No. 32

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

SUMMARY

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MARCH 1989

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

PREFACE

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

The JICA and MMAJ sent to Zimbabwe a survey team headed by Mr.Akiyoshi Komura and Tetsuo Hatasaki from 1986 to 1988.

The team exchanged views with the officials concerned of the Government of Zimbabwe and conducted a field survey in the Kadoma area. After the team returned to Japan, further studies were made and the summary report has been prepared.

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

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

28th February 1989

Kensuke Yanagiya
President
Japan International Cooperation Agency

Junichiro Sato
President
Metal Mining Agency of Japan

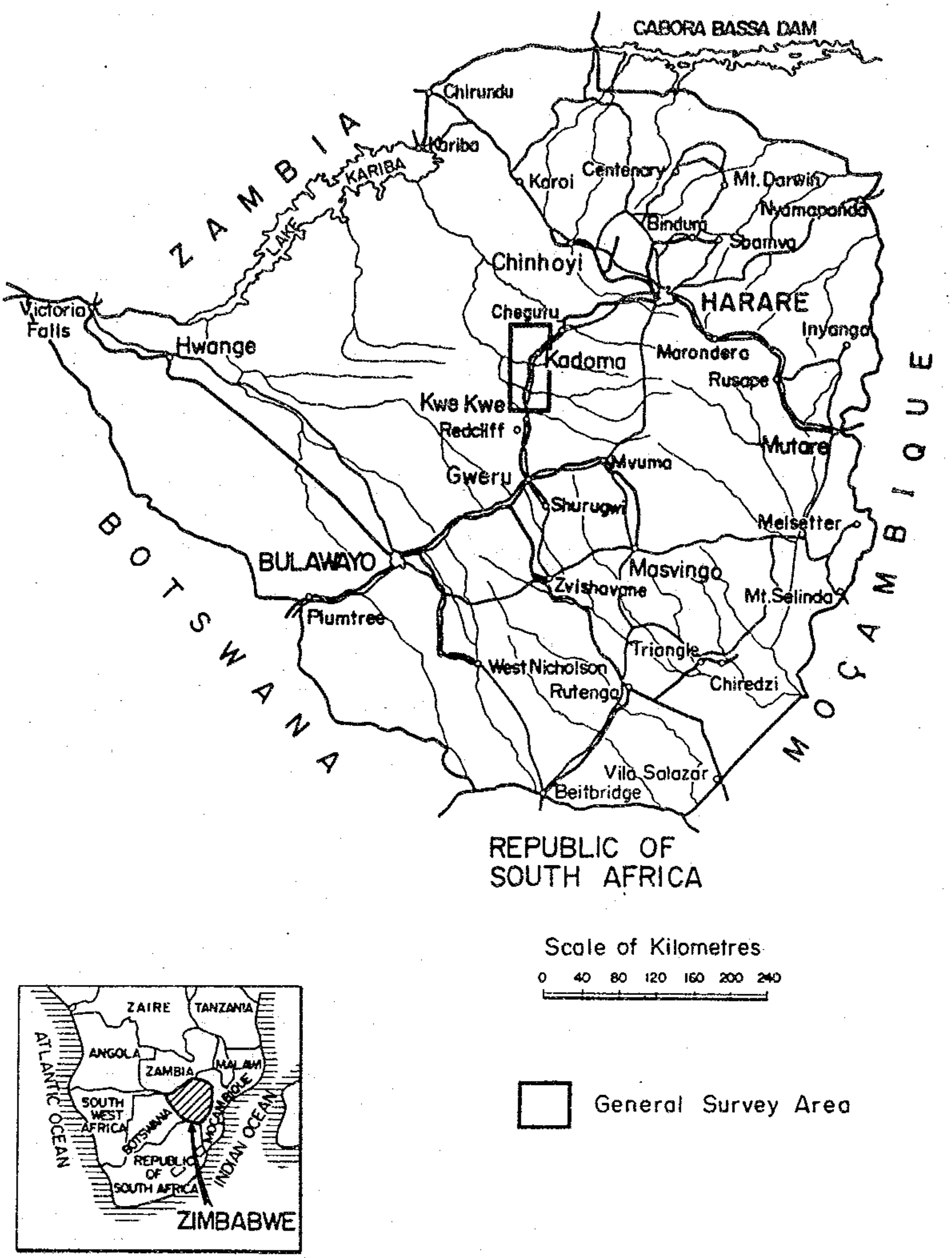

Fig. I-1-1 Location Map of the Kadoma Area, Zimbabwe

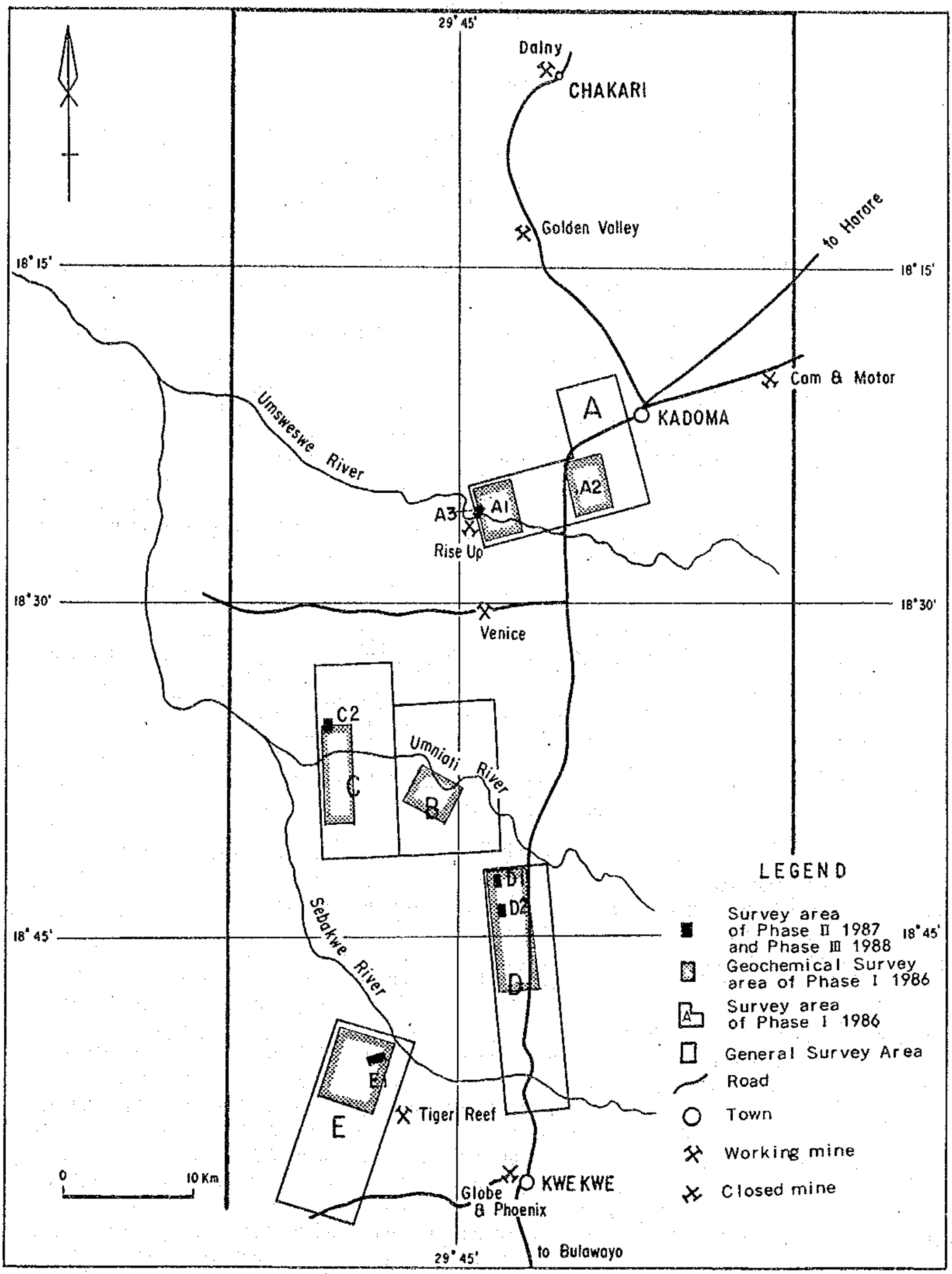

Fig. I-1-2 Location Map of the Survey Areas

SUMMARY

The mineral exploration aid to the Republic of Zimbabwe has been conducted during the period from 1986 to 1988 and has aimed at appraisal of mineral potential beginning with gold, lead, zinc, nickel, chrome and antimony in the Survey Area of five thousand square kilometres in the Kadoma district.

The Phase I programme was started with compilation of the previous exploration work followed by preliminary geological survey and geochemical prospecting using various indicative ele ments in the areas selected. The programme indicated favourable geologic environment for minerals in the areas and geochemical anomaly zones which were evaluated high in terms of their extent, intensity and combination of the elements.

The Phase II programme conducted trenching and detailed geochemical prospecting in the geochemical anomaly zones which had been exracted through Phase I programme. As a result, the potential for gold was highly evaluated through the areas and higher ore potential of gold was indicated in the area A3, C2 and E1 of the five areas on the basis of intense Au geochemical anomalies.

The Phase III has aimed at subsurface gold mineralisation of vein type or disseminated type in the three areas by means of trenching and drilling.

Twenty two drill holes totalling 2,202.9 metres has revealed the mineralisation of auriferous quartz veins in Area A3 and C2 and pyrite network mineralisation in E1. The highest assay values for gold of core samples were 41.21 g/t Au of Area A3 and 53.37 g/t Au in Area E1. The mineralised sections thus so far encoutered were usually thin and therefore, when regarded as a deposit to be exploited by underground operation, the ore grade would be much lower than those of current operating mines. The economic ore potential is hence believed to be low.

On the other hand, the programme revealed close relationships between the soil geochemical anomalies of the other indicative elements than gold and subsurface gold mineralisation. Homogenization temperatures from fluid inclusions suggested that the mineralised quartz and calcite veins intersected by the drill holes have formed at a lower temperature than those of productive gold deposits.

Based upon the three year-exploration, the following guidance for gold exploration is recommended. Geochemical prospecting should be combined with surface mapping and in situ panning for gold using indicative elements of Au, Sb, As and Hg. The areas which were excluded out of the semidetailed survey areas in Phase I and the potential geochemical anomaly zones of Phase II which have not yet drilled, could be recommended for the future exploration using the geochemical prospecting methods which were revealed usefull from a view point of the element association.

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.

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OVERVIEW

PART I OVERVIEW

CHAPTER 1 OUTLINE OF THE SURVEY

1-1. The Survey Area and Aim of the Surveys

Republic of Zimbabwe is blessed with abundant mineral resources and produces gold, coal, asbestos, nickel, copper, chromite, iron ore, silver and tin in increasing order of sales amount in 1987. Most of the mineral products are exported and earn approximately 40 percent of foreign currencies.

The country has therefore put emphasis on the exploration and the development of mineral resources. Japan's technical aid to the mining industry of Zimbabwe has thus been required.

A scope of work agreement was signed between the Japan International Cooperation Agency and Metal Mining Agency of Japan, and the Geological Survey Department, Ministry of Mines of the Republic of Zimbabwe on 29th April 1983. The first project was started in the Shamva area and had been conducted for three years ending in 1985 and suggested the nickeliferous mineralisation in the area.

Following the first project, the second project over three years was planned and started with signature of Scope of Work between the two countries.

The project has aimed at an examination of geological environment favourable for ore potential of the survey area.

1-2 Survey Methods and Survey Team

The survey methods used in the project and the process of exploration are illustrated in Fig. I-1-3 and Fig. I-1-4 .

1-2-1. Phase I (1986)

The Phase I programme was started with a compilation study to select five semidetailed survey areas from the general survey area covering 5,000 square kilometres. Subsequent to the compilation, geological survey and geochemical prospecting combined with some laboratory tests were conducted to study the characteristics of mineralisation and to evaluate mineral potential of the areas.

<u>Compilation of Previous Work</u>

The compilation study which had selected five semidetailed survey areas was based on all collected data such as geological bulletins, relating papers, reports and on the proposal from the Geological Survey Department of Zimbabwe considering about the current mining lease and E.P.O.distribution. The five areas of 100 square kilometres each were selected on the basis of the following favourable criteria.(Table I-1-1)

Area A
(1) Extension of Lion Hill group of ore deposits to the south.
(2) NE and NNW trend-fractures resulted from overlapping of the two phase of deformation are favourable for ascending of mineralising fluid.
(3) Felsic intrusive rocks and Whitewaters Tonalite could be a source of mineralised fluid and a heat source for convection of the fluid.

Area B
(1) Bi-modal volcanism implies stratabound massive sulphide ore deposits
(2) Crossing of NNW and NNE trend-dykes and faults
(3) Felsic intrusive rocks as a heat and mineral source

Area C
(1) Similar geological environment to Area B
(2) Known mineral occurences and deposits such as Cuba mine

Area D
(1) Ultramafic rock terrain and extension of the Hunters Road nickel ore deposit
(2) Ni and Cr geochemical anomalies in E.P.O. report

Area E
(1) Bi-modal volcanism
(2) A series of felsic intrusive body and dyke in the periphery of Sesombi pulton
(3) Known mineral occurences such as Black Prince and Tiger Reef mine

<u>Soil Geochemical Prospecting(Semidetailed)</u>

Indicative elements were selected based on the geological environments and potential ores of each area as follows.

Area	Number of Samples	Indicative Elements
A	1,511	Au, Cu, W
B	1,547	Au, Sb, As
C	2,006	Au, Pb, Zn
D	1,508	Au, Ni, Cr
E	1,527	Au, Sb, As

The sampling was conducted every 50 or 100 metres along survey lines set at 200 metres line spacing. Soil samples were taken from B layer 10 to 20 centimetres deep from the surface and were sieved down to -20 mesh in places, then down to -80 mesh in the camp preparing about 80 grammes for analysis.

Chemical analysis was contracted to Rio Tinto Analytical laboratories based at Eiffel Flats. Only tungusten analysis was contracted to Chemex Labs. Canada because of detection limit.

The methods applied for gold analysis was fire preconcentration / atomic absorption, and that for other elements was ICP-AES(Inductivity Coupled Plasma-Atomic Emission Spectrometry).

Statistical processing of the assay values resulted in definition of anomaly zones using threshold values over geometric mean + standard deviation for area and element.

The statistical processing defined the following characteristic geochemical anomaly zones in each area. The element in parentheses means an anomaly zone delineated with the Au-anomaly zone.

Area A:	A1	northeast	large-sized	intense	W
	A1	southwest	medium	intense	Au
	A2	northwest	large	intense	W

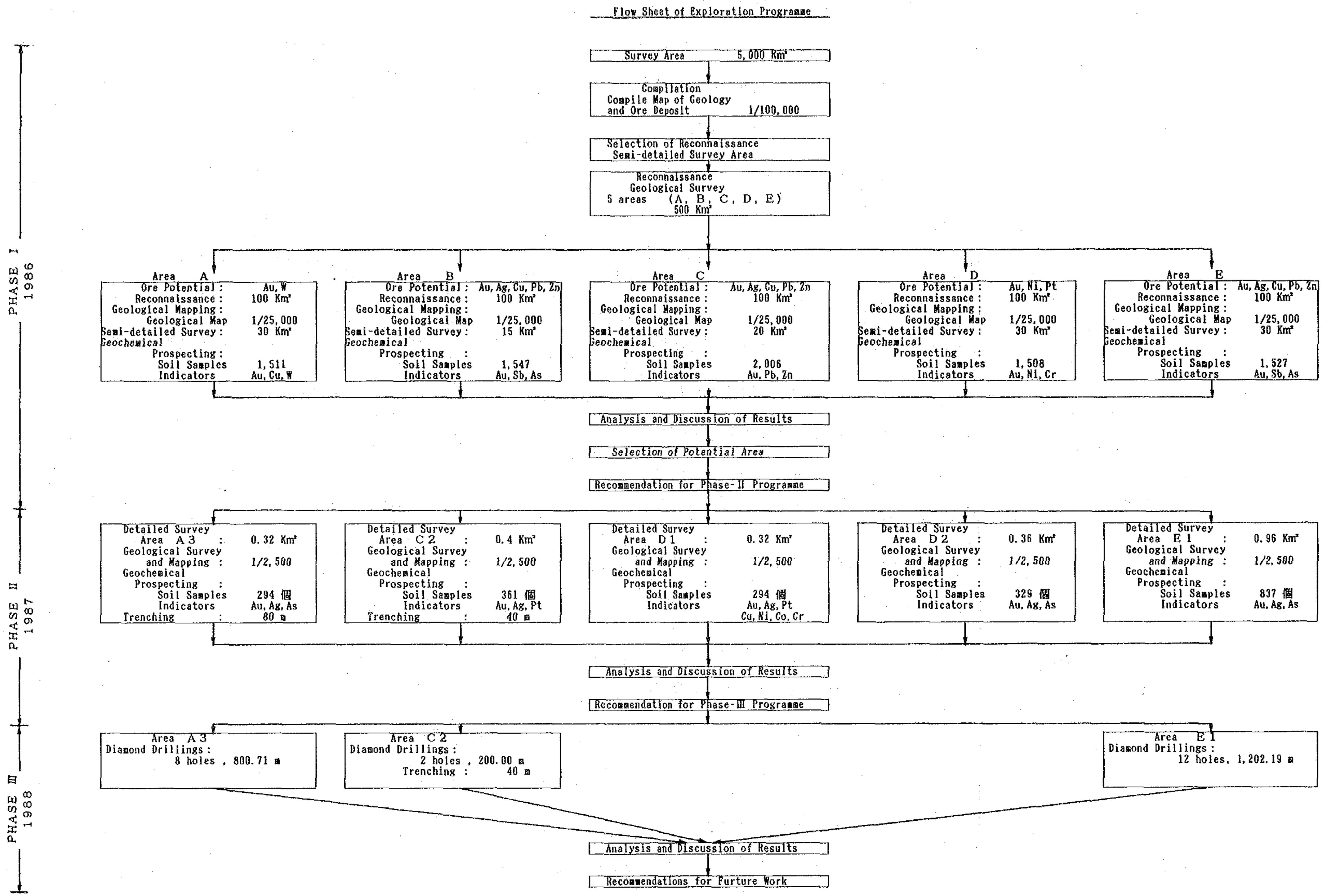


Fig. I-1-3 Flow Sheet of the Survey in the Kadoma Area

Table I-1-1 Compilation of Semidetailed Survey Areas of Phase I

Area	(Km)	Geology	Known Ore Deposits	Criteria	Geochemical Survey Programme			Potential	Priority
					Indicators	Area & Line Spacing	No. of Samples	Type of Deposit	
A	100	Greenstones of Lower Bulawayan Group	Aurora (Au) Cobhurst (Au) Affaire (Au, W)	· Extension of Lion Hill group of deposits to the north · Felsic intrusives and White Tonalite as a source of heat and mineralisation · NE and NW trend fractures by two phase deformations, favourable for mineralization	Au, Cu, W	2 areas A1 5Km×3Km A2 5Km×3Km 200m/100m Boundary of Rock facies	750 750 total 1,500	Au(W)-Qtz Vein	1
B	100	Upper Bulawayan Group	Cricket (Au, As) Oro Bred (Au, As, Sb) Somerset (Au, As)	· Crossing area of NNW & NNE trend dykes/faults · Felsic intrusive rocks as a source of heat and mineralisation · Bi-modal volcanism	Au, Sb, As	1 area 5Km×3Km 200m/50m Extension of known deposit	total 1,500	Au-Qtz Vein Kuroko Type	2
C	100	Upper Bulawayan Group Maliyami Formation	Cuba (Au, Cu, Sb, Pb, As)	· Similar geological environment to Area B · Known mineral occurrence/deposits such as Cuba mine	Au, Pb, Zn	1 area 8Km×2.5Km 200m/50m Extension of known deposit	total 2,000	Au-Qtz Vein Kuroko Type	4
D	100	Rhodesdale Complex Kwekwe Ultramafic Complex	Joanern (Au) Cuprum (Cu) Chlorite schist (Cu) Rosstack (Au)	· Ni and Cr geochemical anomalies · Ultramafic rock terrain/extension of Hunters Road Ni ore deposit	Au, Ni, Cr	1 area 10Km×3Km 200m/100m Rim of Ultramafic Body	total 1,500	Au-Qtz Vein Massive Ni deposit	5
E	100	Upper Bulawayan Group Maliyami Formation	Black prince (Au) Green granite (Au)	· Bi-modal volcanism · Series of felsic intrusive body and dyke · Mineral occurrences such as Black Prince and Tiger Reef mine	Au, Sb, As	1 area 6Km×5Km 200m/100m Extension of known deposit	total 1,500	Au-Qtz Vein Kuroko Type	3

A2	southwest	large	intense	W
Area B:	north	small	intense	Au(As)
Area C:	northwest	small	intense	Au(Zn)
	northeast	small	intense	Au(Zn)
Area D:	northwest	small	intense	Au(Ni, Cr)
Area E:	northeast	large	intense	Au(Sb)

The W-anomalies was believed to be derived from the old working by means of air and surface water. Meanwhile, the anomaly of north B was pending because of less coherent zonation.

Five anomaly zones were raised for further work because of intense Au- anomaly sometimes combined with anomaly of other elements. They were southwest A1(coming A3), northwest C(coming C2), north
west D(coming D1 and D2) and northeast E(coming E1).

1-2-2. Phase II (1987)

The Phase II programme was composed of detailed geochemical prospecting with detailed mapping and trenching in the five areas; A3, C2, D1, D2 and E1 which were defined on the basis of the Phase I results. The geochemical anomalies which were trenched indicated some interesting showing of mineralisation.

Soil samples were collected at 25 metre intervals along the survey lines 50 metres apart from each other, which had been designed so as to cross the geochemical anomaly zones delineated in the Phase I prospecting.

Selection of elementary indicators which have good correlation with Au and to be used in Phase II was made on the basis of the correlation obtained from the Phase I geochemical survey.
The elements thus determined were Au, Ag and As for all areas except for Area D1 where Au, Ag, Pt, Cu, Ni, Co and Cr were used because of ultramafic rock terrain.

Area	Number of Samples	Indicative Elements
A3	1,806	Au, Ag, As
C2	1,806	Au, Ag, As
D1	289	Au, Ag, Pt, Cu, Ni, Co, Cr
D2	1,806	Au, Ag, AS
E1	1,806	Au, Ag, As

The soil samples of Phase II were dispatched to McLahalan & Lazar Co. based at Johannesburg. The methods of assay and data proccessing were the same as those of Phase I however, the Phase II data processing, used an arithmetic mean and a standard deviation in place of geometric ones to give higher threshold values and to therefore extract stronger anomalies.

As a result, the anomaly zones of Area A3, C2 and E1 were assigned to subsequent drilling programme to be conducted in Phase III. Area of D1 and D2 were abandoned because the Au-anomaly zone was small or was suspected to be derived from tailing contamination and low evaluation for Ni ore potential.

Area A3 was favourably evaluated for intense gold anomalies accompanying with As-anomalies nearby and occurrence of an auriferous quartz vein in the trenches.

Area C2 was believed to be of good potential for development of Cu-mineralised quartz veins and Au-anomaly zone of moderate intensity.

Area E1 was highly evaluated because of intense and large anomaly zones overlapping Ag- and As-anomaly zones. (Table I-1-2)

Trenching

The Au-anomaly zones were trenched at the surface in Area A3 and C2 totaling 6 trenches, 120 metres. A quartz vein was unveiled at the contact of granite dyke giving the strike, dip and Au assay value of 1.7 g/t.

1-2-3. Phase III (1988)

The phase III programme was conducted largely in terms of drilling exploration consisting of 22 holes totaling 2,202.9 metres in Area A3, C2 and E1 which were favourably evaluated as of Au ore potential. The evaluation was based upon the comprehensive interpretation of data from detailed geochemical and geological prospecting and trenching conducted in Phase II programme. Each hole was planned 100 metres deep and the hole distribution was designed so that it might cover as largely as possible.

Diamond Drilling

The areas to be drilled were selected on the basis of the following favourable conditions.

Area A3

(1) Distinct zonation and trend of Au-anomaly.

(2) As-anomalies accompanying with nearby or overprinting Au-anomaly.

(3) Fractures and a swarm of dykes such as granite and quartz porphyry which may be related igneous rocks with ore.(Fig.I-1-5)

Area C2

(1) Well defined Au-anomaly zone, nevertheless each anomaly is not so intense.

(2) The boulders of quartz porphyry dyke nearby may suggest development of fractures.

(3) The quartz boulders mineralised with chalcopyrite.(Fig.I-1-6)

Area E1

The Au-anomalies are grouped into three zones of which, east, north and west anomaly zone are nominated as Zone A, B and C respectively.(Fig.I-1-7) These zones were selected for drilling exploration based upon the following favourable criteria.

Zone A

(1) Small-sized but intense anomaly containing as high as 1 g/t Au

(2) Ag and As anomalies mostly overlap Au-anomalies

(3) Argillization on the ground surface

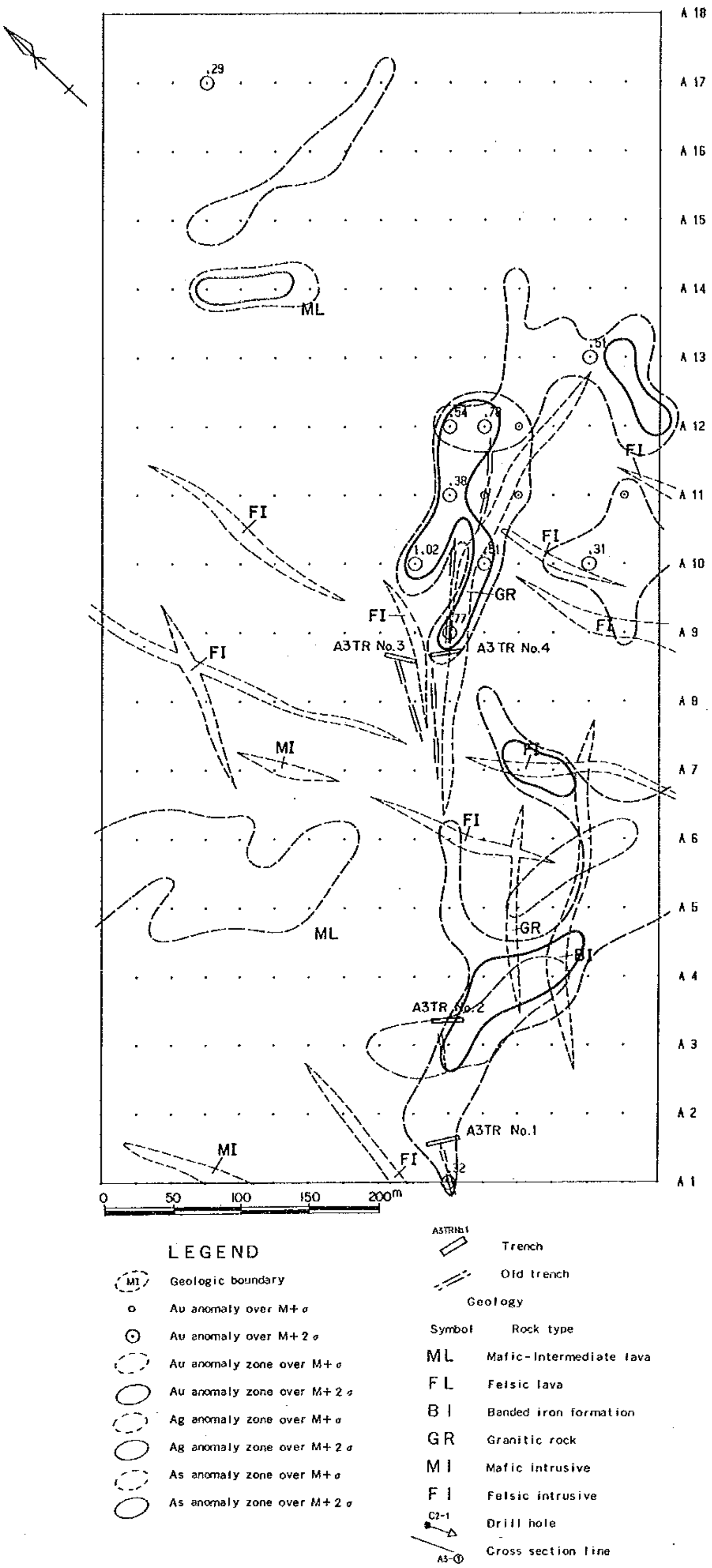


Fig. I-1-5 Geochemical Anomaly Map of Area A3

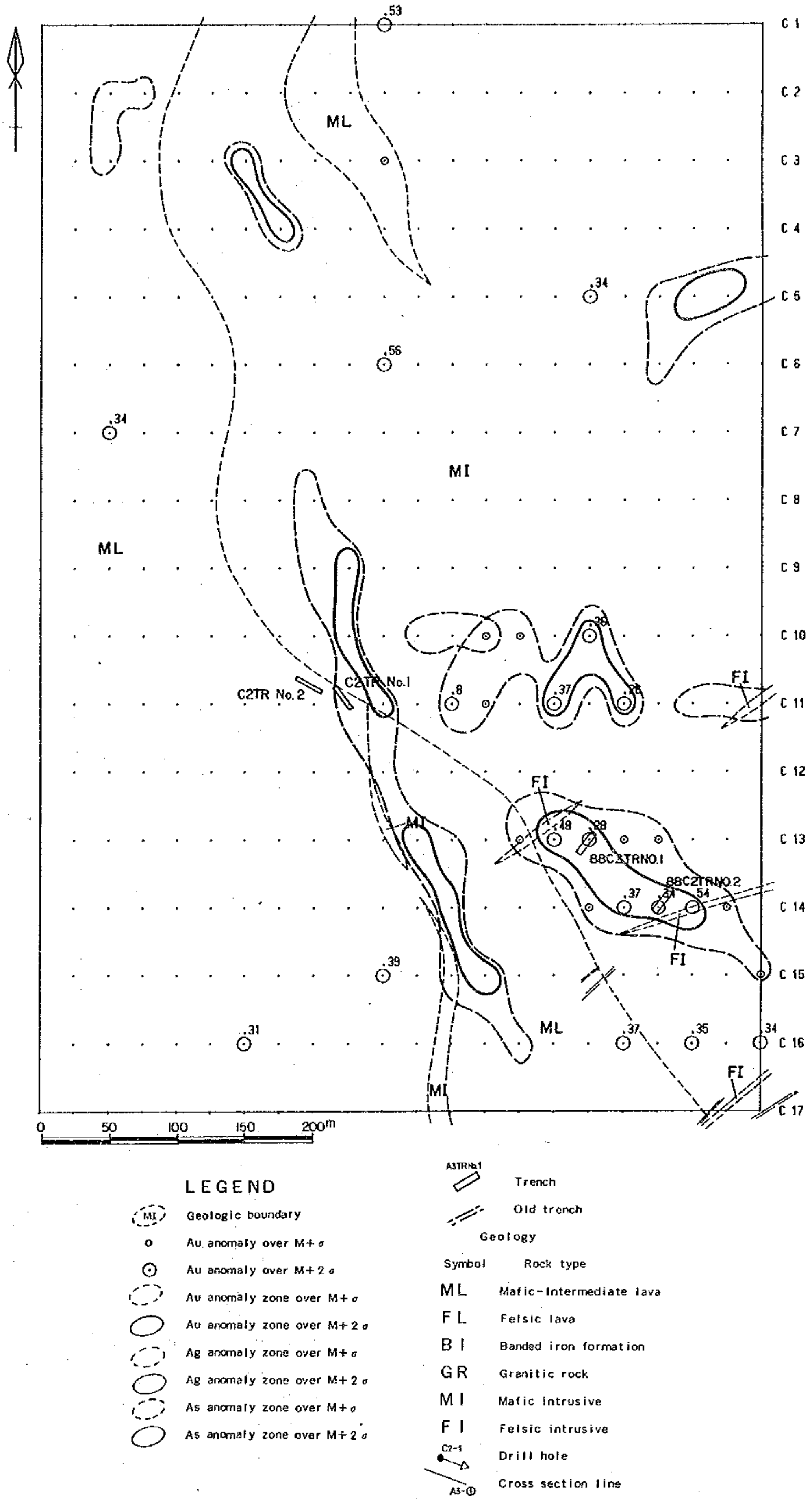


Fig. I-I-6 Geochemical Anomaly Map of Area C2

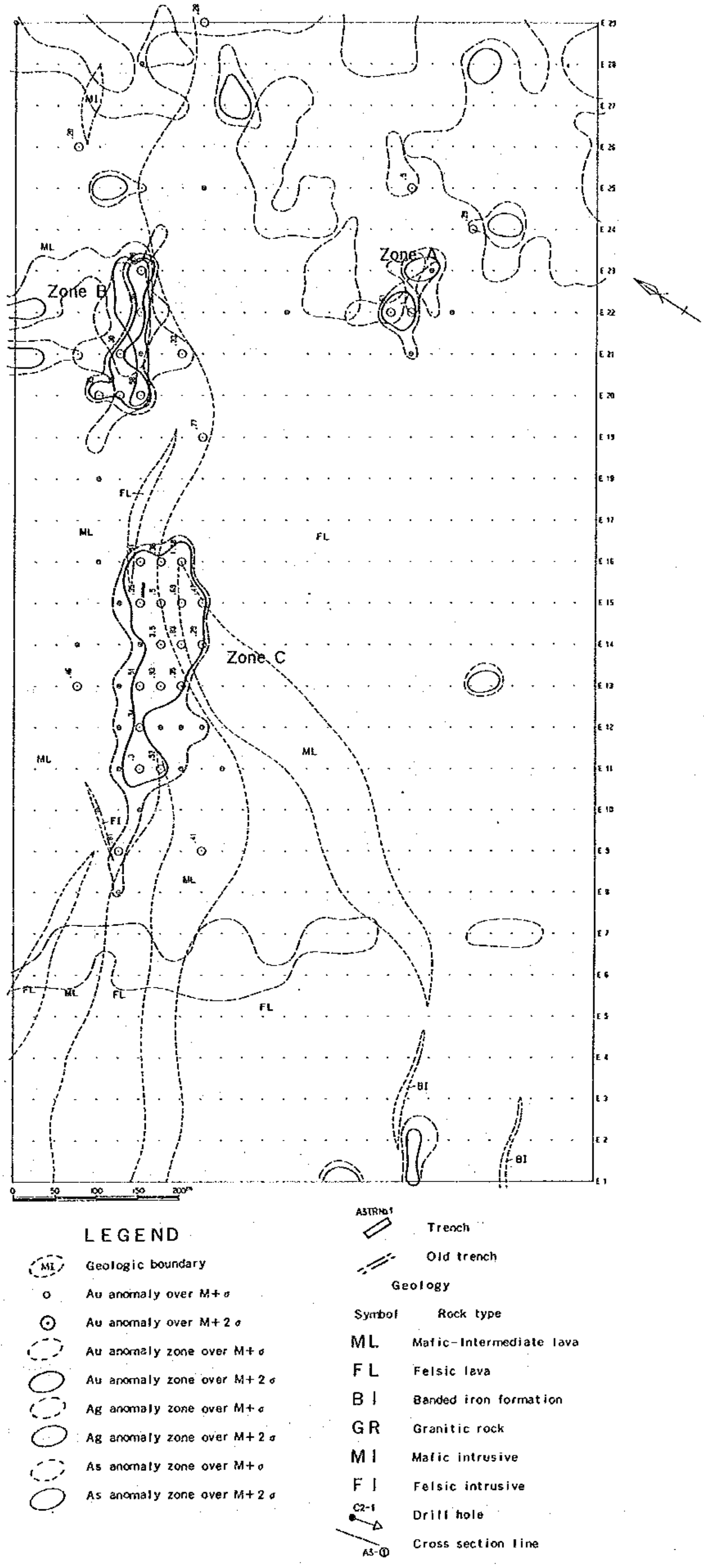


Fig. I-1-7 Geochemical Anomaly Map of Area E1

Table 1-1-2 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	
A3	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
C2	2	9	9	4.3	Mafic Intrusive (Dolerite)	Inffered NE quartz system	Unconformable with Ag, As	Cu mineralisation in quartz vein
D1	2	12	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
D2	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
E1	3	14	25	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?

Zone B
(1) Larger-sized than Zone A
(2) Overlapping Ag- and As-anomalies

Zone C
(1) Neither Ag- nor As-anomalies overlap Au-anomalies but the largest-sized Au-anomaly zone
(2) Comprising the high values more than 1 g/t Au

Geological Ground Checking of Anomaly Zone

Prior to drilling, ground surface checking was conducted around the geochemical anomaly zones aiming to define a possible source of the anomaly. The checking, as the result revealed the gossan lying on the crest of a gentle hill stretching northeasternly in the vicinity of Zone B and C. The gossan is composed of hematite, goethite and quartz frequently showing banding structure, which misassigned the gossan to BIF in 1987 survey.

From the distribution of the gossan of which volume was assumed to indicate the intensity of mineralisation it was unvealed that the minerlaisation zone stretches from the west half of Zone B through Zone C to further west of Zone C.

The some planned hole locations thereby were modified and two additional holes were proposed in Zone C.

The mineralised sections and significant quartz veins were cut with diamond sew to prepare the samples for Au and Ag assay. The analysis was contracted to the Ohdate Laboratory of Chemical Analysis Co.,Ltd.

As a result of the drilling, some quartz veins and silicification zones were intersected in Area A3, of which, two sections were assayed at 41.21 g/t and 7.44 g/t which are as high as ore grade. In the Area E1 the pyrite network mineralisation was encountered. One of the mineralised sections gave 53.37 g/t Au in maximum, however the majority of the assays was under 1 g/t Au. The drilling programme has revealed the close relationship between the subsurface auriferous mineralisation and Au soil geochemical anomalies which overlapped Ag- and As-anomalies.

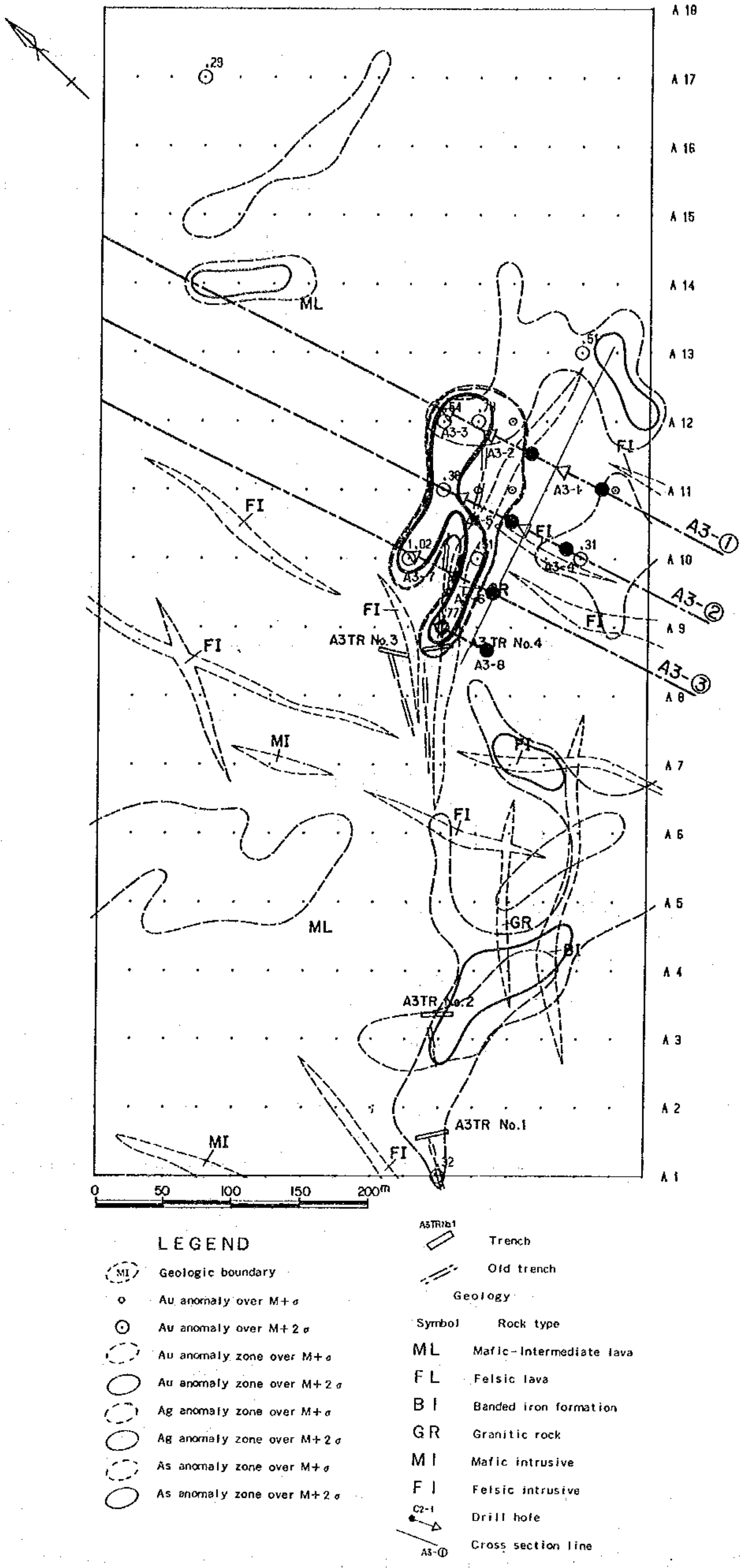


Fig. I-1-8 Location of Drill Holes and Cross Section in Area A3

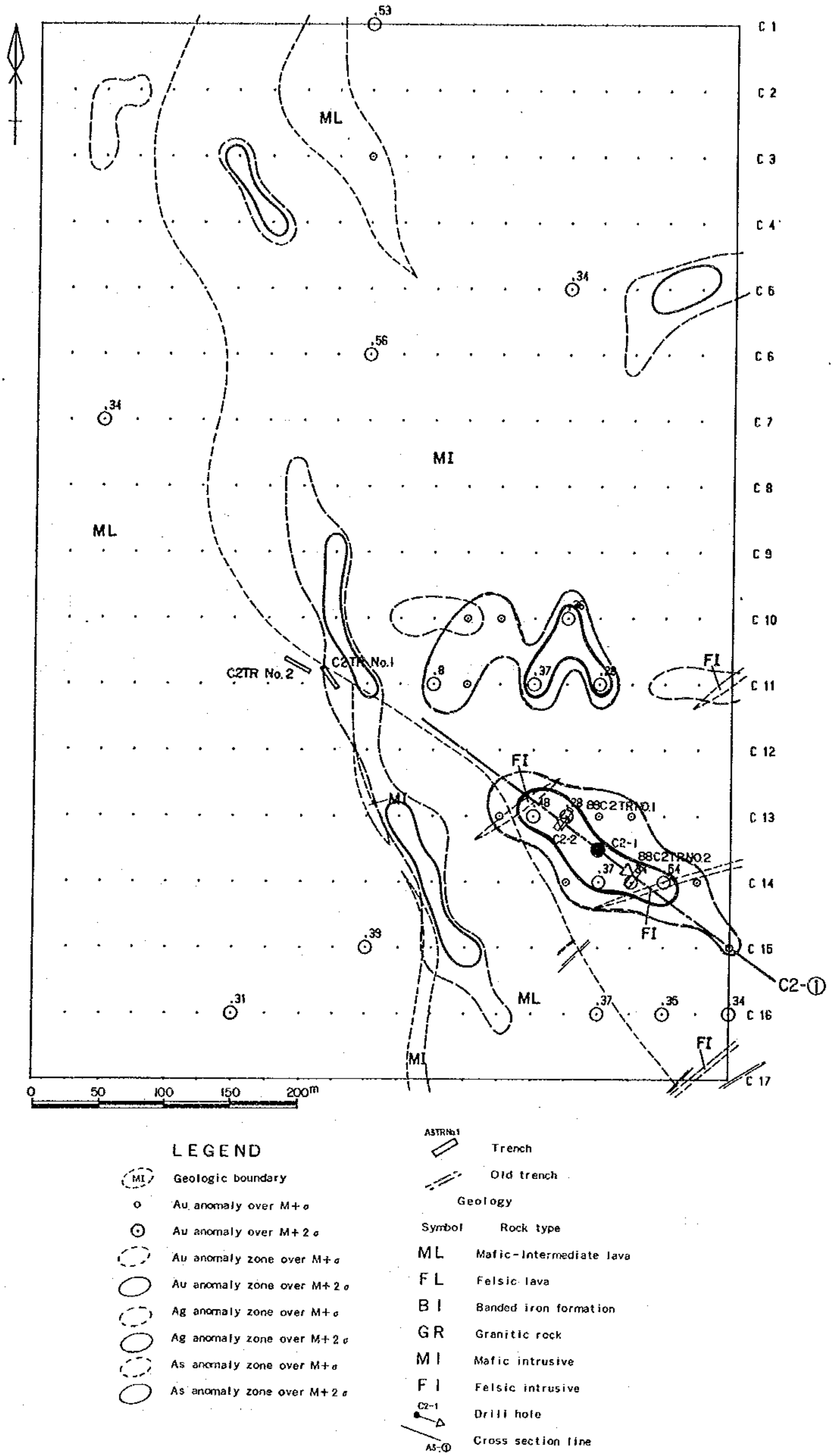


Fig. I-1-9 Location of Drill Holes and Cross Section in Area C2

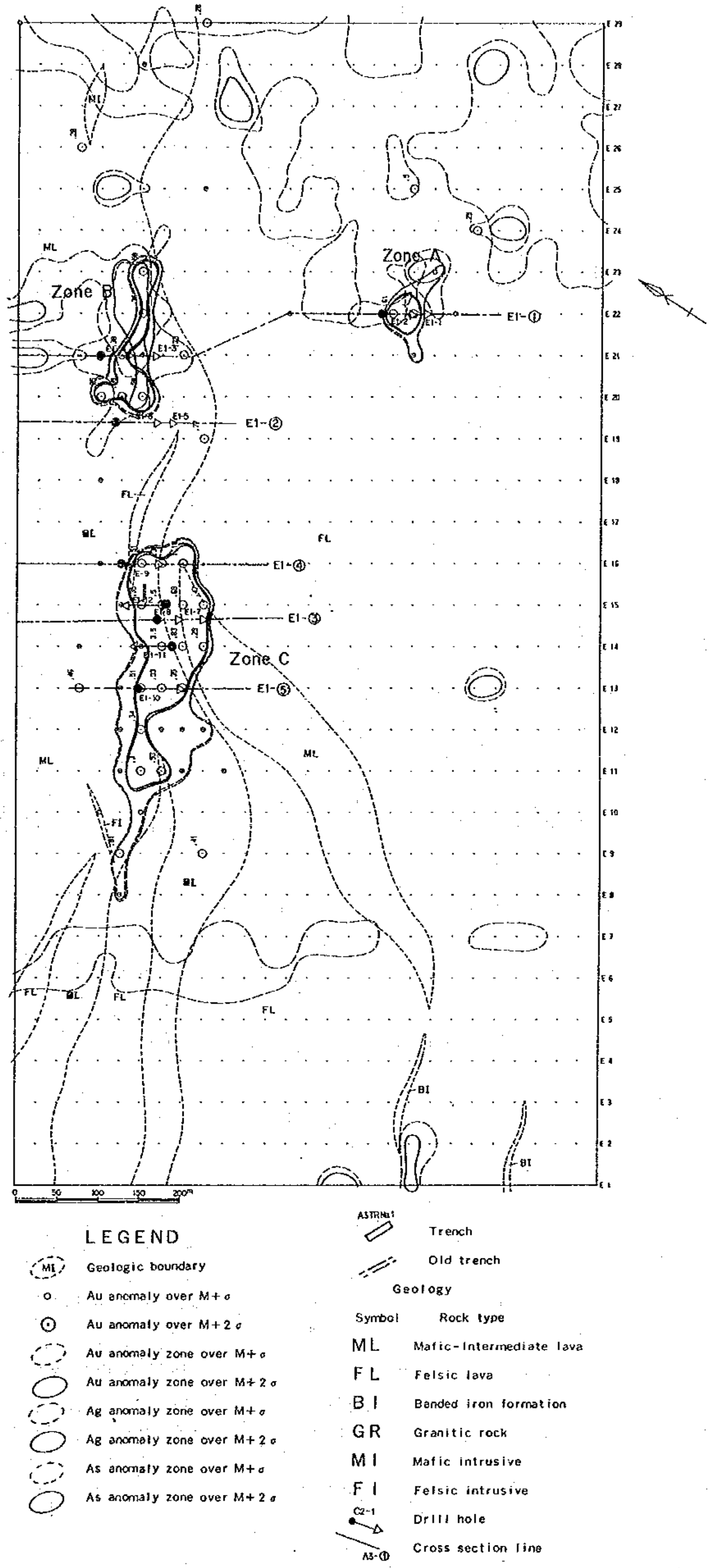


Fig. I-1-10 Location of Drill Holes and Cross Section in Area E1

Table I-I-3 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 I-1-4 Au Mineralisation Intersected by Drill Holes

Hole No.	Depth(m)	Type of Minera-lisation	Assay Values(g/t) Au	Ag
A3-2	97.51-97.61	Chl+Py,Po	1.44	4.42
A3-3	47.67-47.72	Qz,Cal+Po	1.35	2.51
A3-4	96.77-96.85	Qz+Py	7.44	1.83
A3-7	23.56-23.76	Qz+Si	41.21	3.70
C2-1	38.05-38.15	Qz+Py,Cp	1.87	6.75
E1-1	30.45-30.95	Hmt,Py	4.96	3.26
E1-3	59.57-59.95	Hmt	1.39	3.82
E1-3	97.45-97.47	Cal+Py	1.34	5.10
E1-4	39.90-40.10	Qz+Hmt	6.69	7.07
E1-4	74.10-74.20	Si+Py	53.37	63.16
E1-8	81.52-81.77	Py	1.00	3.12
E1-9	20.07	Si+Qz	1.28	4.25

Table I-1-5 Survey Methods and Details of Survey

Programme	PHASE I	PHASE II	PHASE III
Compilation of previous work	5,000 km²		
Geological Survey	5 areas 500 km² Total 600 line-km	5 areas 2.36 km² Total 48 line-km	
Trenching		2 areas 120 m	1 area 40 m
Geochemical Survey	5 areas	5 areas	
Indicative elements & Number of soil samples	Au, As, Sb 3,074 Au, Pb, Zn 2,006 Au, NI, Cr 1,508 Au, Cu, W 1,511	Au, Ag, As 1,806 Au, Ag, Pt Cu, Ni, Cr 289 Cr	
Diamond Drilling Number of Assay			22 holes 2,202.9 m Au, Ag 227
Laboratory Tests			
Thin sections of rock	52	20	10
Polished sections of ore	22	20	10
X-ray diffraction analysis	34	20	
EPMA	35		
Age determination (K/Ar)	3		
Fluid inclusion			
(Homogenation temperature)	20		10
(Salinity)	20		

Table I-1-6 Members of Survey Team

WORK	PHASE I	PHASE II	PHASE III
Planning & Negotiation	Metal Mining Agency of Japan Makoto ISHIDA Kohei ARAKAWA Yoshiyuki KITA Kenji SAWADA Japan International Cooperation Agency Ryuji KAMIKI	Metal Mining Agency of Japan Toshihiko HAYASHI Kenji SAWADA (Nairobi Office)	Metal Mining Agency of Japan Toshihiko HAYASHI Kenji SAWADA (Nairobi Office)
	Geological Survey Department, Ministry of Mines E.R.Morrison C.B.Anderson	Geological Survey Department, Ministry of Mines E.R.Morrison C.B.Anderson	Geological Survey Department, Ministry of Mines E.R.Morrison S.Simango
Field Survey	Dowa Engineering Co., Ltd. Akiyoshi KOMURA Tetsuo HATASAKI Makoto TAKEDA	Dowa Engineering Co., Ltd. Tetsuo HATASAKI Makoto TAKEDA	Dowa Engineering Co., Ltd. Tetsuo HATASAKI
	Geological Survey Department, Ministry of Mines T.J.Broderick D.Shoko	Geological Survey Department, Ministry of Mines S.Simango F.Maguchu	Geological Survey Department, Ministry of Mines S.Simango B.Barber

1-3. Period of the Surveys and Survey Team

Table I-1-7 Survey Period and Members

	PHASE I	PHASE II	PHASE III
Field Survey	Aug. 4 1986 - Nov. 1 1986 (90 days)	Jul. 3 1987 - Aug. 17 1987 (46 days)	Jun. 24 1988 - Dec. 24 1988 (184 days)
Members	Akiyoshi KOMURA Tetsuo HATASAKI Makoto TAKEDA	Tetsuo HATASAKI Makoto TAKEDA	Tetsuo HATASAKI
Analysis & Discussion	Nov. 2 1986 - Feb. 8 1987	Aug. 18 1987 - Jan. 31 1988	Dec. 25 1988 - Feb. 28 1989

CHAPTER 2 PREVIOUS WORK

The survey area has been producing gold, tungsten, magnesite, nickel, iron ore and asbestos since British colonial days and had attracted great attention from foreign investment, particularly mining companies of South Africa and United Kingdom.

The surrounding areas of Dalny mine (Falcon Mines Co.Ltd), Patchway, Cam & Motor and Brompton Mine (Rio Tinto Zimbabwe Co.Ltd) in the north, Venice Mine (Falcon Mines Co.Ltd) in the middle, Indarama Mine, Riverlea Mine and Tiger Reef Mine (Lonrho group) in the south had been prospected by the mining enterprises. A series of E.P.O. final reports of the areas have been deposited in Geological Survey Department, Ministry of Mines which offers it for public perusal.

Areas in the vicinity of the known ore deposits and working mines had thus been covered with exploration works including geological mapping, trenching, geochemical prospecting and oftenly short drilling exploration.

Geological Survey Department prepares and issues bulletins with geological maps of the country. A quadrangle of the bulletin is 50 kilometres by 50 kilometres at a scale of 1 to 100,000 with geology and explanation. Such a bulletin so far covers about 60 percent of the nation with priority given to the mining districts. The survey area is wholly covered thereby. The bulletins refer to stratigraphy, petrography, geological structure, metamorphism and geological evolution and sometimes to mineral occurrences of ore deposits.

INPUT AEM exploration had been conducted in Greenstone Belt including the survey area in terms of Canada's technical aid to Zimbabwe recently. As a result, EM and magnetic anomalies were defined and geophysical ground checking is under way by the CIDA-GSD geophysical joint team.

Geochemical orientation study for gold exploration had been conducted by Mining Research Institute affiliated to the University of Zimbabwe. The study discussed appropriate combination of indicative elements, granularity of soil, sampling density, analytical detection limits and threshold values of anomalies.

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.

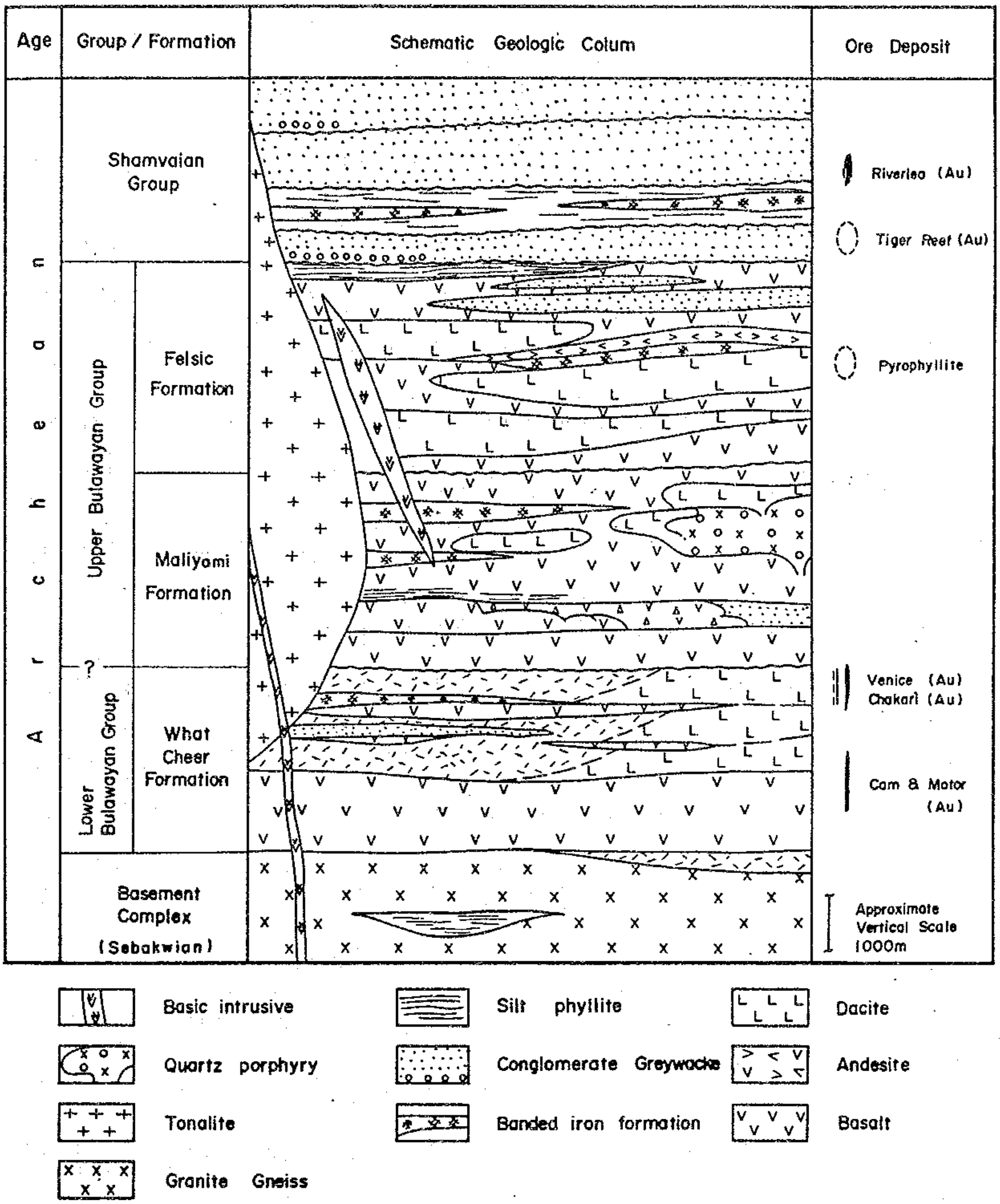


Fig. I-3-1 Schematic Geologic Columnar Section of the Kadoma District

CHAPTER 4 GEOGRAPHY OF THE SURVEY AREA

4 -1 Accessibility

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 between a hundred and two hundred and thirty kilometres southwest of the capital; Harare, which is connected with the second major city of Zimbabwe; Bulawayo, via the main highway and railway running through the survey area.

Two major industrial and farming centres, Kadoma and Kwekwe, are located in the north and south of the general project area respectively. It is about one and three quarters hour drive for a distance of one hundred and forty kilometres from Harare to Kadoma on a good highway, and a one hour drive of eighty kilometres from Kadoma to Kwekwe.

The distances between Area A3, C2 and E1 and Kadoma are twenty three, fifty three and a hundred kilometres respectively through main and local roads. Some places of the local and farm roads are not used due to mud in the rainy season.

4 -2 Geographical Environment

<u>Topography and Drainage System</u>

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.

The relief around the drill sites of Phase III programme is four of five metres at most giving gentle hills.

<u>Climate and Vegetation</u>

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 700㎜to 900㎜of 16° C in summer, and a maximum of 30° C and minimun of 16° C in summer,and a maximum of 21° C and a minimun of 7° C in winter. October is the hottest month of the year and then the temperature decreases, due to cloud cover. Fig.I-4-1 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.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5-1. CONCLUSIONS

As a result of compilation of the previous exploration work at the beginnig of Phase I, mineral potential of gold, copper, lead, zinc, nickel, chromium and antimony was favourably evaluated. Geochemical prospecting had started using various
kind of indicative elements which were determined out of geological environment and mineral occurrences.

Phase I programme resulted in appraisal of good geological settings for ore deposits and the geochemical prospecting delineated some potential anomaly zones. The zones included Au- and W-anomalies in the southwest of Area A (coming Area A3), Au- and Zn-anomalies in the northwest of Area C (coming Area C2), Au,Ni- and Cr-anomalies in the northwest of Area D (coming Area D1 and D2) and Au- and Sb-anomalies in the northeast of Area E (coming E1). These zones were highly evaluated based upon the intensity and size of anomalies and combination of anomalous elements.

Phase II work launched detailed geochemical prospecting and trenching in the five anomaly zones; A3, C2, D1, D2 and E1 which were delineated by Phase I programme. The work revealed that mineral potential of gold was higher than the other minerals in the areas and defined the three small areas; A3, C2, E1 out of the five areas based upon the Au-anomaly. The intense Au-anomalies of the three areas indicated high potential of gold and hence further exploration work was recommended.

Phase III programme aimed at examination of potential vein type or disseminated ore type gold deposit within the three areas selected in Phase II.

Gold potential of the areas were examined by trenching in Area C2 and 22 hole drilling totalling 2,202.9 metres in Area A3, C2 and E1. The drilling encountered auriferous quartz veins in Area A3 and C2 and auriferous pyrite network mineralisation in Area E1.

In Area A3 the quartz veins and silicification zones of A3-7 assayed 41.21 g/t Au and those of A3-4 7.44 g/t Au in maximum.

Microscopic test indicated the association of arsenoyrite with the gold mineralisation. Interpretation and discussion led to the favourable critera of the combination of anomalous indicative elements. However, no quartz veins intersected was more than 30 centimetres in thickness which is the thickness of the quartz vein which had been trenched long before close to the drill sites and no increase was encountered by the drill holes.

The average operating ore grade is at least 4 to 5 g/t Au in the case of underground mining of gold in the Kadoma area and an ore grade of 7 to 8 g/t Au or more should be neccessary in the case of a deposit to be newly exploited. The two mineralised sections gave higher Au values than the above mentioned ore grade however, the thickness is not large enough for retaining of the operating ore grade, because necessary width of a drive for mining would dilute the ore grade to less than 5 to 8 g/t Au even if the maximum value is used for estimation. The potential for economic ore deposits is therefore so far believed low.

In Area E1 the network mineralisation of pyrite was intersected. One of the mineralised sections gave 53.37 g/t Au in maximum and other eight sulphide-rich samples assayed anomalous gold values larger than 0.834 g/t Au.
The geometric mean for all Au-assay values of Area E is 0.04 and the arithmetic mean is 0.176 g/t Au. When the width of the intermittent network mineralisation zone is regarded as about 10 metres in thickness, the average ore grade of 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 grade should be much smaller than the minable minimum value due to waste dilution just as the estimation of Area A3.

Economic ore potential of these areas is thus evaluated still low but the programme indicated that the auriferous mineralisation was closely related to Au soil geochemical anomalies which overlapped Ag- and As-anomalies.

Homogenization temperatures of fluid inclusions enclosed within quartz and calcite were determined. Any values were lower than 180 C indicating that they were lower than those of the known ore deposits.

5-2. RECOMMENDATIONS FOR FUTURE WORK

Based upon the discussion and interpretation of the results derived from the Kadoma project over a period of three years, the following recommendation for future exploration was made.

Soil geochemical prospecting is effective for the gold exploration in the survey area and is recommended to be conducted combined with surface mapping and in situ panning.

Determination of the appropriate indicative elements necessitates further discussion and improvement of analytical precision. However, a combination of Au, Sb, As and Hg is recommended because of common constituent metal elements of working gold deposits.

The other areas than the semidetailed survey areas in Phase I and the potential geochemical anomalies of Phase I which were excluded from the detailed geochemical survey of Phase II, could be recommended for the future exploration using the geochemical prospecting methods which were revealed usefull from the element association view point.

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.

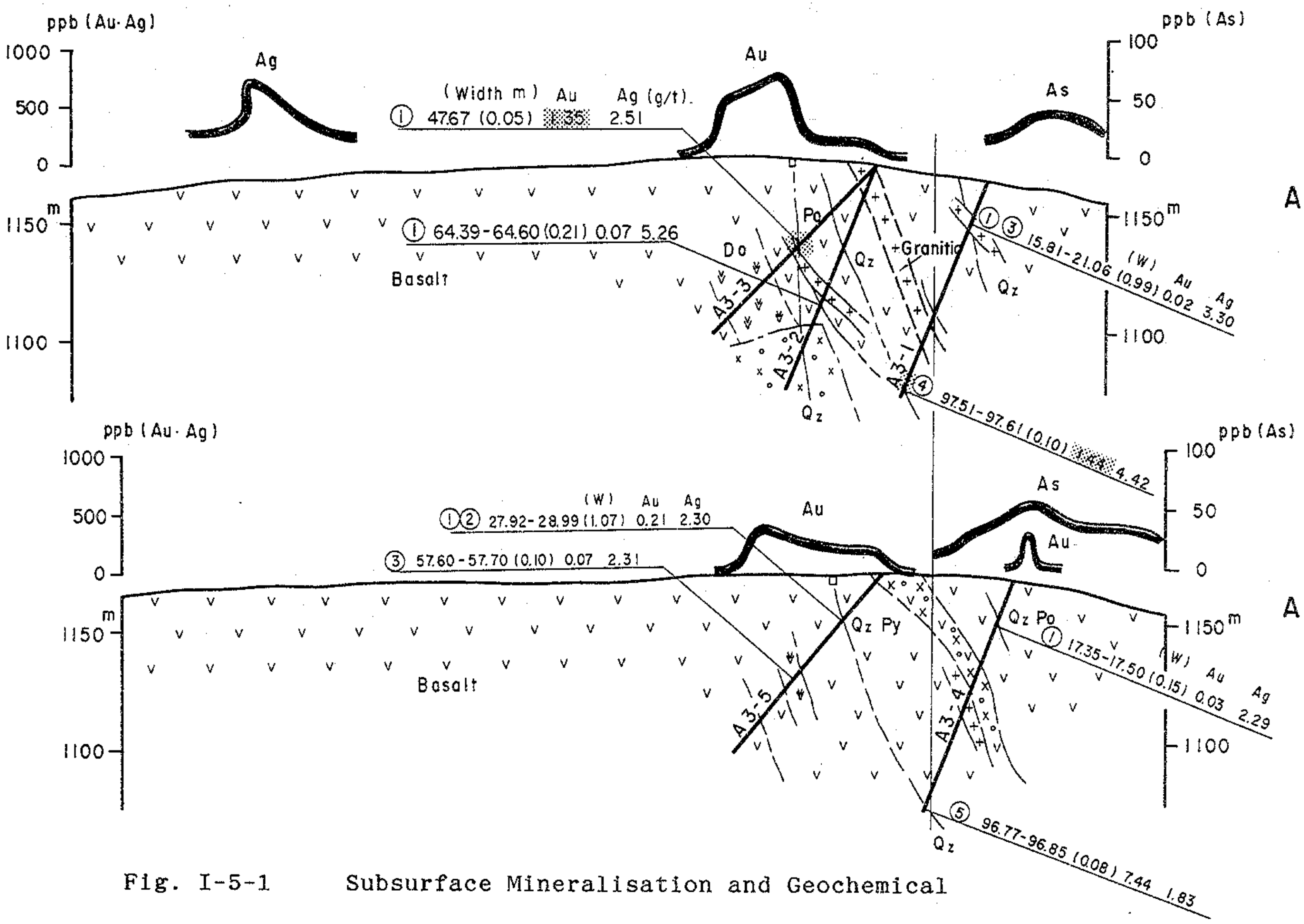
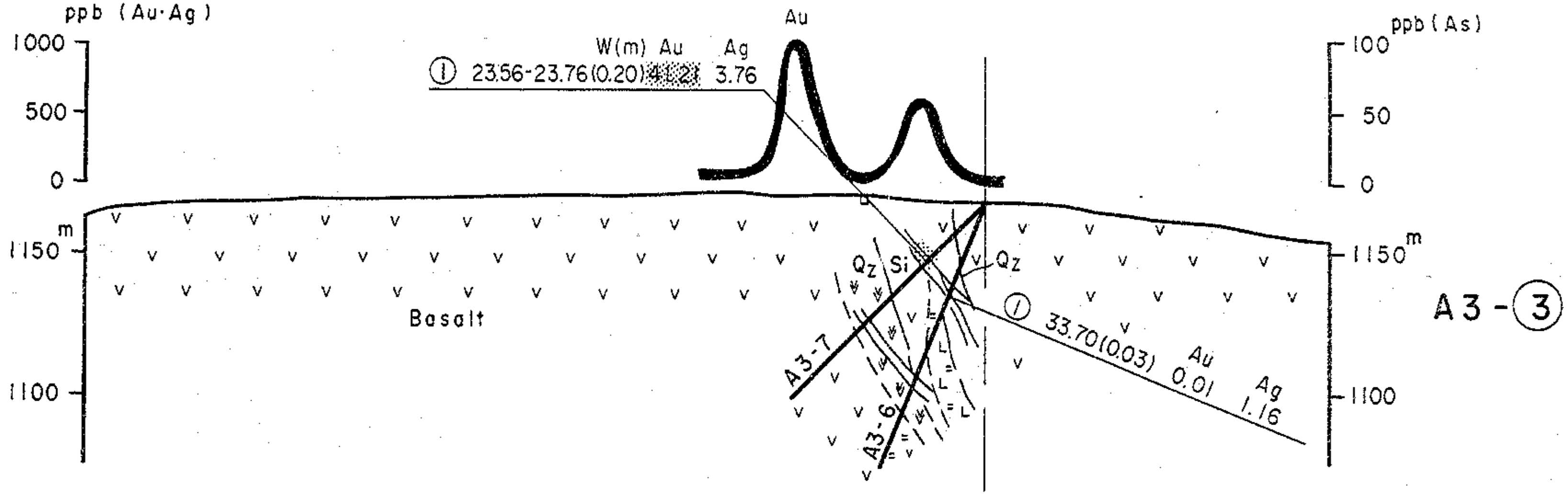


Fig. I-5-1 Subsurface Mineralisation and Geochemical Anomalies of Area A3



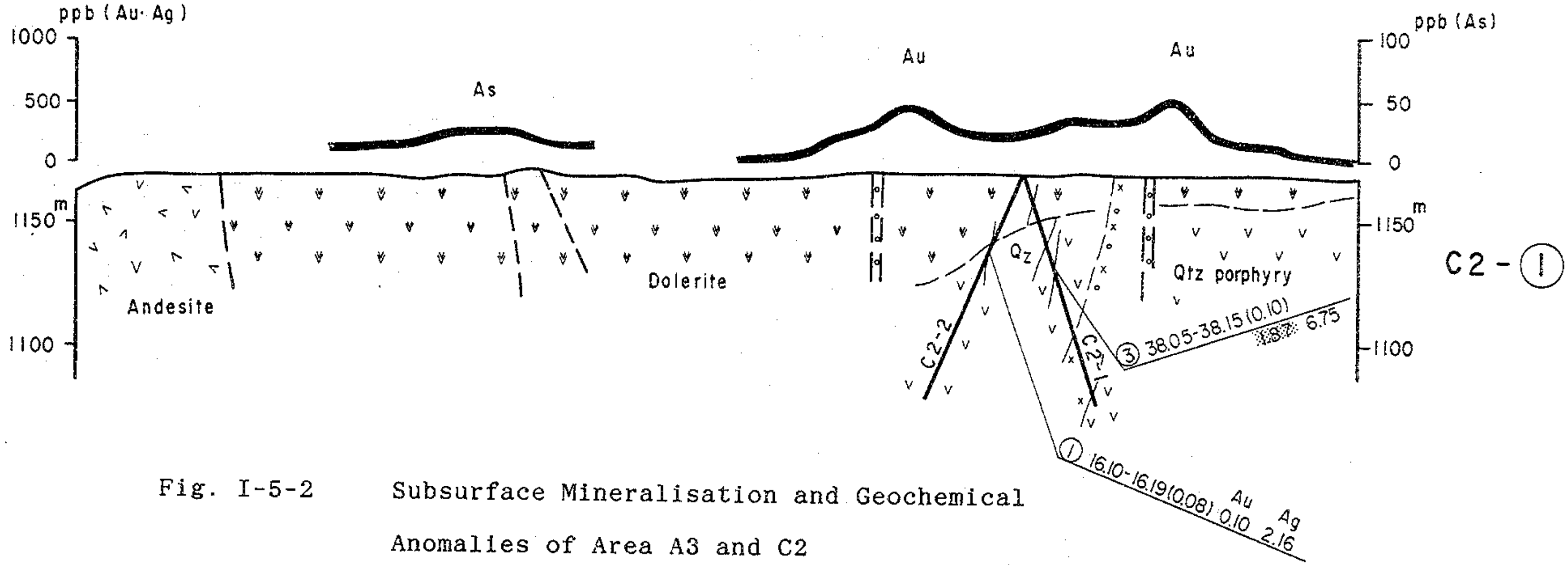


Fig. I-5-2 Subsurface Mineralisation and Geochemical Anomalies of Area A3 and C2

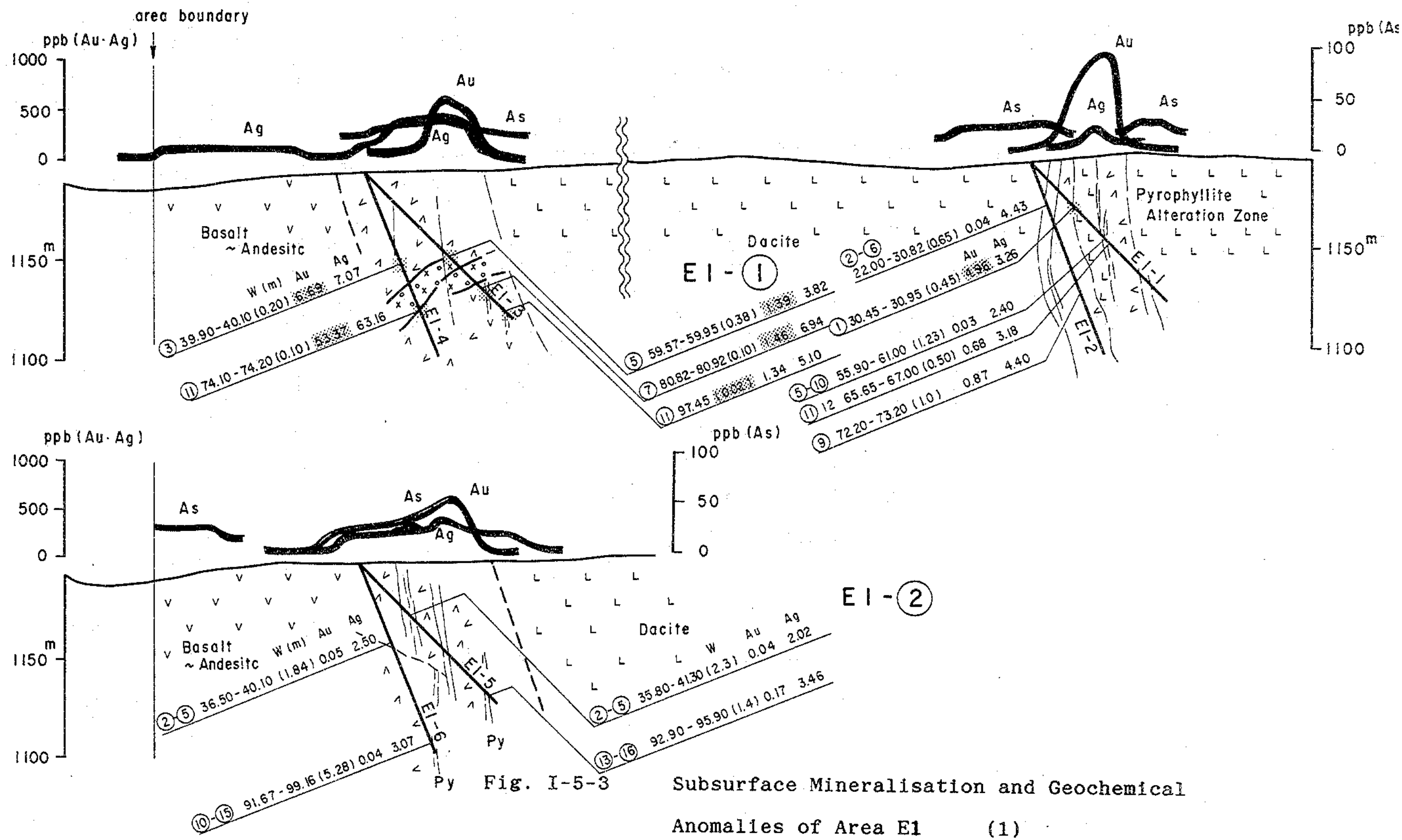


Fig. I-5-3 Subsurface Mineralisation and Geochemical Anomalies of Area E1 (1)

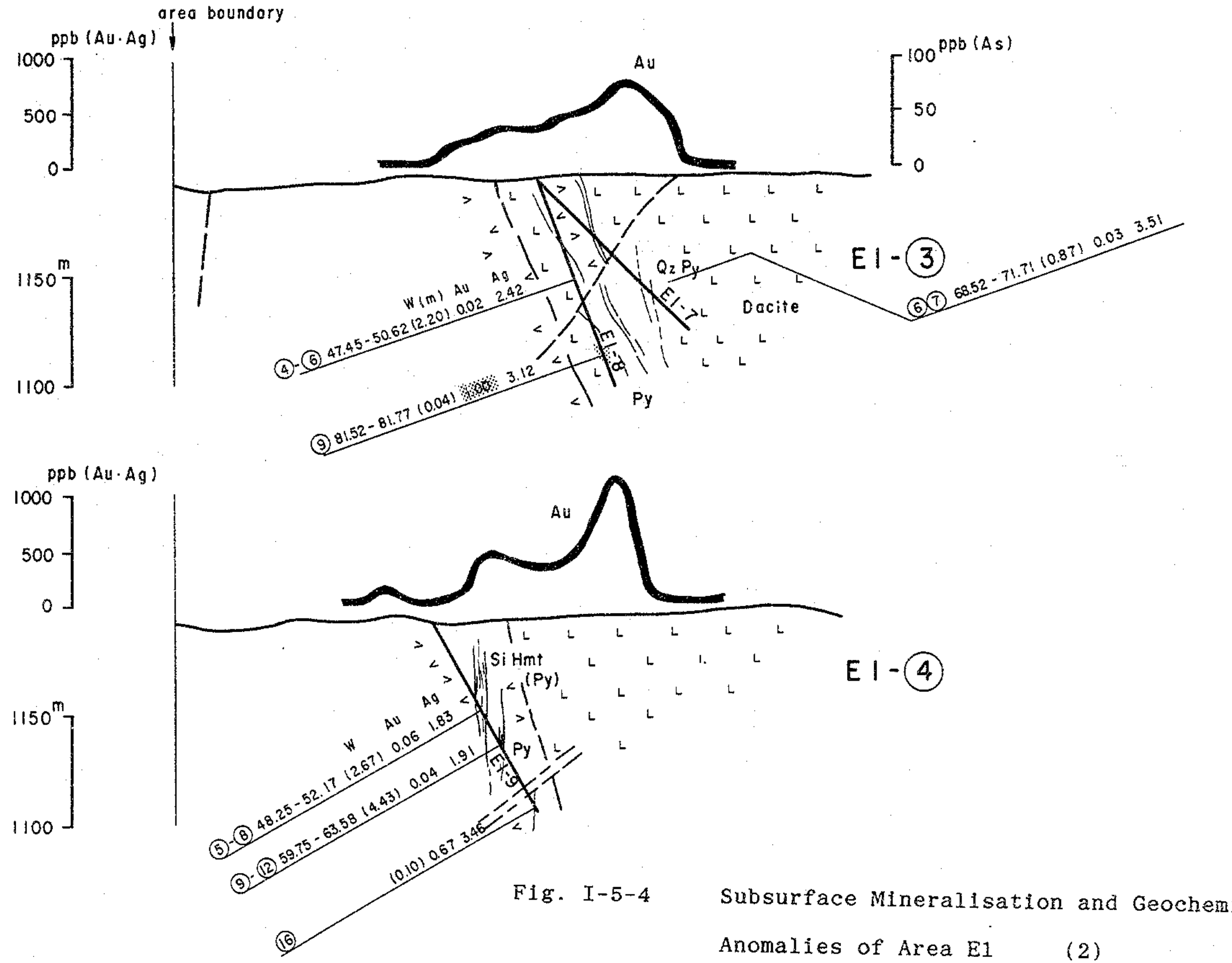
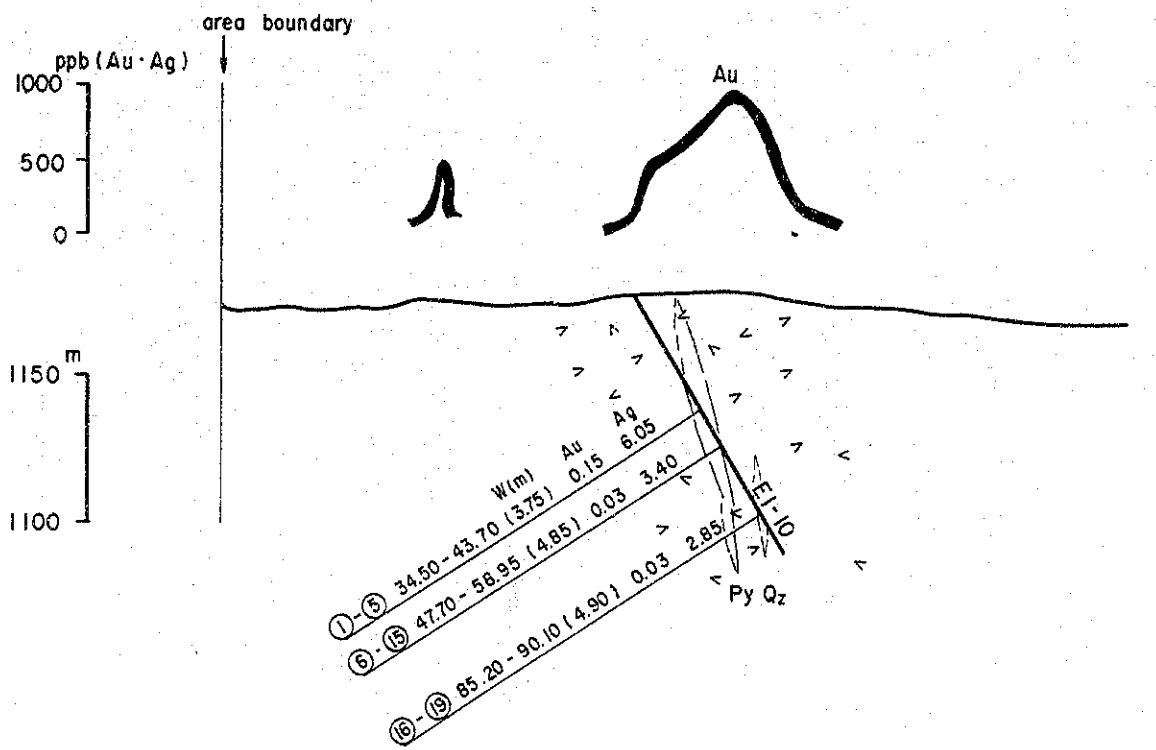


Fig. I-5-4 Subsurface Mineralisation and Geochemical Anomalies of Area E1 (2)



E1-⑤

Fig. I-5-5 Subsurface Mineralisation and Geochemical Anomalies of Area E1 (3)

PART II

DETAILS OF THE SURVEYS

PART Ⅱ DETAILS OF THE SURVEY

CHAPTER 1 AREA A

1 -1 Geology

Most of the Area is occupied by the Greenstones of Bulawayan and the rest is underlain by the Whitewaters Tonalite suite in the west with north south trend. The greenstones strike north-north easterly or northeast and dip to northwest The terrain adjacent to the Tonalite is believed to be folded and faulted repeatedly because of southeast dips therein.

The formation is composed of dark green and massive basalt lava which is assigned to Lower greenstones. Banded iron formation lies mainly south of the Umsweswe river. The Shamvaian group lies in the east consisting of greywacke and conglomerate in unconformable contact with the Bulawayan group.

The environ of the drilling site of Area A3 is underlain by basalt lava, mafic tuff and alternating beds of pelitic sediment and felsic tuff. The formation strikes north-northeast to northeast and dips west to south at an angle of 90 to 60 ° . Intrusive rocks are biotite granite, plagioclase quartz porphyry and quartz porphyry, the first two of which have intruded into the greenstones conformably or intercrossed at a small angle. Meanwhile the quartz porphyry is inferred to trend north.

1 -2 Mineralisation

The mineralisation is characterized by gold and tungsten. Tungsten deposits are believed to be directly related to the Whitewaters Tonalite. Gold deposits are of vein type including closed mines of Heroine, Umsweswe, Rise Up and Cob.

1 -3 Geochemical Prospecting

Semidetailed Prospecting (Phase Ⅰ)

Au, Cu, W were used for indicative elements selected based upon the mineral occurrences of the area. The assay values were statistically processed in principle by rock type. The threshold value of the geometric mean + standard deviation was used for extraction of anomalies and the vales over the geometric mean + 2 x standartd deviation delineated more intense anomalous zone. The geochemical anomalies were thus defined on a map by indicative element and were evaluated.

The map showed a large W-anomaly zone well defined in the vicinity of the tonalite suite including sporadic Au and Cu-anomalies. The Au anomaly zone in the southwest was highly evaluated because of the same trend with that of the Rise Up mine and a detail geochemical survey was therefore planned in terms of Area A3.

Detailed Geochemical Prospecting (Phase II)

The prospecting of Area A3 aimed at gold ore deposits and selected Au, Ag and As for indicative elements. The threshold value of the geometric mean + standard deviation was used for extraction of anomalies and the vales over the arithmetic mean + 2 x standartd deviation delineated more intense anomalous zone. The geochemical anomalies were thus defined on a map by indicative element and were evaluated.

The map showed Au, Ag and some of the As-anomaly zones around old trenches in the south to southwest of the area. The Au-anomaly zone in particular was well concentrated and was intense as much as twenty times of the mean value. A swarm of dykes in the anomaly zone was believed favourable for mineral potential.

1 -4 Diamond Drilling

Drill sites were determined based upon mainly the Au-anomaly and the following criteria. Azimuth and dip were settled so that a hole might have check just subsurface of the geochemical anomaly zone. (Fig. I-1-5)

(1) Definite zonation of the anomaly zone with an obvious trend.

(2) As-anomaly zone overlapping or close to Au-anomaly zone.

(3) A swarm of granite and quartz porphyry dykes favourable for fractures and ore-related igneous rocks.

The mineralisation of the area was characterized by an association of arsenopyrite, pyrrhotite and marcasite with pyrite. Pyrrhotite was identified as primary sulphide under microscope.

Au-mineralisation is sometimes of high grade but erratic and discontinuous. The quartz vein and silicification zones of A3-7 assayed 41.21 g/t Au and those of A3-4 7.44 g/t Au in maximum. Meanwhile Ag-values vary from 1.5 to 6.5 g/t regardless of the Au content, which account for As-anomaly zone lying just south of Au-anomaly zone and weak Ag-anomaly zone lying separately from Au-anomaly zone. The geological projection of the highest Au-anomaly to the surface is coincident with the highest gold value 1.02 g/t of soil geochemical prospecting. (Fig. I-5-1)

CHAPTER 2 AREA B

2 -1 Geology

The Upper Bulawayan group mostly occupies the terrain between Rhodesdale granite-gneiss and Sesombi tonalite pluton. The group is composed of carbonated basalt and andesite lava, basic to intermediate tuff, felsic rocks, sandstone and shale showing bi-modal volcanism.

The formation occupies the axial core of the anticlinal structure which extends from northeast of the area and strikes generally northwest.

2 -2 Mineralisation

Some small scale gold mines of which gold production were recorded at some tens to some hundreds kg include Cricket, Cato, Oro Bredo and Somerset. The Cato mine is tungstiferous. The Oro Bredo mine is recovering gold from disposal dump using cyanide. In the west, a series of quartz veins and trenches run north-northeast but the quartz veins are narrow and free from sulphide.

2-3 Geochemical Prospecting

Semidetail survey (Phase I)

Au- and As-anomaly of the north overlapped together but are of small size. A number of small to medium sized Au-anomaly zones roughly overlap As-anomaly zone but the area was excluded from the subsequent detail survey because the intensity was not significant.

CHAPTER 3 AREA C

3-1 Geology

The Upper Greenstones(Upper Bulawayan Group) consist of andesite to basalt lava, volcanic breccia, tuff and silt. The formation generallly str ikes north-northeast dipping west at 70 to 80 ° . Quartz porphyritic intrusive rock has emplaced in the south and middle.

Geological sections of drilling, trenching and surface mapping indicated that the relation between basalt and dolerite was trasitional and the latter was believed to be a coarser lithofacies of basalt lava. The greenstones strike approximately north to south and dip to the west at 50 ° inferred from the trend of dolerite. Quartz porphyry stretches with a strike of N60 to 70° E dipping northwest at 80° .

3 -2 Mineralisation

Some gold deposits with base metals lie to the north. The Cuba mine recorded the average grade of 8.88 g/t Au of ore and output of 27 kg Au but the deposit were exploited merely 50 meters deep from the surface. A grain of electrum accompanied by sphalerite was observed in quartz chip collected at disposal of the Umniati mine and the chip gave an assay value of 35.9 g/t Au.

3 -3 Geochemical Prospecting

Semidetailed Survey(Phase I)

The occurrence of auriferous lead and zinc veins and massive sulphide ore potential resulted in the determination of Au, Zn and Pb for indicative elements. The survey delineated a small but intense Au-anomaly coupled with Zn-anomaly zone in the northwest end and northeast of the area, of which anomaly zone, that of northwest was subjected to be surveyed in detail in terms of Area C2. No particular mineral showing of massive sulphide deposit was found.

Detailed Survey(Phase II)

Two trenches were excavated on the most intense Au-anomaly zone which had been defined at the result of Phase I but no mineralisation was found. The detailed survey aimed at gold using Au, Ag and As for the indicative elements. At the result, a coherent Au-anomaly zone was exracted. Each anomalous value is high as much as three to twelve times of the mean value and a mineralised quartz vein with relict sulphide was found nearby, hence favourable evaluation. Further work neccessitated the analysis of relationship between the zonation of anomaly and fractures expected.

3 -5 Diamond Drilling

Prior to drilling, the Au-anomaly zone was trenched to collect some information for drilling design. No significant data was obtained but the direction of quartz porphyry dykes and quartz veins. The following favourable conditions for drilling were raised.

(1) Not so strong but considerably coherent Au-anomaly zone.

(2) A swarm of quartz porphyry dyke may suggest good development of factures.

(3) Some boulders mineralised with chalcopyrite.

The mineralisation which was intersected with the drill holes included a quartz vein accompanied by pyrite and chalcopyrite and assayed at 1.87 g/t Au. No grains of arsenopyrite which may be As source was found under microscope. A sample of the quartz vein collected at the trench gave a gold value of 1.59 g/t Au. (Fig.I-5-2)

CHAPTER 4 AREA D

4 -1 Geology

The most of the area is underlain by ultramafic rock. The southeast is occupied by Rhodesdale granite-gneiss complex and the west edge, by basalt and banded iron formation of the Upper Greenstones. The gneiss contains biotite and hornblende for mafic minerals showing the gneissose structure with a strike of N 20 ° E and a dip of about 80° to the west which is paralell to the boundary of the complex. Most of the ultramafic rock has been serpentinized and carbonated. The surfacial porous appearence was derived from dissolution of replaced olivine and pyroxene in calcite in course of weathering. Silicification zone where minor quartz veinlets has penetrated like lattice network extends from north to south within the ultramafic complex. Banded iron formation is comparatively well exposed, showing a strike of N 5° W and a dip of 75 to 85° to the east. The Au-anomaly zone is hosted within this lithological terrain.

4 -2 Mineralisation

A large amount of quartz in the form of veins at the contact of the complex in the southeast has been mined as ferro-silicon. The closed Rosstack mine lies in the middle west with multiple trenches thereby. The deposit is of auriferous banded iron formation type.

4 -3 Geochemical Prospecting

* <u>Semidetailed Survey(Phase I)</u>

The nickeliferous anomaly reported in a part of the complex and the favourable condition that the complex is an extension of the host rock of the Hunters Roads nickel sulphide deposit south of Kwekwe resulted in the selection of Au, Ni and Cr as indicative elements for such a type of ore deposit.

As a result, a small but intense Au-anomaly zone was delineated with a Ni and Cr-anomaly zone overlapped. This is Area D1 in Phase II. Another Au-anomaly zone was delineated in the middle of the area. The zone was small as well but coherent stretching north passing the Rosstack mine. This is Area D2 in Phase II.

<u>Detailed Survey(Phase II)</u>

<u>Area D1</u>

Seven elements of Au, Ag, Pt, Cu, Ni, Co and Cr were determined for geochemical prospecting because of the anomaly zone was hosted near the boundary of the ultramafic complex and because of possible mineralisation of platinum and nickel.

The prospecting defined two Au-anomaly zones, one of which was small in the northwest, and another was medium sized stretching over 400 metres in the west. The trend is the same as that of Greenstones, north north east to north. The mean Au value of soil from the terrain of banded iron formation is obviously larger than that of the other rock types. The intensity magnified by the arithmetic mean + 2 x standard deviation devided with the mean value for banded iron formation, is about 3.5 being not so large compared to that for the other rock types. No other geochemical anomaly zones overlapped the Au-anomaly zone .

Cu/Ni and Ni/Cr ratios were used for potential evaluation of platinum and nickel ore deposits respectively. The samples from the Kwekwe Ultramafic complex gave low content of Cu and Ni and low ratios led to unfavourable evaluation.

Area D2

A element-combination of Au, Ag and As was used for potential evaluation of gold in the banded iron formation in the periphery of the Rosstack mine. The Au-anomaly zone defined around tailing disposal, included high gold value as much as 1 to 3 g/t Au. This was believed to be derived from the contamination of disposal. On the other hand, the zonation showed the north trend across the disposal and hence could be a proper superjacent Au-anomaly related to the stratigraphic trend of the banded iron formation.

A large As-anomaly zone lies in the northwest within the banded iron formation separately from Au-anomaly zone. The values were two or three times of the mean. These are possibly of contaminaion.

CHAPTER 5 AREA E

5 -1 Geology

The area is to the south of the Sesombi Tonalite Pluton and is underlain by the Upper Bulawayan group which consists of mafic volcanic rocks, mafic pyroclastics, felsic volcanics and sandstone and banded ironstones of overlying the Shamvaian group.

Pillow, brecciated and turbidity structures are preserved in the mafic volcanic rocks. The fine clastic formation indicates general geological structure with a trend of north north east to north east and a dip of 60° to the west. The felsic volcanic rocks has massive facies mixed with brecciated facies suggesting lava like occurrence.

The felsic lava in the vicinity of the detailed survey area is dark purplish green and appears to be basalt, however it contains phenocrysts of quartz and plagioclase of one millimetre diametre. The lava is accompanied with lapilli tuff and bedded tuff of red to yellow brown colour. The fissility is parallel to the bedding plane showing a strike of N50° to 70° E with a vertical dip. X-ray diffractometry detected quartz and pyrophyllite. The fractures and the faults mapped at the outcrops showed predominant trend of N70° to 80° E dipping vertically.

The Shamvaian group consists of greywacke, grit sandstone and banded iron formation extending north-northeasternly from the east to southeast of the area.

5 -2 Mineralisation

The Black Prince and Green Granite hosted in the Bulawayan group, are quartz vein type gold deposits lying in an extension area of a swarm of mineral deposits in the aureole of the Sesombi tonalite pluton. Meanwhile the Tiger Reef, Unit, Bell and Riverlea mine are of desseminated, auriferous and banded iron formation type embedded within the Shamvaian.

5 -3 Geochemical Prospecting

Semidetailed Survey(Phase I)

The bi-modal type-vocanic rock underlain in the area and hence potential gold and massive sulphide ore deposit resulted in the selection of Au, Sb and As for indicative elements of geochemical prospecting.

As a result the largest and coherent Au-anomaly zone was delineated in the northeast. The zone extended around the boundary of felsic lava and mafic lava and was accompanied by weak As anomalies. The subsequent detail survey was planned for the anomaly zone. Discussion of Sb and As anomaly was limited because of technical problem of analysis of these elements in Area E in particular.

Detailed Survey(Phase II)

A medium-sized Au-anomaly zone was defined with a northeast trend within the banded iron formation and across the contact between the banded iron formation and the felsic lava (Zone C). Another small anomaly zone within the banded iron formation was located on the northeast extension of northeast trend (Zone B). A small anomaly zone was delineated in felsic tuff which has been affected by pyrophyllitic alteration (Zone A).

At Zone C and B the Au-threshold value of arithmetic mean + 2 x standard deviation is 3.5 times larger than the mean value for banded iron formation and the anomaly zones contain values as extraordinarily high as 3.5, or 1.18 ppm, which is 25 times, or 8.6 times higher than the mean value. Each assay value of Zone A reaches 13 to 22 times as the mean value.

The broadest Ag-anomaly zone in the north overlaps the Au-anonmaly zone (Zone B). The maximum value is 1.2 ppm, which is equivalent to about 11 times the mean value. The easternmost small-sized anomaly zone coincides well with the Au-anomaly (Zone A).

From the north to the east, some small- to medium-sized As-anomaly occur regardless of rock type. Some of the zones show a good correspondence with the Au-or Ag-anomaly zones(Zone B, C), which is a common trend in gold mineral belts. A weak As-anomaly zone is possibly caused by such analytical problems as difference in condition of batches. (Fig. I-1-7)

5 -4 Diamond Drilling

The following anomaly zones were subjected to drilling exploration for favourable conditions undermentioned.

Zone A

(1) Small sized- but intense anomaly containing as high as 1 g/t Au.

(2) Ag- and As-anomalies mostly overlap with Au-anomalies but the largest sized-Au-anomaly zone.

(3) Argillization on the ground surface.

Zone B

(1) Larger extent than Zone A.

(2) Overlapping Ag- and As-anomalies.

<u>Zone C</u>

(1) Neither Ag- nor As-anomalies overlap with Au-anomalies but the largest sized Au-anomaly zone.

(2) Comprising the high values more than 1 g/t Au.

PART III

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

PART III CONCLUSION AND RECOMMENDATION

CHAPTER 1 CONCLUSIONS

As a result of compilation of the previous exploration work at the beginnig of Phase I, mineral potential of gold, copper, lead, zinc, nickel, chromium and antimony was favourably evaluated. Geochemical prospecting had started using various kind of indicative elements which were determined out of geological environment and mineral occurrences.

Phase I programme resulted in appraisal of good geological settings for ore deposits and the geochemical prospecting delineated some potential anomaly zones. The zones included Au- and W-anomalies in the southwest of Area A (coming Area A3), Au- and Zn-anomalies in the northwest of Area C (coming Area C2), Au,Ni- and Cr-anomalies in the northwest of Area D (coming Area D1 and D2) and Au- and Sb-anomalies in the northeast of Area E (coming E1). These zones were highly evaluated based upon the intensity and size of anomalies and combination of anomalous elements.

Phase II work launched detailed geochemical prospecting and trenching in the five anomaly zones; A3, C2, D1, D2 and E1 which were delineated by Phase I programme. The work revealed that mineral potential of gold was higher than the other minerals in the areas and defined the three small areas; A3, C2, E1 out of the five areas based upon the Au-anomaly. The intense Au-anomalies of the three areas indicated high potential of gold and hence further exploration work was recommended.

Phase III programme aimed at examination of potential vein type or disseminated ore type gold deposit within the three areas selected in Phase II.

Gold potential of the areas were examined by trenching in Area C2 and 22 hole drilling totalling 2,202.9 metres in Area A3, C2 and E1. The drilling encountered auriferous quartz veins in Area A3 and C2 and auriferous pyrite network mineralisation in Area E1.

In Area A3 the quartz veins and silicification zones of A3-7 assayed 41.21 g/t Au and those of A3-4 7.44 g/t Au in maximum.

Microscopic test indicated the association of arsenoyrite with the gold mineralisation. Interpretation and discussion led to the favourable critera of the combination of anomalous indicative elements. However, no quartz veins intersected was more than 30 centimetres in thickness which is the thickness of the quartz vein which had been trenched long before close to the drill sites and no increase was encountered by the drill holes.

The average operating ore grade is at least 4 to 5 g/t Au in the case of underground mining of gold in the Kadoma area and an ore grade of 7 to 8 g/t Au or more should be neccessary in the case of a deposit to be newly exploited. The two mineralised sections gave higher Au values than the above mentioned ore grade however, the thickness is not large enough for retaining of the operating ore grade, because necessary width of a drive for mining would dilute the ore grade to less than 5 to 8 g/t Au even if the maximum value is used for estimation. The potential for economic ore deposits is therefore so far believed low.

<u>In Area E1</u> the network mineralisation of pyrite was intersected. One of the mineralised sections gave 53.37 g/t Au in maximum and other eight sulphide-rich samples assayed anomalous gold values larger than 0.834 g/t Au.

The geometric mean for all Au-assay values of Area E is 0.04 and the arithmetic mean is 0.176 g/t Au. When the width of the intermittent network mineralisation zone is regarded as about 10 metres in thickness, the average ore grade of 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 grade should be much smaller than the minable minimum value due to waste dilution just as the estimation of Area A3.

Economic ore potential of these areas is thus evaluated still low but the programme indicated that the auriferous mineralisation was closely related to Au soil geochemical anomalies which overlapped Ag- and As-anomalies.

Homogenization temperatures of fluid inclusions enclosed within quartz and calcite were determined. Any values were lower than 180° C indicating that they were lower than those of the known ore deposits.

CHAPTER 2 RECOMMENDATIONS FOR FUTURE WORK

Based upon the discussion and interpretation of the results derived from the Kadoma project over a period of three years, the following recommendation for future exploration was made.

Soil geochemical prospecting is effective for the gold exploration in the survey area and is recommended to be conducted combined with surface mapping and in situ panning.

Determination of the appropriate indicative elements necessitates further discussion and improvement of analytical precision. However, a combination of Au, Sb, As and Hg is recommended because of common constituent metal elements of working gold deposits.

The other areas than the semidetailed survey areas in Phase I and the potential geochemical anomalies of Phase I which were excluded from the detailed geochemical survey of Phase II, could be recommended for the future exploration using the geochemical prospecting methods which were revealed usefull from the clement association view point.

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.

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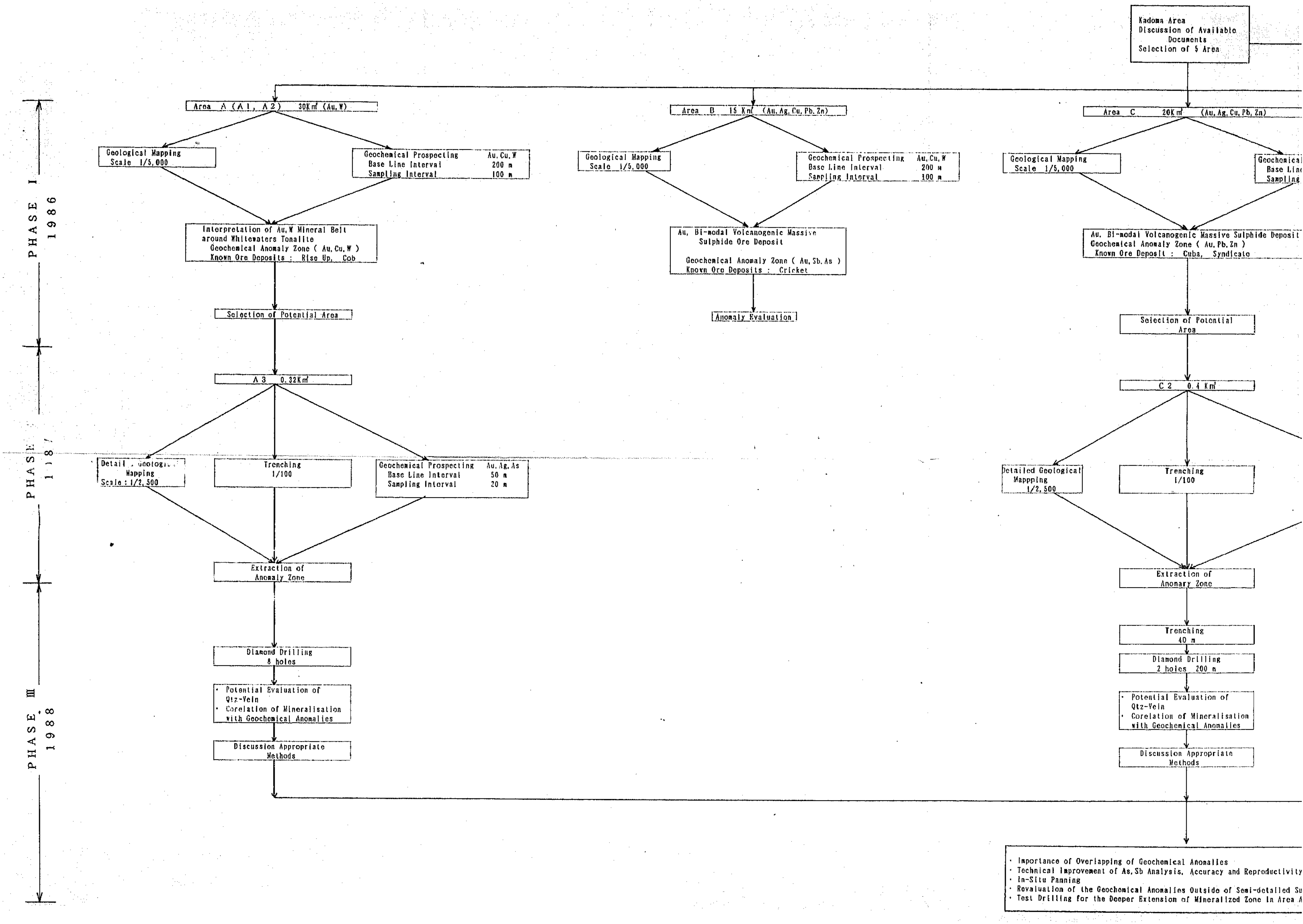

Kadoma Area
Discussion of Available Documents
Selection of 5 Area
PHASE I 1986
PHASE II 1987
PHASE III 1988
Area A (A1, A2) 30Km² (Au, W)
Geological Mapping Scale 1/5,000
Geochemical Prospecting Au, Cu, W
Base Line Interval 200 m
Sampling Interval 100 m
Interpretation of Au, W Mineral Belt around Whitewaters Tonalite
Geochemical Anomaly Zone (Au, Cu, W)
Known Ore Deposits : Rise Up, Cob
Selection of Potential Area
A 3 0.32Km²
Detailed Geological Mapping Scale : 1/2,500
Trenching 1/100
Geochemical Prospecting Au, Ag, As
Base Line Interval 50 m
Sampling Interval 20 m
Extraction of Anomaly Zone
Diamond Drilling 8 holes
Potential Evaluation of Qtz-Vein
Corelation of Mineralisation with Geochemical Anomalies
Discussion Appropriate Methods
Area B 15 Km² (Au, Ag, Cu, Pb, Zn)
Geological Mapping Scale 1/5,000
Geochemical Prospecting Au, Cu, W
Base Line Interval 200 m
Sampling Interval 100 m
Au, Bi-modal Volcanogenic Massive Sulphide Ore Deposit
Geochemical Anomaly Zone (Au, Sb, As)
Known Ore Deposits : Cricket
Anomaly Evaluation
Area C 20Km² (Au, Ag, Cu, Pb, Zn)
Geological Mapping Scale 1/5,000
Geochemical
Base Line
Sampling
Au, Bi-modal Volcanogenic Massive Sulphide Deposit
Geochemical Anomaly Zone (Au, Pb, Zn)
Known Ore Deposit : Cuba, Syndicate
Selection of Potential Area
C 2 0.4 Km²
Detailed Geological Mappping 1/2,500
Trenching 1/100
Extraction of Anomary Zone
Trenching 40 m
Diamond Drilling 2 holes 200 m
Potential Evaluation of Qtz-Vein
Corelation of Mineralisation with Geochemical Anomalies
Discussion Appropriate Methods
Importance of Overlapping of Geochemical Anomalies
Technical Improvement of As, Sb Analysis, Accuracy and Reproductivity
In-Situ Panning
Revaluation of the Geochemical Anomalies Outside of Semi-detailed Su
Test Drilling for the Deeper Extension of Mineralized Zone in Area A

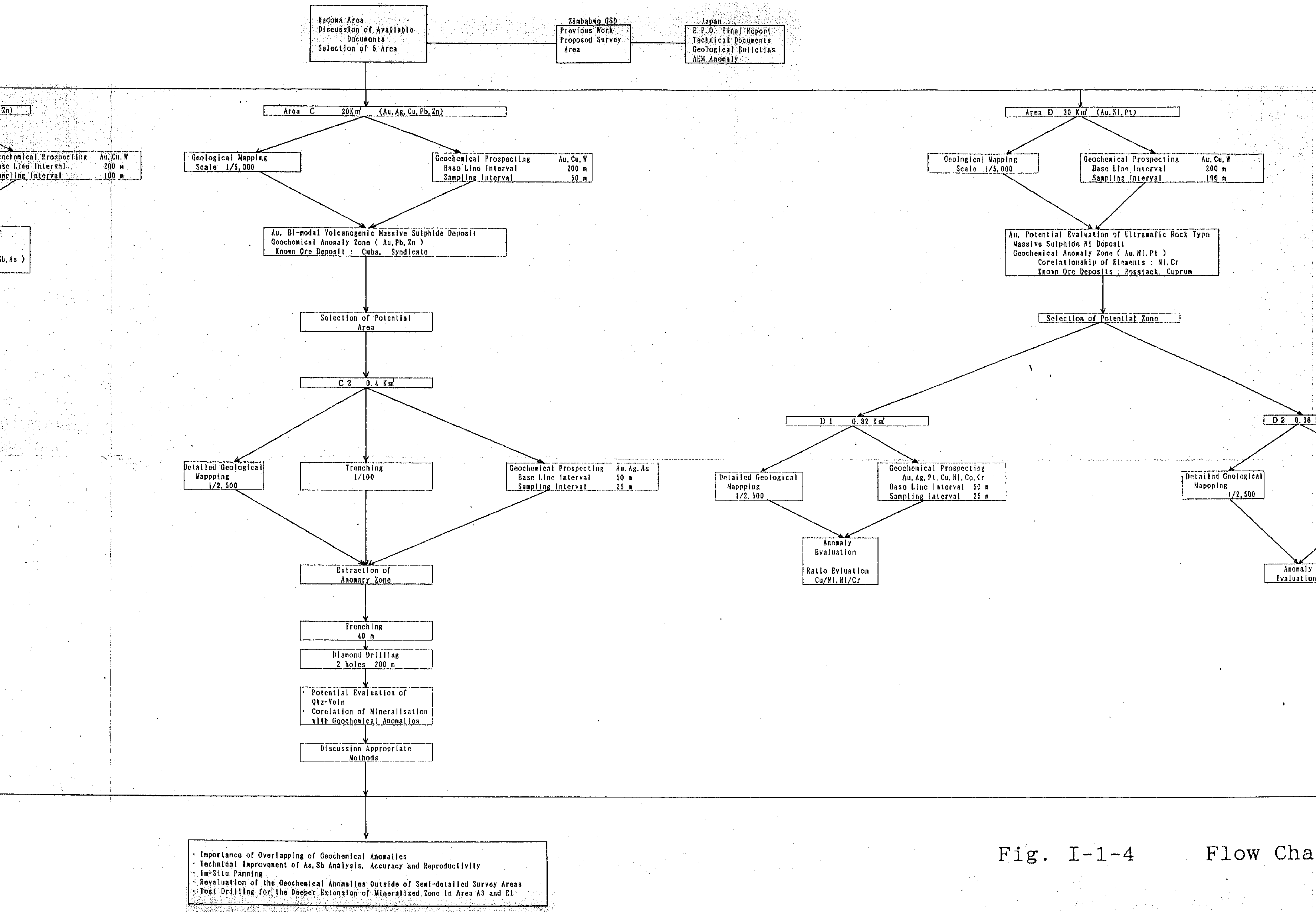

Fig. I-1-4 Flow Cha

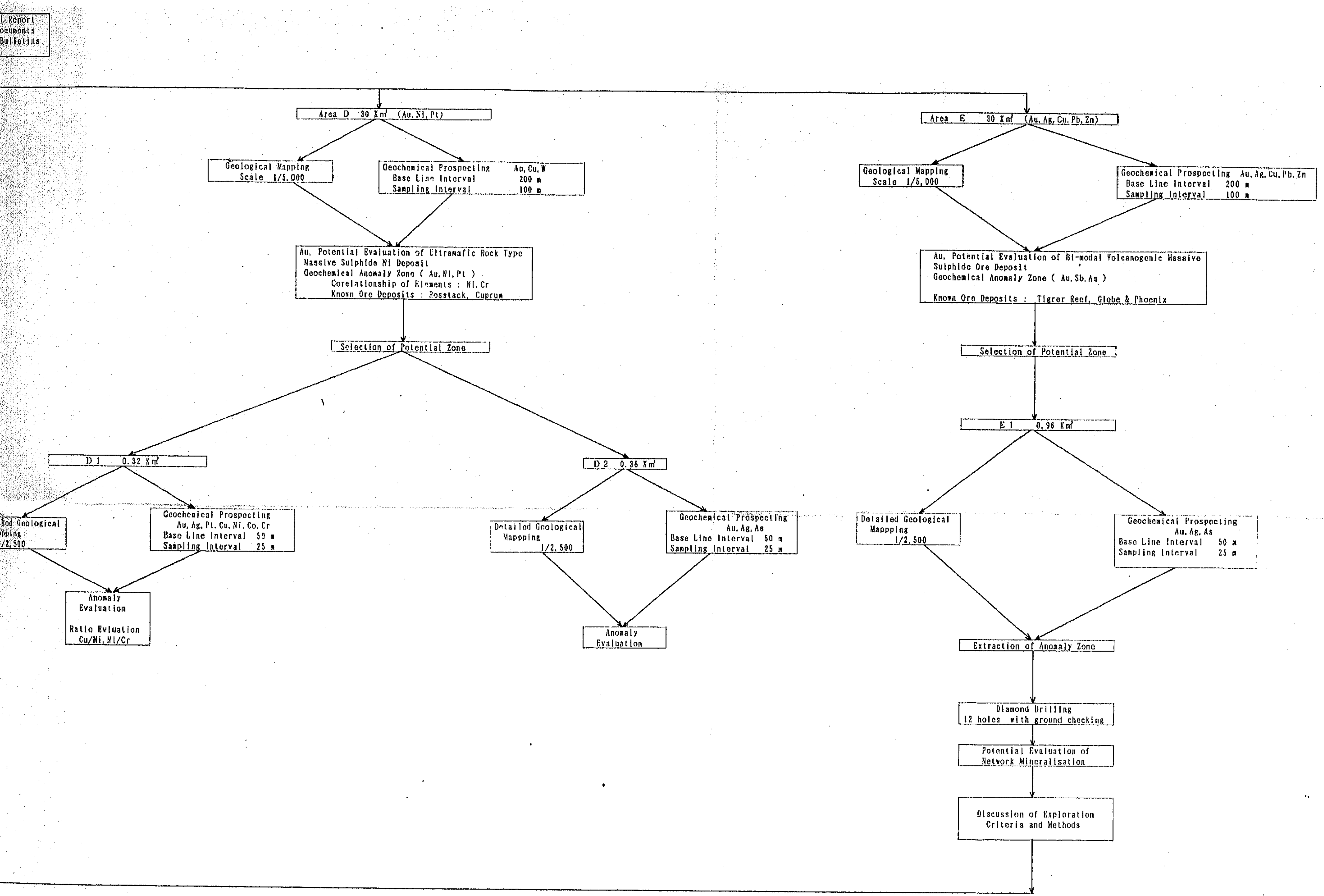

Fig. I-1-4 Flow Chart for Selection of Promising Areas