REPORT ON THE MINERAL EXPLORATION IN THE SNAKE HEAD AREA, THE REPUBLIC OF ZIMBABWE

PHASE II

1996,1997

JICA

MMAJ

REPORT
ON
THE MINERAL EXPLORATION
IN
THE SNAKE HEAD AREA,
THE REPUBLIC OF ZIMBABWE

PHASE II

FEBRUARY, 1997

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

Preface

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

The JICA and MMAJ sent to Zimbabwe a survey team headed by Mr. Yoshioki Nishitani from 29 June to 27 October, 1996.

The team exchanged views with the officials concerned of the Government of Zimbabwe and conducted a field survey in the Snake Head area. After the returned to Japan, further studies were made and the present 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.

February 1997

Kimio FUJITA

President
Japan International Cooperation Agency

Syozaburo KIYOTAKI
President
Metal Mining Agency of Japan

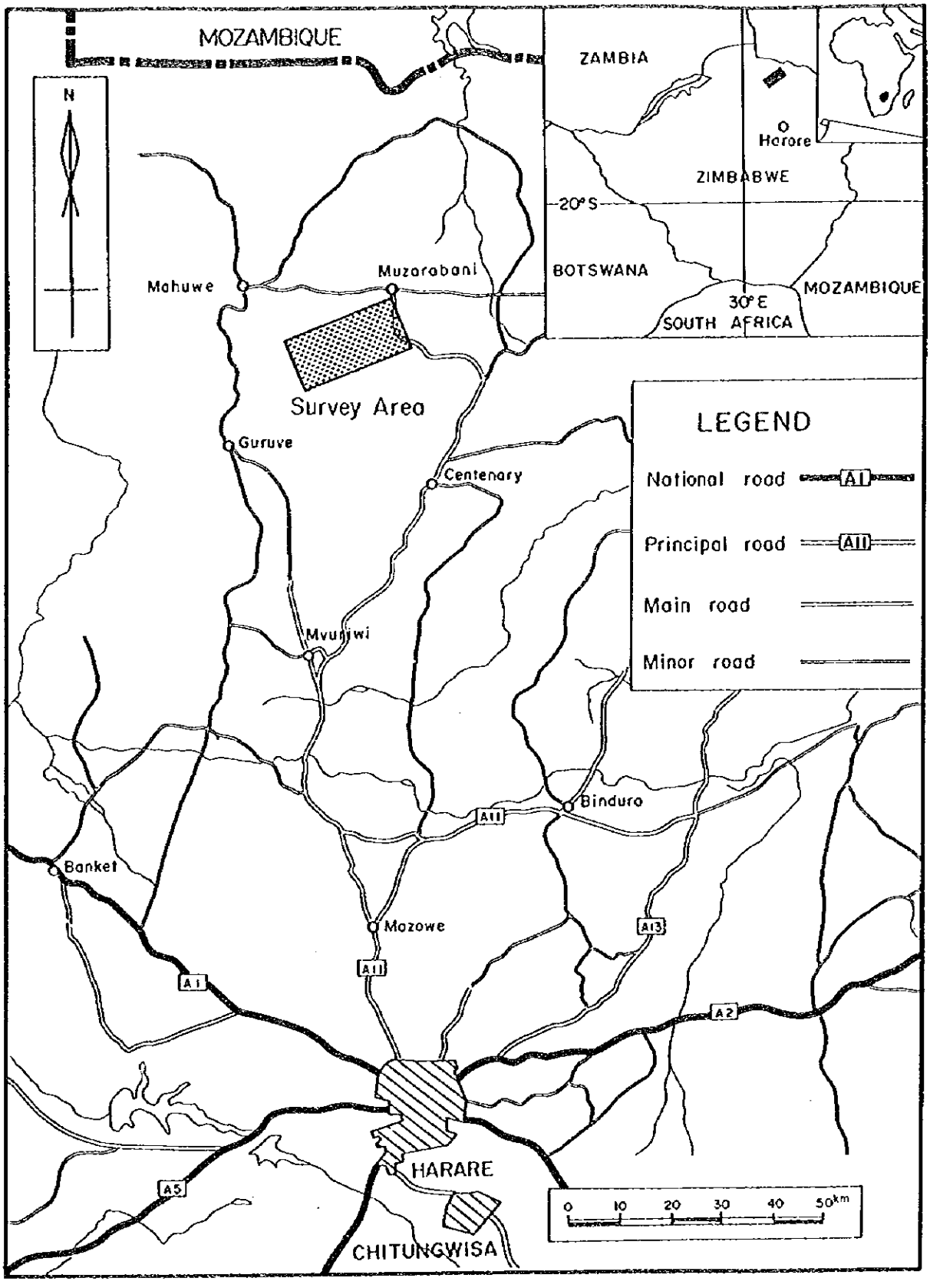

Fig.I-1-1 Locality of the survey area

Abstract

This survey was carried out in order to study the situation of geology and explore new ore deposits of platinum groupe metals in the Snake head area, the Republic of Zimbabwe.

Five holes of drilling survey were carried out in this fiscal year as the Phase II of this project. The results are summarized below.

Maximum metal content of the platinum group elements in the sulphide mineralization zone is as follows.

Hole No.	Depth(m)	Pt(ppb)	Pd(ppb)	Rh(ppb)	PGM(ppb)
MJZS-1	249.50～250.00	533	434	12	979
	250.00～251.00	490	425	15	930
MJZS-2	271.00～271.50	389	373	19	782
MJZS-3	348.00～349.00	583	331	14	928
	349.00～350.00	510	355	51	916
	350.00～351.00	438	394	47	924
MJZS-4	151.00～152.00	426	111	---	537
MJZS-5	168.50～169.50	598	147	17	762
	169.50～170.50	518	138	15	671

As the result of the drilling survey, MSZ was encountered by 5 drillings, LSZ was encountered by 2 drillings.

As the results of comparison of all drillings in this area including previous work, A possibility may be suggested that the mineralization of sulphide and PGM in this area will continue to northern direction and in the southern potion of this area the mineralization will continue to eastern direction.

Therefore additional drilling survey may be necessary in order to find more high content mineralization zone of sulphide and PGM.

According to conclusions obtained through the survey results in Phase I to II and study of them, The method of the Phase III are proposed as follows.

(1) Drilling survey must be carried out in WS area in order to find a new ore deposit which can be expect to develop.

(2) Drilling survey must be carried out in the north-eastern portion of the WN area and the northern portion of the CB area in order to study the probability of the existence of the platinum ore deposit.

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Part I General remarks

Part I General remarks
Chapter 1 Introduction

1-1 Background and purpose of the survey

This survey was commencing from 1995. This year, 1996, is the phase II of this project. The Great Dyke is generally known as main producing region of nickel, cobalt, and platinum group metals in the world. In the Snake Head area, the target area of this survey, is the last expected area where a high potential for existence of Platinum group metals deposit such as those at Hartley, Serious, Zinka, and Mimoza mines. Therefore, the Government of the Republic of Zimbabwe requested the Government of Japan for a Technical Cooperation to carry out mineral exploration In the Snake Head area. The Government of Japan responded to the request and conducted a drilling surveys. A surveys team was dispatched to carry out the survey in order to explore new deposits.

1-2 Conclusion and recommendation of the phase I survey

1-2-1 Conclusion of the phase I survey

Expected ore deposits in this area are strata-bound PGM nickel, cobalt, and copper ore deposits.

Pyroxenite No.1 layer (here in after P1 layer) which is thought to host ore deposits was geologically investigated in the field, and it was identified that the P1 layer occurs under the gabbroic rocks in the central and north eastern portion of the survey area. Sulphide dissemination was recognized upper potions of the P1 layer, suggesting existence of the mineralization.

Result of the geochemical survey indicate that gold and PGM element concentrations are expected in the WS area, the northeastern portion of the WN area and northern portion of CB area.

Result of the geophysical IP surveys identified chargeability anomalies deep below No.6 to 10 stations on E, H, I, J, K, L, M, N survey lines suggesting existence of chargeable body in bottom of the P1 layer or extension of serpentinite layer below P1.

Based on the above facts, WS area, northeastern portion of the WN area and northern portion of CB area in this survey area is considered to have high potential for occurrence of new ore deposits.

1-2-2 Recommendation for the phase II

Based on the survey results mentioned above, the method of the survey for the phase II are proposed as follows :

1. The detailed geological and geochemical survey

Detailed geological, and geochemical surveys should be carried out in portion of WS area, north-eastern portion of the WN and northern portion of CB. The survey should include closely spaced rock sampling and trenching across P1 locate the mineralized horizon.

2. The geophysical IP survey

Geophysical survey should be carried out in areas of geochemical anomalies in the e north-eastern portion of the WN area and northern portion of CB area to investigate the possibility of sulphide horizon.

3. Drillings

Drilling in the most anomalous areas outlined in Phase I survey must be carried out in order to investigate the possibilities of the existence of Au and PGM mineralization.

1-3 Outline on the works of the phase II survey

1-3-1 Survey area

The target area of this survey is the WS area recommended by phase I survey.

1-3-2 Purpose of the survey

The survey was carried out in order to explore the new ore deposit in this area.

1-3-3 Method of the survey

The drilling survey were done for the target sites where geochemical and geophysical anomalies were recognized by phase I survey, and potentiality of new ore deposit were studied.

Specification of each survey are shown in Table I-1-1.

Table I-1-1. Outline of the survey

Specification of the survey	Numbers of survey	
Drilling survey	MJZS-1(W,-60degree)	4500.00m
	MJZS-2(W,-60degree)	500.00m
	MJZS-3(W,-60degree)	500.30m
	MJZS-4(W,-60degree)	300.00m
	MJZS-5(W,-60degree)	400.44m
	Total(5 holes)	2,100.74m

Table I-1-1. Outline of the survey(Continue)

Specifications of laboratory test	Amounts of samples
1. Microscopic observation of rock thin section	10
2. Microscopic observation of polished ore samples	14
3. EPMA Analysis	6
4. Chemical analyses of ore : Au,Ag,Cu,Co,Ni,Pt,Pd,Rh,S	144

1-3-4 Members of the survey team

The following members were organized as the survey team, who conducted and actual survey.

Field survey

(Japanese)

Yoshioki NISHITANI :DOWA Engineering Co.,Ltd.

(Zimbabwean)

Forbes MUGUMBATE :GSD

Fadzanai Bornewell MUPAYA :GSD

1-3-5 Terms of the survey

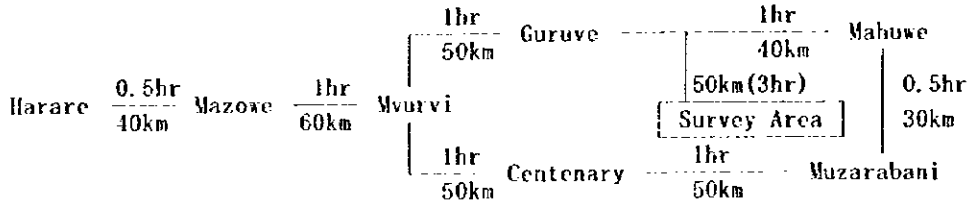
Field survey was carried out as follows:

Field survey (Drilling) from 29 June to 27 October, 1996

Chapter 2 Physical features

2-1 Location and traffics

The Snake Head area is located in the northern part of Zimbabwe as shown in Fig.I-1-1. The distance and travel time by car from Harare are as follows:



There are paved national roads and local roads from the Capital to the north of Guruve, From north of Guruve to survey area is by gravel and mountain roads. Only the 4WD cars can drive in the dry season, however during the rainy season of November to March, it is impossible to access to the survey area.

During the field survey, Japanese engineers and counterpart stayed in Guruve. Labors were employed in the survey area.

2-2 Topography and river system

The topography of the survey area generally affected by fault system, and shows mountain block. Gabbroic rocks and pyroxenite rocks were distributed characteristically along to the mountain range. Elevation are between 500 meters to 1,600 meters. The topography shows steep with valleys that were eroded strongly by river system.

Each streams and rivers flow parallel to the mountain range with the direction of the south-west or the north-east, and flow into Musengezi river which runs to the north to flow into Zambezi river.

All the rivers flow only in the rainy season. There is no water in the river except some pools in the dry season.

2-3 Climate and vegetation

The climate of the survey area is divided into the dry season (from April to October) and the rainy season (from November to March). there is no rainfall in the dry season and maximum rainfall in the rainy season is about 200 to 250mm/month.

As regards vegetation, except short broad-leaved tree as oaks which distributes in the mountainous district, the vegetation is generally thin in the survey area. Many bamboo

characteristically grow along the river.The serpentinite zone shows poor vegetation especially, only grass is glowing.

Big wild animals like a elephant, antelope and buffalo live in the survey area, and also small amount of carnivorous fierce animals like a lion and leopard can recognize.

Chapter 3 General geology

3-1 General geology in the survey area

This survey area is located in northern end of the Great Dyke which pass through the center of the Republic of Zimbabwe as shown in Fig.I-1-2.

Geology of this area consists of gneiss and granites of Archaean era which forms the basement, and ultramafic to mafic rocks of the Great Dyke which intruded in to the basement rocks.

The basement rocks mainly consists of augen gneiss with remarkable feldspar, and distributed in the northwestern and southern side of the survey area.

The Great Dyke is a layered basic intrusion whose geology consists of a topmost layer of gabbroic rocks distributed widely in the center part of the survey area. Gabbro is black to deep green in color, massive, holocrystalline texture. Below gabbro are multi- layers of pyroxenite with deep green to green color, coarse grained, holocrystalline texture. Followed by peridotite(dunite, harzburgite) from top to bottom.

PGM is mainly in the upper most layer(P1) of multi- layered pyroxenite, and chromite occur in the lower pyroxenite layers.

3-2 Geological structure in the survey area

The Great Dyke in the survey area is curved like an "S" form due to the structural movements of the Pan-Africa Zambezi Mobile Belt. In addition, the area is cut by fault systems striking of N-S and E-W direction which resulted in the formation the western mountain block forming the Botera range, the central mountain block forming the Guyu range, and the eastern mountain block of the east bank of the Musengezi river.

The western block strikes N-S to NE-SW and dips to the E to SE direction whereas the central block strikes N-S and dips towards the E in the northern portion and W in the southern portion. the eastern block shows a N-S to NE-SW strike and W to NW direction of dip.

3-3 Known ore deposit

Union Carbide and Cluff resourses zimbabwe Ltd. carried out a geological survey and exploration by E.P.O..

Union Carbide carried out the geochemical soil sampling with sampling distance of 30m at the main sulphide zone(hereinafter called MSZ). For the obtained PGM occurring layer, 4 holes of drillings crossing the layer were carried out. As the result,

MSZ(1.4g/t Of Pt+Pd, thickness 14m) and lower sulphide zone(hereinafter called LSZ) 50m under from MSZ(1.2g/t of Pt+Pd, thickness over 7.6m) were recognized.
Cluff carried out making a topographic map on the scale of 1:25,000, constructing a access road to the survey area, and geological survey confirming a distribution of the P1 layer and fault system to decide the priority of drilling. 5 holes of drillings were carried out, and Cu, Ni, Pt, Pd, Rh, Au, As were analyzed. As the result, 2 layer of PGM mineralized zone(0.88 to 1.16g/t of Pt+Pd, thickness 4.2 and 5.2m) were recognized. Distribution of mineralized zone were estimated to 7km x 4km.

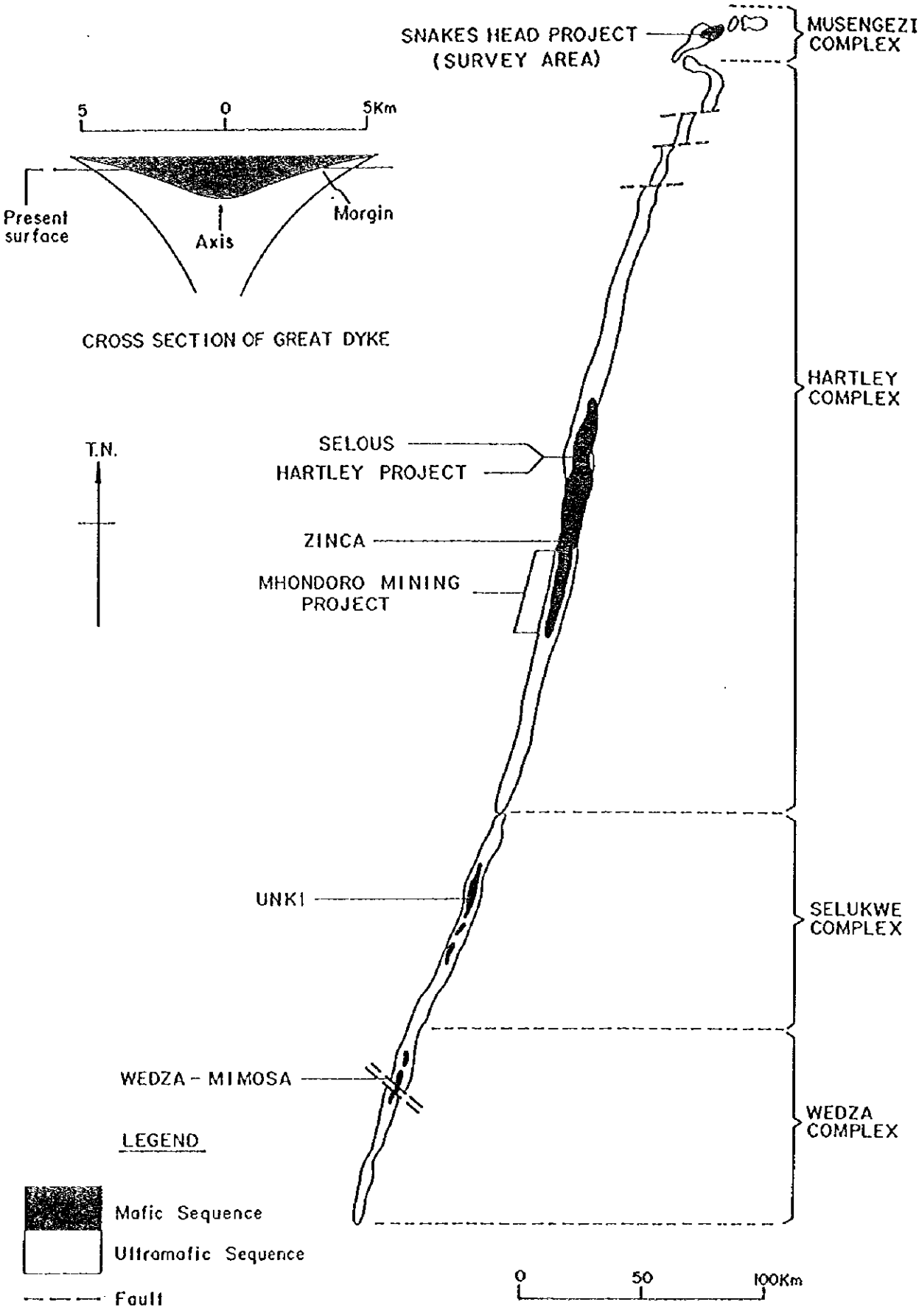


Fig.I-1-2 Outline of the Great Dyke

Chapter 4 Considerations of the survey results

4-1 Controls on mineralization related to the geological structure and characteristics of the mineralization

The Great Dyke is a layered basic intrusion, whose PGM, Ni, and Co ore deposits are reported to occur mainly in the P1 layer just under the gabbroic rocks.

Upper gabbroic rocks are widely distribute in the center portion of the survey area. Rock facies move to lower peridotite (dunite, harzburgite) pass through multi layered pyroxenite.

The sulphide mineralization which can be observed by the naked eye mainly occur in the P1 layer of the upper most pyroxenite layer. Chromite occur mainly in the lower pyroxenite layer.

Sulphide minerals in the mineralized zone consist of pyrrhotite, pentlandite, chalcopyrite as essential minerals and the pyrite, magnetite, chromite as a accessory minerals. A small quantity of violarite, millerite, goethite occurring as secondary minerals were also recognized.

Layering in the western block shows a N-S to NE-SW direction of strike and E to SE direction of dip, whereas the layering in the central block shows a N-S direction of strike and E direction of dip in the northern portion and W direction of dip in the southern portion. The layering in the eastern block shows a N-S to NE-SW direction of strike and W to NW direction of dip.

4-2 Relationship between Results of drilling and mineralization, geochemical anomalies, geophysical IP anomalies.

A summary of the sulphide mineralization zone of each hole which can be observed by the naked eye are as follows.

Hole No.	Depth (m)	Zone	Mineralization	Main Sulphides
MJZS-1	226.00～260.00	MSZ	disseminate	Po, Py, Cp
MJZS-2	266.00～274.00	MSZ	disseminate	Po, Py, Cp
MJZS-3	263.50～273.50	MSZ	disseminate	Po, Py, Cp
MJZS-3	335.00～351.00	LSZ	disseminate	Po, Py, Cp
MJZS-4	70.00～ 87.00	MSZ	disseminate	Po, Py, Cp
MJZS-4	143.00～153.00	LSZ	disseminate	Po, Py, Cp
MJZS-5	160.00～172.50	MSZ	disseminate	Po, Py, Cp

A summary of the PGM content in the sulphide mineralization zone is as follows.

Hole No.	Depth(m)	Pt(ppb)	Pd(ppb)	Rh(ppb)	PGM(ppb)
MJZS-1	247.50~248.00	157	162	---	319
	248.00~248.50	102	122	---	124
	248.50~249.00	277	168	---	445
	249.00~249.50	396	228	---	624
	249.50~250.00	533	434	12	979
	250.00~251.00	490	425	15	930
	251.00~252.00	336	421	15	772
	252.00~253.00	213	353	14	580
	253.00~254.00	176	377	---	553
	254.00~255.00	75	391	---	466
	255.00~256.00	91	302	---	393
	256.00~257.00	106	315	---	421
	257.00~258.00	42	244	---	286
	258.00~259.00	---	299	---	299
	259.00~260.00	---	111	---	111
MJZS-2	269.00~269.50	133	98	---	226
	269.50~270.00	46	62	---	106
	270.00~270.50	167	100	---	267
	270.50~271.00	220	148	---	368
	271.00~271.50	389	373	19	782
	271.50~272.00	172	251	---	423
	272.00~272.50	24	72	---	96
	272.50~273.00	56	158	---	214
	273.00~273.50	106	194	---	300
	273.50~274.00	54	175	---	229
MJZS-3	346.00~347.00	166	108	---	224
	347.00~348.00	324	175	---	499
	348.00~349.00	583	331	14	928
	349.00~350.00	510	355	51	916
	350.00~351.00	438	394	47	924
MJZS-4	85.00~ 86.00	144	68	---	182
	86.00~ 87.00	224	133	---	357
	149.00~150.00	215	19	---	234
	150.00~151.00	402	46	---	448
	151.00~152.00	426	111	---	537
	152.00~153.00	270	81	---	351
MJZS-5	167.50~168.50	383	27	---	410

Hole No.	Depth(m)	Pt(ppb)	Pd(ppb)	Rh(ppb)	PGM(ppb)
	168.50~169.50	598	147	17	762
	169.50~170.50	518	138	15	671
	170.50~171.50	467	152	29	648
	171.50~172.50	431	188	24	643

These mineralization zone of the PGM correspond well to the concentrate zone of platinum group elements of the Phase I survey. The geochemical survey using a rock samples is useful for the platinum exploration.

On the other hand, these mineralization zone dose not show a clear correspondence against the result of the geophysical IP survey. It may be reason why the sulphide content in the mineralized zone is only a few quantity, and a clear difference of chargeability between mineralized rock and country rock does not be shown.

4-3 Potentialities of expected ore deposits

As the result of the drilling survey, MSZ was encountered by 5 drillings, LSZ was encountered by 2 drillings. It is considered that MSZ in this area may be continuous mineralization zone and LSZ may be intermitted.

As the results of comparison of all drillings in this area including previous work, A possibility may be suggested that the mineralization of sulphide and PGM in this area will continue to northern direction and in the southern potion of this area the mineralization will continue to eastern direction.

Therefore additional drilling survey may be necessary in order to find more high content mineralization zone of sulphide and PGM.

Chapter 5 Conclusion and recommendation

5-1 Conclusion

Through the study of results of Phase I survey, A probability of the existence of platinum ore deposit was indicated in the WS area, north-eastern portion of the WN area and northern portion of the CB area.

Drilling exploration of 5 holes were carried out in WS area in order to encounter the mineralization zone and fined a new ore deposit.

A summary of the drilling exploration is as follows.

MJZS-1 (W,-60°)	400.00m
MJZS-2 (W,-60°)	500.00m
MJZS-3 (W,-60°)	500.30m
MJZS-4 (W,-60°)	300.00m
MJZS-5 (W,-60°)	400.44m
Total(5 holes)	2,100.74m

A summary of the sulphide mineralization zone of each hole which can be observed by the naked eye are as follows.

Hole No.	Depth(m)	Zone	Mineralization	Main Sulphides
MJZS-1	226.00~260.00	MSZ	disseminate	Po, Py, Cp
MJZS-2	266.00~274.00	MSZ	disseminate	Po, Py, Cp
MJZS-3	263.50~273.50	MSZ	disseminate	Po, Py, Cp
MJZS-3	335.00~351.00	LSZ	disseminate	Po, Py, Cp
MJZS-4	70.00~ 87.00	MSZ	disseminate	Po, Py, Cp
MJZS-4	143.00~153.00	LSZ	disseminate	Po, Py, Cp
MJZS-5	160.00~172.50	MSZ	disseminate	Po, Py, Cp

Maximum metal content of the platinum group elements in the sulphide mineralization zone is as follows.

Hole No.	Depth(m)	Pt(ppb)	Pd(ppb)	Rh(ppb)	PGM(ppb)
MJZS-1	249.50~250.00	533	434	12	979
	250.00~251.00	490	425	15	930
MJZS-2	271.00~271.50	389	373	19	782

Hole No.	Depth(m)	Pt(ppb)	Pd(ppb)	Rh(ppb)	PGM(ppb)
MJZS-3	348.00~349.00	583	331	14	928
	349.00~350.00	510	355	51	916
	350.00~351.00	438	394	47	924
MJZS-4	151.00~152.00	426	111	---	537
MJZS-5	168.50~169.50	598	147	17	762
	169.50~170.50	518	138	15	671

As the result of the drilling survey, MSZ was encountered by 5 drillings, LSZ was encountered by 2 drillings.

As the results of comparison of all drillings in this area including previous work, A possibility may be suggested that the mineralization of sulphide and PGM in this area will continue to northern direction and in the southern potion of this area the mineralization will continue to eastern direction.

Therefore additional drilling survey may be necessary in order to find more high content mineralization zone of sulphide and PGM.

5-2 Recommendations for the phase III survey

According to conclusions obtained through the survey results in Phase I to II and study of them, The method of the Phase III are proposed as follows.

(1) Drilling survey must be carried out in WS area in order to find a new ore deposit which can be expect to develop.

(2) Drilling survey must be carried out in the north-eastern portion of the WN area and the northern portion of the CB area in order to study the probability of the existence of the platinum ore deposit.

Part II Details of the surveys

Part II Details of the survey

Chapter 1 Outline of the geology

Geology of this area consists of gneiss and granites of Archaean era which forms the basement, and ultramafic to mafic rocks of the Great Dyke which intruded in the basement rocks.

Schematic geological column, geological cross section, and geological map are shown in Fig.II-1-1. to II-1-3, respectively.

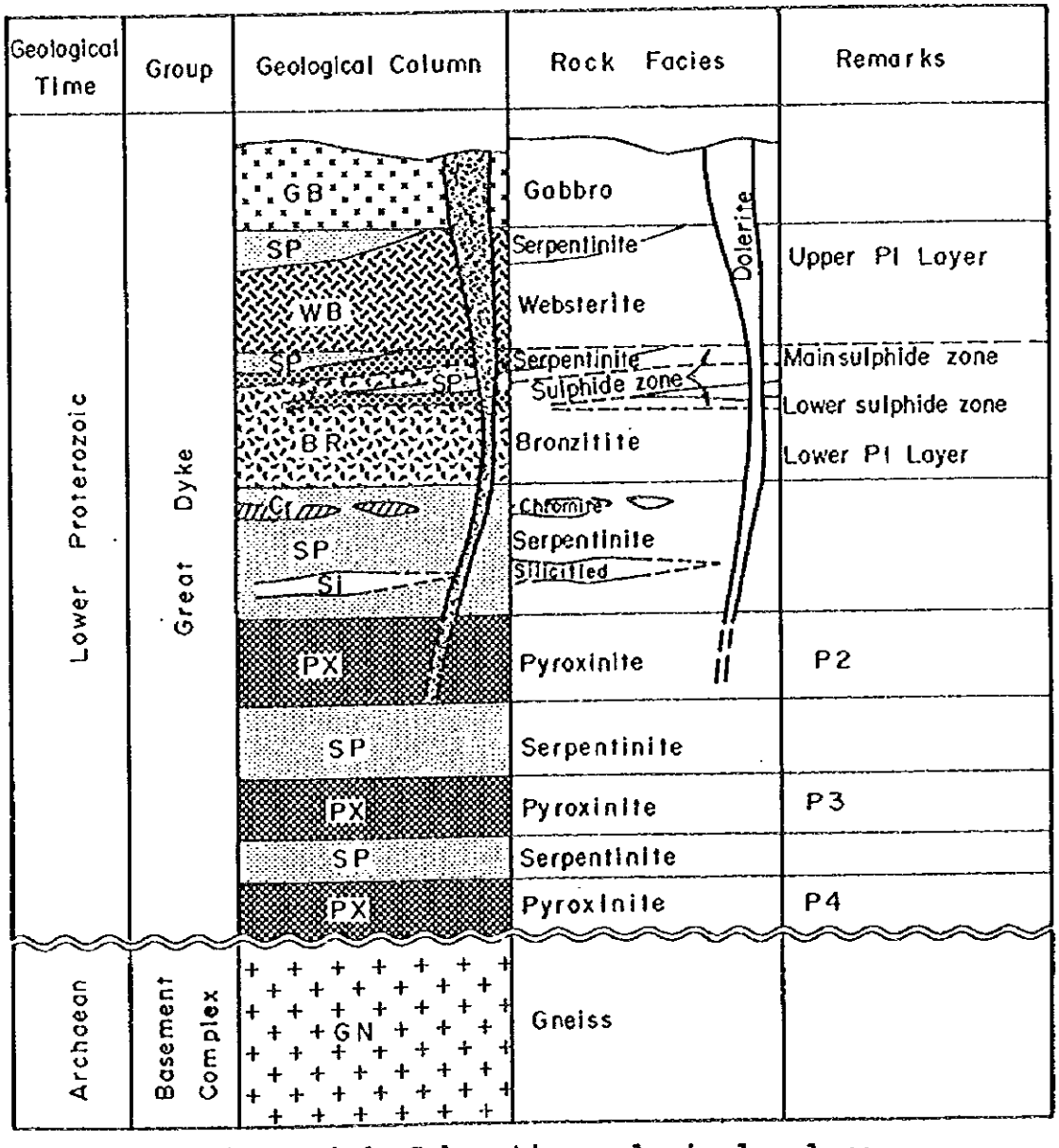


Fig.II-1-1 Schematic geological column

1-1 Basement rocks

The basement rocks are widely distributed in north western and south eastern part of the survey area.

The basement rocks mainly consists of orthogneiss of granodiorite component and granite. These rocks sometimes shows banded structure with few cm to ten and more cm thick alternation of white felsic part and biotite concentration part, and sometimes formed clear augengniss in the outcrop.

1-2 Great Dyke

The Great Dyke is a layered basic intrusion. The geology of the Great Dyke consists of gabbroic rocks which distributed widely in the center part of the survey area, shows black to deep green in color, massive, holocrystalline texture, multi layer of the pyroxenite with deep green to green color, coarse grain, holocrystalline texture, and peridotite(dunite, harzburgite) from upper to lower.

(1). Gabbro

It is distributed widely from Botera range to Guyu range, north east of Guyu range and east bank of Musengezi river.

Gabbroic rocks are situated in upper most of the Great Dyke, increase the thickness in the axial zone.

The main rock facies shows generally dark green to black color, massive holocrystalline equigranular texture. Gabbroic rocks change to the facies from lower gabbro mainly consist of orthopyroxenite, clinopyroxenite and plagioclase to upper quartz diorite with quartz and amphibole , and amphibolite include large quantity of amphibole.

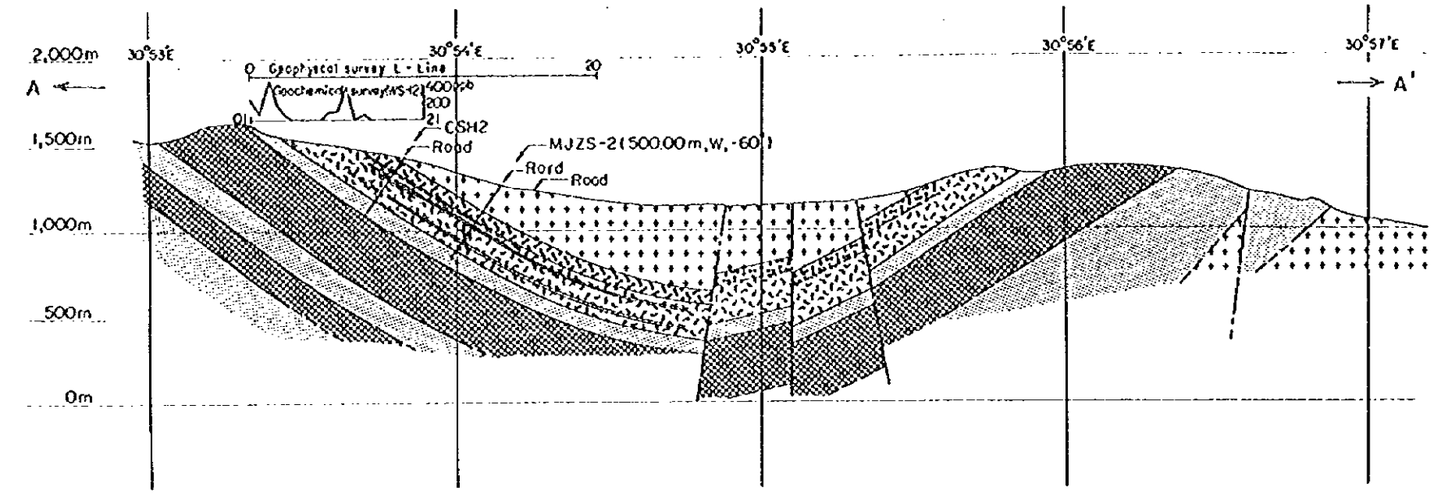
(2). Pyroxenite

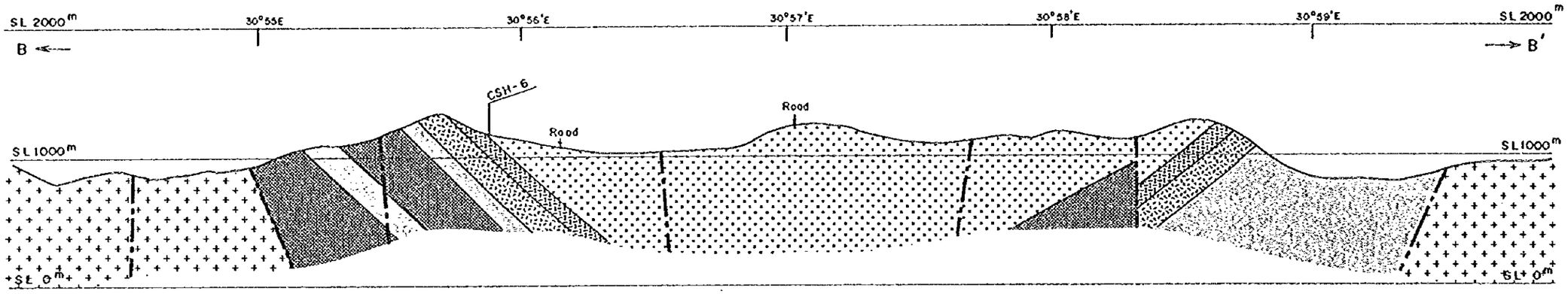
It is distributed characteristically formed a range of the Botera range, Guyu range and east bank of Musengezi river.

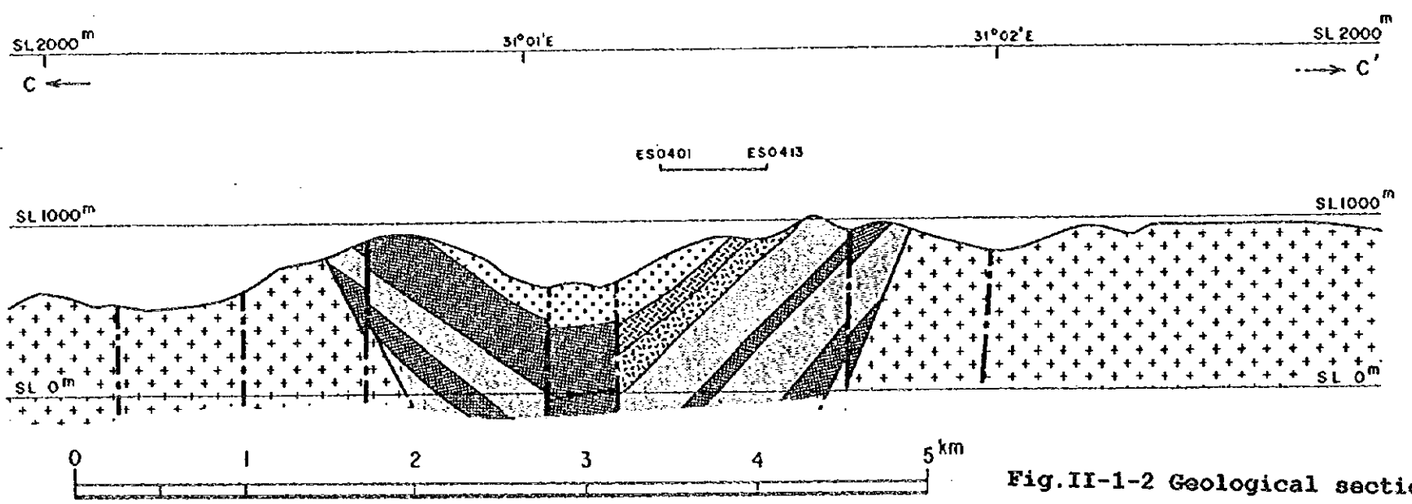
Pyroxenite shows accumulated layer with serpentinite, formed so called cyclic units.

Pyroxenites mainly consist of olivine bronzitite, bronzitite, felspasic bronzitite and websterite From lower to upper(Allen H. Wilson and Marian Tredoux 1990).

The main rock facies are upper websterite which shows generally dark green to black color, medium to fine grain, holocrystalline equigranular texture, and lower orthopyroxenite(bronzitite) which shows generally dark green to green and olive green color, coarse grain, holocrystalline







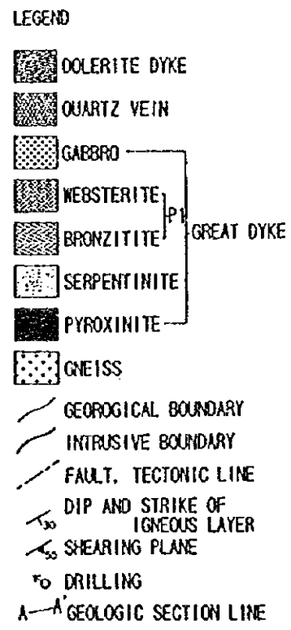


Fig.II-1-2 Geological sections

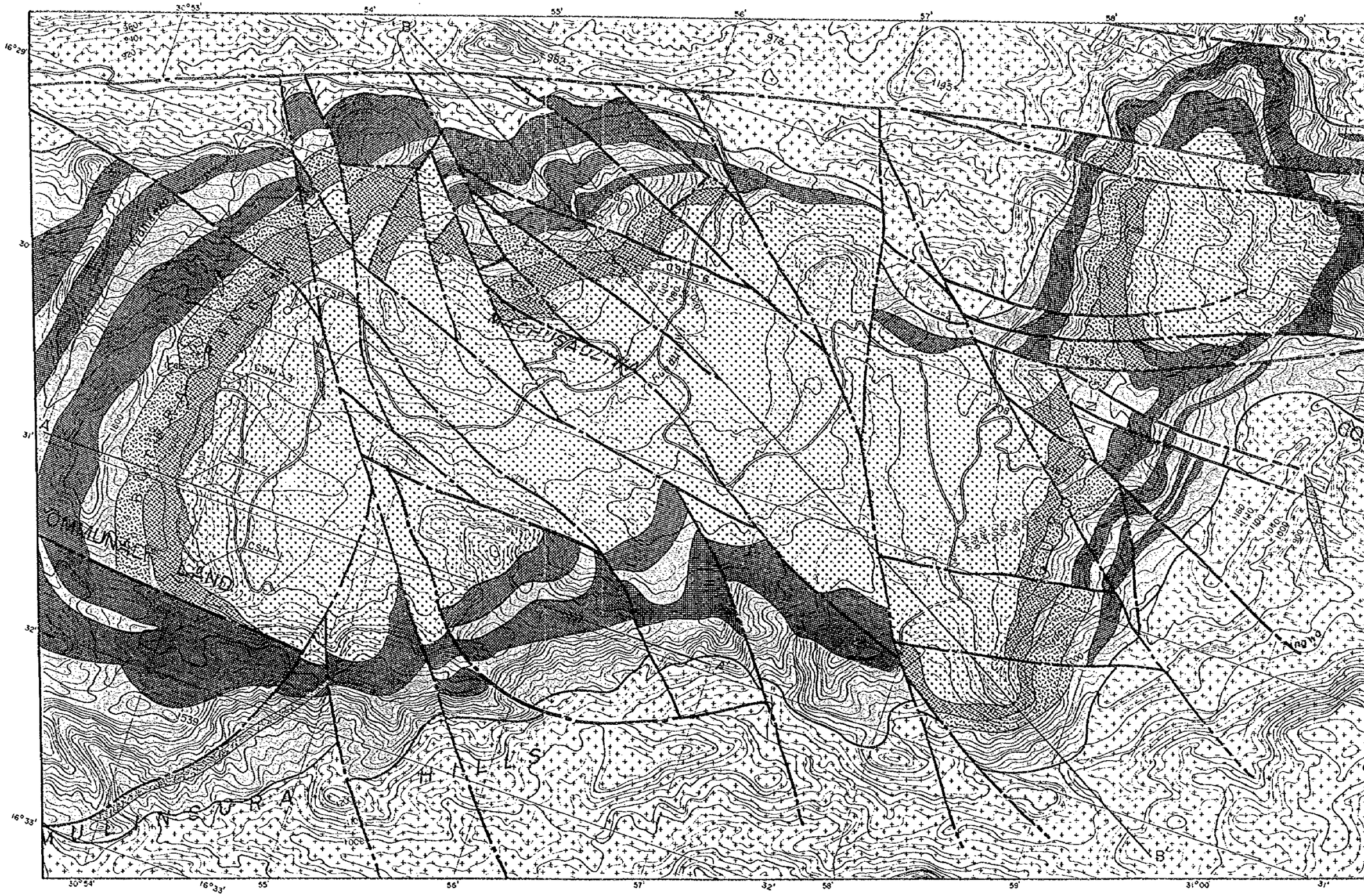
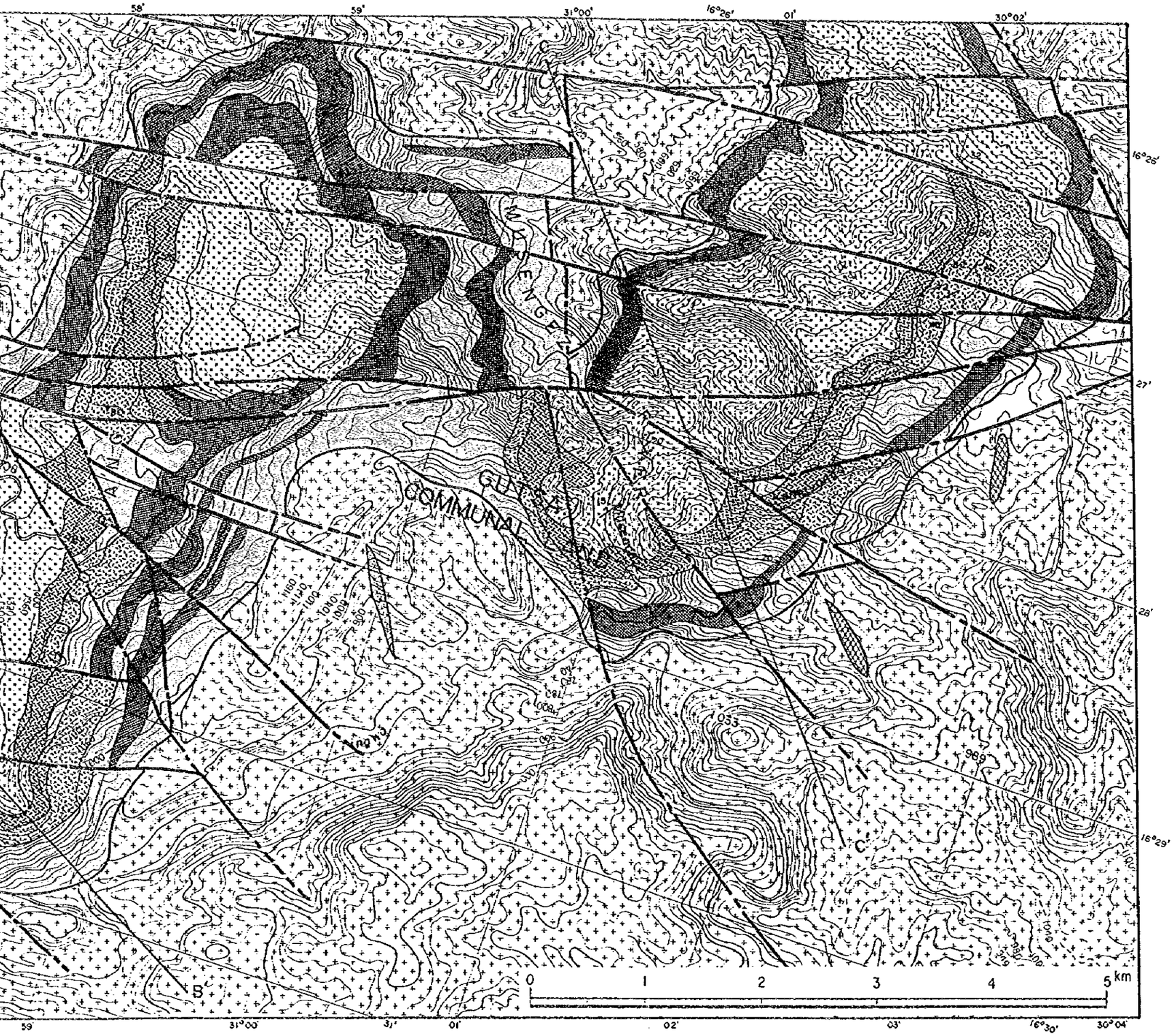


Fig.II-1-3 Geological map



LEGEND

- DOLERITE DYKE
- QUARTZ VEIN
- GABBRO
- WEBSTERITE
- BRONZITITE
- SERPENTINITE
- PYROXINITE

P1 GREAT DYKE

- GNEISS
- GEOROGICAL BOUNDARY
- INTRUSIVE BOUNDARY
- FAULT, TECTONIC LINE
- T_{30} DIP AND STRIKE OF IGNEOUS LAYER
- $\blacktriangleleft_{55}$ SHEARING PLANE
- DRILLING
- A—A' GEOLOGIC SECTION LINE

Fig.II-1-3 Geological map

equigranular texture with clear pyroxene crystal in the field.

(3). Serpentinite

It is distributed along to the range and formed cyclic units with Pyroxenite.

Origin of serpentinite is the dunite and harzburgite(Bulletin 47), (E.P.O.654), (Allen H. Wilson and Marian Tredoux 1990).

The main rock facies shows generally pale yellow to pale brown and pale green color, fine grain. and containing chromite in many case. Fresh dunite and harzburgite are not recognized in this field.

(4). Chlorite-sericite rock

It is distributed characteristically along to the Fault zone.

This rock shows generally white to metallic silver color, strongly stripped, and soft and soapy.

(5). Dyke

Dolerite dyke is recognized in only limited scale.

1-3 Geological structure

The Great Dyke in the survey area is curved like an "S" form due to the structural movements of the Pan-Africa Zambezi Mobile Belt. In addition, the area is cut by fault system striking of N-S and E-W direction to the western mountain block forming the Botera range, the central mountain block forming the Guyu range, and the eastern mountain block of the east bank of the Musengezi river.

The western block strikes N-S to NE-SW and dips to the E to SE direction whereas the central block strikes N-S and dips towards E in the dip in the northern portion and W in the southern portion. The eastern block shows a N-S to NE-SW strike and W to NW direction of dip.

1-4 Mineralization

PGM minerals are closely related to the sulphide minerals like the pyrite, pyrrhotite, chalcopyrite and pentlandite, etc., and accompanied with marginal zone of sulphide(E.P.O.654).

Summary of the mineralization which was obtained by Phase I survey is shown in Fig. II-1-4.

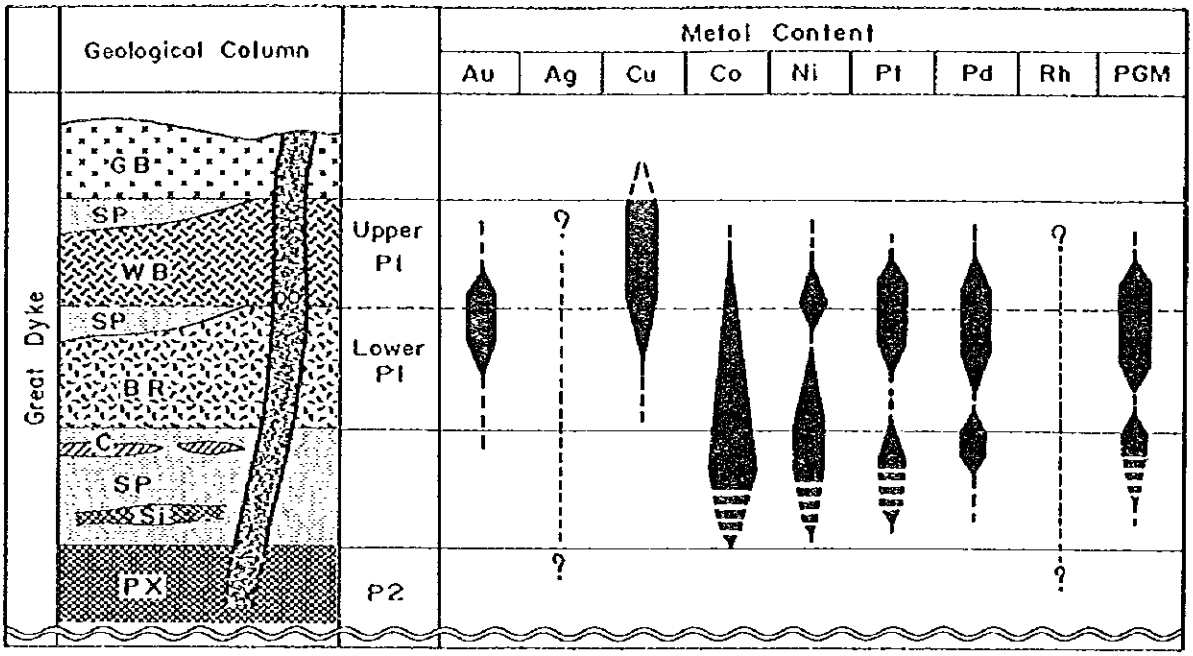


Fig.II-1-4 Summary of the mineralization(I)