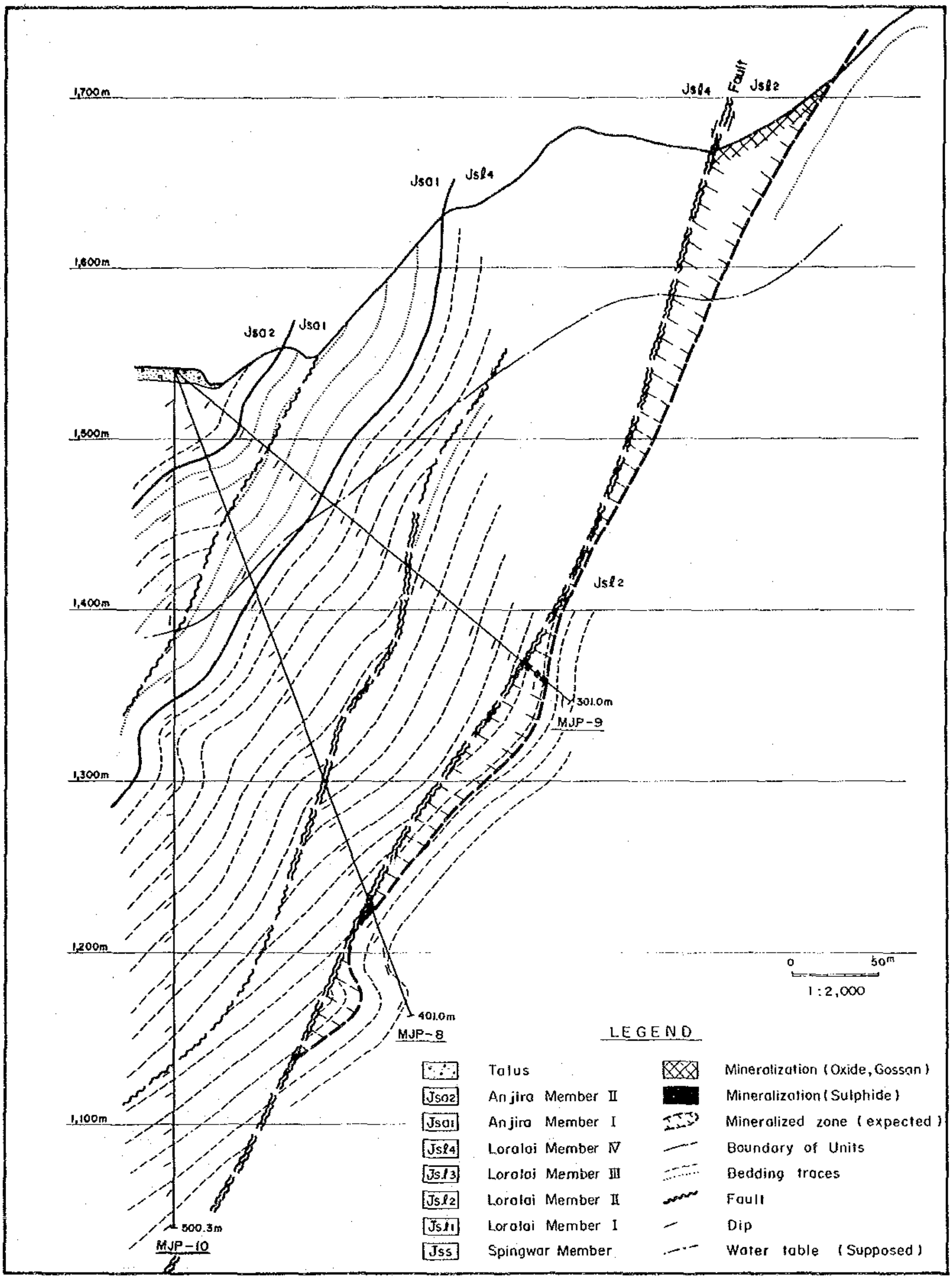



Fig. II-2-15 Geological Profile of Surmai-III (MJP-8, 9, 10)

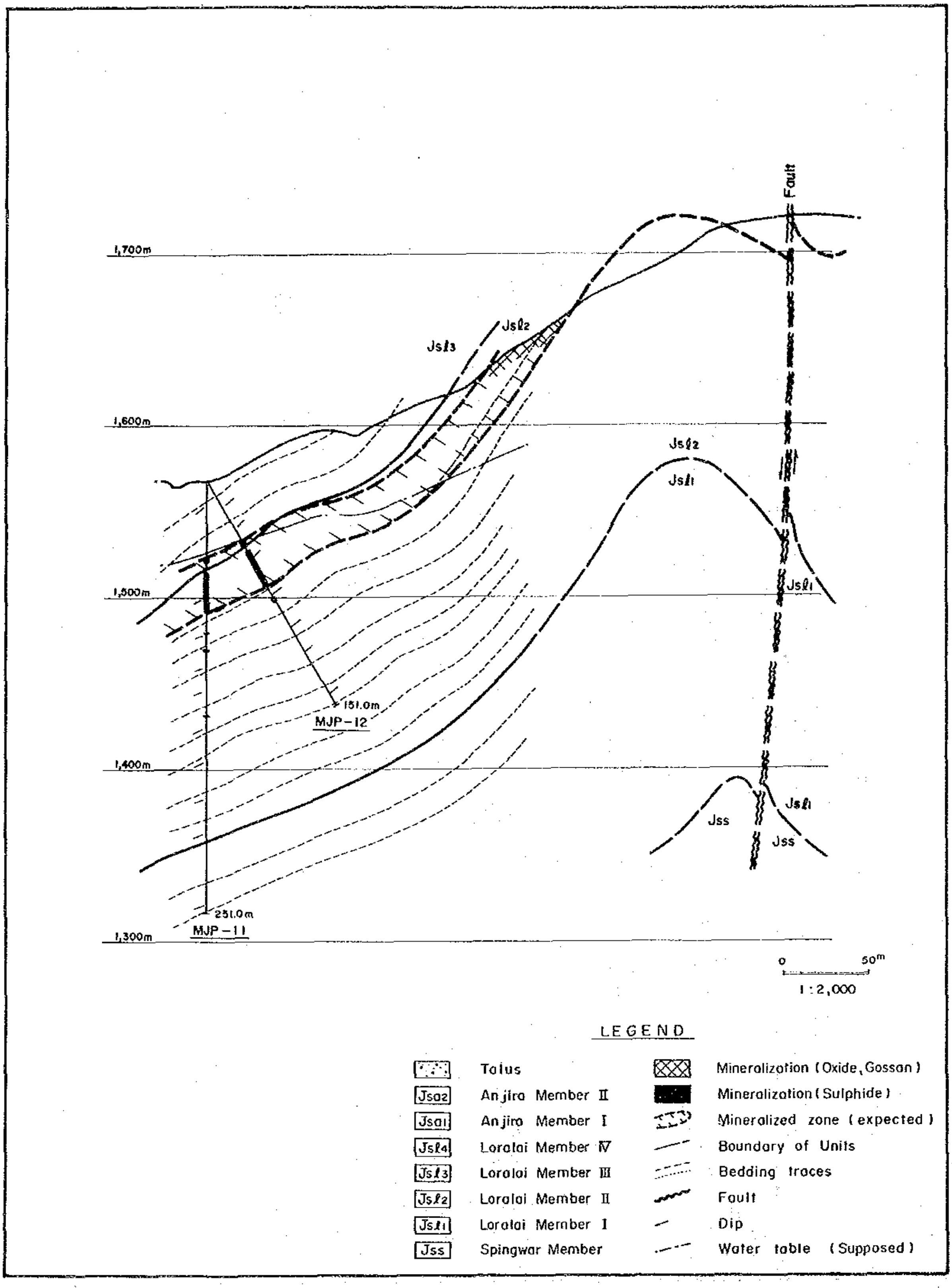



Fig. II-2-16 Geological Profile of Surmai-III (MJP-11, 12)

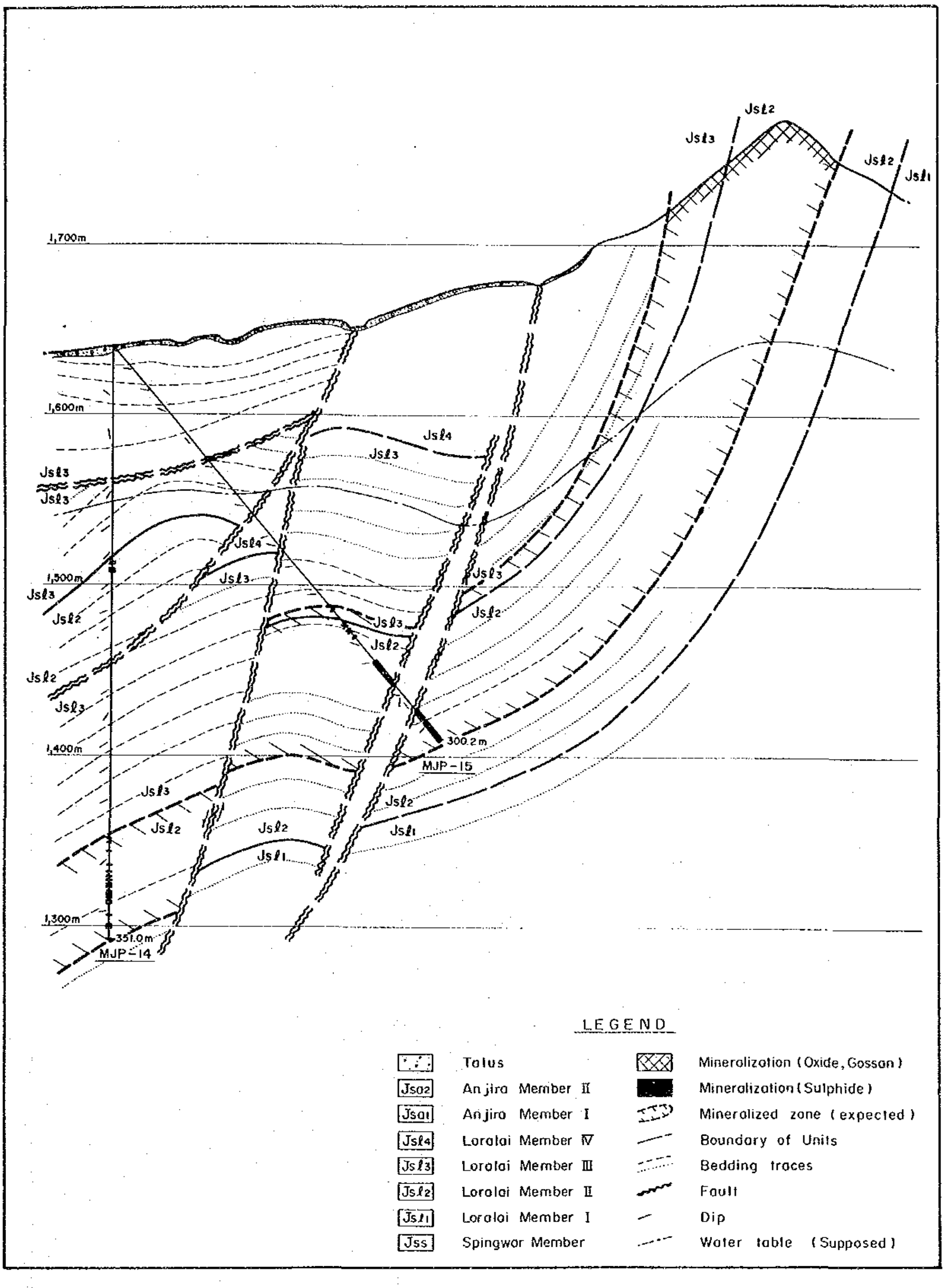



Fig. II-2-17 Geological Profile of Surmai-III (MJP-14, 15)

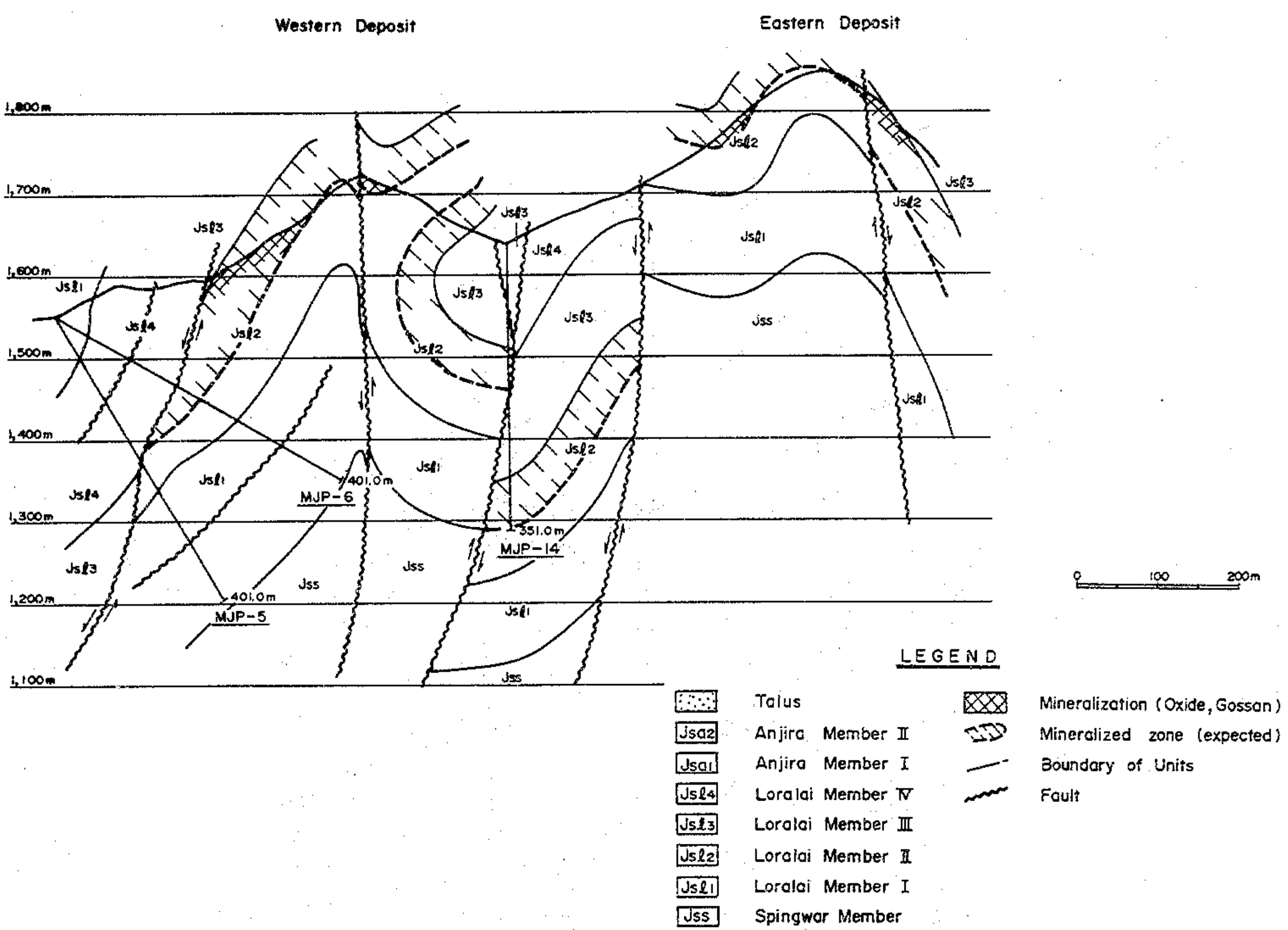



Fig. II-2-18 Geological Profile of Surmai-III (MJP-5, 6, 14)

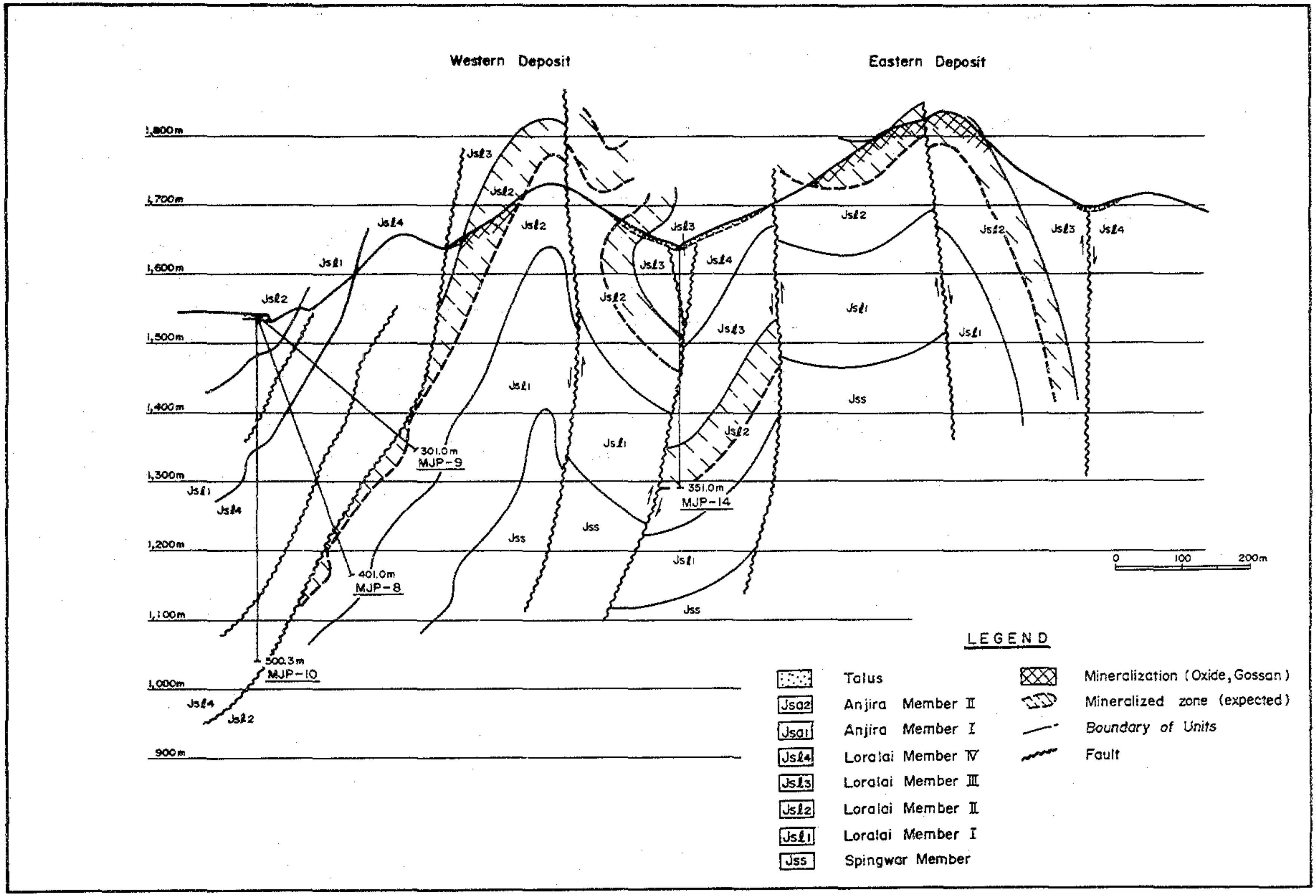



Fig. II-2-19 Geological Profile of Surmai-III (MJP-8, 9, 10, 14)

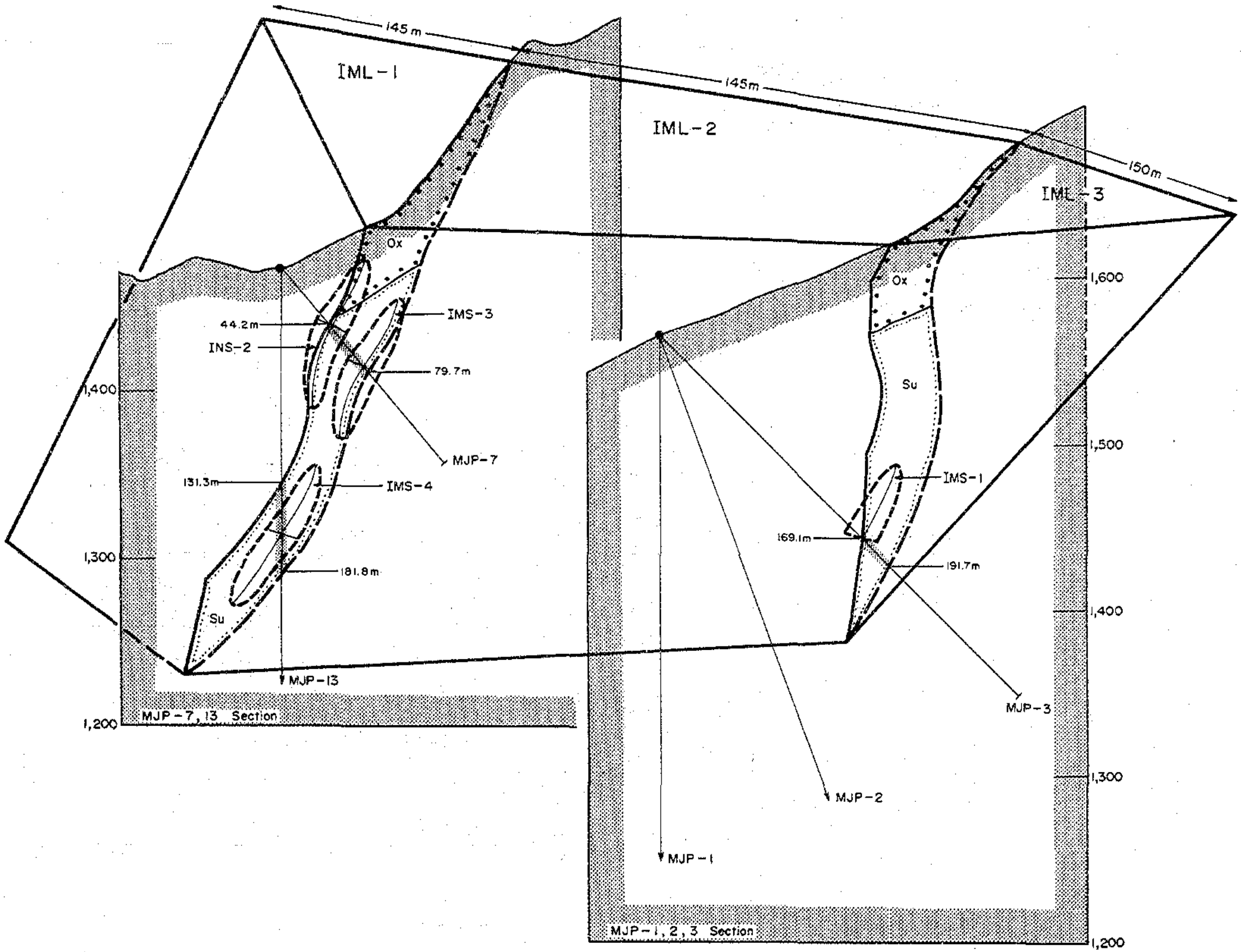



Fig. II-2-20 Schematic Illustration of Mining Blocks of Surmai-I Main Orebody

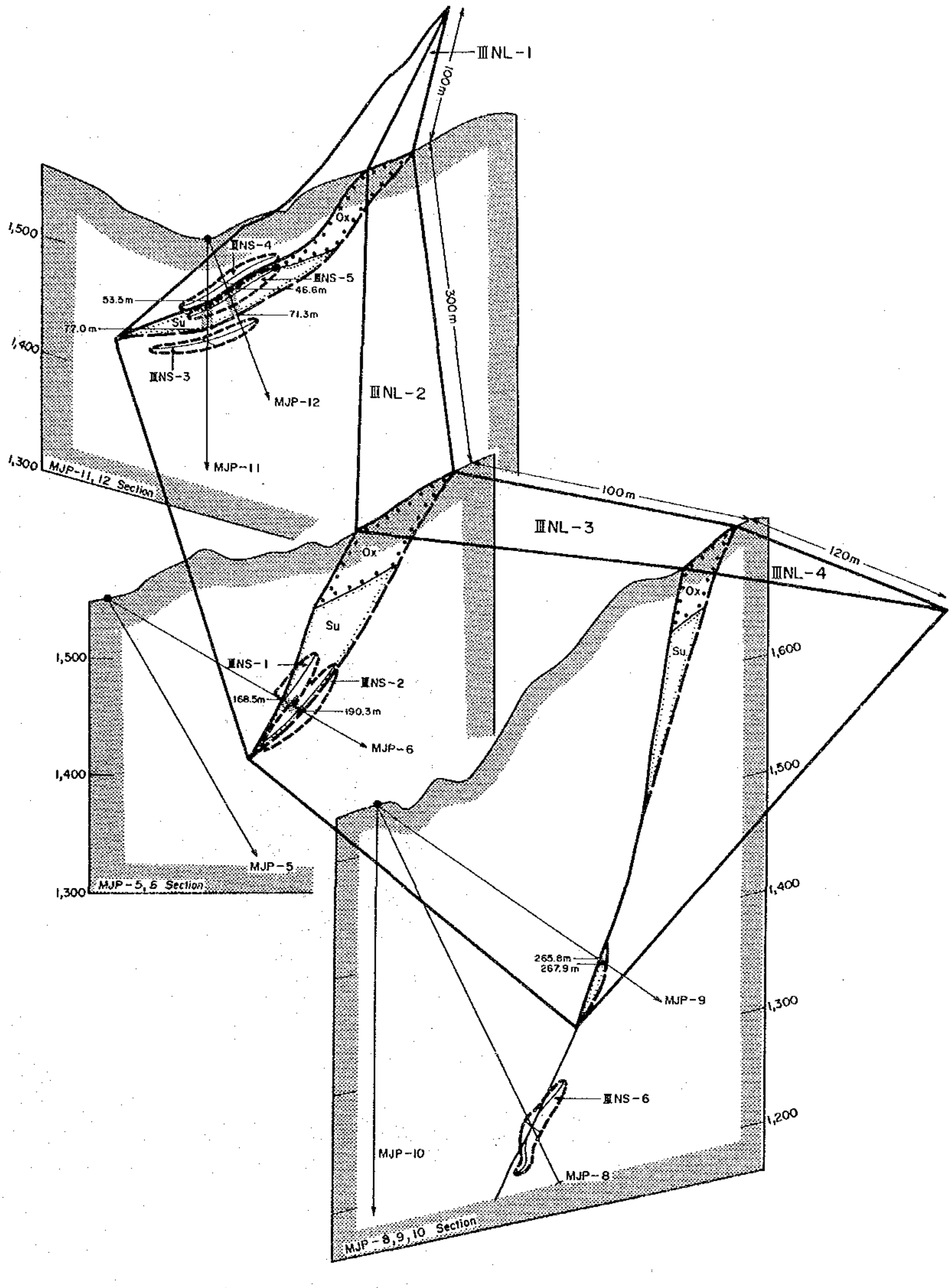



Fig. Ⅱ-2-21 Schematic Illustration of Mining Blocks of Surmai-Ⅲ Northern Orebody

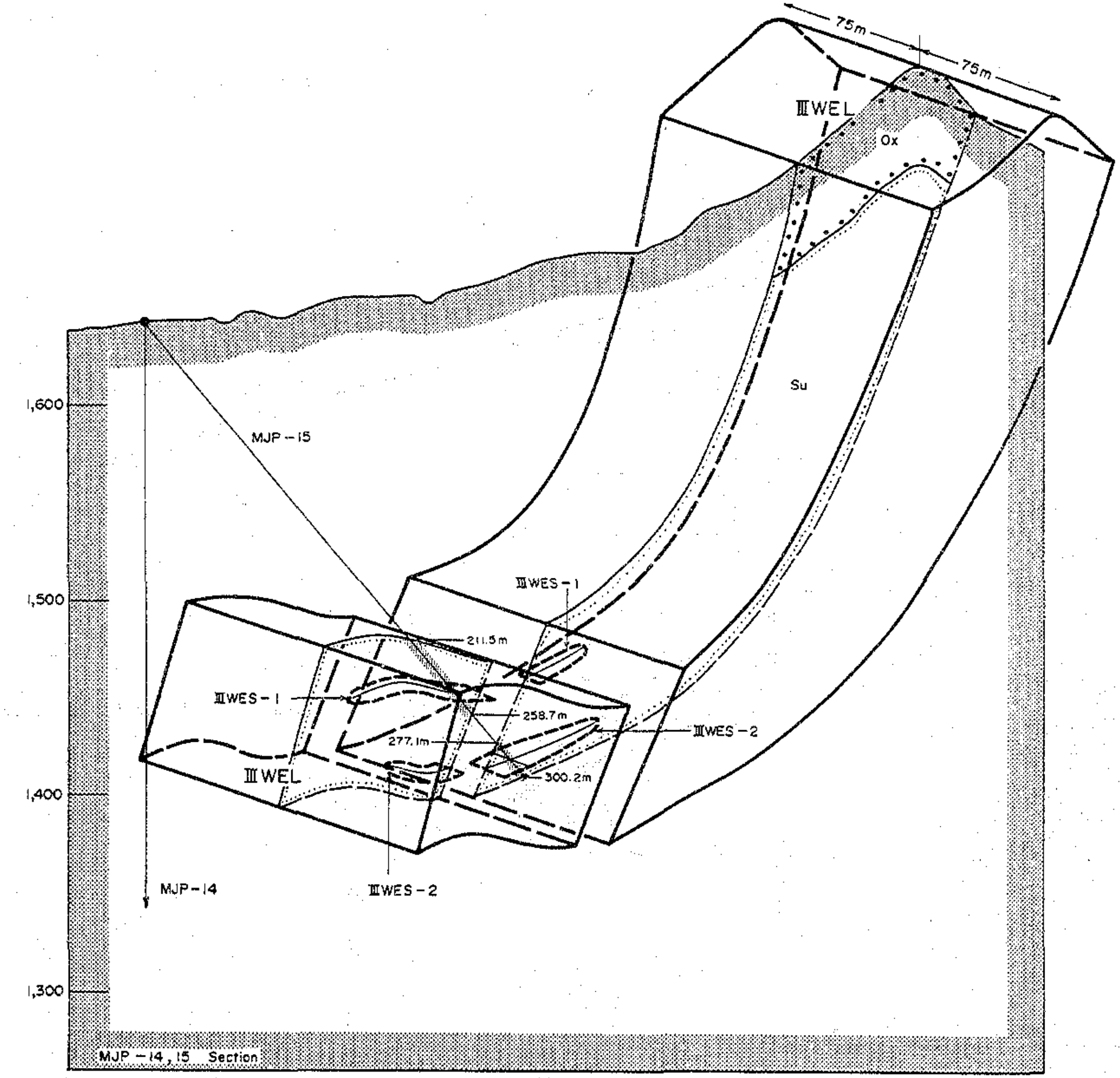



Fig. II－2－22 Schematic Illustration of Mining Blocks of Surmai－III W～E Deposit Area Orebody

# PART III

# CONCLUSIONS

# AND

# RECOMMENDATIONS

# PART III
# CONCLUSIONS AND RECOMMENDATIONS

## CHAPTER 1 CONCLUSIONS

### 1－1 Southern and Northern Khuzdar District

#### 1－1－1 Geological Survey

(1) The Jurassic limestone in this area is the Shirinab Formation which is of Early Jurassic age. This formation comprises, in ascending order, Spingwa Member consisting mainly of calcareous sandstone, Loralai Member composed of limestone-shale alternation and Anjira Member.

(2) The Shirinab Formation is distributed largely in 11 zones, and the blocks making the zones extends in east-west direction protruding northward. The members have complex folded structure of anticlines and synclines.

(3) Prosepects Malkhor, Ranj Laki, East Sekran and Sekran as well as Gunga and Surmai occur in a narrow zone extending 25 km in the central part. All of these showings crop out as gossan, but it is inferred that primary sulfide ores exist below the water table. All mineral showings are combinations of bedded mineralization replacing the host rock along the bedding planes and those filling the fissures and faults. Of the bedded mineralization, that of Gunga occur in the Anjira Member and those of other areas in Loralai Member, while the fissure-filling type occur throughout the Shirinab Formation. From the grade and size, the bedded type seems more promising.

(4) There are four mineral showings in the Malkhor～Sekran mineralized zone. These all show evidences of intense mineralization and some parts appear to have promising lower portions. But the structures are very

complex and the subsurface continuity is not clear.

(5) The mineral showings in the Southern and Northern Khuzdar District are distributed around the ophiolite zone in the southwestern part of the Southern Khuzdar District in the Surmai~Sekran Zone. The Northern Khuzdar District lies to the north, outside, of this zone.

### 1－1－2 Geochemical Prospecting

(1) The results of geochemical prospecting show that elements Pb, Zn, Hg have high positive correlation to each other and form anomalous zones around gossan while Ba forms anomalous zone outside of the Pb, Zn, Hg zone. Lead, zinc, mercury anomalous zones of A-rank were found in Surmai Area and also in the vicinity of Malkhor~Sekran mineralized zone. The study of all geochemical data, obtained by this project clearly shows that the promising geochemical anomalies all exist in the Surmai~Sekran Zone and the vicinity of it, in the Southern Khuzdar District .

## 1－2 Surmai Area

### 1－2－1 Geological Survey

(1) In this area,three members of the Shirinab Formation are distributed and the Loralai Member is divided into I ~IV Units and the Anjira Member into three, I ~III Units.

(2) The structural trend of this area is north-south and the eastern half is the uplifted zone with anticlinal structure while the western part is the subsided zone with synclinal structure.

(3) There are three mineral showings consisting of gossan, the weathered product of lead-zinc mineralization, along the uplifted zone. They are called Surmai-I, II, III from the north. These showings are considered to be of Mississippi Valley type mineralization. The mineralization of these showings is a combination of replacement along the bedding of host rock

and fissure filling. The bedded type is seen in Surmai-Ⅰ,Ⅲ and large-scale mineralization is developed in Loralai Units Ⅱ and Ⅲ. The fissure filling type is distributed in Surmai-Ⅱ and in the vicinity of the bedded type, but they are of small scale and not promising.

### 1－2－2 Geochemical Prospecting

(1) The results of geochemical prospecting show high positive correlation among Pb, Zn, Hg in the high anomalies around gossan and with Ba on its outerside. This is similar to the results of the Southern and Northern Khuzdar District.

### 1－2－3 Geophysical Prospecting

(1) Geophysical prospecting showed A-rank anomalies believed to be caused by sulfide minerals in the lower parts of the Main Orebody of Surmai-Ⅰ and the Northern Orebody of West Deposit of Surmai-Ⅲ.

(2) The location of the mineralized zones confirmed by the drilling coincides with the geophysical (IP,SIP) PFE anomaly zones with the exception of the traverses where the electrode intervals were excessive.

### 1－2－4 Drilling

(1) The horizons confirmed by the drillng range from the lower part of Unit-Ⅰ of Loralai Member to the upper part Unit-Ⅱ of Anjira Member. The lithology of these units is mainly limestone and shale. They form alternation of unit beds of 0.2～10m thickness. The structure of the survey area is complex with folds and faults of varying dimensions.

(2) Of the 15 holes drilled during the project, lead-zinc sulfide mineralization was confirmed in 13 holes. The mineralized horizons are classified into three, namely A, B and C Horizons from the uppermost one. These horizons all occur in Units-Ⅱ～Ⅲ of Loralai Member. The mineralized zones are distributed in these horizons with varying vertical positions.

The mineralized zones which are evaluated to be promising from both size and grade occur in A-Horizon.

(3) The mineralization is composed of powdery to granular sphalerite and galena which are disseminated replacing the limestone host rock and siderite and calcite veins and veinlets which intersect the disseminated ore. Minor amount of pyrite and chalcopyrite is associated. Microscopic studies confirmed the existence of lead-zinc carbonates and electrum and also although too minute to identify with certainly, indicated the probable existence of Pb-Bi and Pb-Sb silver minerals.

(4) The level of the water table is estimated to be approximately 100 m below the surface. The boundary between the oxide and sulfide ores is inferred to be at approximately 50 m below the surface.

(5) The mining blocks were drawn and reserves calculated for the Surmai-I Main Orebody, Surmai-Ⅲ Northern Orebody of West Deposit and Surmai-Ⅲ Intermediate Orebody between West and East Deposits. These are possible reserves and the total reserves are 30,513,000t ( Pb:0.66%, Zn:2.13%, Ag: 7.4 g/t) of which 22,700,000t are sulfide and the balance of 7,813,000t oxide ores. The reserves of the small blocks ( sulfide ) within the above are 870,000t (Pb:2.03%,Zn:6.51%,Ag:23.4g/t). These reserves and grades are considered to be insufficient for commercial development at current world metal market.

(6) There are three promising zones which warrant further exploration. They are vicinity of Surmai-Ⅲ East Deposit, the zone between Surmai-Ⅲ West and East Deposits and area east of Surmai-Ⅱ.

## CHAPTER 2 RECOMMENDATIONS FOR THE FUTURE SURVEY

### 2-1 Southern and Northern Khuzdar District

It is desirable that exploration with emphasis on geophysical prospecting and drilling be carried out in the Malkhor～Sekran mineralized zone that has high resource potential same as the Surmai Area. It is concluded that gold should be added to the objective of exploration.

## 2－2 Surmai Area

The economic feasibility of the reserves calculated on the basis of the work of the past three years and laid out in 1-2-4-(5), 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 and also that exploration with emphasis on drilling be carried out in the three zones with high resource potential, vicinity of Surmai-Ⅲ East Deposit, the zone between Surmai-Ⅲ West and East Deposits and area east of Surmai-Ⅱ ( Fig.2 ). It is concluded that gold should be added to the objective of exploration.

# REFERENCES

# References

## 【Geological and Geochemical Survey】


Ahmed, W., et al. (1983) : Brief report on evaluation of Gunga Pb-Zn-Ba deposit, PAK/79/016, Unpublished report. GSP.

Asad, J. & Subhani, A. M., et al. (1986) : Zinc-lead prospect of Surmai-Garri, Khuzdar, Baluchistan. GSP.

Cowan, D. S. (1974) : Deformation and metamorphismofthe Franciscan subduction zone complex, nortwest of pacheoPass, California, Geol. Soc. Am. Bull., 85, 1623-1634

Durrazai, M. I., et al. (1983) :Lead-zinc-barite deposit, Gunga district, Khuzdar, Baluchistan. GSP.

Fatmi, A. N., et al. (1986) : Stratigraphy of "Zidi formation" (Ferozabad group) and "Parh group" (Mona Jhal group) Khuzdar district, Baluchistan, Pakistan. GSP.

Govett, G. J. S. (1983) : Handbook of Exploration Geochemistry. Elsevier Scientific Publishing Company.

GSP. (1964) : Geological map of Pakistan. GSP.

GSP. (1977) : Stratigraphy of Pakistan. GSP.

GSP. (1979) : Geodynamics of Pakistan. GSP.

GSP. (1982) : Tectonic map of Pakistan. GSP.

Heyl, A. V. (1968) : The Upper Mississippi Valley Base-Metal District. Ore Deposits of the United States, 1933-1967. vol-1, 431-459. USGS.

Hunting Survey Co., Ltd. (1961) : Reconnaissance geology of part of west Pakistan (A Colombo plan co-operative project). Published for the government of Pakistan by the government of Canada.

Igarashi, T., Fujinuki, T. (1978) : Autogenous Quartz in Carbonate Rocks., Studies on Geology. No. 15, 61-80

Isihara, S. (1985) :Mississippi Vally Type Deposit in Tennessee State. Chisitu News, vol. 375, P6-19. GSJ. (in Japanese)

Jankovic, S. (1983) :Final Report on exploration & preliminary evaluation, lead-zinc-barite deposits, Lasbela-Khuzdar district, Baluchistan. United Nations.

Jankovic, S. (1984) :Preliminary evaluation of the lead-zinc-barite deposit at

Gunga.

Jenkyns, H. C. (1986) :Plelagic Environments in H. G. Reading ed., Sedimentary Environments and Facies. 343-398

JICA and MMAJ(1987):Report on the cooperative mineral exploration in the Khuzdar area of Baluchistan, the Islamic Republic of Pakistan, Phase I.

Lepeltier, C. (1969) :Simplified statistical treatment of geochemical data by graphical representation. Econ. Geol. 64, 538-550.

MMAJ. (1974～1977) : Report on The Overseas Geotectonic Survey (Central Iran). MMAJ. (in Japanese)

MMAJ. (1975) : Report on The Overseas Mining Circumstances. MMAJ. (in Japanese)

Nakajima, T. (1986～1987) : Himalayan Sea and Its Disappearance(1～3). Chisitu News. vol. 376, 387, 389. GSJ. (in Japanese)

OTCA. (1971) : Report on The Plane of Mineral Resources Development in West Pakistan. OTCA. (in Japanese)

Rankama, K. K., and Sahama, T. G., (1950) :Geochemistry. Univ. Chicago Press, 912p.

Sellwood, B. W. (1986) : Shallow-marine Carbonate Environments., ibid., 283-342.

Sinclair, A. J. (1974) :Serection of Threshold Values in Geochemical Data Using Probability Graphs. J. Geoch. Explor. 3, 129-149.

TAGCJ. (1987) : Chigaku jiten(Geological Glossary, in Japanese)

TAO. (1988) : Rika nenpyo(Chronogical Scientific Tables, in Japanese)

Tucker, M. E. (1981) : Limestone, in SedimentaryPetrology an Introduction., 96-157

United Nations(1984) :Strengthening the Geological Survey of Pakistan. United Nations.

Vredenburg, E. W. (1909) : Report on the goelogy of Sarawan, Jhalwan, Makran and the State of Lasbela. Ibid., Recs., v. 38, pt. 3, 189-215.

Williams, M. D. (1959) : Stratigraphy of the Lower Indus Basin, West Pakistan. World Petroleum Cong., 5th, New York, Proc., sec. 1, Paper19, 377-390.

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

# APPENDICES

App. 1 Microscopic Observation of Thin Section of Surthern Khuzdar District

| Sample No. | Locality | Rock Name | Rock Facies | Allochems /Grain | Orthochems /Matrix | Unit |
|---|---|---|---|---|---|---|
| A-2 | Sur-I | Ls. | biomicrite | bioclasts. gastropd. d:1mm. | micrite. | An-I |
| A-20 | Sur-II | Ls. | oomicrite. | ooids, bioclasts. limo, d:0.2mm. | micrite>sparite | Lo-II |
| A-23 | Sur-II | Ls. | biomicrite | bioclasts. bivalve. d:+1mm. | micrite. | Lo-III |
| A-37 | Sur-I | S.s. | limy sandstone | qz, d:0.1mm. | fine cal, clay, opaque min. | Sp |
| A-38 | Sur-I | Sh. | limy shale (siltstone) | fine qz, cal. | clay, dolc. | Lo-I |
| B-3 | Sur-II | Ls. | biomicrite | bioclasts. d:1mm. sparry cal. | micrite. | Lo-IV |
| B-5 | Sur-II | Ls. | biomicrite | bioclasts. d:1mm. sparry cal. | micrite. | Lo-III |
| B-10 | Sur-III | Ls. | cherty biomicrite | radioraria. d:0.1mm. qz, cal. | micrite. limo, dolc. | An-I |
| B-21 | Sur II ~ III | Ls. | cherty biomicrite | radioraria. d:0.1mm. qz, cal. | micrite. limo, dolc. | An-II |
| B-22 | Sur II ~ III | Sh. | cherty biomicrite | radioraria. d:0.1mm. qz, cal. | micrite. limo, clay, dolc. | An-II |
| B-35 | Sur-I | Ls. | oosparite | ooids. d:0.4mm. | sparite. | An-III |
| C-7 | Sur-II | Ls. | biomicrite | bioclasts. d:1mm. sparry cal. | micrite. | Lo-IV |
| D-1 | Sur II ~ III | Ls. | biomicrite | bioclasts. d:0.5mm. sparry cal. | micrite, dolc. opaque min. | Lo-III |
| D-22 | Sur-III | Ls. | oomicrite | ooids, bioclasts. d:0.3mm. micrite. | micrite, clay. | Lo-II |
| D-60 | Sur-III | Ls. | oosparite | ooids. d:0.3mm. | sparite. | Lo-II |
| E-9 | Sur-I | Ls. | oomicrite | ooids d:0.2mm. sparry cal. | micrite., dolc. | Lo-III |
| E-12 | Sur-I | Ls. | biomicrite | bioclasts. d:1mm. sparry cal. | micrite. | Lo-IV |
| E-22 | Sur-I | Ls. | oosparite | ooids d:0.2mm | sparite. | Lo-II |
| E-23 | Sur-I | Ls. | micrite | (sparry cal vein wd:0.3mm) | micrite. | Lo-I |
| E-48 | Sur-I | Ls. | biomicrite | bioclasts. d:0.5mm. gastropod. | micrite. | Lo-IV |

Sur:Surmai d:diameter min:mineral An:Anjira
Ls.:Limestone limo:limonite dolc:dolomitic Lo:Loralai
Sh.:Shale qz:quartz Sp:Spingwar
S.s.:Sandstone cal:calcite

App. 2 Microscopic Observation of Thin Section of Northern Khuzdar District

| Sample No. | Locality (Sheet No) | Rock Name | Rock Facies | Allochems /Grain | Orthochems /Matrix | Unit |
|---|---|---|---|---|---|---|
| 2G-40 | 34/8 | Ls. | Oomicrite | ooids, bioclasts. | micrite. | An |
| 2G-113 | 34/8 | Ls. | Sparite | Sparry calcite. Fe-oxide. | | An |
| 2G-169 | 34L/11 | Ls. | oomicrite | ooids :0.1mm bioclasts:0.35. | micrite/sparite. | Lo |
| 2G-171 | 34L/11 | Ls | biomicrite | bioclasts :0.53mm calcite vein, Fe-oxide | micrite | Lo |
| 2G-172 | 34L/11 | Ls. | sparite | sparry cal(0.06mm). | sparite>micrite | Lo |
| 2G-176 | 34L/11 | Ls. | biomicrite | bioclasts. hematite | micrite. | Lo |
| 2G-191 | 34/8 | Sh. | limy shale | bioclasts. fine Quartz, cal. | clay | An |
| 2G-192 | 34/8 | Ss. | sandston | Quartz, d:0.1mm. hematite, mica. | | Sp |
| 2F- 26 | 34/8 | Go. | cherty gossan | bioclast, d:1mm. opaque mineral. | micrite | Lo |
| 2F-160 | 34L/11 | Ls. | biomicrite | bioclast, d:0.1mm. opaque mineral | micrite | Lo |
| 2F-173 | 34L/11 | Ls. | oomicrite | ooids, d:0.2mm ooiclast. | micrite. | An |
| TY-880 11-001 | | Dio. | diorite | hornblende pyroxen, biotite. | carbonate. | |

Sur :Surmai
Ls. :Limestone
Sh. :Shale
S.s. :Sandstone

An:Anjira
Lo:Loralai
Sp:Spingwar

d :diamater
cal:calcite
Go :gossan

App. 3 Whole Rock Composition of the Carbonate Rocks in Southern Kuzdar District

| Sample NO. | $SiO_2$ % | $Al_2O_3$ % | $Fe_2O_3$ % | MgO % | CaO % | $Na_2O$ % | $K_2O$ % | $TiO_2$ % | $P_2O_5$ % | MnO % | LOI % | FeO % | Ba ppm | Total % | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A - 38 | 27.86 | 10.74 | 2.89 | 1.67 | 26.22 | 0.14 | 2.12 | 0.45 | 0.17 | 0.05 | 26.38 | 1.23 | 180 | 99.94 | Lora-Ⅰ, Shale |
| B - 21 | 24.76 | 3.94 | 1.17 | 1.30 | 34.57 | 0.38 | 0.81 | 0.22 | 0.10 | 0.11 | 29.96 | 1.81 | 190 | 99.13 | Anji-Ⅱ, Ls |
| D - 22 | 4.23 | 0.29 | 0.88 | 0.42 | 50.59 | 0.02 | 0.08 | 0.01 | 0.04 | 0.08 | 41.22 | 0.29 | 70 | 98.16 | Lora-Ⅱ, Ls |
| E - 12 | 6.83 | 1.14 | 0.99 | 0.53 | 47.51 | 0.04 | 0.21 | 0.05 | 0.06 | 0.08 | 39.39 | 0.60 | 60 | 97.44 | Lora-Ⅳ, Ls |
| H - 148 | 1.66 | 0.51 | 0.14 | 0.35 | 52.72 | 0.02 | 0.14 | 0.01 | 0.05 | 0.01 | 42.66 | 0.14 | 40 | 98.44 | Lora-Ⅲ, Ls |

App. 4 Whole Rock Compositions of the Carbonate Rocks in Northen Khuzdar District

| Sample NO. | $SiO_2$ % | $Al_2O_3$ % | $Fe_2O_3$ % | MgO % | CaO % | $Na_2O$ % | $K_2O$ % | $TiO_2$ % | $P_2O_5$ % | MnO % | LOI % | FeO % | Ba ppm | Total % | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2F-160 | 4.92 | 1.53 | 0.89 | 0.78 | 48.73 | 0.26 | 1.40 | 0.05 | 0.11 | 0.04 | 41.12 | 0.38 | <0.01 | 100.25 | Lora, Ls |
| 2G- 40 | 3.34 | 0.66 | 1.08 | 0.55 | 50.22 | 0.30 | 1.13 | 0.03 | 0.12 | 0.14 | 41.96 | 0.25 | 0.04 | 99.86 | Anji, Ls |
| 2G-172 | 1.55 | 0.42 | 0.52 | 1.70 | 50.49 | 0.27 | 1.26 | 0.02 | 0.10 | 0.01 | 43.34 | 0.22 | <0.01 | 99.94 | Lora, Ls |
| 2G-191 | 34.36 | 7.62 | 2.36 | 1.82 | 24.31 | 0.51 | 2.80 | 0.43 | 0.15 | 0.03 | 24.38 | 0.67 | 0.01 | 99.53 | Anji, Sh |
| 2G-192 | 80.05 | 6.06 | 1.46 | 0.50 | 3.73 | 0.27 | 2.18 | 0.34 | 0.19 | 0.03 | 5.15 | 0.06 | 0.02 | 100.05 | Spin, Ss |

Average Composition of Mainly Sedimentary Rocks in the World (Reference)

| Rock Name | $SiO_2$ % | $Al_2O_3$ % | $Fe_2O_3$ % | MgO % | CaO % | $Na_2O$ % | $K_2O$ % | $TiO_2$ % | $P_2O_5$ % | MnO % | LOI % | FeO % | Ba ppm | Total % | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ls | 5.2 | 0.8 | 0.5 | 0.05 | 42.6 | 0.05 | 0.3 | 0.07 | 0.09 | 0.05 | 42.4 | ** | | 99.96 | *[1] |
| Ss | 78.7 | 4.8 | 1.1 | 1.2 | 5.5 | 0.5 | 1.3 | 0.25 | 0.04 | 0.01 | 6.6 | 0.3 | | 100.30 | *[2] |
| Pel | 58.9 | 16.7 | 2.8 | 2.6 | 2.2 | 1.6 | 3.6 | 0.77 | 0.16 | 0.1 | 6.3 | 3.7 | | 99.43 | *[3] |

Abbreviation

Lora-Ⅰ : Unit of Loralai Member
Ls : Limestone
Ss : Sandstone
Pel : Pelitic Rock

*[1] :Average of 345 Samples, Clarke(Chronological Scientific Tables, 1986)
*[2] :Average of 253 Samples, Clarke(Chronological Scientific Tables, 1986)
*[3] :Average of 277 Samples, Wedepohl(Chronological Scientific Tables, 1986)
** :Contained in $Fe_2O_3$

App. 5 Chemical Analyses of Gossan Samples of Southern Khuzdar District and Surmai Area

| Sample No. | Formation | Locality | Pb (%) | Zn (%) | Ba (%) | Ag (g/T) |
|---|---|---|---|---|---|---|
| A - 6 | Loralai - II | Surmai III | 0.18 | 0.42 | 0.02 | 3.3 |
| A - 10 | Loralai - II | Surmai III | 0.48 | 4.92 | <0.01 | 6.5 |
| A - 11 | Loralai - II | Surmai III | 0.34 | 1.22 | 0.01 | 3.9 |
| A - 33 | Loralai - II | Surmai III | 0.09 | 2.77 | 0.01 | 1.9 |
| B - 13 | Loralai - II | Surmai III | 0.19 | 2.32 | <0.01 | 2.3 |
| C - 10 | Loralai - IV | Surmai II | 2.90 | 2.66 | <0.01 | 24.0 |
| C - 15 | Loralai - IV | Surmai II | 0.57 | 4.60 | <0.01 | 12.0 |
| C - 20 | Anjira - I | Surmai II | 1.63 | 1.92 | 0.02 | 8.0 |
| D - 29 | Loralai - II | Surmai III | 0.93 | 1.30 | <0.01 | 33.0 |
| D - 41 | Loralai - II | Surmai III | 0.63 | 3.05 | 0.02 | 8.5 |
| D - 55 | Loralai - II | Surmai III | tr | tr | <0.01 | 5.5 |
| D - 68 | Loralai - II | Surmai III | 1.34 | 0.35 | 0.02 | 21.5 |
| E - 5 | Loralai - III | Surmai I | 0.57 | 1.59 | <0.01 | 6.5 |
| E - 8 | Loralai - II | Surmai I | 0.23 | 5.64 | 0.01 | 4.1 |
| E - 29 | Loralai - III | Surmai I | 0.26 | 0.13 | <0.01 | 3.3 |
| E - 35 | Loralai - I | Surmai I | 0.13 | <0.01 | <0.01 | 2.3 |
| E - 42 | Loralai - I | Surmai I | <0.01 | 0.43 | <0.01 | 1.7 |
| K - 12 | Loralai | Sekran | 0.02 | 3.15 | <0.01 | 1.7 |
| M - 1 | Loralai | Malkhor | 0.02 | 0.59 | <0.01 | 2.3 |
| M - 14 | Loralai | Ranj Laki | 0.30 | 2.61 | <0.01 | 7.0 |

Ditection Limit : Pb 0.01%, Zn 0.01%, Ba 0.01%, Ag 0.1g/t

Analytical method : Atomic Absorption and Common Assey

## 6. X-ray Diffraction Analyses of Gossan Samples of Southern Khuzdar District and Surmai Area (1)

| Sample No. | Locality | Minerals | | | | | | | | | | | | | | | | | | | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ca | Q | Do | Ka | Se | E | Ch | Fe | Ge | Fl | Sp | Hf | He | Es | Gy | Cr | Ce | Sm | Mg | |
| A - 2 | Surmai-[illegible] | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Anj-[illegible] |
| A - 6 | Surmai-[illegible] | △ | ● | | | | | | ◎ | ● | | | | | | | | | | | Ore,(Lo-[illegible]) |
| A - 10 | Surmai-[illegible] | | ◎ | | | | | | ◎ | o | | | | | | | | | | | Ore,(Lo-[illegible]) |
| A - 11 | Surmai-[illegible] | ○ | ○ | | | | | | ◎ | o | | | | | | | | | | | Ore,(Lo-[illegible]) |
| A - 20 | Surmai-[illegible] | ◎ | ● | | ? | | | | | △ | | | | | | | | | | | Ls.,Lo-[illegible] |
| A - 23 | Surmai-[illegible] | ◎ | ● | ? | | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| A - 26 | Surmai-[illegible]~[illegible] | o | ◎ | ? | △ | | | | ◎ | ● | | | | | | | | | | | Ore,(Lo-[illegible]) |
| A - 33 | Surmai-[illegible] | ● | ● | o | | | | | ◎ | ● | | | | | | | | | | | Ore,(Lo-[illegible]) |
| A - 35 | Surmai-[illegible] | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| A - 37 | Surmai-[illegible] | ○ | ◎ | | o | | | | | | | | | | | | | | | | S.s.Spi |
| A - 38 | Surmai-[illegible] | ◎ | ○ | △ | △ | △ | | | | | | | | | | | | | | | Ls.Lo-[illegible] |
| A - 40 | Surmai-[illegible] | ◎ | ● | ? | | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| B - 3 | Surmai-[illegible] | ◎ | | ● | ● | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| B - 5 | Surmai-[illegible] | ◎ | ● | | △ | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| B - 10 | Surmai-[illegible] | ◎ | ● | △ | | | | | | | | | | | | | | | | | Ls.,Anj-[illegible] |
| B - 13 | Surmai-[illegible] | △ | ○ | o | | | | | ○ | ● | | | | | | | | | | | Ore(Lo-[illegible]) |
| B - 21 | Surmai[illegible]~[illegible] | ◎ | ○ | △ | △ | | ? | | | | | | | | | | | | | | Ls.,Anj-[illegible] |
| B - 22 | Surmai[illegible]~[illegible] | ◎ | ◎ | △ | ● | ● | ? | | | | | | | | | | | | | | Sh.Anj-[illegible] |
| B - 35 | Surmai-[illegible] | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Anj-[illegible] |
| C - 5 | Surmai-[illegible] | △ | ○ | | | | | | ◎ | ● | | | | | | | | | | | Ore(Anj-[illegible]) |
| C - 7 | Surmai-[illegible] | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| C - 10 | Surmai-[illegible] | △ | ◎ | | | | | | ○ | ● | | | | | | | | | | | Ore(Lo-[illegible]) |
| C - 15 | Surmai-[illegible] | ● | ◎ | | | | | | ○ | | | | △ | | | | | | | | Ore(Lo-[illegible]) |
| C - 17 | Surmai-[illegible] | △ | ○ | | | | | | ◎ | | | | ● | | | | | | | | Ore(Anj-[illegible]) |
| C - 20 | Surmai-[illegible] | ● | ○ | | | | | | ◎ | ○ | | | | | | | | | | | Ore(Anj-[illegible]) |
| D - 1 | Surmai[illegible]~[illegible] | ◎ | ● | △ | | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| D - 22 | Surmai-[illegible] | ◎ | ● | | △ | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| D - 27 | Surmai-[illegible] | | | | | | | | ◎ | △ | | | ● | | ○ | | | | | | Ore(Lo-[illegible]) |
| D - 29 | Surmai-[illegible] | ● | ○ | | | | | | ◎ | ● | | | △ | o | | | | | | | Ore(Lo-[illegible]) |
| D - 38 | Surmai-[illegible] | o | ◎ | | | | | | ○ | o | | | ● | | | | | | | | Ore(Lo-[illegible]) |
| D - 41 | Surmai-[illegible] | △ | o | | | | | | ◎ | o | | | | | | | | | | | Ore(Lo-[illegible]) |
| D - 46 | Surmai-[illegible] | ? | ◎ | | | | | | ○ | o | | | ● | | | | | | | | Ore(Lo-[illegible]) |
| D - 53 | Surmai-[illegible] | ● | ○ | | | | | | ◎ | ● | | | | | | | | | | | Ore(Lo-[illegible]) |
| D - 55 | Surmai-[illegible] | △ | ○ | | | | | | ◎ | ○ | | | | | | | | | | | Ore(Lo-[illegible]) |
| D - 60 | Surmai-[illegible] | ◎ | ● | △ | | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| D - 68 | Surmai-[illegible] | ● | ◎ | | | | | | ○ | ● | | | | | | | | | | | Ore(Lo-[illegible]) |
| E - 5 | Surmai-[illegible] | ● | ○ | | | | | | ◎ | o | | | | ● | | | | | | | Ore(Lo-[illegible]) |
| E - 8 | Surmai-[illegible] | ? | o | | | | | | ◎ | o | | | | | | | | | | | Ore(Lo-[illegible]) |
| E - 9 | Surmai-[illegible] | ◎ | ○ | ● | | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| E - 12 | Surmai-[illegible] | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-[illegible] |
| E - 19 | Surmai-[illegible] | | ○ | | | | | | ◎ | ● | | | △ | | | | | | | | Ore(Lo-[illegible]) |

Abbreviation

- ◎ : very Abundant
- ○ : Abundant
- o : Common
- ● : A Few
- △ : Rare
- ? : Unclear

Shirinab Formation

- Anj : Anjira Member
- Lo-[illegible] : Loralai Member [illegible]
- Lo-[illegible] : Loralai Member [illegible]
- Lo-[illegible] : Loralai Member [illegible]
- Lo-[illegible] : Loralai Member [illegible]

Ca : Calcite　E : Eurite　Sp : Sphalerite　Cr : Cristobalite　Ls : Limestone
Q : Quartz　Ch : Chlorite　Hf : Hemimorphite　Ce : Cerussite　Sh : Shale
Do : Dolomite　Fe : Oxide Iron　He : Hematite　Sm : Smithsonite　Ss : Sandstone
Ka : Kaolinite　Ge : Goethite　Es : Esperite　Mg : Magnesite
Se : Sericite　Fl : Fluorite　Gy : Gypsum

## 6. X-ray Diffraction Analyses of Gossan Samples of Southern Khuzdar District and Surmai Area (2)

| Sample No. | | Minerals | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ca | Q | Do | Ka | Se | E | Ch | Fe | Ge | Fl | Sp | Hf | He | Es | Gy | Cr | Ce | Sm | Mg | |
| E - 22 | Surmai-Ⅰ | ◎ | △ | | | | | | | | | | | | | | | | | | Ls., Lo-Ⅱ |
| E - 23 | Surmai-Ⅰ | ◎ | ● | ● | | | | | | | | | | | | | | | | | Ls., Lo-Ⅰ |
| E - 26 | Surmai-Ⅰ | ● | ◎ | | | | | | ◎ | ● | | | | | | | | | | | Ore, (Lo-Ⅰ) |
| E - 29 | Surmai-Ⅰ | ● | ○ | △ | | | | | ◎ | ● | | | | | | | | | | | Ore, (Lo-Ⅲ) |
| E - 35 | Surmai-Ⅰ | ● | ● | | | | | | ◎ | ● | | | | △ | | | | | | | Ore, (Lo-Ⅰ) |
| E - 42 | Surmai-Ⅰ | ● | ● | | | | | | ◎ | ● | | | | | | | | | | | Ore, (Lo-Ⅰ) |
| E - 43 | Surmai-Ⅰ | ● | ◎ | △ | | | | | ○ | ● | | | | | | | | | | | Ore, (Lo-Ⅰ) |
| E - 48 | Surmai-Ⅰ | ◎ | ● | | | | | | | | | | | | | | | | | | Ls., Lo-Ⅳ |
| E - 51 | Surmai-Ⅰ | ◎ | ● | ● | △ | | | | | | | | | | | | | | | | Ls., Lo-Ⅰ |
| K - 3 | Sekran | ◎ | △ | | | | | | | | | | | | | | | | | | Ls., Lo |
| k - 4 | Sekran | ○ | | | | | | | ◎ | ● | | | | | | | | | | | Ore, (Lo) |
| K - 6 | Sekran | ◎ | ● | | | | | | | | | | | | | | | | | | Ls., Lo |
| K - 12 | Sekran | ○ | ○ | | | | | ● | ◎ | ● | | | | | | | | | | | Ore, (Lo) |
| K - 15 | Sekran | | ◎ | | | | | | ○ | ● | | ● | | | | | | | | | Ore, (Lo) |
| K - 16 | Sekran | ◎ | △ | | | | | | | | | | | | | | | | | | Ls., Lo |
| K - 23 | Sekran | ◎ | ○ | | | | | | | | | | | | | | | | | | S.s., Spi |
| K - 24 | Sekran | ○ | ● | | ? | | | | ◎ | ● | | | | | | | | | | | Ore, (Lo) |
| K - 25 | Sekran | ◎ | ● | | | | | | | | | | | | | | | | | | Ls., Lo |
| k - 26 | Sekran | ◎ | ● | △ | | | | | | | | | | | | | | | | | Ls., Lo |
| M - 1 | Malkhor | ● | ◎ | | △ | | | | ○ | | | | | ● | | | | | | | Ore, (Lo) |
| M - 2 | Malkhor | △ | ○ | | | | | | ◎ | ● | | | | ● | | | | | | | Ore, (Lo) |
| M - 3 | Malkhor | ◎ | ● | | | | | | | | | | | | | | | | | | Ls., Lo |
| M - 4 | Malkhor | ◎ | ● | | | | | | | | | | | | | | | | | | Ls., Lo |
| M - 6 | Malkhor | ● | ◎ | | △ | | | | ● | △ | | | | △ | | | | | | | Ore, (Lo) |
| M - 7 | Malkhor | ◎ | ● | △ | | △ | | | | | | | | | | | | | | | Ls., Lo |
| M - 8 | Malkhor | ◎ | ● | | | | | | | | | | | | | | | | | | Ls., Lo |
| M - 9 | Ranj Laki | ● | ○ | | | | | | ◎ | ● | ● | | | ● | | | | | | | Ore, (Lo) |
| M - 10 | Ranj Laki | ◎ | ● | | | | | | | | | | | | | | | | | | Ls., Lo |
| M - 11 | Ranj Laki | △ | ○ | | ? | | | | ◎ | ● | | | | ● | | | | | | | Ore, (Lo) |
| M - 12 | Ranj Laki | ◎ | △ | | | | | | | | | | | | | | | | | | Ls., Lo |
| M - 13 | Ranj laki | △ | ○ | | | | | ? | ◎ | △ | | | | ● | | | | | | | Ore(Lo) |
| M - 14 | Ranj Laki | | ○ | | | | | | ◎ | ● | | | | | | | | | | | Ore, (Lo) |
| M - 15 | Ranj Laki | ● | ○ | | | | | ? | ◎ | o | | | ● | | | | | | | | Ore, (Lo) |
| M - 17 | Ranj Laki | ◎ | ● | | | | | | | | | | | | | | | | | | Ls., Lo |
| M - 18 | Ranj Laki | ○ | ○ | | | | | ? | ◎ | | | | ● | | | | | | | | Ore, (Lo) |
| M - 20 | Ranj Laki | ◎ | ● | | | | | | | | | | | | | | | | | | Ls., Lo |
| M - 21 | Ranj Laki | △ | ◎ | | | | | | ● | ● | | | ○ | | | | | | | ? | Ore, (Lo) |
| M - 22 | Ranj Laki | ◎ | ◎ | | ● | | | | | | | | | | | | | | | | S.s., Sp |
| M - 23 | Ranj Laki | ◎ | ● | | | | | | | | | | | | | | | | | | Ls., Lo |
| M - 24 | Ranj Laki | ● | ● | | | | | | ◎ | ● | | | | | | ? | | | | | Ore, (Lo) |

Abbreviation
- ◎ : very Abundant
- ○ : Abundant
- o : Common
- ● : A Few
- △ : Rare
- ? : Unclear

Shirinab Formation
- Anj : Anjira Member
- Lo-Ⅳ : Loralai Member Ⅳ
- Lo-Ⅲ : Loralai Member Ⅲ
- Lo-Ⅱ : Loralai Member Ⅱ
- Lo-Ⅰ : Loralai Member Ⅰ

Ca : Calcite
Q : Quartz
Do : Dolomite
Ka : Kaolinite
Se : Sericite
E : Eurite
Ch : Chlorite
Fe : Oxide Iron
Ge : Goethite
Fl : Fluorite
Sp : Sphalerite
Hf : Hemimorphite
He : Hematite
Es : Esperite
Gy : Gypsum
Cr : Cristobalite
Ce : Cerussite
Sm : Smithsonite
Mg : Magnesite
Ls : Limestone
Sh : Shale
Ss : Sandstone

## 6. X-ray Diffraction Analyses of Gossan Samples of Southern Khuzdar District and Surmai Area (3)

| Sample No. | Locality | Ca | Q | Do | Ka | Se | E | Ch | Fe | Go | Fl | Sp | Hf | He | Es | Gy | Cr | Ce | Sm | Mg | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Minerals | | | | | | | | | | | | | | | | | | | |
| S - 1 | C-D Section | ○ | ◎ | | ● | | | | | | | | | | | | | | | | S.s.,Spi |
| S - 6 | C-D Section | ◎ | ○ | | △ | △ | | | | | | | | | | | | | | | Ls.,Spi |
| S - 14 | C-D Section | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-I |
| S - 17 | C-D Section | ◎ | ● | | ? | | | | | | | | | | | | | | | | Ls.,Lo-I |
| S - 20 | C-D Section | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-I |
| S - 40 | C-D Section | ◎ | ● | △ | △ | | | | | | | | | | | | | | | | Ls.,Lo-II |
| S - 48 | C-D Section | ◎ | ● | | △ | | | | | | | | | | | | | | | | Ls.,Lo-III |
| S - 54 | E-F Section | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-III |
| S - 57 | E-F Section | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-IV |
| S - 58 | E-F Section | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-IV |
| S - 59 | E-F Section | ◎ | ● | ● | | | | | | | | | | | | | | | | | Ls.,Anj |
| S - 60 | E-F Section | ◎ | ● | | | | ? | | | | | | | | | | | | | | Ls.,Anj |
| S - 64 | A-B Section | ◎ | ○ | | ● | | | | | | | | | | | | | | | | S.s.,Spi |
| S - 67 | A-B Section | ◎ | ● | | ● | △ | | | | | | | | | | | | | | | Ls.,Spi |
| S - 70 | A-B Section | ◎ | ● | △ | ● | | | | | | | | | | | | | | | | Ls.,Lo-I |
| S - 72 | A-B Section | ◎ | ● | ● | | | | | | | | | | | | | | | | | Ls.,Lo-I |
| S - 78 | A-B Section | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-II |
| S - 90 | A-B Section | ◎ | ○ | | △ | | | | | | | | | | | | | | | | Ls.,Lo-II |
| S - 99 | A-B Section | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-III |
| S - 102 | A-B Section | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-II |
| S - 104 | A-B Section | ◎ | ● | | | | | | | | | | | | | | | | | | Ls.,Lo-IV |
| S - 105 | A-B Section | ◎ | ● | | | | ? | | | | | | | | | | | | | | Ls.,Lo-IV |
| S - 106 | A-B Section | ◎ | ● | | | | ? | | | | | | | | | | | | | | Ls.,Anj |
| S - 107 | A-B Section | ● | ● | | | | ? | | | | | | | | | | | | | | Ls.,Anj |

Abbreviation

◎ : *very Abundant*
○ : Abundant
o : Common
● : A Few
△ : Rare
? : Unclear

Shirinab Formation

*Anj* : *Anjira Member*
Lo-IV : Loralai Member IV
Lo-III : Loralai Member III
Lo-II : Loralai Member II
Lo-I : Loralai Member I

Ca : Calcite
Q : Quartz
Do : Dolomite
Ka : Kaolinite
Se : Sericite
E : Eurite
Ch : Chlorite
Fe : Oxide Iron
Go : Goethite
Fl : Fluorite
Sp : Sphalerite
Hf : Hemimorphite
He : Hematite
Es : Esperite
Gy : Gypsum
Cr : Cristobalite
Ce : Cerussite
Sm : Smithsonite
Mg : Magnesite
Ls : Limestone
Sh : Shale
Ss : Sandstone

App. 7 Statistic Parameters of Khuzdar District for Basic Statistical Analysis

| | | by Member of Shirinab F. | | | | by Block Number | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Anjira | Loralai | Springwar | I | II | III | IV | V | VI | VII | VIII | IX | X | XI |
| Number of Sample | | 4,633 | 1,287 | 2,914 | 405 | 265 | 731 | 874 | 505 | 339 | 142 | 58 | 905 | 184 | 580 | 50 |
| Pb (ppm) | min | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | max | 10,000 | 10,000 | 10,000 | 950 | 33.0 | 10,000 | 4,600 | 10,000 | 27 | 13 | 2 | 54 | 7 | 30 | 48 |
| | σ | 0.459 | 0.346 | 0.489 | 0.478 | 0.279 | 0.736 | 0.330 | 0.722 | 0.302 | 0.194 | 0.055 | 0.134 | 0.134 | 0.117 | 0.235 |
| | ave.(M) | 1.49 | 1.38 | 1.43 | 2.61 | 1.35 | 3.13 | 1.40 | 2.21 | 1.46 | 1.20 | 1.02 | 1.04 | 1.08 | 1.05 | 1.08 |
| | M+σ | 4.3 | 3.1 | 4.40 | 7.84 | 2.6 | 17.0 | 3.0 | 11.6 | 2.9 | 1.8 | 1.2 | 1.4 | 1.5 | 1.4 | 1.9 |
| | M+2σ | 12.4 | 6.8 | 13.58 | 23.56 | 4.9 | 93.1 | 6.4 | 61.5 | 5.9 | 2.9 | 1.3 | 1.9 | 2.0 | 1.8 | 3.2 |
| Zn (ppm) | min | 1 | 3 | 1 | 1 | 4 | 1 | 1 | 1 | 3 | 5 | 6 | 3 | 4 | 3 | 6 |
| | max | 10,000 | 10,000 | 10,000 | 5,500 | 215 | 10,000 | 3,340 | 10,000 | 90 | 54 | 66 | 2,400 | 110 | 96 | 38 |
| | σ | 0.422 | 0.308 | 0.461 | 0.422 | 0.314 | 0.640 | 0.355 | 0.574 | 0.309 | 0.266 | 0.246 | 0.299 | 0.262 | 0.260 | 0.200 |
| | ave.(M) | 14.50 | 16.57 | 13.73 | 14.13 | 11.36 | 20.74 | 13.17 | 20.09 | 14.73 | 12.88 | 14.64 | 12.17 | 14.63 | 12.4 | 10.37 |
| | M+σ | 38 | 34 | 40 | 37 | 23 | 90 | 30 | 75 | 30 | 23 | 26 | 24 | 27 | 22 | 16 |
| | M+2σ | 101 | 68 | 114 | 99 | 48 | 394 | 68 | 282 | 61 | 43 | 45 | 48 | 49 | 41 | 26.1 |
| Hg (ppb) | min | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 100 | 10 | 10 | 10 | 100 |
| | max | 55,000 | 4,500 | 55,000 | 1,640 | 1,660 | 55,000 | 2,000 | 29,000 | 540 | 90 | 500 | 5,500 | 150 | 900 | 220 |
| | σ | 0.495 | 0.406 | 0.535 | 0.393 | 0.392 | 0.507 | 0.443 | 0.559 | 0.295 | 0.222 | 0.141 | 0.477 | 0.237 | 0.394 | 0.684 |
| | ave.(M) | 32.87 | 29.14 | 36.38 | 23.10 | 22.75 | 23.90 | 27.14 | 25.68 | 17.55 | 14.57 | 159.13 | 86.17 | 32.38 | 28.40 | 146.80 |
| | M+σ | 103 | 74 | 124 | 57 | 56 | 76 | 75 | 73 | 35 | 24 | 220 | 258 | 56 | 70 | 176 |
| | M+2σ | 321 | 189 | 428 | 141 | 138 | 246 | 209 | 212 | 68 | 40 | 305 | 775 | 97 | 174 | 216 |
| Ba (ppm) | min | 10 | 10 | 10 | 20 | 10 | 30 | 20 | 50 | 10 | 100 | 10 | 10 | 80 | 10 | 10 |
| | max | 6,800 | 5,800 | 6,800 | 6,400 | 1,720 | 5,800 | 2,700 | 6,400 | 6,800 | 2,800 | 60 | 6,200 | 5,800 | 1,800 | 80 |
| | σ | 0.481 | 0.387 | 0.501 | 0.301 | 0.328 | 0.287 | 0.200 | 0.271 | 0.276 | 0.244 | 0.200 | 0.550 | 0.310 | 0.415 | 0.255 |
| | ave.(M) | 131.99 | 202.18 | 101.69 | 226.12 | 148.43 | 226.36 | 194.16 | 231.65 | 201.49 | 211.95 | 16.34 | 38.23 | 242.68 | 126.17 | 17.49 |
| | M+σ | 400 | 492 | 323 | 453 | 316 | 437 | 307 | 432 | 380 | 371 | 26 | 138 | 495 | 328 | 32 |
| | M+2σ | 1,210 | 1,199 | 1023 | 906 | 673 | 847 | 487 | 807 | 718 | 651 | 41 | 498 | 1,011 | 853 | 57 |
| Mg (ppm) | min | 300 | 450 | 320 | 300 | 1,200 | 320 | 300 | 350 | 800 | 1,900 | 1,800 | 600 | 700 | 1,200 | 1,950 |
| | max | 92,500 | 48,500 | 92,500 | 85,000 | 70,000 | 70,000 | 90,000 | 80,000 | 52,000 | 21,000 | 13,500 | 92,500 | 37,500 | 62,500 | 17,500 |
| | σ | 0.290 | 0.211 | 0.287 | 0.455 | 0.359 | 0.343 | 0.306 | 0.272 | 0.249 | 0.209 | 0.175 | 0.270 | 0.247 | 0.219 | 0.165 |
| | ave.(M) | 3,604 | 3,892 | 3,402 | 4,297 | 4,678 | 3,266 | 3,129 | 4,114 | 4,502 | 4,094 | 3,464 | 3,460 | 3,649 | 3,673 | 3,121 |
| | M+σ | 7,29 | 6,331 | 6,588 | 12,244 | 10,696 | 7,200 | 6,335 | 7,687 | 7,985 | 6,629 | 5,237 | 6,448 | 6,438 | 6,080 | 4,563 |
| | M+2σ | 13,709 | 10,300 | 12,757 | 34,890 | 24,454 | 15,877 | 12,828 | 14,365 | 14,163 | 10,734 | 7,917 | 12,019 | 11,360 | 10,064 | 6,673 |
| S (%) | min | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | <0.001 | 0.0005 | <0.001 | 0.0005 | 0.001 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 |
| | max | 1.21 | 1.21 | 0.86 | 0.64 | 0.167 | 0.862 | 0.123 | 1.210 | 0.221 | 0.301 | 0.023 | 0.229 | 0.313 | 0.394 | 0.187 |
| | σ | 0.659 | 0.637 | 0.638 | 0.678 | 0.627 | 0.661 | 0.607 | 0.675 | 0.604 | 0.512 | 0.604 | 0.643 | 0.805 | 0.656 | 0.665 |
| | ave.(M) | 0.003 | 0.006 | 0.003 | 0.004 | 0.003 | 0.004 | 0.003 | 0.005 | 0.005 | 0.007 | 0.002 | 0.002 | 0.004 | 0.002 | 0.003 |
| | M+σ | 0.015 | 0.024 | 0.011 | 0.017 | 0.013 | 0.017 | 0.012 | 0.024 | 0.022 | 0.022 | 0.009 | 0.010 | 0.023 | 0.011 | 0.016 |
| | M+2σ | 0.068 | 0.105 | 0.048 | 0.083 | 0.058 | 0.079 | 0.049 | 0.112 | 0.087 | 0.079 | 0.038 | 0.043 | 0.144 | 0.049 | 0.072 |

App. 8 Coefficiency Correlation of Geochemical Analyses in Khuzdar District

Total (N:4,633)

| | Pb | Zn | Ba | Mg | Hg |
|---|---|---|---|---|---|
| Zn | 0.634 | | | | |
| Ba | 0.155 | 0.139 | | | |
| Mg | -0.037 | 0.049 | 0.067 | | |
| Hg | 0.232 | 0.301 | -0.550 | -0.085 | |
| S | 0.187 | 0.247 | 0.240 | 0.162 | 0.071 |

Anjira M. (N:1,287)

| | Pb | Zn | Ba | Mg | Hg |
|---|---|---|---|---|---|
| Zn | 0.485 | | | | |
| Ba | 0.131 | 0.211 | | | |
| Mg | 0.150 | 0.321 | 0.120 | | |
| Hg | 0.141 | 0.234 | -0.363 | -0.061 | |
| S | 0.165 | 0.239 | 0.252 | 0.175 | 0.110 |

Loralai M. (N:2,914)

| | Pb | Zn | Ba | Mg | Hg |
|---|---|---|---|---|---|
| Zn | 0.698 | | | | |
| Ba | 0.157 | 0.107 | | | |
| Mg | -0.098 | -0.043 | 0.003 | | |
| Hg | 0.279 | 0.331 | -0.629 | -0.093 | |
| S | 0.209 | 0.239 | 0.156 | 0.125 | 0.095 |

Spingwar M. (N: 405)

| | Pb | Zn | Ba | Mg | Hg |
|---|---|---|---|---|---|
| Zn | 0.521 | | | | |
| Ba | 0.027 | 0.105 | | | |
| Mg | -0.041 | 0.182 | 0.109 | | |
| Hg | 0.251 | 0.324 | -0.068 | 0.034 | |
| S | 0.177 | 0.236 | 0.345 | 0.214 | 0.081 |

App. 9 Statistic Parameters of Khuzdar District for Principal Component Analysis

(1) Correlation Matrix

| | Pb | Zn | Hg | Ba | Mg | S |
|---|---|---|---|---|---|---|
| Pb | 1.000 | 0.634 | 0.231 | 0.155 | -0.037 | 0.187 |
| Zn | 0.634 | 1.000 | 0.001 | 0.139 | 0.050 | 0.248 |
| Hg | 0.231 | 0.301 | 1.000 | -0.550 | -0.085 | 0.071 |
| Ba | 0.155 | 0.139 | -0.550 | 1.000 | 0.067 | 0.240 |
| Mg | -0.037 | 0.050 | -0.085 | 0.067 | 1.000 | 0.162 |
| S | 0.187 | 0.248 | 0.071 | 0.240 | 0.162 | 1.000 |

(2) Eigenvector

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Pb | 0.600 | 0.021 | -0.257 | -0.259 | -0.709 | 0.042 |
| Zn | 0.632 | 0.008 | -0.092 | -0.225 | 0.630 | -0.382 |
| Hg | 0.319 | -0.618 | -0.251 | 0.151 | 0.166 | 0.655 |
| Ba | 0.102 | 0.698 | -0.251 | 0.008 | 0.232 | 0.621 |
| Mg | 0.050 | 0.236 | 0.823 | -0.504 | -0.060 | 0.088 |
| S | 0.352 | 0.275 | 0.386 | 0.778 | -0.127 | -0.173 |
| Eigenvalue | 1.921 | 1.610 | 1.042 | 0.777 | 0.362 | 0.288 |
| Cumulative Contribution Ratio | 0.320 | 0.589 | 0.762 | 0.892 | 0.952 | 1.000 |
| Standard Deviation * | 1.386 | 1.269 | 1.021 | 0.882 | 0.602 | 0.537 |

*:Score Standard Deviation

(3) Factor Loading

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Pb | 0.834 | 0.027 | -0.263 | -0.228 | -0.426 | 0.022 |
| Zn | 0.875 | 0.010 | -0.094 | -0.198 | 0.379 | -0.205 |
| Hg | 0.443 | -0.784 | 0.196 | 0.133 | 0.100 | 0.352 |
| Ba | 0.141 | 0.885 | -0.256 | 0.007 | 0.140 | 0.333 |
| Mg | 0.069 | 0.299 | 0.839 | -0.444 | -0.035 | 0.047 |
| S | 0.488 | 0.349 | 0.394 | 0.686 | -0.076 | -0.093 |

App. 10　Microscopic Observation of Polished Section of Surumai Area Gossan

| Sample No. | Localty | Mineral | | | | | | | | | | | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ge | Ma | Py | He | | | Q | Ca | Do | Hf | | |
| A - 6 | Surmai - III | ◎ | ● | | | | | ◎ | ◎ | | | | Lo- II |
| A - 10 | Surmai - III | ○ | | | | | | ◎ | | | | | Lo- II |
| A - 11 | Surmai - III | ◎ | △ | | | | | ○ | ○ | | | | Lo- II |
| A - 33 | Surmai - III | ○ | △ | | | | | ● | ● | ○ | | | Lo- II |
| B - 13 | Surmai - III | ○ | | △ | | | | ○ | △ | ○ | | | Lo- II |
| C - 10 | Surmai - II | ◎ | | | | | | ○ | △ | | | | Lo- IV |
| C - 15 | Surmai - II | ○ | △ | | △ | | | ○ | ● | | △ | | Lo- IV |
| C - 20 | Surmai - II | ◎ | | | | | | ○ | ● | | | | Anj- I |
| D - 29 | Surmai - II | ◎ | | | | | | ○ | ● | | △ | | Lo- II |
| D - 41 | Surmai - II | ○ | | | ● | | | ○ | ● | | | | Lo- II |
| D - 46 | Surmai - II | ◎ | | | | | | ○ | | | ● | | Lo- I |
| D - 53 | Surmai - II | ◎ | | | | | | ○ | ● | | | | Lo- I |
| D - 55 | Surmai - II | ○ | | | | | | ◎ | ○ | | | | Lo- II |
| D - 68 | Surmai - II | ◎ | | △ | | | | ◎ | ○ | | | | Lo- II |
| E - 5 | Surmai - I | ◎ | | | ● | | | ○ | ● | | | | Lo- III |
| E - 8 | Surmai - I | ○ | | | | | | ◎ | △ | | | | Lo- II |
| E - 26 | Surmai - I | ◎ | | | | | | ◎ | ○ | | | | Lo- I |
| E - 29 | Surmai - I | ◎ | △ | | | | | ○ | ● | | | | Lo- III |
| E - 35 | Surmai - I | ◎ | | △ | | | | △ | ○ | | | | Lo- I |
| E - 42 | Surmai - I | ◎ | | △ | | | | ○ | ○ | | | | Lo- I |

Abbreviation

◎ : Abundant
○ : Common
● : A Few
△ : Rare

Shirinab Formation

Anj : Anjira Member
Lo-IV : Loralai Member IV
Lo-III : Loralai Member III
Lo-II : Loralai Member II
Lo-I : Loralai Member I

Ge : Goethite　Ma : Marcasite　Py : Pyrite　He : Hematite
Q : Quartz　Ca : Calcite　Do : Dolomite　Hf : Hemimorphite

App. 11 Statistic Parameters of Surmai Area for Basic Statistical Analysis

| Elements | Group | Total | Anjira Member | Loralai Member I, II, III | Loralai Member IV | Loralai Member total | Spingwar Member | Mineralized Zone |
|---|---|---|---|---|---|---|---|---|
| | N | 169 * | 39 | 93 | 34 | 127 | 3 | 36 |
| Pb | min | 1 | 1 | 1 | 1 | 1 | 9 | 4 |
| | max | 900 | 68 | 900 | 430 | 900 | 74 | 10,000 |
| | σ | 0.781 | 0.629 | 0.795 | 0.797 | 0.811 | 0.374 | 1.050 |
| | ave.(M) | 11.12 | 6.08 | 16.34 | 7.23 | 13.14 | 25.19 | 1,626 |
| | M+σ | 67 | 25 | 101 | 45 | 85 | 59 | 18,241 |
| | M+2σ | 406 | 110 | 636 | 284 | 550 | 140 | 204,549 |
| | M+3σ | 2,454 | 470 | 3,972 | 1,782 | 3,562 | 333 | 2,293,713 |
| Zn | min | 9 | 12 | 13 | 9 | 9 | 20 | 19 |
| | max | 8,630 | 490 | 8,630 | 1,080 | 8,630 | 44 | 10,000 |
| | σ | 0.519 | 0.326 | 0.568 | 0.47 | 0.558 | 0.147 | 0.861 |
| | ave.(M) | 70.42 | 48.13 | 96.21 | 49.78 | 80.63 | 31.93 | 2,676 |
| | M+σ | 232 | 101 | 355 | 146 | 291 | 44 | 19,415 |
| | M+2σ | 770 | 215 | 1,317 | 431 | 1,053 | 62 | 140,845 |
| | M+3σ | 2,546 | 456 | 4,873 | 1,268 | 3,805 | 88 | 1,021,752 |
| Hg | min | 10 | 10 | 10 | 10 | 10 | 20 | 20 |
| | max | 4,000 | 4,000 | 1,500 | 260 | 1,500 | 30 | 29,000 |
| | σ | 0.477 | 0.597 | 0.438 | 0.372 | 0.438 | 0.08 | 0.899 |
| | ave.(M) | 35.90 | 37.69 | 35.74 | 42.28 | 22.58 | 22.89 | 1,000 |
| | M+σ | 107 | 149 | 115 | 53 | 98 | 27 | 7,939 |
| | M+2σ | 322 | 589 | 317 | 125 | 269 | 33 | 62,972 |
| | M+3σ | 969 | 2,332 | 871 | 295 | 738 | 40.62 | 499,490 |
| Ba | min | 100 | 160 | 120 | 100 | 100 | 180 | 50 |
| | max | 1,400 | 980 | 1,400 | 1,240 | 1,400 | 220 | 1,620 |
| | σ | 0.200 | 0.185 | 0.203 | 0.213 | 0.206 | 0.037 | 0.307 |
| | ave.(M) | 226.67 | 243.16 | 222.53 | 222.82 | 222.60 | 195.95 | 123.14 |
| | M+σ | 359 | 372 | 354 | 364 | 357 | 213 | 249 |
| | M+2σ | 569 | 569 | 565 | 595 | 569 | 232 | 509 |
| | M+3σ | 902 | 872 | 902 | 974 | 921 | 253 | 1,030 |
| Mg | min | 600 | 2,200 | 1,700 | 1,200 | 1,200 | 600 | 1,050 |
| | max | 38,500 | 16,000 | 38,500 | 35,500 | 38,500 | 20,000 | 61,000 |
| | σ | 0.279 | 0.173 | 0.294 | 0.267 | 0.288 | 0.690 | 0.304 |
| | ave.(M) | 4,671 | 4,520 | 4,849 | 4,306 | 4,698 | 5,646 | 3,255 |
| | M+σ | 8,882 | 6,725 | 9,547 | 7,965 | 9,120 | 27,674 | 6,559 |
| | M+2σ | 16,888 | 10,005 | 17,706 | 18,796 | 14,735 | 135,649 | 13,219 |
| | M+3σ | 32,112 | 14,887 | 39,003 | 27,257 | 34,374 | 664,884 | 26,641 |
| S | min | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | max | 0.04 | 0.025 | 0.04 | 0.02 | 0.004 | 0.005 | 1.21 |
| | σ | 0.553 | 0.535 | 0.545 | 0.563 | 0.554 | 0.429 | 0.793 |
| | ave.(M) | 0.003 | 0.0039 | 0.002 | 0.003 | 0.003 | 0.002 | 0.009 |
| | M+σ | 0.009 | 0.013 | 0.008 | 0.011 | 0.009 | 0.005 | 0.056 |
| | M+2σ | 0.036 | 0.046 | 0.029 | 0.044 | 0.033 | 0.014 | 0.344 |
| | M+3σ | 0.128 | 0.157 | 0.100 | 0.159 | 0.116 | 0.038 | 2.135 |

* N : Number of Samples except mineralized zone

σ : log.

App.12 Drilling Machine and Equipment Used

| | |
|---|---|
| Drilling Machine Model "L-38" | 1 set |
| Specifications: | |
| Capacity | 700m (BQ-WL) |
| Dimensions L x W x 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 "WLMG-15h" | 1 set |
| Specifications: | |
| Piston diameter | 68mm |
| Stroke | 100mm |
| Capacity | discharge capacity 100ℓ/min |
| Dimensions L x W x 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. 1 3　Working Time Analysis of the Drilling Operation in Phase-Ⅱ Survey

| Hole No | Bit siz | Drilling: Drilling length (m) | Drilling: Core length (m) | Shift: Drill-ing (shift) | Shift: Total (shift) | Working man: Engin-eer (man) | Working man: Worker (man) | Working Time: Drilling (h) | Working Time: Other working (h) | Working Time: Recove-ring (h) | Working Time: Total (h) | Working Time: Removing (h) | Working Time: Water transpor-tation (h) | Working Time: Road con-struction and others (h) | Working Time: G.Total (h) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MJP-1 | HX | 4.10 | 0.10 | 1 | 2 | 4 | 12 | 1°50′ | 5°10′ | - | 7°00′ | 9°00′ | | - | 16°00′ |
| | NQ | 236.40 | 235.00 | 35 | 39 | 52 | 152 | 173°40′ | 129°50′ | 9°30′ | 313°00′ | - | | - | 313°00′ |
| | BQ | 160.50 | 160.00 | 17 | 19 | 27 | 82 | 103°20′ | 40°40′ | - | 144°00′ | 9°00′ | | - | 153°00′ |
| | Total | 401.00 | 395.10 | 53 | 60 | 83 | 246 | 278°50′ | 175°40′ | 9°30′ | 464°00′ | 18°00′ | (149°00′) | - | 482°00′ |
| MJP-2 | HX | 4.10 | 3.00 | 1 | 3 | 10 | 30 | 2°30′ | 5°30′ | - | 8°00′ | 18°00′ | | - | 26°00′ |
| | NQ | 206.00 | 204.40 | 28 | 28 | 37 | 109 | 156°30′ | 67°30′ | - | 224°00′ | - | | - | 224°00′ |
| | BQ | 140.90 | 139.60 | 18 | 20 | 28 | 82 | 102°20′ | 49°40′ | 3°00′ | 155°00′ | 6°00′ | | - | 161°00′ |
| | Total | 351.00 | 347.00 | 47 | 51 | 75 | 221 | 261°20′ | 122°40′ | 3°00′ | 387°00′ | 24°00′ | (210°00′) | - | 411°00′ |
| MJP-3 | HX | 4.10 | 1.80 | 1 | 7 | 28 | 69 | 2°30′ | 5°30′ | - | 8°00′ | 59°30′ | | - | 67°30′ |
| | NQ | 176.00 | 173.90 | 32 | 33 | 43 | 110 | 172°20′ | 91°40′ | - | 264°00′ | - | | - | 264°00′ |
| | BQ | 120.70 | 120.40 | 22 | 25 | 36 | 87 | 108°00′ | 84°00′ | - | 192°00′ | 9°00′ | | - | 201°00′ |
| | Total | 300.80 | 296.10 | 55 | 65 | 107 | 266 | 282°50′ | 181°10′ | - | 464°00′ | 68°30′ | (302°00′) | - | 532°30′ |
| MJP-4 | HX | 4.10 | 2.00 | 1 | 3 | 10 | 30 | 2°00′ | 3°00′ | - | 5°00′ | 18°00′ | | - | 23°00′ |
| | NQ | 236.40 | 233.30 | 26 | 26 | 34 | 105 | 130°10′ | 75°20′ | 5°30′ | 211°00′ | - | | - | 211°00′ |
| | BQ | 160.50 | 158.80 | 18 | 20 | 31 | 95 | 98°20′ | 60°40′ | - | 159°00′ | 7°00′ | | - | 166°00′ |
| | Total | 401.00 | 394.10 | 45 | 49 | 75 | 230 | 230°30′ | 139°00′ | 5°30′ | 375°00′ | 25°00′ | ( 97°00′) | - | 400°00′ |
| MJP-5 | HX | 4.10 | 0.60 | 1 | 1 | 3 | 9 | 1°30′ | 2°30′ | - | 4°00′ | 5°00′ | | - | 9°00′ |
| | NQ | 227.40 | 220.10 | 32 | 34 | 46 | 136 | 145°20′ | 128°40′ | - | 274°00′ | - | | - | 274°00′ |
| | BQ | 169.50 | 169.40 | 21 | 26 | 42 | 125 | 114°40′ | 69°20′ | - | 184°00′ | 27°00′ | | - | 211°00′ |
| | Total | 401.00 | 390.10 | 54 | 61 | 91 | 270 | 261°30′ | 200°30′ | - | 462°00′ | 32°00′ | (121°00′) | - | 494°00′ |
| MJP-6 | HX | 4.10 | 0.20 | 1 | 6 | 22 | 66 | 2°30′ | 3°00′ | - | 5°30′ | 48°30′ | | - | 54°00′ |
| | NQ | 206.40 | 200.50 | 29 | 32 | 42 | 121 | 126°00′ | 134°30′ | - | 260°00′ | - | | - | 260°30′ |
| | BQ | 190.50 | 190.30 | 24 | 27 | 39 | 117 | 110°50′ | 103°10′ | - | 214°00′ | 4°00′ | | - | 218°00′ |
| | Total | 401.00 | 391.00 | 54 | 65 | 103 | 304 | 239°20′ | 240°40′ | - | 480°00′ | 52°30′ | (234°00′) | - | 532°30′ |
| Grand Total | | 2,255.80 | 2,213.40 | 308 | 351 | 534 | 1,537 | 1,554°20′ | 1,059°40′ | 18°00′ | 2,632°00′ | 220°00′ | (1,113°00′) | - | 2,852°00′ |

## App. 1 4 Working Time Analysis of the Drilling Operation in Phase-Ⅲ Survey

| 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°30′ | 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. 15 Microscopic Observation of Thin Section of Cores

| 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

App. 16 Chemical Analyses of Cores of Phase-II Survey (1)

| Number | Drill No. | Horizon | Sample No. | Depth | Width | Grade Pb % | Zn % | Ba % | Ag g/t | Cu ppm | Mother rock | Mineralization |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MJP-3 | A-3-1 | DH3-1 | 169.1~171.5 | 2.4 | 0.02 | 4.26 | <0.01 | 3.5 | 44 | L-I Ls | Sp>Ga dis,Ca+Si vn~ntwk |
| 2 | | | -2 | ~171.9 | 0.4 | 0.59 | 0.15 | <0.01 | 8.9 | 24 | L-I Sh | |
| 3 | | | -3 | ~172.9 | 1.0 | 1.17 | 7.68 | <0.01 | 17.0 | 132 | L-I Ls | Sp>Ga dis,Ca+Si vn~ntwk |
| | | | | (Average) | 3.8 | 0.38 | 4.73 | <0.01 | 7.6 | 65 | | |
| 4 | | | -4 | 176.3~177.1 | 0.8 | 0.20 | 8.86 | <0.01 | 15.2 | 100 | L-I Ls | Sp>Ga dis,Si>Ca vn~ntwk |
| 5 | | A-3-2 | -5 | ~178.0 | 0.9 | 0.15 | 0.96 | <0.01 | 5.0 | 32 | L-I Ls | Sp>Ga dis,Si>Ca vn~ntwk |
| 6 | | | -6 | ~178.3 | 0.3 | 0.02 | 0.01 | <0.01 | <0.5 | 12 | L-I Ls | Ca vnt |
| 7 | | | -7 | ~179.4 | 1.1 | 0.34 | 0.01 | <0.01 | 5.7 | 68 | L-I Ls | Ga dis,Ca>Si ntwk |
| 8 | | | -8 | ~180.1 | 0.7 | 0.16 | 0.01 | <0.01 | 3.0 | 580 | L-I Ls | Ga dis,Ca>Si vnt,Cp?,Py |
| 9 | | | -9 | ~180.9 | 0.8 | 0.02 | 0.01 | <0.01 | <0.5 | 8 | L-I Ls | Ca vnt |
| 10 | | | -10 | ~183.7 | 2.8 | 0.24 | 0.37 | <0.01 | 3.7 | 36 | L-I Ls | Sp>Ga dis,Si+Ca vn~ntwk,Py |
| 11 | | | -11 | ~184.2 | 0.5 | 0.01 | 0.01 | <0.01 | <0.5 | Tr | L-I Ls | Ca vnt |
| 12 | | | -12 | ~186.3 | 2.1 | 0.43 | 0.01 | <0.01 | 5.4 | 12 | L-I Ls | Ga dis,Si+Ca vn~ntwk,Py |
| 13 | | | -13 | ~187.3 | 1.0 | 0.10 | 0.01 | <0.01 | 2.3 | 20 | L-I Ls,Sh | Py dis |
| 14 | | | -14 | ~189.1 | 1.8 | 0.50 | 0.07 | <0.01 | 7.4 | 20 | L-I Ls | Ga dis,Si+Ca vn~ntwk,Py |
| 15 | | | -15 | ~191.0 | 1.9 | 0.02 | 0.01 | <0.01 | <0.5 | 12 | L-I Ls,Sh | Ca vnt |
| 16 | | | -16 | ~191.7 | 0.7 | 0.63 | 4.52 | <0.01 | 15.3 | 20 | L-I Ls | Sp>Ga dis,Si>Ca vn~ntwk |
| | | | | (Average) | 15.4 | 0.25 | 0.80 | <0.01 | 4.9 | | | |
| 17 | | | -17 | 210.1~211.8 | 1.7 | 0.54 | 2.02 | <0.01 | 5.7 | 29 | L-I Ls | Sp>Ga dis,Si>Ca vn~ntwk |
| | | A-3-3 | | | | | | | | | | |
| 18 | | | DH2-1 | 288.2~289.7 | 1.5 | 0.01 | 0.05 | <0.01 | <0.5 | | L-I Ls | Si,Ca vnt |
| 19 | MJP-2 | B-2 | -2 | ~290.4 | 0.7 | 0.01 | <0.01 | <0.01 | <0.5 | | L-I Sh | |
| 20 | | | -3 | ~291.0 | 0.6 | 0.23 | 5.74 | <0.01 | 3.9 | | L-I Ls | Sp,Ga dis,Si>Ca vnt,Py dis |
| 21 | | | -4 | ~292.3 | 1.3 | 0.01 | 0.09 | <0.01 | <0.5 | | L-I Sh | Sp,Ga,Si wk dis,Ca vnt |
| | | | | (Average) | 4.1 | 0.04 | 0.89 | <0.01 | 1.0 | | | |
| 22 | | C-2 | -5 | 323.2~323.4 | 0.2 | 0.01 | 0.03 | <0.01 | <0.5 | | L-I Ls | Si dis |
| 23 | | | -6 | ~323.9 | 0.5 | 0.01 | 0.41 | <0.01 | <0.5 | | L-I Ls,Sh | |
| 24 | | | -7 | ~326.0 | 2.1 | 0.01 | 0.56 | <0.01 | <0.5 | | L-I Ls | Sp,Ga dis,Si>Ca vnt |
| 25 | | | -8 | ~328.6 | 2.6 | 0.06 | 1.54 | <0.01 | 0.8 | | L-I Ls | Sp,Ga dis,Si>Ca vnt |
| | | | | (Average) | 5.4 | 0.03 | 1.00 | <0.01 | 0.6 | | | |
| 26 | MJP-4 | B-4 | DH4-1 | 283.4~284.6 | 1.2 | <0.11 | 0.19 | <0.01 | <0.5 | | L-I Sh | Cp wk dis,Ca ntwk |
| 27 | | | -2 | ~285.6 | 1.0 | 0.02 | 0.18 | <0.01 | <0.5 | | L-I Ls | Sp reb+Ga dis,Ca ntwk |
| 28 | | | -3 | ~286.9 | 1.3 | 0.36 | 0.06 | <0.01 | 2.5 | | L-I Sh | Py>Ga dis,Si>Ca vnt |
| 29 | | | -4 | ~289.0 | 2.1 | 0.75 | 0.54 | <0.01 | 7.4 | | L-I Ls | Sp>Cp,Ga dis,Ca>Si vnt |
| 30 | | | -5 | ~289.6 | 0.6 | 0.16 | 4.11 | <0.01 | 2.8 | | L-I Ls | Sp>Ga dis,Si dis,Ca vnt |
| 31 | | | -6 | ~290.1 | 0.5 | 0.02 | 0.05 | <0.01 | <0.5 | | L-I Sh | Si,Ca vnt,Si>Ca vnt |
| | | | | (Average) | 6.7 | 0.33 | 0.62 | <0.01 | 3.3 | | | |
| 32 | | C-4-1 | -7 | 308.5~309.6 | 1.1 | 0.01 | 0.03 | <0.01 | <0.5 | | L-I Ls | Py dis,Ca vnt |
| 33 | | | -8 | ~310.4 | 0.8 | 0.01 | 0.03 | <0.01 | <0.5 | | L-I Ls | Ca,Si vnt |
| | | | | (Average) | 1.9 | 0.01 | 0.03 | <0.01 | <0.5 | | | |
| 34 | | C-4-2 | -9 | 316.2~317.1 | 0.9 | 0.01 | <0.01 | <0.01 | <0.5 | | L-I Ls | Si>Py dis |
| 35 | | | -10 | ~318.1 | 1.0 | 0.01 | 0.02 | <0.01 | <0.5 | | L-I Ls | Sp dis,Ca vn,Si dis |
| 36 | | | -11 | ~319.9 | 1.8 | 0.08 | 0.72 | <0.01 | 0.5 | | L-I Ls | Sp>Ga dis,Si dis~vn,Ca vn |
| 37 | | | -12 | ~320.2 | 0.3 | 0.06 | 11.10 | <0.01 | 5.6 | | L-I Ls | Si>Py>Ga dis |
| 38 | | | -13 | ~320.4 | 0.2 | 0.02 | 0.12 | <0.01 | 0.5 | | L-I Ls | Si>Py dis,Ca vnt |
| | | | | (Average) | 4.2 | 0.04 | 1.11 | <0.01 | 0.9 | | | |

App. 16 Chemical Analyses of Cores of Phase-II Survey (2)

| Number | Drill No. | Horizon | Sample No. | Depth | Width | Grade Pb % | Zn % | Si % | As*/t | Cu ppm | Mother rock | Mineralization |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39 | MJP-6 | A-6-1 | DH6-1 | 168.5~169.5 | 1.0 | 0.13 | 4.26 | <0.01 | 2.0 | 57 | L-I Ls | Sp dis,Si+Ca vnt |
| 40 | | | -2 | ~170.3 | 0.8 | <0.01 | 0.04 | <0.01 | 0.5 | 20 | L-I Sh | Si vnt,wk Sp dis |
| 41 | | | -3 | ~172.4 | 2.1 | 1.81 | 13.90 | <0.01 | 16.8 | 154 | L-I Ls | Sp>Ga dis,Si>Ca vn~vnt |
| 42 | | | -4 | ~173.3 | 0.9 | 0.97 | 0.57 | <0.01 | 7.5 | 16 | L-I Ls | Sp>Ga dis |
| 43 | | | -5 | ~173.9 | 0.6 | 0.11 | 0.04 | <0.01 | 1.0 | 31 | L-I Sh | arg |
| 44 | | | -6 | ~174.6 | 0.7 | 0.82 | 2.96 | <0.01 | 5.6 | 41 | L-I Ls | Si dis,Si vnt |
| 45 | | | -7 | ~176.2 | 1.6 | 1.22 | 0.51 | <0.01 | 11.0 | 21 | L-I Ls | Ca>Sp dis,Si>Ca vnt |
| 46 | | | -8 | ~176.8 | 0.6 | 0.14 | 0.03 | <0.01 | 1.0 | 32 | L-I Sh | cly |
| 47 | | | -9 | ~179.2 | 2.4 | 0.37 | 0.69 | <0.01 | 3.8 | 15 | L-I Ls | Sp,Ga wk dis,Si>Ca ntwk |
| 48 | | | -10 | ~179.4 | 0.2 | <0.01 | 0.01 | <0.01 | <0.5 | 33 | L-I Sh | cly |
| 49 | | | -11 | ~180.8 | 1.4 | 0.09 | 1.11 | <0.01 | 0.8 | 19 | L-I Ls | Ca>Si vn~ntwk |
| | | | | ~181.3 | 0.5 | — | — | (Non core) — | | | | |
| 50 | | | -12 | ~181.5 | 0.2 | 0.02 | 0.01 | <0.01 | 0.8 | 35 | L-I Sh | cly |
| 51 | | | -13 | ~182.4 | 0.9 | 0.31 | 3.84 | <0.01 | 2.5 | 49 | L-I Ls | Sp dis,Ca,Si vnt |
| | | | | (Average) | 13.9 | 0.66 | 3.25 | <0.01 | 6.0 | 45 | | |
| 52 | | | -14 | ~184.8 | 2.4 | 0.02 | 0.04 | <0.01 | <0.5 | 11 | L-I Ls | |
| 53 | | | -15 | ~185.6 | 0.8 | 0.02 | 0.02 | <0.01 | <0.5 | 30 | L-I Sh | arg |
| | | | | | | | | | | | | |
| 54 | | A-6-2 | -16 | ~186.0 | 0.4 | 0.06 | 1.22 | <0.01 | 0.5 | 25 | L-I Ls | Sp dis,Ca vn,Si vnt |
| 55 | | | -17 | ~186.6 | 0.6 | 0.34 | 20.90 | <0.01 | 8.5 | 224 | L-I Ls | Sp,Sg dis,Si dis |
| 56 | | | -18 | ~187.8 | 1.2 | 0.29 | 2.96 | <0.01 | 3.0 | 37 | L-I Ls | Sp,Ga dis,Si vnt |
| 57 | | | -19 | ~188.4 | 0.6 | <0.01 | 0.04 | <0.01 | <0.5 | 15 | L-I Sh | |
| 58 | | | -20 | ~188.8 | 0.4 | 0.66 | 0.24 | <0.01 | 5.8 | 19 | L-I Ls | Si>Ca vnt |
| 59 | | | -21 | ~189.3 | 0.5 | 0.05 | 0.01 | <0.01 | 1.0 | 35 | L-I Sh | |
| 60 | | | -22 | ~190.3 | 1.0 | 1.51 | 0.50 | <0.01 | 14.0 | 17 | L-I Ls | Ga dis,Si>Ca vnt |
| | | | | (Average) | 4.7 | 0.51 | 3.66 | <0.01 | 5.5 | 51 | | |
| 61 | | | -23 | ~191.5 | 1.2 | 0.05 | 0.01 | <0.01 | <0.5 | 10 | L-I Ls | |
| 62 | | | -24 | ~191.8 | 0.3 | 0.01 | 0.01 | <0.01 | 1.0 | 36 | L-I Sh | cly |
| | | | | | | | | | | | | |
| 63 | | A-6-3 | -25 | ~193.8 | 2.0 | 0.10 | 1.59 | <0.01 | 0.8 | 23 | L-I Ls | Sp>Ga dis,Ca,Si vnt |
| 64 | | | -26 | ~194.0 | 0.2 | 0.18 | 0.01 | <0.01 | 2.0 | 15 | L-I Sh | |
| 65 | | | -27 | ~196.2 | 2.2 | 0.44 | 0.06 | <0.01 | 3.3 | 10 | L-I Ls | Ga dis,Ca,Si vnt |
| 66 | | | -28 | ~196.4 | 0.2 | 0.10 | 0.01 | <0.01 | 0.5 | 18 | L-I Sh | |
| 67 | | | -29 | ~197.5 | 1.1 | 0.20 | 0.05 | <0.01 | 1.3 | 11 | L-I Ls | Ga dis,Ca>Si vn |
| 68 | | | -30 | ~197.9 | 0.4 | <0.01 | 1.32 | 0.02 | <0.5 | 29 | L-I Sh | arg |
| | | | | (Average) | 6.1 | 0.24 | 0.64 | <0.01 | 0.7 | 21 | | |
| 69 | | | -31 | ~198.1 | 0.2 | <0.01 | 0.12 | <0.01 | <0.5 | 9 | L-I Ls | Ga dis,Si,Ca vnt |
| 70 | | | -32 | ~199.3 | 1.2 | 0.03 | 0.11 | <0.01 | <0.5 | 12 | L-I Ls | |
| | | | | | | | | | | | | |
| 71 | | A-6-4 | -33 | ~199.7 | 0.4 | <0.01 | 4.79 | <0.01 | <0.5 | 38 | L-I Ls | Sp dis,Si,Ca vnt,Py |
| | | | | | | | | | | | | |
| 72 | | | -34 | ~200.2 | 0.5 | <0.01 | 0.06 | <0.01 | <0.5 | 14 | L-I Ls | |
| 73 | | | -35 | ~201.1 | 0.9 | <0.01 | 0.02 | <0.01 | <0.5 | 30 | L-I Sh | arg |
| 74 | | | -36 | ~202.1 | 1.0 | <0.01 | <0.01 | <0.01 | <0.5 | 11 | L-I Ls | Ca,Si vnt |
| | | | | | | | | | | | | |
| | | | | (Ground Av) | 33.6 | 0.38 | 1.99 | <0.01 | 3.7 | 34 | | |
| 75 | | | -37 | 326.7~327.1 | 0.4 | <0.01 | <0.01 | 0.23 | <0.5 | 10 | Ls | Si,Ca vnt |
| | | | | | | | | | | | | |
| 76 | MJP-5 | B-5 | DH5-1 | 215.0~215.2 | 0.2 | 0.12 | <0.01 | <0.01 | 1.3 | | L-I Sh | Si>Ca vnt |
| 77 | | | -2 | ~215.8 | 0.6 | 0.39 | 1.89 | <0.01 | 3.7 | | L-I Ls | Sp>Ga dis,Si,Ca vnt |
| 78 | | | -3 | ~216.8 | 1.0 | 0.09 | 0.40 | <0.01 | 0.8 | | L-I Ls | Sp>Ga dis,Si,Ca vnt |
| | | | | (Average) | 1.8 | 0.19 | 0.85 | <0.01 | 1.8 | | | |
| | | | | | | | | | | | | |

App. 17 Chemical Analyses of Cores of Phase-III Survey (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 |

App. 17 Chemical Analyses of Cores of Phase-III Survey (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 |

App. 17 Chemical Analyses of Cores of Phase-III Survey (3)

| Drill No. | Posi-tion | 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 |

App. 1 8. Microscopic Observation of Polished Section of Cores of Phase-Ⅱ Survey

| Sample No. | Minerals | | | | | | Position & mineralization |
|---|---|---|---|---|---|---|---|
| | Sp | Ga | Py | Cp | Ma | He | |
| DH3- 1-1 | ◎ | | △ | | | | 170.0m, Sp>Si dis, Si>Ca vnt. |
| DH3- 1-2 | ◎ | | △ | | • | | 170.5m, Sp>Si dis, Si+Ca vnt. |
| DH3- 1-3 | ◎ | • | △ | | • | | 170.8m, Sp>>Si dis, Ca>Si vnt. |
| DH3- 1-4 | ○ | | △ | | | | 171.3m, Sp dis, Ca>Si vnt. |
| DH3- 1-5 | △ | | | | ○ | | 171.5m, Sp dis, Ca+Si vnt. |
| DH3- 3 | ◎ | △ | △ | | | | See Table-Ⅱ-2-20. |
| DH3- 4 | | ○ | △ | | | | ditto |
| DH3- 5 | ○ | △ | △ | | | △ | ditto |
| DH3- 7 | • | ○ | △ | | | | ditto |
| DH3- 8 | △ | | • | ○ | | △ | ditto |
| DH3-10 | ◎ | | △ | | | | ditto |
| DH3-12 | | ○ | △ | | | | ditto |
| DH3-14 | | ○ | △ | | | | ditto |
| DH3-16 | ◎ | △ | △ | | | | ditto |
| DH3-17 | ◎ | • | △ | | | | ditto |

Legend ◎: abundant ○: common △: a few •: rare

Sp: Sphalerite Ga: Galena Py: Pyrite Cp: Chalcopyrite

Ma: Marcasite He: Hematite Ca: Calcite Si: Siderite

App. 19　Microscopic Observation of Polished Section of Cores of Phase-Ⅲ Survey

| Sample No. | Posi-tion(m) | Minerals Sp | Ga | Py | Cp | Li | He | Ce | Sm | Tn | El | Ma | Si | Ca | Mc | Do | Q | Ab | Au | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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

## App. 2 0　X-ray Diffraction Analyses of Cores

| Sample No. | Minerals | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sp | Ga | Py | Cp | Qz | Si | Ca | Ak | Se | Ch |
| DH2- 3 | ○ | • | | | ◎ | ○ | ○ | ○ | | • |
| DH3- 1 | △ | | | | △ | ◎ | ○ | △ | | △ |
| DH3- 3 | ○ | △ | | | ○ | ○ | ○ | △ | | • |
| DH3- 4 | ○ | | | | ○ | ○ | • | | | |
| DH4- 4 | • | • | △ | | ○ | ○ | • | • | | |
| DH4- 6 | | | • | | ◎ | △ | △ | △ | • | |
| DH5- 2 | △ | | | | ○ | ○ | ○ | ○ | | • |
| DH6- 3 | ○ | △ | | | ○ | ○ | • | △ | | |
| DH6-17 | ○ | • | | | △ | ○ | • | • | | |
| DH6-20 | • | • | | | ○ | ○ | △ | | | |

Legend　◎: abundant　○: common　△: a few　• : rare

Sp: Sphalerite　Ga: Galena　Py: Pyrite　Cp: Chalcopyrite

Qz: Quartz　Si: Siderite　Ca: Calcite　Ak: Ankerite

Se: Sericite　Ch: Chlorite

See Table-II-2-20 about the position and mineralization of each samples.