AN INTERIM REPORT ON
THE PRE-FEASIBILITY STUDY FOR THE DEVELOPMENT
IN
TSAV AREA, MONGOLIA
(PHASE I)

MARCH, 1993

JAPAN INTERNATIONAL COOPERATION AGANCY
METAL MINING AGENCY OF JAPAN

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Preface:

In response to a request from the Mongolian government the Japanese government initiated geological surveys for the purpose of local area development in Tsav, an area located in the eastern part of Mongolia's Dolnot prefecture. These surveys were entrusted to Japan International Cooperation Agency(JICA). As the scope of these surveys were in the areas of geological and mineralogical sciences, JICA further commissioned the actual undertaking of the surveys to Metal Mining Agency of Japan (MMAJ).

In 1992, the first year of this project, MMAJ dispatched a preliminary survey team and a conference was held with the Mongolian government regarding the undertaking of this survey. Rules and regulations regarding these surveys were confirmed on July 30, 1992. In accordance to these adopted rules and regulations, a survey team consisting of seven members was consigned to the area from August 31 to September 19, 1992 to initiate the planning of the surveys to be conducted. Further, also in conjunction to the first year of the survey period, a survey team was dispatched to the area from January 31 to February 11 1993.

Through the cooperation of the relevant organs of the Mongolian government, our surveys of the designated area were completed as scheduled.

This report represents a collection of the first year's surveying results, and will be included as part of the final report.

In closing, we would like to extend our deep appreciation to the related organs of the Mongolian government, as well as the Ministry of Foreign Affairs, the Ministry of International Trade and Industry, the local area Japanese Embassy, and to each of the many companies involved.

March 1993

Kensuke YANAGIYA
President
Japan International Cooperation Agency

Takashi ISHIKAWA
President
Metal Mining Agency of Japan

SUMMARY

SUMMARY

The first year's survey:

(1) Analysis of existing data

Through the identification and analysis of the mineral deposits, an understanding of the TsaV ore deposit's total mineral content was obtained and guidelines for the planning of a future mining project in the area were established.

(2) Tunnel Prospecting

To help facilitate the tunnel prospecting that is to be conducted in fiscal 1993, arrangements are made for the supply and transportation of all necessary provisional set-up equipment and materials.

(3) Mineral Tests

Proceeding to the designated area, samples of Tsav's ores were collected and general mineralogical tests as well as basic tests for specific minerals were conducted for the purpose of obtaining the basic data necessary to frame a working plan.

The resulting data from these tests indicated the following:

(1) Analysis of existing data

1) Excluding the No,4 vein, A summary of ore reserves was 567,050 tons consisting of 6.73% lead, 4.03% zinc, and 314 grams of silver per ton.

2) Most of the mineralized zones in this area are confined to a region between the surface and the 500m level and have thicknesses of 300m or less.

3) The sections of the mineralized zones of medium to high grade on the grade distribution map are between the 600m and 700m levels.

4) No.8 vein, which was most heavily investigated in the Tsav deposit above the horizontal tunnel, is assumed to have a 200m

horizontal extent and a 100m vertical thickness.

5) Judging from the tunneling and trenching maps, the existing percentage of ore is 18% in the tunnels and 36% in the trenches with an arithmetic average of 27%.

(2) Tunnel Prospecting

To help facilitate the tunnel prospecting that are to be conducted in fiscal 1993, arrangements were made for the supply and transportation of all necessary provisional set-up equipment and materials on march 8,1993. The equipment and materials are expected to arrive at the designated site on April 10, 1993.

(3) Mineral Tests

1) Sphalerite and galena are major mineral of the Tsav ore (#4 Vein),followed by pyrite and chalcopyrite. As a minor component, tetrahedrite is detected. Mineral combination observed through the microscope is simple. The main mineral ore grains are coarse to medium (Generally 1.0 to 1.5 mm in size) and the paragenetic relationship is generally homogeneous.

2) The gangue mineral of the Tsav ore (#4 Vein)consists of quartz,carbonate ore, and sericite. Rhodochrosite ($MnCO_3$) and calcite ($CaCO_3$) were detected as carbonate ores.

3) The true specific gravity (Average value)of 4.187 was obtained after measuring three times. When carrying out a full scale survey and test, another measurement shall be taken by adjusting the product grade with a plural number of ores.

4) Work index (Average value)of Tsav ore of 10.84 has been obtained by measuring twice.

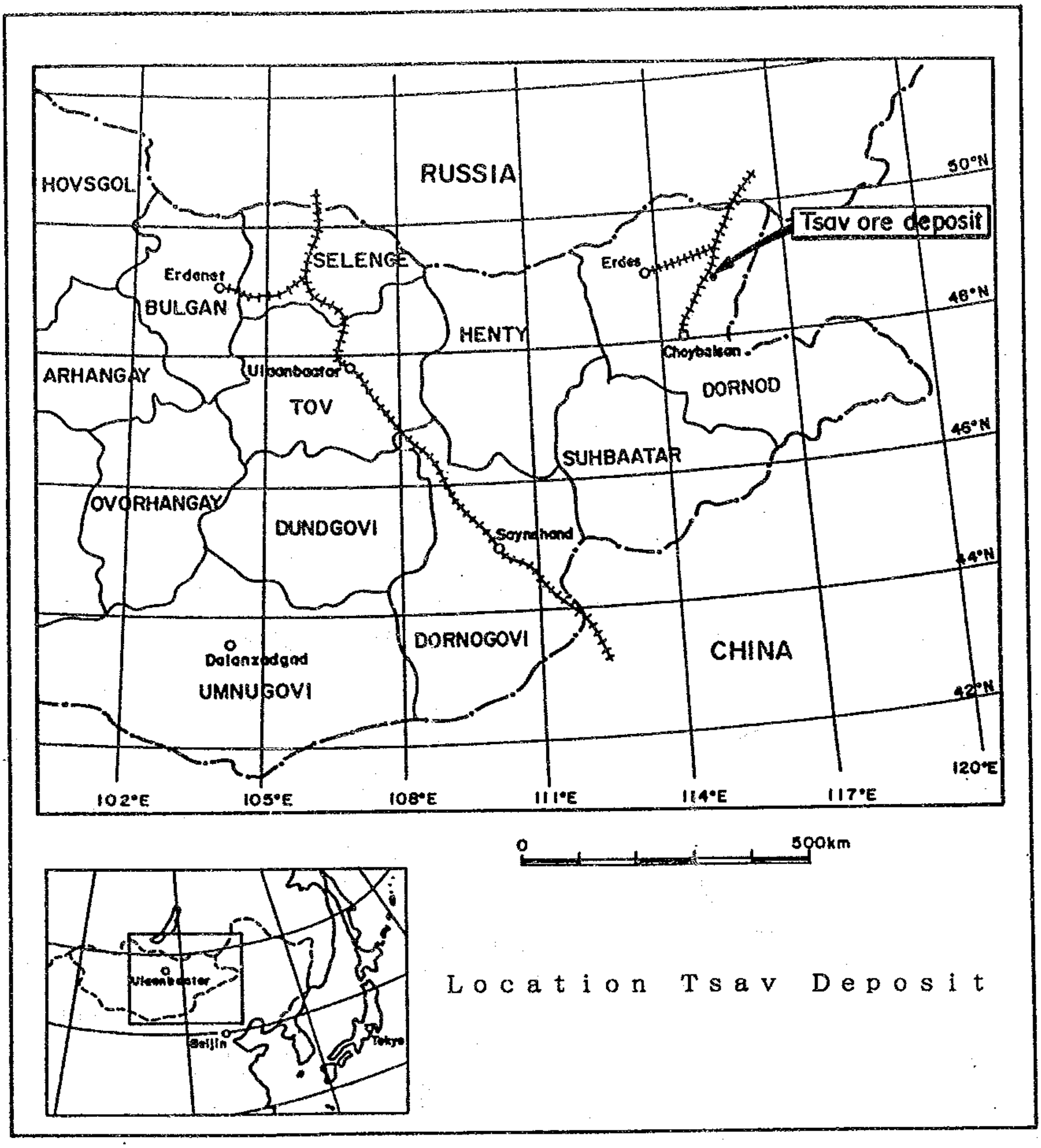
5) Under microscopic observation of the testing ore, it was proved that the main minerals are composed of coarse or fine grains whose size are between 1.0 and 0.5 mm, and that they liberate at coarse grain.Flotation size is presumed relativery coarse.

6) The total Recovery of Pb rougher concentrate + Zn rougher concentrate exceeded 97% for both of Pb and Zn, as well as the results of the tactile test.Therefore test criteria was thought to be appropriate roughly.

7) This time ,Pb and Zn rougher flotation were executed without cleaning. As a depression for Fe is not sufficient, it is necessary to examine the execution of cleaning, the type of depressant, and the quantity of addition when implementing the coming full-scale test.

8) The ore contained 0.05% of As, an analysis of the As grade in flotation concentrate and tailing, and an examination on flotation behavior were not executed in this test, and will be studied in the full-scale test. In particular, deterioration of the As grade in the concentrate shall be considered.

9) Au and Ag in the ore are basically accumulated to Pb and Zn concentrates (Particular the Pb concentrate), the total recovery was high exceeding 90~95%. If Pb and Zn cleaning flotation are executed,the recovery may decrease. In the Full-scale test, the increase in the recovery shall be studied (Au and Ag grade deterioration in the Zn concentrate and Tailing).



Location Tsav Deposit

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Part I GENERAL REMARKS

Part I. General Remarks

Chapter 1. Introduction

1-1 Scope of the survey

Mongolia possesses an exceptional potential for the production of virtually all types of metal ores. Presently, copper, molybdenum, tin, and fluorite are produced there. By tapping and developing its resources, we anticipate that Mongolia will also become an important supplier of the world's future increased demands in copper, lead, and zinc, etc.

Reform of Mongolia's economic structure has progressed steadily since 1987. However, in recent years, the scale of its resource development efforts has scaled down considerably due to diminished technological cooperation from the former Soviet Union and other Eastern European Countries. This scaling down of Mongolia's mineral resource industry, an industry vital to the country's acquisition of foreign currency, has caused the industry to enter a period of stagnation.

Our concentrated surveys in Tsav, an area in the northeastern section of Mongolia's Dolnot prefecture, indicate an exceptional potential for a commercially feasible mine. The Mongolian government has also expressed a strong interest in the development of the area and in February of 1992 helped provide the technological cooperation necessary for our country's survey of the area's potential in the production of lead, zinc, copper,and silver.

The development of a new mine will have a significant effect on the economic growth of Mongolia while at the same time establishing an additional stable supply of metal ore resources for the global market. From these perspectives it is necessary that we support the development of this area without reservation. For these reasons, new budgetary measures for the development planning surveys have been devised and our country's project structure has been adjusted accordingly.

Under these circumstances, our country dispatched a preliminary survey team and held a conference with the Mongolian government regarding the surveys to be conducted. And, on July 30, 1992, the rules and regulations regarding the surveys to be conducted were established. Under these formally established rules and regulations, a survey team consisting of seven members was consigned to the designated area between August 31 and September 19 and the framing of the plans for the survey project was initiated.

1-2 An outline of the adopted rules and regulations

(1) Test objective:
Along with the appropriate organ of the Mongolian government (Ministry of Geology and Mineral Resources), the JICA and MMAJ cooperatively studied matters necessary for the development of Tsav's deposit.

(2) Survey outline:

1. Object of survey: Tsav mine potential for silver, lead, zinc, and other metal ores.

2. Survey period: Three years commencing in 1992.

3. Survey content: To prepare a survey design, to conduct tunnel prospecting, boring surveys (analysis of the survey results is to be completed in Japan) and surveys for the design of a production mine (Pre F/S).

4. Survey plan: To be established through a conference between the Mongolian Ministory of Geological and Mineral Resources, JICA and MMAJ.

(3) Report:

JICA and MMAJ will present an interim report and final report (with a copy in English).

(4) Other:

1. The Mongolian government will strive to provide the necessary support to ensure smooth progress of the surveys (guarantee the safety of the survey teams, facilitate the import and

return of necessary equipment and materials, provide other necessary materials, provide transport of items out of the country, and provide assistance from people in addition to the survey team's Mongolian counterpart members).

2. Japan will be responsible for dispatching the survey teams and through the survey process transfer the necessary technology to its Mongolian counterparts.

1-3 Organization of the survey teams

The negotiating and planning members and the on site survey team members are as follows:

1-3-1 Survey Programming and Negotiation

(1) Japanese side

Shozo SAWAYA	(MMAJ)
Takeshi OGITSU	(〃 Peijing office)
Noboru HOMMA	(MITI)
Koh NAITOU	(JICA)
Hideya METSUGI	(MMAJ)
Taro KAMIYA	(〃)
Tsuyoshi SHIROMIZU	(Interpreter ICSC,JICA)

(2) Mongolian Side

Zaahuugiin BARAS	(SGC)
Tsegmidiin TSOGT	(MTI)
Lodoidanbyn NASANBUYAN	(MTI)
Jam'yangiin TSEND-AYUSH	(SGC)
Oidovyn CHULUUN	(SGC)

1-3-2 Survey of Planning

Naoto AIZAWA	(OMRD)
Akira SAKUMA	(〃)
Masakazu KAWAI	(〃)
Kazuo OOKUBO	(〃)
Hideto KASAHARA	(〃)
Katsuhiko ENOMOTO	(〃)

Masayoshi NISHIO (〃)

1-3-3 Survey Team

(1) Japanese side

Kunitoshi OE (MINDECO)

(2) Mongolian Side

Lodoin AYUR (MGMR)

MMAJ :METAL MINING AGENCY OF JAPAN
MITI :THE MINISTRY OF TRADE AND INDUSTRY OF MONGOLIA
JICA :JAPAN INTERNATIONAL COOPERATION AGENCY
SGC :THE STATE GEOLOGICAL CENTER OF MONGOLIA
MTI :THE MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY
OMRD :OVERSEAS MINERAL RESOURCES DEVELOPMENT Co.,LTD.
MINDECO:MITSUI MINERAL DEVELOPMENT ENGINEERING Co.,LTD.
MGMR :THE MINISTRY OF GEOLOGY AND MINERAL RESOURCES OF MONGOLIA

Chapter 2. Topographical conditions of the designated area.

2-1 Location and transportation

The Tsav mineral deposits are in the Somon area of the Choybalsan district of the Dolnot prefecture in the eastern region of Mongolia. It is located approximately 120 kilometers northeast of Choybalsan City (refer to map of the survey location). The first area surveys,conducted in 1989, encompassed an area of approximately 45 km^2 and included the Tsav ore deposits. As indicated on the map, this area is located between a north latitude of 48° 50′ to 49° 00′ and an east longitude of 115° 15′ to 115° 30′ . The geographical coordinates at the heart of the Tsav ore deposits which includes an area of approximately 12 km^2 is at a north latitude of 48° 55′ 40″ and an east longitude of 115° 20′ 33″ .

Approximately 45 kms west of the Tsav ore deposits is the main trunk line of the Siberian Railway which runs in a southerly direction from Siberian Railway's Bolsha Station across the border towards Choybalsan to Elentsab (Sorobefusuku), and then on to Choybalsan (Bayan Toumen). The distance to the neighboring Habilka Station is approximately 17 kms.

An unpaved road which is manageable throughout the year runs between the Tsav ore deposits and Choybalsan. The distance takes approximately three hours by car. In July of 1992, a new customs house (the name in Chinese reads 35 Kokuzantou Customs) was established at the border of the autonomous Chinese Mongolian State located approximately 50 kms east southeast of the Tsav ore deposits. For three months following July the customs house conducted business during the first half of each month. From the Tsav ore deposits the customs house can be reached by car over an unpaved road in approximately ninety minutes.

2-2 Topography

The Tsav topography is a moderate one which includes a small but long, extinct volcano and a hilly terrain undulating intermittently with open plains. Its topography is characteristic of mountainous regions. The slope gradient of the Tsav ore deposit area does not exceed 5 to 10 degrees. It is a moderately hilly terrain with smooth slopes. The highest peak is 825 meters above sea level. The difference between the lowest mountain ridge and valley is 50 to 80 meters. A scattering of trailing vegetation is widely distributed over the Tsav ore deposit area. This is the primary vegetation which grows in the surrounding loamy soil. This not yet firmly established vegetation can be found in the valleys, on the top of the hills, and on the mountain ridges. The density of these trailing plants are 0.5 to 3.5 meters on the mountain ridges and hilltops, and 5 to 15 meters in the valleys. Protruding rock formations are extremely rare and usually appear in the shape of narrow and small mountain ridges.

2-3 Vegetation and Climate

Vegetation of the Tsab ore deposit area is typical of steppe lands with a variety of grain plants and an absence of trees. The nearest wooded area is located towards the northwest and is approximately 150 kilometers away.

The climate reflects characteristics that are typical of a continental dry environment. The daily and annual changes in temperature and atmospheric pressure is striking. Winter consists of many windy days with little precipitation. On the average, annual snowfall does not exceed 80 to 150 millimeters. The daily temperature changes in spring are severe. Dry air, strong winds, and sand storms are characteristic of that season. Summer is short and mild. The temperature differences between day and night are severe. The primary wind direction is northwest with an average speed of three to five meters per second. The maximum wind speed is between 20 to 25 meters per second. The average temperature throughout the year is 0℃. The lowest recorded temperature is -37.5℃ (1987). The highest recorded temperature is -37.5℃ (1982). According to the Choybalsan meteorological observatory, the average annual rainfall for the region is 244 millimeters. However, according to the Eldes Town (Maludai Mine) observatory, the average annual rainfall is 402 millimeters.

The table belows shows the average temperature and rainfall on a monthly basis (courtesy of the Eldes meteorological observatory).

Month	1	2	3	4	5	6	7	8	9	10	11	12
Temp. (℃)	-20	-18	-8	0	+11	+16	+18	+16	+9	+1	-10	-17
Rainfall (mm)	3	2	4	11	15	51	91	117	36	3	7	3

The depth of the frozen earth surface in winter is between 2.4 to 4.2 meters. By the end of June, the surface completely thaws. There are not permanently frozen surfaces in the designated area. There are no continuously flowing springs or watercourses in the vicinity of the Tsav ore deposits. The Bellan River which runs 40 kilometers south of the Tsab ore deposits completely freezes over during severe winters. The Bellan River is the principal river of the Eastern Mongolia district. From records obtained from the Choybalsan water surveys the annual average water flow of the river is 16.5 cubic meters per second. In a rare area near the Tsab undulating ore deposit tract is a slightly salty lake. This lake, however, dries up during the extremely dry periods.

Part Ⅱ PARTICULARS

Part II. Particulars

Chapter1 Analysis of Previous Works

1-1 Data used in analysis

Information from the following sources has been analyzed.

Surface geological maps	:1:5000 and 1:1000 scale
Geological sketch of trenches (No.6 Vein)	:1: 200 scale
Geological sketches of tunnels (No.8 Vein)	:1: 200 and 1: 500 scale
Diamond drilling sections	:1:1000 scale

Geological data from this area is not adequate to allow structural analysis of the geology. The names given to veins in previous works have been adopted in this paper, although there is some confusion in previous works regarding the structural geology of the area.

1-2 Mode of mineralized zone occurrence

Ten major veins (No.1 to 10) and eight subordinate veins (No.1A, 1B, 2A, 2B, 3A, 4A, 6A and 8A), exist in the area. Fourteen of these eighteen veins are sizable and may contain appreciable ore reserves. They are veins No.1, 1A, 1B, 2, 2A, 2B, 4, 4A, 6, 8, 8A, 10, 2 hanging wall(HW) and 8 foot wall(FW). All of these veins except No.4 and 4A were investigated in this study.

An underground geological sketch of No.8 vein (scale 1:200) and a geological sketch of trenches through No.6 vein (scale 1:200) have been provided for this study.

1-2-1 Trenching of No.6 vein

No.6 vein is located in the western study area. It is parallel to No.4 vein to the east and No.8 vein to the west. It strikes N-S in the north and NW-SE in the south. A trench about 700 meters in length has been dug at the south end of the northern part of the vein. Samples have been taken from the vein at 5 meter intervals in the trench. The following has been revealed from the sketch of the trench and assay results.

1) The vein occurs in an alteration zone.

2) The width of the alteration zone varies from a few meters to over ten meters.

3) The strike of the vein varies from N-S to NNW-SSE over intervals of a few meters to tens of meters.

4) The vein generally dips steeply (60-85) to the east, but it dips more gently when the strike of vein is NNW-SSE.

5) There are six ore blocks above a 3% (Pb+Zn) cut off grade. The average strike length of these ore blocks is 41 meters and their average width is 0.74 meters. The maximum length and width are 110 and 1.09m and the mean strike length is 20 meters.

6) The average grade of the samples taken is 12.43% Pb, 0.96% Zn , 187g/t Ag, 0.70g/t Au.

1-2-2 No.8 vein at the 630m level of the tunnel

No.8 vein is located in the west of the study area. It strikes N-S in the north and NNW-SSE in the south. A drift has been driven along the vein for about 170m in the northern part of the area and the vein has been cross cut at 5 to 20m intervals.
Sorted channel samples have been taken at 3m intervals in the drift and from the wall of cross cut drives.
From this work and assay of the samples, the following geological setting for the vein system has been revealed.

1) The vein occurs only in the alteration zone.

2) The width of the vein varies from a few meters to tens of meters.

3) The strike of the vein periodically varies from N-S to NNW-SSE or NNE-SSW at intervals of tens of meters.

4) The vein dips steeply eastward (50-70) in areas where it strikes N-S, and it dips more gently to the east (40-60) where it strikes NNW-SSE or NNE-SSW.

5) There is one ore block 30m long and 1.14m wide in this vein.

6) The average grade of the ore block is 2.13% Pb, 6.24% Zn, 9.76g/t Ag and 0.07g/t Au.

1-2-3 Summary of the geological setting of the vein.

The following can be concluded from the geological information obtained by trenching and tunneling.

1) The vein is confined to the alteration zone.

2) The alteration zone is several meters to tens of meters in width.

3) The strike of the vein varies periodically.

4) The ore block in this vein is 20 to 40 meters long and about one meter wide.

5) The lead and gold grades are higher and the zinc grade is lower near surface.

6) Since there is no correlation between the silver and lead grades, the presence of silver minerals is assumed.

1-3 Ore grade distribution

The distributions of lead, zinc and silver ore grades in the 12 sizable veins have been derived from analytical values shown on diamond drilling sections.
The maximum ore grades in these veins are 48.69% lead, 21.63% zinc and 2,983g/t Ag. Iso-grade contours shown on the spectral maps delimit ore of the following ranks.

	Rank		Rank		Rank		Rank		Rank
Pb		1%		3%		7%		15%	
Zn	1	1%	2	2%	3	4%	4	9%	5
Ag		30g/t		100g/t		300g/t		1,000g/t	

These contours are drawn based upon the supposition that high grade

zones are always surrounded by low grade zones.
The ore grade ranks used in this paper are defined in the figure above. Areas with grades of rank 2 or higher are called mineralized zones.

1-3-1 No.1 Vein

1) Lead grade

Three zones of lead mineralization have been confirmed in the survey area.

In the northern and southern, mineralized zones which have rank 5 and 4 grades outcrop but in the central part of the survey area the mineralization is blind. These three mineralized zones can be combined to one zone. The northern and central bodies show a zonal distribution of ore grade which is centered at about the 700 meter level. The pattern of this zonal arrangement is relatively simple.

2) Zinc grade

Mineralized zones of zinc which are rank 4 or higher grade are distributed in 6 areas between the 600 and 700m levels (slightly south of and deeper than the lead mineralization zone).

3) Silver grade

Though the pattern of silver ore grade distribution is irregular, zones of anomalous silver mineralization occur in the northern and southern parts of the survey area. The southern silver ore zone occurs in the southern zone of lead mineralization.

There are two notable features in the zone of silver mineralization. The first is a silver mineralized zone of rank 3, which is accompanied by a central lead mineralized zone. The second is a silver mineralized zone of ranks 3 and 4 located in the low grade lead zone on the north side of the northern lead mineralization zone.

1-3-2 No.1A Vein

1) Lead grade

Two zones of lead mineralization have been found in vein 1A. In these zones there are three areas above the rank of 4. All of these areas are in the northern body and the high grade zone is centered at around 700m depth.

2) Zinc grade

There are two zones of zinc mineralization in this vein. In these zones ore which has a rank of 4 or more occurs in 3 areas. Two of these areas are in the northern body and one of them is in the southern body. The high grade zone is spread between the 600 and 700m levels in the northern body.

3) Silver grade

The silver mineralization in this vein occurs in a single zone. Ore which is over the rank of 4 is found in 3 areas, two of which nearly coincide with a high grade lead zone.

1-3-3 No.1B Vein

1) Lead grade

There are 3 zones of lead mineralization in vein 1B. There is rank 4 data at the surface of the northern body in the northern part of the survey area. This data has been neglected, however, because drilling data from 10m below the surface is not described in the analytical results. Samples over the rank of 4 were found in 2 areas of the southern body. The sample which showed the highest lead rank was situated at the surface and the other was located below the 600m level.

2) Zinc grade

There are three zones of zinc mineralization in this vein which nearly coincide with zones of lead distribution, while they are somewhat deeper. Ore over rank 4 is seen in the central body and ore of rank 5 is found in the southern body. The center of the ore distribution is between the 600 and 700m levels.

3) Silver grade

Five zones of silver mineralization occur in this vein. These mineralized zones can be divided into two areas which are in the northern and southern lead bodies. There is an area of rank 4 silver occurrence which coincides with rank 5 lead occurrence in this vein.

1-3-4 No.2 Vein

1) Lead grade

Four zones of lead mineralization occur in vein 2. Two of these have been neglected in the interpretation, in that they were detected in only one drill hole.

Ore which is over the rank of 4 is seen 4 areas, three of which are located in southern body. Rank 5 ore exists in two areas in southern body. One of these areas is between surface and 700m level and the other is between the 700 and 600m levels. The ore distribution is centered around the zone of highest grade. In the northern body, the highest grade zone is situated at the 500m level at the center of the ore grade distribution.

2) Zinc grade

Vein 2 contains two zones of zinc mineralization. One of these 7 is accompanied by a deeper mineralized zone of lead, which is not mentioned in the lead grade section above. This zone is smaller than the zone of lead mineralization. Rank 4 ore occurs in three areas. Two of which coincide with zones of rank 4 lead ore bodies.

3) Silver grade

There are three zones of silver mineralization in vein 2, two of which are deep ore bodies. The location of the third zone coincides with a combination of the northern and southern lead bodies. Ore of rank 4 or higher is seen in 6 areas. Half of them are near the surface and the other half are between 600 and 700m depth.

1-3-5 No.2A Vein

While there are five zones of lead mineralization in vein 2A, all of them are small.

Zinc mineralization was found in three areas which coincide with the three central lead bodies.

There are three zones of silver mineralization in this vein. One of them encompasses the area of the southern three lead zones.

The lead and silver ore of highest rank was found at the surface, and the highest grade zinc was found between the 600 and 700m levels. These high grade zones are isolated and lack continuity, however.

1-3-6 No.2B Vein

There are two zones of lead mineralization in this vein and the zinc and silver mineralization occurs in one zone which coincides with northern of these two lead bodies. Lead over the rank of 4 was found between the 600 and 700m levels.

1-3-7 No.2HW Vein

There is one mineralized zone containing lead, zinc and silver in this vein. While the patterns of lead and silver occurrence coincide, the shape of the zinc distribution is similar to that of lead but of more limited extent. Two lead and one zinc anomaly over the rank of 4 are seen in this vein. The high grade lead occurrences are spotty, but high grade zinc ore is widespread at the 700m level.

1-3-8 No.6 Vein

1) Lead grade

There are six areas of lead occurrence in vein 6. These six occurrences can be separated into three ore zones in the northern, central and southern parts of the survey area. The southern ore zone iscomposed of a main body and three satellite bodies.

There is ore over a rank of 4 in two areas of the central body and in two areas south of the main body. These ore occurrences are distributed between surface and the 600m level in the central body with spotty high grade zones and from surface to the 700m level south of the main body.

2) Zinc grade

Eight zones of zinc mineralization occur within the lead zone of this vein. Three of these are in the center of the lead zone and four of them are in the southern part of the lead zone.

There are five high grade (rank 4 or higher) zinc areas. One of them in the central mineralized zone, and two are in the southern mineralized zone. These high grade areas are distributed between the surface and the 700m level.

3) Silver grade

The pattern of silver distribution in this vein is similar to that of lead. The area of silver mineralization, however, is larger in the south and divided and smaller in the center of the mineralized zone. The difference between the distributions of silver and lead mineralization is that the silver zones occur between the northern

and central zones of lead mineralization.
There is one high grade (rank 4 or higher) area in each of the zones of silver mineralization. These high grade areas are between the surface and 700 meters depth.

1-3-9 No.8 Vein

1) Lead grade
Twelve zones of lead mineralization occur in vein 8. The majority of these are concealed ore bodies. Rank 4 ore is seen in seven areas, but the occurrence of high grade ore is spotty. The high grade ore is distributed between the 700 and 400m levels.

2) Zinc grade
There are nine zones of zinc mineralization in this vein and it can be assumed that the ore grade varies violently, due to the scattered distribution of rank 4 ore which occurs in eleven areas between surface and the 200m level.

3) Silver grade
There are five zones of silver mineralization in this vein, distributed in a pattern which is similar to that of the lead mineralization. Samples which rank 4 or higher were found in twelve areas. These high grade samples were taken between the surface and the 400m level and many were found between the 600m and 700m levels.

1-3-10 No.8A Vein

In vein 8A, there are eight zones of lead mineralization, nine zinc zones and eight of silver zones. All of these are relatively small concealed bodies. The distribution of samples with a rank of 4 or more is spotty. There are 3 lead, 4 zinc and 7 silver samples which are of high grade. They occur between the 700 and 300m levels.

1-3-11 No.8B Vein

Each of the ore minerals occurs in one zone of vein 8B. Ore over the rank of 4 is found between the 600 and 700m levels where the lead and silver ores have the highest grades.

1-3-12 No.10 Vein

There are two zones in which each mineral element occurs in vein 10. These zones are distributed between the surface and 700m depth. Silver is the most predominate ore mineral and occurs in the highest grade in each ore body.

1-4 Rough estimate of ore reserves

1-4-1 Norms for setting an ore block

1) Probable ore block

Data from the trench and tunnel sketches has been used to define blocks in which ore occurrence is probable. The following criteria have been used in defining these probable ore blocks.

· Reserves of the following four mineral elements were calculated ; Pb, Zn, Ag and Au. Occurrences of other mineral elements were excluded from the calculations.

· Assay sampling was conducted by a method of classified sampling. The cut off grade was 4% Pb at the point of sampling. This percentage was calculated from a weighted average of sample length.

· In cases in which the grade was less than 4% but more than 2% Pb at the sampling point, the grade of samples from adjacent points was considered. When the grade of samples from two adjacent sample point were found to be above 4% Pb, the two points were considered to forma continuous single ore body.

· The areas of ore zones were measured on an assay map with a scale of 1:200 using a planimeter. Areas were calculated by averaging the values of three consecutive measurements, the error of which was less than 1%.

· The grade of an ore blocks was taken as the weighted average of the ore grade at the sampling points within the block.

· The vertical dimension which is used in calculating the volume of a probable ore block is one half the horizontal extent of the ore block.

Ore blocks have been assumed to have a maximum thickness of 20m and blocks with thicknesses of less than 5m have not been included in ore reserve calculations.

· The areas of the blocks at their upper and lower limits were assumed to be equal in the calculations.

· The volume of ore blocks were calculated by multiplication of the horizontal area of the blocks and their vertical extent.

· The specific gravity of the ore was assumed to be 3.

· In calculation of ore reserves, ore has been assumed to exist throughout each probable ore block and blocks containing less than 10 tons of ore have been ignored.

2) Possible ore block

Surface and the underground drill log data have been used in delineating blocks in which ore may possibly exist. The following criteria have been used to define possible ore blocks.

· Longitudinal cross sections were drawn based on existing drill hole cross sections.

· Points at which drill holes intersect cross sections are plotted on the longitudinal cross sections. The points at which inclined drill holes would intersect the sections have been calculated and these points have been projected onto the sections.

· The grade of ore in possible ore blocks has been estimated from values shown on the existing cross sections of drill holes within the blocks.

· Demarcation of ore blocks was done using a quasi-polygon method connecting zones in which more than 4% Pb was observed in drill holes (hereafter to be called a mineralized hole).

· Adjacent mineralized holes were assumed to form single ore bodies.

· The outer limits of ore blocks were taken to be midway between mineralized and non)mineralized holes.

- In cases in which the midpoint is far from the mineralized hole, ore blocks are limited to 20m vertically or horizontally from the mineralized hole.

- The areas of the ore blocks were measured with a planimeter on the longitudinal cross sections which were drawn at a scale of 1:2,000. The average of three consecutive measurements, with an error of less than 1%, was used as the area of the ore blocks.

- The horizontal lengths of mineralized holes was calculated by the following formula.

$$\text{Horizontal length} = a \cos \alpha + a \sin \alpha \times \tan \beta$$

a:length of mineralized zone on the drill log
α:inclination of the drill hole on the drill hole cross section
β:inclination of the ore vein on the drill hole cross section

- The projected length of drill holes which were oblique to cross sections were plotted on the sections and the formula mentioned above was then used to calculate their horizontal lengths.

- The average horizontal lengths of ore bodies were calculated from the arithmetic average of the lengths of the mineralized holes.

- The grades of the ore blocks were calculated from the weighted average of the horizontal lengths of holes containing Pb, Zn and Ag.

- Volumes were calculated by multiplication of cross section areas and average horizontal lengths.

- An average specific gravity of 3 was used in calculations.

- In the probable ore blocks above the 630m level of No.8 vein, the existing percentage of ore is 50%. In the other ore blocks, the existing percentage of ore is 25%. Blocks with reserves of less than ten tons of ore have be ignored in these calculations.

· The grades of the ore bodies were calculated from a weighted average of their tonnages.

1-4-2 Calculation results

A summary of ore reserves is shown in the following table. Details of the method of calculation and the cross sections used in ore reserve calculations are presented in the appendix of this report.

Table 1-1 Ore reserve estimation

Name of Vein		Volume m³	S.F %	S.G	Reserve t	Ore Grade			
						Pb %	Zn %	Ag g/t	Au g/t
Probable	No. 6	1,813.95	100	3	5,410	12.43	0.96	187	0.70
	No. 8	684.0	100	3	2,050	2.13	6.24	976	0.07
	Subtotal	2,497.95	100	3	7,460	9.60	2.41	404	0.53
Possible	No. 1	143,435.7	25	3	107,490	5.05	6.68	164	
	No. 2	232,624.3	25	3	174,410	7.86	2.67	231	
	No. 6	169,768.0	25	3	127,310	7.77	4.00	204	
	No. 8	162,834.9	29	3	142,560	5.59	3.84	589	
	No. 10	6,440.5	25	3	4,820	4.81	2.98	1,305	
	Subtotal	715,103.4	26	3	556,590	6.69	4.05	313	
Total		717,601.35	26	3	564,050	6.73	4.03	314	

S.F = Safety Factor(Probability) S.G = Specific Gravity

1-5 Characteristics of the Tsav deposit

Some characteristics of the Tsav deposit can be derived from the grade distribution and ore reserve maps. These characteristics are as follows.

1) Most of the mineralized zones in this area are confined to a region between the surface and the 500m level and have thicknesses of 300m or less.

2) The sections of the mineralized zones of medium to high grade on the grade distribution map are between the 600m and 700m levels.

3) The high grade lead, zinc and silver zones almost coincide. High grade zinc, however, tends to occur at greater depth than high grade lead.

4) An overall view of the Tsav deposit reveals that mineralization is shallowest in vein No.2 and that it gradually deepens to both sides of that vein.

5) No.8 vein, which was most heavily investigated in the Tsav deposit above the horizontal tunnel, is assumed to have a 200m horizontal extent and a 100m vertical thickness.

6) Judging from the tunneling and trenching maps, the existing percentage of ore is 18% in the tunnels and 36% in the trenches with an arithmetic average of 27%.

Chapter2. Tunnel Prospecting

2-1 Table of equipment and materials

(refer to appendices B-1)

2-2 Route for Transporting equipment and materials

(refer to appendices B-2)

2-3 Transportation Schedule

M	Day	Note
'93		
2	16	Cargoes arrided at work for packing (packing work)
	25	Preparation for custums entry
	26	Inspection by MMAJ,Application to custums
3	1	Inspection by custums
	2	Permission by custums,Packing in container
	7	a ship arrive at Yokohama Port(“YIN FENG ”)
	8	a ship depart Yokohama Port
	12	a ship arrive at Dalian Port (custums entry at Dalian)
	19	a train depart Dalian Port
4	2	a train arrive at Manzshouli
	5	a truck depart Manzshouli
	10	a truck arrive at mine site

Chapter3. Mineral Tests

3-1 On-site Survey

Visited the Tsav ore deposit in Choybalsan in Mongolia from February 6 to 8, 1993, and brought back about 40 kg of test samples from the No. 4 vein for mineral tests.

3-2 Adjustment of Ore samples

1) Purpose and substance

Tsav ore brought from the No. 4 vein to Japan was adjusted by combining the ore after grade analysis of Cu, Pb, Zn, and Fe.

2) Test Findings

The grade of main component of Tsav ore are shown in Table 3-1.

Table 3-1 Grade of Ore (Tsav #4 Vein)

Element / Sample	Grade [%]			
	Cu	Pb	Zn	Fe
Tsav #4 Ore	0.18	9.36	5.41	8.06

3-3 Identification of Mineral Composition of the Ore

Fundamental properties of Tsav ore (No. 4 Vein) for the flotation test were obtained by defining the basic geological properties (constituent mineral species, grain size, structure, and paragenetic relationship) in tests involving observation under microscope, emission spectro-analysis, ore analysis, major component analysis, and EPMA.

3-3-1 Emission spectro-analysis

The results of Emission spectro-analysis of Tsav Ore are shown in Table 3-2.

Table 3-2 Results of Emission spectro-analysis of Tsav Ore

Element	Data	Element	Data
As	Rare	Mo	Extremely Rare
B	Rare	Sn	Extremery Rare
Mn	Abundant	V	Extremery Rare
Pb	Abundant	Cu	Little
Mg	Abundant	Ag	Little
Si	Abundant	Zn	Abundant
Bi	Little	Ti	Little
Fe	Abundant	Ca	Little
Al	Little	Cr	Rare

① Pb,Zn,Fe,Mn,Si and Mg were detected as abundant component.

② Cu,Ag,Ca,Ti,Al and Bi were detected as little component.

③ Cr,As and B were detected as rare component.

④ Mn,Sn and V were detected as extremely rare component.

⑤ In this anlysis, no elements were detected except for mentioned above.

3-3-2 Chemical analysis

Ingredients were selected for chemical analysis on the basis of emission spectro-analysis results, the results of which are shown in Table 3-3.

Table 3-3 Results of Analisis of Tsav Ore

Element	Data	Element	Data
Au	1.8 g/t	B	<0.01 %
Ag	556.3 g/t	V	<0.01 %
Cu	0.16 %	Mo	<0.01 %
Fe	7.95 %	Sn	<0.01 %
Pb	9.01 %	S	9.51 %
Zn	5.67 %	SiO_2	41.20 %
Cd	0.56 %	Al_2O_3	5.54 %
Mn	5.40 %	CaO	0.64 %
As	0.05 %	MgO	0.50 %
Bi	0.11 %	TiO_2	0.17 %
Cr	<0.01 %*		

*;Less than 0.01%

① The ore is highly valuable due to large amounts of the valuable metals Pb and Zn; the Ag grade is higher than 500 g/t; also contains Au.

② Contains less than 0.01% of minor components (such as Cr, B,and Mo) including As, which is 0.05%.

③ 0.16% of low-grade Cu.

④ Contains 5.40% of Mn of gangue ingredient.

3-3-3 Microscpoic Observation of polishing section

1) Test sample: Ore samples from the No. 4 vein at the Tsav deposit.

2) Test item

(a) Making the polishing section and microscopic observation

(b) X-ray diffraction analysis

(c) EPMA analysis

3) Test results

(a) Microscopic observation -- Refer to microphotograph PL-1 to PL-3

Sphalerite and galena are major components comprizing the main ore, followed by pyrite and chalcopyrite. As a minor component, tetrahedrite is detected. Mineral combination observed through the microscope is simple. The main mineral ore grains are coarse to medium (generally 1.0 to 1.5 mm in size) and the paragenetic relationship is generally homogeneous.

Sphalerite is an idiomorphic and coarse-grain mineral, whose maximum diameter reaches 1.5 mm. Although liquefied chalcopyrite with dropping form apparently shows irregular distribution in the crystal of sphalerite and both grains present a close paragenetic structure with small-scale arrangement along the grain boundary or cleavage. Although galena is idiomorphic and finer-grain mineral than compared to the sphalerite, it has maximum diameter of approximately 2.5 mm. It is produced included in coarse grain of sphalerite.

Pyrite is idiomorphic with a grain size of medium to fine and maximum diameter of approximately 1.0 mm. The crystal contains galena in parts and crystallization seems to have proceeded at a comparatively early age judging from the microscopic observation. Though tetrahedrite is idiomorphic, it is made up of particulates of length approximately 50 μm and has a close paragenetic relationship with sphalerite and chalcopyrite.

(b) X-ray diffraction analysis --- Refer to X-ray diffraction chart

To confirm the presence of a gangue mineral in the testing sample, X-ray diffraction analysis was carried out on the Tsav ore No. 4 vein (Feed for the flotation test: -28 mesh) used in the flotation test.

The results of the analysis are shown in the following table.

	Qz	Cal	Rh	Ser	Gn	Sp	Cp	Py
Feed	◎	△	○	△	◎	○	·	△*

[Abbreviations]

Qz:Quartz, Cal:Calcite, Rh:Rhodochrosite, Ser:Sericite
Gn:Galena, Sp:Sphalerite, Cp:Chalcopyrite, Py:Pyrite

*: ◎;Abundant
○;Common
△;Little
·;Rare

The gangue mineral consists of quartz, carbonate ore, and s sericite.Rhodochrosite ($MnCO_3$) and calcite ($CaCO_3$) were detected as carbonate ores.

(c) EPMA analysis --- Refer to the EPMA test results (EPMA No. 1)

Qualitative surface analysis was executed on a trace quantity of particulates existing in the ore sample (#4 Vein) The optical characteristic is similar to that of tetrahedrite.

The particulate matter has a close paragenetic relationship with sphalerite, galena, and chalcopyrite.

This particulate proved to be argentiferous tetrahedrite as the main components are consisting of Cu, Sb and S, and companying As and Ag as a minor component.

3-4 Measurement of the physical properties of ore

3-4-1 Measurement of the true specific gravity

(1) Method: Measurement by Pycno-meter

True specific gravity shall be calculated using the following formula.

$$S = \frac{a \times d}{a + b - c}$$

S: Specific gravity

a: Mass of testing sample (g)

b: Mass of the pycno-meter, filled to the specified level with dipping liquid (g)

c: Mass of the pycno-meter, containing the test sample and filled to the specified level with dipping liquid (g)

d: Specific gravity of dipping liquid at 23℃ (Specific gravity of water = 0.9975)

Measurement shall be repeated at least 3 times. Then, calculate the average value to 3 decimal places.

(2) Results of measurement

The results of measurement are shown in Table 3-4.

Table 3-4 Specific gravity of Tsav Ore

Measuring times	Specific gravity
No1	4.236
No2	4.164
No3	4.160
Average	4.187

An average value of 4.187 was obtained after measuring three times. This high value is presumed because the testing ore contained 9.01% of Pb, 5.67% of Zn, and 7.95% of Fe.

When carrying out a regular survey and test, another measurement shall be taken by adjusting the product grade with a plural number of ores.

3-4-2 Measurement of grinding work index

(1) Method: Measurement of grinding work index (Hard grove method)

(a) Test sample: After drying the extracted test sample, grind the sample to a size of less than 4760 μm and repeat grinding until the grain size is between 1190 μm and 590 μm.
Prepare the specimen by screening and adjusting the grain.

(b) Equipment: Hardgrove grindability tester.

(c) Calculation: After calculating the Hardgrove Grinding Index (H.G.I.), calculate the grinding Work Index (Wi).

$$H.G.I. = 13 + 6.93\ W$$

(Provided that W is the grain quantity at -200 mesh)

$$Wi = \frac{435}{\{H.G.I.\}^{0.91}}$$

(2) Results of test

The test results are shown in Table 3-5. An average value of 10.84 has been obtained by measuring twice.

Table 3-5 Results of Work index(Wi)Test of Tsav Ore

	+200mesh (g)	-200mesh (g)	H.G.I	Wi (kWh/st)
No1	43.56	6.44	57.629	10.87
No2	43.51	6.49	57.976	10.81
Average	43.54	6.47	57.803	10.84

3-5 Grinding test

Under microscopic observation of the testing ore, it was proved that the main minerals are composed of coarse or fine grains whose size are between 1.0 and 0.5 mm, and that they liberate at coarse grain. So size distribution was obtained after grinding the ore to comparatively coarse grain (+65 Mesh product quantity (%) = 15% level). The abundance distribution rate of valuable metal by grain size was calculated after carrying out a constituent analysis on 7 products, which were obtained by screening the grain into 7 size fractions using Mesh between +65 Mesh and -325 Mesh.

3-5-1 Ore grinding and size distribution

The size distribution of the ore is shown in Table 3-6 and Fig. 3-1.

Table 3-6 Results of Size Analysis of Tsav Ore

SIZE (Mesh)	WEIGHT (g)	WEIGHT (%)
+65	72.90	14.90
-65～+100	63.75	13.03
-100～+150	55.20	11.28
-150～+200	48.10	9.83
-200～+270	36.20	7.40
-270～+325	31.00	6.34
-325	182.17	37.23
合計	489.32	100.00

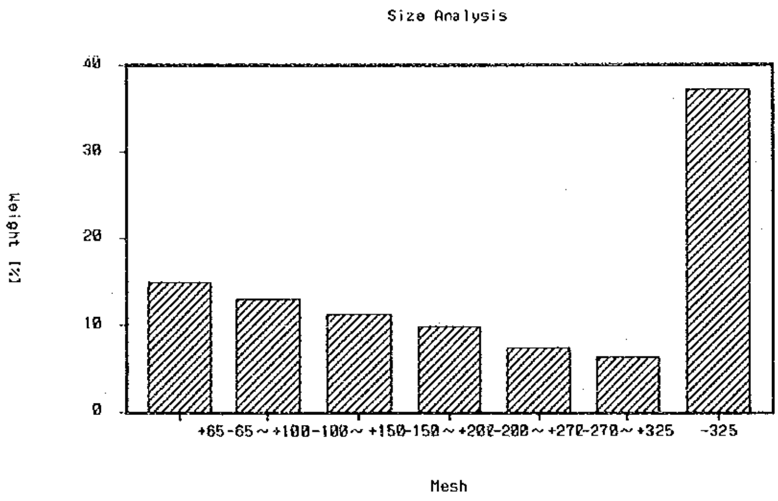


Fig.3-1 Size distribution of Tsav Ore

① About 10% of grain is distributing at size fraction of +325 Mesh

② Although approximately 35% of grain is distributing at size fraction of -325 Mesh, it is not considered to be overgrinding.

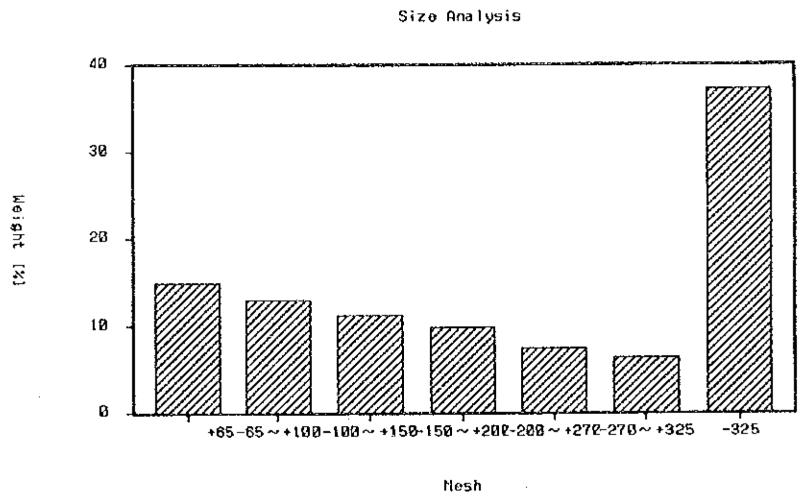


Fig.3-1 Size distribution of Tsav Ore

① About 10% of grain is distributing at size fraction of +325 Mesh

② Although approximately 35% of grain is distributing at size fraction of -325 Mesh, it is not considered to be overgrinding.

Table 3-7 Metal distribution of Tsav ore

SIZE	WEIGHT	WEIGHT	GRADE								METAL DISTRIBUTION							
(Mesh)	(g)	(%)	Cu(%)	Pb(%)	Zn(%)	Fe(%)	As(%)	S(%)	Au(g/t)	Ag(g/t)	Cu(%)	Pb(%)	Zn(%)	Fe(%)	As(%)	S(%)	Au(%)	Ag(%)
+65	72.90	14.90	0.15	6.66	5.70	7.47	0.04	8.70	1.60	358.0	12.8	10.1	14.5	13.8	10.0	13.1	12.4	8.2
-65～+100	63.75	13.03	0.18	10.17	6.44	7.67	0.05	10.02	2.00	606.0	13.4	13.4	14.4	12.4	10.9	13.2	13.5	12.1
-100～+150	55.20	11.28	0.19	11.47	6.55	7.75	0.05	10.66	2.10	677.7	12.3	13.1	12.6	10.8	9.4	12.1	12.3	11.7
-150～+200	48.10	9.83	0.20	11.86	6.56	8.12	0.06	11.21	2.10	837.3	11.3	11.8	11.0	9.9	9.9	11.1	10.7	12.6
-200～+270	36.20	7.40	0.20	12.68	6.58	8.62	0.07	11.90	2.20	854.0	8.5	9.5	8.3	7.9	8.7	8.9	8.4	9.7
-270～+325	31.00	6.34	0.21	12.89	6.66	8.92	0.07	12.23	2.40	903.7	7.6	8.3	7.2	7.0	7.4	7.8	7.9	8.8
-325	182.17	37.22	0.16	8.96	5.01	8.33	0.07	9.03	1.80	650.0	34.1	33.8	32.0	38.2	43.6	33.8	34.8	36.9
合計	489.32	100.00									100.0	100.0	100.0	100.0	99.9	100.0	100.0	100.0

3-5-2 Grade analysis by size fraction

The results of grade analysis of valuable metal by size fraction are shown in Fig. 3-2 and Table 3-7.

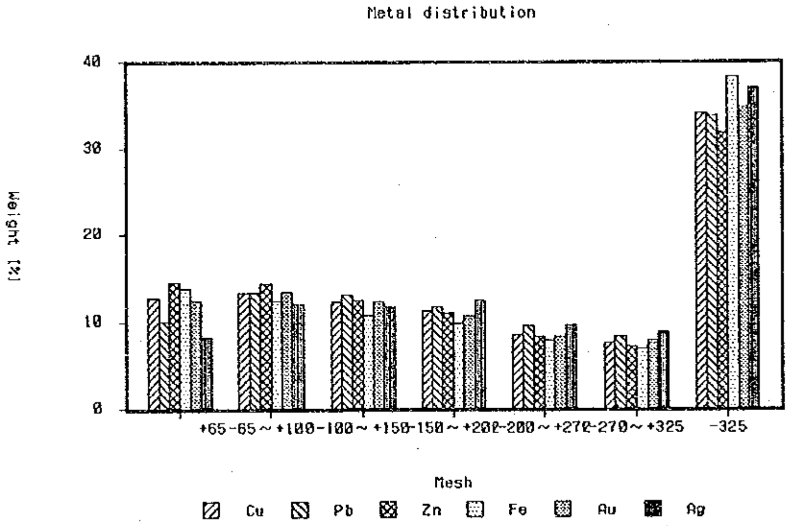


Fig.3-2 Metal distribution of Tsav Ore

① Although a little dispersion is seen due to the metal species, size distribution of metal is almost similar to that of ore such as 10% in +325 Mesh (+65 Mesh to +325 Mesh) and 35% in -325 Mesh.

② The distribution of Au and Ag by abundant size fraction is similar to that of base metal.

③ Each metal is distributed approximately 10% at the coarse part of the grain size (+65 Mesh).

3-6 Flotation characteristic test

(1) Purpose

To estimate the proper combination of flotation reagent and range of additive quantity by direct differential flotation after preparing the specimen to the flotation size presumed in the grinding test. Also, to study the flotation behavior of Au and Ag the concentrations of rougher Pb and Zn obtained in the flotation test were observed under microscope.

3-6-1 Preliminary test (Experimental plan L9 test)

(1) Tactile test

To obtain information on the type and quantity of reagent for the preliminary test, the tactile test was carried out by direct differential flotation as shown in the flow sheet in Fig. 3-3. Only ore crashed into -28 Mesh was used for the following flotation test after grinding with a ball mill. The grinding time is 3 minutes as shown in Fig. 3-4 and the flotation size was set at +65 Mesh with product quantity = 15% as settled at the grinding test.

The results of the test are shown in Table 3-8.

A summary of the test is as follows:

① Total recovery of Pb rougher concentrate + Zn rougher concentrate exceeded 97% for both Pb and Zn. Thus, the conditions set for the tactile test seem to be almost adequate.

② Zn grade (13.32%) at Pb rougher concentrate and Fe grade (18.29%) at Zn rougher concentrate are high, and the distribution factor of each (Recovery rate) is also high. In order to improve these results, the following preliminary test conditions were planned. The following practical conditions were listed in the preliminary test.

(a) Study of Zn depressant at Pb flotation

(b) Raising of pH at Zn flotation (pH9 → pH10)

(c) Increment of Fe depressant ($Ca(OH)_2$) at Zn flotation

(d) Study of collector at Zn flotation

③ As the Cu grade in ore is low, Cu flotation or Cu removed from Pb rougher concentrate was not performed in this test.

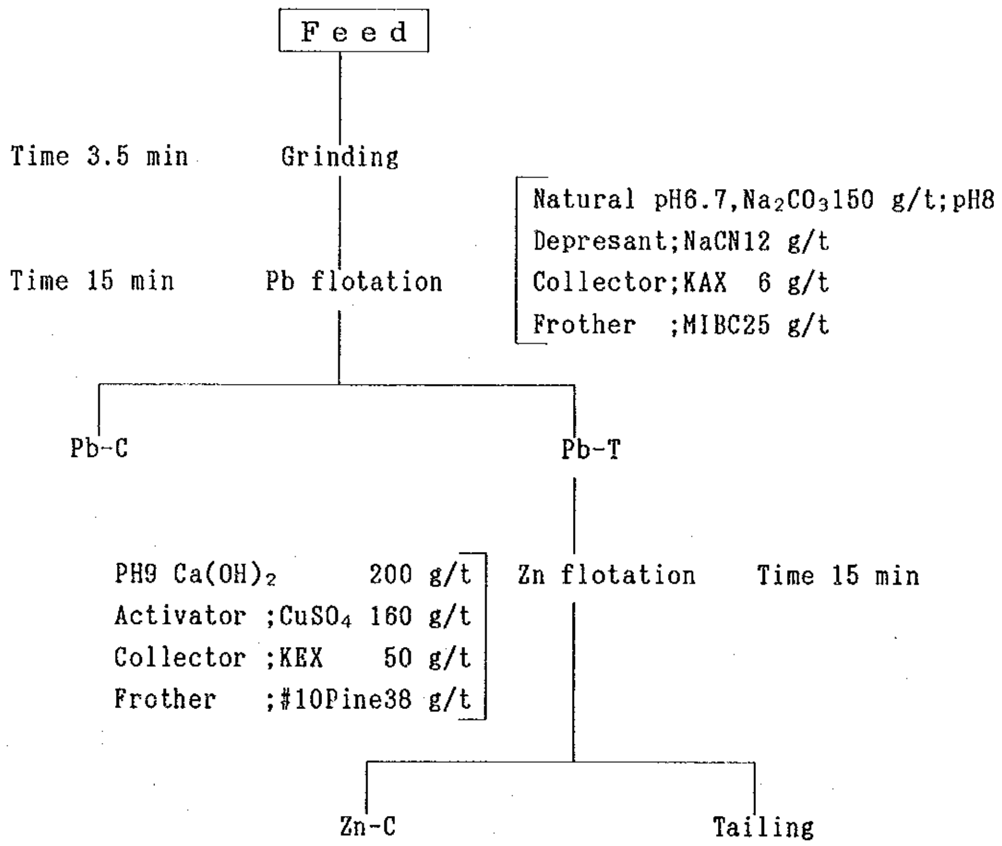


Fig.3-3 Flowsheet of Tactile flotation test

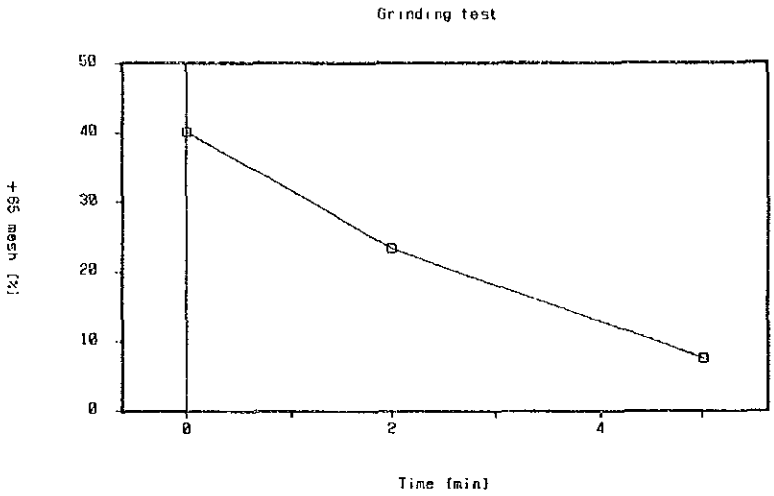


Fig.3-4 Results of Grinding Test of Tsav Ore

Table 3-8 Results of Tactile Flotation Test of Tsav Ore

Sample Name	Weight [g]	Weight [%]	Grade [%]			
			Cu	Pb	Zn	Fe
Feed	498.61	100.00	0.20	9.33	5.14	6.53
Pb-C	81.17	16.28	0.61	53.70	13.32	3.48
Pb-T	417.44	83.72	0.12	0.70	3.55	7.13
Zn-C	74.82	15.01	0.53	2.60	18.84	18.29
T	342.62	68.71	0.03	0.29	0.21	4.69

Sample Name	Weight [g]	Weight [%]	Recovery [%]			
			Cu	Pb	Zn	Fe
Feed	498.61	100.00	100.00	100.00	100.00	100.00
Pb-C	81.17	16.28	49.79	93.68	42.18	8.67
Pb-T	417.44	83.72	50.21	6.32	57.82	91.33
Zn-C	74.82	15.01	39.88	4.18	55.01	42.01
T	342.62	68.71	10.33	2.14	2.81	49.32

(2) Preliminary test based on the experimental plan (L9)

Considering the results of the tactile test, the preliminary test was executed by revising various conditions. The test flow sheet is shown in Fig. 3-5. Basically the same as the tactile test, only Pb and Zn rougher direct differential flotation method was executed and Cu flotation was not. Test conditions of the experimental plan (L9) and test results are shown in Table 3-9 and Table 3-10, respectively.

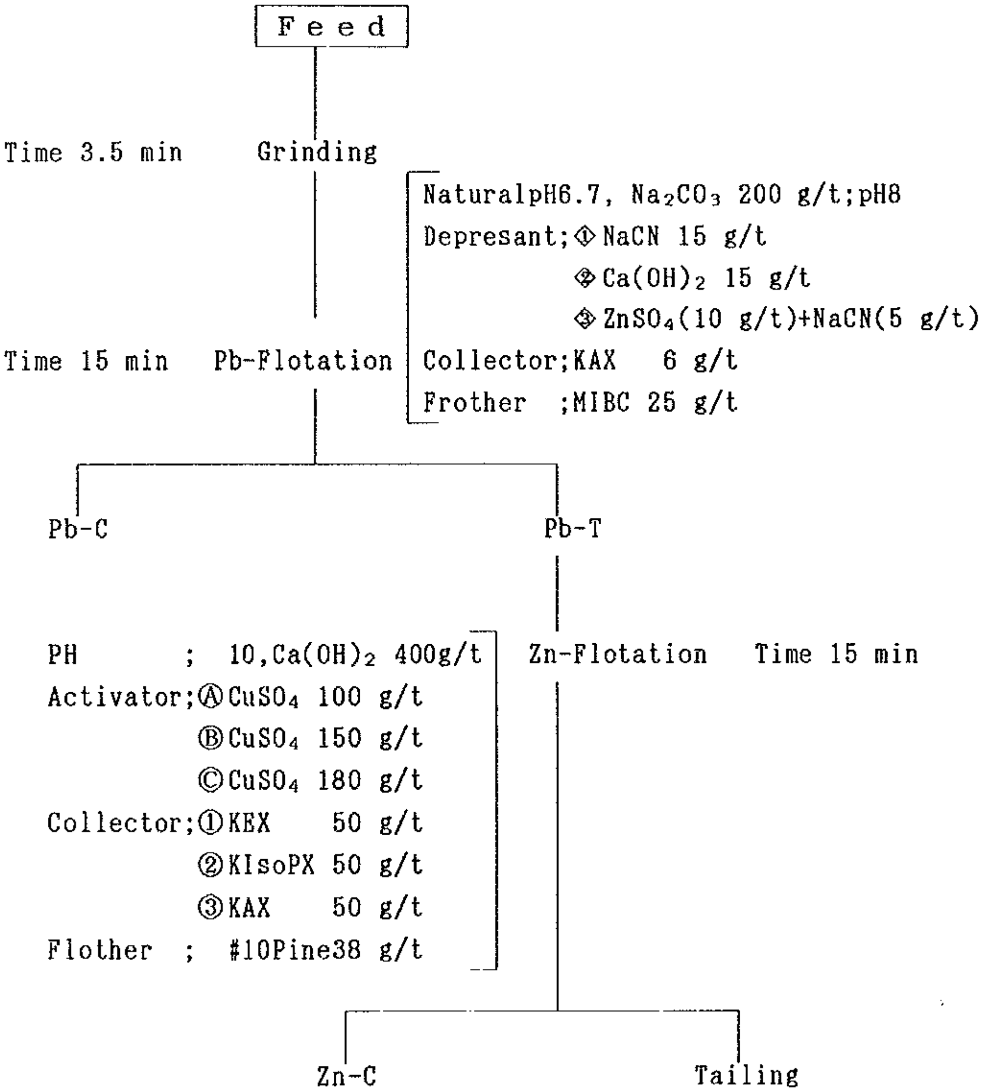


Fig.3-5 Flowsheet of Preliminary Flotation Test of Tsav Ore

Table 3-10 Results of preliminary flotation test of Tsav ore

Sample No Name	Weight [g]	Weight [%]	Grade [%]							Recovery [%]						
			Cu	Pb	Zn	Fe	Au *	Ag *	S	Cu	Pb	Zn	Fe	Au	Ag	S
Feed	499.39	100.00	0.18	8.79	5.11	10.85	2.4	600	9.47	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NO.1Pb-C	82.7	16.56	0.59	47.00	12.79	4.93	9.0	3206	18.51	55.5	88.6	41.5	7.5	62.5	88.4	32.4
(NO.1Pb-T)	416.69	83.44	0.09	1.21	3.59	12.03	1.1	83	7.68	44.5	11.4	58.5	92.5	37.5	11.6	67.6
NO.1Zn-C	51.46	10.30	0.62	7.36	27.70	14.14	1.6	510	24.94	36.2	8.6	55.8	13.4	6.9	8.8	27.1
NO.1T	365.23	73.14	0.02	0.34	0.19	11.73	1.0	23	5.25	8.3	2.8	2.7	79.1	30.6	2.8	40.5
Feed	500.12	100.00	0.16	8.79	4.46	10.21	2.7	591	9.40	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NO.2Pb-C	75.98	15.19	0.54	53.53	9.84	4.72	14.2	3503	18.86	50.8	92.5	33.6	7.0	79.4	90.0	30.5
(NO.2Pb-T)	424.14	84.81	0.09	0.78	3.49	11.19	0.7	70	7.71	49.2	7.5	66.4	93.0	20.6	10.0	69.5
NO.2Zn-C	75.45	15.09	0.48	2.64	18.95	19.84	1.4	291	31.41	44.9	4.5	64.1	29.3	7.8	7.4	50.4
NO.2T	348.69	69.72	0.01	0.38	0.15	9.32	0.5	22	2.58	4.3	3.0	2.3	63.7	12.8	2.6	19.1
Feed	496.85	100.00	0.18	8.33	5.02	10.12	2.5	594	9.32	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NO.3Pb-C	71.56	14.40	0.55	48.85	7.12	4.59	14.8	3524	18.79	44.9	84.5	20.4	6.5	85.4	85.4	29.0
(NO.3Pb-T)	425.29	85.60	0.11	1.52	4.67	11.06	0.4	101	7.73	55.1	15.5	79.6	93.5	14.6	14.6	71.0
NO.3Zn-C	77.32	15.56	0.49	6.49	24.97	16.21	1.0	445	29.68	43.2	12.1	77.4	24.9	6.2	11.7	49.6
NO.3T	347.97	70.04	0.03	0.41	0.16	9.91	0.3	25	2.85	11.9	3.4	2.2	68.6	8.4	2.9	21.4
Feed	499.11	100.00	0.17	8.29	5.30	9.68	2.1	536	9.24	100.0	100.0	100.0	99.9	100.0	100.0	100.0
NO.4Pb-C	75.81	15.19	0.56	44.60	10.14	9.72	11.4	2569	22.83	51.2	81.7	29.1	15.2	82.1	72.7	37.6
(NO.4Pb-T)	423.3	84.81	0.10	1.79	4.43	9.67	0.5	172	6.80	48.8	18.3	70.9	84.7	17.9	27.3	62.4
NO.4Zn-C	69.27	13.88	0.48	8.46	25.83	12.16	1.7	521	28.38	40.2	14.2	67.7	17.4	11.2	13.5	42.6
NO.4T	354.03	70.93	0.02	0.48	0.24	9.18	0.2	104	2.58	8.6	4.1	3.2	67.3	6.7	13.8	19.8
Feed	500.89	100.00	0.18	8.57	4.85	9.22	3.5	590	9.30	100.0	100.0	100.0	100.1	100.0	100.0	100.0
NO.5Pb-C	92.29	18.43	0.51	39.28	8.15	8.86	16.9	2760	23.35	53.5	84.4	31.0	17.8	90.0	86.2	46.3
(NO.5Pb-T)	408.6	81.57	0.10	1.64	4.11	9.30	0.4	100	6.13	46.5	15.6	69.0	82.3	10.0	13.8	53.7
NO.5Zn-C	65.09	12.99	0.47	8.32	24.83	14.32	1.1	510	27.09	34.8	12.6	66.5	20.2	4.1	11.2	37.8
NO.5T	343.51	68.58	0.03	0.37	0.18	8.35	0.3	22	2.16	11.7	3.0	2.5	62.1	5.9	2.6	15.9
Feed	502.21	100.00	0.16	8.63	5.12	9.48	3.1	585	9.24	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NO.6Pb-C	79.71	15.87	0.51	42.98	7.68	11.09	17.4	3057	23.31	50.3	79.0	23.8	18.6	88.7	82.9	40.0
(NO.6Pb-T)	422.5	84.13	0.09	2.15	4.64	9.18	0.4	119	6.58	49.7	21.0	76.2	81.4	11.3	17.1	60.0
NO.6Zn-C	77.09	15.35	0.43	10.15	24.65	15.58	1.4	572	27.65	41.1	18.1	73.9	25.2	6.9	15.0	46.0
NO.6T	345.41	68.78	0.02	0.36	0.17	7.75	0.2	18	1.88	8.6	2.9	2.3	56.2	4.4	2.1	14.0
Feed	499.92	100.00	0.16	7.32	4.20	7.99	2.5	560	9.34	100.0	100.0	100.0	100.1	100.0	100.0	100.0
NO.7Pb-C	89.67	17.94	0.54	38.48	8.59	4.88	11.7	2866	20.07	59.8	94.3	36.7	11.0	83.4	91.9	38.5
(NO.7Pb-T)	410.25	82.06	0.08	0.51	3.24	8.66	0.5	56	7.00	40.2	5.7	63.3	89.1	16.6	8.1	61.5
NO.7Zn-C	50.73	10.15	0.50	1.49	24.69	16.27	1.3	223	31.07	31.3	2.1	59.7	20.7	5.2	4.0	33.8
NO.7T	359.52	71.92	0.02	0.37	0.21	7.59	0.4	32	3.60	8.9	3.6	3.6	68.4	11.4	4.1	27.7
Feed	502.46	100.00	0.15	8.35	5.35	9.72	3.0	587	9.30	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NO.8Pb-C	69.59	13.85	0.57	50.58	10.43	5.26	18.6	3546	19.37	52.6	83.9	27.0	7.5	87.3	83.7	28.9
(NO.8Pb-T)	432.87	86.15	0.08	1.56	4.54	10.43	0.4	111	7.68	47.4	16.1	73.0	92.5	12.7	16.3	71.1
NO.8Zn-C	78.39	15.60	0.41	7.11	24.24	17.87	1.5	518	30.65	42.7	13.3	70.6	28.7	7.9	13.8	51.4
NO.8T	354.48	70.55	0.01	0.33	0.18	8.79	0.2	21	2.60	4.7	2.8	2.4	63.8	4.8	2.5	19.7
Feed	499.93	100.00	0.16	9.17	5.25	9.47	3.3	606	9.44	100.0	100.0	100.0	99.9	100.0	100.0	100.0
NO.9Pb-C	76.95	15.39	0.54	55.88	10.77	5.78	18.8	3588	19.78	52.3	93.8	31.6	9.3	88.3	91.2	32.3
(NO.9Pb-T)	422.98	84.61	0.09	0.67	4.25	10.14	0.5	63	7.56	47.7	6.2	68.4	90.6	11.7	8.8	67.7
NO.9Zn-C	64.13	12.83	0.48	2.08	26.95	13.02	1.3	276	31.44	38.7	2.9	65.8	17.6	5.1	5.8	42.7
NO.9T	358.85	71.78	0.02	0.42	0.19	9.63	0.3	25	3.29	9.0	3.3	2.6	73.0	6.6	3.0	25.0

*; g/t

Table 3-9 Experimental Design Table

NO	A	B	C
1	◇1 NaCN 15g/t	① KEX 50g/t	Ⓐ $CuSO_4$ 100g/t
2	◇1 NaCN 15g/t	② KIPX 50g/t	Ⓑ $CuSO_4$ 150g/t
3	◇1 NaCN 15g/t	③ KAX 50g/t	Ⓒ $CuSO_4$ 180g/t
4	◇2 $Ca(OH)_2$ 15g/t	① KEX 50g/t	Ⓑ $CuSO_4$ 150g/t
5	◇2 $Ca(OH)_2$ 15g/t	② KIPX 50g/t	Ⓒ $CuSO_4$ 180g/t
6	◇2 $Ca(OH)_2$ 15g/t	③ KAX 50g/t	Ⓐ $CuSO_4$ 100g/t
7	◇3 $ZnSO_4$(10g/t)+NaCN(5g/t)	① KEX 50g/t	Ⓒ $CuSO_4$ 180g/t
8	◇3 $ZnSO_4$(10g/t)+NaCN(5g/t)	② KIPX 50g/t	Ⓐ $CuSO_4$ 100g/t
9	◇3 $ZnSO_4$(10g/t)+NaCN(5g/t)	③ KAX 50g/t	Ⓑ $CuSO_4$ 150g/t

Among the anlysis variance of the test data,we showed those which significance can be detected and data from Table 3-11 to Table 3-16 and from Fig. 3-6 to Fig. 3-11.

Table 3-11 Analysis variance of Pb in Zn-Tailing

Zn-T-Pb (After pooling into error terms)

Factor	S *	φ	V *	Fo	
B	2688.92	2	1344.46	1.375	
C	10422.30	2	5211.13	5.330	10% significant
e	3910.92	4	977.73		
T	17022.12	8			

*; × 1/1000000

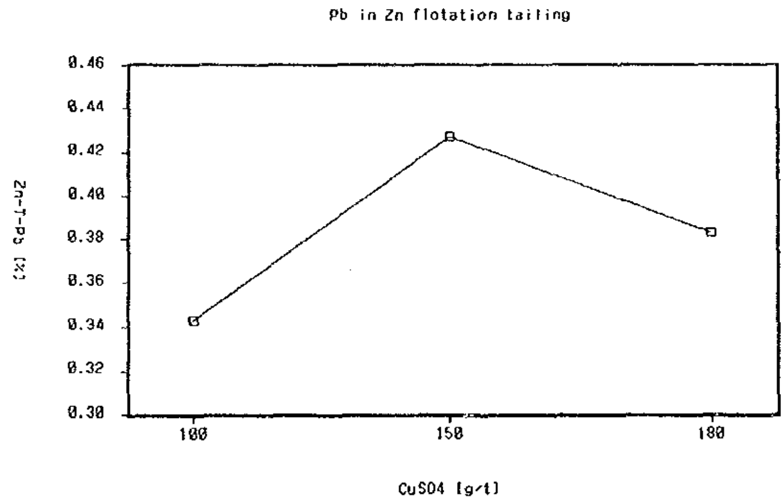


Fig.3-6 Residual Pb in Zn-flotation tailing (Effect of Activator)

Table 3-12 Analysis variance of Zn in Zn-Tailing

Zn-T-Zn (After pooling into error terms)

Factor	S *	φ	V *	Fo	
B	3488.85	2	1744.43	4.486	10% significant
e	2333.31	6	388.88		
T	5822.16	8			

*; ×1/1000000

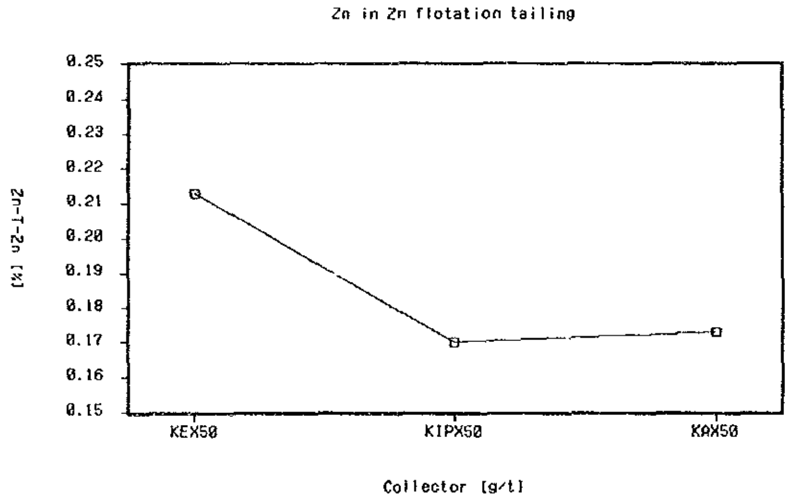


Fig.3-7 Residual Zn in Zn-flotation tailing (Effect of Collector)

Table 3-13 Analysis variance of Pb-Recovery

Pb-Rec (After pooling into error terms)

Factor	S	ϕ	V	Fo	
A	130.8910	2	65.445	4.929	10% significant
C	50.8906	2	25.445	1.916	
e	53.1094	4	13.277		
T	234.8906	8			

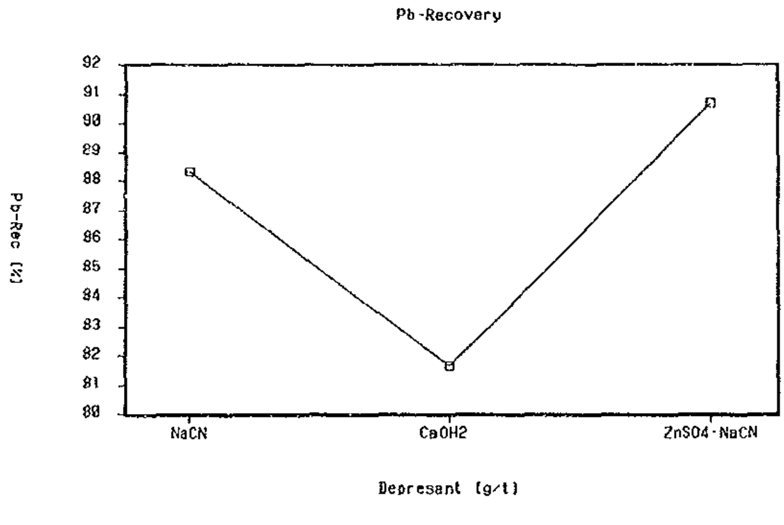


Fig.3-8 Pb Recovery in Pb-concentrate (Effect of Depresant)

Table 3-14 Analysis variance of Pb in Pb-tailing

Pb-T-Pb (After pooling into error terms)

Factor	S	φ	V	Fo	
A	1.43816	2	0.7191	5.269	10% significant
C	0.50776	2	0.2539	1.860	
e	0.54591	4	0.1365		
T	2.49182	8			

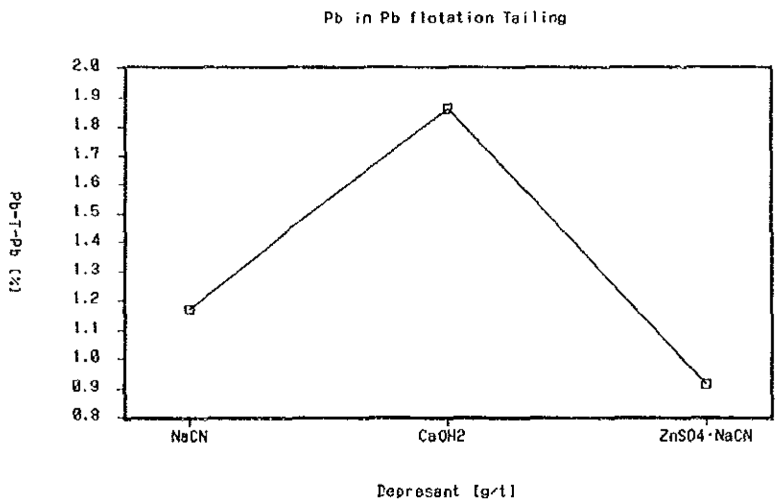


Fig.3-9 Pb in Pb-flotation Tailing(Effect of Depresant)

Table 3-15 Analysis variance of Au in Pb-concentrate

Pb-C-Au (After pooling into error terms)

Factor	S	φ	V	Fo	
A	21.562400	2	10.781200	47.692	1% significant
B	74.295600	2	37.147800	164.327	
e	0.904243	4	0.226061		
T	96.762238	8			

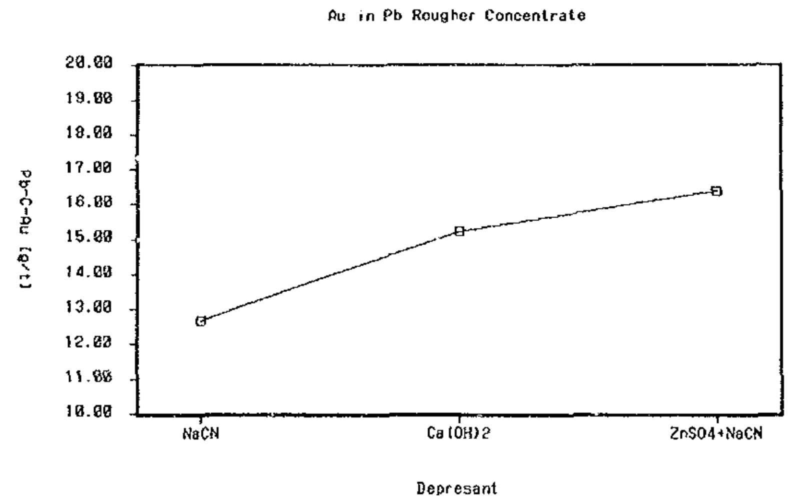


Fig.3-10 Au in Pb-concentrate (Effect of Depresant)

Table 3-16 Analysis variance of Ag in Pb-concentrate

Pb-C-Ag (After pooling into error terms)

Factor	S	φ	V	Fo	
A	674,525.00	2	337,263.00	15.457	5% significant
B	425,405.00	2	212,703.00	9.748	
e	87,276.34	4	21,819.07		
T	1,187,207.00	8			

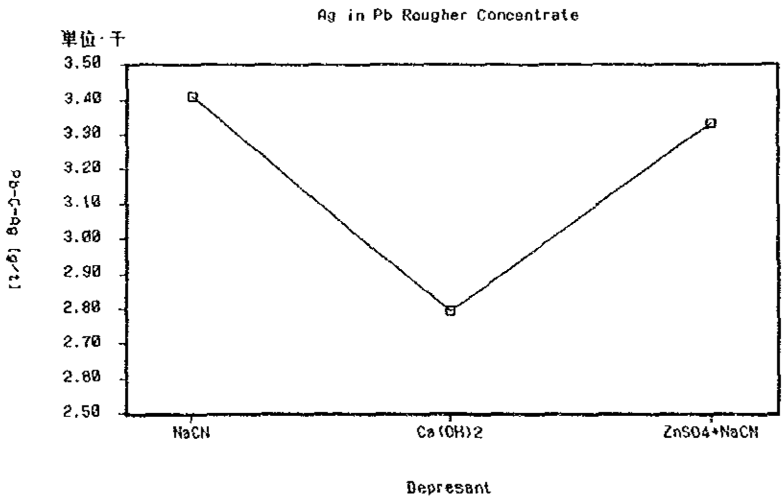


Fig.3-11 Ag in Pb-concentrate (Effect of Depresant)

A summary of flotation test results is as follows:

① Pb grade in Zn rougher tailing has a tendency to increase along with the quantity of additives, while the amount of $CuSO_4$ additive is 100 g/t, the grade remains low.

② Zn grade decreases when high-class collector xanthate (abundant molecular weight such as KIPX and KAX) is used to Zn rougher tailing on the contrary low-class collector (KEX).

③ When NaCN or $ZnSO_4$+NaCN is used in Pb rougher flotation as an depressant, the Pb recovery is higher than compared with $Ca(OH)_2$.

④ When NaCN or $ZnSO_4$+NaCN is used in Pb rougher tailing, the Pb grade decreases in comparison with $Ca(OH)_2$.

⑤ The total Recovery of Pb rougher concentrate + Zn rougher concentrate exceeded 97% for both of Pb and Zn, as well as the results of the tactile test.

⑥ This time Pb and Zn rougher flotation were executed without cleaning. As an degree of depression for Fe is not sufficient, it is necessary to examine the execution of cleaning, the type of depressant, and the quantity of addition when implementing the coming full-scale test.

⑦ In this test, Cu flotation or Cu removing flotation from Pb concentrate were not executed since the Cu grade in the ore was comparatively low. In full-scale tests Cu flotation may be requir ed depending on the Pb and Cu grades in the Pb concentrate and Cu grade in the ore. Further study is necessary.

⑧ As the ore contained 0.05% of As, an analysis of the As grade in flotation concentrate and tailing, and an examination on flotation behavior were not executed in this test, and will be studied in the full-scale test. In particular, deterioration of the As grade in the Zn concentrate shall be considered.

⑨ When $Ca(OH)_2$ or $ZnSO_4$+NaCN is used as a Pb depressant, Au and Ag grades in the Pb rougher concentrate are higher than compared with NaCN.

⑩ As Au and Ag in the ore are basically accumulated to Pb and Zn concentrates (particular the Pb concentrate), the total recovery was high exceeding 90～95%. If Pb and Zn cleaning flotation are executed, the recovery may decrease. However, the result seems to be satisfactory as in the preliminary test. In the full-scale test, the increase in the recovery shall be studied (Au and Ag grade deterioration in the Zn concentrate and tailing.)

3-6-2 Microscopic Observation of polishing section of flotation concentrate products

(1) Test sample: Each specimen of Pb concentrate and Zn concentrate (both of rougher concentrates) was obtained in the above preliminary flotation test.

Chemical composition of the specimen is shown in the following Table.

	Cu	Pb	Zn	Fe	S	Au	Ag
No.9 Pb-C	0.54	55.88	10.77	5.78	19.78	18.8	3588
No.9 Zn-C	0.48	2.08	26.95	13.02	31.44	1.3	276

Units : Cu,Pb,Zn,Fe,S ; %
Au,Ag ; ppm

In the above table it is understood that both Au and Ag have accumulation tendency to Pb concentrate. Compared with the content of Au and Ag (Au: 1.8 ppm, Ag: 556.3 ppm), each grade goes higher ten times for Au and six times for Ag.

(2) Test item

(a) Polishing piece manufacturing and microscopic observation --- No. 9 Pb-c and No. 9 Zn-c

(b) EPMA analysis --- No. 9 Pb-c

(3) Results of the test

(a) Microscopic observation --- Refer to the microphotograph PL-4 to PL-12

No.9 Pb-C: Most galena particles exist as free particles. The main coexistent contaminants of free particles are perceived sphalerite, pyrite, gangue, and chalcopyrite. For bullion minerals, electrum (Au, Ag), argentiferous-tetrahedrite [$(Cu, Fe)_{12}Sb_4S_{15}$] and polybasite [$(Ag, Cu)_{16} Sb_2S_{11}$] are studded. In the test sample, 3 grains of electrum were noticed two of which exist as an inclusion in idiomorphic pyrite of particle size 5 to 20 μm.

The other grain has a long, slender configuration of length 40 μm, and they paragenetically fill up intercrystalline crack between chalcopyrite and sphalerite. Argentiferous-tetrahedrite has mainly observed as an inclusion in galena of particle size 10 to 40 μm. A grain of polybasite was noticed in idiomorphic galena with paragenesis to argentiferous-tetrahedrite.

No. 9 Zn-C: Sphalerite mainly exists in free particles. There are two types of crystals of the particle, one of which contains numerous dropping-form chalcopyrite while the other does contains no chalcopyrite at all. Also, the quantity of Fe containing sphalerite is presumed to be scattered as the particle color changes considerably from red-brown to transparent through transmitted light. As coexisting contaminants, numerous particles of pyrite, a small quantity of gangue, and a trace quantity of galena were observed. Bullion mineral were not noted in the test sample.

(b) EPMA analysis --- Refer to EPMA test results (EPMA No. 2 to No. 5)

EPMA No. 2: Electrum including pyrite.
The eletrum is presumed to contain a comparatively abundant amount of Ag as shown in an X-ray characteristic pattern of An and Ag.

EPMA No. 3: Paragenesis formation of polybasite and tetrahedrite.
Polybasite and tetrahedrite were found in galena of idiomorphic coarse grain. Tetrahedrite has a trace quantity of Ag.

EPMA No. 4: Tetrahedrite included in galena
An X-ray of the Ag characteristic pattern revealed a small quantity of Ag evenly distributed in the tetrahedrite.

EPMA No. 5: Tetrahedrite is closely paragenetic with galena, chalcopyrite, and sphalerite.
Minor component contained in tetrahedrite was presumed to be Zn>Fe.

3-7 Conclusion

① Sphalerite and galena are major mineral of the Tsav ore (#4 Vein), followed by pyrite and chalcopyrite. As a minor component, tetrahedrite is detected. Mineral combination observed through the microscope is simple. The main mineral ore grains are coarse to medium (Generally 1.0 to 1.5 mm in size) and the paragenetic relationship is generally homogeneous.

② The gangue mineral of the Tsav ore (#4 Vein)consists of quartz, carbonate ore, and sericite. Rhodochrosite ($MnCO_3$) and calcite ($CaCO_3$) were detected as carbonate ores.

③ Qualitative surface analysis was executed on a trace quantity of particulates existing in the sample ore (#4 Vein). The optical characteristic is similar to that of tetrahedrite. The particulate matter has a close paragenetic relationship with sphalerite, galena and chalcopyrite. This particulate proved to be argentiferous-tetraahedrite as the main components are consisting of Cu, Sb and S, and companying As and Ag as a minor component.

④ The true specific gravity (Average value)of 4.187 was obtained after measuring three times. When carrying out a full-scale survey and test, another measurement shall be taken by adjusting the product grade with a plural number of ores.

⑤ Work index (Average value)of Tsav ore of 10.84 has been obtained by measuring twice.

⑥ Under microscopic observation of the testing ore, it was proved that the main minerals are composed of coarse or fine grains whose size are between 1.0 and 0.5 mm, and that they liberate at coarse grain.Flotation size is presumed relativery coarse.

⑦ Although a little dispersion is seen due to the metal species, size distribution of metal is almost similar to that of ore such as 10% in +325 Mesh (+65 Mesh to +325 Mesh) and 35% in -325 Mesh.

⑧ The total Recovery of Pb rougher concentrate + Zn rougher concentrate exceeded 97% for both of Pb and Zn, as well as the results of the tactile test.Therefore test criteria was thought to be appropriate roughly.

⑨ This time ,Pb and Zn rougher flotation were executed without cleaning. As a depression for Fe is not sufficient, it is necessary to examine the execution of cleaning, the type of depressant, and the quantity of addition when implementing the coming full-scale test.

⑩ The ore contained 0.05% of As, an analysis of the As grade in flotation concentrate and tailing, and an examination on flotation behavior were not executed in this test, and will be studied in the full-scale test. In particular, deterioration of the As grade in the Zn concentrate shall be considered.

⑪ Au and Ag in the ore are basically accumulated to Pb and Zn concentrates (Particular the Pb concentrate), the total recovery was high exceeding 90～95%. If Pb and Zn cleaning flotation are executed, the recovery may decrease. In the Full-scale test, the increase in the recovery shall be studied (Au and Ag grade deterioration in the Zn concentrate and Tailing).

⑫ It is understood that both Au and Ag have accumulation tendency to Pb concentrate. Compared with the ore content of Au and Ag (Au: 1.8 g/t, Ag: 556.3 g/t), each grade goes higher ten times for Au and six times for Ag.

⑬ Most galena particles of the Pb rougher concentrate exist as free particles. The main coexistent contaminants of free particles are perceived sphalerite, pyrite, gangue, and chalcopyrite.

And for bullion minerals, electrum (Au, Ag), argentiferous-tetrahedrite [$(Cu, Fe)_{12}Sb_4S_{15}$] and polybasite [$(Ag, Cu)_{16} Sb_2S_{11}$] are studded.

Appendices

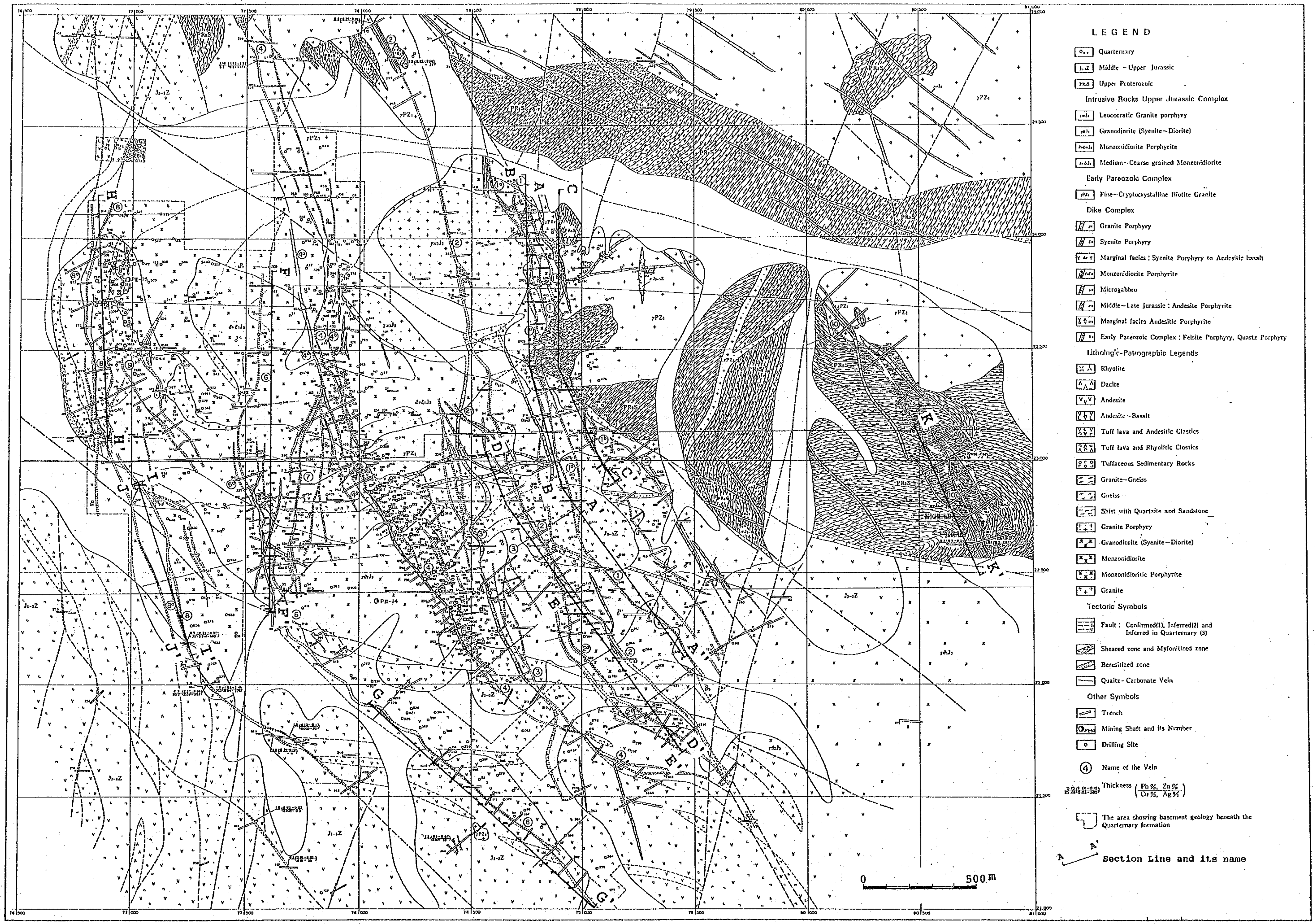
A P P E N D I C E S

A-1 Assay Results showing on the Longiudinal Section of the Tsav Veins

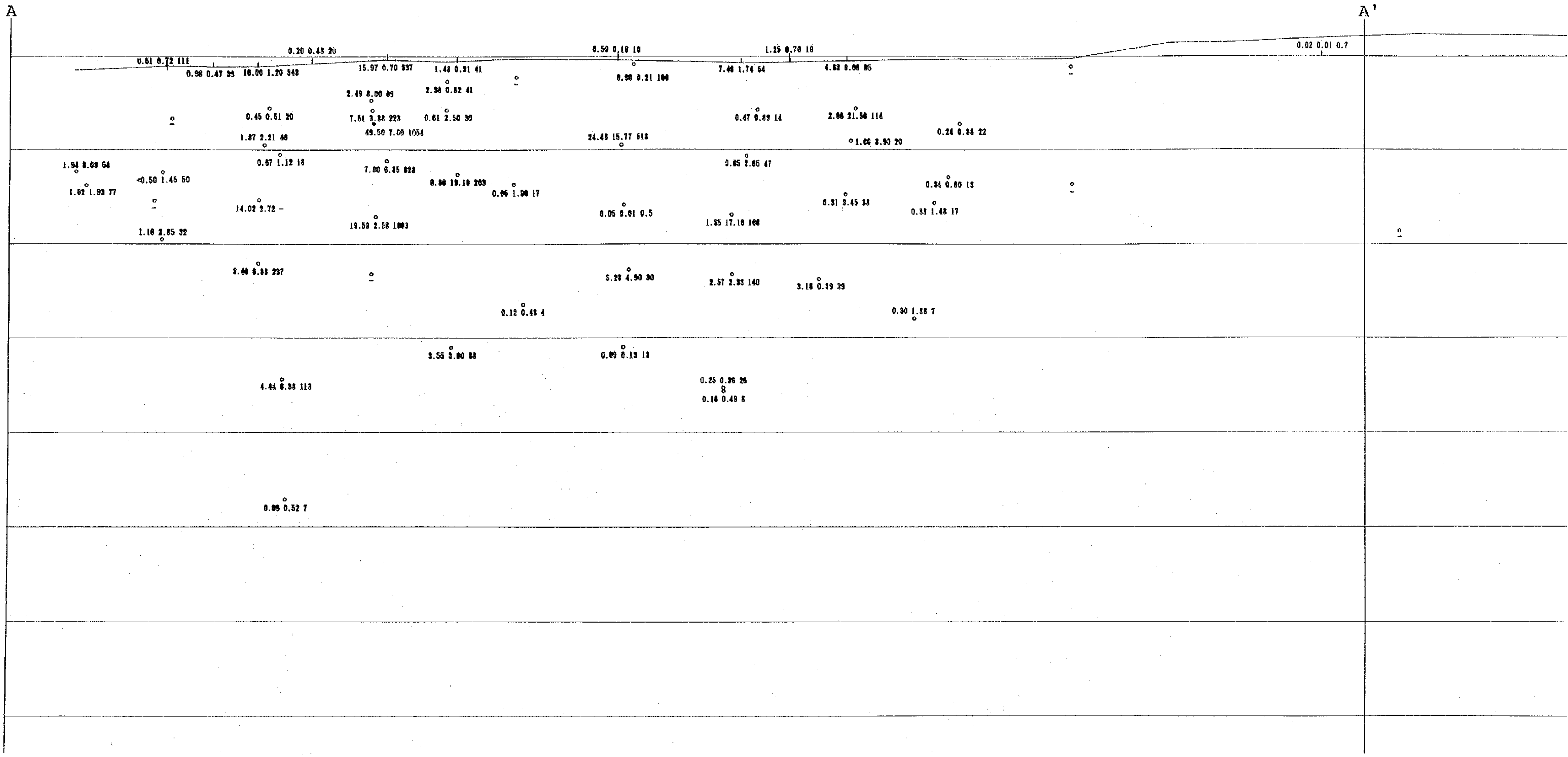
A-2 Spectral Map from the Assay Results showing on the Longitudinal Section of the Tsav Veins

A-3 Ore Reserve Estimation Results

A-4 Ore Blocks Distribution Map on the Longitudinal Section of the Tsav Veins

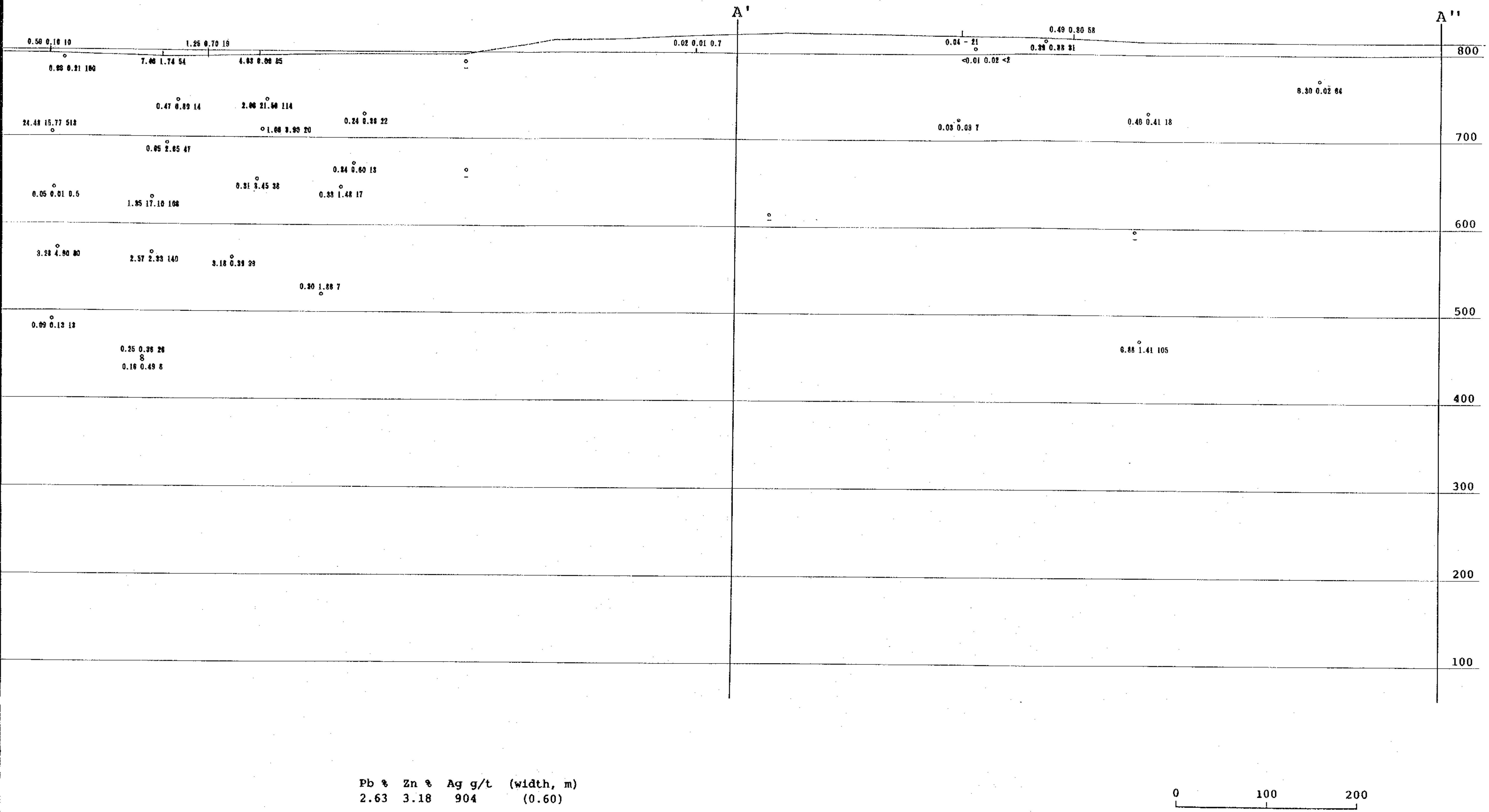


A - 1 - 1 Orientaling map of the Longitudinal Section

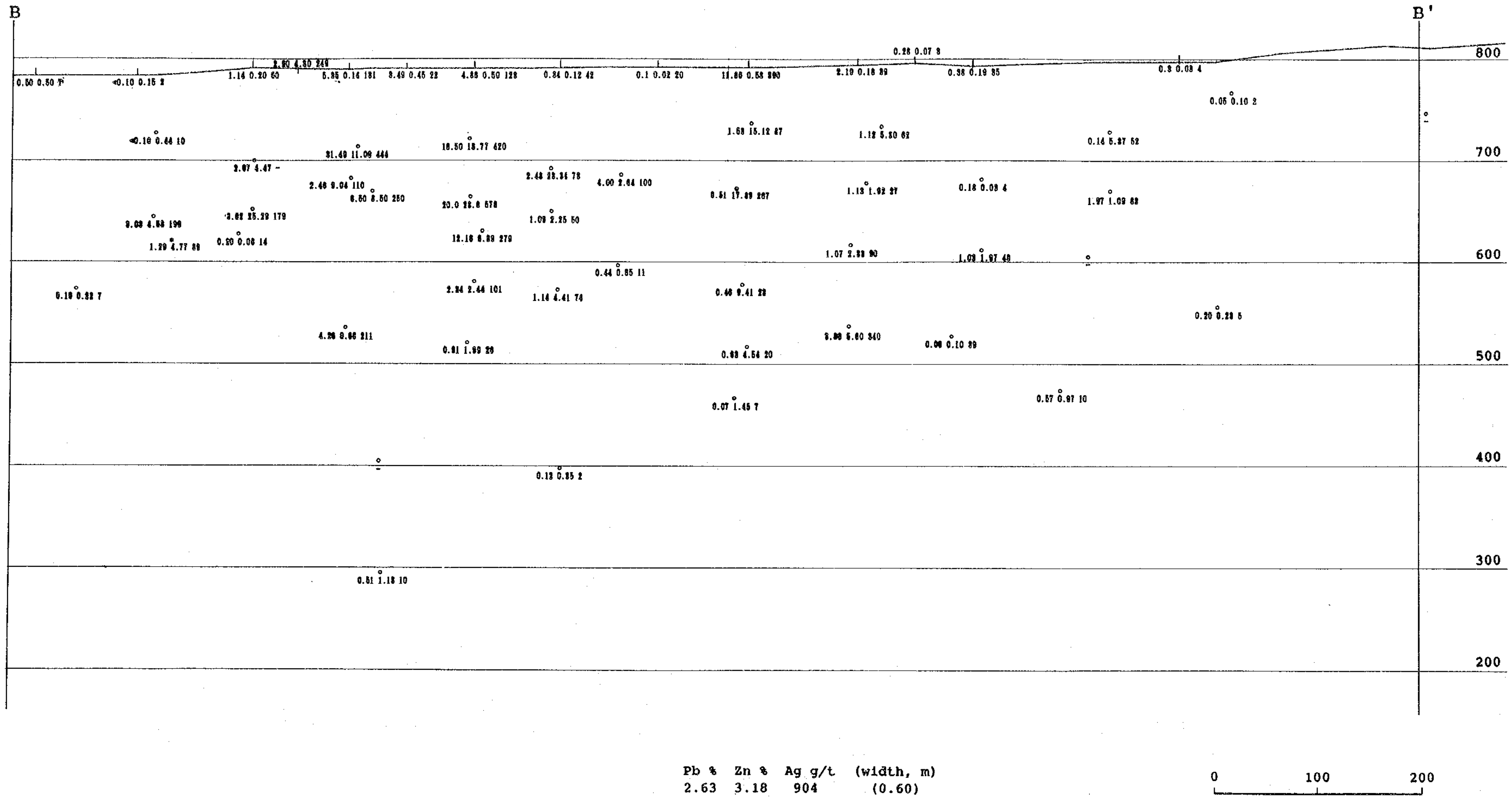


Pb %	Zn %	Ag g/t	(width, m)
2.63	3.18	904	(0.60)

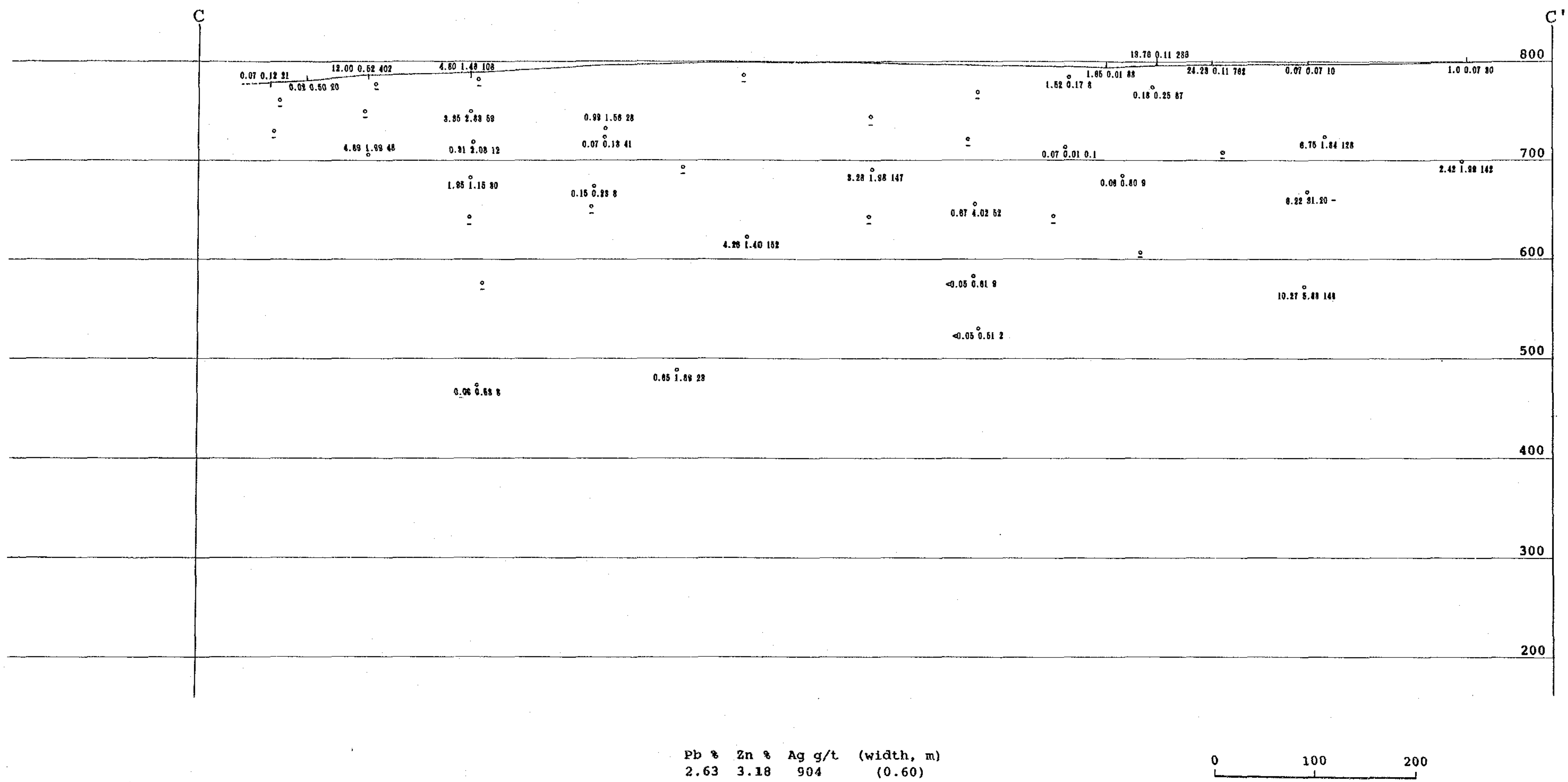
A - 1 - 2 Assay Results of the No.1 Vein



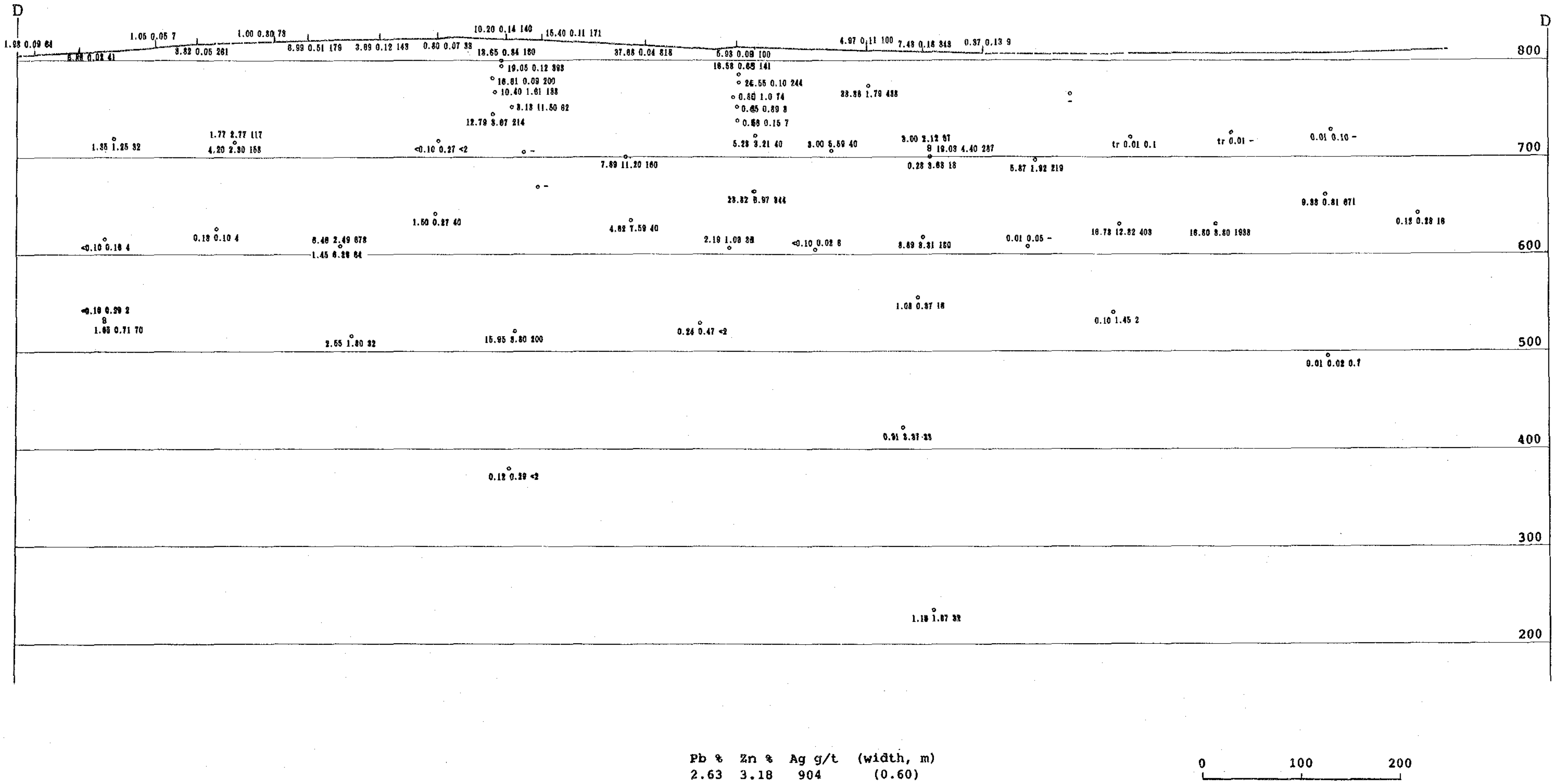
A - 1 - 2 Assay Results of the No.1 Vein



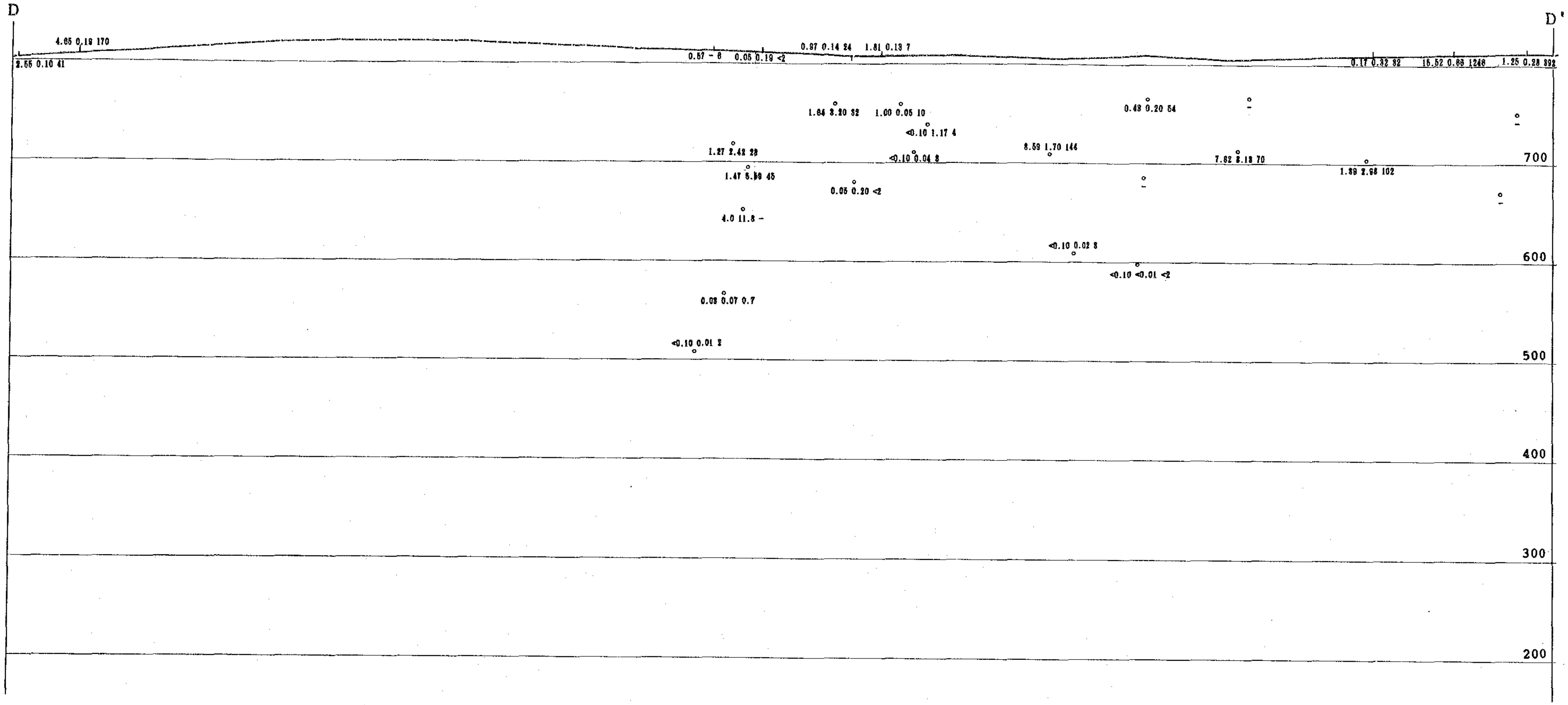
A - 1 - 3 Assay Results of the No.1A Vein



A - 1 - 4 Assay Results of the No.1B Vein



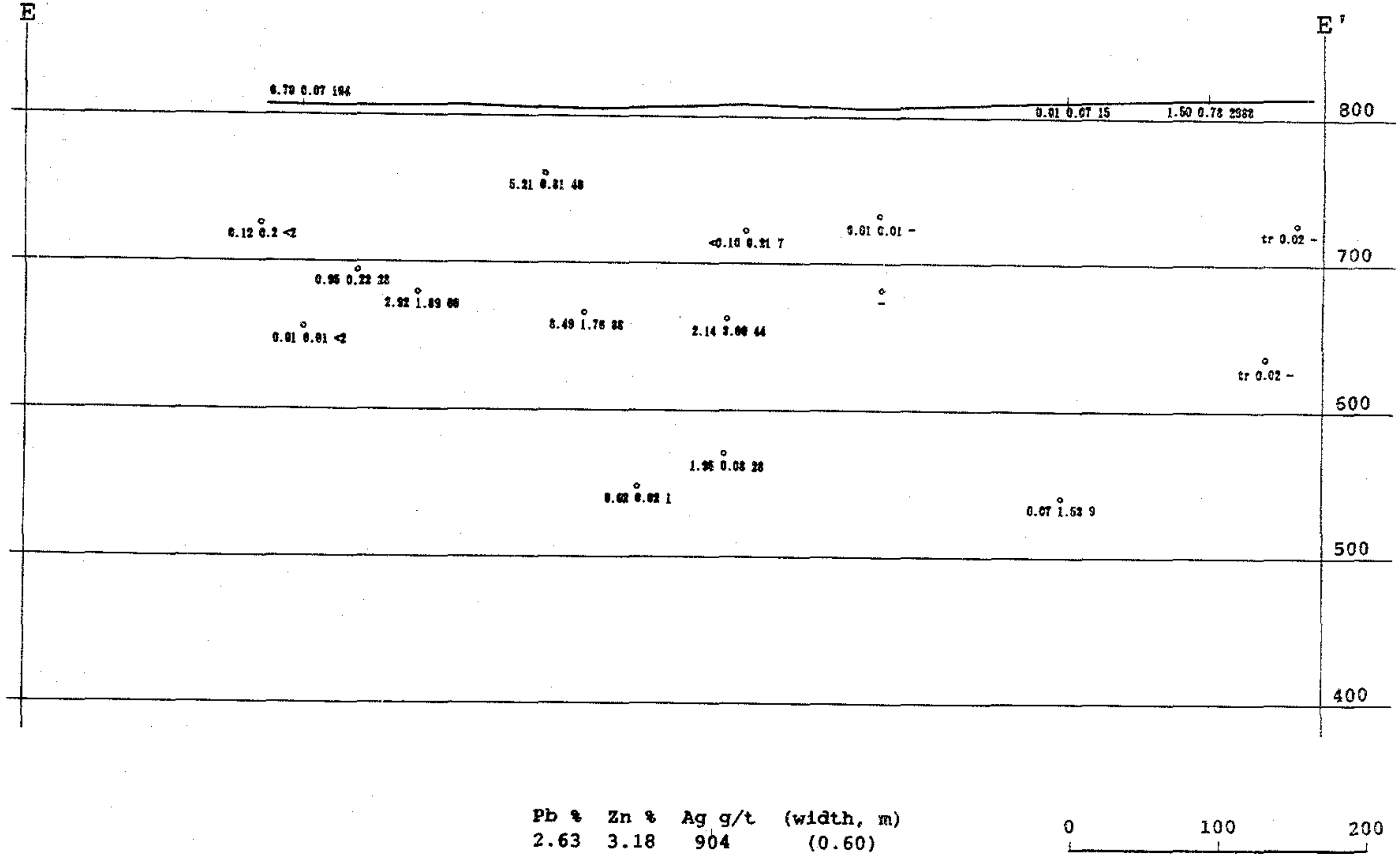
A - 1 - 5 Assay Results of the No.2 Vein



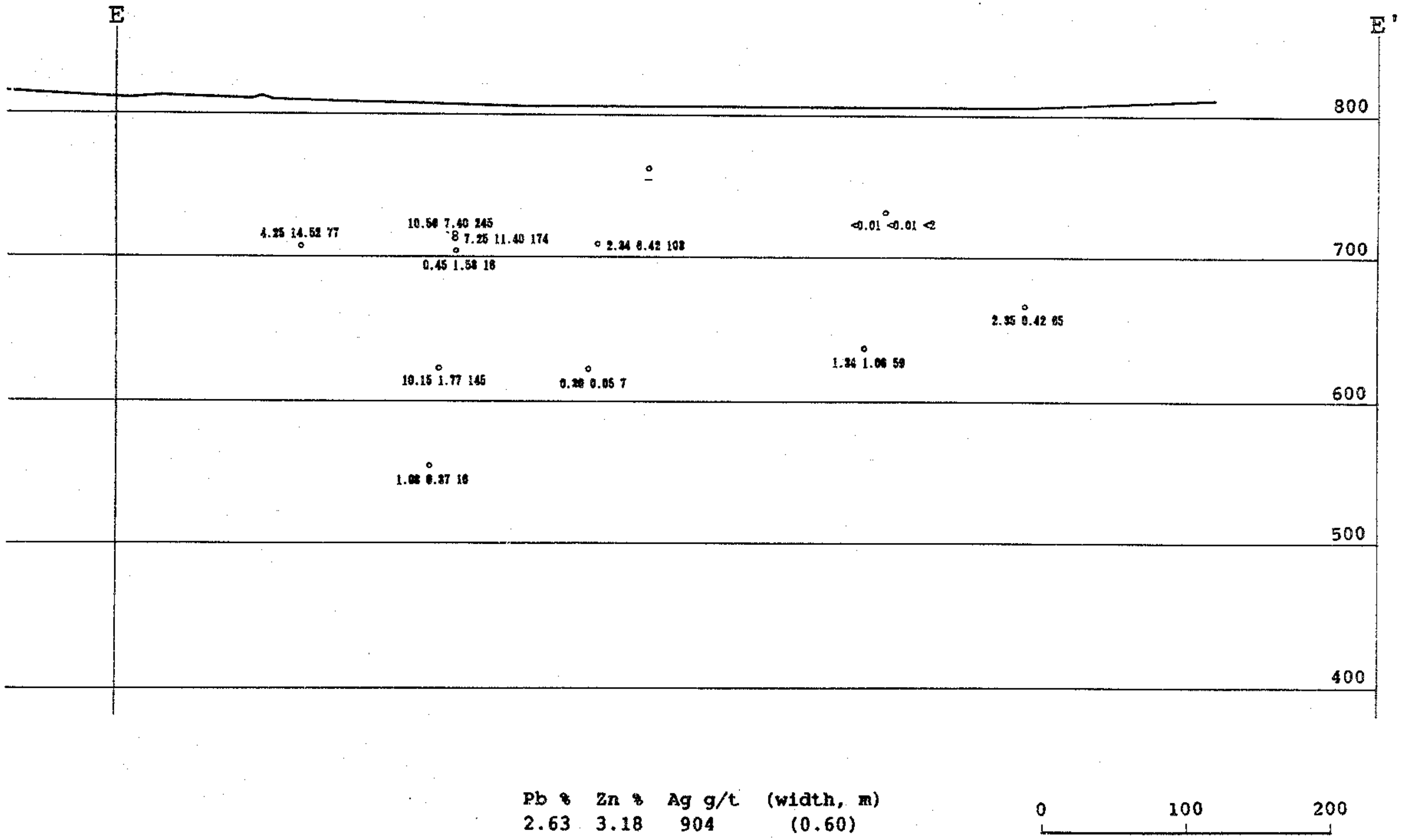
Pb % Zn % Ag g/t (width, m)
2.63 3.18 904 (0.60)

0 100 200

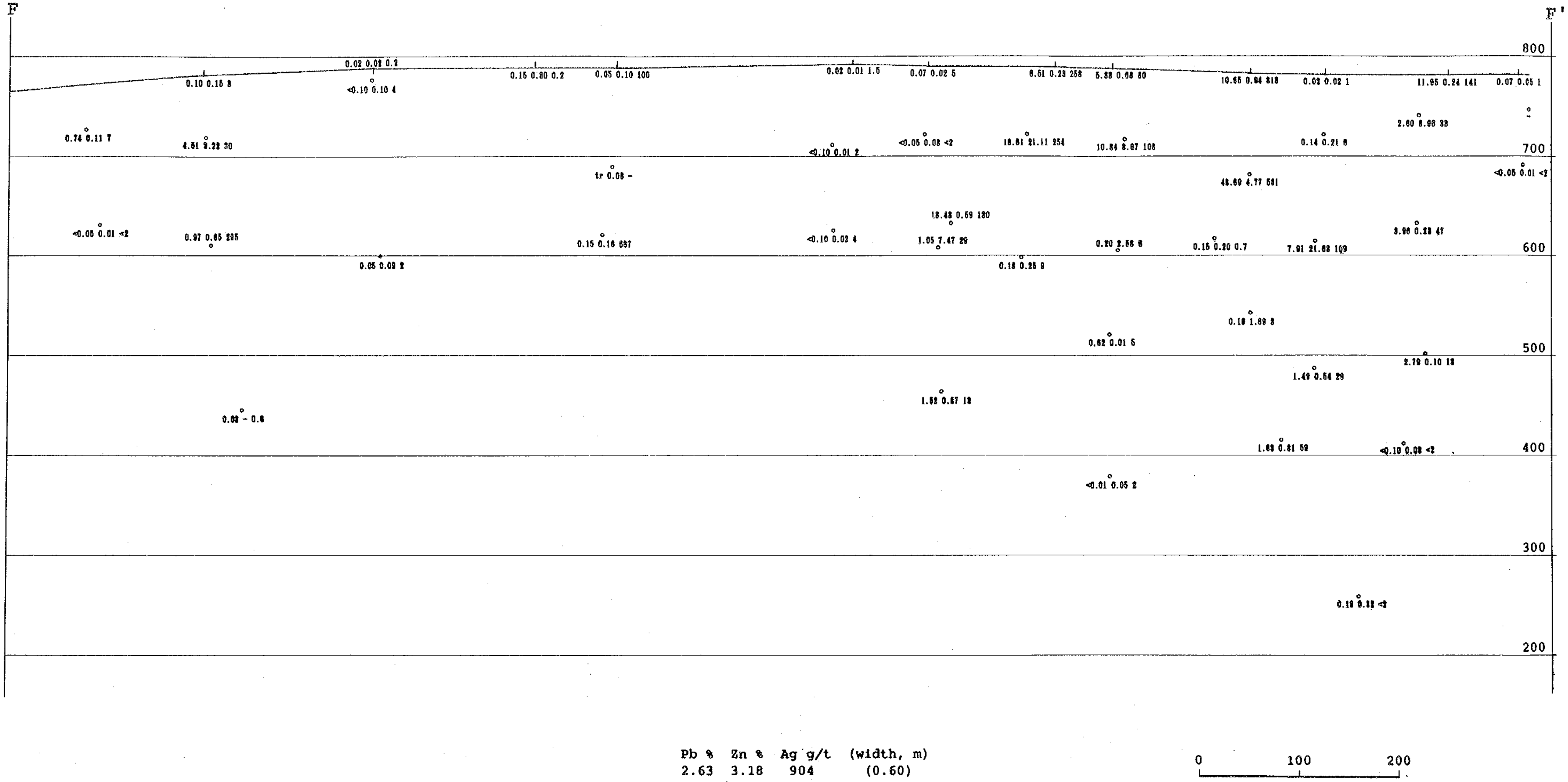
A - 1 - 6 Assay Results of the No.2A Vein



A - 1 - 7 Assay Results of the No.2B Vein

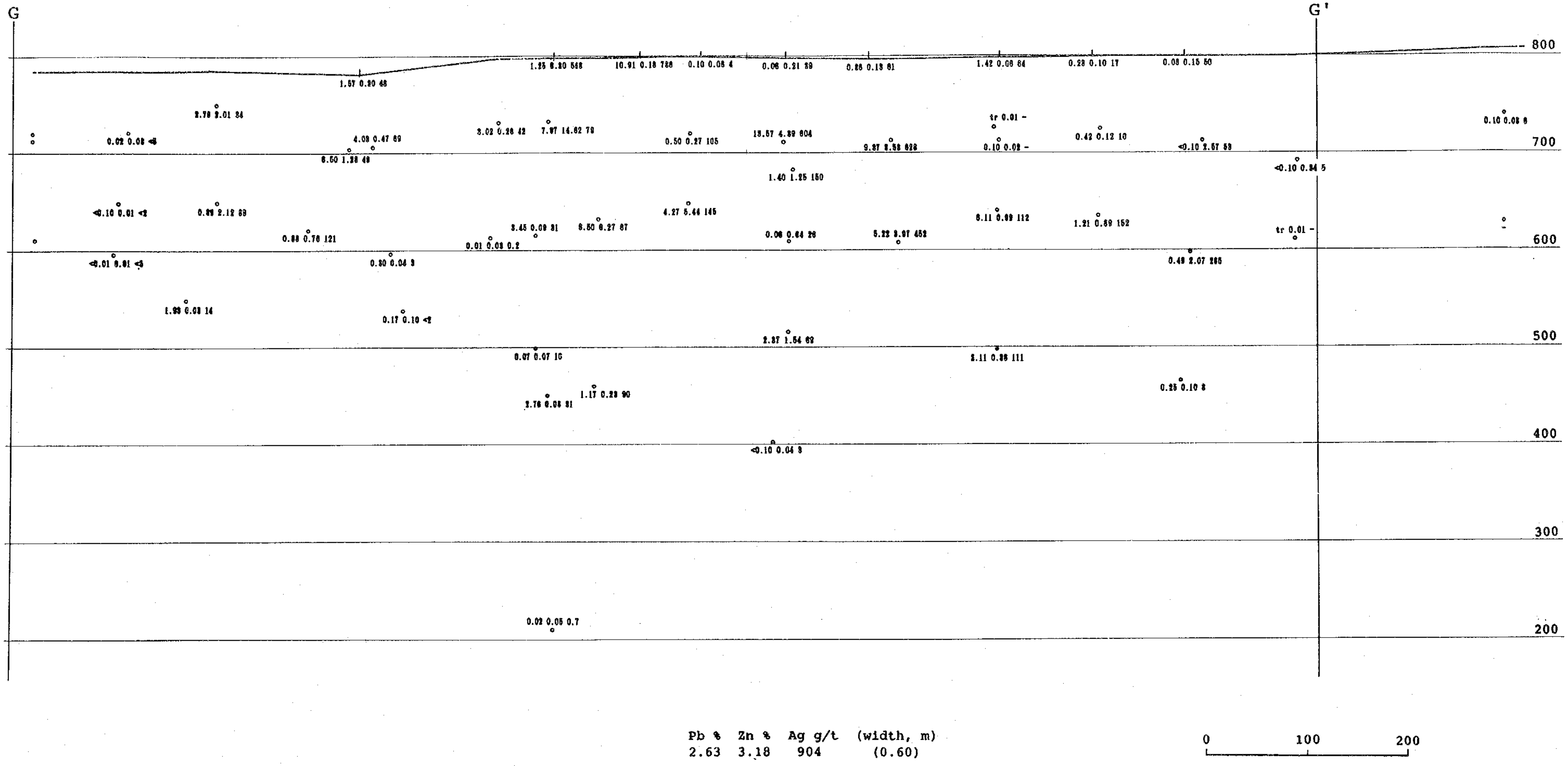


A - 1 - 8 Assay Results of the No.2HW Vien



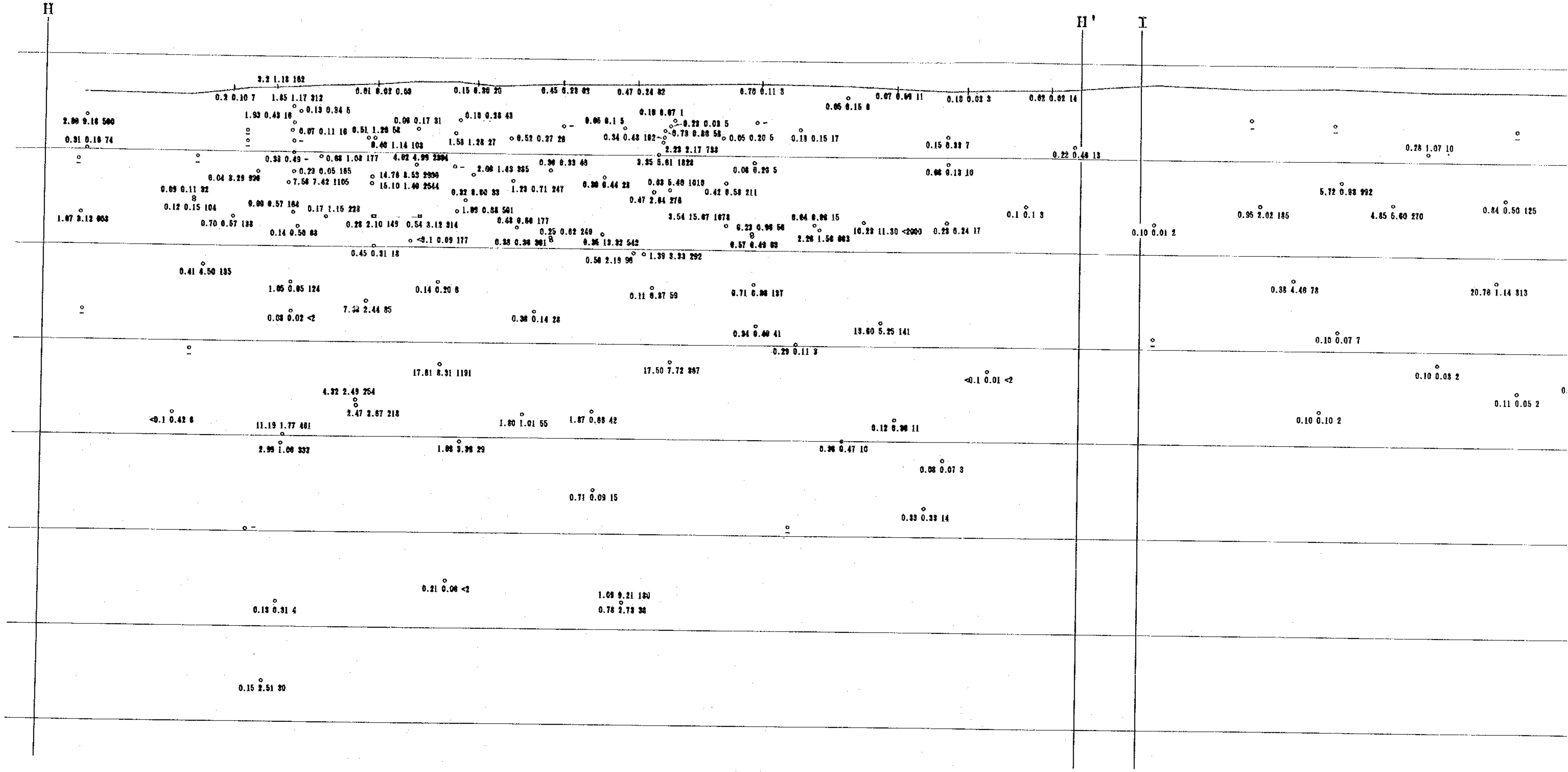
Pb % Zn % Ag g/t (width, m)
2.63 3.18 904 (0.60)

A - 1 - 9 Assay Results of the No.6 Vein (North)



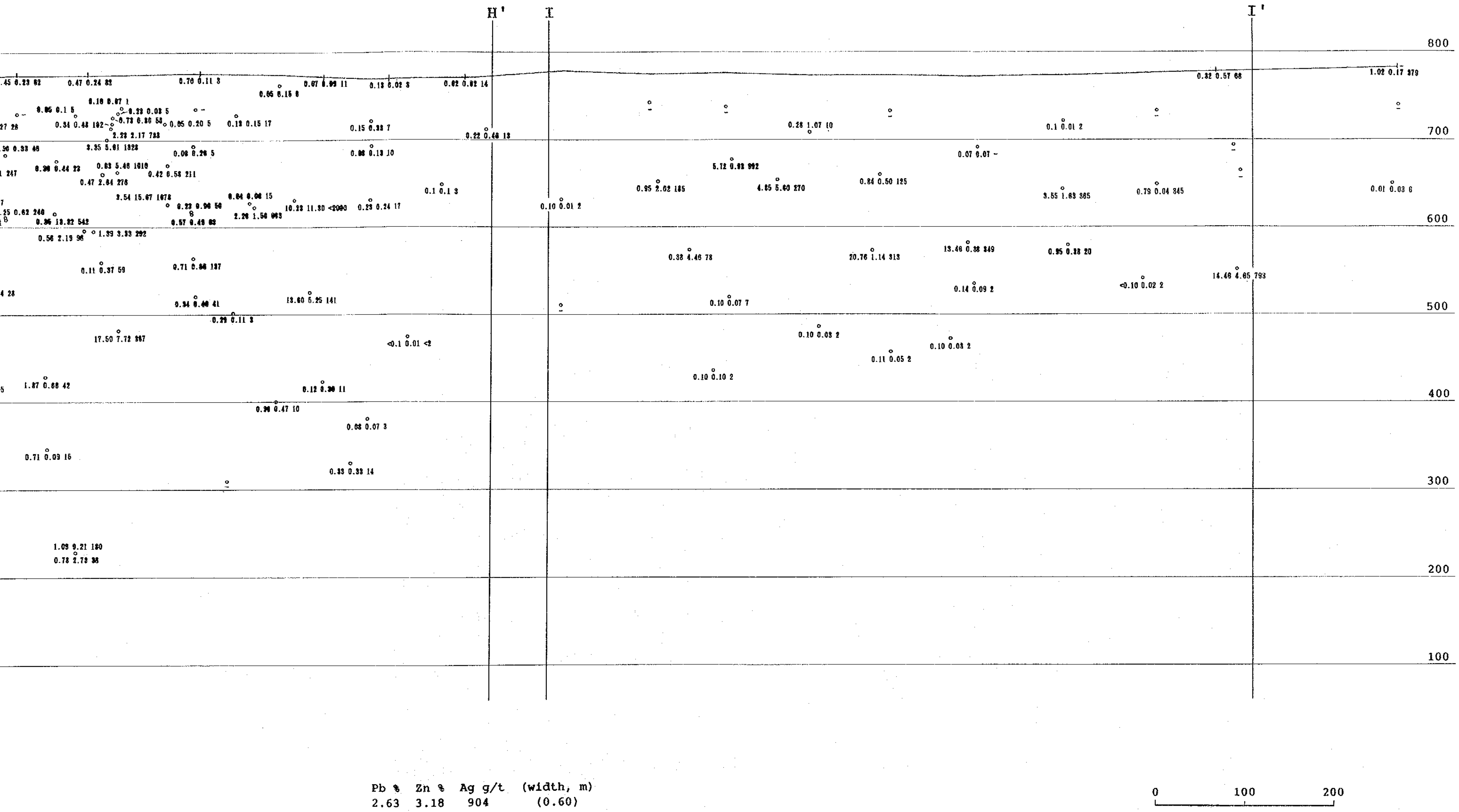
Pb % Zn % Ag g/t (width, m)
2.63 3.18 904 (0.60)

A - 1 - 10 Assay Results of the No.6 Vein (South)

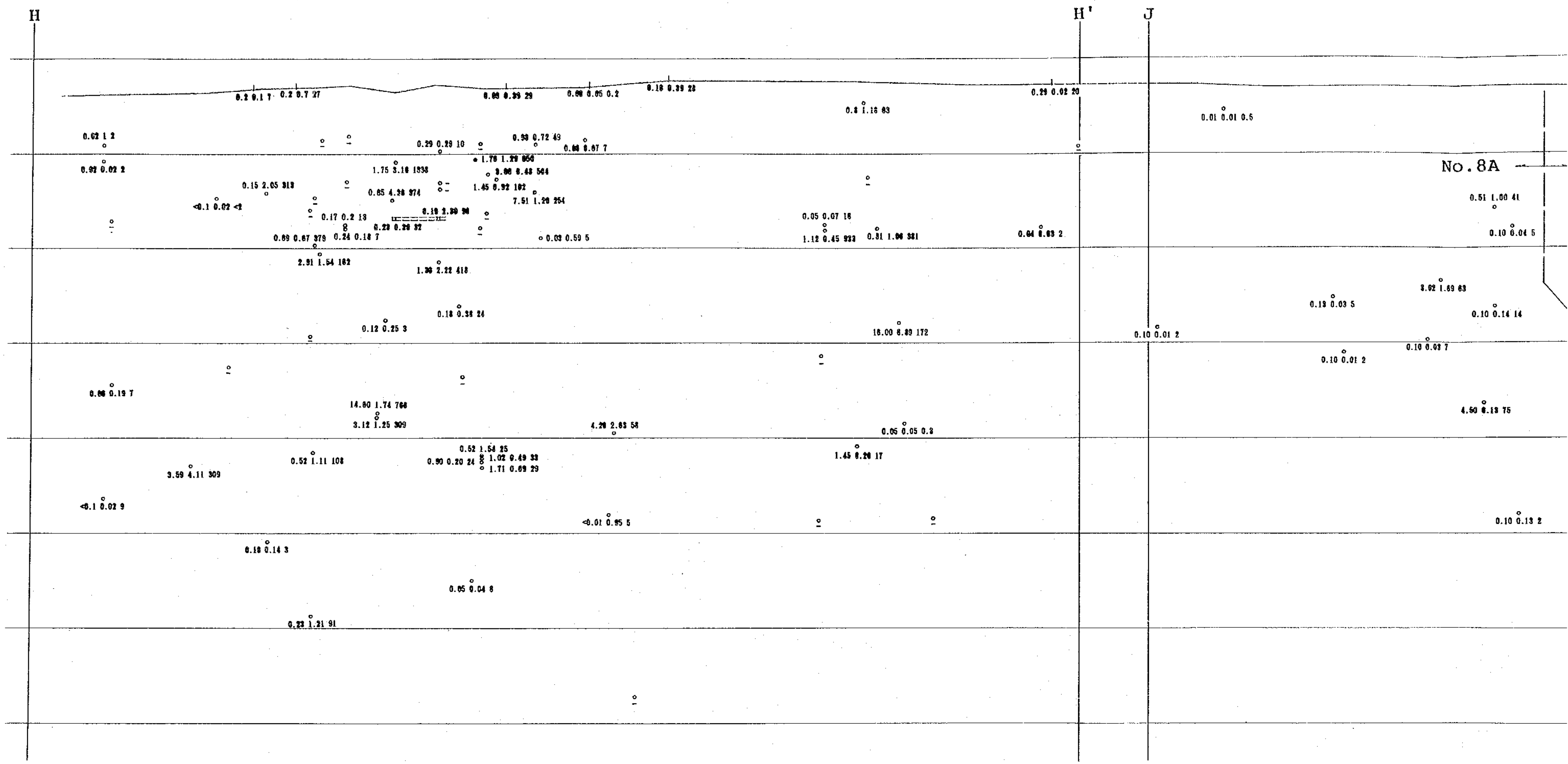


Pb % Zn % Ag g/t (width, m)
2.63 3.18 904 (0.60)

A - 1 - 11 Assay Results of the No.8 Vein

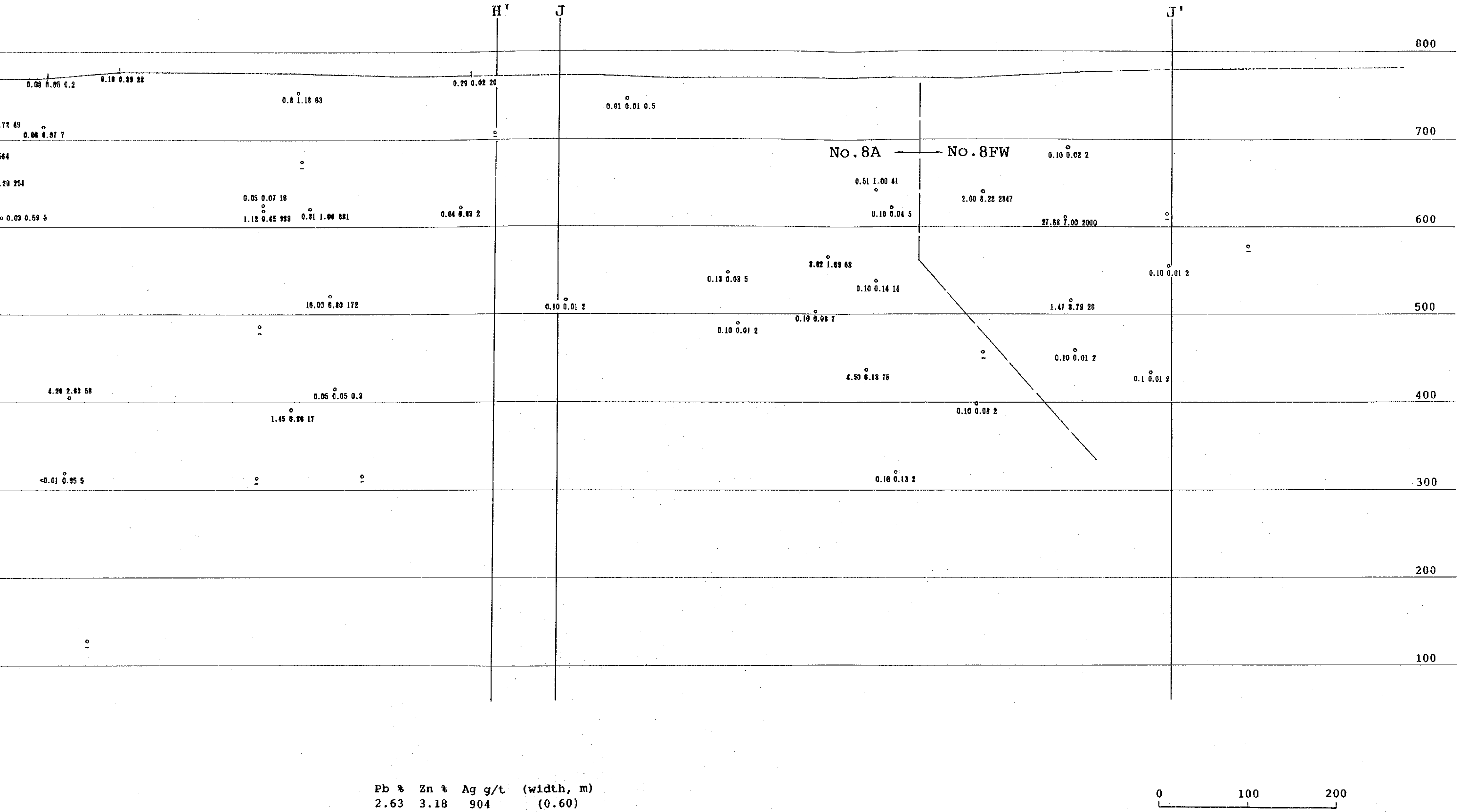


A - 1 - 11 Assay Results of the No.8 Vein

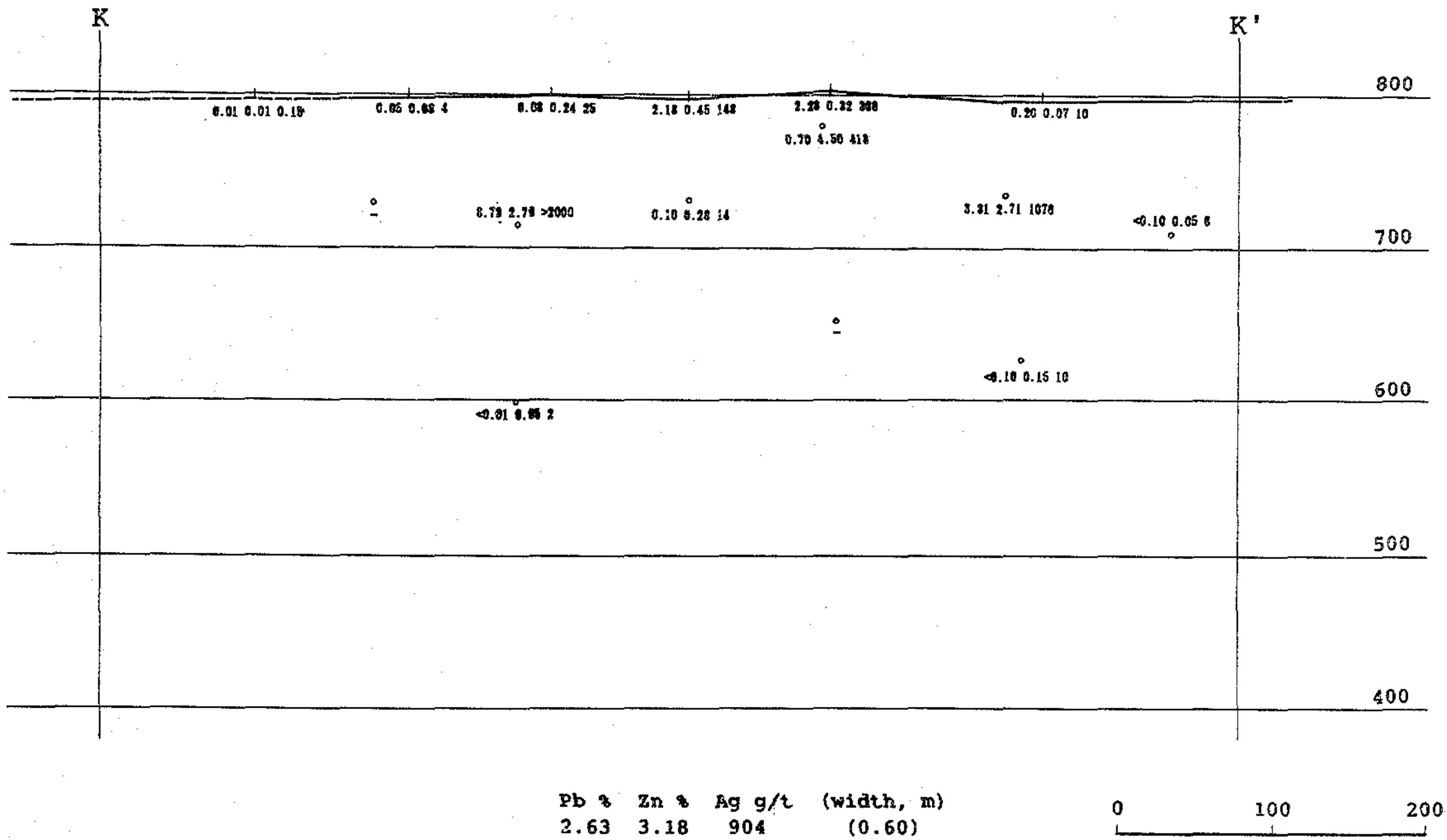


Pb % Zn % Ag g/t (width, m)
2.63 3.18 904 (0.60)

A - 1 - 12 Assay Results of the No.8A and 8FW Vein

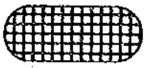
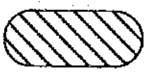
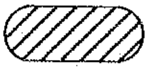
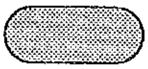


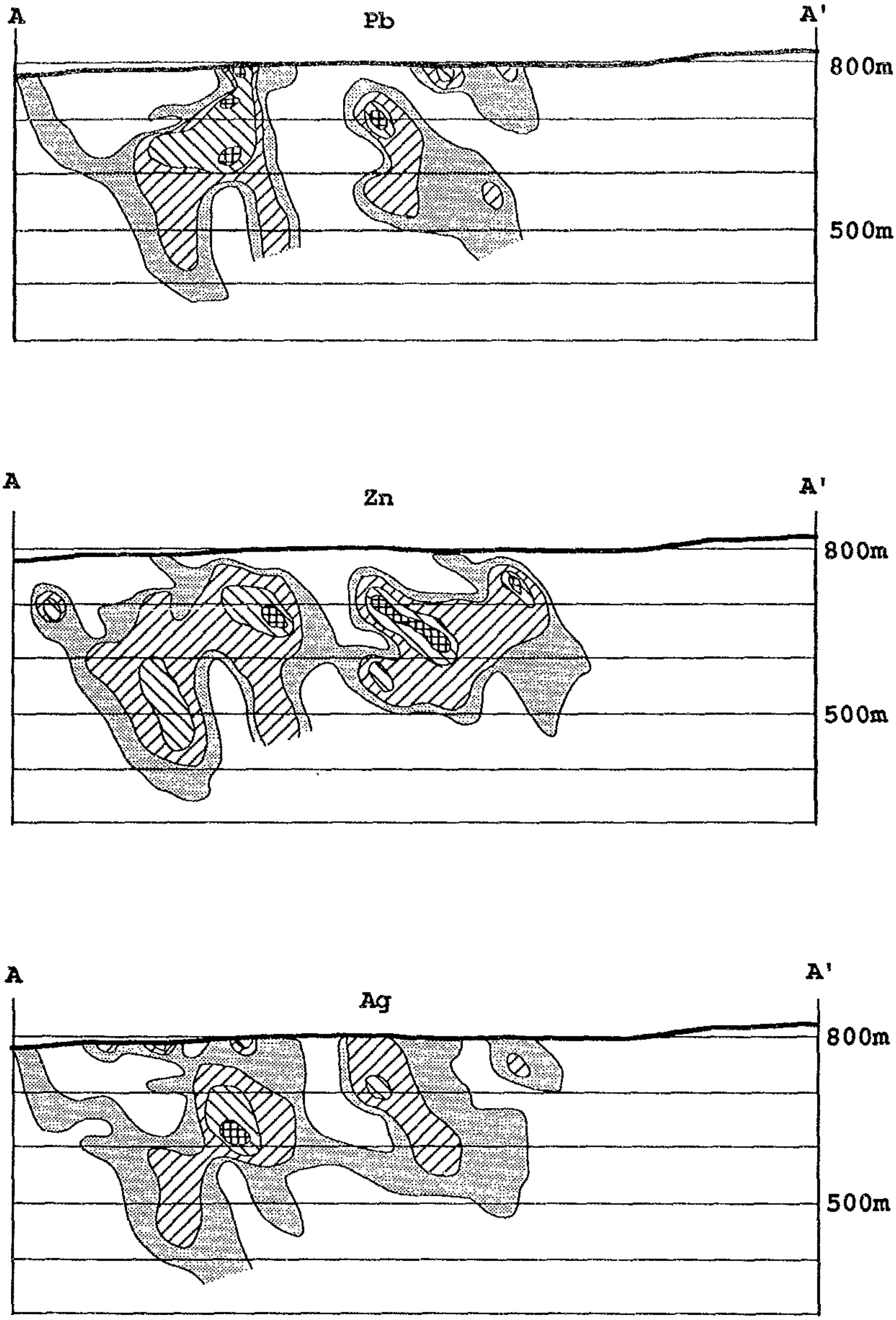
A - 1 - 12 Assay Results of the No.8A and 8FW Vein



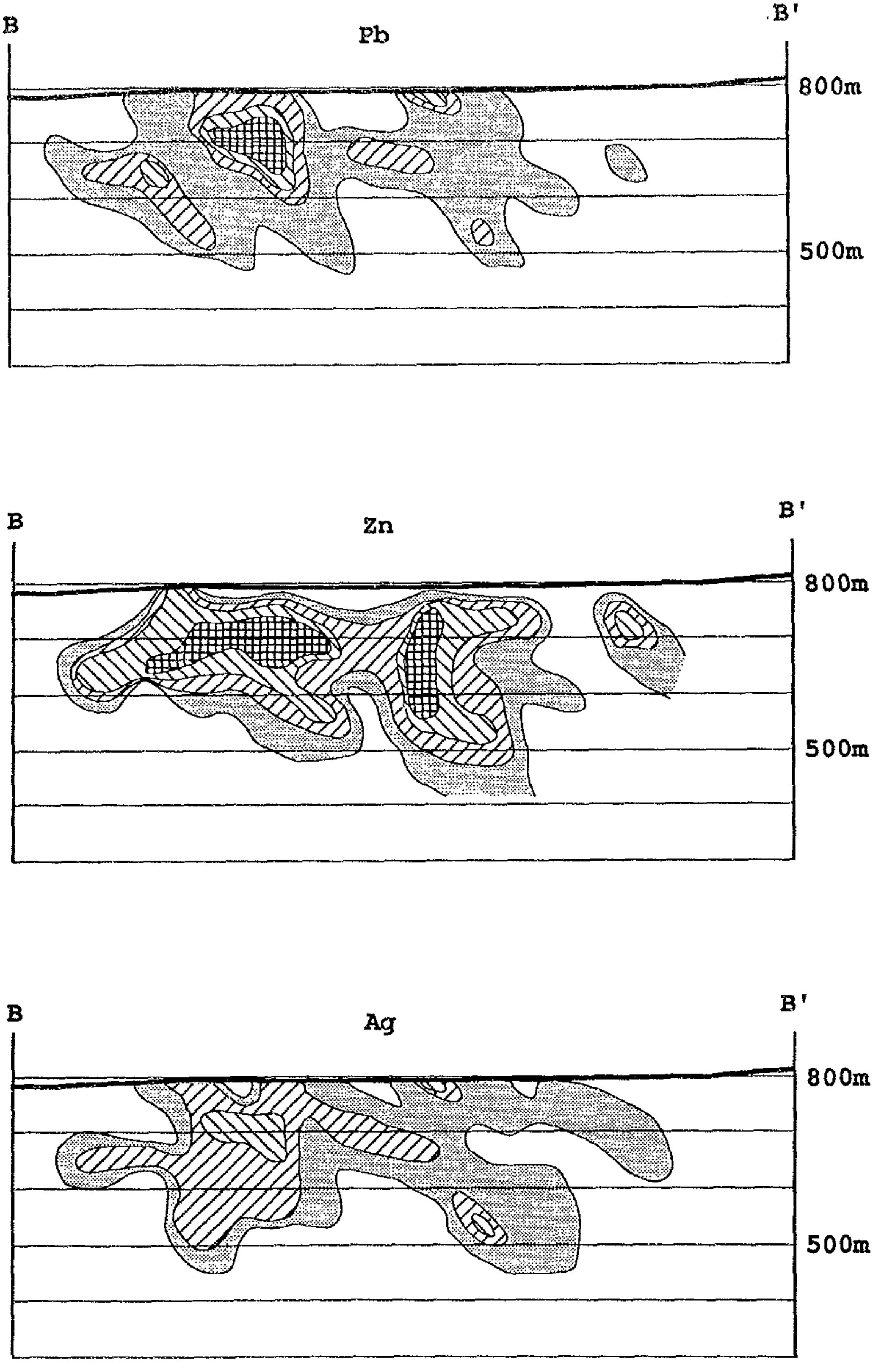
A - 1 - 13 Assay Results of the No.10 Vein

L E G E N D

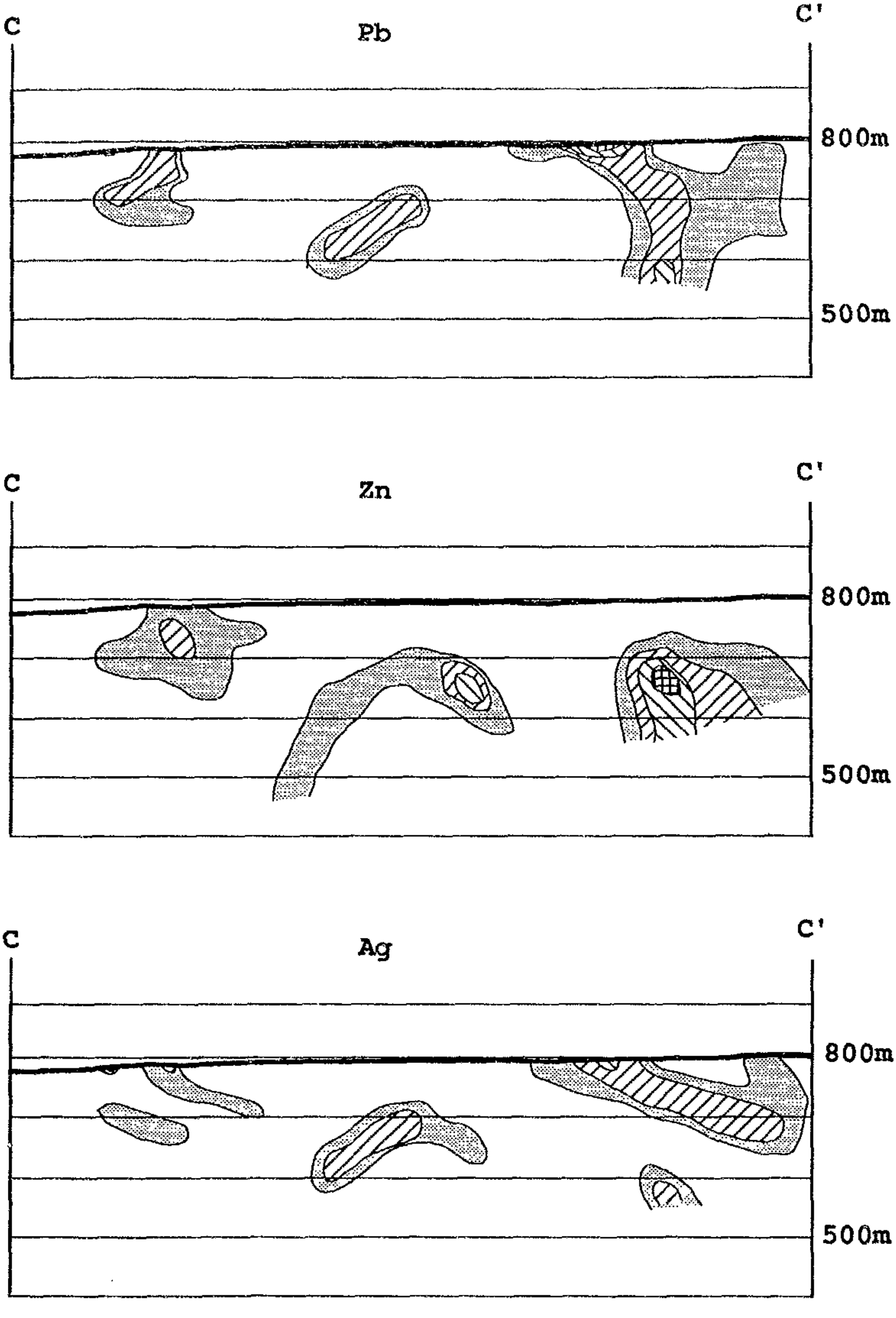
	Pb	Zn	Ag
	>15%	>9%	>1000g/t
	7 - 15%	4 - 9%	300 - 1000g/t
	3 - 7%	2 - 4%	100 - 300g/t
	1 - 3%	1 - 2%	30 - 100g/t



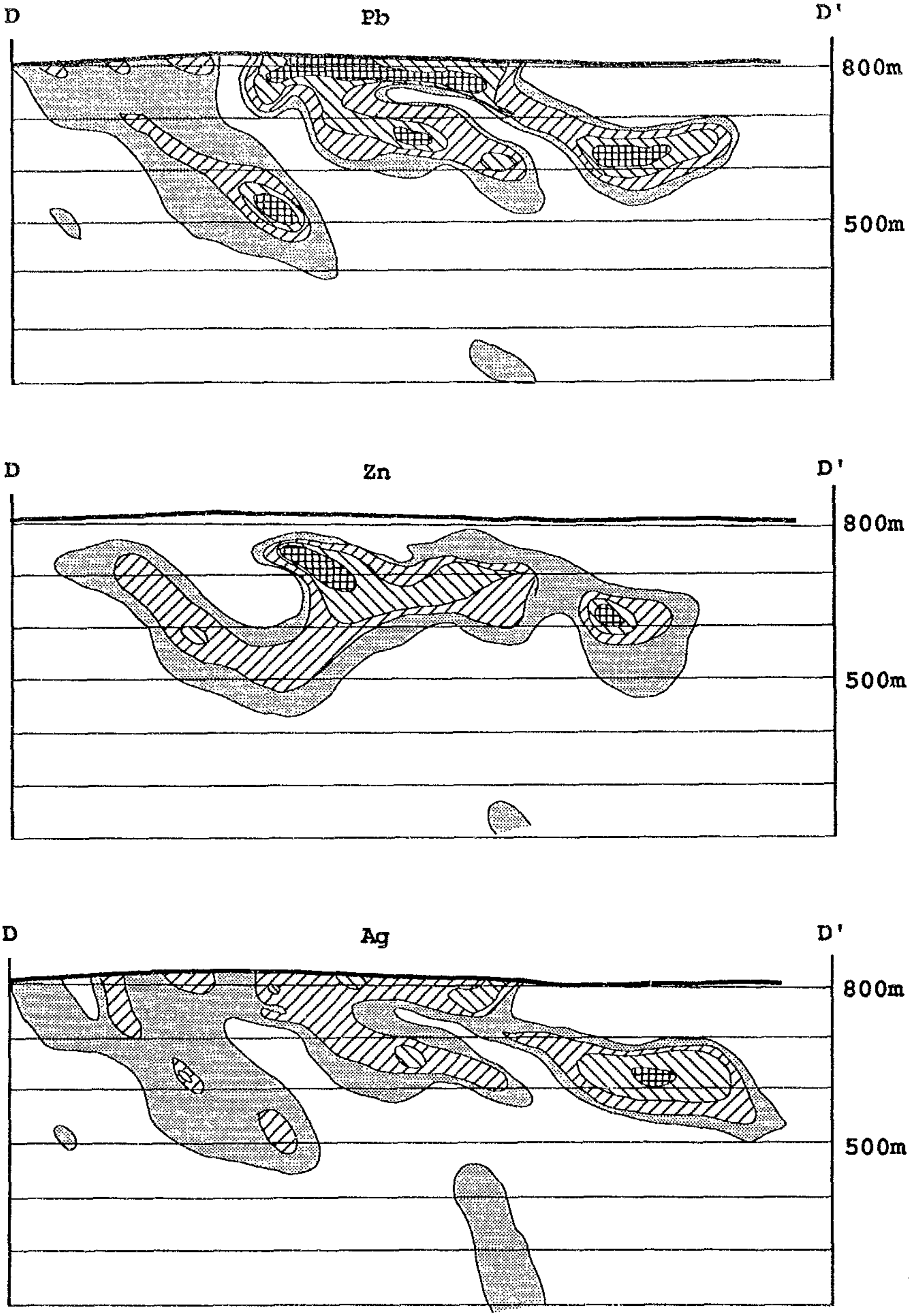
A-2-1 Spectral Map of the No.1 Vein



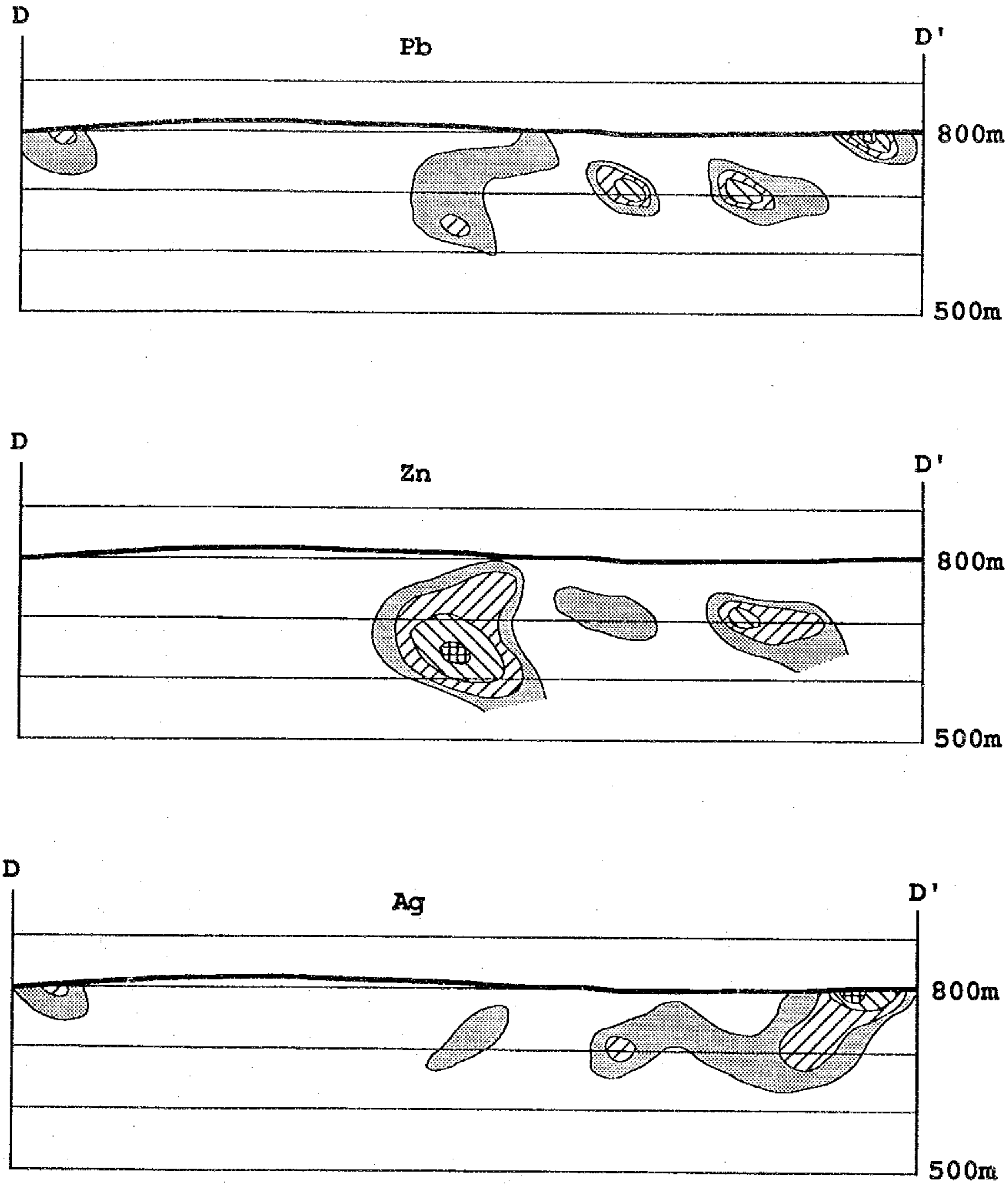
A-2-2 Spectral Map of the No.1A Vein



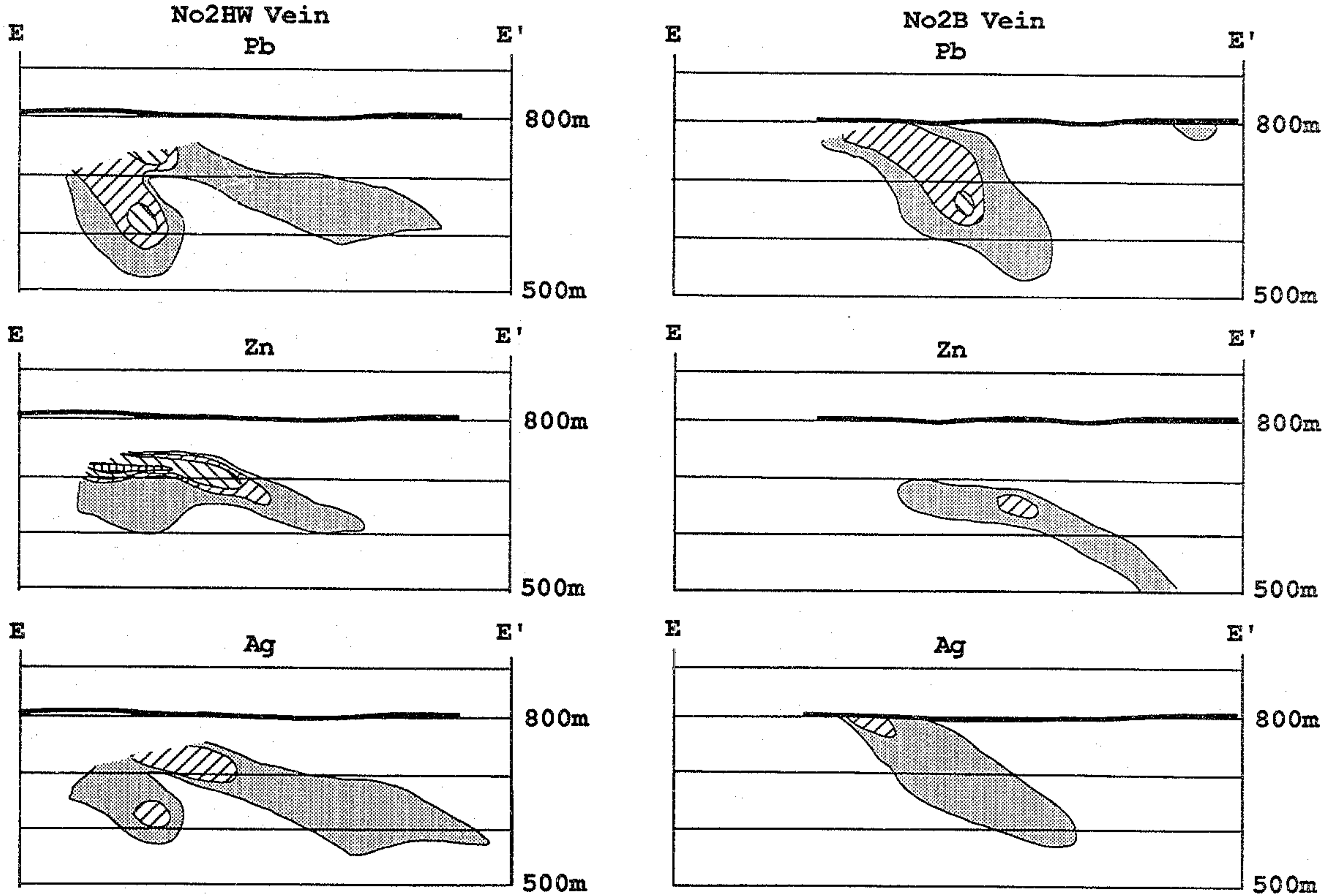
A-2-3 Spectral Map of the No.1B Vein



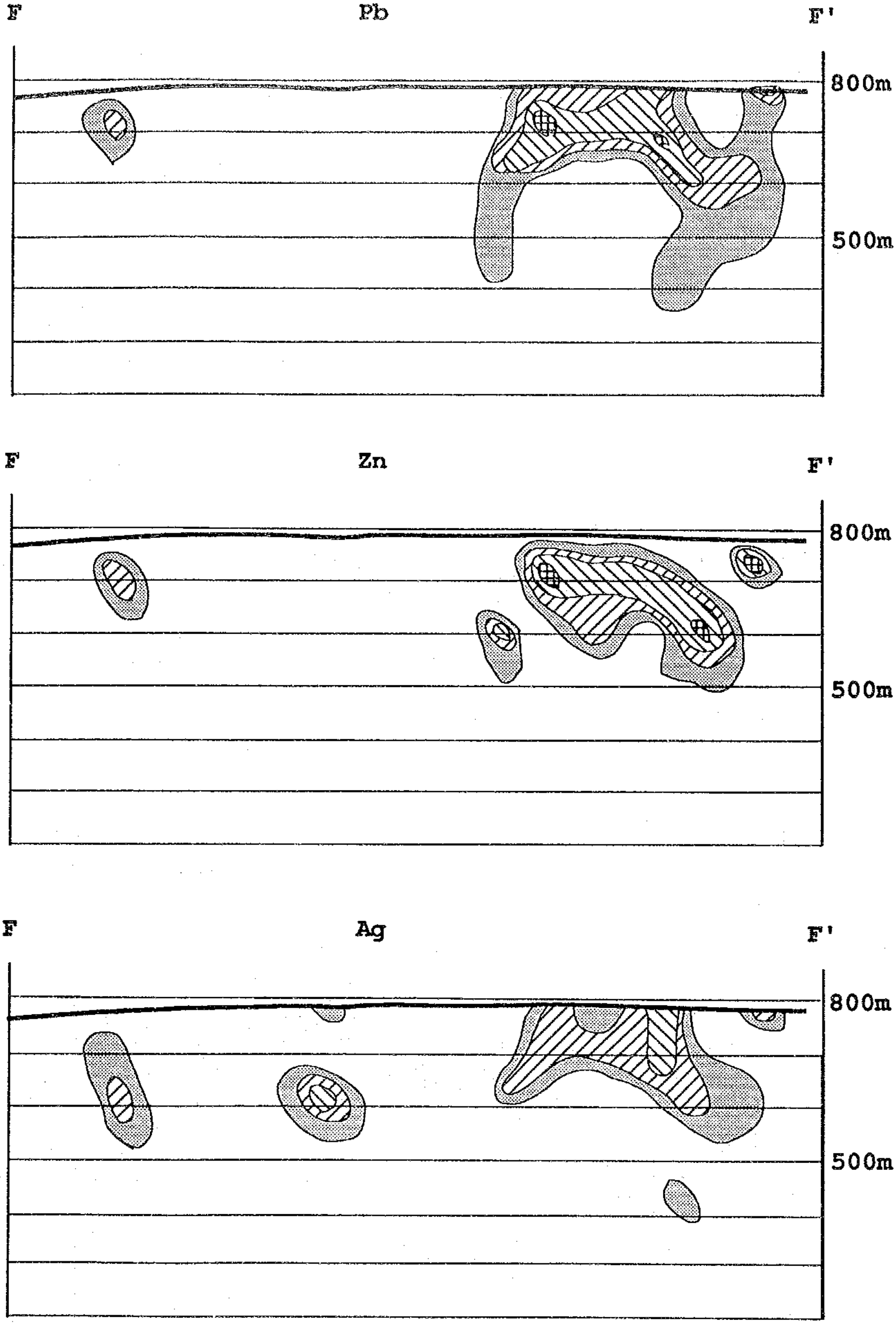
A-2-4 Spectral Map of the No.2 Vein



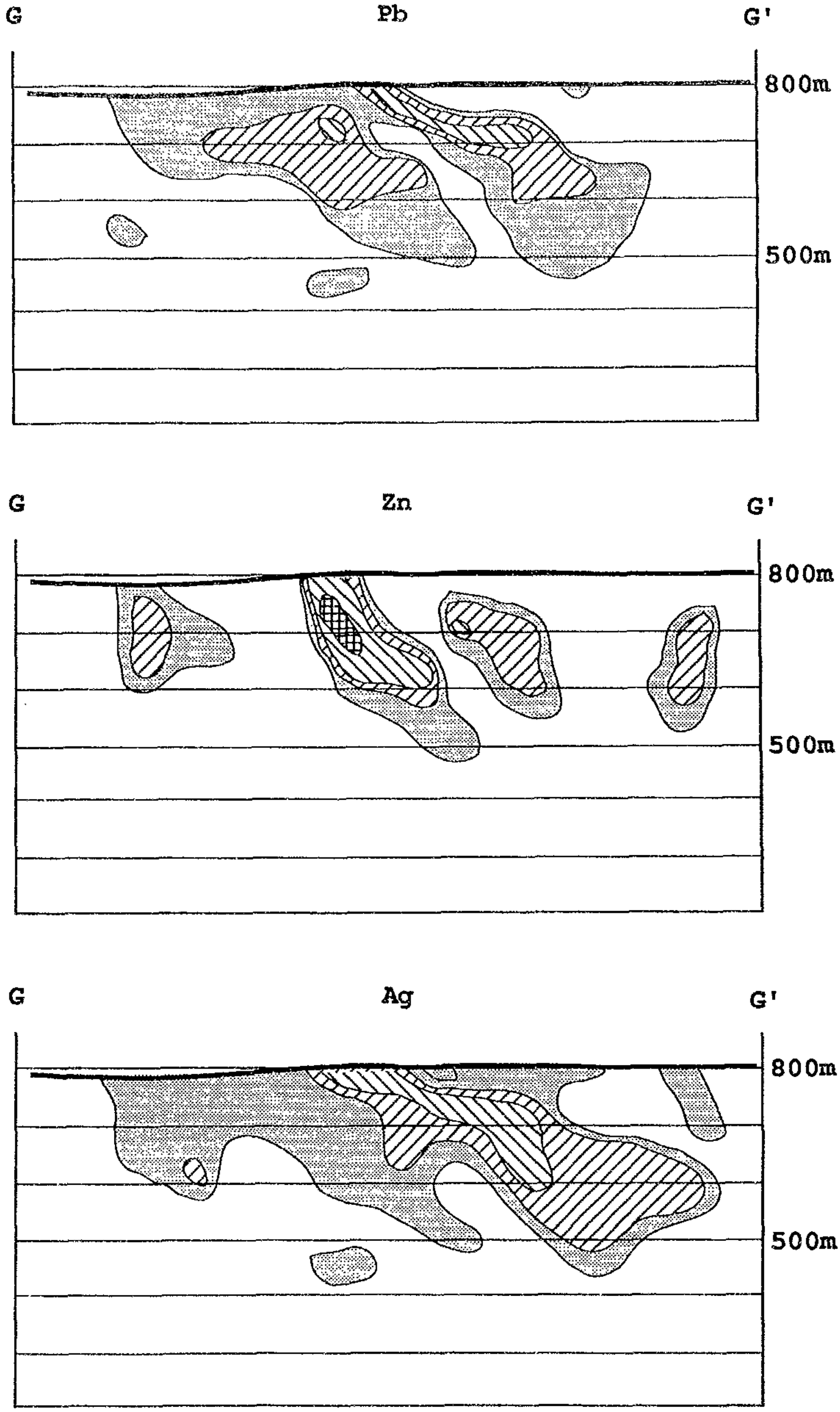
A-2-5 Spectral Map of the No.2A Vein



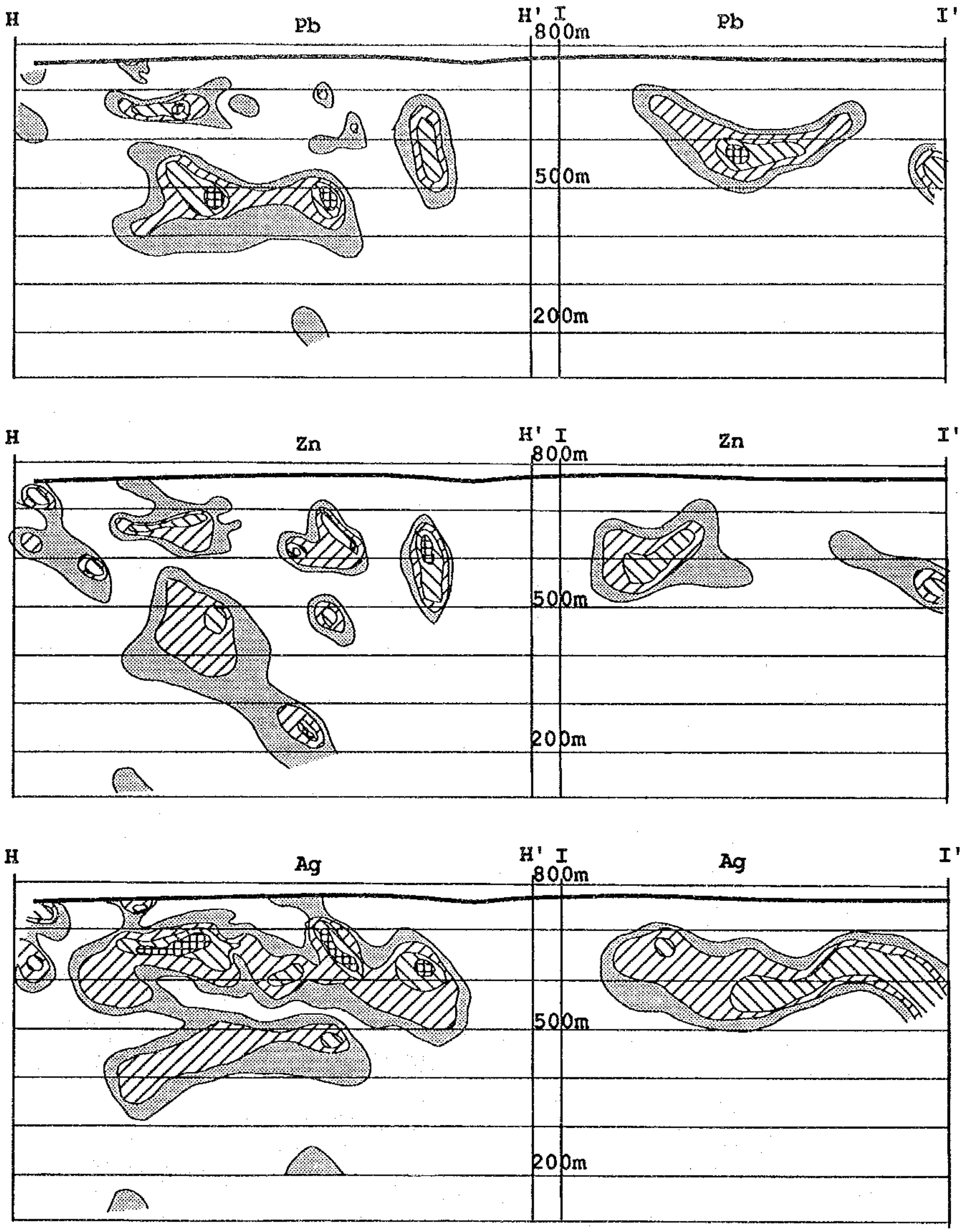
A-2-6 Spectral Map of the No.2B and 2HW Veins



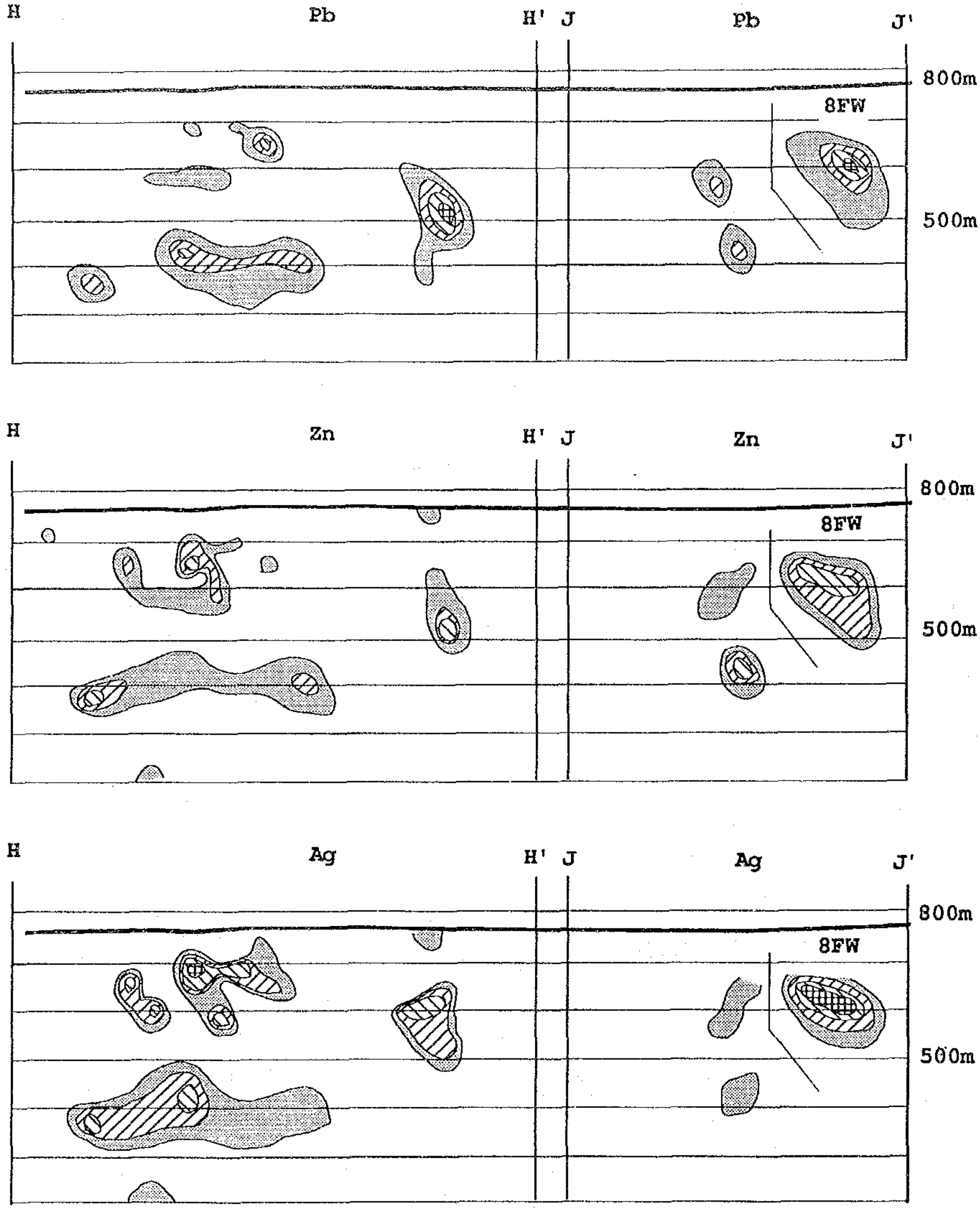
A-2-7 Spectral Map of the No.6 Vein(North)



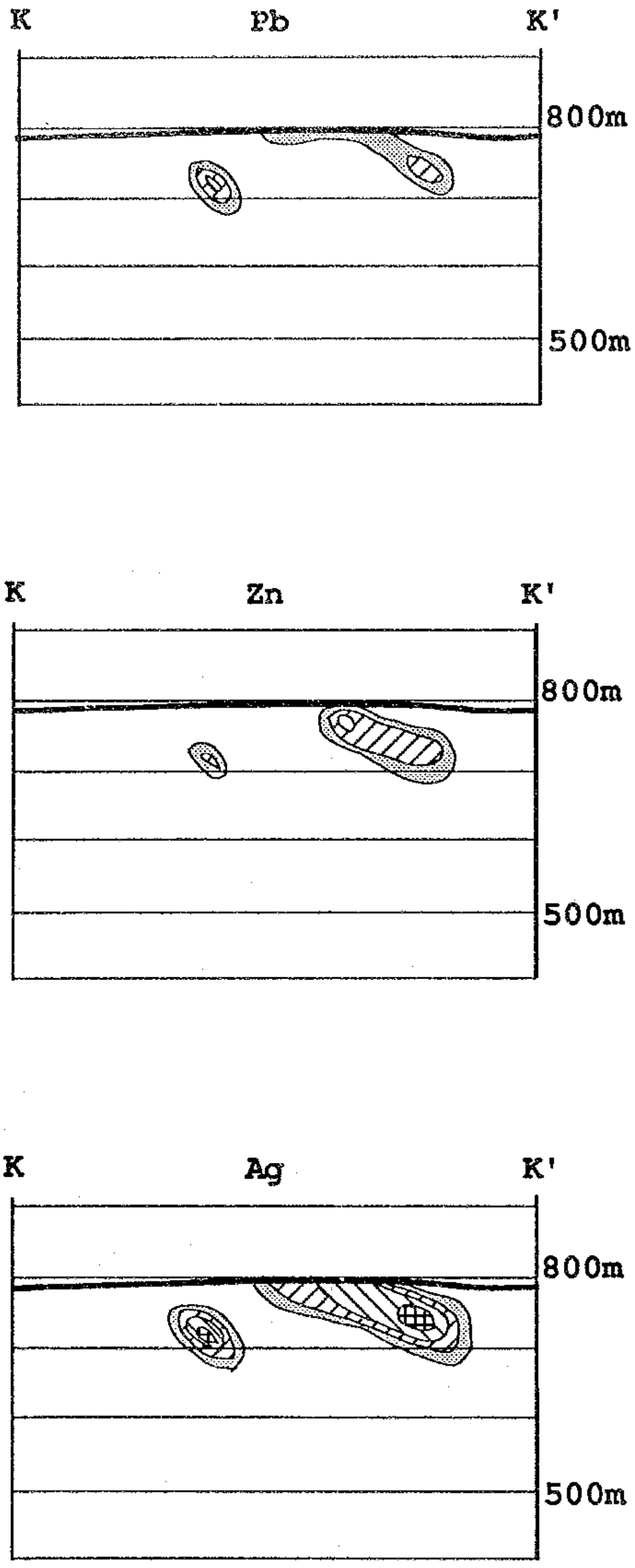
A-2-8 Spectral Map of the No.6 Vein(South)



A-2-9 Spectral Map of the No.8 Vein



A-2-10 Spectral Map of the No.8A and 8FW Veins



A-2-11 Spectral Map of the No.10 Vein

Vein	No. of Block	Length m	Width m	Height m	Volume m3	Safty Rate %	S.G.	Reserve t	Ore Grade				Metal Content			
									Pb %	Zn %	Ag g/t	Au g/t	Pb t	Zn t	Ag kg	Au kg
No. 6 vein, surface (Trench)	1	20	0.16	10	32.00	100	3	90	7.09	0.11	118	1.44	6.381	0.099	10.62	0.130
	2	20	0.45	10	90.00	100	3	270	5.67	0.11	117	1.04	15.309	0.297	31.59	0.281
	3	110	0.72	10	792.00	100	3	2,370	14.63	0.45	243	1.00	346.731	10.665	575.91	2.370
	4	75	1.09	10	817.50	100	3	2,450	11.04	1.64	141	0.38	270.480	40.180	345.45	0.931
	5	5	0.43	3	6.45	100	3	10	6.21	0.65	103	0.12	0.621	0.065	1.03	0.001
	6	20	0.38	10	76.00	100	3	220	15.06	0.18	221	0.32	33.132	0.396	48.62	0.070
	subtotal	250	0.74	9.86	1,813.95	100	3	5,410	12.43	0.96	187	0.70	672.654	51.702	1,013.22	3.783
No. 8 vein, Tunnel		30	1.14	20	684.00	100	3	2,050	2.13	6.24	976	0.07	43.665	127.920	2,000.80	0.144
	subtotal	30	1.14	20.00	684.00	100	3	2,050	2.13	6.24	976	0.07	43.665	127.920	2,000.80	0.144
total		280	0.81	10.95	2497.95	100	3	7,460	9.60	2.41	404	0.53	716.319	179.622	3,014.02	3.927

A－3－1 Probable Ore Reserve Estimation

Vein		Area m²	Width m	Volume m3	Safty Rate %	S. G.	Reserve t	Ore Grade			Metal Content		
								Pb %	Zn %	Ag g/t	Pb t	Zn t	Ag kg
No. 1 vein	No. 1 vein	122,460	0.47	57,733.10	25	3	43,250	5.37	8.39	206	2,322.36	3,628.70	8,902.21
	No. 1A vein	175,510	0.40	70,431.30	25	3	52,810	4.74	6.18	141	2,500.78	3,264.04	7,436.98
	No. 1B vein	45,060	0.34	15,271.30	25	3	11,430	5.29	2.56	110	604.49	292.10	1,263.01
	subtotal	343,030	0.42	143,435.70	25	3	107,490	5.05	6.68	164	5,427.63	7,184.85	17,602.20
No. 2 vein	No. 2 vein	184,920	0.94	173,359.60	25	3	129,990	8.78	2.37	267	11,412.35	3,076.39	34,735.82
	No. 2A vein	29,970	0.74	22,094.50	25	3	16,560	3.07	4.29	131	508.87	709.70	2,174.73
	No. 2B vein	27,500	0.56	15,403.00	25	3	11,540	5.63	0.89	107	649.73	102.81	1,238.00
	No. 2 vein (hanging wall)	23,660	0.92	21,767.20	25	3	16,320	6.99	4.66	129	1,140.77	760.51	2,105.28
	subtotal	266,050	0.87	232,624.30	25	3	174,410	7.86	2.67	231	13,711.73	4,649.41	40,253.83
No. 6 vein subtotal		183,740	0.92	169,768.00	25	3	127,310	7.77	4.00	204	9,887.82	5,094.46	26,034.17
No. 8 vein	No. 8 vein	153,240	0.94	143,474.20	30	3	127,360	4.83	3.75	540	6,154.19	4,773.56	68,738.21
	No. 8A vein	27,060	0.37	10,106.70	27	3	8,260	6.47	2.99	416	534.06	246.62	3,438.43
	No. 8 vein (foot wall)	26,440	0.35	9,254.00	25	3	6,940	18.51	6.64	1,708	1,284.59	460.82	11,853.52
	subtotal	206,740	0.79	162,834.90	29	3	142,560	5.59	3.84	589	7,972.84	5,480.99	84,030.16
No. 10 vein subtotal		22,710	0.28	6,440.50	25	3	4,820	4.81	2.98	1,305	231.84	143.65	6,291.84
total		1,022,270	0.70	715,103.40	26	3	556,590	6.69	4.05	313	37,231.86	22,553.36	174,212.20

A－3－2 Possible Ore Reserve Estimation (Summary)

Vein		No. of Block	Area m²	Width m	Volume m3	Safty Rate %	S.G.	Reserve t	Ore Grade Pb %	Zn %	Ag g/t	Metal Content Pb t	Zn t	Ag kg
No. 1 vein	No. 1 vein	1	1,600	0.14	224.00	25	3	160	6.30	0.02	64	10.08	0.03	10.24
		2	1,600	0.44	704.00	25	3	520	6.88	1.41	105	35.78	7.33	54.60
		3	800	1.00	800.00	25	3	600	4.63	0.06	85	27.78	0.36	51.00
		4	800	2.20	1,760.00	25	3	1,320	7.46	1.74	54	98.47	22.97	71.28
		5	57,880	0.58	33,570.40	25	3	25,170	2.63	10.19	99	661.97	2,564.82	2,491.83
		6	54,970	0.35	19,239.50	25	3	14,420	9.90	6.95	421	1,427.58	1,002.19	6,070.82
		7	1,600	0.19	304.00	25	3	220	3.55	3.60	88	7.81	7.92	19.36
		8	800	0.45	360.00	25	3	270	16.00	1.20	343	43.20	3.24	92.61
		9	2,410	0.32	771.20	25	3	570	1.70	3.48	71	9.69	19.84	40.47
		subtotal	122,460	0.47	57,733.10	25	3	43,250	5.37	8.39	206	2,322.36	3,628.70	8,902.21
	No. 1A vein	1	11,840	0.55	6,512.00	25	3	4,880	1.52	2.14	75	74.18	104.43	366.00
		2	800	0.50	400.00	25	3	300	11.86	0.58	390	35.58	1.74	117.00
		3	162,870	0.39	63,519.30	25	3	47,630	5.02	6.63	146	2,391.03	3,157.87	6,953.98
		subtotal	175,510	0.40	70,431.30	25	3	52,810	4.74	6.18	141	2,500.78	3,264.04	7,436.98
	No. 1B vein	1	26,400	0.20	5,280.00	25	3	3,960	7.19	3.17	137	284.72	125.53	542.52
		2	1,250	0.85	1,062.50	25	3	790	16.22	0.11	360	128.14	0.87	284.40
		3	8,200	0.44	3,608.00	25	3	2,700	1.62	3.28	87	43.74	88.56	234.90
		4	1,600	0.16	256.00	25	3	190	4.26	1.40	152	8.09	2.66	28.88
		5	1,050	1.20	1,260.00	25	3	940	3.35	2.83	59	31.49	26.60	55.46
		6	6,560	0.58	3,804.80	25	3	2,850	3.80	1.68	41	108.30	47.88	116.85
		subtotal	45,060	0.34	15,271.30	25	3	11,430	5.29	2.56	110	604.49	292.10	1,263.01
	t o t a l		343,030	0.42	143,435.70	25	3	107,490	5.05	6.68	164	5,427.63	7,184.85	17,602.20

A－3－3 Possible Ore Reserve Estimatin of No. 1 vein

	Vein	No. of Block	Area m²	Width m	Volume m3	Safty Rate %	S.G.	Reserve t	Ore Grade Pb %	Zn %	Ag g/t	Metal Content Pb t	Zn t	Ag kg
No. 2 vein	No.2 vein	1	121,680	0.88	107,078.40	25	3	80,300	11.06	2.90	274	8,881.18	2,328.70	22,002.20
		2	1,600	0.30	480.00	25	3	360	0.91	3.37	33	3.28	12.13	11.88
		3	1,600	0.68	1,088.00	25	3	810	1.16	1.87	32	9.40	15.15	25.92
		4	1,860	0.65	1,209.00	25	3	900	5.21	0.30	160	46.89	2.70	144.00
		5	57,360	1.09	62,544.20	25	3	46,900	5.18	1.53	267	2,429.42	717.57	12,522.30
		6	800	1.20	960.00	25	3	720	5.86	0.02	41	42.19	0.14	29.52
		subtotal	184,920	0.94	173,359.60	25	3	129,990	8.78	2.37	267	11,412.35	3,076.39	34,735.82
	No.2A vein	1	800	1.60	1,280.00	25	3	960	15.52	0.66	1,246	148.99	6.34	1,196.16
		2	13,290	0.41	5,448.90	25	3	4,080	2.90	4.19	94	118.32	170.95	383.52
		3	1,600	0.41	656.00	25	3	490	8.59	1.70	144	42.09	8.33	70.56
		4	13,480	1.02	13,749.60	25	3	10,310	1.61	5.07	39	165.99	522.72	402.09
		5	800	1.20	960.00	25	3	720	4.65	0.19	170	33.48	1.37	122.40
		subtotal	29,970	0.74	22,094.50	25	3	16,560	3.07	4.29	131	508.87	709.70	2,174.73
	No.2B vein	1	26,700	0.57	15,219.00	25	3	11,410	5.67	0.86	108	646.95	98.13	1,232.28
		2	800	0.23	184.00	25	3	130	2.14	3.60	44	2.78	4.68	5.72
		subtotal	27,500	0.56	15,403.00	25	3	11,540	5.63	0.89	107	649.73	102.81	1,238.00
	No.2 vein (hanging wall)	1	23,660	0.92	21,767.20	25	3	16,320	6.99	4.66	129	1,140.77	760.51	2,105.28
		subtotal	23,660	0.92	21,767.20	25	3	16,320	6.99	4.66	129	1,140.77	760.51	2,105.28
total			266,050	0.87	232,624.30	25	3	174,410	7.86	2.67	231	13,711.73	4,649.41	40,253.83

A-3-4 Possible Ore Reserve Est:matin of No. 2 vein

Vein		No. of Block	Area m²	Width m	Volume m3	Safty Rate %	S.G.	Reserve t	Ore Grade			Metal Content		
									Pb %	Zn %	Ag g/t	Pb t	Zn t	Ag kg
No. 6 vein	No. 6 vein	1	44,800	0.83	37,184.00	25	3	27,880	6.70	3.47	510	1,867.96	967.44	14,218.80
		2	63,860	0.56	35,761.60	25	3	26,820	4.26	2.96	67	1,142.53	793.87	1,796.94
		3	1,600	1.73	2,768.00	25	3	2,070	2.37	1.54	69	49.06	31.88	142.83
		4	73,480	1.28	94,054.40	25	3	70,540	9.68	4.68	140	6,828.27	3,301.27	9,875.60
		subtotal	183,740	0.92	169,768.00	25	3	127,310	7.77	4.00	204	9,887.82	5,094.46	26,034.17
total			183,740	0.92	169,768.00	25	3	127,310	7.77	4.00	204	9,887.82	5,094.46	26,034.17

A−3−5 Possible Ore Reserve Estimatin of No. 6 vein

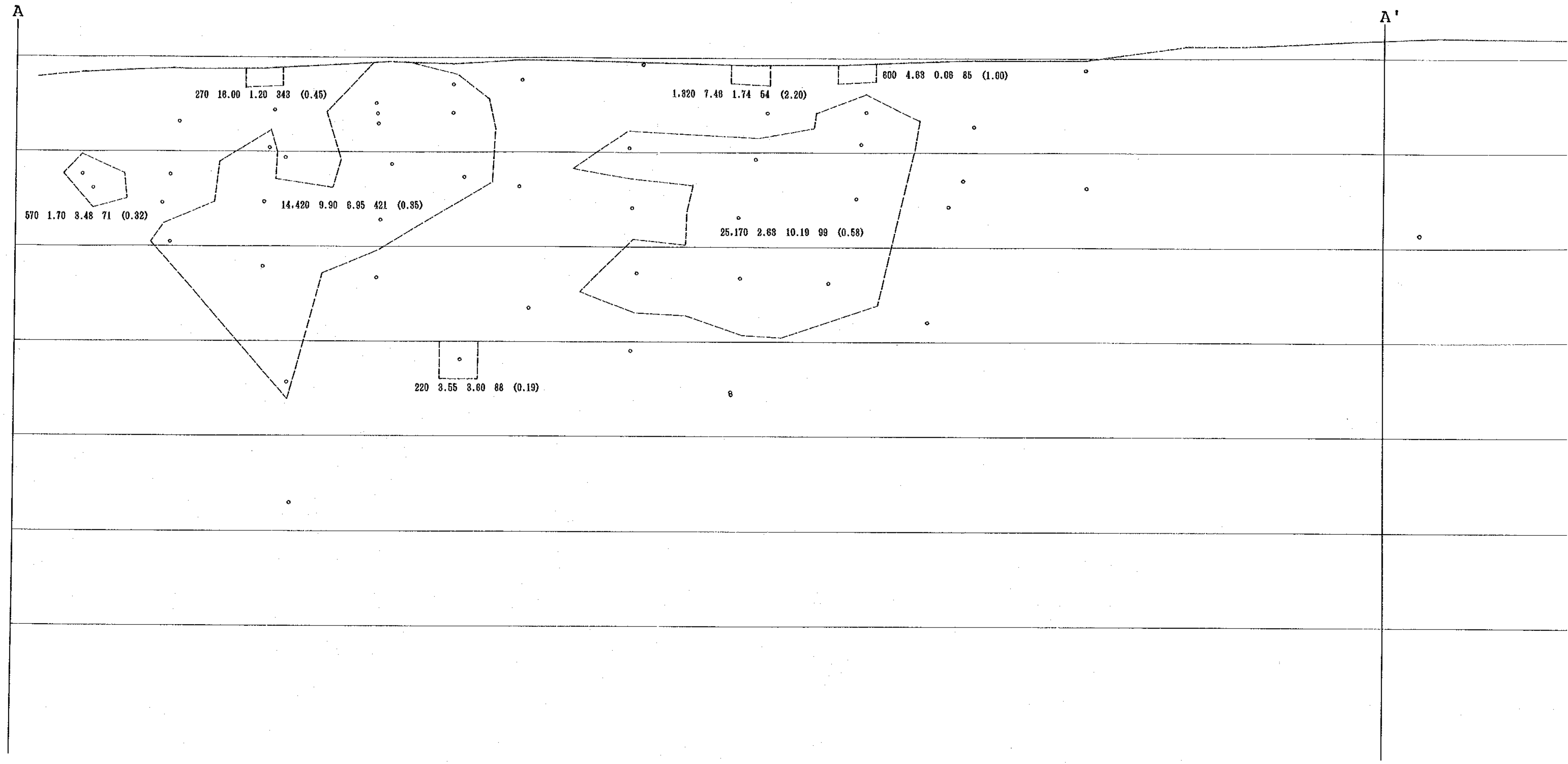
	Vein	No. of Block	Area m²	Width m	Volume m3	Safty Rate %	S.G.	Reserve t	Ore Grade Pb %	Ore Grade Zn %	Ore Grade Ag g/t	Metal Content Pb t	Metal Content Zn t	Metal Content Ag kg
No. 8 vein	No. 8 vein	1	51,840	0.40	20,736.00	25	3	15,550	9.81	2.31	353	1,525.46	359.21	5,489.15
		2	15,120	1.00	15,120.00	25	3	11,340	7.18	4.99	884	814.21	565.87	10,024.56
		3	14,130	1.52	21,477.60	50	3	32,210	1.68	4.60	739	541.13	1,481.66	23,803.19
		4	1,600	0.53	848.00	25	3	630	17.50	7.72	367	110.25	48.64	231.21
		5	1,600	1.23	1,968.00	25	3	1,470	0.82	3.66	58	12.05	53.80	85.26
		6	4,830	0.45	2,173.50	50	3	3,260	13.10	4.73	2,653	427.06	154.20	8,648.78
		7	48,320	1.42	68,614.40	25	3	51,460	4.57	2.99	263	2,351.72	1,538.65	13,533.98
		8	2,190	1.25	2,737.50	50	3	4,100	7.38	6.94	1,085	302.58	284.54	4,448.50
		9	13,610	0.72	9,799.20	25	3	7,340	0.95	3.91	337	69.73	286.99	2,473.58
		subtotal	153,240	0.94	143,474.20	30	3	127,360	4.83	3.75	540	6,154.19	4,773.56	68,738.21
	No. 8A vein	1	3,530	0.15	529.50	25	3	390	3.20	1.69	63	12.48	6.59	24.57
		2	6,170	0.14	863.80	25	3	640	4.50	6.13	75	28.80	39.23	48.00
		3	1,600	0.63	1,008.00	25	3	750	16.00	6.80	172	120.00	51.00	129.00
		4	1,600	0.59	944.00	25	3	700	4.26	2.63	56	29.82	18.41	40.60
		5	1,690	0.32	540.80	25	3	400	7.51	1.20	254	30.04	4.80	101.60
		6	2,880	0.34	979.20	50	3	1,460	1.09	3.88	760	15.91	56.65	1,109.60
		7	1,600	0.39	624.00	25	3	460	1.36	2.22	418	6.26	10.21	192.28
		8	6,390	0.66	4,217.40	25	3	3,160	8.86	1.50	538	279.98	47.40	1,700.08
		9	1,600	0.25	400.00	25	3	300	3.59	4.11	309	10.77	12.33	92.70
		subtotal	27,060	0.37	10,106.70	27	3	8,260	6.47	2.99	416	534.06	246.62	3,438.43
	No. 8 vein (foot wall)	1	26,440	0.35	9,254.00	25	3	6,940	18.51	6.64	1,708	1,284.59	460.82	11,853.52
		subtotal	26,440	0.35	9,254.00	25	3	6,940	18.51	6.64	1,708	1,284.59	460.82	11,853.52
total			206,740	0.79	162,834.90	29	3	142,560	5.59	3.84	589	7,972.84	5,480.99	84,030.16

A-3-6 Possible Ore Reserve Estimatin of No. 8 vein

Vein		No. of Block	Area m²	Width m	Volume m3	Safty Rate %	S.G.	Reserve t	Ore Grade			Metal Content		
									Pb %	Zn %	Ag g/t	Pb t	Zn t	Ag kg
No. 10 vein	No. 10 vein	1	15,550	0.23	3,576.50	25	3	2,680	2.63	3.18	904	70.48	85.22	2,422.72
		2	7,160	0.40	2,864.00	25	3	2,140	7.54	2.73	1,808	161.36	58.42	3,869.12
		subtotal	22,710	0.28	6,440.50	25	3	4,820	4.81	2.98	1,305	231.84	143.65	6,291.84
total			22,710	0.28	6,440.50	25	3	4,820	4.81	2.98	1,305	231.84	143.65	6,291.84

A-3-7 Possible Ore Reserve Estimatin of No. 10 vein

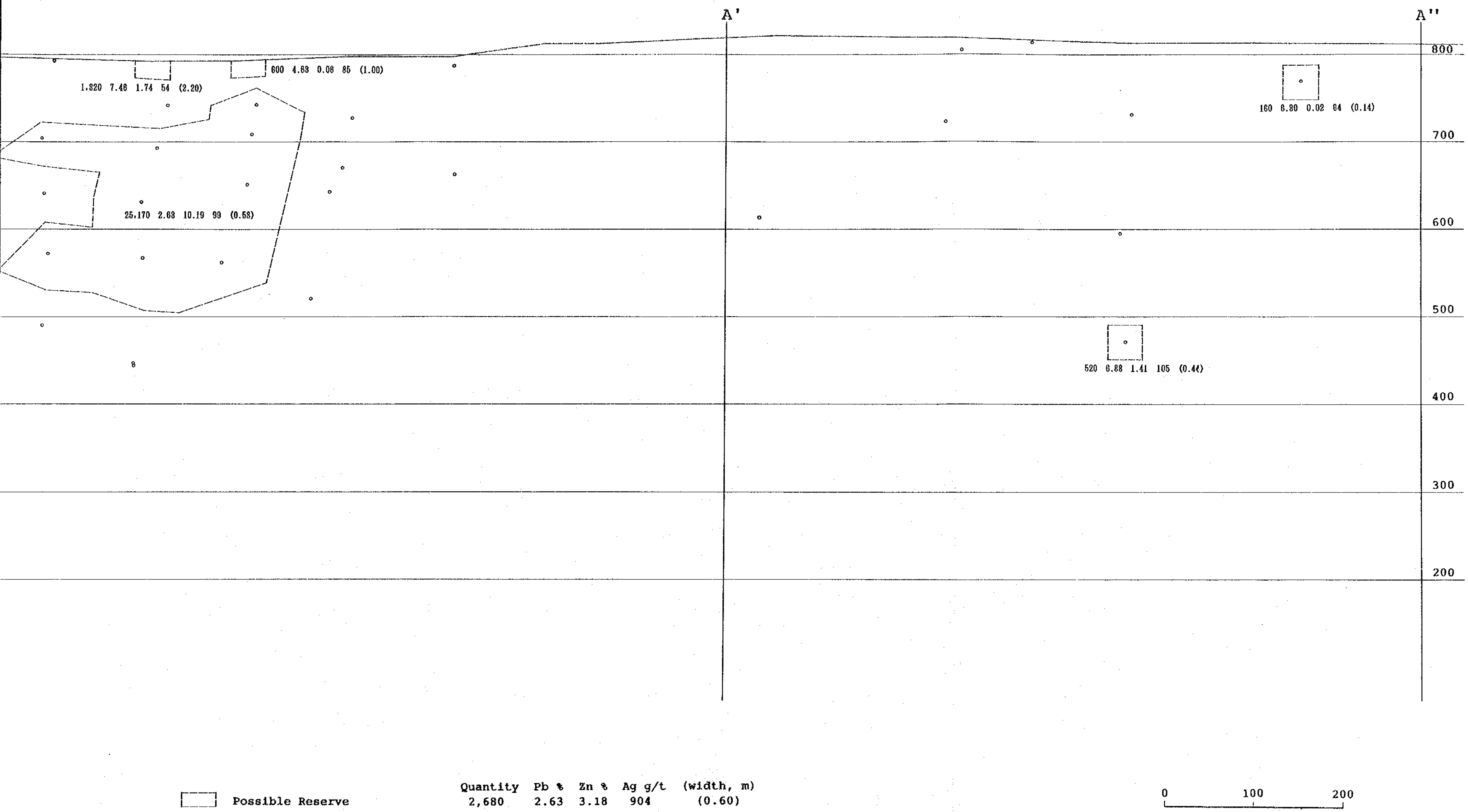
A-4- 1	Ore Blocks of the No.1 Vein
A-4- 2	Ore Blocks of the No.1A Vein
A-4- 3	Ore Blocks of the No.1B Vein
A-4- 4	Ore Blocks of the No.2 Vein
A-4- 5	Ore Blocks of the No.2A Vein
A-4- 6	Ore Blocks of the No.2B Vein
A-4- 7	Ore Blocks of the No.2HW Vein
A-4- 8	Ore Blocks of the No.6 Vein (North)
A-4- 9	Ore Blocks of the No.6 Vein (South)
A-4-10	Ore Blocks of the No.8 Vein
A-4-11	Ore Blocks of the No.8A and No.8FW Veins
A-4-12	Ore Blocks of the No.10 Vein



Possible Reserve

	Quantity	Pb %	Zn %	Ag g/t	(width, m)
Possible Reserve	2,680	2.63	3.18	904	(0.60)

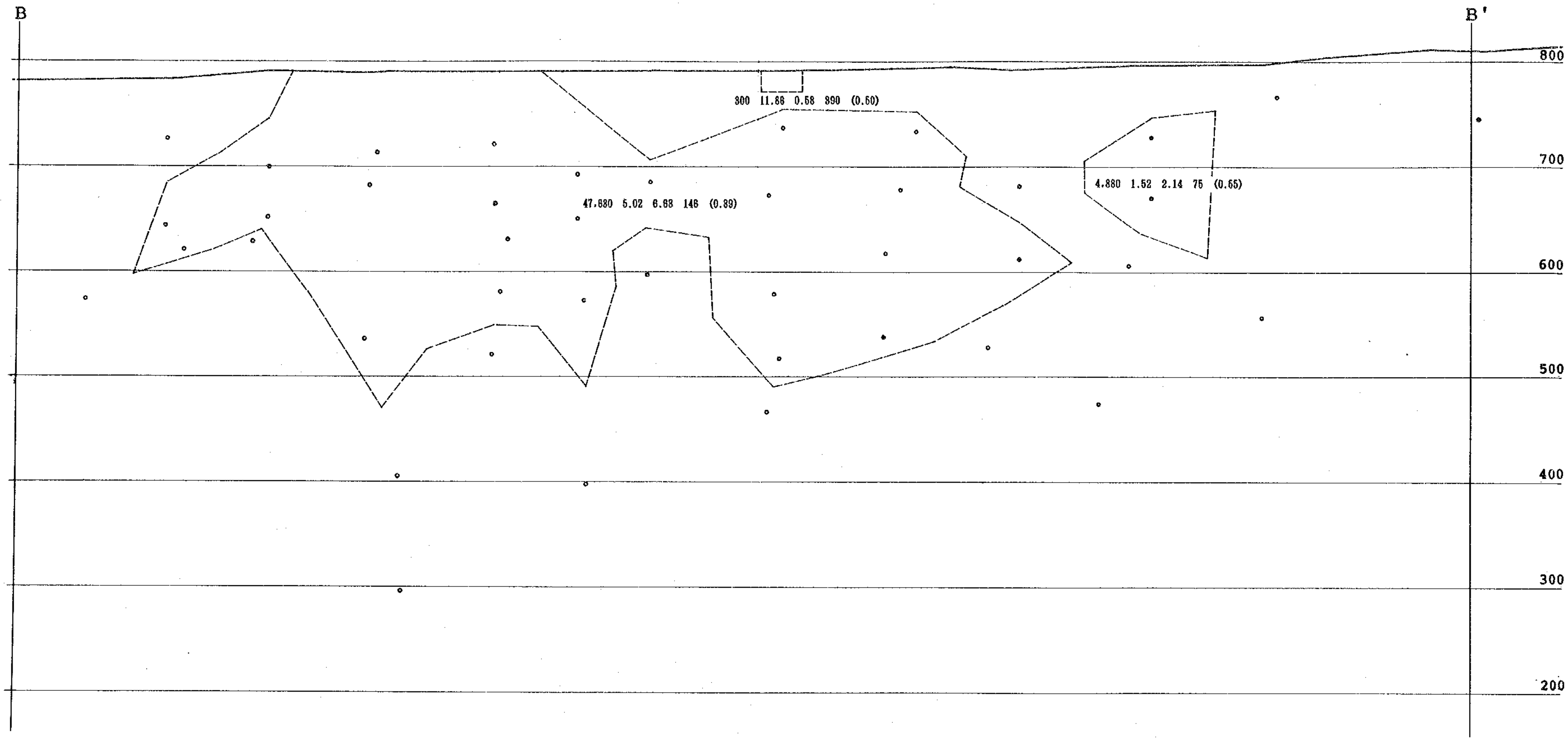
A - 4 - 1 Ore Blocks of the No.1 Vein



Possible Reserve

Quantity	Pb %	Zn %	Ag g/t	(width, m)
2,680	2.63	3.18	904	(0.60)

A - 4 - 1 Ore Blocks of the No.1 Vein

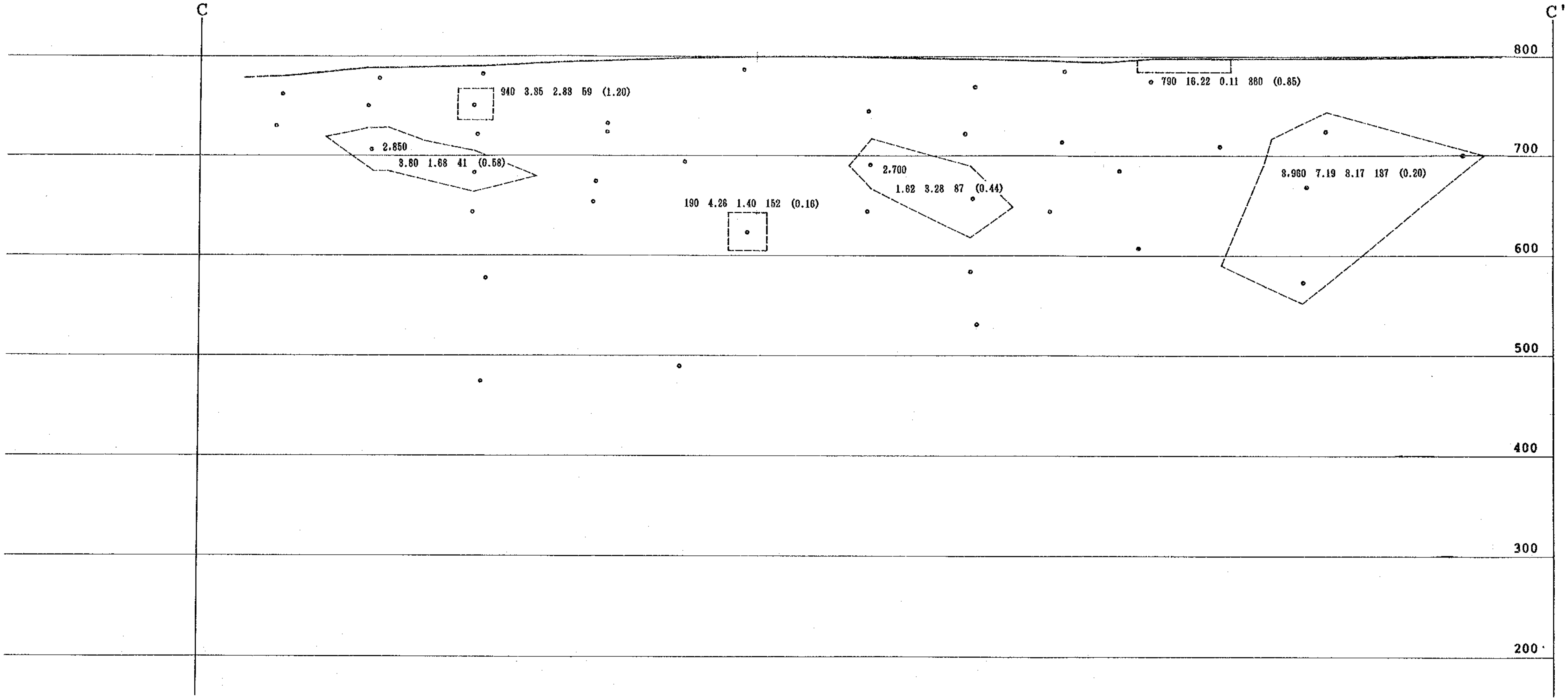


Possible Reserve

Quantity	Pb %	Zn %	Ag g/t	(width, m)
2,680	2.63	3.18	904	(0.60)

0 100 200

A - 4 - 2 Ore Blocks of the No.1A Vein

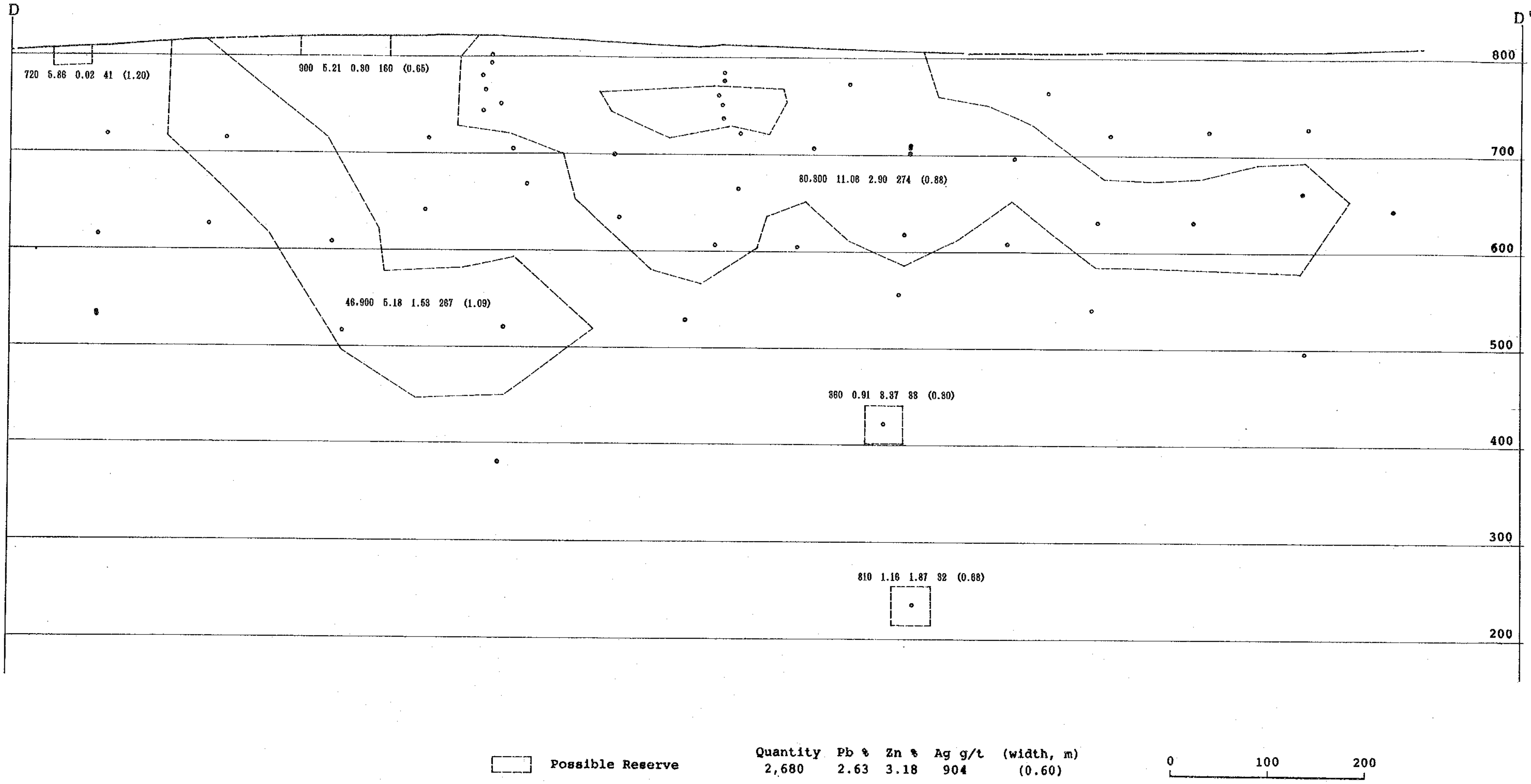


Possible Reserve

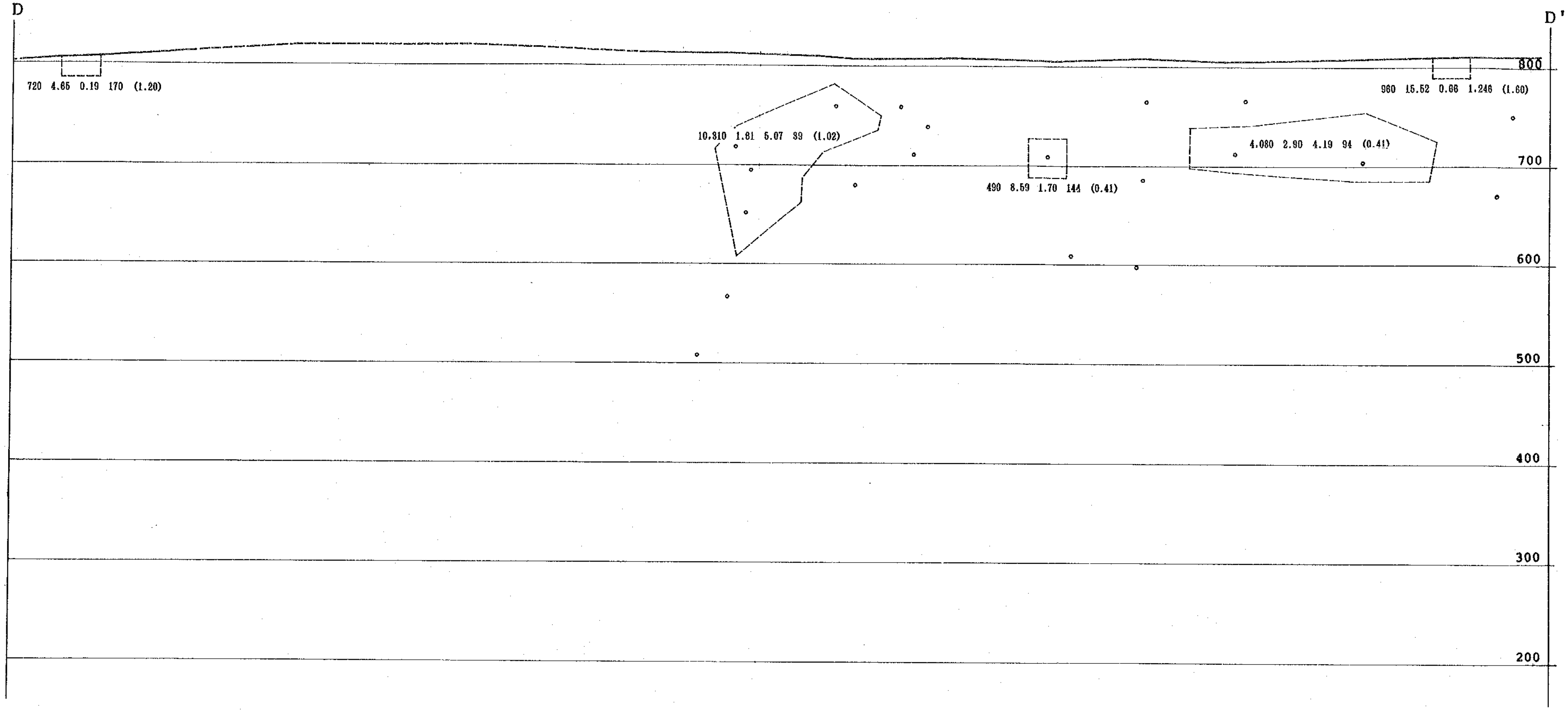
Quantity	Pb %	Zn %	Ag g/t	(width, m)
2,680	2.63	3.18	904	(0.60)

0 100 200

A - 4 - 3 Ore Blocks of the No.1B Vein



A - 4 - 4 Ore Blocks of the No.2 Vein

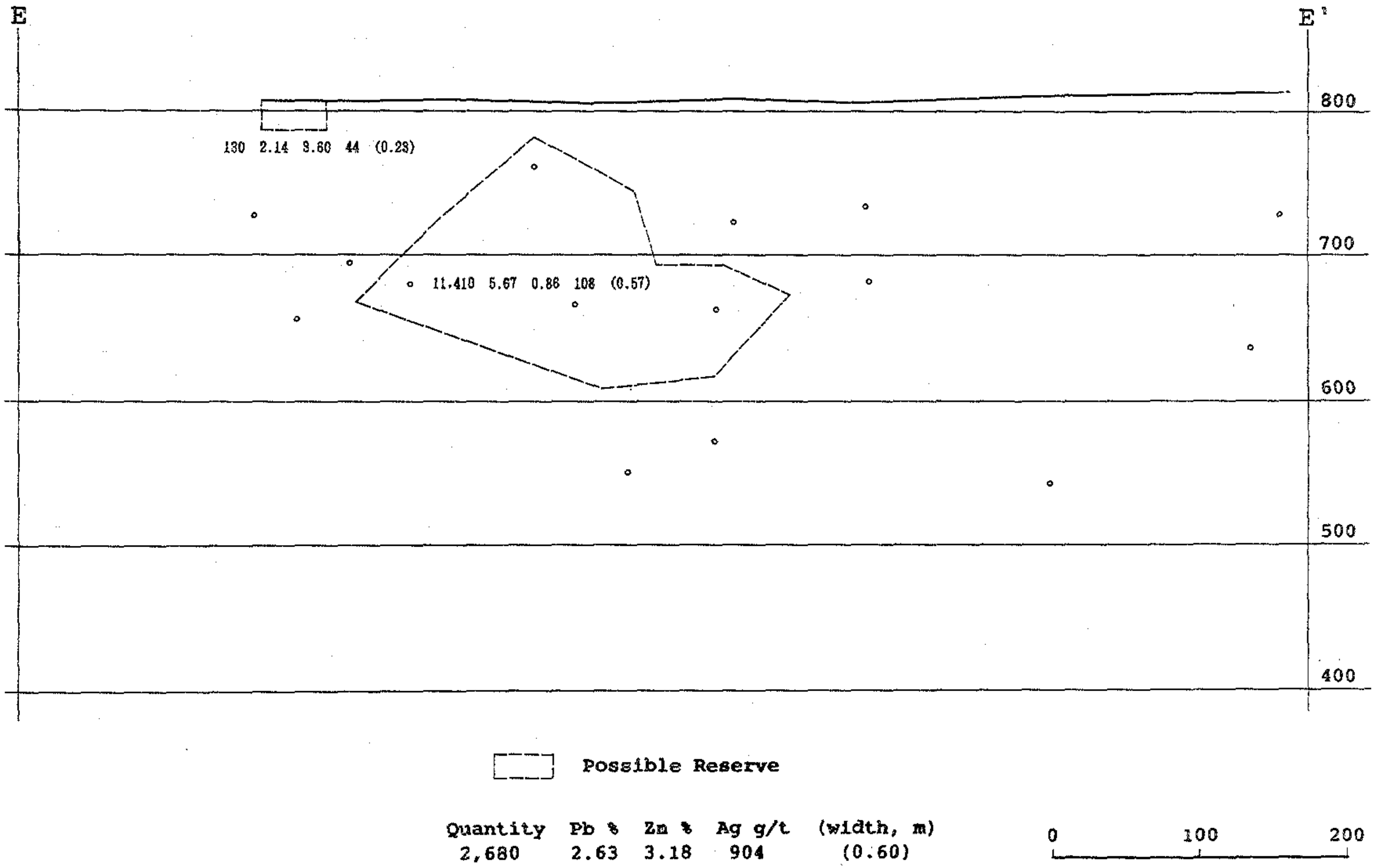


Possible Reserve

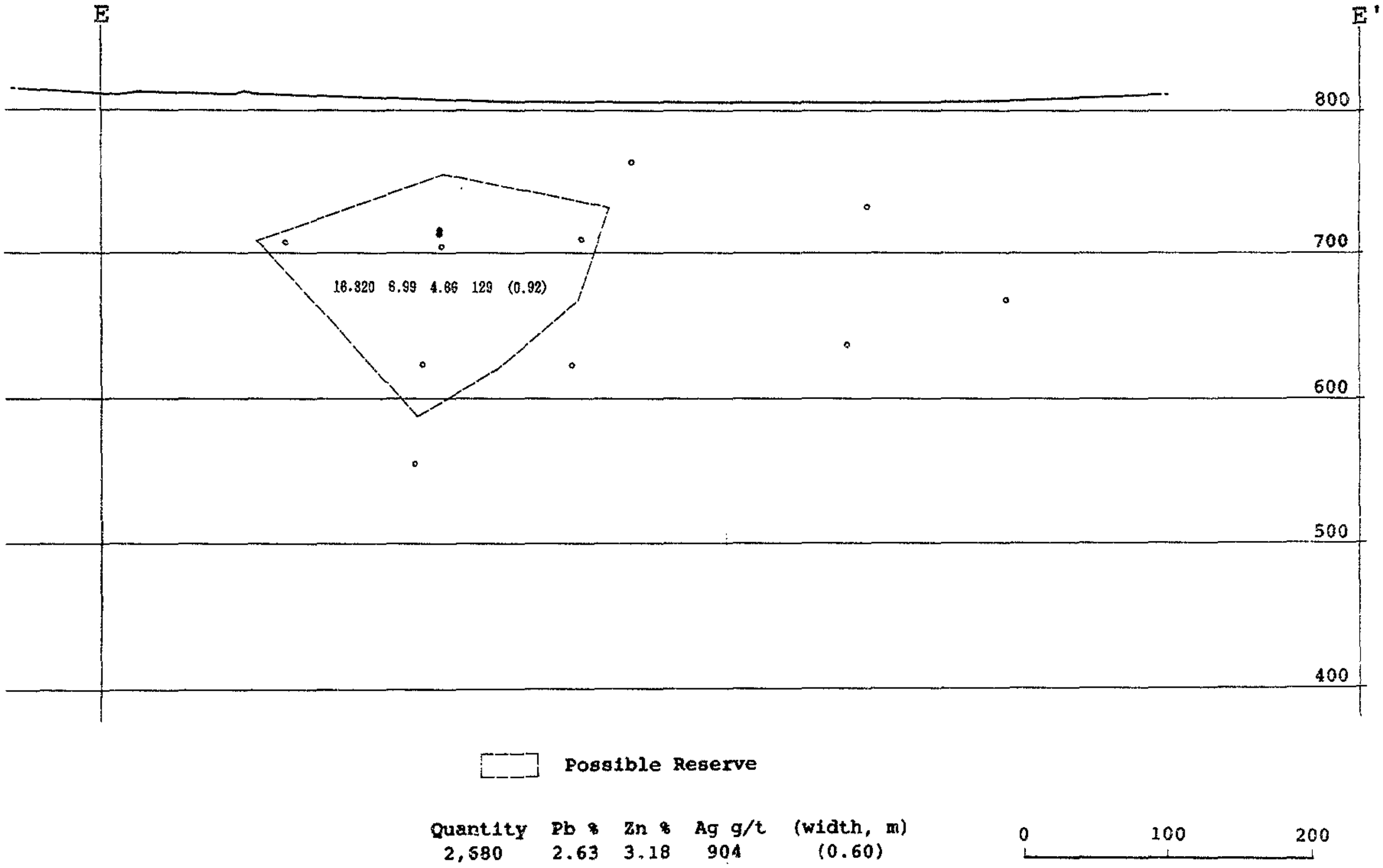
Quantity	Pb %	Zn %	Ag g/t	(width, m)
2,680	2.63	3.18	904	(0.60)

0 100 200

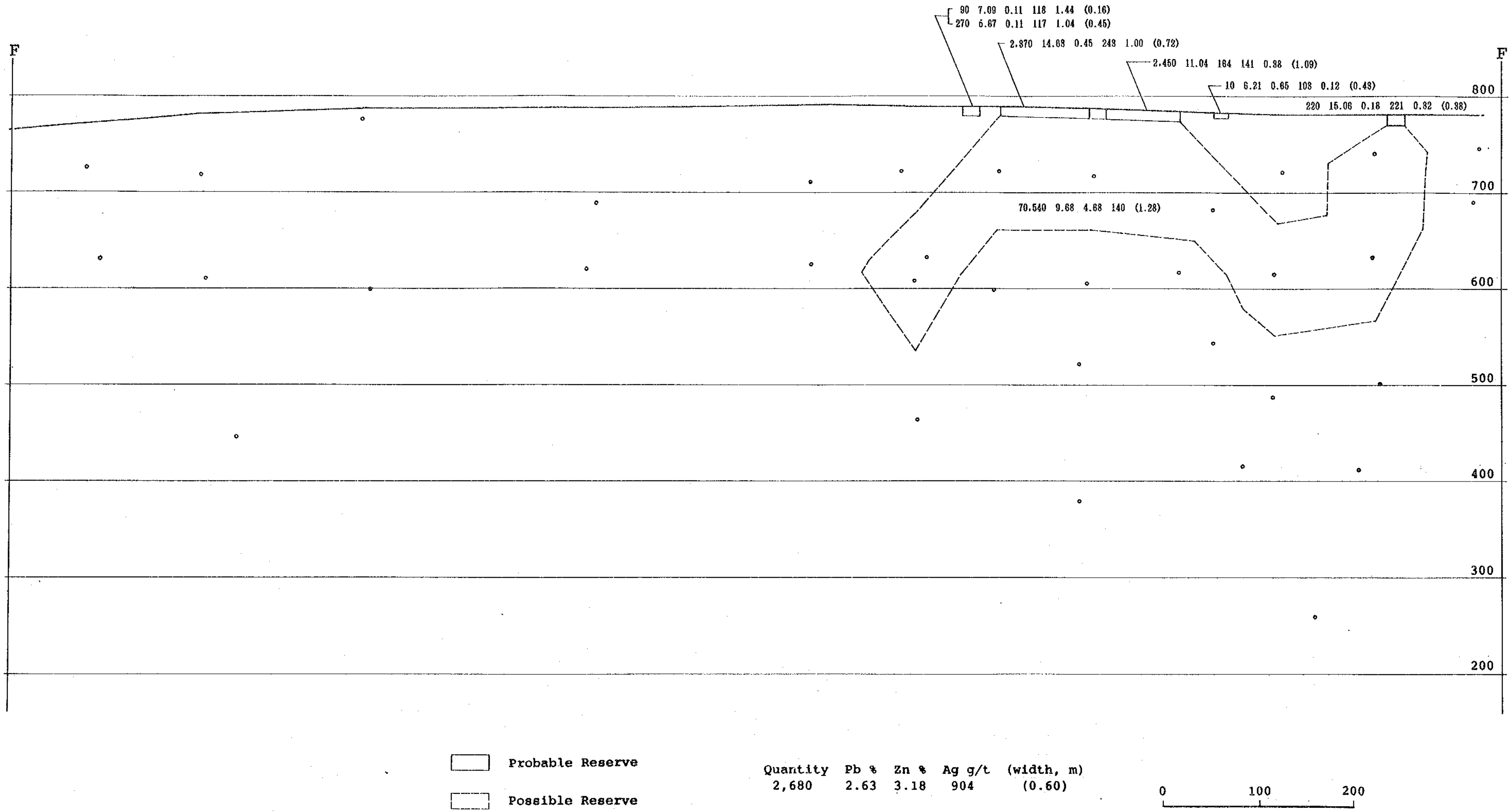
A - 4 - 5 Ore Blocks of the No.2A Vein



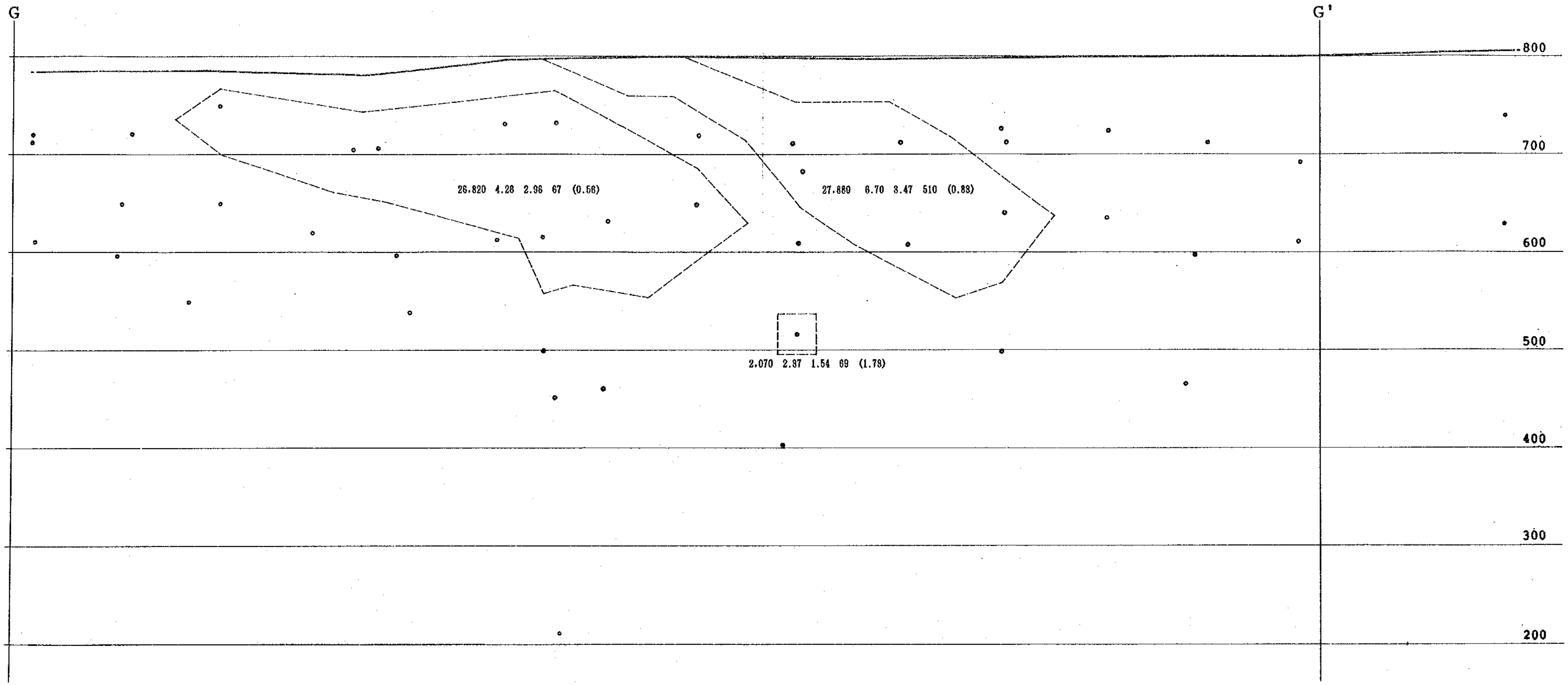
A - 4 - 6 Ore Blocks of the No.2B Vein



A - 4 - 7 Ore Blocks of the No.2HW Vein



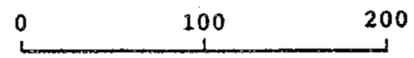
A - 4 - 8 Ore Blocks of the No.6 Vein (North)



Probable Reserve

Possible Reserve

Quantity	Pb %	Zn %	Ag g/t	(width, m)
2,680	2.63	3.18	904	(0.60)



A - 4 - 9 Ore Blocks of the No.6 Vein (South)