REPORT

ON

THE COOPERATIVE MINERAL EXPLORATION

IN

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REPORT
ON
THE COOPERATIVE MINERAL EXPLORATION
IN
THE KADOMA AREA
REPUBLIC OF ZIMBABWE

PHASE Ⅲ

MARCH 1989

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

PREFACE

In response to the Government of Zimbabwe, the Japanese Government has decided to conduct a Mineral Exploration in the Kadoma Area and entrusted it to the Japan International Cooperation Agency (JICA) and Metal Mining Agency of Japan (MMAJ).

The JICA and MMAJ sent a survey team, headed by Mr.Tetsuo Hatasaki, to Zimbabwe and the survey was conducted from 24th June to 24th December, 1988. Apart from the field survey, the team had the opportunity to exchange views with the concerned officials of the Government of Zimbabwe. After the field survey, further studies were carried out in Japan and this report was prepared.

We hope that this report will be useful for the development of this Project and contribute to the promotion of friendly relations between our two countries.

We wish to express our deep appreciation to the concerned officials of the Government of Zimbabwe for their close cooperation during the investigation.

28th February 1989

Kensuke Yanagiya
President
Japan InternationalCooperation Agency

Junichiro Sato
President
Metal Mining Agency of Japan

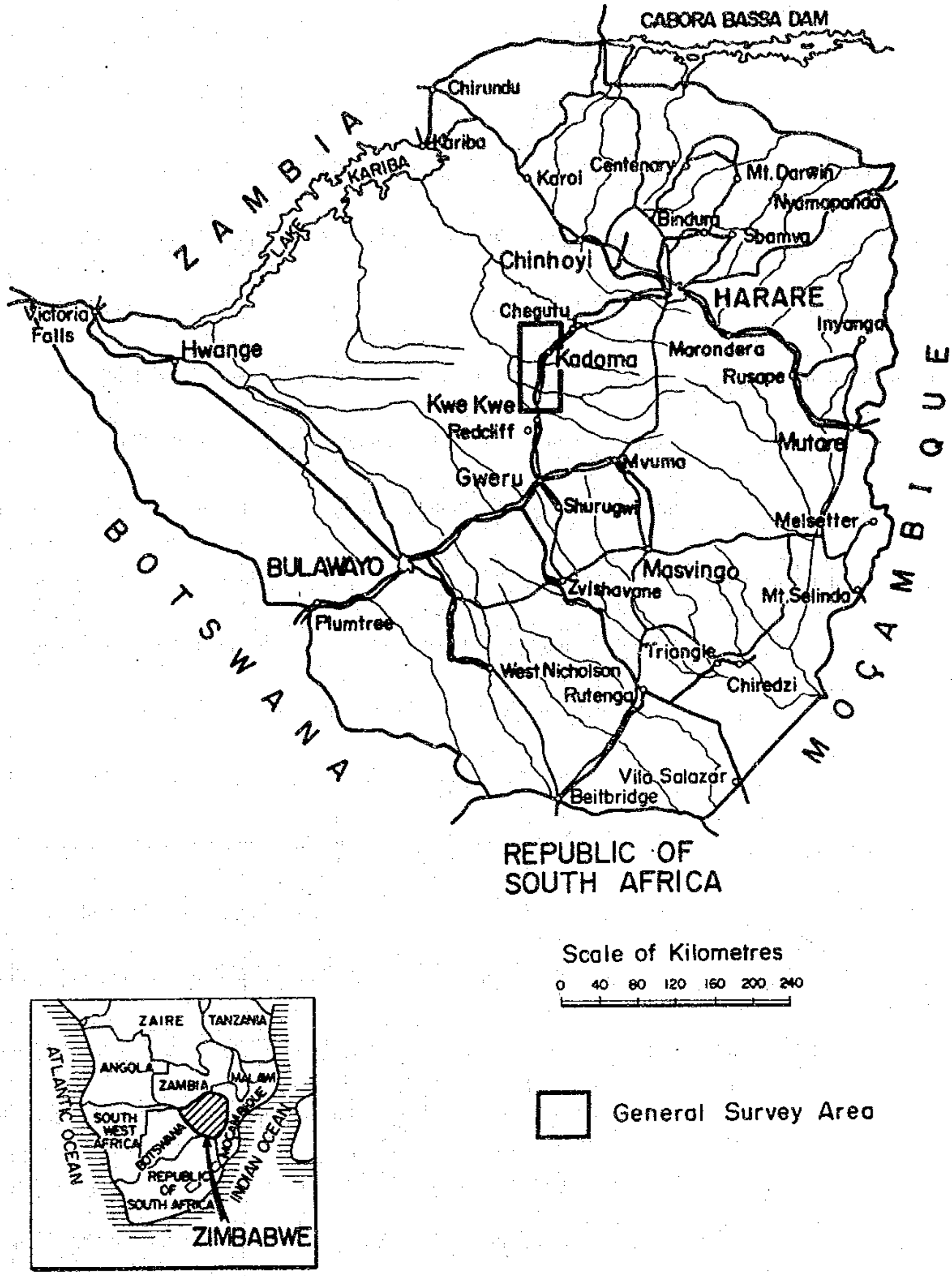

Fig. I-1-1 Location Map of the Kadoma Area, Zimbabwe

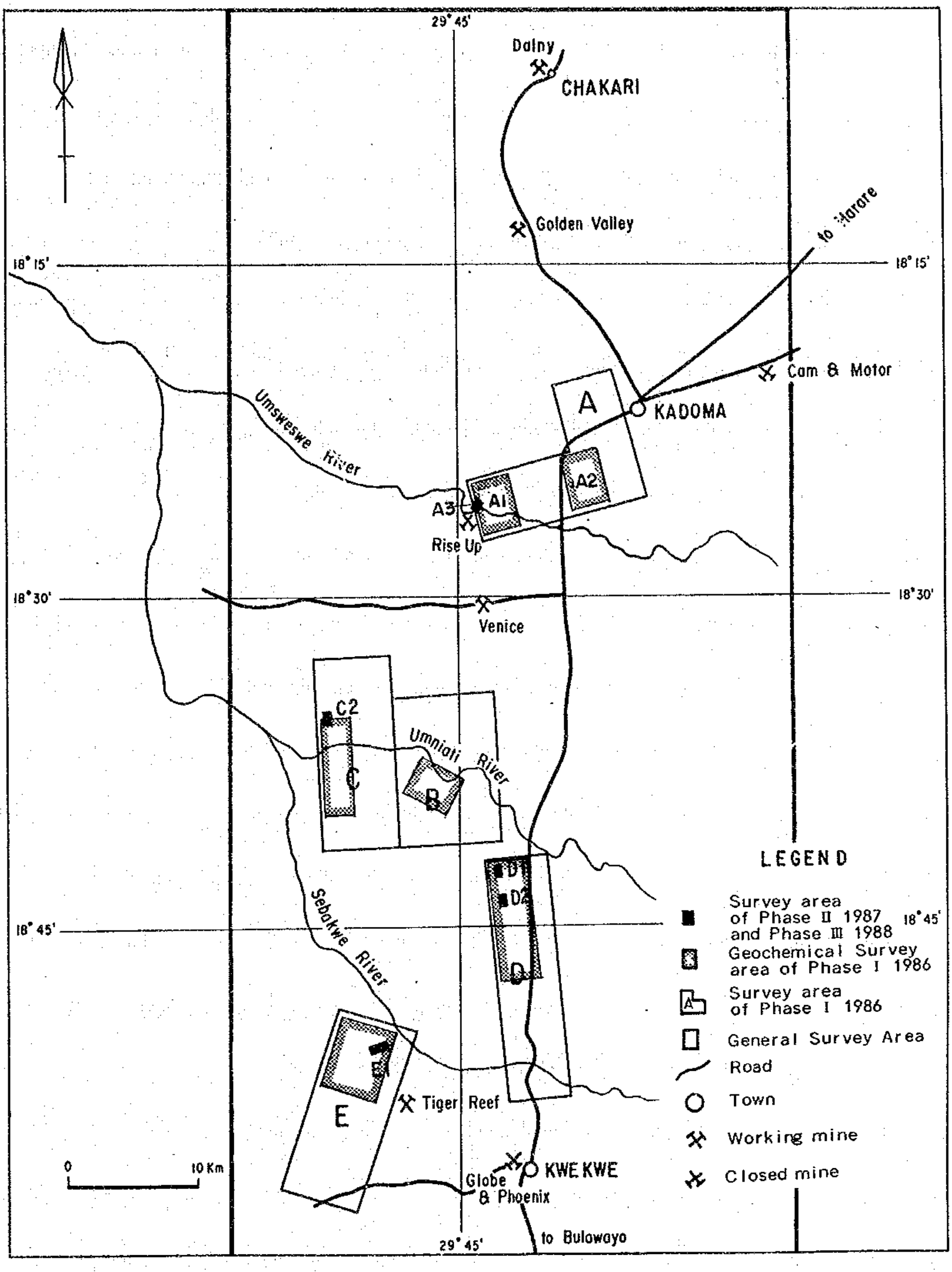

Fig. I-1-2 Location Map of the Survey Areas

Summary

The aim of this third year's programme involved with the Kadoma project was to examine the potential of vein type gold deposit within the three areas, selected on the basis of the detailed geochemical exploration in 1988. The programme included trenching and making 22 drill holes of totally 2202.9 metres.

The maximum Au yield from the quartz veins in the A3 and E1 areas are 41.23 and 53.37 g/t, respectively. Thickness of the mineralisation in these areas are poor and therefore, when regarded as a deposit to be exploited by underground operation, the ore grade would be much lowe than those of current operating mines. The economic ore potential for the deposits is not believed to be high.

However, this programme revealed some relationships between the geochemical anomalies of various indicative elements in the soil and subsurface mineralisation. This three year survey would be an important case study and provide information regarding the gold mineral potential within the Greenstone belt.

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PART I

OVERVIEW

CHAPTER 1 INTRODUCTION

1-1. Conditions of the Survey

The Cooperative Mineral Exploration programme in the Shamva area, Republic of Zimbabwe, was completed in 1985 and on the request of the Zimbabwean Government, the Japanese government dispatched a mission for a preliminary study and conduct negotiations for a new project. As a result, the Kadoma area has been selected for the second mineral exploration programme based on the agreement, Scope of Work, signed on June 2, 1986.

The five areas of 500 km, which subjected to the geological and geochemical survey, were selected out of 5000 km area on the basis of technical documents, exploration history and the proposals of the Geological Survey Department of Zimbabwe.

Some of the anomalous zones of elements, which were identified during the phase 1 of the survey, thought to be favorable for a detailed geochemical survey. Thus, the five small areas were selected, and sampled at closer intervals than those in the Phase 1. Proposals for a new exploratory drilling programme in the areas, A3 C2 and E1 were made according to the results of the Phase II geochemical exploration and trenching programme.

The aim of the Phase III drilling programme was to encounter the mineralisation which caused the geochemical anomalies in the three surveyed areas and the estimation of the mineral potential of the Kadoma area.

1 -2. Conclusions and Recommendations of Phase II

1-2-1. Conclusions of Phase II

At the beginning of the phase 11, the the 2.36 km target area for a detailed geochemical geological survey was selected from an area of 125 km upon the results of the Phase I programme. The selection of some geochemical anomalies with high ore-bearing potential was carried out through discussions and interpretations. Results of the geochemical survey and trenching programme suggested a good correspondence between some geochemical anomalies and the geological environment. Some of the areas revealed high potentials for mineral deposits.

Table I-1-1 gives a summary of the Phase II geochemical survey.

The Au-anomaly zone of Area A3 which extends over 10,000 square metres, have drawn the first priority, because, anomalies were 5 to 20 times as intense as the mean value. The occurrence of anomaly zone on the structural extension of Rise Up mine to the southeast, might support to this evaluation.

Area E1 is characterized by some overlapped Au-anomaly zones and pyrophyllitic alteration zones. The average Au-anomaly values were 4 to 20 times intense than the mean and one included 1 g/t of Au. The survey, thus, revealed a high mineral potential worthy of further exploration.

In Area C2, zones with intense Au-anomalies with the values of 3 to 12 times higher than the average and mineralized quartz veins with some sulphide, provided a good mineral potential. But the area is ranked lower than the A3 and E1 due to the lack of sufficient information on fractures and mineralisation. Trenching and Au assay of quartz veins are necessary for further work.

All Au-anomalies Area D1 are located within the BIF and are superjacent. The intensity is 2 to 4 times the mean value, and which gives the area a lower Au potential than other areas. Contents of Ni, Pt and Cr and indicative ratios of Cu/Ni and Ni/Cr suggest a very low potential for platinoid or Ni mineralisation.

It is difficult evaluate correctly the mineral potential in Area D2 because the apparent contamination of Au-anomalies by a tailings dump. But the Ns anomaly zonation, which may not be due to contamination, provide clues to some potential.

1-2-2. Recommendations For Phase III Survey

The following exploration programme is recommended on the basis of the previous conclusions.

1. Diamond drilling on the Au geochemical anomaly zones in Area A3, E1 and C2 to test the mineralisation. Holes are shallower than 100 metres and the maximum depth of the holes should be determined.

2. Chemical analysis of core samples from quartz veins and shear zones for Au, Ag, As, Sb and Hg.

3. In Area C2 trenching is necessary to obtain information such as trend and dip of quartz veins and fractures, prior to drilling.

1-3. Outline of the Phase III survey

1-3-1. Survey area

Fig. I-1-1 and Fig.I-1-2 show the survey area including the three small target areas of the Phase III drilling survey. The survey area is located about two hundred and thirty kilometres southwest of the capital, Harare, and hundred kilometres north of Bulawayo, the second major city of Zimbabwe. The main highway and railway , which connect these major cities, run through the survey area.

Two major industrial and farming centers, Kadoma and Kwekwe, are located in the north and south of the project area, respectively. It is about one hour and forty five minutes drive from Harare to Kadoma (140 km) and one hour drive from kadoma to Kwekwe (80 km) on a good highway. The distance between A3, C2 and E1 areas and the Kadoma are twenty three, fifty three and one hundred kilometres, respectively through main and local roads.

1-3-2. Purpose of the Survey

Table I -1-1 Appraisal of Geochemical Anomalies of Phase II

Area	Au Anomaly							Other Anomalies than Au
	Number of Anomaly Zone	Number of over $M+\sigma$	Number of over $M+2\sigma$	$\frac{M+2\sigma}{M}$	Host Rock	Structural Control	Correlation with Anomalies of other Indicators	
A 3	1	1	6	5. 5	Basalt Felsic Dike Granitic Intrusi-ve	NE fractures and Felsic dike Aurifeous quartz veins max. 1.7 g/t Au	Unconformable with Ag, As	Ag, As ≦B.G.x 2.5 small zone of 4 samples of ≦ $M+2\sigma$ Ag, As anomalies No coinciden-ce with Au anomalies
C 2	2	9	9	4. 3	Mafic Intrusive (Dolerite)	Inffered NE quartz system	Unconformable with Ag, As	Cu mineralisation in quartz vein
D 1	2	1 2	9	3. 5	Banded Iron Form-ation (BIF)	NNE to NS trend conformable to BIF strike	Unconformable to any other indicators	Ni Co Cr anomalies located at convex contact of Kwekwe Complex, Intensity is small
D 2	1	3	6	5. 0	BIF	NS ? Contamination by dump dispo-sal	As anomalies lie some hundred metres north	Intensity of As anomalies 2~2.5 times of the mean
E 1	3	1 4	2 5	3. 5 5. 0	BIF Felsic tuff	elongated zonation parallel to geological trend	North and east anomali-es overprint Ag, As ano-malies	Ag anomalies concentrate in the north Some analytical problem with As?

The purpose of Phase III survey was to conduct an exploratory drilling to test the mineral potential in the anomaly zones, selected on the basis of Phase I and II surveys. (Fig. I-1-2)

1-3-3. Methods of the Survey

Methods and specifications of the survey are as follows.

Drilling Survey					
	Area A3	8	holes	totally	800 m
	Area C2	2	holes	totally	200 m
	Area E1	12	holes	totally	1200 m
Total of	3 areas	22	holes		2200 m
Geochemical Assay					
	Au, Ag	220 samples		totally	440 elements
Thin section		10			
Polished section		10			
Homogenization temperature		20			

1-3-4. Organization of the survey team

The members involved in the planning, managing and drilling survey are as follows.

Planning and Negotiation

Japanese member		Zimbabwean member	
Toshihiko Hayashi	Metal mining Agency of Japan Japan(MMAJ)	E.R.Morrison, C.B.Anderson,	Geological Survey Department Ministry of Mines

Drilling Survey

Tetsuo Hatasaki	Dowa Engineering Co., Ltd.	S.Simango B.Barber	Geological Survey Department Ministry of Mines

1-3-5. Period of the survey

*Survey in Zimbabwe : 184 days ; 24 June ~ 24 December, 1988

*Analysis and Preparation of Phase III and Summary Report : 25 December, 1988- 28 Februa 1989

CHAPTER 2 GEOGRAPHY OF THE SURVEY AREA

2 -1. Topography and Drainage system

The survey area is located on the Southern African Plateau at an altitude of 1,000 to 1,300 metres above sea level. Topography of the area is mostly quite flat, but there are some hills (approximately 100 metres high) in the area south of Kwekwe. The Umsweswe river in the north and the Sebakwe river in the south of the area flow from east to west. The two join with the Umniati river flowing northwestward and this in turn flows into the Zambezi river.

2 -2. Climate and Vegetation

Despite the latitude ranging from 18° 00′ to 19° 00′ south, the climate of the area is not tropical due to the high altitude. The year is clearly divided into two seasons a dry season from April to October and a wet season between November and March. Annual precipitation is usually 700mm to 900mm millimetres. The temperature is a maximum of 30° C and a minimum of 16° C in summer, and a maximum of 21° C and a minimum of 7 in winter. October is the hottest month of the year and then the temperature decreases, due to cloud cover. Fig.I-2-1 shows average temperature and rainfall of each month.

The area is sparsely vegetated, generally being a few shrubs, occasionally broken by thickets of thorn trees.

Fig. I-2-1 shows the average monthly rainfall, mean, maximum and minimum temperatures at Kadoma through a year.

2 -3. Mining industry

The value of the metals mined, except gold, in Zimbabwe in 1987 is $ 816 million, 16.6 percent increase from the previous year. The increased rate of output was 4 percent. This is the highest level in 10 years and the mining industry, thus, supports Zimbabwe's economy as well as agriculture.

The main reason for this higher growth is the increased metal prices in the world market. This year, the price of nickel has soared more than four times that in January, 1987. Bindura Nickel Corporation of Anglo American group has cleared the cumulative deficit and announced reallotment.

Gold production of 1987 was 14710 kg with the value of $350 million. An increase in the gold price was not predicted in 1988. However, the exploration and mine development for gold is still active, especially in the Greenstone Belt. The number of EPO applications and grants have increased rapidly these days. Cluff Minerals is planning the develop the Freda and Rebecca mines. Chase Minerals of the Australian capital and African Gold of British capital are involved in gold exploration in Zimbabwe.

The gold productions of the important mines in the Kadoma area are as follows.

Dalny	1,334 kg	5.42g/t	
Venice	542	3.98	
Patchway/Brompton	557	7.68	
Cam & Motor	151	0.51	(Dump)
Riverlea	24.5	5.00	

Indarama	22.8	7.00	
Renco	1,728	7.31	(Outside of the area)

The number of employees in the mining industry has estimated to be sixty thousand, which is, one per hundred of the total population. It increases up to five hundred thousand when employees family members and dependents have taken in to account. The mining industry has a demand since, it supply raw material for chemicals, explosives, electricity, transport and many other necessities of life.

Zimbabwe exports minerals and mineral-related products worth of over $1 billion and that is, more than 40 percent of the country's total foreign exchange earnings. But, allocation of foreign currency to the mining industry is insufficient for keep it moving and expansion of production. Thus, the foreign exchange earnings are vulnerable to the fluctuation of world market prices and exchange rates.

With in the SADDC member countries, Zimbabwe is still the most rich one in minerals. Recent discovery of the platinum group metal deposit in the Great Dyke as well as the trend of economic sanctions against South Africa, stimulated foreign investors to study and develop the mining industry.

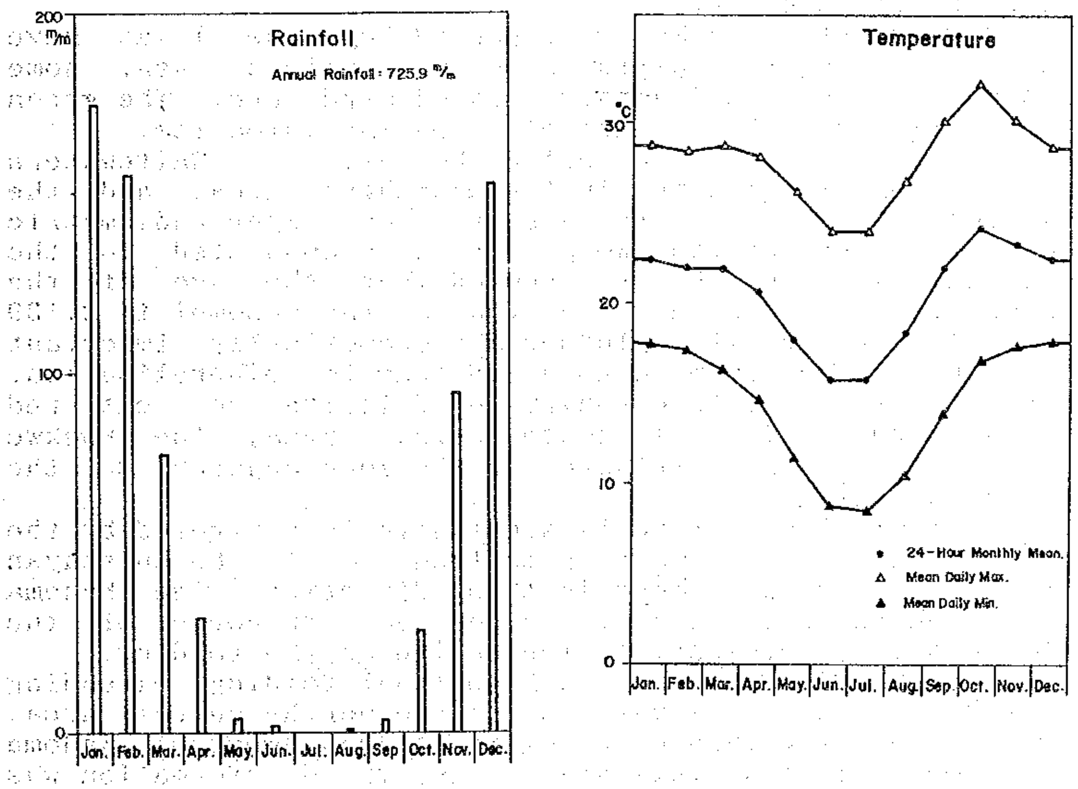

Fig. I-2-1 Monthly Average Rainfall and Temperature in the Kadoma Area

CHAPTER 3 GENERAL GEOLOGY

Fig.I-3-1 illustrates the geologic column section of the Kadoma Area. The area consists of a granitic-gneissic terrain, greenstones and intrusive bodies of Archean age.

The Rhodesdale Granite-Gneiss Complex is exposed in the eastern area as the western edge of the Complex. Locally, highly metamorphosed rocks of the Sebakwian Group, the oldest group in the area, are enclosed within the Complex.

The Greenstone belt consists of the Bulawayan and Shamvaian groups. The Bulawayan Group, occupying the most part of the area, is dated at from 2.7 to 3 billion year and is divided into two subgroups; the Lower and the Upper Greenstones. Both sub-groups mainly consist of mafic volcanic rocks and pyroclastic rocks, accompanied by felsic volcanic rocks and pyroclastic rocks, banded ironstone, and sedimentary rocks. The Shamvaian Group lying in a northeast trending belt of synclinal axis, is dated at from 2.5 to 2.7 billion year and consists of shallow marine sediments such as sandstone and conglomerate.

The green rocks which occur repeatedly in each group are composed of dark green basalt lava with subordinate andesite. The basalt lava shows distinct pillow structure of 0.5 to 1.0 metre in longer diametre and preserves quenched glassy crust and vesicles inside of it.

The pyroclastic rocks accompanied by the lavas have lithofacies varying from pillow breccia to volcanic ash, some of which show obvious sedimentary graded structure. The green rocks are believed to be product of submarine volcanism.

With regard to the intrusive bodies, the Whitewaters Tonalite Pluton is located in the northern area, and the Sesombi Tonalite Pluton in the western area. K/Ar radiometric age determinations of the two plutons were conducted in the Phase I survey. The results showed that the age of the Whitewaters is 1,829 + 91 Ma, and that of the Sesombi is 2,139 + 112 Ma. The two tonalite plutons are economically important due to their association with gold and tungsten mineralisation. Other small-scale quartz porphyry and dolerite are scattered across the area. In the south-central area, the Kwekwe Ultramafic Complex is distributed in the zone adjacent to the Rhodesdale Complex.

The geological structure is substantially controled by the primary folding structure whose axes trend NE-SW. The Bulawayan and Shamvaian Group are zoned in this direction. The Kadoma Anticline, which plunges from the northeastern corner of the area to the south-southwest, is indicative of the folding.

The second deformation is of isoclinal folding extending north-northwest to south-southeast in the north-central area. The complicated structure occuring in the southwest of Kadoma seems to have formed at this stage. The third deformation was caused by the intrusion of the tonalite resulting in shearing and block rotation.

Fracture systems with an outstanding trend which has formed during a series of deformations, could be a host to gold mineral deposits.

The survey area is within a major gold producing district, where working mines such as Dalny, Venice, Riverlea, Tiger Reef, numerous old workings and mineral occurrences are located. They are classified into; Banded Iron Formation type, auriferous network shear zone type and stratabound disseminated type by ore genesis and host rock.

Dalny is the largest of the producing gold mines, with five million tons of ore extracted to the present, accounting for 40 tons of gold. The annual production rate of the mine in 1987 was approximately 250,000 tons with an average grade of 5.42 g/t Au and produced 1,334 kg of gold.

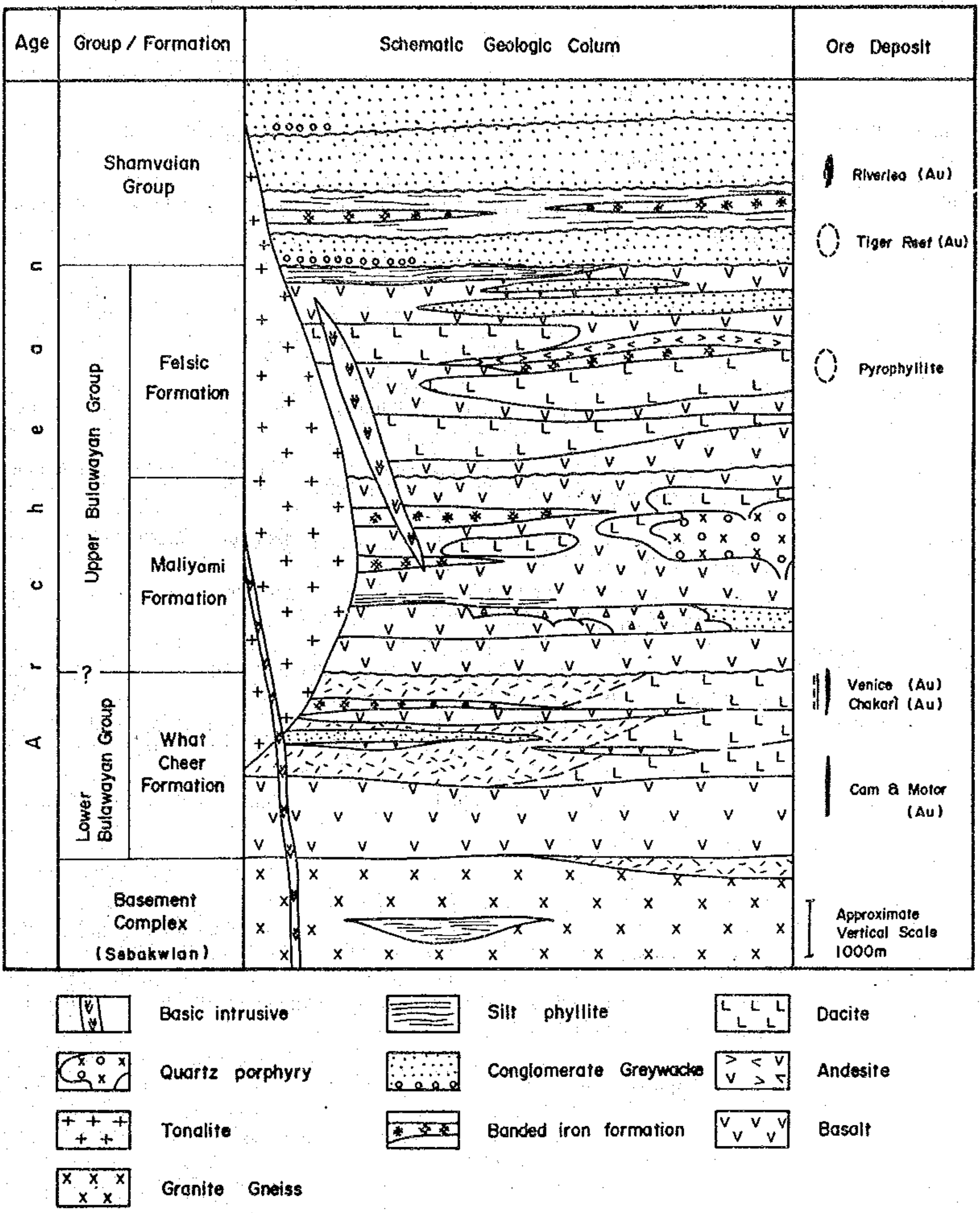

Fig. I-3-1 Schematic Geologic Columnar Section of the Kadoma District

CHAPTER 4 COMPREHENSIVE DISCUSSION

4 -1. Geological structure, Characteristics and control of mineralisation

The Au-mineralisation in the survey are is mostly occurred within the Greenstone member of the Upper to Lower Bulawayan Group. However, the geological structure and characteristics of mineralisation are different from each other with in the drilled area.

Area A3

This area occupies the west wing of the Kadoma Anticlinorium which trends NNE with some secondary fold structures parallel to the NNW. The Greenstone is mainly composed of basalt and Whitewaters tonalite intrusions and had been subjected to weak thermal metamorphism. The sequence trends approximately towards EW and dips south, with the angle varying from 60 to vertical. Strike of the dyke swarms varies from EW to ENE and one set of them is parallel to the Greenstone trend and the other is perpendicular.

Mineralisation is closely related to the dykes and fractures of ENE trend, and is thought to be the extension of the Rise Up mine across the Umsweswe river.

The deposit is of vein type quartz with orientation and dipping concordant with the dykes. The quartz veins contain minor amount of pyrite, pyrrhotite, arsenopyrite and marcasite. The pyrrhotite is identified as a primary mineral.

The mineralisation is believed to be taken place after the emplacement of Whitewaters tonalite or the deposition of the Shamvaian Group because, the quartz veins run through the fractures and faults of ENE trend which occur within the tonalite. (Fig. II-2-1～6)

Area C2

This area is underlain by the greenstone rocks of Upper Bulawayan Group. The formation, generally, strikes towards NS or NNS. But, the drilled area is dominant in massive basalt and dolerite. The dolerite seems to be a facies of the basalt with intergradational relationships between the two.

Quartz porphyry is a dyke rock extending towards northeast and is thought to be similar to the dykes which run from NE and ENE to the west, across the Sesombi pluton.

Mineralisation is as same as the vein type quartz of A3 area and it seems that they fill the fractures parallel to the quartz porphyry. Since, no mineralisation with in the dykes exsists, it might have occurred before emplacement of the dykes. (Fig. II-3-1)

Area E1

This area occupies the west wing of a synclinorium in which the axial part is underlain by the Shamvaian Group and the rest is principally underlain by andesite, dacite and felsic tuff. These formations trend northeast and steeply dip to the southeast.

The mineralisation is characterized by larger amount of pyrite network, which frequently occurs near the contact between the andesite and dacite. The intense mineralisation is apparently restricted around some breccia zones, which are parallel to the lithological boundary. (Fig.II-4-3～10)

4 -2. Mineral potential

Area A3

The quartz and silicified zone between 23.56 to 23.76 metres in the Hole A3-7 yield the maximum amount of gold, 41.21 g/t. Which is followed by 7.44 g/t of Au in the section between 96.77 to 96.85 metres in the Hole A3-4.

The fluctuation of gold content with in the same quartz vein was a reson to estimate the mineral potential of this area to be poor. Each vein and silicified zone are generally a few to tens of centimetres thick.

The average operating ore grade is at lowest 4 to 5 g/t Au in the case of undergound mining of gold in the Kadoma area and an ore grade of 7 to 8 g/t Au or more should be neccesary in the case of a deposit to be newly exploited. Meanwhile, the mineralised sections would give less than 5 to 8 g/t Au due to waste dilution when mined. (Fig.II-2-1～6)

Area C2

The quartz vein yield 1.87 g/t of Au and is associated with thin pyrite and chalcopyrite veins. A quartz sample, taken from the working trench, contained more than 1 g/t of Au but, the vein is not thick. Further sampling around old trenches in the east is recommended. (Fig. II-3-1)

Area E1

The geometric and arithmetic mean value of all assays of gold in the area, except for the maximum amount, 53.37 g/t, are 0.044 g/t and 0.176 g/t, respectively. Although, the mineralisation network is about 10 metres thick, from the assays of drill cores, the average ore grade of a such a deposit would be less than 0.1 g/t Au. If a higher grade zone than 1 g/t Au be defined, the zone should be limited to a part of Zone B and the garde should be much smaller than the minable minimum value due to waste dilution just as the estimation of Area A3. Economic ore potential of this area is evaluated to be poor to moderate.
(Fig. II-4-3～10)

4 -3. Relationship between geochemical anomalies and mineralisation

Area A3

Geochemical anomalies of Au are approximately coincide with the upward projection of quartz veins encountered in the drill holes. The maximum value of 41.21 g/t of Au in the Hole A3-7 seems to reflect the maximum soil geochemical value.

The distribution of As anomaly zone next to the Au anomaly in the south and the occurrence of arsenopyrite grains with pyrite (identified microscopically) suggest that the As-anomaly may have been derived from the same source and slightly dispersed. (Fig. II-5-4～5)

Area C2

Au-anomalies in this area are weak compared to those of the other areas. The trenching and drilling on such anomaly zones encountered only mineralized veinlets containing 1 to 2 g/t of Au.

Ag- and As-anomalies are separated spatially from Au-anomaly and no grains of arsenopyrite are identified in the polished sections. (Fig. II-5-5)

Area E1

The number of anomalies with the values of more than the arithmetic mean plus standard deviation is nine, out of 176 samples. Seven assays of the nine are assigned to be Au-anomaly zones where, As and Ag anomaly zones are overlapped. Only two assays are due to the subsurface Au-anomaly zone, which has the largest extent but, without any overlapping with the anomalies of the other indicative elements. This may suggest that the combined or overlapped anomalies of the other specific indicative elements could be more effective than the magnitude of Au-anomaly, in the case of soil geochemical exploration for gold. (Fig. II-5-6～8)

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

5 -1. Conclusions

The exploration programme of this year included trenching and drilling of 22 holes of totally 2202.9 metres in the three areas. The aim of this survey was to test the mineral potential of the zones containing vein type or disseminated type gold ore.

As a result, mineralized quartz veins and silicified zones with 41.21 g/t and 7.44 g/t of Au, respectively, were encountered in the Hole A3-7 of Area A3, while, in Area E1, network pyrite mineralisation with the maximum of 53.37 g/t of Au was encountered. But the economic mineral potential is evaluated to be low in all areas because the mineralized sections are not thick.

The drilling revealed the relationship between subsurface mineral potential and soil geochemical anomalies, and this information should be discussed in the future exploration programmes for the gold deposits of same type and the same geological province.

5 -2. Recommendations for future work

Based upon the results of this exploration programme as well as the conclusions derived through discussions, we recommend the following guidelines for future gold exploration.

Soil geochemical exploration technique is effective for gold and should be combined with outcrop mapping and in-situ panning. Selection of indicative elements usually accompanies the technical problems such as analytical accuracy. However, gold, antimony, arsenic and mercury are believed to be good pathfinders in geochemical prospecting for gold.

The combination of geochemical anomalies with multiple overlapping should be discussed for area evaluation. The areas excluded out of the semidetailed survey areas in Phase I and and potential anomalies geochemical survey of Phase II, could be recommended for the future exploration using the geochemical propecting.

A deeper drill hole to Area A3 and E1 will assist in the better establishment of the criteria for area selection when the Au-assay values and homogenization temperature from the deep, are collected.

PART II

DETAILS OF THE SURVEYS

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CHAPTER 1 SURVEY METHODS

1 -1. Trenching

Trenching and mapping in the Au geochemical anomaly zone of Area C2 were planned to obtain sufficient information on the fractures and mineralization to design drill holes because the spatial discordance of the Au-anomaly zone, defined from the first and second year's geochemical surveys.

Two trenches, stretching southeastwards, were designed to cross the Au-anomaly zone. The trenching revealed that quartz porphyry dyke rocks have northeast trend and some quartz veins could also be parallel with them. The details of the trenches were mapped at a scale of one hundred and some samples were collected for ore assay. The trenches were re-covered after completion of the work. (Fig. II-1-1～2)

1 -2. Diamond Drilling

1-2-1.Outline of the drilling

The exploratory drilling was conducted in Area A3, C2 and E1 where the Au mineral potential had been most promising according to the general discussion of the geologic setting, trenching and detailed geochemical prospection, which were conducted in the first year. The programme started with making 20 holes of totally 2,000 metres and 100 metres assigned for each hole in order to cover the largest extent possible. The interim geological investigation added two holes of totally 200 metres to the programme. Fig.II-1-3 5 and Table II-1-1 show locations of the holes and summary of the drilling, respectively.

The drilling was conducted by two local contractors; R.A. Longstaff (Pvt) Ltd. and De Meillon (Pvt) Ltd. Japanese geologist was responsible for core logging and sampling for further tests and analyses. The Longstaff, ordinarily worked on a 10-hour day, 6-day week system with a crew of one driller and five workers was assigned to Area C2 and E1 to make 14 holes. The De Meillon worked on a 12-hour day, 7-day week system with two crews, each with one driller and four workers, on a seven day shift basis. They assigned to Area A3 to make 8 holes.

1-2-2.Drilling method and consumables

The method used was the wireline system with a final core diametre of TBW. No mudwater was used during the normal drilling. The main equipments and consumables used are listed in the Table II-1-10～12.

1-2-4. Mobilization, Moving and Demobilization

The main equipments and consumables were transported by large trucks through main and local routes. Route preparation and filling up of the drill sites were followed by automoving of the rigs. Around the end of the November, due to the heavy

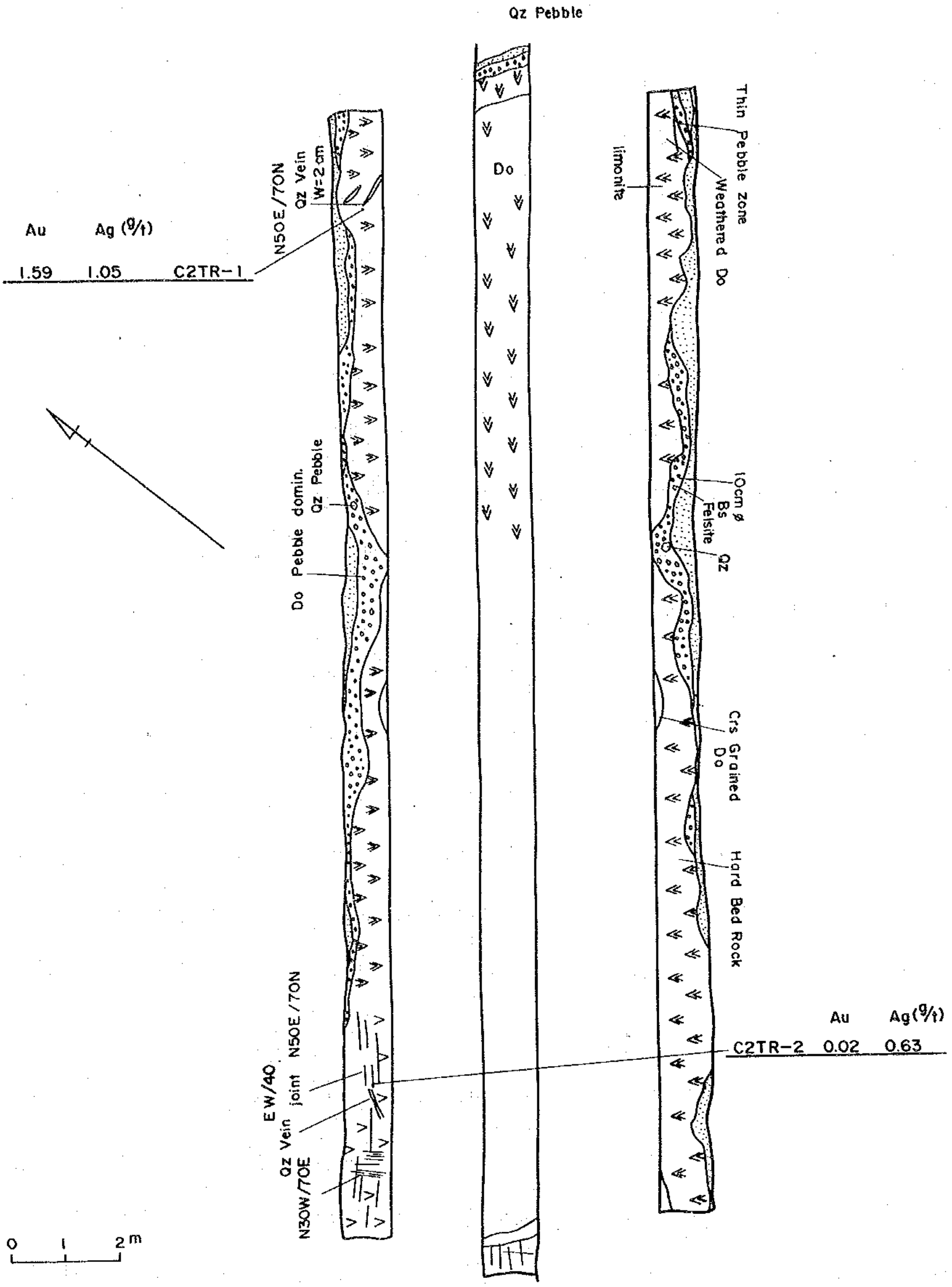

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Fig. II-1-1 Geologic Sketch of Trench in Area C2 (1)

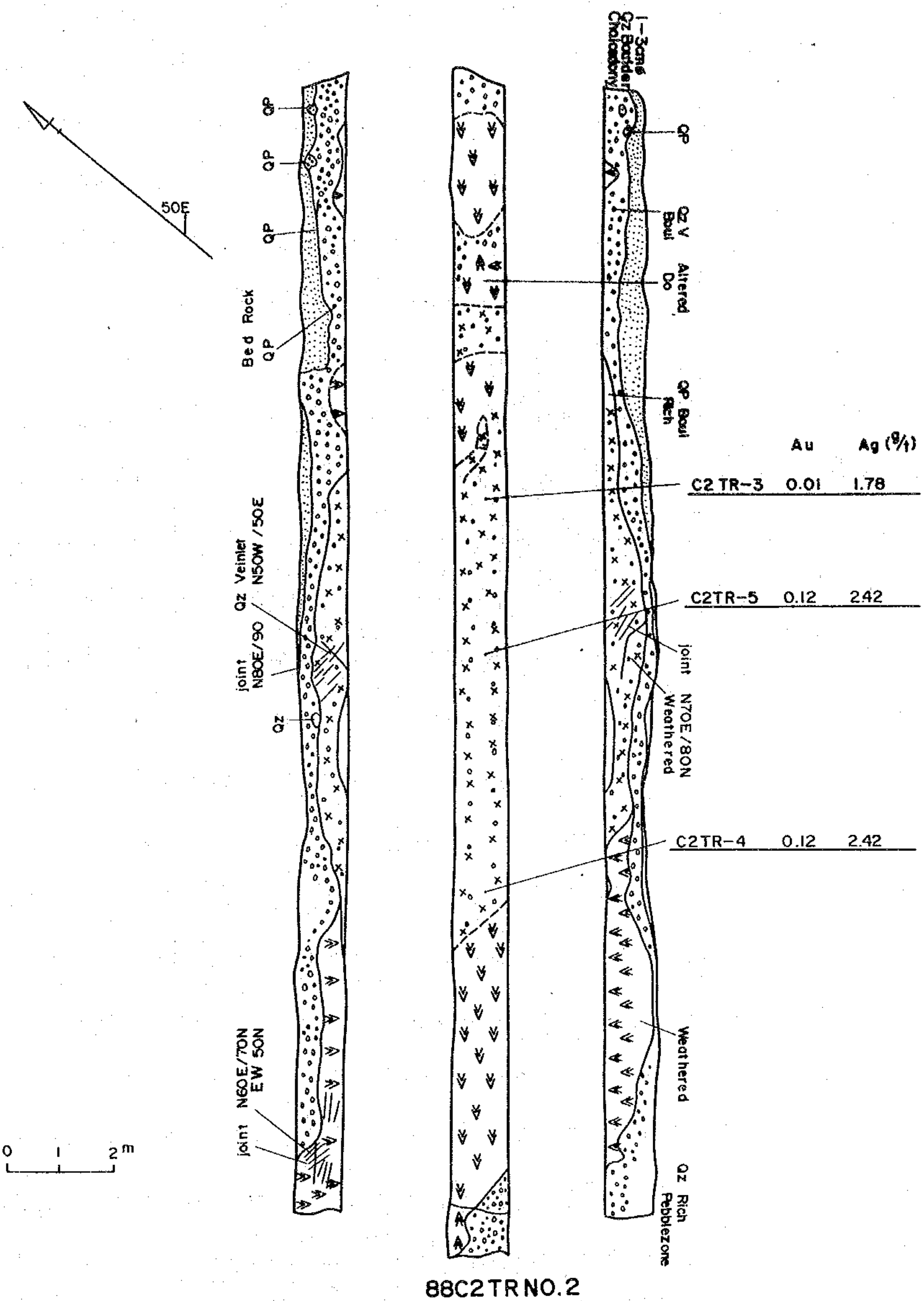


Fig. II-1-2 Geologic Sketch of Trench in Area C2 (2)

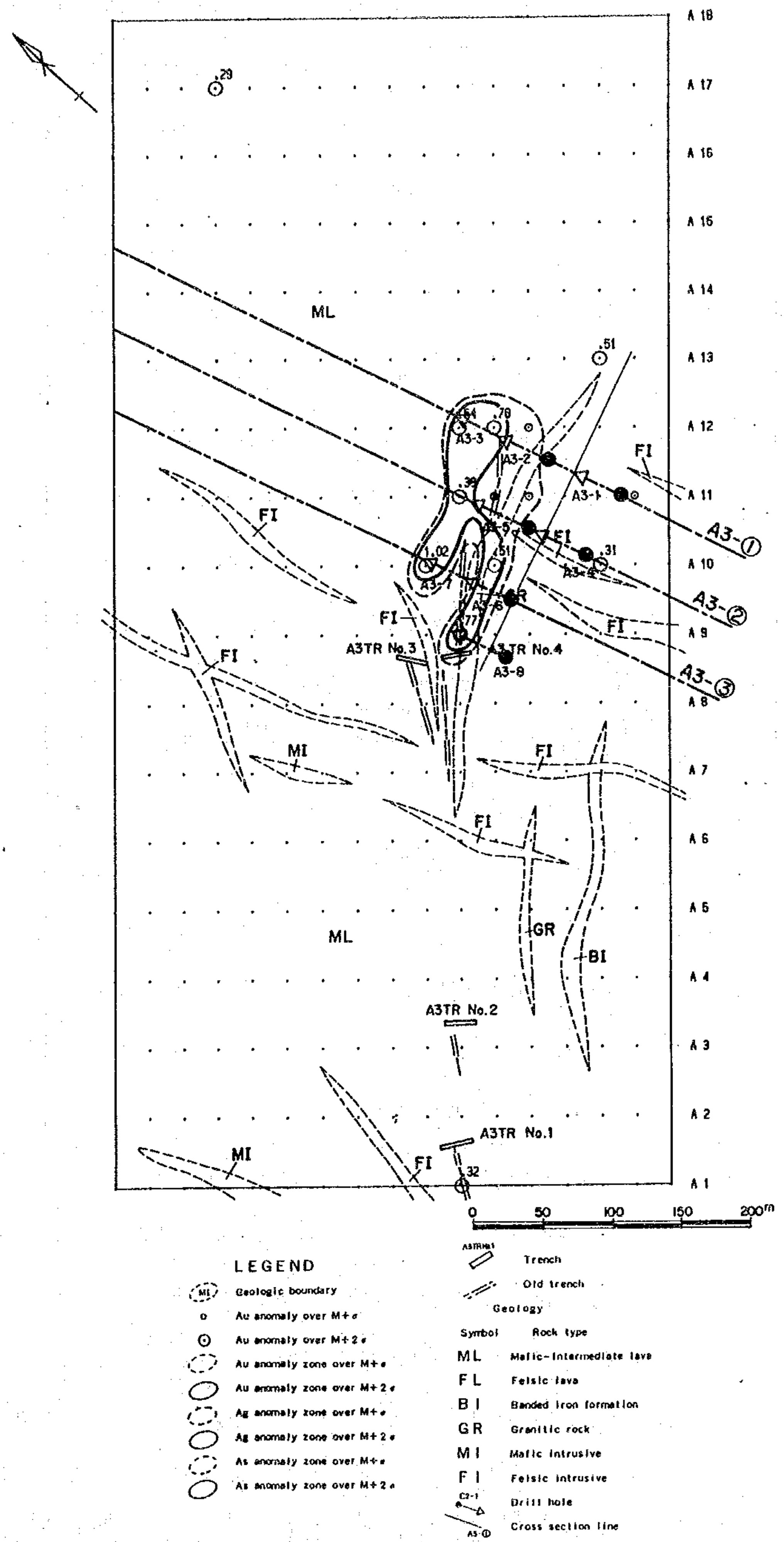


Fig. II-1-3 Location Map of Drill Holes in Area A3

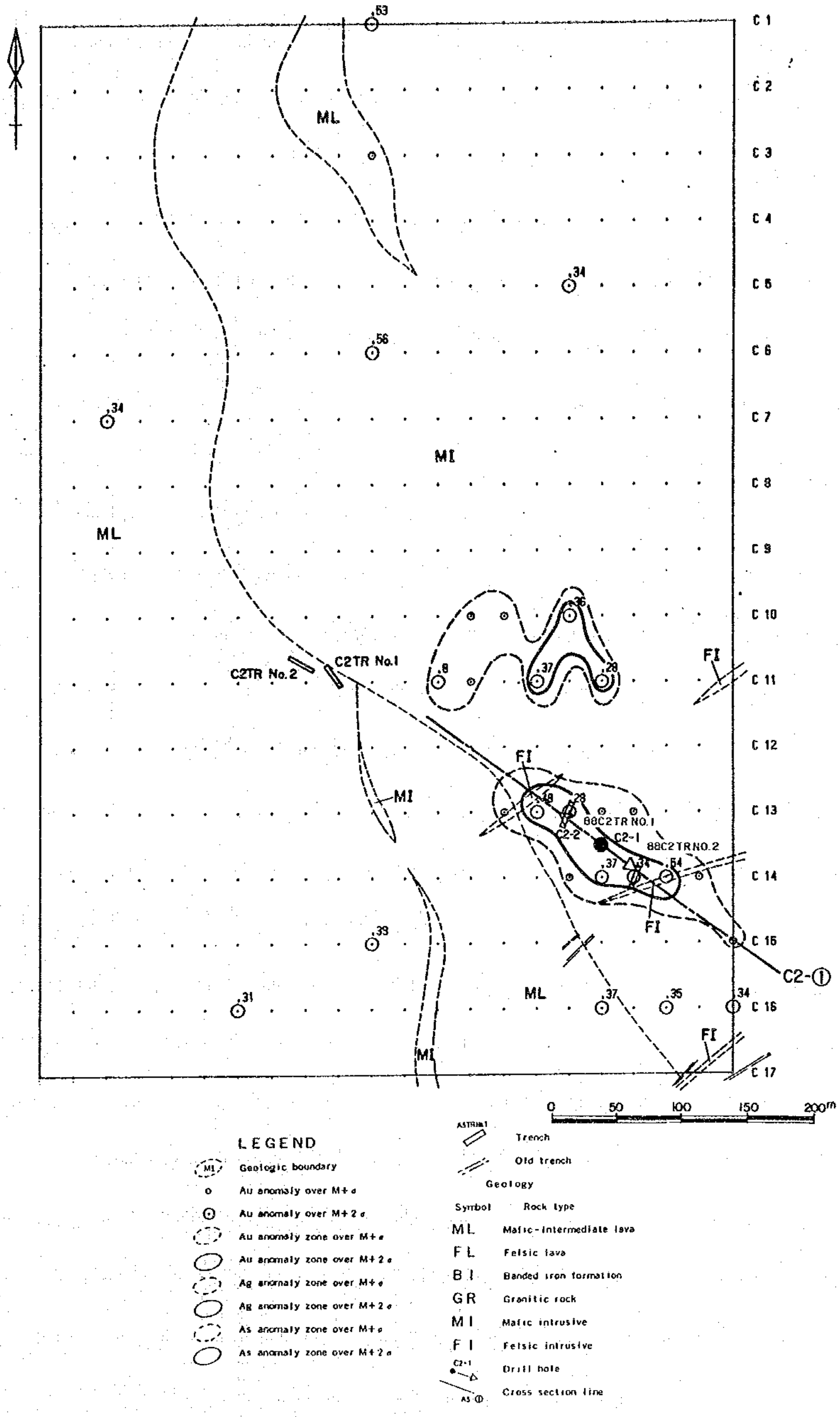


Fig. II-1-4 Location Map of Drill Holes in Area C2

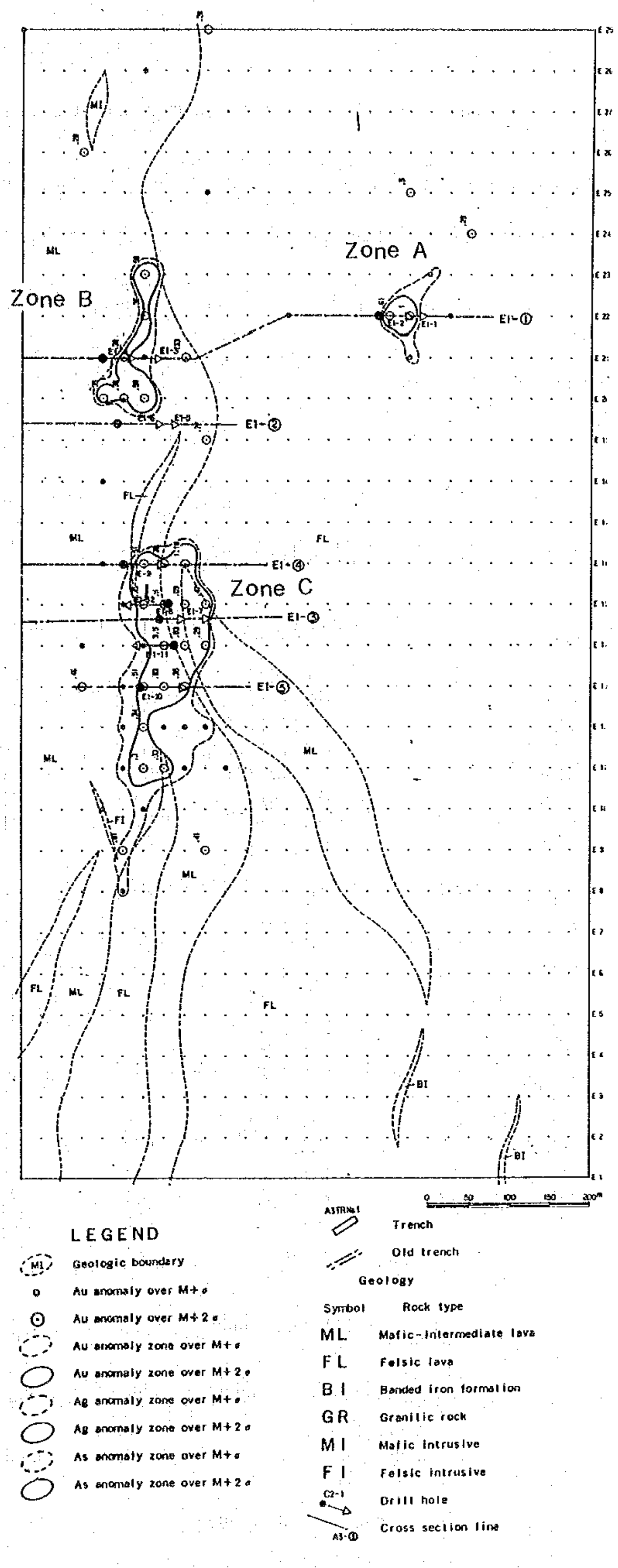


Fig. II-1-5 Location Map of Drill Holes in Area E1

rain, routes were partially flooded and the demobilization was difficult. A camp for the crew was set near the drill sites. The rig moved between the holes using its own power.

The equipments were carried back to the workshops of the the companies by trucks after the holes were completed and, the core cases were stored in the Ministry of Mines yard in Harare.

1-2-4. Water supply

In Area A3 water pumped directly to the drill holes from the Umsweswe river with a hose because the site was within 500 metres from the river.

In Area C2 the sites were more than 5 kilometres away from appropriate points of water pumping and therefore, a vauser of 4.3 m3 was used.

Table II-1-1 Summary of Drilling Programme

Hole No.	Azimuth	Dip	Depth(m)	Period	
A3-1	342	-70	100.10	15.10.1988	26.10.1988
A3-2	342	-70	100.00	14. 9.1988	22. 9.1988
A3-3	342	-45	100.07	22. 9.1988	11.10.1988
A3-4	342	-70	100.09	28.10.1988	11.11.1988
A3-5	342	-50	100.25	30. 8.1988	12. 9.1988
A3-6	342	-70	100.20	4. 8.1988	17. 8.1988
A3-7	342	-45	100.00	17. 8.1988	28. 8.1988
A3-8	342	-70	100.00	15. 7.1988	2. 8.1988
C2-1	125	-70	100.00	18.11.1988	5.12.1988
C2-2	305	-70	100.00	17.11.1988	24.11.1988
E1-1	150	-45	100.00	18.11.1988	29.11.1988
E1-2	150	-70	100.00	8.11.1988	17.11.1988
E1-3	150	-45	100.00	12.10.1988	27.10.1988
E1-4	150	-70	100.00	1.11.1988	14.11.1988
E1-5	150	-45	100.05	15. 9.1988	26. 9.1988
E1-6	150	-70	100.50	26. 9.1988	10.10.1988
E1-7	150	-45	100.34	14. 7,1988	24. 7.1988
E1-8	150	-70	100.73	27. 7.1988	5. 8.1988
E1-9	150	-60	100.00	31. 8.1988	12. 9.1988
E1-10	150	-60	100.40	15. 8.1988	27. 8.1988
E1-11	330	-60	100.06	8.10.1988	19.10.1988
E1-12	330	-60	100.11	21.10.1988	3.11.1988
22 holes			2,202.90	14. 7.1988	5.12.1988

Table II-1-2 Summary of Drilling Programme in Area A3 (1)

Summary of Drilling Programme; A3-1

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Oct.13-Oct.14	2	2	0	4
Drilling	Oct.14-Oct.26	12	12	0	4
Demobilization	Oct.26-Oct.27	2	2	0	4
Total	Oct.13-Oct.27	15	15	0	4

Depth Planned		100m	Depth Drilled		100.10m
Overburden		1m			
Core Length		91.38m	Recovery Rate		91%
Casing	NX	5.28m	Recovery	BX	32%
	BX	11.99m		TBW	100%
Drilling Speed		8.34m/Drilling Day			
		6.67m/Total Working Day			

Summary of Drilling Programme; A3-2

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Sep.13-Sep.14	2	2	0	4
Drilling	Sep.14-Sep.22	9	9	0	4
Demobilization	Sep.22	1	1	0	4
Total		10	10	0	4

Depth Planned		100m	Depth Drilled		100.00m
Overburden		3m			
Core Length		86.14m	Recovery Rate		100%
Casing	NX	0 m	Recovery	BX	6%
	BX	10.56m		TBW	96%
Drilling Speed		11.11m/Drilling Day			
		10.00m/Working Day			

Smmary of Drilling Programme; A3-3

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Sep.22	1	1	0	4
Drilling	Sep.22-Oct.11	20	13	7	4
Demobilization	Oct.11-Oct.12	2	2	0	4
Total		22	15	7	4

Depth Planned		100m	Depth Drilled		100.07m
Overburden		3m			
Core Length		89.23m	Recovery Rate		89%
Casing	NX	6.68m	Recovery	BX	28%
	BX	10.76m		TBW	97%
Drilling Speed		7.70m/Drilling Day			
		6.67m/Working Day			

Table II-1-3 Summary of Drilling Programme in Area A3 (2)

Summary of Drilling Programme; A3-4

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Oct.27-Oct.28	2	2	0	5
Drilling	Oct.28-Nov.11	15	13	2	5
Demobilization	Nov.11-Nov.12	2	2	0	5
Total	Oct.13-Oct.27	18	16	2	5

Depth Planned		100m	Depth Drilled		100.09m
Overburden		1m			
Core Length		93.39m	Recovery Rate		93%
Casing	NX	5.28m	Recovery	BX	22%
	BX	8.61m		TBW	100%
Drilling Speed		7.70m/Drilling Day			
		6.26m/Working Day			

Summary of Drilling Programme; A3-5

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Aug.29-Aug.30	2	2	0	4
Drilling	Aug.30-Sep.12	14	13	0	4
Demobilization	Sep.12	1	1	0	4
Total		15	15	0	4

Depth Planned		100m	Depth Drilled		100.25m
Overburden		1m			
Core Length		93.31m	Recovery Rate		93%
Casing	NX	4.65m	Recovery	BX	0%
	BX	m		TBW	98%
Drilling Speed		7.71m/Drilling Day			
		6.68m/Working Day			

Smmary of Drilling Programme; A3-6

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Aug.3-Aug.4	2	2	0	4
Drilling	Aug.4-Aug.17	14	14	0	4
Demobilization	Aug.17	1	1	0	4
Total		15	15	0	4

Depth Planned		100m	Depth Drilled		100.20m
Overburden		1m			
Core Length		94.49m	Recovery Rate		94%
Casing	NX	3.07m	Recovery	BX	37%
	BX	5.44m		TBW	99%
Drilling Speed		7.16m/Drilling Day			
		6.68m/Working Day			

Table II-1-4 Summary of Drilling Programme in Area A3 (3)

Summary of Drilling Programme; A3-7

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Aug.17	1	1	0	4
Drilling	Aug.17-Aug.28	12	12	0	4
Demobilization	Aug.28-Aug.29	2	2	0	4
Total	Aug.17-Aug.29	13	13	0	4

Depth Planned		100m	Depth Drilled		100.00m
Overburden		1m			
Core Length		94.31m	Recovery Rate		94%
Casing	NX	5.28m	Recovery	BX	64%
	BX	10.88m		TBW	100%
Drilling Speed		8.33m/Drilling Day			
		7.69m/Working Day			

Summary of Drilling Programme; A3-8

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Jul.12-Jul.14	3	3	0	4
Drilling	Jul.15-Aug.2	19	19	0	4
Demobilization	Aug.2	1	1	0	4
Total	Jul.12-Aug.2	22	22	0	4

Depth Planned		100m	Depth Drilled		100.00m
Overburden		1m			
Core Length		92.19m	Recovery Rate		92%
Casing	NX	3.20m	Recovery	BX	11%
	BX	6.80m		TBW	98%
Drilling Speed		5.26m/Drilling Day			
		4.55m/Working Day			

Table II-1-5 Summary of Drilling Programme in Area C2

Smmary of Drilling Programme; C2-1

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Nov.14-Nov.17	4	4	0	4
Drilling	Nov.18-Dec.5	18	16	2	4
Demobilization	Dec.5-Dec.7	3	3	0	4
Total	Nov.14-Dec.7	24	22	2	4

Depth Planned		100m	Depth Drilled		100.00m
Overburden		3m			
Core Length		90.41m	Recovery Rate		90%
Casing	NX	0 m	Recovery	BX	43%
	BX	8.74m		TBW	99%
Drilling Speed		6.25m/Drilling Day			
		4.55m/Working Day			

Summary of Drilling Programme; C2-2

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Nov.16-Nov.17	2	2	0	4
Drilling	Nov.17-Nov.24	8	7	1	4
Demobilization	Nov.25-Nov.26	2	2	0	4
Total	Nov.16-Nov.26	11	10	1	4

Depth Planned		100m	Depth Drilled		100.00m
Overburden		3m			
Core Length		89.65m	Recovery Rate		90%
Casing	NX	0 m	Recovery	BX	13%
	BX	8.40m		TBW	97%
Drilling Speed		14.29m/Drilling Day			
		10.00m/Working Day			

Table II-1-6 Summary of Drilling Programme in Area E1 (1)

Summary of Drilling Programme; E1-1

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Nov.18	1	1	0	5
Drilling	Nov.18-Nov.29	12	10	2	5
Demobilization	Nov.30-Dec.2	3	3	0	5
Total	Nov.18-Dec.2	15	13	0	5

Depth Planned		100m	Depth Drilled		100.00m
Overburden		1m			
Core Length		83.16m	Recovery Rate		83%
Casing	NX	0 m	Recovery	BX	36%
	BX	5.80m		TBW	86%
Drilling Speed		10.00m/Drilling Day			
		7.69m/Working Day			

Smmary of Drilling Programme; E1-2

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Nov.4-Nov.7	4	3	1	5
Drilling	Nov.8-Nov.17	10	9	1	5
Demobilization	Nov.18	1	1	0	5
Total	Nov.4-Nov.18	15	13	2	5

Depth Planned		100m	Depth Drilled		100.00m
Overburden		1m			
Core Length		96.90m	Recovery Rate		97%
Casing	NX	0 m	Recovery	BX	64%
	BX	7.65m		TBW	100%
Drilling Speed		11.11m/Drilling Day			
		8.33m/Working Day			

Sammary of Drilling Programme; E1-3

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Oct.11	1	1	0	5
Drilling	Oct.12-Oct.27	16	15	1	5
Demobilization	Oct.28	1	1	0	5
Total	Oct.11-Oct.28	18	17	1	5

Depth Planned		100m	Depth Drilled		100.00m
Overburden		1m			
Core Length		67.38m	Recovery Rate		67%
Casing	NX	0 m	Recovery	BX	24%
	BX	32.50m		TBW	68%
Drilling Speed		6.67m/Drilling Day			
		5.88m/Working Day			

Table II-1-7 Summary of Drilling Programme in Area E2 (2)

Smmary of Drilling Programme; E1-4

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Oct.29-Oct.31	3	2	1	5
Drilling	Nov.1-Nov.14	14	13	1	5
Demobilization	Nov.15	1	1	0	5
Total	Oct.29-Nov.15	18	16	2	5

Depth Planned		100m	Depth Drilled		100.00m
Overburden		1m			
Core Length		71.92m	Recovery Rate		72%
Casing	NX	m	Recovery	BX	23%
	BX	7.50m		TBW	77%
Drilling Speed		7.69m/Drilling Day			
		6.25m/Working Day			

Smmary of Drilling Programme; E1-5

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Sep.14	1	1	0	5
Drilling	Sep.15-Sep.26	12	11	1	5
Demobilization	Sep.26	1	1	0	5
Total	Sep14-Sep.26	13	12	1	5

Depth Planned		100m	Depth Drilled		100.05m
Overburden		1m			
Core Length		74.50m	Recovery Rate		74%
Casing	NX	9.00m	Recovery	BX	3%
	BX	30.00m		TBW	90%
Drilling Speed		9.09m/Drilling Day			
		8.33m/Working Day			

Summary of Drilling Programme; E1-6

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Sep.26	1	1	0	5
Drilling	Sep.26-Oct.10	14	13	1	5
Demobilization	Oct.11	1	1	0	5
Total	Sep.26-Oct.11	15	14	1	5

Depth Planned		100m	Depth Drilled		100.50m
Overburden		1m			
Core Length		67.73m	Recovery Rate		67%
Casing	NX	9.00m	Recovery	BX	32%
	BX	31.00m		TBW	99%
Drilling Speed		7.73m/Drilling Day			
		7.18m/Working Day			

Table II-1-8 Summary of Drilling Programme in Area E3 (3)

Summary of Drilling Programme; E1-7

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Jul.8-Jul.13	6	4	2	5
Drilling	Jul.14-Jul.25	12	8	4	5
Demobilization	Jul.26	1	1	0	5
Total	Jul.8-Jul.26	19	13	6	5

Depth Planned		100m	Depth Drilled		100.34m
Overburden		1m			
Core Length		86.64m	Recovery Rate		86%
Casing	NX	0 m	Recovery	BX	0%
	BX	4.30m		TBW	91%
Drilling Speed		12.54m/Drilling Day			
		7.72m/Working Day			

Smmary of Drilling Programme; E1-8

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Jul.26	1	1	0	5
Drilling	Jul.27-Aug.5	9	7	2	5
Demobilization	Aug.6	1	1	0	5
Total	Jul.26-Aug.6	11	9	2	5

Depth Planned		100m	Depth Drilled		100.73m
Overburden		1m			
Core Length		87.33m	Recovery Rate		87%
Casing	NX	0 m	Recovery	BX	15%
	BX	9.00m		TBW	95%
Drilling Speed		14.39m/Drilling Day			
		11.19m/Working Day			

Sammary of Drilling Programme; E1-9

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Aug.30	1	1	0	5
Drilling	Aug.31-Sep.12	13	9	4	5
Demobilization	Sep.13	1	1	0	5
Total	Aug.30-Sep.13	15	11	4	5

Depth Planned		100m	Depth Drilled		100.00m
Overburden		1m			
Core Length		71.72m	Recovery Rate		72%
Casing	NX	0 m	Recovery	BX	24%
	BX	9.30m		TBW	76%
Drilling Speed		11.11m/Drilling Day			
		9.09m/Working Day			

Table II-1-9 Summary of Drilling Programme in Area E4 (4)

Smmary of Drilling Programme; E1-10

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Aug.8-Aug.10	3	3	0	5
Drilling	Aug.11-Aug.27	17	11	6	5
Demobilization	Aug.28-Aug.29	2	1	1	5
Total	Aug.8-Aug.29	22	15	7	5

Depth Planned		100m	Depth Drilled		100.40m
Overburden		1m			
Core Length		81.60m	Recovery Rate		81%
Casing	NX	6.00m	Recovery	BX	21%
	BX	17.50m		TBW	100%
Drilling Speed		9.13m/Drilling Day			
		6.69m/Working Day			

Smmary of Drilling Programme; E1-11

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Oct.6-Oct.7	2	2	0	5
Drilling	Oct.8-Oct.19	12	10	2	5
Demobilization	Oct.19	1	1	0	5
Total	Oct.6-Oct.19	14	12	2	5

Depth Planned		100m	Depth Drilled		100.06m
Overburden		1m			
Core Length		85.88m	Recovery Rate		86%
Casing	NX	0 m	Recovery	BX	0%
	BX	4.8 m		TBW	90%
Drilling Speed		10.01m/Drilling Day			
		8.34m/Working Day			

Smmary of Drilling Programme; E1-12

	Period	No. of Days	Working Day	Day off	No.of Worker
Mobilization	Oct.20	1	1	0	5
Drilling	Oct.21-Nov.3	14	11	3	5
Demobilization	Nov.4-Nov.5	2	2	0	5
Total	Oct.20-Nov.5	17	14	3	5

Depth Planned		100m	Depth Drilled		100.11m
Overburden		1m			
Core Length		86.04m	Recovery Rate		86%
Casing	NX	0 m	Recovery	BX	0%
	BX	4.2 m		TBW	90%
Drilling Speed		9.10m/Drilling Day			
		7.15m/Working Day			

Table II-1-10 List of Equipment Used in Area A3

LIST OF EQUIPMENT USED (De Meillon PVT Co.)

Item	Model	Quantity	Capacity or Specification
Drilling machine	Sullivan 22	one	a 4 cyl. Ford engine
Drill pump	Boyles Bros	one	7/12 piston pump
Supply pump	Honda	one	a 9 HP Briggs engine
Water supply pipeline		50 metres	
Shear legs	4 (100 mm)	one	
Drill rods	HQ-WL 3m	9 metres	
Drill rods	NQ-WL 3m	15 metres	
Drill rods	AW-WL 3m	105 metres	
Core barrel	HQ-WL 3m	3 metres	
Core barrel	NQ-WL 3m	6 metres	
Core barrel	AW-WL 3m	6 metres	
Casing	HX 3m	9 metres	
Casing	NX 3m	30 metres	
Casing	BX 3m	45 metres	

Table II-1-11 List of Equipment Used in Area C2 and E1

LIST OF EQUIPMENT USED (Longstaff PVT Co.)

Item	Model	Quantity	Capacity or Specification
Drilling machine	Sullivan 22	two	a 4 cyl. Ford engine
Drilling machine	Boyles BBS 10	one	
Drill pump	Royal Bean	three	
Tractor	Massey Ferguson	two	
Bowser	Tinto	two	1000 galon
Supply pump	Honda	two	a 9 HP Briggs engine
Shear legs	4 (100 mm)	three	9 metre pull
Drill rods	HQ-WL 3m	9 metres	
Drill rods	NQ-WL 3m	45 metres	
Drill rods	AW-WL 3m	360 metres	
Core barrel	99 mm 3m	9 metres	
Core barrel	NQ-WL 3m	18 metres	
Core barrel	AW-WL 3m	18 metres	
Casing	NX 3m	27 metres	
Casing	BX 3m	90 metres	
Radio		one	

Table II-1-12 List of Supplies and Consumables Spent

LIST OF SUPPLIES AND CONSUMABLES SPENT

Specification	Item	Area A3	C2+E1	Others
Metal bit	118 mm	2		pcs
	97 mm		2	
Diamond bit	NQ-WL	2		
	BQ-WL	7	14	
	TBW-WL	19	25	
Diamond reamer	NQ-WL	1		
	BQ-WL	4	12	
	TBW-WL	11	19	
Wireline coring equipment				
Drill rods	NQ-WL 3m	1	1	
	BQ-WL 3m	2	4	
	TBW-WL 3m	6	12	
Core barrel assembly	BQ-WL	1	2	
	TBW-WL	1	2	
Core lifter & case	HQ,NQ,TBW	35	105	
Over shot assembly	NQ-WL	1	1	
	BQ-WL	1	1	
Casing equipment				
Casing tube	HX 3m	2		
	NX 3m	3	1	
	BX 3m	2	3	
Miscellaneous tools				
Pipe wrench	900,600,450mm	6	12	
Core hammer		2	4	
Tractor tyre			2	7.50x16
Wire brush		4	10	
Spare parts for drilling machine				
Chuck piece	NQ	1	1	set
	BQ	1	1	set
Clutch disc			1	pcs
Brack band assembly			1	
Spare parts for Pump				
Piston rod		2	4	
Ball valve seat		8	8	
V-packing		40	64	
O-ring		16	16	
Water hose		1	1	set
Fuel and Oil				
Diesel		2000	3000	ltrs
Engine oil		200	85	
Gear oil		15	25	
Hydraulic oil		80	65	
Lubricating Grease		5	9	kg
Rod grease		70	150	
Petrol		1400	125	
Cement				
Portland	50kg	46	31	sacks
Mud materials				
Bentonite	25kg	360	488	
Lignite	20kg	178	251	kg
CMC	20kg	141	208	kg
Soluble cutting oil		128	142	ltrs
Telstop	20kg	75	55	sacks

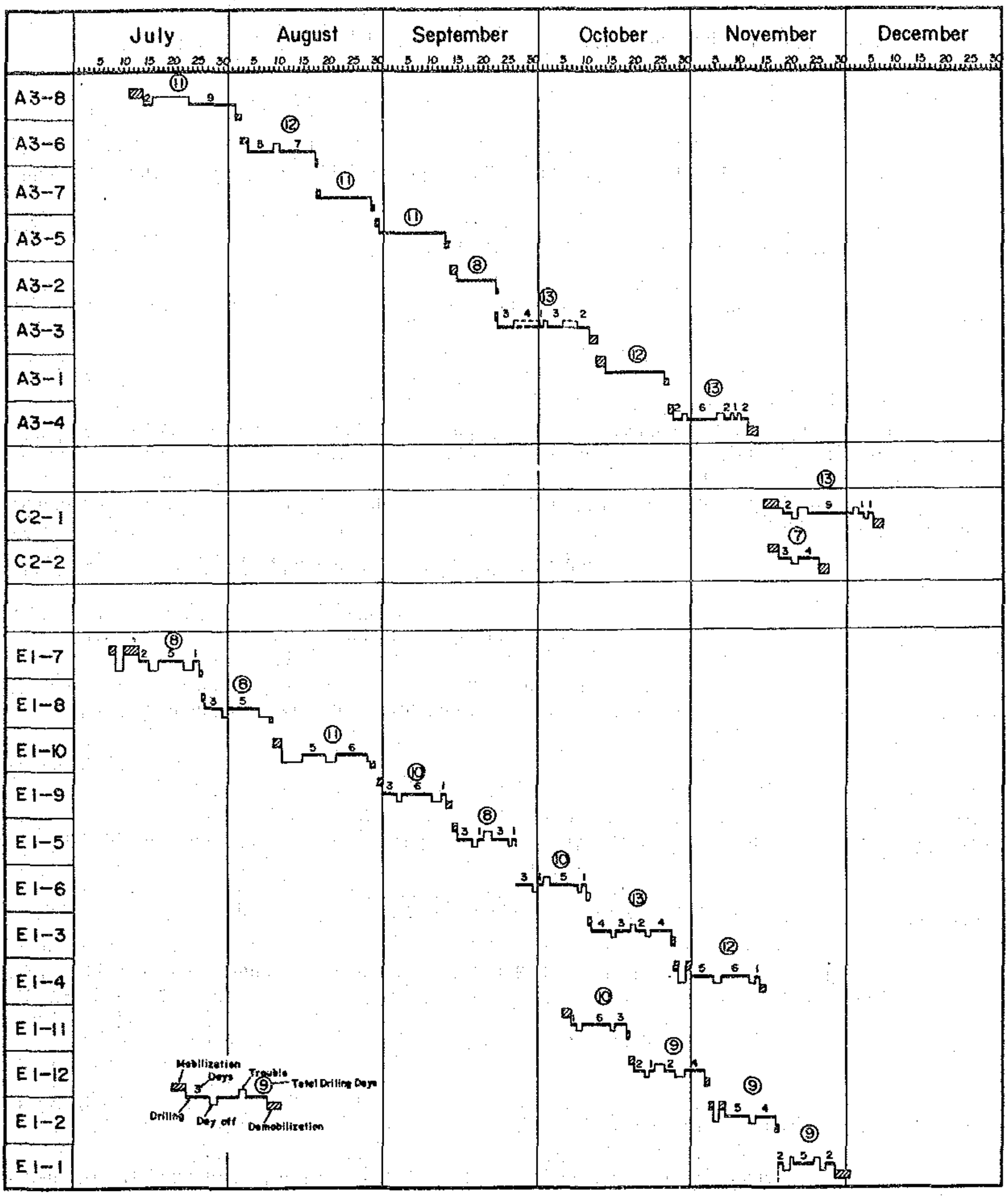


Fig. II-1-6 Progress of Drilling Programme of All Areas

2-1. Selection of drill site

The drill site of the area was selected on the basis of the following criteria other than Au geochemical anomaly. The holes were designed to penetrate the subsurface right below the anomaly.

(1) Well defined Au anomaly zone and its distinctive trend
(2) As anomaly zone - overlapped or occur in the periphery of the Au anomaly zone
(3) Fractures and a swarm of granite and quartz porphyry dykes, which may be related to the ore mineralization.

2-2. Details of the holes

A3-1

Drilling

The overburden is very thin. Shallower level of the basalt formation contains a calcite network and, due to the groundwater, the rocks in that part had been finely fractured. The core recovery performance up to 12.77 metres depth was 16 percent and the drilling rates was poor due to the core block and lost circulation. The core penetration rate and core recovery performance were satisfactory, after that.

Geology and Mineralization

The hole intersected, principally, a basalt formation containing several granitic dykes. The thickest one of the dykes was about 7 metres. The basalt was generally massive and homogeneous with rare alternations of pelitic rock and felsic tuff. The section between 61.50 and 64.85 metres shows a lava like structure.

Multiple bands of chlorite-biotite-calcite minerals occur in the basaltic tuff near the bottom of the hole, indicating the bedding planes. The angle between the planes and the core axis gives the local dip of the strata.

Calcite veins are sometimes weakly mineralized with chalcopyrite and pyrrhotite. The fine to medium grained granitic dyke rock contains biotite. Both the basalt and this granitic rock combined together by a broad silicification zone at 16.54 metres. No significant quartz vein was encountered. (Fig.II-2-1)

A3-2

Drilling

Conditions of the near surface rocks were same as those of A3-1. Drilling was interrupted for two days due to a breakdown of the pump just prior to the completion.

Geology and Mineralization

Approximately as same as in A3-1. The basalt comprises typical lapillistone structure. Quartz porphyry occurs from 72.30 metres to the bottom with rare patches of pelite. This indicates that they could be of felsic tuff origin. However, this rock was assigned to the dyke rock because, the similar size and round form of quartz phenocrysts.

Calcite and quartz veinlets, mineralized with pyrite and pyrrhotite, were frequently intersected below 37.55 metres. No valuable assay was recorded. (FIg.II-2-2).

A3-3

Drilling

The hole collapse between 27.18 and 28.03 metres interrupted the work and another collapse at 56.10 metres required a series of cementing. But the cementing failed to stop the lost circulation.

Geology and Mineralization

The intrusive rocks include a quartz porphyry dyke near a granitic intrusion. The dyke rock contained a smaller amount of quartz phenocryst without biotite flakes. The relationship between the two is not very obvious.

No significant quartz and calcite veins were encountered but a thin quartz vein at 47.67 metres contained 1.35 g/t of Au. (Fig.II-2-3)

A3-4

Drilling

The work efficiency was satisfactory after the fracture zone. Breakdown of the drill rig and the pump required two days to repair.

Geology and Mineralization

Felsic tuff contains porphyritic plagioclase phenocrysts and a chlorite network. A quartz vein, occurs disseminated with pyrite at the contact with granitic intrusive rock, gave a significant assay value of 7.44 g/t of Au. (Fig.II-2-4)

A3-5

Drilling

The hole intersected a lost circulation zone from 3.67 to around 20 metres in a fragmented carbonate basalt layer and the drilling rate was 3 to 5 metres a day. Drilling was efficient between 40 and 90 metre interval with 15 to 18 metres per day.

Geology and Mineralization

Dolerite is intercalated with pelitic patches and therefore, it could be considered as basaltic lava flow. A brecciated zone between 27.92 to 28.57 metres is accompanied by a mineralized quartz vein of 42 cm wide. Another shear zone was encountered at 99.30 metres, where, pyrite bearing calcite fills the interbreccia. (Fig. II-2-4)

A3-6

Drilling

The core recovery performance was 100% after the 6 metre level owing to the perfect casing operation, improved after the A3-8 failure.

Geology and Mineralization

The mafic tuff grades into felsic tuff around 40 metres. No obvious boundary between the basalt and the dolerite has been found. A thin and irregular quartz vein, occurs between 19.70 to 19.90 metres, is disseminated with pyrite, chalcopyrite and arsenopyrite. (Fig. II-2-5)

A3-7

Drilling

The weak battery of the starter cell and the lost circulation zone up to 25 metres resulted the poor rate of drilling. The work progressed fairly good, after that.

Geology and Mineralization

The basalt near the 80 metres depth shows pillow breccia texture suggesting a lava flow. Quartz vein and silicified zone of totally 20 cm wide, occur at the contact of the porphyritic dyke with basalt, gave a maximum gold assay of 41.21 g/t.(Fig. II-2-5)

A3-8

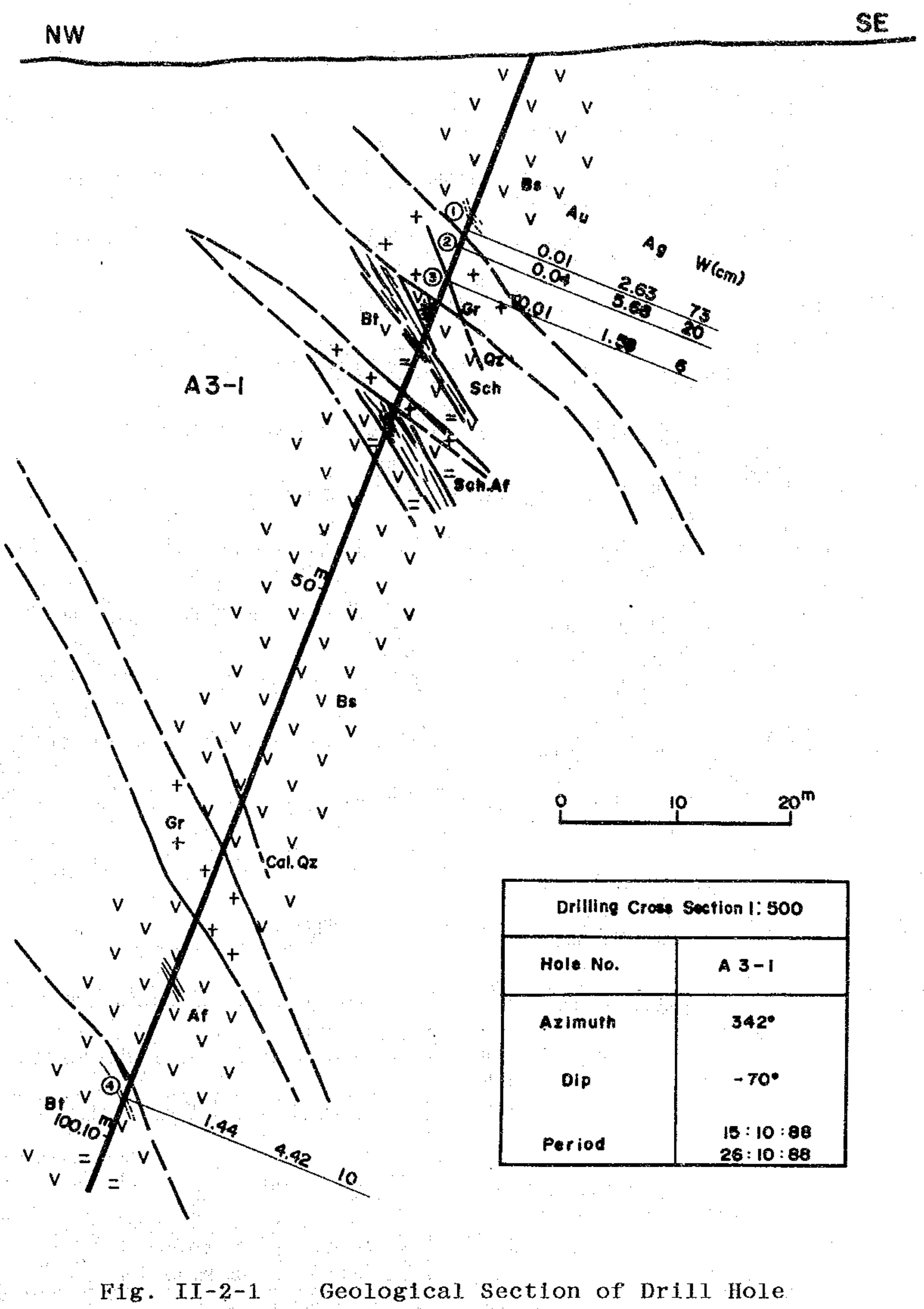
Drilling

A jamming was caused by the hole collapse at 8.23 metres. The immediate operation of casing and cementing failed to recover from the worst situation. It took a week to resume the drilling with lost circulation.

Geology and Mineralization

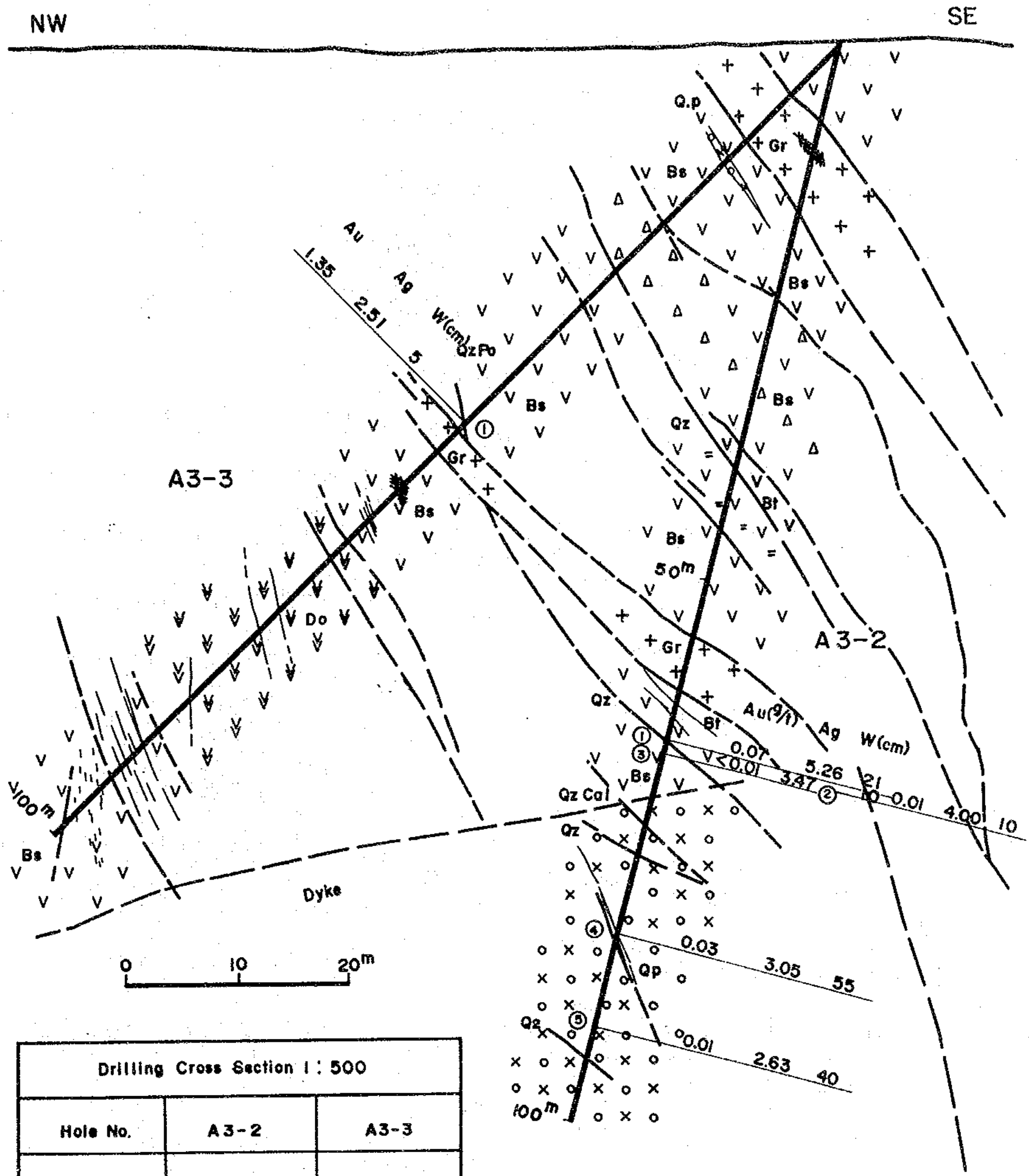
Granitic dyke rock consist of three notable zones of silicification with minor amount of sulphide at the contacts. The sulphide characterizes a pyrite-chalcopyrite-pyrrhotite association.

A swarm of disseminated quartz and calcite veinlets with sulphide occurs below 70 metres. However, no veins of more than 5 cm thick were logged. The green rock was intercalated with thin tuff and pelite layers containing larger amount of biotite probably formed by the thermal effect granite intrusions. (Fig.II-2-6)



Drilling Cross Section 1: 500	
Hole No.	A 3-1
Azimuth	342°
Dip	-70°
Period	15:10:88 26:10:88

Fig. II-2-1 Geological Section of Drill Hole in Area A3 (1) A3-1



Drilling Cross Section 1 : 500		
Hole No.	A3-2	A3-3
Azimuth	342°	342°
Dip	-70°	-45°
Period	14:09:88 22:09:88	22:09:88 11:10:88

Fig. II-2-2 Geological Section of Drill Hole in Area A3 (2) A3-2, A3-3

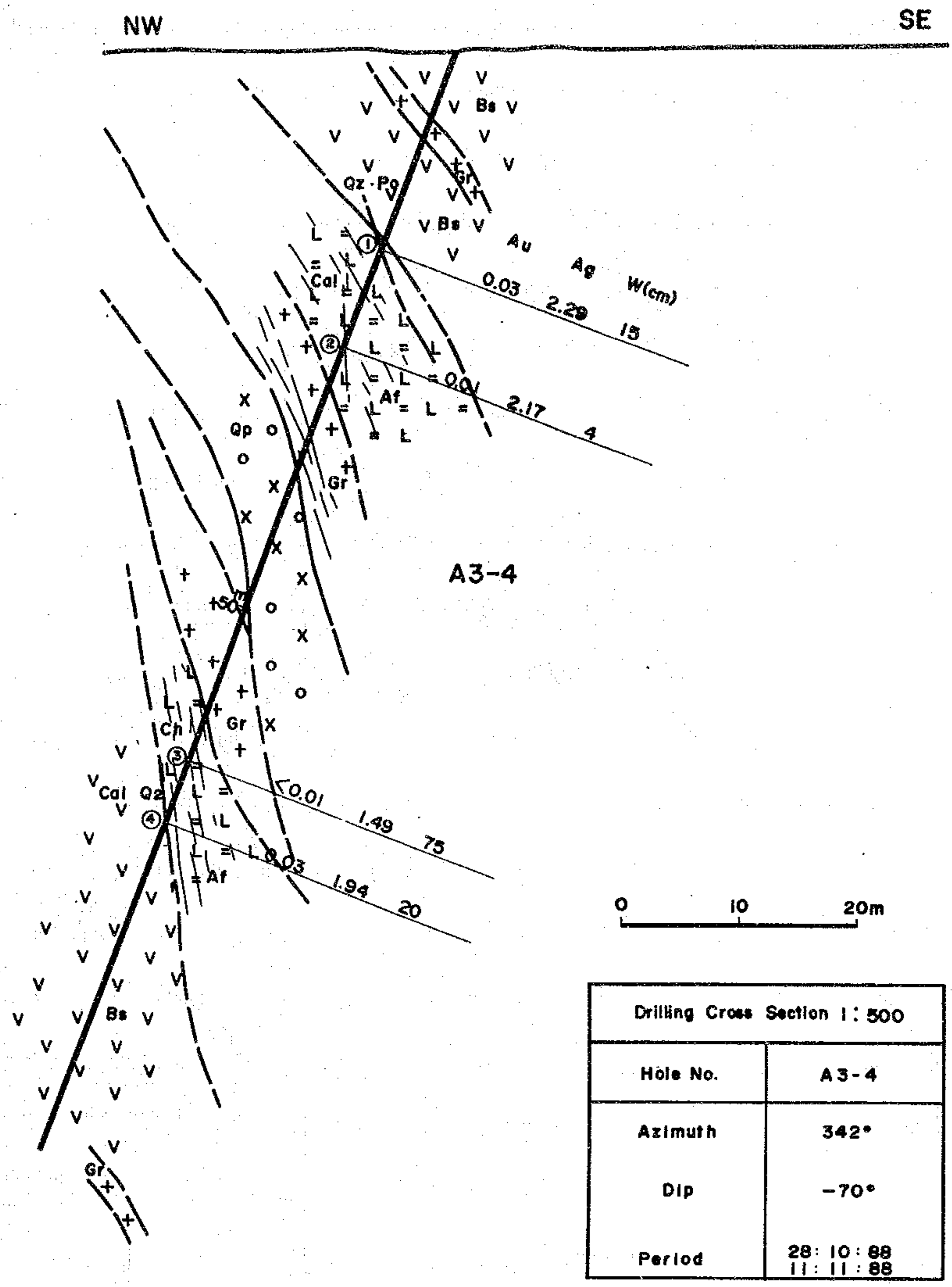
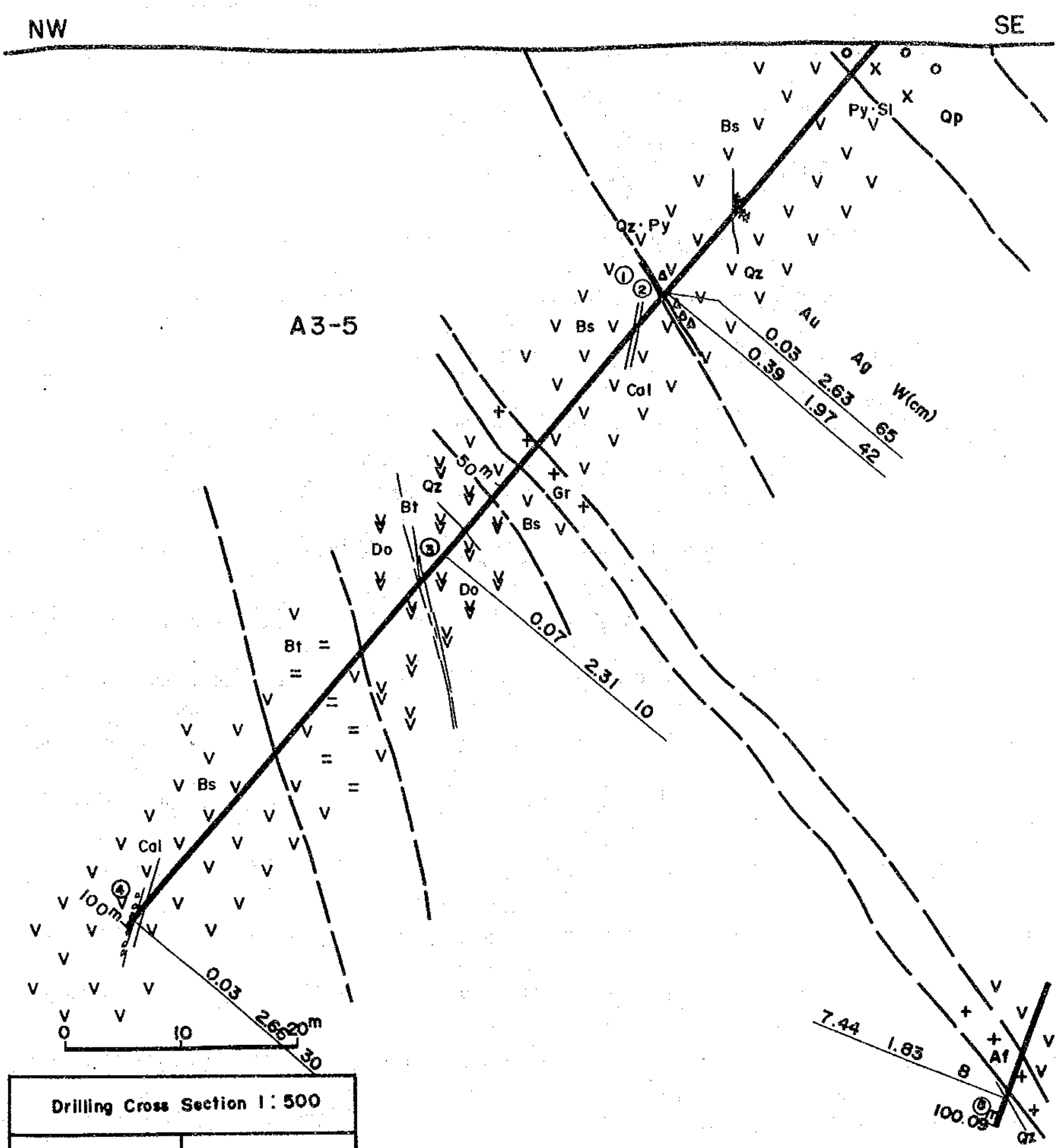
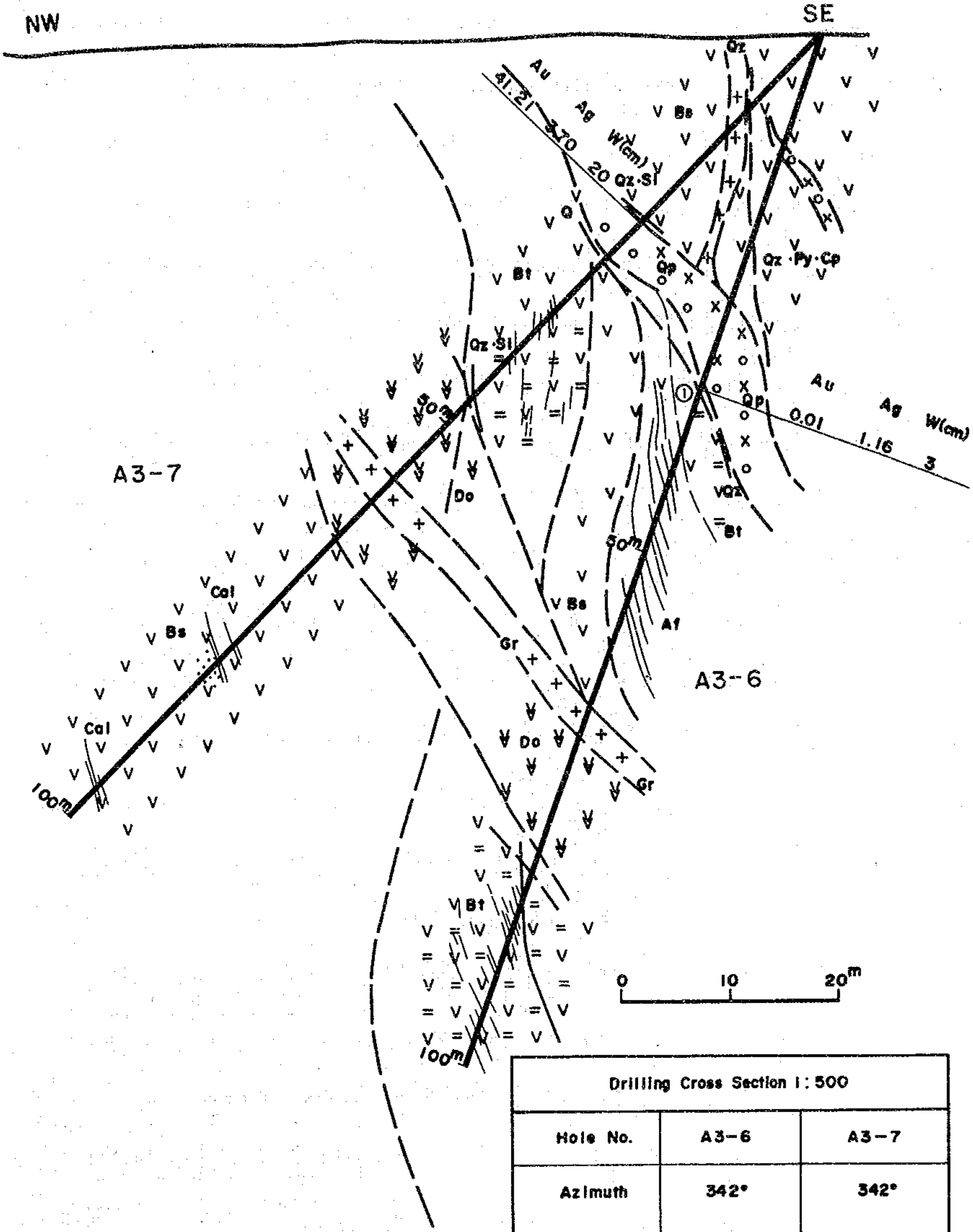


Fig. II-2-3 Geological Section of Drill Hole in Area A3 (3) A3-4



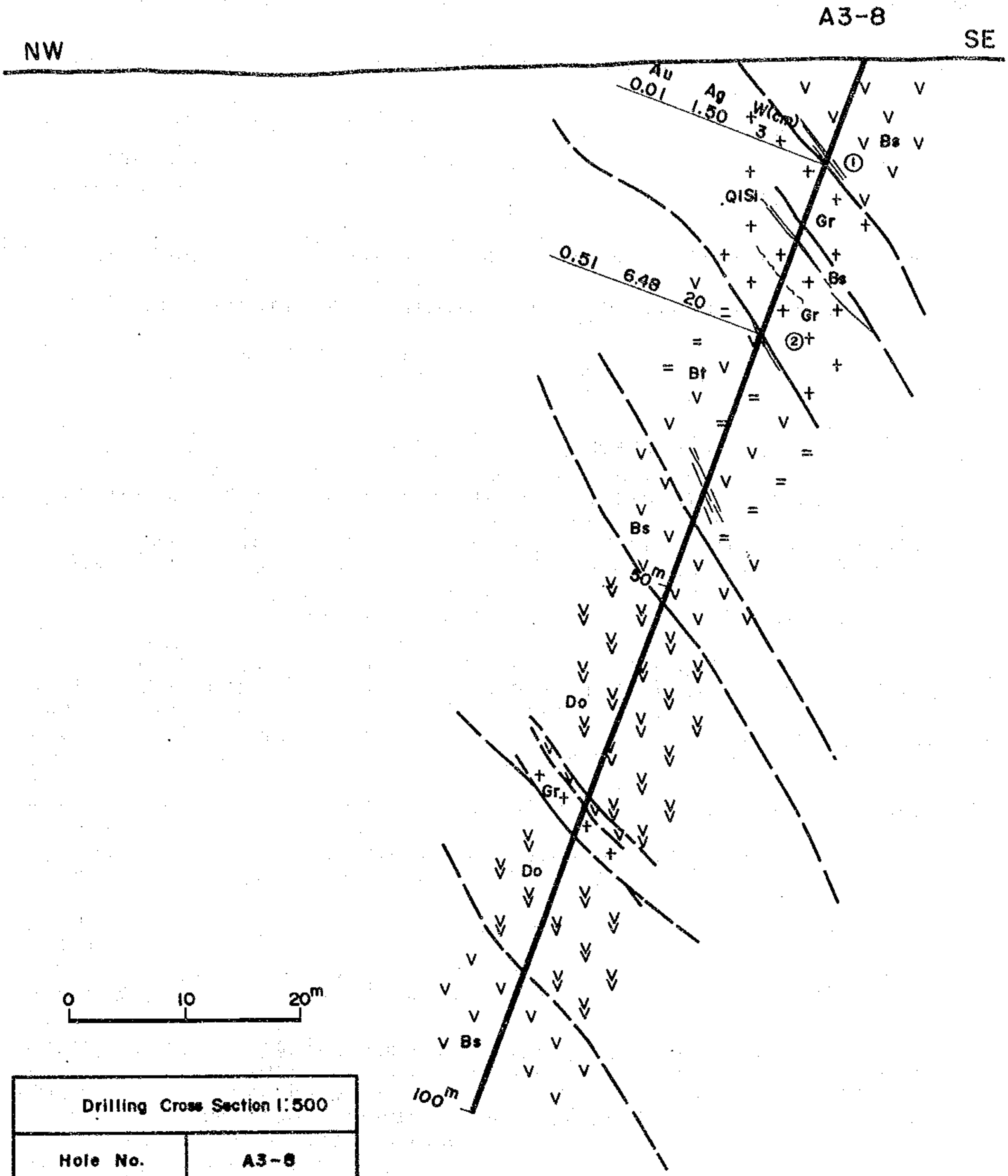
Drilling Cross Section 1 : 500	
Hole No.	A3-5
Azimuth	342°
Dip	-50°
Period	30:08:88 12:09:88

Fig. II-2-4 Geological Section of Drill Hole in Area A3 (4) A3-5



Drilling Cross Section 1:500		
Hole No.	A3−6	A3−7
Azimuth	342°	342°
Dip	−70°	−45°
Period	04:08:88 17:08:88	17:08:88 28:08:88

Fig. II-2-5 Geological Section of Drill Hole in Area A3 (5) A3-6, A3-7



Drilling Cross Section 1:500	
Hole No.	A3-8
Azimuth	342°
Dip	-70°
Period	[illegible]:07:88 02:08:88

Fig. II-2-6 Geological Section of Drill Hole in Area A3 (6) A3-8

CHAPTER 3 AREA C2

3 -1. Selection of drill site

The conditions which favored for the drilling survey were as follows.

(1) The Au anomaly zone was well defined, nevertheless, the each anomaly is not very intense.
(2) The boulders of quartz porphyry dyke nearby may suggest the development of fractures.
(3) The quartz boulders mineralized with chalcopyrite.

3 -2. Details of the holes

C2-1

Drilling

A newly introduced small sized drill rig was operated. After drilling up to 6 metre level the pump was broke down and drilling was interrupted for two days until the arrival of the parts and alternatives. The drill penetration rate was low, varied from 4 to 8 metres a day, and the rate decreased further below 65.4 metre depth, where a series of intensely silicified quartz porphyry dykes were occurred in the basalt.

Geology and Mineralization

This area is overlain by dolerite from the surface up to 16.6 metres depth and there it grades into basalt. Most of the quartz and calcite veins occur in the upper half of the basalt and dolerite and a few veins exist near or within the quartz porphyry dykes. These veins make 20 to 40 degree angle with the core axis and are characterized by pyrite-chalcopyrite mineralization. A quartz vein of 3 cm wide at 38.05 metres contained 1.87 g/t of Au. No other veins gave significant assay values. The dolerite is disseminated with pyrite between the phenocrysts in some occasions. (Fig. II-3-1)

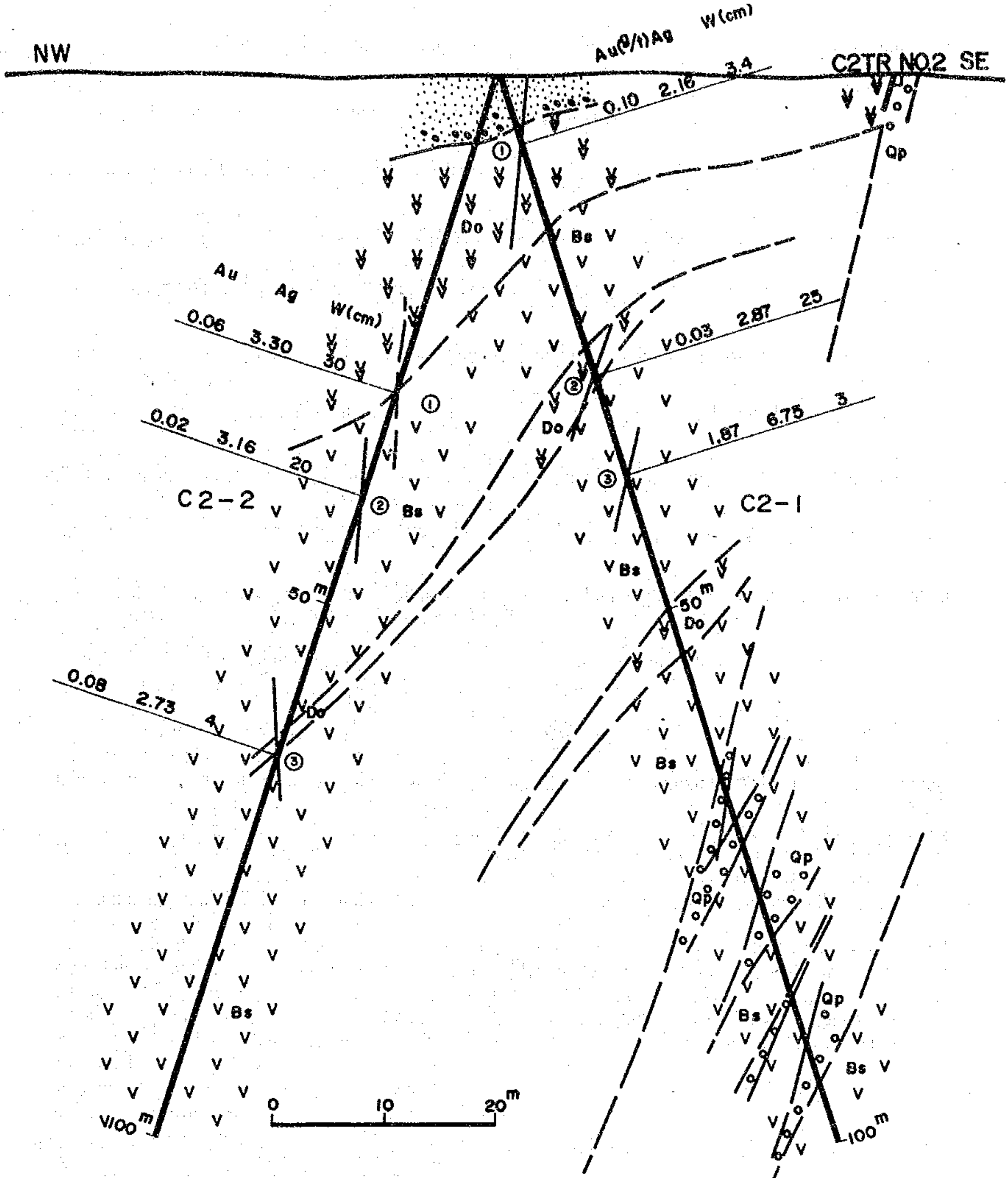
C2-2

Drilling

The good condition of the rocks resulted in the excellent penetration rate of 14.29 metres a day.

Geology and Mineralization

The geology is almost as same as the C2-2 hole, except for a quartz porphyry dyke. Quartz and calcite veins, mostly less than 5 cm wide, occur frequently in the zone from 20 to 50 metres depth without valuable assays. (Fig.II-3-1)



Drilling Cross Section 1 : 500		
Hole No.	C2-1	C2-2
Azimuth	125°	305°
Dip	-70°	-70°
Period	16:11:88 05:12:88	17:11:88 24:11:88

Fig. II-3-1 Geological Section of Drill Hole in Area C2 C2-1, C2-2

CHAPTER 4 AREA E1

4 -1. Selection of Drill sites

In order to make the explanation easier we named the Au-anomaly zones of east, north and west of this area as Zone A, B and C, respectively. These zones were selected for drilling considering the following favorable criteria.

Zone A
(1) A small zone but, the anomaly is intense-Au content is as high as 1 g/t.
(2) Ag and As anomalies are mostly overlap with that of Au.
(3) Argillization on the ground surface.

Zone B
(1) Larger extent than the zone A
(2) Overlapping of Ag and As anomalies

Zone C
(1) Neither Ag nor As anomalies overlap with the Au anomalies but the largest Au anomaly zone
(2) Contain a high Au value of more than 1 g/t of Au

4 -2. Geological investigation for the Anomaly

Prior to drilling, the ground surface was investigated around the geochemical anomaly zones with the aim of defining a possible source for the anomaly. The investigation revealed that the gossan occur on the crest of the gentle hill stretching northeasternly, in the vicinity of the Zones B and C. The gossan is composed of hematite, goethite and quartz and frequently showing banded structure and which was wrongly assigned to BIF in the 1987 survey.

From the distribution of the gossan, the volume of which was assumed to be indicative of the intensity of mineralization, revealed that the mineralization zone trends from the west half of the Zone B through Zone C to further west of Zone C. Therefore, some planned hole locations were modified and two additional holes were proposed in the Zone C. (Fig.II-4-1,2)

4 -3. Details of the Holes

E1-1

Drilling

The well stratified tuffaceous rock from the surface to 22 metres depth was fragmented to small pieces and which resulted a core blockage. Therefore, no satisfactory drilling rate was recorded.

After 22 metres, the conditions of the rocks turned better and the rate exceeded over 10 metres a day. Troubles such as tire puncture of a water bowser interrupted the drilling.

Geology and Mineralization

The hole intersected green dacite, white dacite, felsic fine tuff and andesite. The green dacite was differentiated from the andesite by visible quartz phenocrysts. X-ray diffractometer analysis of the felsic tuff revealed the occurrence of pyrophyllite during the laboratory tests, in 1986 and 1987.

The white dacite are rich in quartz phenocrysts and are intensely carbonated and sericitized with chlorite network alteration. The mineralization zone occurs preferably in the andesite rather than in the white dacite and therefore, alteration seems to have no direct relation with the mineralization.

Dacite and andesite host the pyrite mineralization network from 44.44 to 68.30 metres. All the samples from this section gave the gold values less than 1 g/t and silver values less than 3 g/t.

The gold assay of 4.96 g/t was detected from hematite and pyrite at 30.45 metres. A quartz vein of 30 cm wide and a pyrite disseminated zone at 96.60 and 97.46 metres, respectively contained gold values less than 0.1 g/t.

The sulphide is composed of euhedral pyrite with very small amount of spharelite and chalcopyrite. (Fig.II-4-3)

E1-2

Drilling

The hole was completed without any serious problem. The oxidation zone near the surface was thinner than those of the holes E1-3 to E1-12. Which resulted in approximately 100 percent core recovery below the 8 metre level.

Geology and Mineralization

The hole intersected a zone with alternations of green dacite and felsic tuff up to 31.80 metres and andesite after that. The andesite shows breccia structure, partly.

Quartz veins and upper pyrite network occur within the felsic tuff and no significant assay value of gold and silver were recorded. (Fig.II-4-3)

E1-3

Drilling

After good penetration rate of 13 metres a day up to 30 metres, frequent breakdowns interrupted the drilling for two days until the delivery and fixing of the parts.

Geology and Mineralization

The rock type is principally andesite with quartz porphyry intrusions. A dark or black green mafic rock which associated with the andesite in sharp contacts was assigned to basalt. The dyke rock contains altered phenocrysts of plagioclase and finer quartz than the former. Mafic phenocrysts have been altered to chlorite.

The hematite vein at 59.57 metres near the basalt andesite boundary is believed to be an oxidation product of

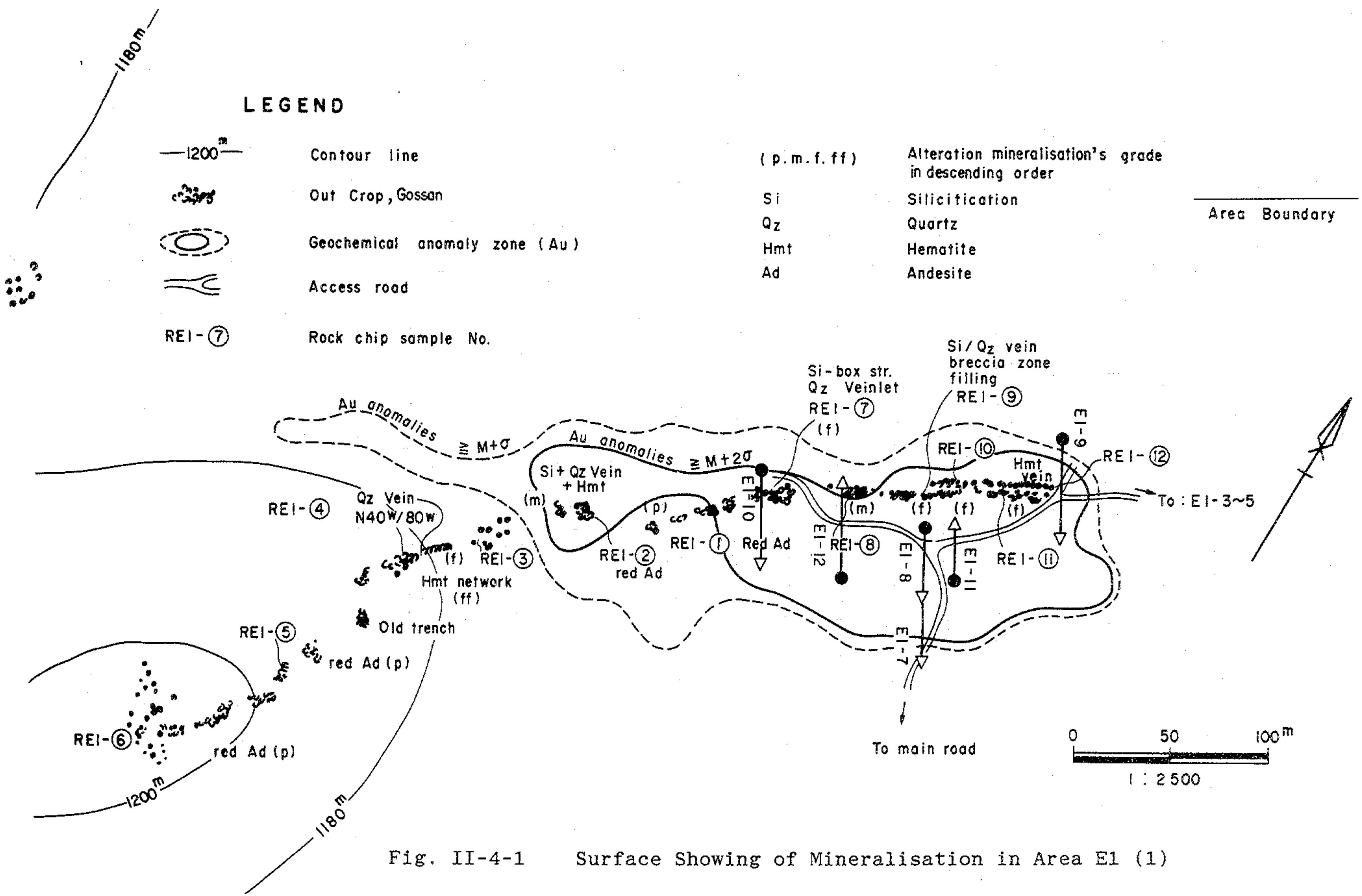
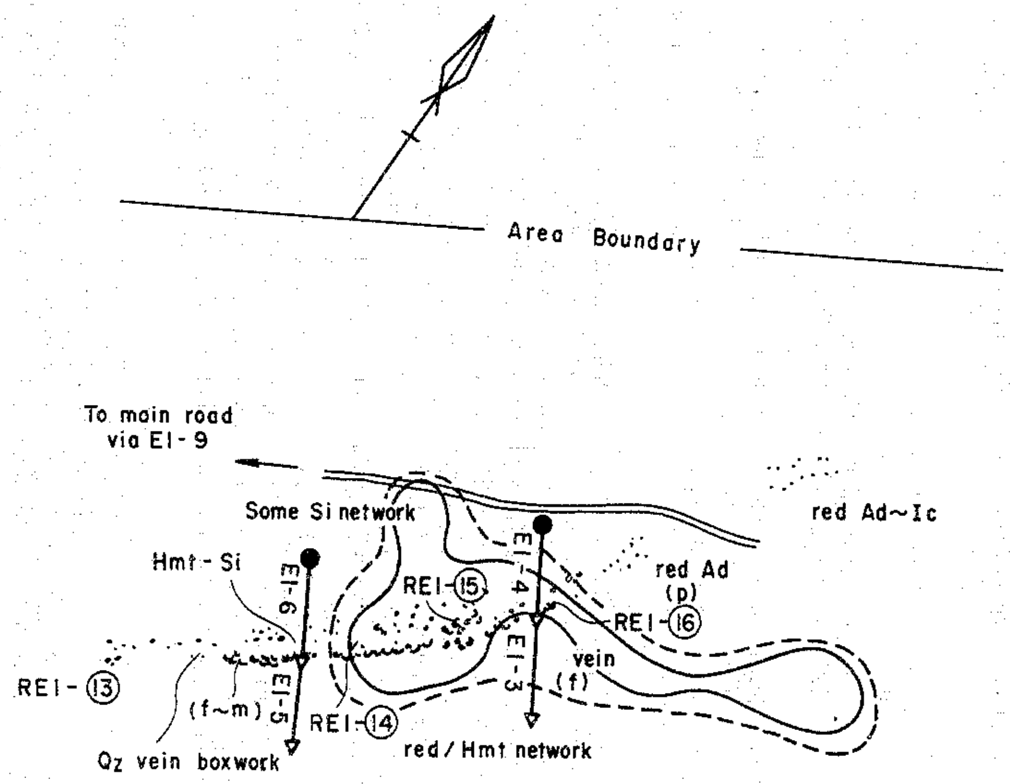


Fig. II-4-1 Surface Showing of Mineralisation in Area E1 (1)



SAMPLE No.	ASSAYS	
	Au (g/t)	Ag (g/t)
RE1- 1	0.30	3.98
RE1- 2	0.45	3.46
RE1- 3	0.03	3.46
RE1- 4	0.27	3.04
RE1- 5	0.01	2.94
RE1- 6	0.01	9.33
RE1- 7	0.56	4.09
RE1- 8	<0.01	9.12
RE1- 9	0.35	2.62
RE1-10	0.01	2.52
RE1-11	0.12	6.18
RE1-12	0.22	3.25
RE1-13	<0.01	8.28
RE1-14	1.95	7.65
RE1-15	1.09	4.93
RE1-16	0.77	3.98

Fig. II-4-2 Surface Showing of Mineralisation in Area E1 (2)

pyrite and it contained 1.39 g/t of Au. Calcite-pyrite veins of 5 cm wide at 80.82 and 97.45 metres contained 1.46 and 1.34 g/t of Au respectively. Both samples gave anomalous silver values. (Fig.II-4-4)

<u>E1-4</u>

<u>Drilling</u>

The hole intersected the oxidation zone deeper than that in the E1-3 in spite of gentle angle of inclination. When the hole passed the quartz porphyry dyke the non oxidation zone started and the average drilling rate was recovered.

<u>Geology and mineralization</u>

The mineralization is divided into two zones. One occurs intermittently with argillization between 36.30 and 44.72 metres and the other lies within and below the quartz porphyry dyke. The pyrite bearing silicification zone is 10 cm wide and occurs inside of the dyke at 74.10 metres. It gave 53.37 g/t of Au. This is the highest gold assay of the area.

The hematite quartz vein at 39.90 metres, where some sulphide also exist, contained 6.69 g/t of Au. But no electrum grain was identified in the polished section of hematite, taken from a nearby place. (Fig.II-4-4)

<u>E1-5</u>

<u>Drilling</u>

The hole intersected an intense oxidation zone composed of soil and laterite from the surface up to 28.3 metres. Hence no drill core was recovered.

The repeated breakdown of the pump led to the poor drilling rate and to the interruption of the work in the first half of the hole. The rest progressed favorably with a rate of 20 metres a day.

<u>Geology and Mineralization</u>

The hole is completely covered by andesite except a porphyritic dyke around 34 metres. The andesite formation has been faulted and locally fractured as a brecciated zone. White argillization zone overlaps the hematite network zone over 6 metres in the apparent footwall side of the dyke. No significant assay values were reported from this oxidized ore.

Other networks, which developed near the footwall and hanging wall contacts of the brecciated zones, gave no anomalous gold values.

The sulphide includes, mainly, pyrite with a very small amount of sphalerite, chalcopyrite and pyrrhotite. A very fine particulate of electrum of 3 micron was identified in a polished sulphide section from 92.72 metres. (Fig.II-4-5)

<u>E1-6</u>

<u>Drilling</u>

The work progressed favorably, even with the poor core recovery, up to 34 metres. As the recovery improved, a core blockade occurred due to the intensely fractured oxidation zone and this, in turn led to the poor drilling rate.

Meanwhile the rig broke down at the crankshaft of the engine, interrupting the drilling. Generally, the work efficiency was very low.

Geology and Mineralization

The rocks of this hole are locally fractured andesite and dark green basalt. The angle between the core axis and the bedding plane of the thin mafic tuff layer at 74.3 metres depth, suggest the dip of the andesitic sequence.

The mineralization, in the form of a hematite-pyrite network and a quartz vein, occurs in the hole with a tendency of developing predominantly near the argillization zone, brecciated zone and the faults.

In the non oxidation zone, a small amount of sphalerite, chalcopyrite and magnetite other than the pyrite were observed under the microscope.

No significant values of gold and silver were reported.(Fig. II-4-5)

E1-7

Drilling

The drilling progressed smoothly because of the better rock conditions than in the other holes.

Geology and Mineralization

The hole intersected laterite and andesite from the surface up to 32.81 metres and felsic tuff and dacite after that. The andesite is green and fine grained with a locally porous texture. Quartz phenocrysts, with 1 to 2 mm diameter, helped to distinguish the dacite from andesite.

The brecciated structure between 68.32 to 71.71 metres hosts some well developed quartz veinlets. Felsic tuff is sandwiched between andesite and dacite with sheared contacts.

Pyrite network and quartz veinlets have been formed in the sheared zone within the dacite or around the brecciated zone but, no sample gave a low content of gold and silver. (Fig.II-4-6)

E1-8

Drilling

The hole was drilled approximately as satisfactorily as the above mentioned hole.

Geology and Mineralization

The geology this hole is comparable to that of E1-8. The dacite rock between 26.88 and 45.96 metres is very poor in quartz phenocrysts and contains, intermittently, porous andesite layers. Sometimes the boundaries of these andesite layers are not discernible. The bedding planes of a banded iron formation (BIF) around 47 metres make an angle of 60 degree with core axis.

This hole was weakly mineralized as the previous one and no sample gave less than 0.1 g/t of Au, with the exception of a 4 cm wide pyrite vein at 81.52 metres containing 1 g/t of Au.

A minute grain of electrum was found in pyrite dotted with chalcopyrite and sphalerite in the polished section from 68.25 metres. (Fig.II-4-6)

E1-9

Drilling

The hole was drilled at a satisfactorily as a whole.

Geology and mineralization

The only rock of this hole is andesite except a 6.6 metres thick quartz porphyry intrusion around 90 metres. The andesite is believed to be derived from tuff and has been affected by weak thermal metamorphism producing a larger amount of chlorite. The dyke in this hole is comparable with those of E1-3 and 4.

Mineralization is associated with silicification in most cases. The primary pyrite up to 90 metres depth has commonly oxidized to hematite. The geostructural control is not so obvious than the other holes. However, the mineralized network is limited to the andesite. The silicification zone gave an assay value of 1.28 g/t of Au. Other mineralized parts gave no anomalous values except for 0.67 g/t of Au at 96.86 metres depth. (Fig.II-4-7)

E1-10

Drilling

The rate of penetration was as low as 4 to 5 metres a day up to the 31 metre level, due to the intensely fractured oxidation zone. The rate improved satisfactorily to 10 to 14 metres a day after that, even with a hard sequence including quartz veins.

Geology and Mineralization

The main rock of the hole is andesite with some brecciated zones. A network of multiple quartz veins and hematite occurs within and near the zone from 8.85 to 61.46 metres. The section from 85.70 to 90.10 metres consists of a bleached pyrite network. The oxidation zone extends down to 60 metres until the hematite disappears in the mineralization zone. The pyrite in the oxidized ore from 54.4 and 56.4 metres have almost wholly replaced by goethite, iron hydroxide and hematite with some particulates of sphalerite and chalcopyrite. Meanwhile, the sulphide from non the oxidation zone at 93.0 metres consist of pyrite and a small amount of sphalerite and chalcopyrite.

No sample from the oxidation and non oxidation zones gave gold more than 1 g/t. (Fig.II-4-8)

E1-11

Drilling

Generally, the work was efficient in spite of a strongly fractured zone between 37.52 and 44.47 metres where the pulling time of the drilling rods have increased.

Geology and Mineralization

The hole intersected a nearly homogeneous andesite formation containing amygdaloidal vesicles.
The mineralization occurs below 38 metres. The oxidation zone covers the above 75 metres. Massive sulphide contains coarse grained pyrite and a small amount of sphalerite, chalcopyrite

and chalcocite. But, most of those mineralized parts contained less than 0.1 g/t of Au. (Fig.II-4-9)

E1-12

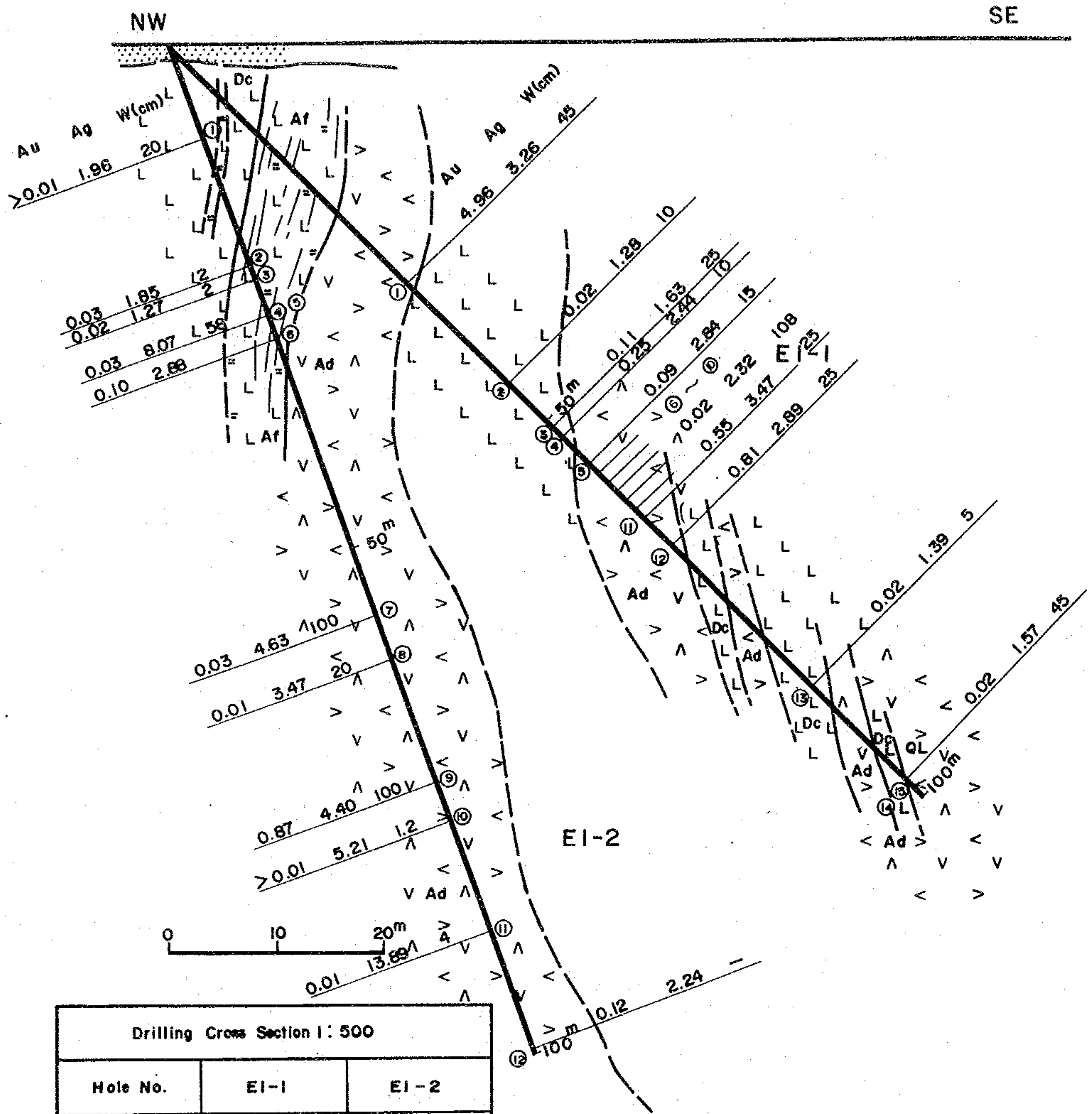
Drilling

The lost circulation from 15.31 to 17.52 metres and the resulted casing pipes insertion delayed the work for three days. The work progressed smoothly after that depth.

Geology and Mineralization

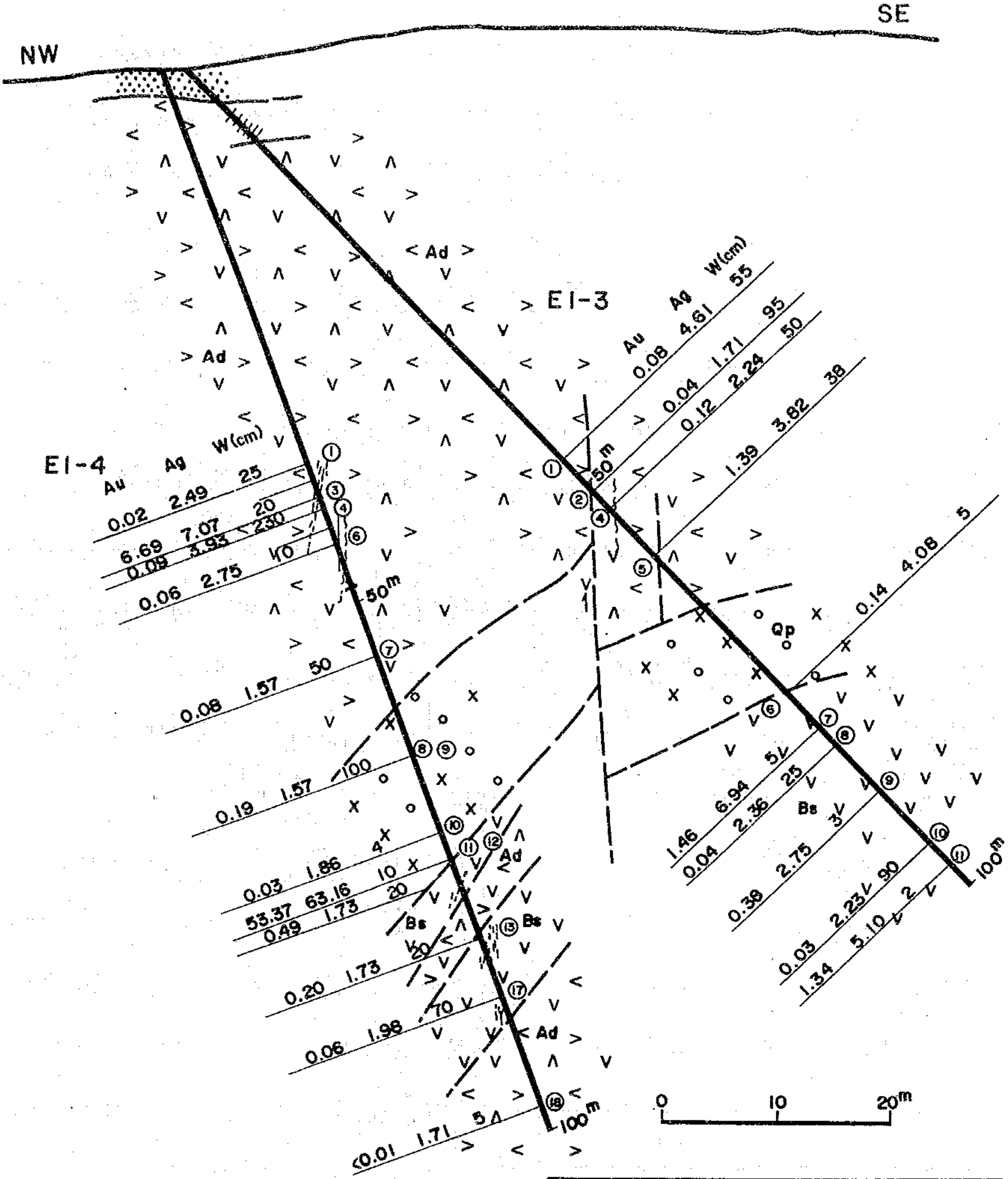
This hole comprises andesite with intruded quartz porphyry dykes. The andesite from 74.5 metres to the bottom is dark green or blackish green. The dyke rock contains porphyritic plagioclase phenocrysts and is believed to be the extension of the dyke of E1-9 and E1-5.

Mineralization is not found within the dyke rock and it is thought that it post dates the pyrite mineralization. The assays were mostly less than 0.1 g/t of Au. (Fig.II-4-10)



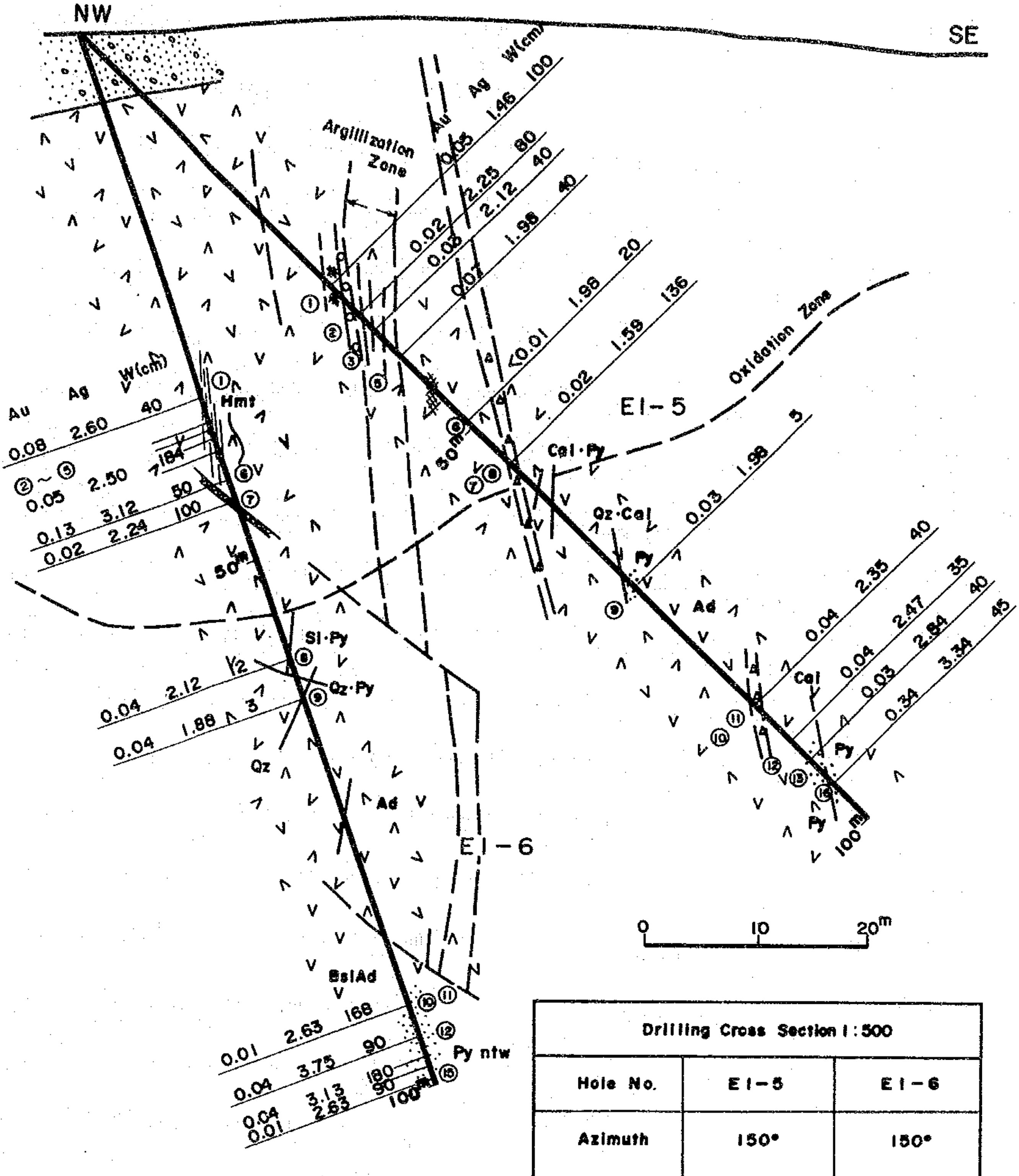
Drilling Cross Section 1 : 500		
Hole No.	E1-1	E1-2
Azimuth	150°	150°
Dip	-45°	-70°
Period	18:11:18 29:11:18	8:11:88 17:11:88

Fig. II-4-3 Geological Section of Drill Hole of Area E1 (1) E1-1, E1-2



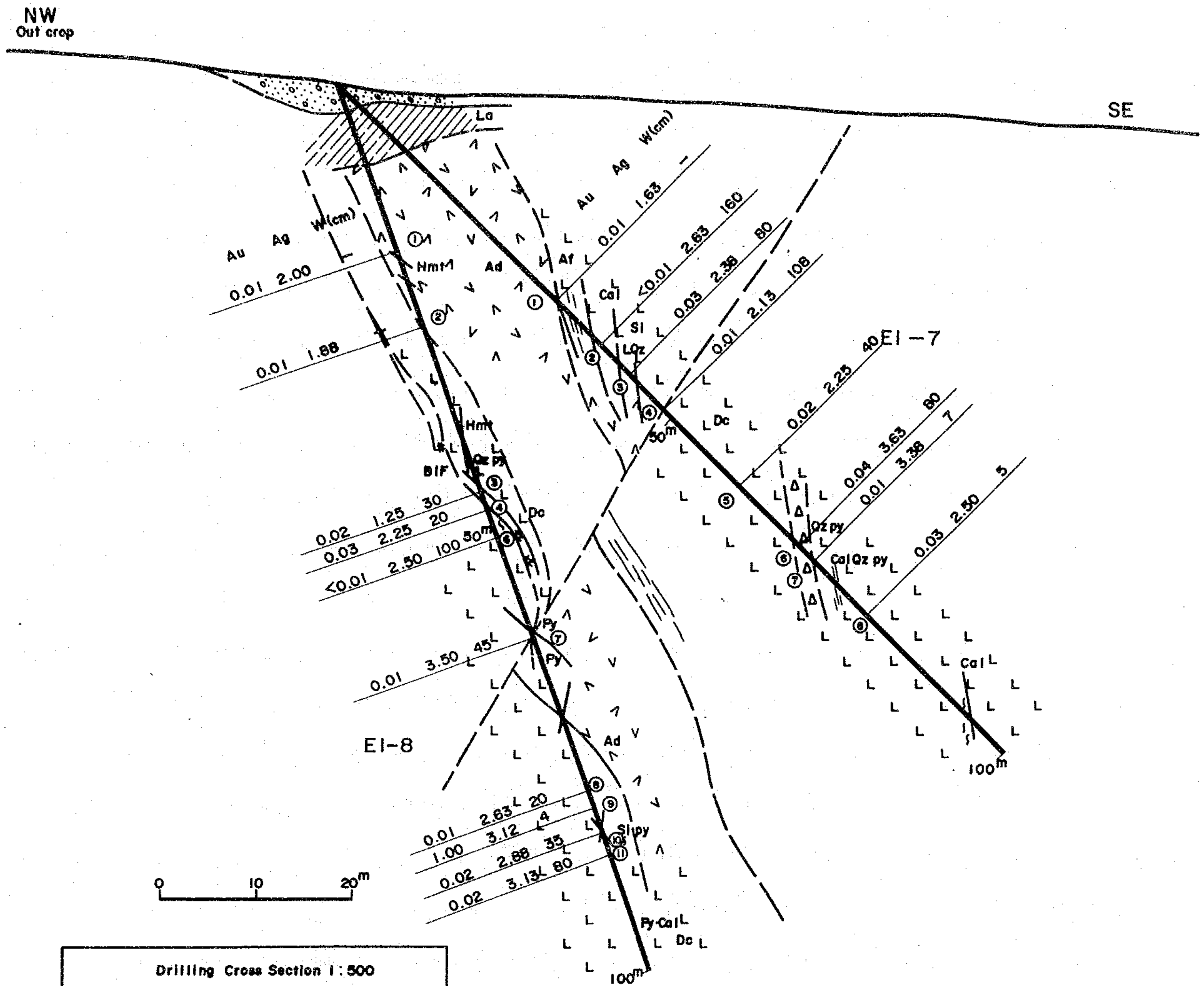
Drilling Cross Section 1 : 500		
Hole No.	E1-3	E1-4
Azimuth	150°	150°
Dip	-45°	-70°
Period	12:10:88 27:10:88	1:11:88 14:11:88

Fig. II-4-4 Geological Section of Drill Hole in Area E1 (2) E1-3, E1-4



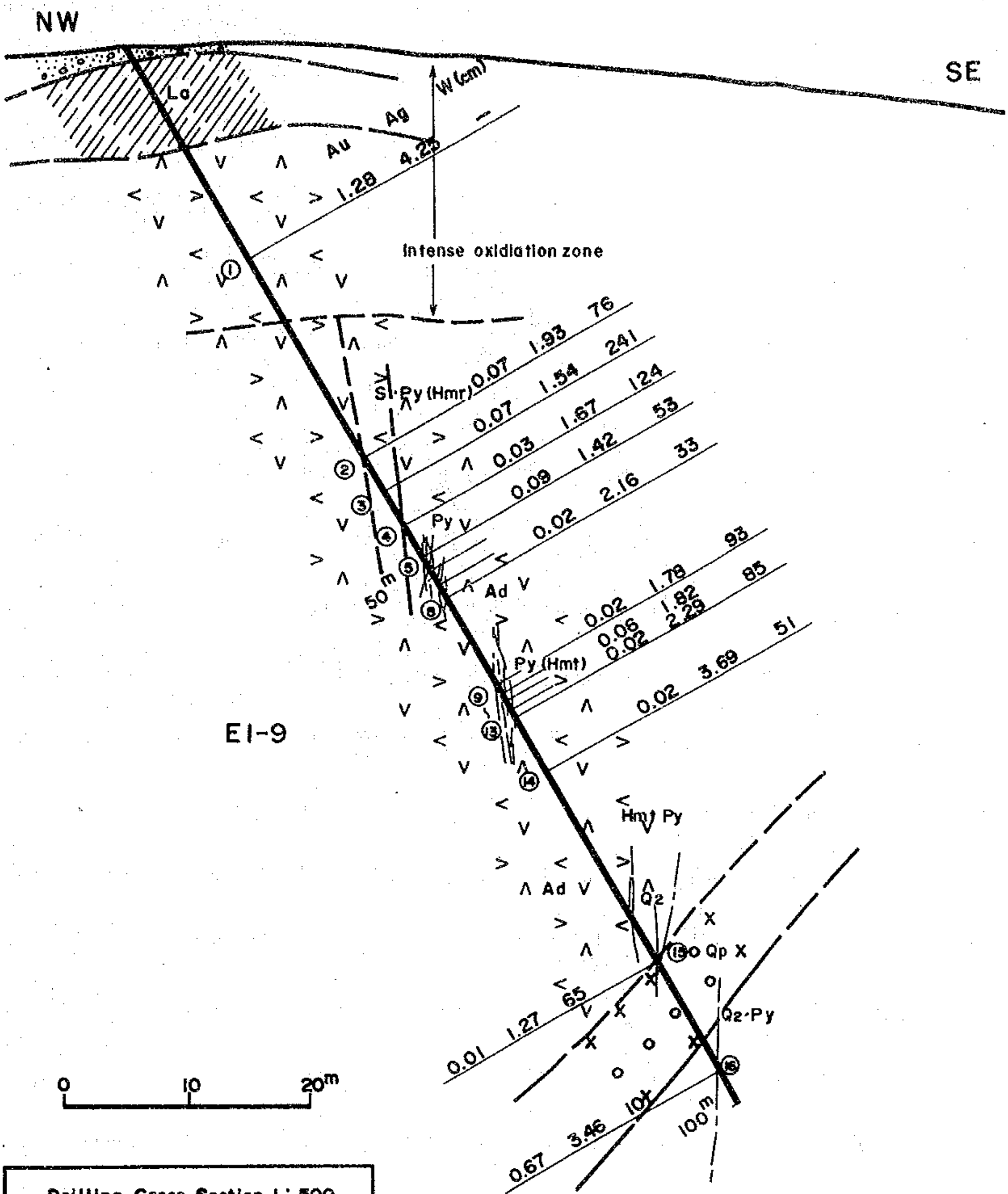
Drilling Cross Section 1:500		
Hole No.	E1-5	E1-6
Azimuth	150°	150°
Dip	-45°	-70°
Period	15:09:88 26:09:88	26:09:88 10:10:88

Fig. II-4-5 Geological Section of Drill Hole in Area E1 (3) E1-5, E1-6



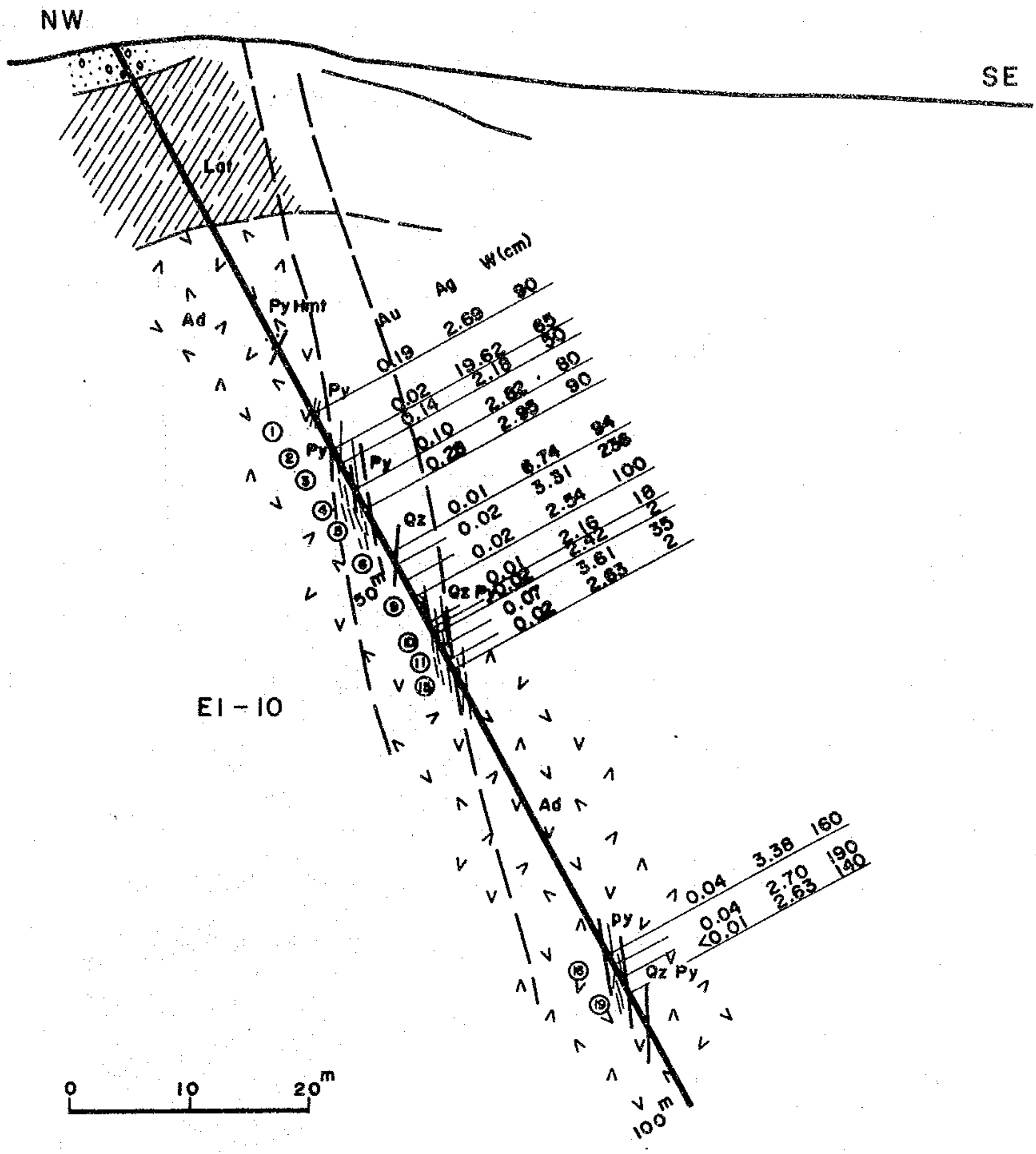
Drilling Cross Section 1:500		
Hole No	E1-7	E1-8
Azimuth	150°	150°
Dip	-45°	-70°
Period	14:07:88 -25:07:88	27:07:88 05:08:88

Fig. II-4-6 Geological Section of Drill Hole in Area A3 (4) E1-7, E1-8



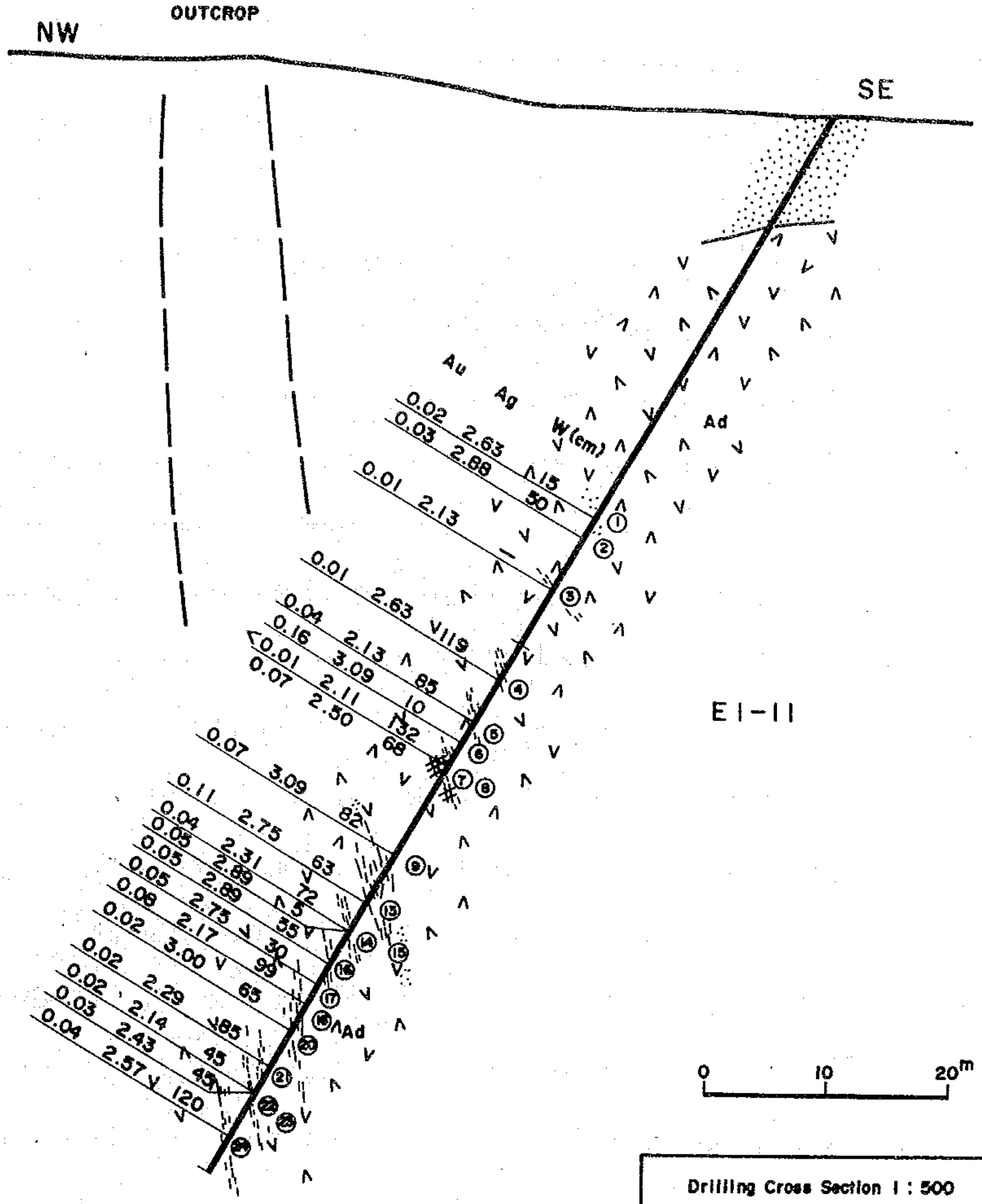
Drilling Cross Section 1 : 500	
Hole No.	E1-9
Azimuth	150°
Dip	-60°
Period	31 : 08 : 88 12 : 09 : 88

Fig. II-4-7 Geological Section of Drill Hole in Area E1 (5) E1-9



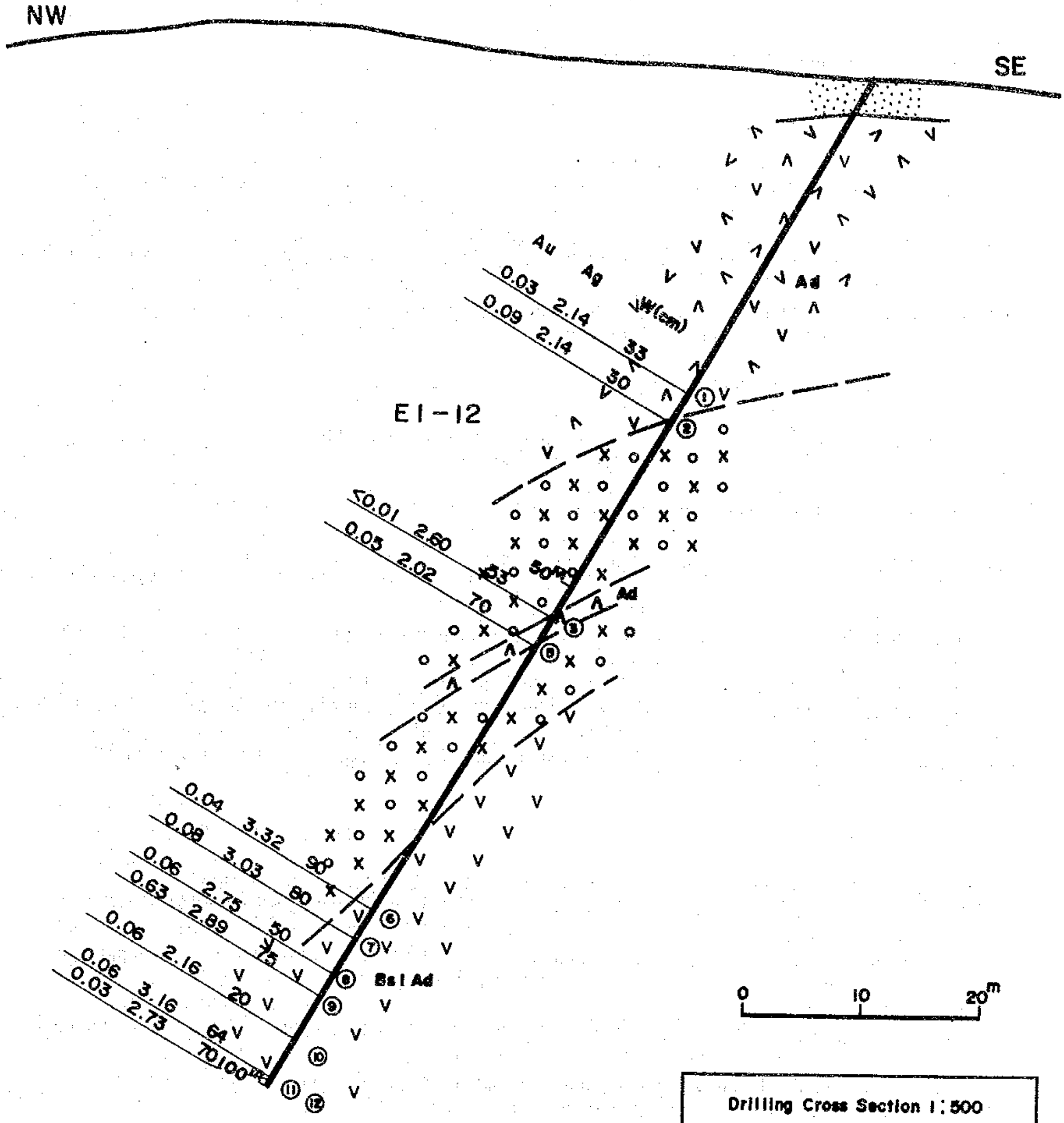
Drilling Cross Section 1 : 500	
Hole No.	E1 - 10
Azimuth	150°
Dip	-60°
Period	15:08:88 27:08:88

Fig. II-4-8 Geological Section of Drill Hole in Area E1 (6) E1-10



Drilling Cross Section 1 : 500	
Hole No.	E1-11
Azimuth	330°
Dip	-60°
Period	8 : 10 : 88 19 : 10 : 88

Fig. II-4-9 Geological Section of Drill Hole in Area E1 (7) E1-11



Drilling Cross Section 1:500	
Hole No.	E1-12
Azimuth	330°
Dip	-60°
Period	21:10:88 3:11:88

Fig. II-4-10 Geological Section of Drill Hole in Area E1 (8) E1-12