No. 33

REPORT
ON
THE COOPERATIVE MINERAL EXPLORATION
IN
THE VITI LEVU AREA, THE REPUBLIC OF FIJI

PHASE III

MARCH 1993

JAPAN INTERNATIONAL COOPERATION AGENCY

METAL MINING AGENCY OF JAPAN

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PREFACE

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

The JICA and MMAJ sent a survey team headed by Mr. Masaaki Sugawara to the Republic of Fiji from 15 August to 19 December 1992.

The team exchanged views with the officials concerned of the Government of the Republic of Fiji and conducted a field survey in the Viti Levu area. After the team returned to Japan, further studies were made and the present report is the result.

We hope that this report will serve towards 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 officials concerned of the Government of the Republic of Fiji for the close cooperation extended to the team.

March 1993

Kensuke Yanagiya

Kensuke YANAGIYA
President,
Japan International Cooperation Agency

Takashi Ishikawa

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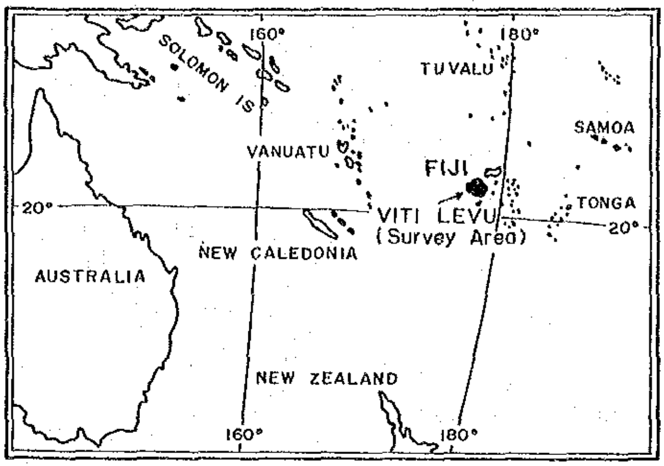

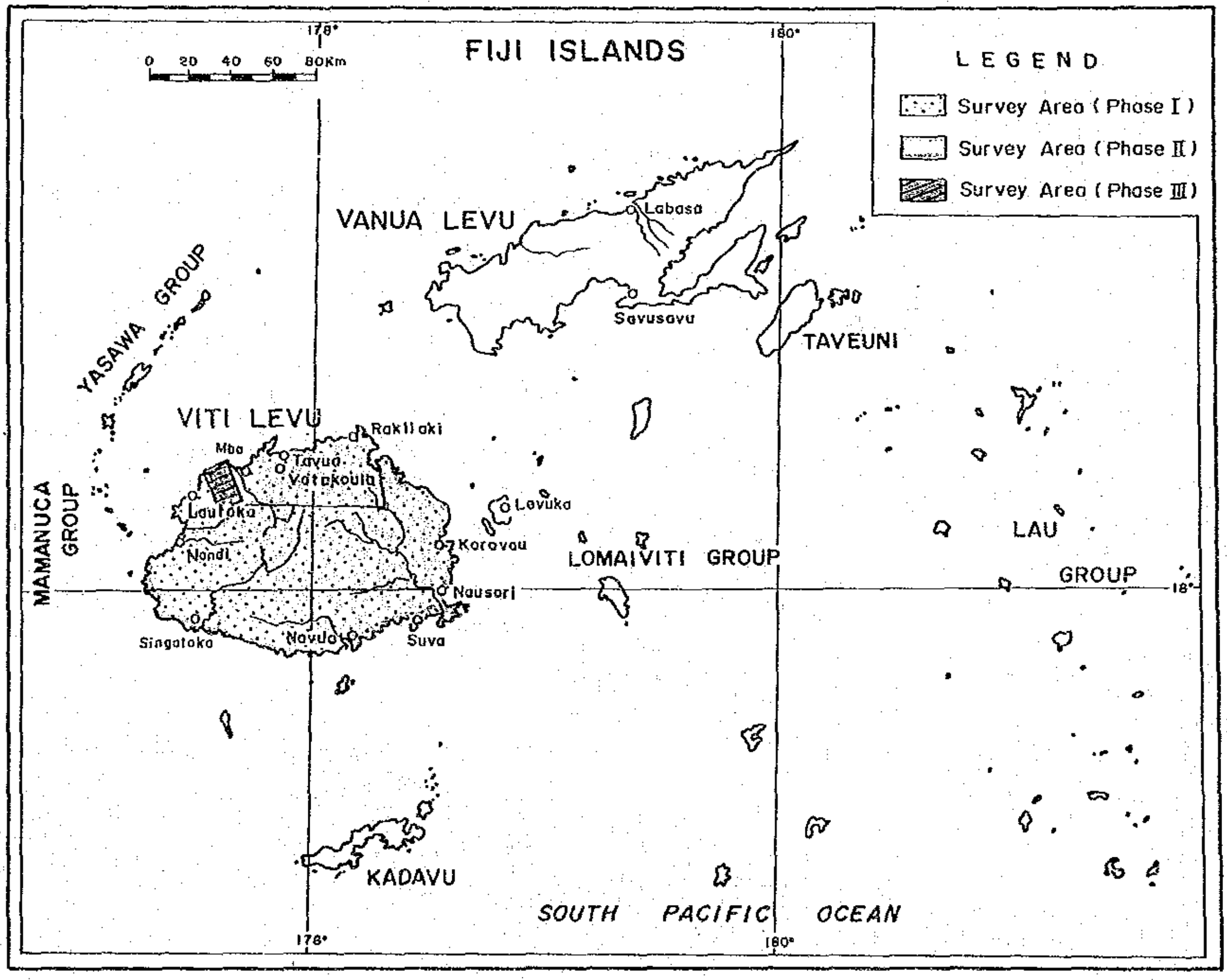

Fig. 1-1 Index Map of the Project Area

SUMMARY

Geological survey and drilling were carried out in three localities of Mba-west during the third phase of the mineral exploration project of Viti Levu. The results are summarized below.

(1) Nayanggali Creek Geochemical Anomaly Zone

The geology of this zone comprises Pliocene basalt lava, basaltic pyroclastics, sedimentary rocks, and basalt dykes.

Mineral showings and alteration of significance were not found by surface survey and drilling.

The Au, As, Hg geochemical anomalies of this zone is inferred to have formed by ascendant post-volcanic small scale hydrothermal fluids through NE-SW fissures.

Subsurface gold mineralization, if any in this zone, is believed to be of small scale.

(2) Nalotawa Alteration Zone

The geology of this zone comprises Pliocene basalt lava, basalt pyroclastics, and intrusive bodies (basalt, hornblende andesite, altered andesite).

Evidences of gold mineralization is not observed on the surface of this zone, but many gold showings are confirmed by drilling. The most promising part has 18.10m of core containing Au 0.176g/t (including Au 0.52g/t, 1m wide).

The assemblage of the major ore minerals and of the alteration minerals of host rock near the veins is very close to that of the low sulfidation epithermal veins.

The potential for finding subsurface gold veins in this zone is believed to be high.

(3) Yaloku Alteration Zone

The geology of this zone comprises Miocene-Pliocene andesite lava, andesite pyroclastics, basalt lava, and dykes (basalt, andesite).

Low-grade gold veins including a relatively wide auriferous vein (Au

0.055g/t, sampling width 400cm) and low-grade auriferous veins containing high-grade Ag-Cu (Au 0.375g/t, Ag 880g/t, Cu 6.76%; sampling width 3cm) were confirmed by drilling in this zone. The veins are generally not developed in the eastern part, but in the west the development of auriferous veins were confirmed below the gold-bearing veins (Au 12.10g/t, 15cm wide and others). The possibility exists for occurrence of bonanza in the deeper parts.

The veins of this zone is inferred from the assemblage of ore minerals to be of epithermal origin formed in relatively deeper parts and under high temperature. From the assemblage of the ore, gangue and alteration minerals of the host rocks near the veins, the veins are concluded to be the products of low sulfidation epithermal process.

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PART I OVERVIEW

PART I OVERVIEW

Chapter 1 Introduction

1-1 Background and Objectives

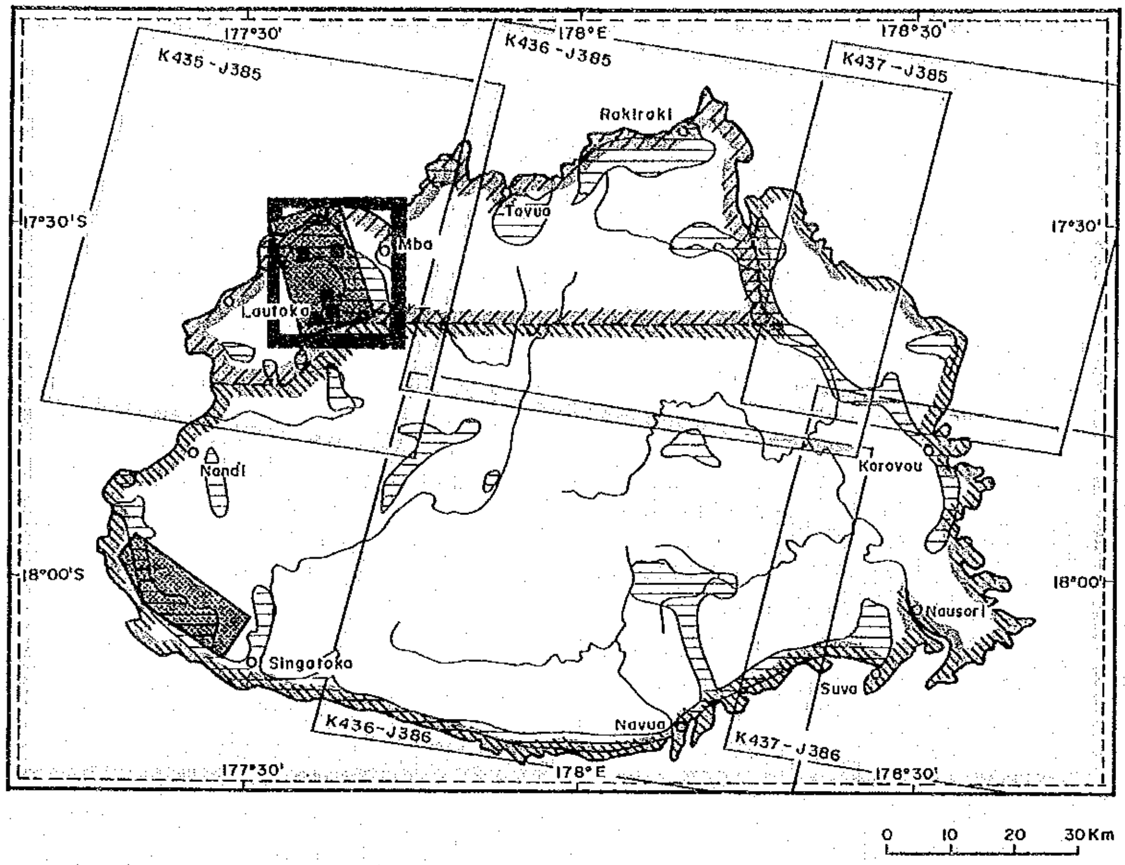
In response to the request by the Government of the Republic of Fiji to conduct mineral exploration in the Viti Levu area, the Japanese Government dispatched a mission to discuss the details of the project. And as a result of the consultation between the Mineral Resources Department (MRD) of the Ministry of Lands and Mineral Resources and the Metal Mining Agency of Japan an agreement was reached for cooperative exploration of the Viti Levu Island. The "Scope of Work"(SW) was signed by the representatives of both governments in August 1990. The objective of this project is to assess the mineral potential of the area through geological survey, geochemical exploration, geophysical exploration and drilling during the three year period of Fiscal 1990 to 1992.

The survey carried out during the present Fiscal 1992 is, thus, the third phase of the project.

The first phase of this project was carried out in Fiscal 1990. The objective of that phase was to clarify the geological environment and thereby understand the occurrence and conditions of ore deposits of Viti Levu Island. The work carried out included; compilation of available geological information and data concerning the whole island (areal extent 10,400 km^2), analysis and interpretation of SLAR and SPOT images together with geological survey of the whole island, gravity survey (517 stations) over 2,000 km^2 of Tavua area in the north, and geochemical orientation survey in the area east of the Emperor Mine.

The second phase was conducted in Fiscal 1991. The objective of this phase is to survey, in detail, the prospective areas extracted by the first phase and to clarify the geologic structure of the southern Viti Levu. The following work was carried out. Photogeological analysis and interpretation, geological survey, geochemical prospecting, and drilling of Mba-west area (areal extent 206 km^2); geological survey and geochemical prospecting of the Sigatoka area (160 km^2); and gravity survey of the unsurvyed areas (8,400 km^2) of the whole island.

The third phase was carried out during Fiscal 1992. The objective of this phase is the detailed survey and exploration of the promising zones



LEGEND

- Area of SPOT Images (Phase I)
- Area of SLAR Imageries (Phase I)
- Area of Geological Survey (Phase I)
- Area of Gravity Survey (Phase I)
- Area of Geological Survey and Geochemical Prospecting (Phase II)
- Area of Gravity Survey (Phase II)
- Area of Aerial photographs Interpretation (Phase II)
- Area of Drilling Exploration (Phase II)
- Area of Drilling Exploration (Phase III)

Fig.1-2 Location Map of the Project Area (Viti Levu Island)

which were extracted by the second phase survey. The third phase comprised geological survey and drilling of three localities within the Mba-west area.

1-2 Conclusions of the Second Phase and Recommendations for the Third Phase

1-2-1 Conclusions of the Second Phase Survey

[Mba-west Area]

Photogeological analysis, geological survey, geochemical prospecting and drilling were carried out. The following conclusions were obtained.

(1) The Mba-west area was photogeologically analyzed. The geology was classified into 10 units and gently northward dipping general structure was identified.

(2) Total of ninety five lineaments were extracted photogeologically. Many of these are concentrated in the southern and northern parts of the area. The directions of the maximum horizontal compressional stress axes were inferred to be NNW to NNE and ENE to ESE from the en echelon arrangement of the lineaments.

(3) The photogeological characteristics of the known mineral prospects of Mba-west were identified to be low resistance and low relief. Eight localities with these features were delineated.

(4) The geology of Mba-west consists mostly of; Miocene-Pliocene andesitic /basaltic volcanic products and limestone; Pliocene basaltic/andesitic volcanic products, sandstone, and conglomerates; Holocene alluvium; and intrusive rocks (monzonite, dacite, andesite, basalt) penetrating the Pliocene formations. The Miocene and Pliocene formations largely dip northward at low angles and are superposed. Thus the strata become younger northward.

(5) The following characteristics are noted in the intrusive bodies of Mba-west.

Monzonite is arranged in the NNE-SSW direction within the photogeological annular structures in the southern part.

Andesite and basalt dykes occur mostly in the south and north. They are particularly dominant in the south.

Many of the dykes in the south and some of the northern dykes are arranged radially.

In the south, andesite is distributed mainly within the photogeological annular structures and extend northward and southeastward from these structures. Basalt is distributed in the periphery of the andesite area.

(6) Marked Au, As, Te geochemical anomaly zones which coincide with the altered/mineralized zones on the surface were extracted at four localities. Aside from the above, small geochemical anomalies not associated with alteration/mineralization were confirmed at several localities and blind buried altered/mineralized zones were anticipated to occur in shallow subsurface parts.

(7) Two holes drilled in the Mba-west area penetrated through basalt lava and basaltic pyroclastics of the Pliocene Namosau Volcanics and confirmed the existence of a wide argillized zone accompanied by pyrite dissemination, but promising Au mineralization could not be confirmed.

(8) The circular depression extracted in southern Mba-west as photogeological annular structure is believed to have been the center of volcanic activity from the distribution of the volcanic products and intrusive bodies. A large scale medium-wavelength gravity high is distributed throughout this area. This gravity high is believed to reflect high density rock bodies (deep-seated bedded basic intrusive bodies) formed by the solidification of the magma chamber which supplied the volcanic products of this area. The above annular structure is located near the center of this high gravity anomaly.

(9) There is a photogeological dome structure. Plutonic monzonite and the dome occur within the annular structure in southern Mba-west, this is considered to be the evidence of uplift of the structure after the effusion of the volcanic products. The process of formation of this structure is inferred as follows. First, volcanic collapsed structure was formed in relation to the effusion of volcanic material. Subsequently the depressed structure was uplifted by the rise of magma, resulting in the extinction of the clear collapsed structure.

(10) Monzonite and andesite intruded into basaltic volcanic products near the above annular structure in southern Mba-west. This is believed to indicate the differentiation from basaltic to andesitic magma in the magma chamber after the effusion of the volcanic products.

(11) The monzonite bodies are arranged in the NNE-SSW direction in southern Mba-west, and thus it is inferred that, at the time of the intrusion (4.96 ± 0.30 Ma), extensional deep fractures were formed in that direction by

maximum horizontal compressional stress. This inferred stress field coincides with that of Pliocene obtained by photogeological analysis.

(12) Many lineaments of Mba-west are developed near the inferred volcanic centers in north and south, also lineaments with various trends are developed within the photogeologic annular structures. Also in short-wavelength low gravity zones and in parts of the short-wavelength high gravity zones, lineaments parallel to the elongation of the zones are developed in and near the zones. This is interpreted as reflecting fractures which were developed as the result of the vertical block movement accompanying the rise of magma.

(13) Propylitized zones and sericitized zones are developed near the southern photogeological annular structures, and geochemical anomalies related to Au mineralization and auriferous quartz veins occur overlapping some of these altered zones. These features regarding geologic structure and mineralization/alteration are very similar to those of the Emperor Mine area. It is anticipated that low sulfidation epithermal gold mineralization akin to that of the Emperor Mine would exist in this area.

(14) Photogeological caldera structures are extracted at three localities in northern Mba-west and volcanic products are distributed in the vicinity. These calderas all occur in short-wavelength high gravity zones. This reflects the fact that these calderas are crater and/or volcanic collapsed structures and that the short-wavelength highs are caused by shallow high density rocks. These shallow bodies are considered to be small magma chambers formed as offshoots of the large, deeper chamber whose existence is inferred from medium-wavelength gravity high.

(15) Acidic alteration zones accompanied by silicification are developed in some of the photogeological calderas in northern Mba-west. Geochemical anomalies related to Au mineralization occur overlapping these altered zones. This is of the high sulfidation epithermal gold mineralization. This type is considered to form under shallower environment than the low sulfidation type. The results of drilling at Namosau Alteration Zone of this year, showed that the deposits could have been eroded out. But the conditions of the lower parts of the Raviravi Alteration Zone is not clear, and the possibility of the occurrence of gold deposits still exists.

The high sulfidation type mineralization/alteration also occur in short-wavelength high gravity zone at the southeastern border of Mba-west.

(16) The mineralization of Mba-west was brought about by hydrothermal

activities related to Pliocene volcanism. And it is considered that high sulfidation type epithermal gold mineralization occurred above the shallow small magma chamber while low sulfidation type occurred near the volcanic center in the central part of the deep and large chamber.

[Sigatoka Area]

Gravity survey, geological survey and geochemical prospecting were carried out. The following conclusions were obtained.

(1) The geology of Sigatoka consists of; Miocene basaltic and/or andesitic volcanic products, and detrital sediments; Pleistocene (?) fluviatile sediments; and intrusive bodies (granodiorite porphyry-diorite porphyry, granodiorite, diorite, diorite porphyry, quartz porphyry, aplite, basalt, andesite, dacite, and rhyolite) penetrating the Miocene Series. The Miocene units largely dip southwestward and are superposed.

(2) The major faults of Sigatoka area have trends (E-W to WNW-ESE) similar to the direction of the elongation of the Colo Plutonic Suite (WNW-ESE), there are, however, a few which intersect them at oblique angles. The major faults transect the relatively old porphyry bodies (10.1 ± 1.6 Ma) of Colo Plutonic Suite, and, in turn, is transected by younger plutonic bodies (8.1 ± 0.3 Ma). This indicates that the activities of the fault and the Colo Plutonism overlap.

To the south of Colo Plutonic Suite, dykes occur en echelon in the NW-SE to E-W direction and the existence of right lateral faults are inferred.

(3) The trends of the SLAR lineaments of Sigatoka are NW-SE, WNW-ESE, and NE-SW. There are Colo Plutonic Suite bodies with elongation similar to these lineaments in respective areas.

(4) Most of the mineralized/altered zones occur near the above faults, near the Colo Plutonic Suite bodies, near the SLAR lineaments, and near the en echelon dykes. Also some of them occur within the Colo Plutonic Suite bodies.

(5) Four large geochemical anomalous zones were extracted in the Sigatoka area. These four zones coincide with the surface mineralized/altered zones, and many other small anomalies were also extracted. These are believed to be anomalies related to the activities of the Colo Plutonic Suite which occur extensively below.

(6) The mineralization of the Sigatoka area is closely related to the activities of the Colo Plutonic Suite and they are emplaced in fractured zones in the vicinity of the plutonic and porphyry bodies, thus, it is considered that the mineralization took the form of veins, replacement, porphyry, and other types of meso- to hypothermal activity.

(7) The intensity of the mineralization/alteration is weak with some exceptions. The intensity of the geochemical anomalies is also generally low. Many of the altered zones and anomalies have been drilled without significant success. There are two undrilled localities where multi-component anomalies are noted. If large deposits are anticipated, the weak surface manifestation indicates deep occurrences.

[Gravity Survey]

Gravity survey was conducted in the southern part of Viti Levu Island, and analysis was carried out from the data of the first and second phase surveys. The following conclusions are obtained.

(1) Medium-wavelength gravity features indicate that large scale gravity highs with circular to oval shape occur isolated in a generally low gravity area to the north of the NE-SW trending line joining Verevere in the northeast and Sigatoka in the southwest. While to the southeast of the above line, alternating high and low anomaly belts occur elongated in the NE-SW direction. Thus the gravity features of the two areas are clearly different. The westernmost high anomaly southeast of Nadi in the northwestern part coincides well with the distribution of the Yavuna Group, but the other three highs cannot be correlated with surface geology. The zonal distribution of the high and low anomalies in the southeast more or less coincides with the distribution of the "Wainimala Group - Colo Plutonic Suite" and "Medrausucu Group - Verata Sedimentary Group".

(2) There are large medium-wavelength gravity highs at three localities, southwest of Mba, east of Vatukoula, and west of Rakiraki. Annular, caldera, dome structures identified photo-geologically and collapsed structures, intrusive bodies, altered zones, and marked short-wavelength gravity anomalies are concentrated in the centers of these medium-wavelength gravity highs.

The gravity gradient of the peripheral parts of these medium-wavelength highs is steep and the shape of these anomalies is circular to oval. These facts indicate the existence of subsurface high density igneous bodies and it is inferred that there was a large magma chamber in the deeper parts.

(3) The Emperor Mine is situated at the periphery of the collapsed structure. The structure is in the center of the medium-wavelength gravity high to the east of Vatukoula. The Kingston Mine is situated in the center of the medium-wavelength gravity high to the southwest of Mba.

Together with the gravity high west of Rakiraki, the centers of these medium-wavelength gravity highs are considered to be the localities where active volcanism occurred repeatedly. Therefore, these are listed as promising for epithermal gold exploration. The anomalies in northern Mba-west are the northern extension of the medium-wave-length gravity high in southwest Mba.

With the coincidence of SLAR annular and caldera structures and the short-wavelength gravity highs, it is believed that small magma chambers branched out from the large magma chamber were active in northern Mba-west. The area is listed as promising for epithermal gold deposit occurrence.

1-2-2 Recommendations for the Third Phase Survey

It is recommended that the following activities be undertaken during the third phase survey.

(1) Drilling at Yaloku and Nalotawa-Nanuku Alteration Zones in south Mba-west in order to confirm the conditions related to low sulfidation epithermal gold mineralization. These zones are located near the photogeological annular structures in south Mba-west.

(2) Drilling at Raviravi Alteration Zone in north Mba-west in order to confirm the conditions related to high sulfidation epithermal gold mineralization.

(3) Geophysical surveys in order to clarify the conditions of subsurface mineralization/alteration at several localities where small geochemical anomalies are not related to surface mineralization/alteration. And drilling if the above geophysical survey provides promising results

1-3 Outline of the Third Phase Survey

1-3-1 Survey Area

The third phase survey was carried out in the Mba-west area. It lies to the west and southwest of Mba which is in the northwestern part of Viti Levu (Figs. 1-2, 1-3 and 1-4)

The detailed survey was conducted at three geochemical anomaly zones, namely Nayanggali Creek, Nalotawa, and Yaloku Zones.

(1) Nayanggali Creek Anomaly Zone

This zone is located 15km west of Mba. Geological survey and drilling were conducted in this zone. Geological investigation was carried out for an area of $4km^2$ delineated by the following coordinates.

	Latitude	Longitude		Latitude	Longitude
(1) (3)	17°32.4' 17°33.5'	177°33.6' 177°33.6'	(2) (4)	17°32.4' 17°33.5	177°34.8' 177°34.8'

(2) Nalotawa Anomaly Zone

This zone is located 15km southwest of Mba. Geological survey and drilling were conducted in this zone. Geological investigation was carried out for an area of $6km^2$ delineated by the following coordinates.

	Latitude	Longitude		Latitude	Longitude
(1) (3)	17°37.0' 17°38.4'	177°36.5' 177°36.5'	(2) (4)	17°37.0' 17°38.4'	177°37.9' 177°37.9'

(3) Yaloku Anomaly Zone

This zone is located 20km southwest of Mba and 6km south of Nalotawa Anomaly Zone. Geological survey and drilling were conducted in this zone. Geological investigation was carried out in the vicinity of two drilling sites within and area of $7km^2$ delineated by the following coordinates.

	Latitude	Longitude		Latitude	Longitude
(1) (3)	17°40.3' 17°41.5'	177°37.0' 177°37.2'	(2) (3)	17°40.0' 17°40.9'	177°39.0' 177°39.1'

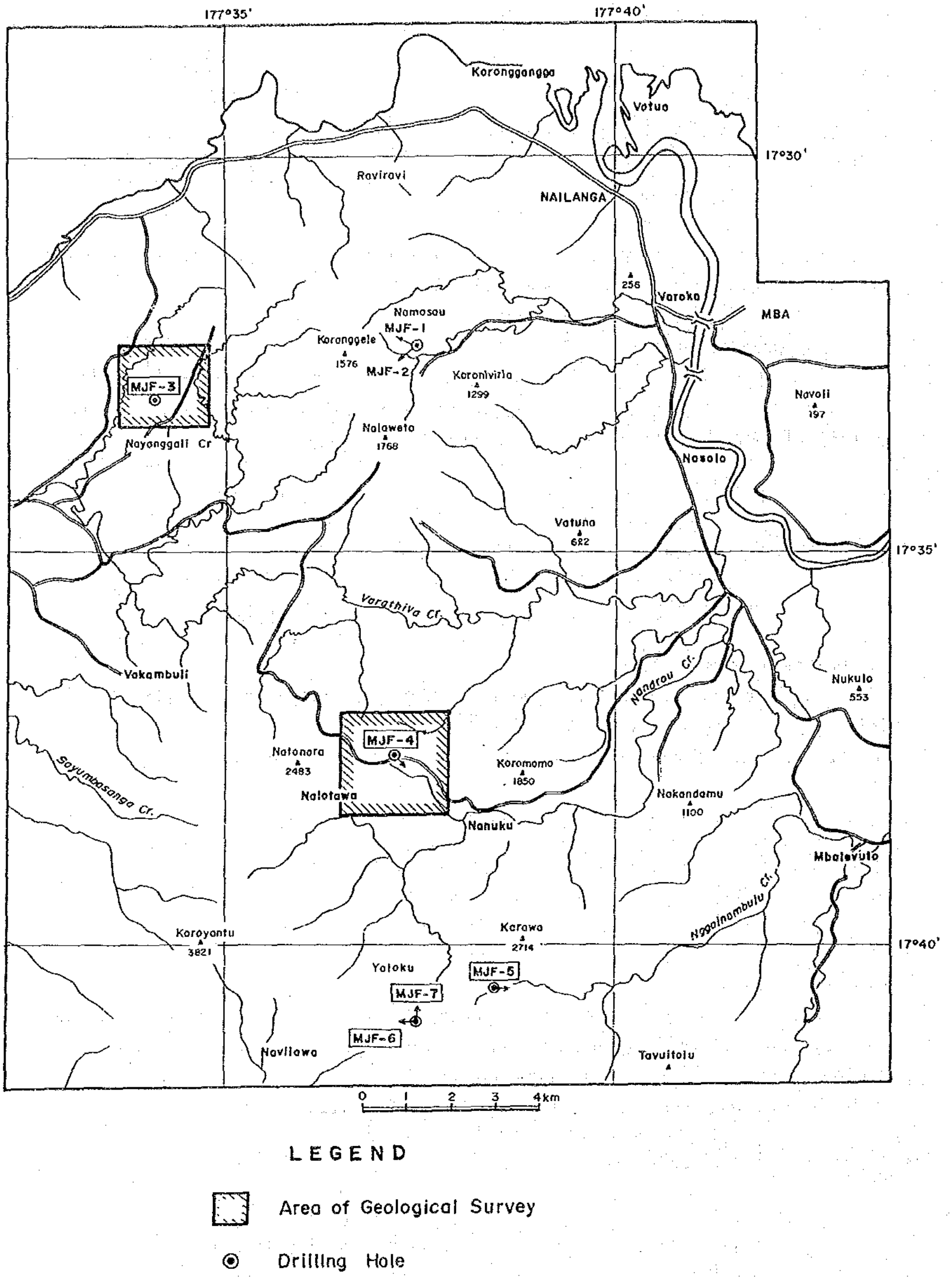
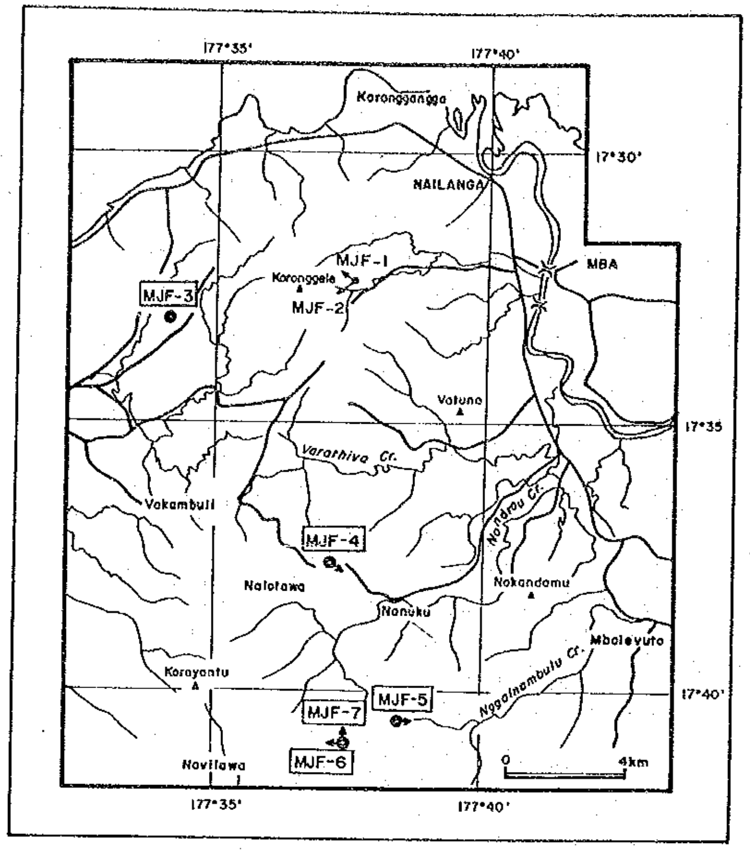
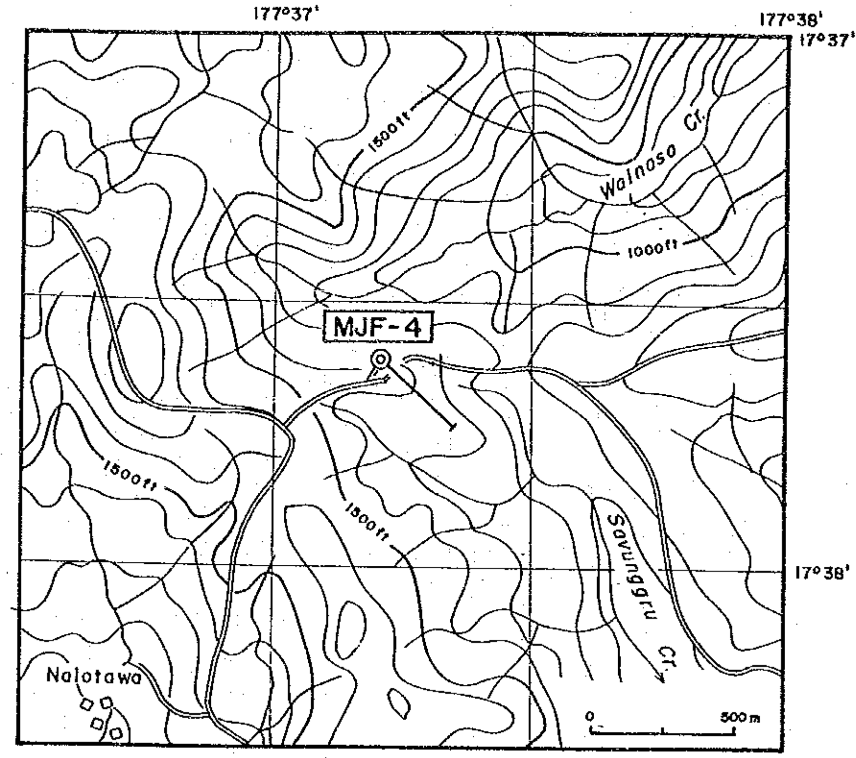
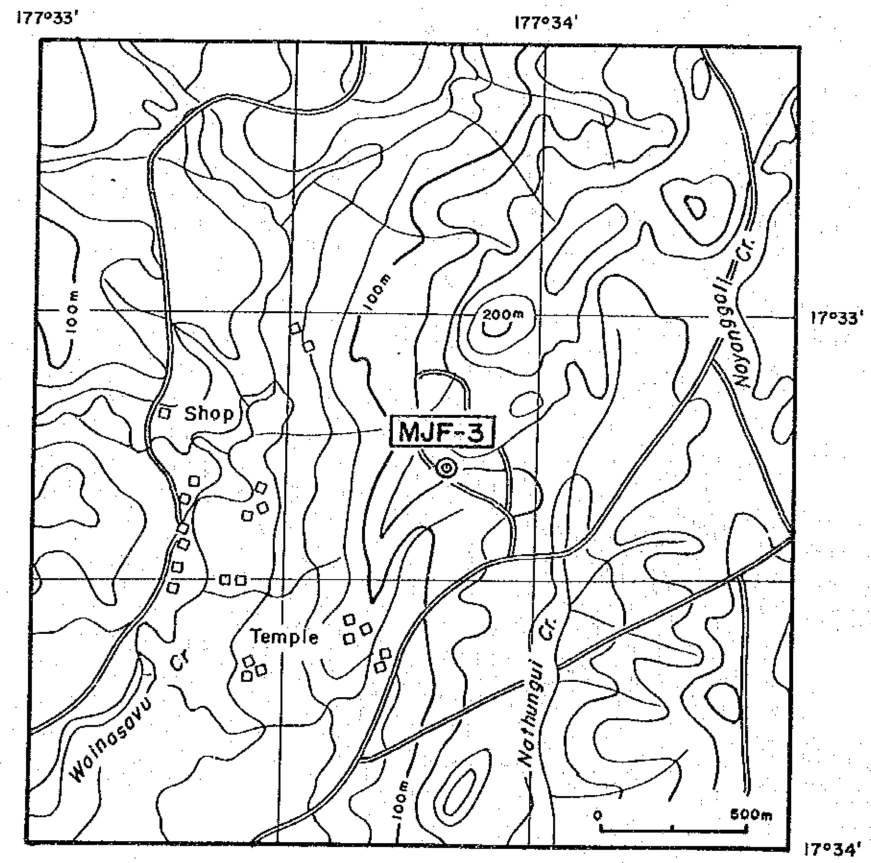


Fig. 1-3 Location Map of the Survey Area (Mba-west Area)







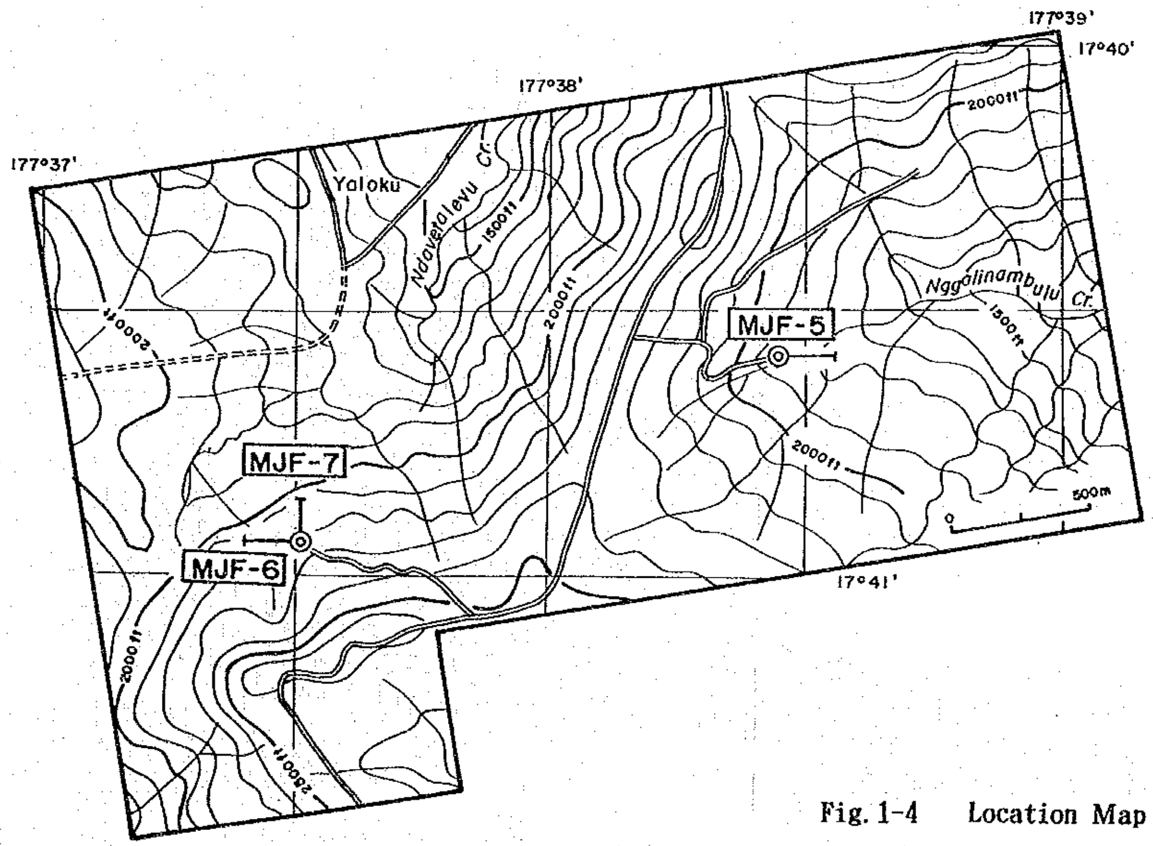


Fig. 1-4 Location Map of Drill Holes

1-3-2 Objectives of the Survey

The objectives of the third phase survey are to locate new ore concentration by clarifying the geology and the mineralization of the area considered to have relatively high mineral potential from the results of the second phase survey, and to transfer technology to the Fijian counterparts.

1-3-3 Survey Methods

The work carried out during the third phase comprises geological survey and drilling.

(1) Geological survey

The base camp for the survey was located at the western part of Mba.

For the field survey, route geology were plotted over 1:10,000 scale topographic maps prepared by enlarging 1:50,000 scale published maps. Where necessary, 1:2,000 scale route maps were prepared by 100m tape and Brunton-type compass.

Important outcrops were sketched at 1:100-200 scale and photographed in color.

Existing material such as aerial photographs and route maps of the previous year were fully utilized.

Regarding rocks with evidences of mineralization or alteration, representative samples were analysed chemically and by X-ray diffraction.

The results of the above work are summarized in mineralization maps.

(2) Drilling

a. Methods

HX single bit was used for drilling through the surficial weathered zone, reamed by HX casing metal shoe, and HX casing pipe was inserted. For deeper parts, wire-line method was used with NQ (ø 79mm) and BQ (ø 62) oversized bits. The encountered rocks were mainly basalt, andesite, tuff breccia, and propylite. As the upper weathered rocks are prone to collapse, casing pipe was extended until the rocks became stable. Regarding loss of circulation which occurred rather frequently during the operation, thick drilling mud mixed with Telstop and Multi seal were pressured into the hole to prevent the loss with satisfactory results.

With the exception of the surfacial soil, total core recovery was attempted. In cases where total recovery was not possible, at least 80% of the core was recovered.

b. Machinery

Drilling rig Kokenkogyo Type RK-3 was used. The specifications for the drilling rig, pump, and other machinery are listed in Table 1-1, the conditions of the diamond bits in Table 1-2 and the used consumables in Table 1-3.

c. Operations

Operations: Construction, moving, and withdrawal were done by one shift per day, while drilling was carried out by three eight hour shifts. Each shift consisted of one Japanese drilling engineer and three Fijian drillers. The Japanese team and the Fijian counterparts commuted by jeep for 30 - 40km from the base camp in western Mba.

Transportation of machinery: The drilling equipment stored in the MRD warehouse in Mba and supplementary material sent from Japan were transported to MJF-3 site by a truck with crane. Subsequent transportation was also done by a crane truck.

Drilling water: Waters from nearby streams were pumped up for drilling use. The pumped distances for each site are as follows.

	Length of water supply pipe	Height from head of a stream
MJF-3	330m	about 15m
MJF-4	460m	about 35m
MJF-5	80m	about 7m
MJF-6	580m	about 50m
MJF-7	580m	about 50m

Road construction: Drilling in Yaloku was decided after the completion of the MJF-4 Hole. Roads for transporting drilling equipment were constructed for a total of 1600m to Sites MJF-5, -6, and -7. A bulldozer (D 8), a loader, and a 10-ton dump truck were used. Parts of the existing road between Nanuku and Yaloku were repaired and graveled.

Drill core study: The recovered drill cores were studied in detail and 1:200 scale columns were prepared.

Representative rocks were sectioned and studied microscopically, the mineralized parts were chemically analysed and polished sections were

Table 1-1 Drilling Machine and Equipment Used

Drilling Machine Model "RK－3A"	1 set
Specifications:	
Capacity	500m (BQ－WL)
Dimensions L x W x H	2,260mm×1,050mm×1,560mm
Hoisting capacity	3,000kg
Spindle speed	Forward 50,120,220,355rpm
Engine Model "F3L912"	41ps／1,800rpm
Drilling Pump Model "WLMG－15h"	1 set
Specifications:	
Piston diameter	85mm
Stroke	75mm
Capacity	discharge capacity 190ℓ/min
Dimensions L x W x H	2,350mm×720mm×1,120mm
Engine Model "NFD－13E"	12.5ps／2,400rpm
Wire line Hoist Model "WLH－4"	1 set
Specifications:	
Rope capacity	500m
Hoisting speed	8～105m／min
Engine Model "NS－75C"	8ps／2,400rpm
Mud mixer Model "HM－250"	1 set
Specifications:	
Capacity	200ℓ／600rpm
Engine Model "NS－90C"	9ps／2,200rpm
Generator Model "YDG3005E"	1 set
Specifications:	
Capacity	2.7KW 50Hz 100V
Water supply pump Model "MG－5h"	1 set
Specifications:	
Piston diameter	68mm
Stroke	60mm
Capacity	discharge capacity 65ℓ／min
Dimensions L x W x H	1,630×465×675mm
Engine Model "NS－90C"	9ps／2,200rpm
Derrick	1 set
Specifications:	
Height	9.5m
Max load capacity	8,000Kg
Drilling tools	
Drilling rod NQ－WL 3.0m	60 pcs
BQ－WL 3.0m	140 pcs
Casing pipe HX 1.0m	10 pcs
NX－NW 1.0m	6 pcs
NX－NW 3.0m	20 pcs
BX－BW 1.0m	6 pcs
BX－BW 3.0m	60 pcs

Table 1-2 Drilling Meterage of Diamond Bit Used

Item	Size	Bit No.	Drilling Meterage by Unit:Meter					Total(m)
			MJF-3	MJF-4	MJF-5	MJF-6	MJF-7	
Diamond bit	HX-SW	12604	4.10	5.70	5.10	12.10	11.10	38.10
			4.10	5.70	5.10	12.10	11.10	38.10
		Total	Drilling length／bit (38.10m/1pc)					38.10
	NQ-WL	111331	63.70					63.70
		111332	53.20					53.20
		111333		97.30				97.30
		111334		37.10				37.10
		121429		40.20				40.20
		121430			74.40			74.40
		121431			50.00			50.00
		121432			20.70	17.10		37.80
		121433				45.80		45.80
		121434				41.00		41.00
		121435				34.20		34.20
		121436					44.30	44.30
		121437					63.00	63.00
		121438					31.80	31.80
			116.90	174.60	145.10	138.10	139.10	713.80
		Total	Drilling length／bit (713.80m/14pcs)					50.98
	BQ-WL	111336	39.60					39.60
		111337	40.40					40.40
		111338		63.20				63.20
		121441		31.30				31.30
		121442		65.50				65.50
		121443		60.70				60.70
		121444			46.20			46.20
		121445			46.30			46.30
		121446			58.30			58.30
		121447				39.50		39.50
		121448				31.10		31.10
		121449				25.20		25.20
		121450				54.90		54.90
		121451					43.10	43.10
		121452					42.10	42.10
		121453					38.70	38.70
		121454					26.90	26.90
			80.00	220.70	150.80	150.70	150.80	753.00
		Total	Drilling length／bit (753.00m/17pcs)					44.29
	Grand	Total	201.00	401.00	301.00	300.90	301.00	1,504.90
Diamond shoe	NX-NW (Reaming)	12618	23.00	24.40				50.40
		12619		3.00	10.00	27.00	8.00	45.00
			23.00	27.40	10.00	27.00	8.00	95.40
		Total	Reaming length／shoe (95.40m/2pcs)					47.70

Table 1-3 Consumables Used (1 of 2)

Description	Specifications	Unit	Quantity MJF－3	MJF－4	MJ－5	MJF－6	MJF－7	Total
Light oil		ℓ	730	2,490	2,120	2,600	2,080	10,020
Hydraulic oil		ℓ	30	-	10	-	20	60
Engine oil		ℓ	17	35	28	30	40	150
Gear oil		ℓ	10	2	4	6	10	32
Grease		kg	15	10	10	10	15	60
Bentonite	25kg/sx	kg	1,225	3,250	1,900	3,300	2,600	12,300
C. M. C	10kg/sx	kg	40	29	13	31	24	137
Telnite－BX	20kg/sx	kg	-	100	-	60	60	220
Tel－stop (G)	20kg/sx	kg	-	120	40	50	30	240
Tel－stop (P)	25kg/sx	kg	8	15	15	28	16	82
Seaclay	20kg/sx	kg	40	300	100	130	65	635
Mud oil	18ℓ/can	ℓ	20	180	90	108	64	462
Cement	40kg/sx	kg	560	480	480	640	480	2,640
Diamond bit	HX－SW	pc	1	(1)	(1)	(1)	(1)	1
Diamond bit	NQ－WL	pc	2	3	3	3	3	14
Diamond bit	BQ－WL	pc	2	4	3	4	4	17
Diamond reamer	HX－ST	pc	1	(1)	(1)	(1)	(1)	1
Diamond reamer	NQ－WL	pc	1	2	2	2	2	9
Diamond reamer	BQ－WL	pc	1	2	2	2	2	9
Casing diamond shoe	NX－NW	pc	1	1	(1)	(1)	(1)	2
Casing metal shoe	H X	pc	1	1	1	1	1	5
Casing metal shoe	N X	pc	1	1	1	1	1	5
Casing metal shoe	B X	pc	1	1	1	1	1	5
Core barrel Ass'y	NQ－WL	set	1	(1)	(1)	(1)	1	2
Core barrel Ass'y	BQ－WL	set	1	(1)	(1)	(1)	1	2
Inner tube Ass'y	NQ－WL	set	1	(1)	(1)	(1)	(1)	1
Inner tube Ass'y	BQ－WL	set	1	(1)	(1)	(1)	(1)	1
Outer tube	NQ－WL	pc			1			1
Outer tube	BQ－WL	pc			1			1
Inner tube	NQ－WL	pc			2		2	4
Inner tube	BQ－WL	pc			2		2	4
Locking coupling	NQ－WL	pc			1			1
Locking coupling	BQ－WL	pc			1			1
Adapter coupling	NQ－WL	pc			1			1
Adapter coupling	BQ－WL	pc			1			1
Landing ring	NQ－WL	pc			1			1
Landing ring	BQ－WL	pc			1			1
Core lifter case	NQ－WL	pc	2	4	6	4	4	20
Core lifter case	BQ－WL	pc	2	4	6	4	4	20
Core lifter	NQ－WL	pc	2	6	6	4	4	22
Core lifter	BQ－WL	pc	2	8	6	6	6	28

Table 1-3 Consumables Used (2 of 2)

Description	Specifications	Unit	Quantity					
			MJF−3	MJF−4	MJ−5	MJF−6	MJF−7	Total
Stop ring	NQ−WL	pc	2	4	4	4	4	14
Stop ring	BQ−WL	pc	2	4	4	4	4	14
Thrust ball bearing	NQ−WL	pc	2	4	6	4	4	20
Thrust ball bearing	BQ−WL	pc	2	4	6	4	4	20
Hanger bearing	NQ−WL	pc	2	2	4	2	2	12
Innertube stabilizer	NQ−WL	pc	1	2	3	2	2	10
Innertube stabilizer	BQ−WL	pc	1	2	3	2	2	10
Chack piece	NQ−WL	set	1	(1)	1	(1)	(1)	2
Chack piece	BQ−WL	set	1	(1)	1	(1)	(1)	2
Cylinder liner	MG−15h 85mm	pc	2		2		2	6
Cylinder liner	MG− 5h 65mm	pc		1		1		2
Piston rod	MG−15h	pc	2	2	2		2	8
Piston rod	MG− 5h	pc		1		1		2
Piston rubber	MG−15h 85mm	pc	4	8	4	4	4	24
Piston rubber	MJ− 5h 65mm	pc	2	2	2	2	2	10
V−packing	MG−15h	pc		14		14		28
V−packing	MG− 5h	pc		7		7	7	21
Hoisting wire rope	20mm x 25m	roll		1	1		1	3
Wire line rope	6mm x 500m	roll	1		1			2
Open wire	#-16(1.6mm)	kg	5	5	5	5	12	32
Galvanized wire	#-10(3.2mm)	kg	10	15	15	15	25	80
Waste		kg	10	15	25	20	40	110
Core box	NQ−WL	pc	19	29	22	22	24	116
Core box	BQ−WL	pc	11	30	23	20	20	104

Table 1-4 Working Time Analysis of the Drilling Operation

Hole	Drilling			Shift		Working man		Working Time							
	Bit No.	Drilling size (m)	Core length (m)	Drill-ing (shift)	Total (shift)	Engin-eer (man)	Worker (man)	Drilling (h)	Other working (h)	Recove-ring (h)	Total (h)	Reassem-blage (h)	Dismant-lement (h)	Road con-struction and Tran-sportation (h)	G. Total (h)
MJF-3	HX	4.10	-	1	9	33	80	1°00′	2°30′	-	3°30′	70°00′	-	-	73°30′
	NQ	116.90	105.50	12	13	17	52	69°40′	38°50′	-	108°30′	-	-	-	108°30′
	BQ	80.00	80.00	10	11	15	50	58°00′	22°00′	-	80°00′	-	9°00′	-	89°00′
	Total	201.00	185.50	23	33	65	182	128°40′	63°20′	-	192°00′	70°00′	9°00′	-	271°00′
MJF-4	HX	5.70	-	1	11	40	140	2°00′	2°00′	-	4°00′	91°30′	-	-	95°30′
	NQ	174.60	156.10	22	22	31	92	117°20′	56°40′	2°00′	176°00′	-	-	-	176°00′
	BQ	220.70	220.70	31	42	81	182	178°10′	105°50′	-	284°00′	-	12°00′	40°00′	336°00′
	Total	401.00	376.80	54	75	152	414	297°30′	164°30′	2°00′	464°00′	91°30′	12°00′	40°00′	607°30′
MJF-5	HX	5.10	-	1	12	46	109	1°10′	2°30′	-	3°40′	42°00′	-	48°00′	93°40′
	NQ	145.10	142.90	17	17	22	68	99°20′	41°00′	-	140°20′	-	-	-	140°20′
	BQ	150.80	150.80	18	20	28	84	109°50′	43°10′	-	153°00′	-	7°00′	-	160°00′
	Total	301.00	293.70	36	49	96	261	210°20′	86°40′	-	297°00′	42°00′	7°00′	48°00′	394°00′
MJF-6	HX	12.10	-	1	5	18	54	2°40′	5°20′	-	8°00′	35°00′	-	-	43°00′
	NQ	138.10	126.40	17	17	22	68	88°40′	42°00′	5°00′	135°40′	-	-	-	135°40′
	BQ	150.70	150.70	21	22	32	93	115°50′	50°30′	2°00′	168°20′	-	9°00′	-	177°20′
	Total	300.90	277.10	39	44	72	215	207°10′	97°50′	7°00′	312°00′	35°00′	9°00′	-	356°00′
MJF-7	HX	11.10	-	1	3	10	28	4°00′	4°00′	-	8°00′	18°00′	-	-	26°00′
	NQ	139.10	135.00	16	16	21	64	99°00′	29°00′	-	128°00′	-	-	-	128°00′
	BQ	150.80	150.80	20	30	69	178	114°40′	45°20′	-	160°00′	-	8°00′	77°00′	245°00′
	Total	301.00	285.80	37	49	100	270	217°40′	78°20′	-	296°00′	18°00′	8°00′	77°00′	399°00′
Grand Total		1,504.90	1,418.90	166	250	485	1,342	1,061°20′	490°40′	9°00′	1,561°00′	256°30′	45°00′	125°00′	2,027°30′

studied microscopically. Also constituent minerals were identified using X-ray diffraction when necessary.

Surface outcrops were investigated and correlated with the cores as necessary.

Withdrawal: Drilling was completed on 8 December and withdrawal was planned to begin on the 10th. The area, however, was struck by a cyclone on the scheduled day and transportation by vehicles became impossible because of the rise of the water level of the rivers. At the same time, parts of the newly constructed roads were damaged and repair by bulldozer became necessary. We began withdrawal on the 15th, but the road was softened by the continuous rain rendering truck movement difficult. Thereby the truck was towed by bulldozer parts of the way. The withdrawal equipments were gathered at the MRD base in Mba, packed, transported to Lautoka Port on the 19th of December and sent through customs procedure. All the drill cores are stored in MRD warehouse in Suva.

(3) Contents of survey and amount of work

Survey Method	Area	Amounts
Geological Survey	Mba-west	Areal extent 10 km^2 Length of traverse 10.5 km Laboratory work X-ray diffraction analysis 3 samples Ore assay 44 samples (277 elements)
Drilling	Mba-west	Number of drill holes 5 holes Total length drilled 1504.9 m Laboratory work Thin section microscopy 21 sections Polished section microscopy 15 sections X-ray diffraction analysis 55 samples Ore assay 159 samples (976 elements)

1-3-4 Participants of the Third Phase Survey

Field Supervisor

Katsuo YOKOYAMA (Metal Mining Agency of Japan)
Takechiyo TAKATA (Metal Mining Agency of Japan)
Osamu TSUKAMOTO (Metal Mining Agency of Japan)

Survey Team

Fijian members (Mineral Resources Department)

Alf SIMPSON	(Director, Coordinator)
Don J. FLINT	(Coordinator)
Suli NIUROU	(Coordinator, Geological and geochemical survey)
Subashni DEO	(Geological survey, Coordinator)

Japanese members (Nikko Exploration and Development Co.,Ltd.)

Masaaki SUGAWARA	(Team leader, Geological survey, Drilling)
Yukio KAWAMURA	(Drilling)
Mitsuo SASAKI	(Drilling)
Yoshiki IMURA	(Drilling)

1-3-5 Duration of the Survey

Field survey	
Geological survey	15 Aug -- 4 Aug 1992
Drilling	15 Aug -- 19 Dec 1992
Laboratory work, report preparation	25 Sep -- 25 Feb 1993

Chapter 2 Geography of the Survey Area

2-1 Topography and Drainage

2-1-1 Topography of Mba-west

The southwestern margin of this area belongs to a part of the Mt. Evans Range and has a very rugged topography with elevation of 800 - 900m. The Yaloku Altered Zone is located on the northern steep slope (elevation, 400-750m) of the ridge which extends in the ESE direction from the eastern edge of the Mount Evans Range. The vicinity of Nalotawa, Nanuku, and Yaloku Villages in the southern part of this area is in the periphery of the Mount Evans Range and has a topography with abundant relief between 300 to 500m.

The relative topographic high of this area extends northward from Nalotawa and forms the drainage divide between the Mba area to the east and Lautoka area to the west. The Nalotawa Altered Zone is developed on the steep slope on the eastern side of this divide.

In the northern part of this area, a topographic high of around 450m elevation including Mt. Koronggele is distributed in a semi-circle opening eastward. Also in the northwesternmost part of the area, a high of 150-200m elevation continuing to Mt. Koroivunatoto further west is distributed in a semi-circle opening northward. The geochemical anomaly zone of Nayanggali Creek is located in the gentle hills (elevation, about 100m) between the above two high lands.

Low hills and lowland occupy the 2km wide area between the northern coast and the inner part of the area and deltas occur along the coastal zone.

2-1-2 Drainage System of Mba-west

Mba River meanders from the southeast to northwest in the eastern part of this area. The drainage system of this area all belong to this river system with the exception of the northwestern part and the northern coastal zone. Relatively large rivers flow in this area with fairly large discharge throughout the year, they are; Nggalinambulu Creek, and Nandrou Creek in the south, Varathiva Creek in the central part and Namosau Creek in the north. The tributaries of these rivers usually have low discharge and many are underflows.

The Yaloku Altered Zone is situated in the uppermost reaches of Nggalinambulu and Nandrou Creeks and the Nalotawa Alteration Zone in the uppermost reaches of Wainasa Creek which is a tributary of the Varathiva Creek. On the other hand, the Nayanggali Geochemical Anomalies occur in the upper reaches of the Teidamu Creek which belongs to the drainage system of the Lautoka area.

2-2 Climate and Vegetation

2-2-1 Climate

As Fiji belongs to the tropical rain forest climatic zone, it has two seasons, dry (May-October) and rainy (November-April). Also the country is located in the monsoon zone, and there is a southeasterly trade wind throughout the year. Since there is a highland with an altitude of around 1,000m extending in the N-S to ENE-WSW direction in the central part of Viti Levu, precipitation is high in the southeastern side of the island - over 200 days of rain every year -, and annual precipitation reaches 5,000mm in the Namosi district, while the northwestern side is relatively dry with the temperature often approaching 40°C.

The Mba-west area in the northwestern part of Viti Levu belongs to the drier areas, but during the wet season strong rainfall is not uncommon and heavy rain due to cyclones is observed. The annual precipitation in the southern part of Mba-west reaches 3,000mm.

The monthly mean temperature and precipitation observed at Nadi in western Viti Levu over 30 years (1951-1980) is shown below.

1990

	Jan	Feb	Mar	Apl	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Average(°C) Temperature	26.6	26.6	26.3	25.7	24.6	23.8	23.0	23.2	24.0	24.8	25.6	26.2	25.0
Average(mm) Precipitation	313.8	292.5	367.4	172.3	83.7	77.9	51.9	58.1	92.9	96.9	168.9	168.9	1912.6

The average annual precipitation over 47 years (1942 - 1989) is 3,036 mm in Suva and 1,849 mm in Nadi.

2-2-2 Vegetation

Viti Levu belongs to the tropical rain forest zone, but from the west to the northeastern part of the island including the Mba-west area, the low land and low hills are almost all cultivated for sugar cane. Jungles remain along the creeks and in the mountainous areas. Also reforested pines and 2m high reeds often cover the relatively low and high parts of the mountains.

The Yaloku Alteration Zone is mostly covered by jungle with partly thick reed cover in the eastern part.

In the Nalotawa Altered Zone, jungle exists along the creeks with pine and thick reeds in the mountains.

In the Nayanggali Creek Geochemical Anomaly Zone, lower parts are sugar cane fields and the relatively high parts are pine forests and shrubs with minor jungles along the creeks.

Chapter 3 General Geology

3-1 Geology of Viti Levu and its Vicinity

The geology of Viti Levu and its vicinity was reviewed after Rodda

(1989) during the first phase of this project in 1990.

The geological units constituting the Fijian Islands are all of Cenozoic Era and the oldest rock is Eocene limestone and volcanics in Viti Levu and the youngest is the effusive rocks of historical times in Taveuni Island.

Plate tectonically, The Fijian Islands form an island arc which is situated in the eastern margin of the Australia-India Plate and is a part of the Lau Ridge where it bends from ENE-WSW to N-S trend. The ENE-WSW trending left lateral Fiji Transform Fault occurs to the north of Viti Levu and there is the NE-SW trending Hunter Fracture Zone (a left lateral transform fault). Also WNW trending left lateral transform fault is considered to extend from the eastern edge of the Hunter Fracture Zone between Viti Levu and Vanua Levu (Tectonic Map of the Circum Pacific Region, Southwest Quadrant, 1991). Northern Fiji is considered to be rotating counter clockwise by the expansion of the North Fiji Basin to the west of Viti Levu and the eastern movement of the Australia-India Plate. This rotation is believed to have started during Late Miocene to Early Pliocene time.

The geologic units constituting Viti Levu are: Late Eocene-Early Oligocene Yavuna Volcanics (basaltic effusives, dacitic effusives, limestone) and tonalite; Late Oligocene-Middle Miocene Wainimala Group (basaltic effusives, dacitic effusives, limestone, sandstone, conglomerate, mudstone), Savura Volcanic Group (basaltic effusives, dacitic effusives); Middle-Late Miocene Colo Plutonic suite (tonalite, diorite, granodiorite, gabbro), Late Miocene Tuva Group (sandstone, conglomerate, andesites), Ra Sedimentary Group (sandstone, mudstone, conglomerate), Nadi Sedimentary Group (andesitic pyroclastics, sandstone marl), Navosa Sedimentary Group (conglomerate, sandstone, mudstone, andesitic effusives); Late Miocene-Early Pliocene Medrausucu Group (conglomerate, sandstone, mudstone, limestone, marl, tuff, andesitic effusives, basalt, intermediate to silicic porphyries), Koroimavua Volcanic Group (basaltic effusives, andesitic effusives, sandstone, conglomerate, monzonite), Cuvu Sedimentary Group (sandstone, siltstone, limestone, marl); latest Miocene- Early Pliocene Ba Volcanic Group (greywacke, siltstone, sandstone, basaltic effusives, andesitic effusives, monzonite, diorite, gabbro); Late Pliocene-early Pleistocene Verata Sedimentary Group (conglomerate, sandstone, siltstone, tuff); Pleistocene Ucuna Limestone; Pleistocene-early Holocene fluviatile deposits; and late Pleistocene-Holocene alluvial sediments and beach sands.

The geological units of Viti Levu can be largely grouped stratigraphically into; Late Eocene-Early Oligocene volcanics, Early-Middle Miocene volcanic and sedimentary rocks and latest Miocene-Late Pliocene volcanic and sedimentary units. Usually, sedimentary formations are lacking between the above units and orogenic movements accompanied by intrusive activities occurred at those times.

Vein, network dissemination, porphyry copper, replacement, skarn and sedimentary type mineralization occur in Viti Levu.

The vein and dissemination types are grouped into epithermal gold and meso-hypothermal base-metal mineralization. The epithermal group is further classified into low sulfidation (adularia-sericite) type and high sulfidation (acidic sulfate) type. The epithermal gold mineralized zones in the Mba Volcanic Group (Uppermost Miocene-Upper Pliocene) and Koroimavua Volcanic Group (Upper Miocene-Lower Pliocene) occur near the volcanic centers.

The epithermal gold mineralized zones are distributed in the ENE-WSW direction from the northern to western Viti Levu.

The porphyry copper type mineralization is classified into the plutonic and volcanic types.

The volcanic type porphyry copper mineralized zones occur within and the vicinity of the latest Miocene to Early Pliocene volcano-plutonic complex (Namosi Andesite of Medrausucu Group, Sabeto Volcanics - Navilawa Stock - Nawainiu Intrusive Complex of Koroimavua Volcanic Group).

The plutonic type porphyry copper and the meso to hypothermal base metal mineralized zones occur within and the vicinity of the Middle to Late Miocene Colo Plutonic Suite.

The skarn type mineralization occurs in the contact zone of the Colo Plutonic Suite and Wainimala Group limestone. The replacement type mineralization occurs in the Wainimala Group in the vicinity of the Colo Plutonic Suite.

Sedimentary mineralization is divided into massive sulfide, bedded manganese, residual and placer type concentration.

The massive sulfide mineralization is strata-bound type which occurs in pyroclastics of the Wainimala Group formed by submarine volcanic activity.

The major bedded manganese deposits are stratabound type which occur in the bedded volcano-sedimentary formations of the Wainimala Group. These also tend to occur near the replacement and skarn type mineralized zones.

The residual deposit found in Viti Levu is a small bauxite deposit formed by lateritic weathering of basaltic pyroclastics of the Ba Volcanic Group.

The placer deposits in Viti Levu are gold concentration in alluvium and iron oxides in deltas and sand dunes.

The most important known mineralization in Viti Levu is the gold veins of low-sulfidation epithermal type of the Emperor Mine and the porphyry copper deposit of Namosi. The former occurs in the fissures at the periphery of a caldera and the latter is associated with an intrusive body. In the SLAR imageries, annular and caldera structures were identified in the area of the above two mineralized zones and dome structures were observed in the area of the Namosi deposit.

3-2 Geology of Mba-west Area

The geology of this area consists of Miocene-Pliocene Series, Pliocene Series, Holocene Series, and intrusive bodies in the Pliocene formations. The stratigraphic classification is after Rodda (1989).

The Miocene-Pliocene Series consists of Sabeto Volcanics of the Koroimavua Volcanic Group. It is composed of andesitic volcanic products, basalt lava, and others. The Pliocene Series consists of the following units from the lower horizon upward. Koroyanitu Volcanic Products, Saru Formation, Namosau Volcanics, Karavi Volcanics, and Wainatio Volcanic Products. Koroyanitu Volcanic Products consists mostly of volcanic products of basaltic nature. Saru Formation consists of basaltic volcanic products, andesite lava, and sandstone-conglomerate deposits. Namosau Volcanics is composed of volcanic rocks of basaltic nature. Karavi Volcanics consists of volcanic rocks of andesitic nature. Wainatio Volcanic Products consists of volcanic rocks of basaltic nature. Holocene Series consists of alluvium deposits comprising sand, pebbles and clay.

The intrusive rocks are; monzonite and dacite which intrude into Koroyanitu Volcanic Products, andesite dykes which intrude into Karavi Volcanics and basalt dykes which intrude into Wainatio Volcanic Products.

The formations of this area are generally superposed with gentle northward dip with local gentle fold structure (Fig. 1-7).

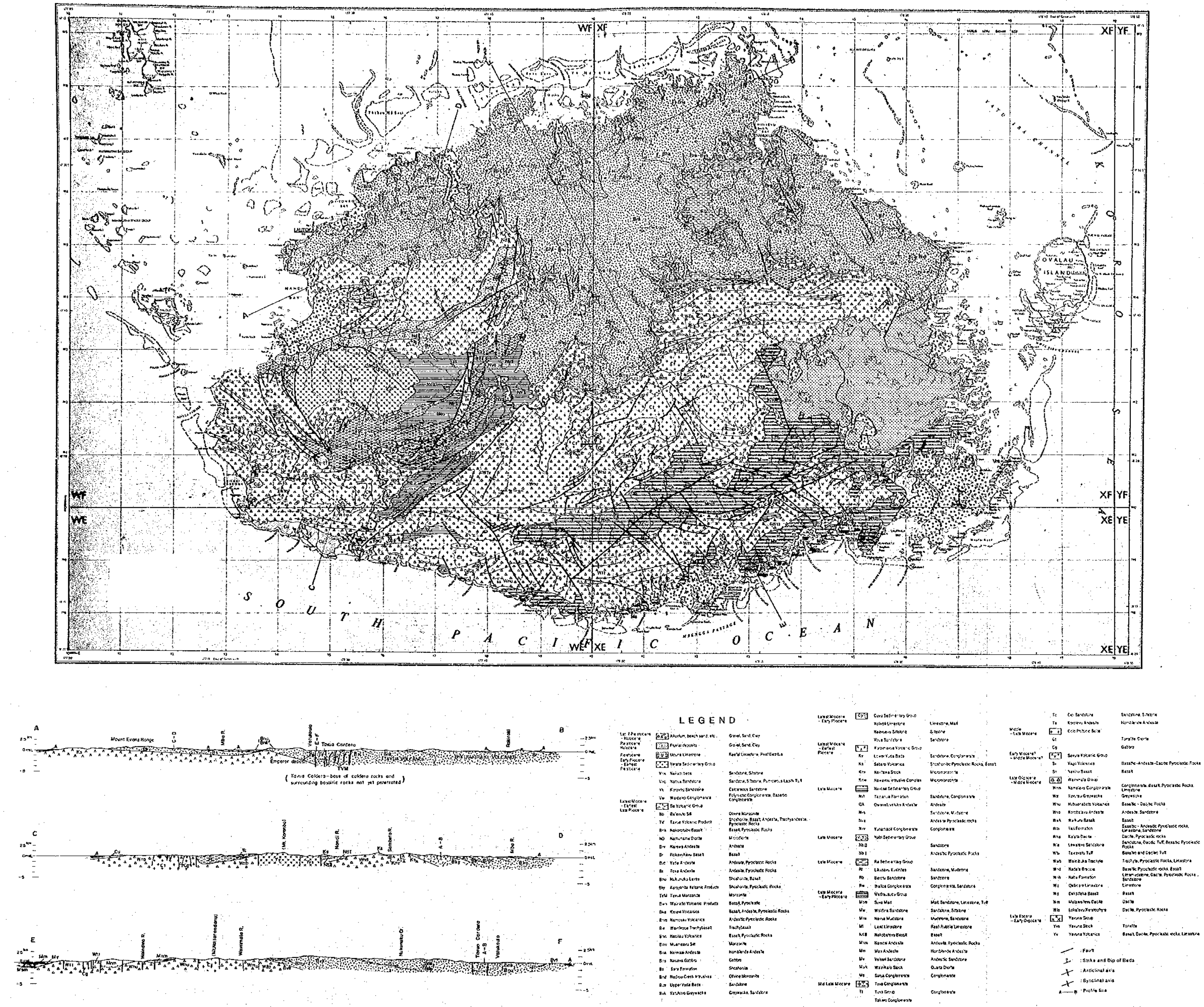


Fig. 1-5 Geological Map with Geological profiles of Viti Levu Island

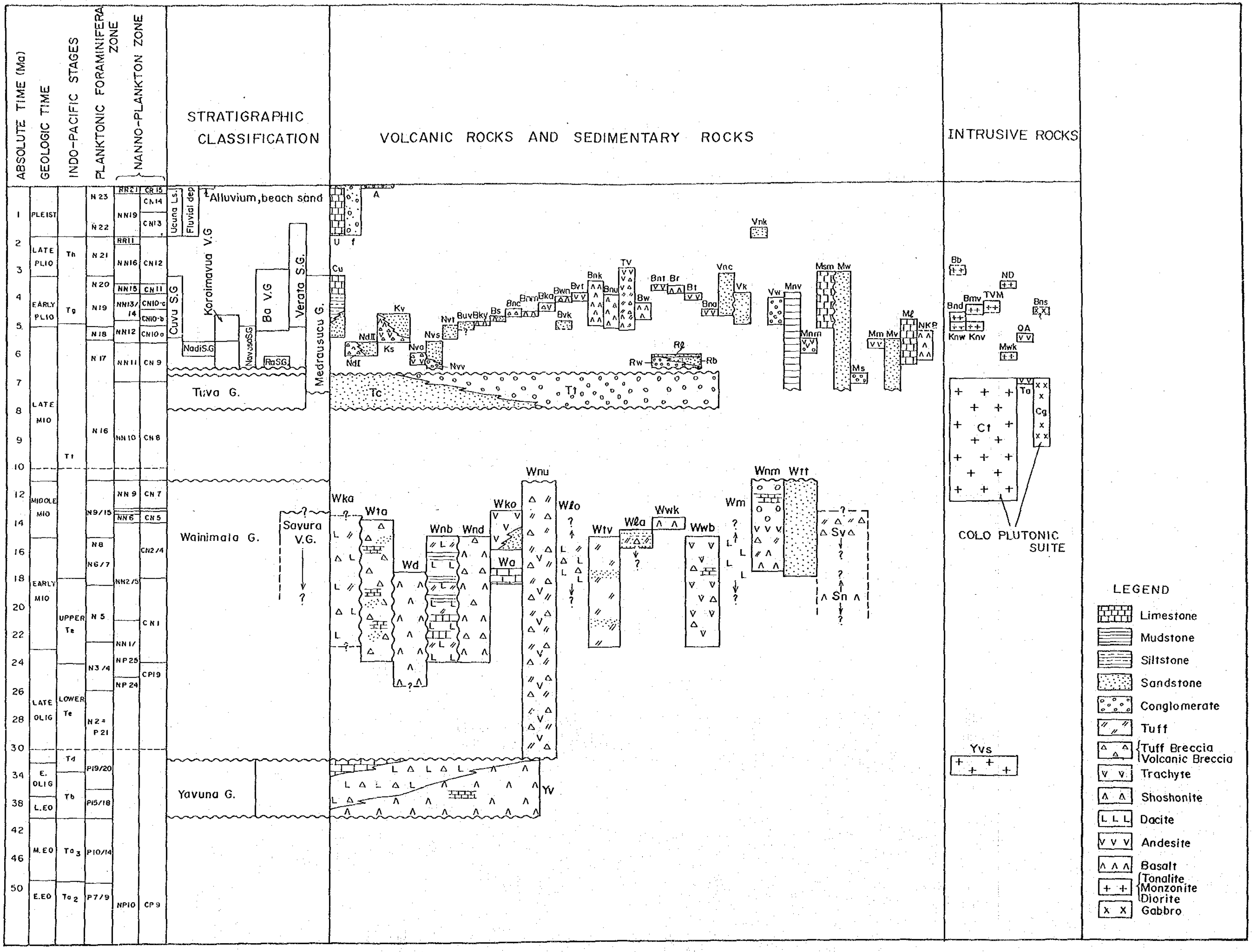
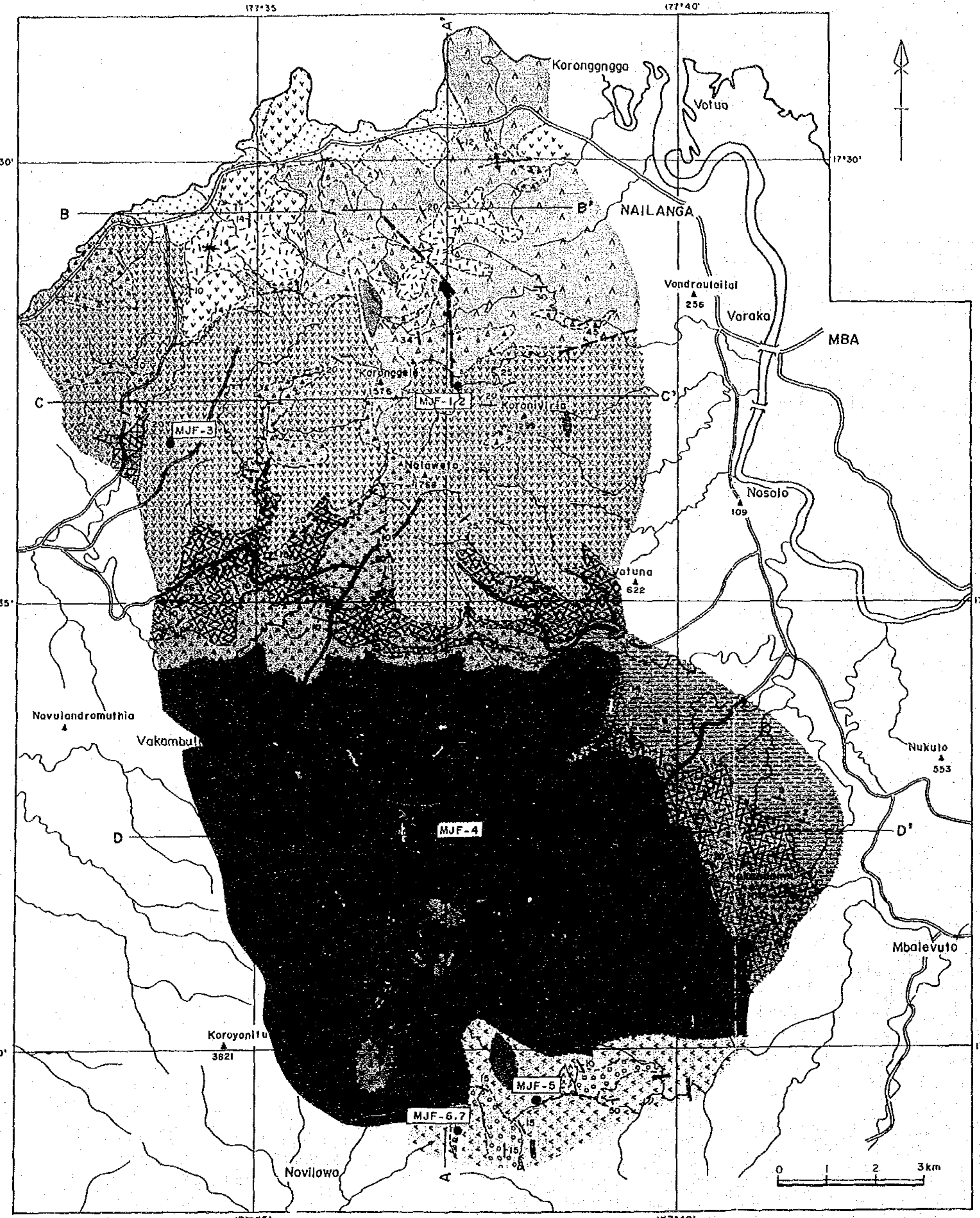


Fig. 1-6 Schematic Stratigraphic Columns of Viti Levu Island



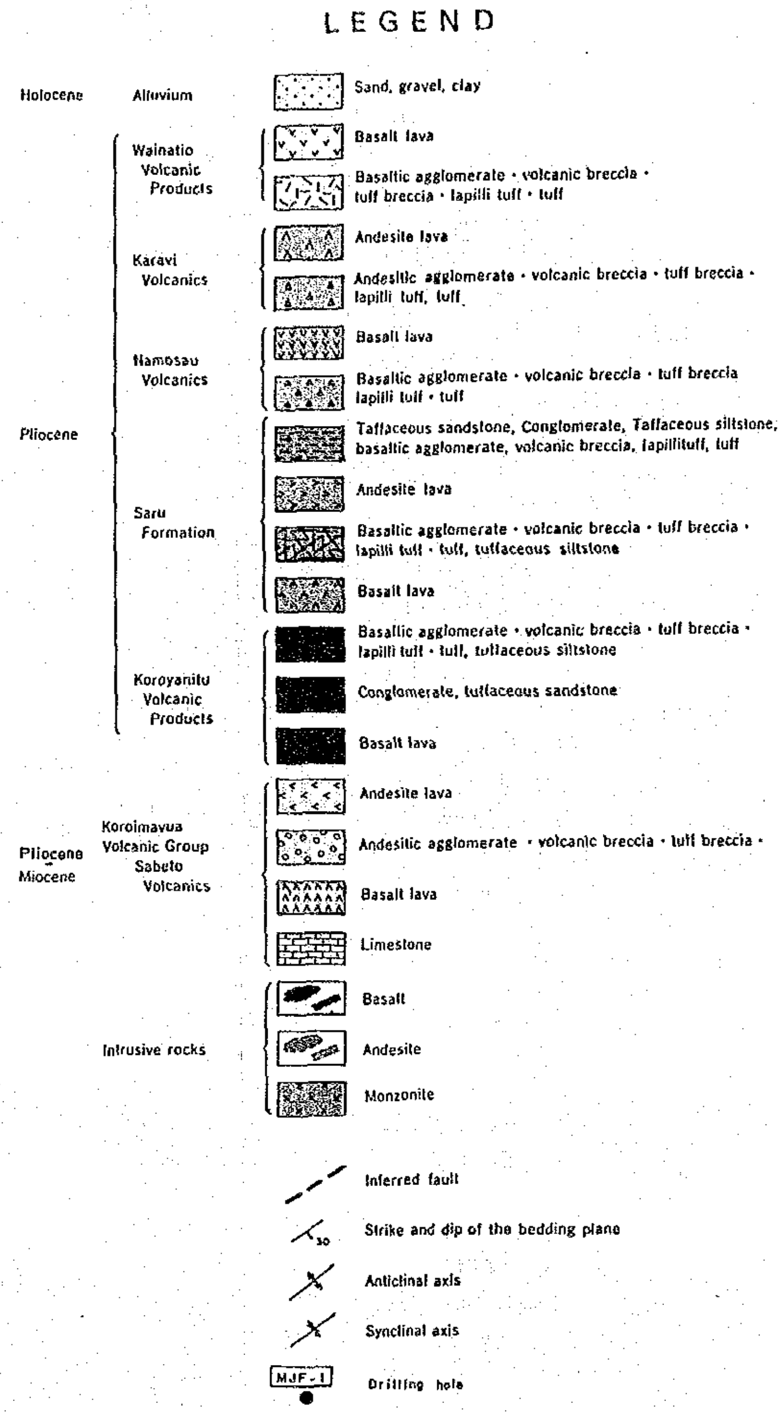


Fig.1-7 Geological Map with Geological Profiles of the Mba-west Area (1)

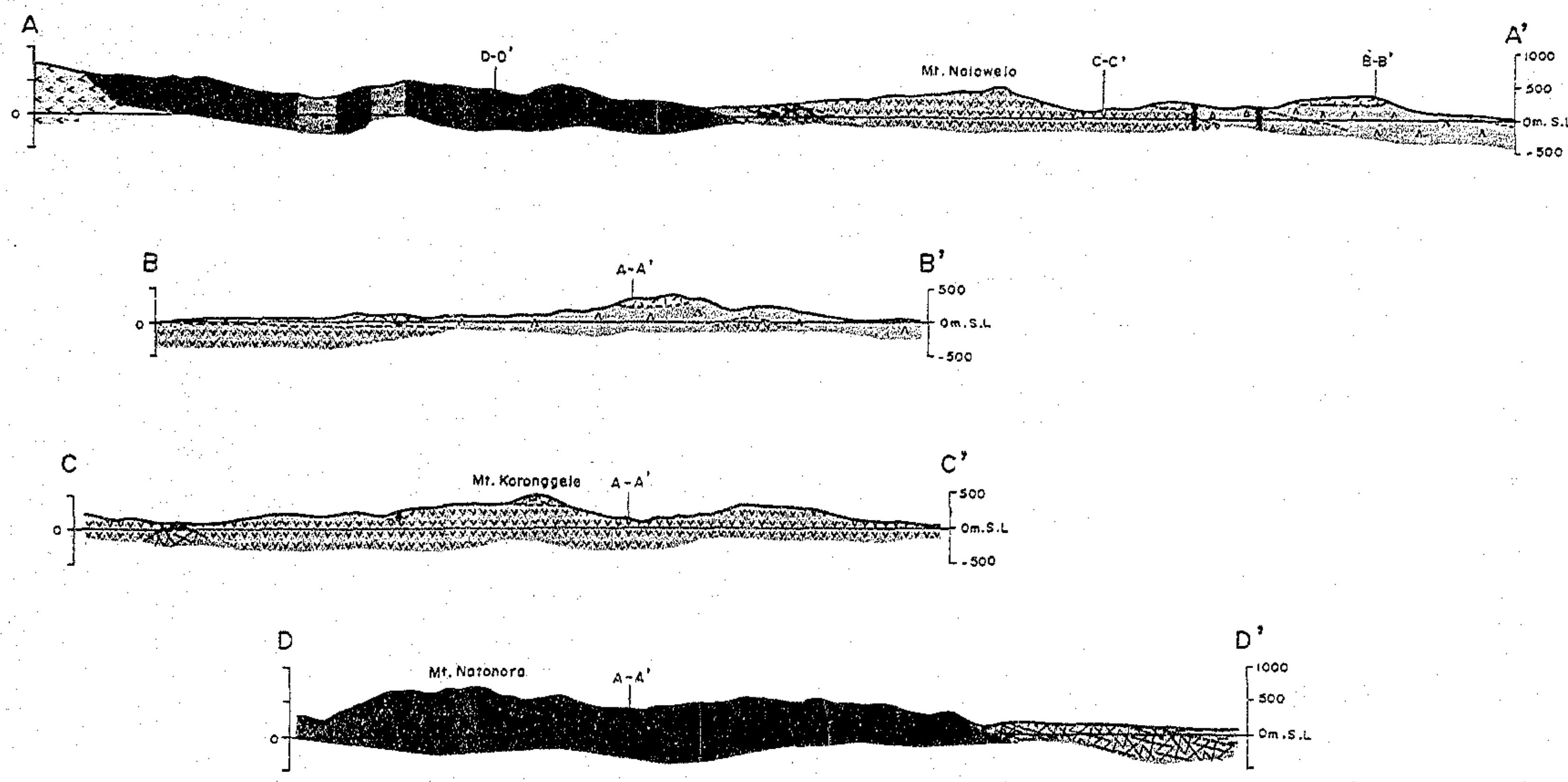


Fig.1-7 Geological Map with Geological Profiles of the Mba-west Area (2)

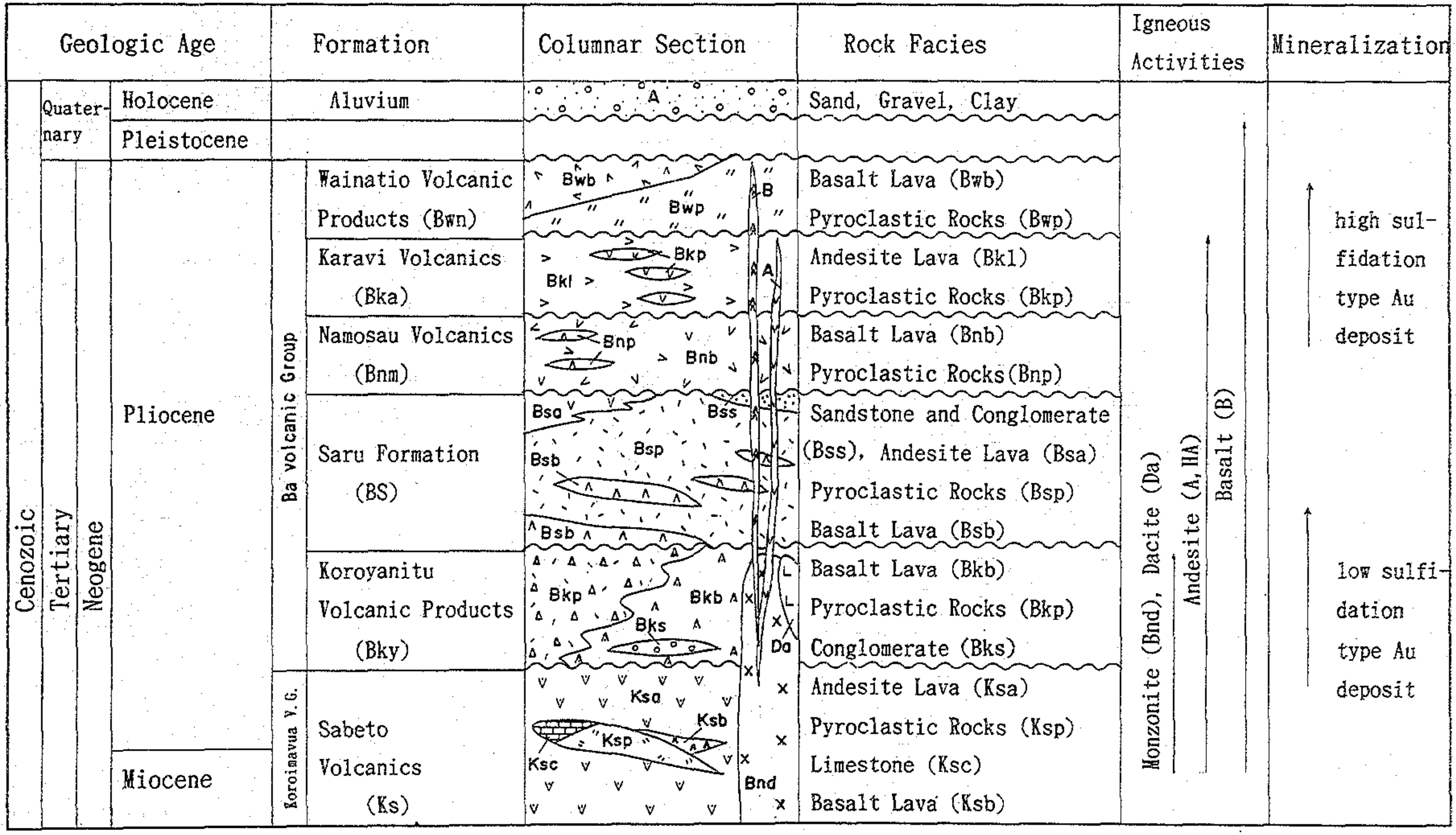


Fig. 1-8 Schematic Stratigraphic Columns of the Mba-west Area

Chapter 4 Comprehensive Analysis of the Survey Results

4-1 Geologic Structure, Characteristics and Control of Mineralization (Fig.1-9)

4-1-1 Nayanggali Creek Geochemical Anomaly Zone

This zone is located within the Namosau Volcanics area of the Pliocene Ba Volcanic Group. The Namosau Volcanics and the underlying Saru Formation are lying almost horizontally with gentle undulation. MJF-3 borehole was drilled on the topographic ridge which extends in the NE-SE direction and the results show that it is the raised part of the beds. The ridge and the vicinity is composed of compact volcanic rocks and the surrounding zones comprise fractured volcanics and pyroclastics. This fact indicates that the vicinity of the ridge was the center of volcanic activities.

This geochemical anomaly zone is located in the short-wavelength low gravity zone. This low gravity is distributed in the vicinity of the medium-wavelength high gravity anomaly with the center near Yaloku in southern Mba-west. A right lateral fault with NE-SW strike is inferred to occur at the boundary of the low gravity on the northwest side from the distribution of the lineaments. If the NE-SW trending ridge were the center of volcanic activities as mentioned above, there would be fractures with the same trend in the deeper parts. There are no clear mineral showings in this zone. The small Au, As, Hg geochemical anomalies along the ridge are considered to be the product of the post volcanic ascending hydrothermal fluid along the above fractures. Similar mechanism of formation is also considered for the Lololo Creek geochemical anomalies extending in the NNE-SSW direction to the south of this zone.

4-1-2 Nalotawa Alteration Zone

This zone is located within the Koroyanitu Volcanic Products area of the Pliocene Ba Volcanic Group. This alteration zone also lies on the photogeologic annular structure extracted as the margin of a circular depression. This structure is close to the center of the medium-wavelength high gravity anomaly. There are NW-SE trending lineaments in this zone. The pattern of lineaments of this zone as well as the vicinity indicate the existence of a NE-SW trending left lateral fault system through this zone.

Many clay-pyrite veins, geochemical anomalies (Au, As, Te), and argillization (smectite-sericite, smectite-pyrite) of propylite occur on the surface of this zone. Many of the clay-pyrite veins occur within the As anomalies or in the vicinity while parts of the Te anomalies and Au anomalies occur within the As anomaly zone.

The attitudes of the veins on the surface can be grouped into the following three systems, namely NNE-SSW to NNW-SSE, NE-SW to ENE-WSW, and NW-SE to WNW-ESE. The gold content of these veins are very low at <0.005-0.024g/t.

Almost horizontal volcanic rocks, many intrusive bodies, and groups of veins with steep dip from 60°E-90° were confirmed in drill hole MJF-4. These veins occur either within or in the vicinity of the intrusive bodies. Those containing more than 0.05g/t Au are located below the surface Au geochemical anomaly.

The above auriferous veins are; quartz-calcite veins, calcite veins, clay (smectite, sericite)-pyrite-(calcite) network and adjacent altered host rocks often contain gold (Au>0.05g/t). The highest gold grade is in clay-pyrite-calcite network with 0.52g/t (sampling width, 1m).

The assemblage of the major gangue minerals (quartz, calcite, potash feldspar, smectite, sericite) of the veins and that of the major alteration minerals (quartz, calcite, pyrite, smectite, adularia) of the adjacent host rock are very similar to that of the low sulfidation epithermal veins.

4-1-3 Yaloku Alteration Zone

This zone occurs in the Sabeto Volcanics area and is located on the photogeologic annular structure and its vicinity. Sabeto Volcanics is a member of the Pliocene Koroimavua Volcanic Group.

Propylitized rocks are distributed in the zone and many veins occur in these altered bodies. The veins in this zone are divided into two groups, eastern and western groups. N-S and ENE-WSW to E-W systems are dominant in the western group while NNW-SSE system are abundant in the eastern group. In both groups quartz veins are abundant with smaller amount of clay-pyrite and calcite veins. The highest gold grade is 12.10g/t (vein width 15cm) in the western group and 4.52g/t (vein width 3cm) in the eastern group. Cavities are often developed in the quartz veins and brecciated structure is observed in some of the western veins.

The results of the MJF-5 drilling indicate that dykes are not developed in the subsurface zones below the eastern veins and the width and

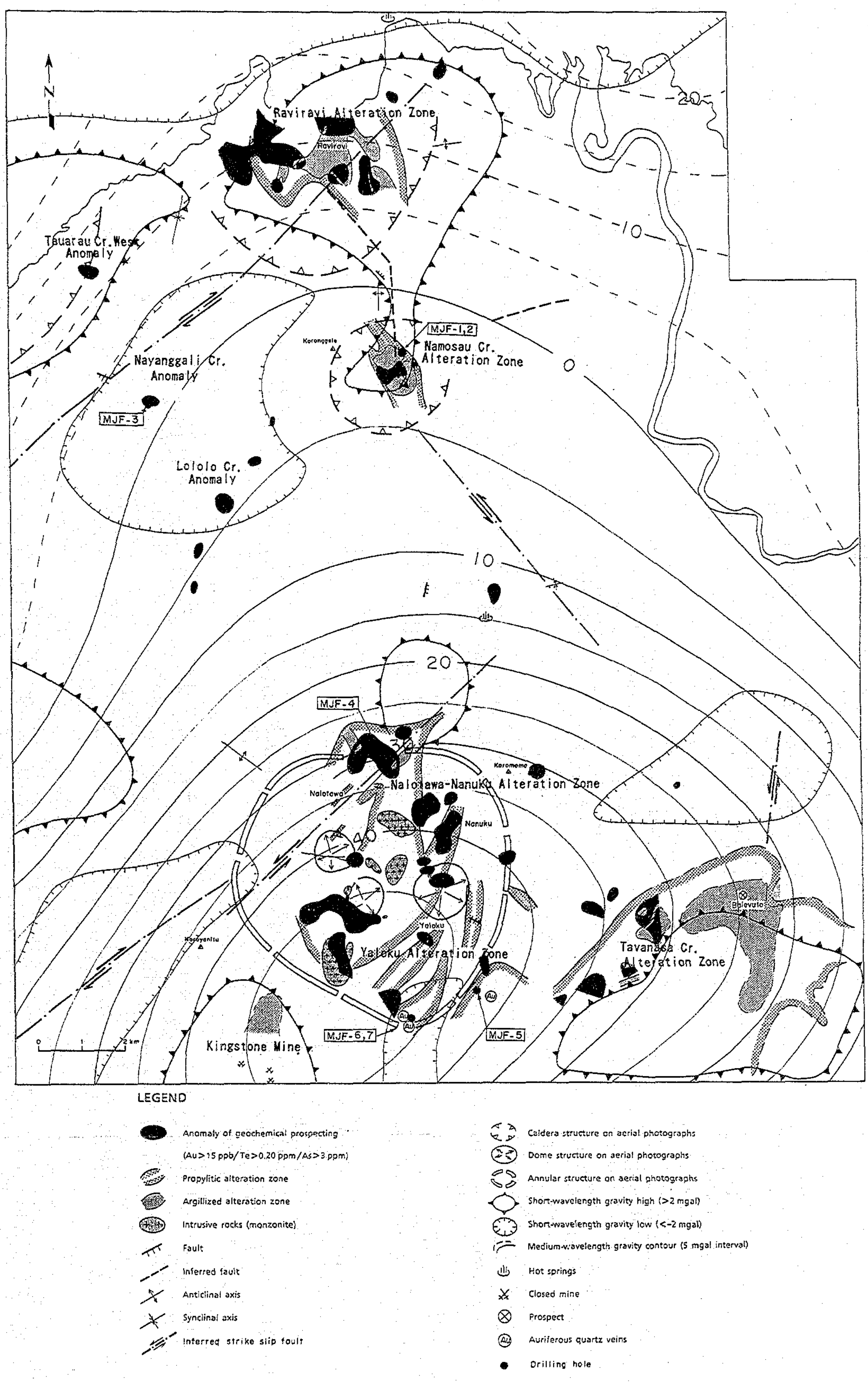


Fig.1-9 Integrated Interpretation Map (Mba-west Area)
(調査結果総合解析図－バ西地区)

the gold grade of the veins are low. There is only one sample with gold content exceeding 0.05g/t (calcite-quartz vein, Au 0.114g/t, sampling width 40cm). On the other hand, dykes are well developed below the western veins. And there are auriferous veins inferred to be thick (clay-calcite-dolomite veins; Au 0.055g/t, sampling width 400cm, others:MJF-6) with N-S strike and high Cu-Au grade veins inferred to trend ENE-WSW to E-W (chalcopyrite veins; Au 0.375g/t, Ag 880g/t, Cu 6.76%, sampling width 3cm:MJF-7).

Chalcopyrite and pyrite are common ore minerals in this zone and molybdenite, bornite, galena, and stromeyerite also occur in some localities. This mineral assemblage corresponds to that of the relatively low depth and high temperature of formation, epithermal veins.

The gangue minerals are quartz-chlorite-calcite in the eastern veins and quartz-adularia in the west.

The assemblage of major alteration minerals of the host rocks near the veins also differ between the western and the eastern groups. Quartz-chlorite-calcite-smectite are common for both groups, but sericite occurs in the east and adularia in the west.

The above mineral assemblages are close to those seen in the low sulfidation epithermal veins and the western veins appear to have formed under higher temperature.

The mode of occurrence of the veins confirmed by drilling in this zone corresponds to the quartz + adularia + illite + Ag sulfides + base metal sulfide zone of the low sulfidation (quartz-adularia type) epithermal model (Berger and Eimon, 1983).

4-2 Mineral Potential

4-2-1 Nayanggali Creek Geochemical Anomalies

Evidences of mineralization and alteration of significance were not found and the scale of the geochemical anomalies are relatively small. Thus gold mineralization, if any were found, would be small in this zone.

4-2-2 Nalotawa Alteration Zone

Evidences of auriferous mineralization of low sulfidation epithermal type was confirmed by drilling MJF-4 in this zone. This prospect is inferred to comprise veins of NNE-SSW to NE-SW system and the low grade and the scale is large (ex. width of ore in core, 18.10m, Au 0.176g/t). On the surface, however, the exposed clay-pyrite veins are small and not auriferous. This fact indicates that the auriferous veins are developed in subsurface parts. Also NW-SE trending veins and lineaments occur on the surface and the lower parts of these manifestations need to be explored.

This zone was selected as a target for drilling because of the similarity of the geologic environment, particularly the structure, to that of the Emperor Mine and also of the existence of the geochemical anomalies. Aside from the Au geochemical anomaly, evidences of gold mineralization had not been found and the gold showing confirmed by MJF-4 drilling is the first concrete evidence of gold mineralization in this zone. This finding, including the Au 0.52g/t content in 1m width core, is an extremely important step in the exploration of this zone. The fact that this was discovered by the first drilling is believed to indicate the high potential of the area.

4-2-3 Yaloku Alteration Zone

The eastern part of the zone where MJF-5 drilling was carried out is not considered to have high gold potential because fissures, the conduits for the ore fluids, are not well developed. However, the lower parts of the Au anomaly to the north of MJF-5 have not been explored. This anomaly is distributed in the N-S direction which is similar to the trend of the veins in the vicinity of MJF-5. Thus, there is a possibility of the occurrence of subsurface veins with N-S to NNW-SSE trend in this locality.

Regarding the MJF-6,7 drill holes in the west, it is inferred that the bonanza is above the gold showings which are only about 70m below the surface. Therefore, the potential of these veins are controlled by the topography and the direction of the ore shoots. In other words, for veins of the ENE-WSW to E-W system, if the direction of shoot is east the potential lies to the east of MJF-7, for N-S veins, if the direction of the shoot is south the potential lies to the south of MJF-6 (Fig. 2-3-1). There is not sufficient data for determining the direction of the shoot.

Chapter 5 Conclusions and Recommendations

5-1 Conclusions

Geological survey and drilling were carried out in three localities of Mba-west during the third phase of the Viti Levu Mineral Exploration

Project. The following conclusions were reached as a result of the above.

(1) Nayanggali Geochemical Anomaly Zone

The surface geology of this zone consists of basalt lava of the Namosau Volcanics belonging to the Pliocene Ba Volcanic Group. The subsurface geology confirmed by MJF-3 drilling comprises basalt lava, basaltic pyroclastics, and sedimentary rocks of Saru Formation of the Ba Volcanic Group, basalt lava and basaltic pyroclastics of the Namosau Volcanics, and basalt dykes.

Mineral showings and alteration of significance are not found in this zone. A center of volcanic activities could have been located in this zone and fractures of NE-SW trend are inferred to exist in the deeper parts. The Au, As, Hg geochemical anomalies are inferred to be the products of ascending post volcanic hydrothermal fluids along the NE-SW trending fissures. Subsurface gold mineralization of this zone, if any, is concluded to be small.

(2) Nalotawa Alteration Zone

The surface geology of this zone consists of basalt lava of the Koroyanitu Volcanic Products of the Pliocene Ba Volcanic Group and dykes (basalt, hornblende andesite). The subsurface geology comprises basalt lava, basaltic pyroclastics of the Koroyanitu Volcanic Products and intrusive bodies (basalt, hornblende andesite, altered andesite).

There are many clay-pyrite veins on the surface, but evidences of gold mineralization do not exist.

On the other hand, in the subsurface parts, occurrence of gold in quartz-calcite veins, calcite veins, and clay-pyrite-(calcite) network is confirmed by MJF-4 drilling. The best part contains Au 0.176g/t in 18.10m of the drill core (include 1m of Au 0.52g/t).

In this zone, the assemblage of major gangue minerals (quartz, calcite, potash feldspar, smectite, sericite) and that of the major alteration minerals in the host rock near the veins (quartz, calcite, pyrite, smectite, adularia) is very close to that of the low sulfidation epithermal veins.

The potential for gold occurrence in the deeper parts of this zone is concluded to be high.

(3) Yaloku Alteration Zone

The surface geology of this zone consists of andesite lava, andesitic pyroclastics of the Sabeto Volcanics of the Miocene- Pliocene Koroimavua Volcanic Group, and dykes (basalt, andesite). The subsurface geology comprises andesite lava, andesitic pyroclastics, and basalt lava of the Sabeto Volcanics, and basalt dykes.

Quartz veins, clay-pyrite veins, and calcite veins occur on the surface of this zone. These veins are divided into the western and eastern groups. Auriferous quartz veins occur in both groups and the highest grades are 12.10g/t (15cm wide) in the western group and 4.52g/t (3cm wide) in the east.

In the east, calcite-quartz network with Au 0.114g/t (sampling width 40cm) was confirmed by MJF-5 drilling, but generally the development of the veins is poor. The auriferous quartz veins exposed on the surface deteriorates downward. The potential for gold vein occurrence is concluded to be poor in the part where MJF-5 drilling was carried out.

In the west, although of low grade, a large number of auriferous veins were confirmed by drilling (MJF-6, 7). Regarding N-S trending veins, a group of relatively wide auriferous veins (Au 0.055g/t, sampling width 400cm, clay-calcite-dolomite vein; Au 0.20g/t, sampling width 15cm, pyrite-calcite-dolomite vein; others) was confirmed almost at the lower extension of the exposed gold-bearing quartz vein (Au 12.10g/t) by MJF-6 drilling. With ENE-WSW to E-W veins, the grade of the downward extension of the exposed vein (Au 2.19g/t) deteriorates, but a different group of auriferous veins (Au 0.375g/t, Ag 880g/t, Cu 6.76%, sampling width 3cm, chalcopyrite vein; others) were found by MJF-7 drilling.

The common ore minerals of this zone are chalcopyrite and pyrite, with rare association of molybdenite, bornite, galena, and stromeyerite in the west. This mineral assemblage corresponds to those of the high temperature epithermal deposits formed at relatively deeper parts.

The assemblage of the main gangue minerals is quartz-smectite-chlorite-calcite in the east while it is quartz-adularia in the west.

The alteration mineral assemblage of the host rock near the veins also differ between the western and the eastern groups. The assemblage common for both groups is quartz-chlorite-calcite-smectite with sericite in the east and adularia in the west.

The above assemblages of gangue and alteration minerals are very similar to those of the low sulfidation epithermal mineralization. Also it is concluded that the veins in the west were formed under higher temperature.

The mode of occurrence of the veins confirmed by drilling in this zone corresponds to the quartz + adularia + illite + Ag sulfides + base metal sulfide zone of the low sulfidation (quartz-adularia type) epithermal model (Berger and Eimon, 1983).

Regarding the drill holes in the west, it is inferred from the above model that the bonanza lies higher than the gold showings confirmed by drilling. This gold occurrence is only about 70m below the surface. Therefore, the potential of these veins are controlled by the topography and the direction of the ore shoots. There is not sufficient data for determining the direction of the shoot.

5-2 Recommendations for Future Exploration

It is recommended from the results of the third phase survey that the following be carried out in future prospecting.

(1) Nalotawa Alteration Zone

A total of three holes should be drilled in order to confirm the state of gold mineralization of the veins located by MJF-4. These veins are inferred to extend in the NNE-SSW direction and two holes should be drilled westward from the eastern side of MJF-4. Also one hole should be drilled south-westward from MJF-4 in order to explore the lower parts of the NE-SW veins which exist in this zone.

(2) Yaloku Alteration Zone

A total of three holes should be drilled as follows in order to confirm the state of gold mineralization of the auriferous veins located by MJF-6 and 7 in western part of this zone. One hole should be drilled westward for exploring the N-S trending veins to the south of MJF-6. Also one northward hole should be drilled each from the east and west of MJF-7 in order to explore the ENE-WSW to E-W veins.

PART II DETAILED DISCUSSIONS

PART II DETAILED DISCUSSIONS

Chapter 1 Nayanggali Creek Geochemical Anomaly Zone

1-1 Objectives and Methods of Survey

Geological survey ($4km^2$) was carried out in the Nayanggali Creek Geochemical Anomaly Zone in order to clarify the details of the surface mineral showings and to determine the most appropriate site for drilling. One hole was drilled in order to clarify the subsurface mineralization of this Zone (Figs. 1-3, Fig. 1-4). The locality and the length of drilling is shown below.

Drill No.	Locality	Coordinates Latitude	 Longitude	Elevation	Direction	Inclination	Drilled length
MJF-3	Nayanggali Cr.	S17°33.28'	E177°33.83'	120m	-	-90°	201.00m
MJF-4	Nalotawa	S17°37.61'	E177°37.21'	442m	135°	-40°	401.00m
MJF-5	Yaloku (Rara)	S17°40.58'	E177°38.44'	570m	90°	-50°	301.00m
MJF-6	Yaloku	S17°40.94'	E177°37.51'	686m	270°	-50°	300.90m
MJF-7	Yaloku	S17°40.94'	E177°37.51'	686m	0°	-55°	301.00m

1-2 Geology and Mineral Deposits of the Zone

The geology of the eastern part of the area comprises basaltic pyroclastics and tuffaceous siltstone of the Saru Formation of the Pliocene Mba Volcanic Group which is unconformably overlain by widely distributed basalt lava of Pliocene Namosau Volcanics (Fig. 1-7).

The soil geochemical anomalies are distributed in a small zone along the ridge to the west of the Nayanggali Creek and comprises As, Hg anomalies (As ≥ 3ppm, Hg ≥ 120ppb) in the ridge and Au anomalies (Au ≥ 15ppb) in the low lands east of the ridge. The area is very strongly weathered and the alteration and mineralization are not clear on the surface, but network of iron oxide is observed in the above ridge. The ridge is composed of compact volcanic rocks and the vicinity is comprised of fractured lava and pyroclastic rocks (Fig. 2-1-1).

1-3 Drilling

Soil and weathered zone were drilled to a depth of 4.10m by HX single bit, reamed to 3.10m by HX metal casing shoe, and HX casing pipe was inserted. NQ wireline and bentonite mud were used for further drilling. Reaming by NX casing shoe was done together with drilling to 27.10m, and then NX-NW casing pipe was inserted.

Some circulation was lost during the process, but it was prevented by high pressure insertion of TELSTOP. BX-BW casing pipe was inserted after drilling to 121.00m. BQ wireline, bentonite, and mud oil were used for further operation to the depth of 201.00m and completed the drilling for this zone (Fig. 2-1-2, Table 2-1-1 and 2-1-2).

1-4 Geology, Mineralization, and Alteration of the Drill Hole

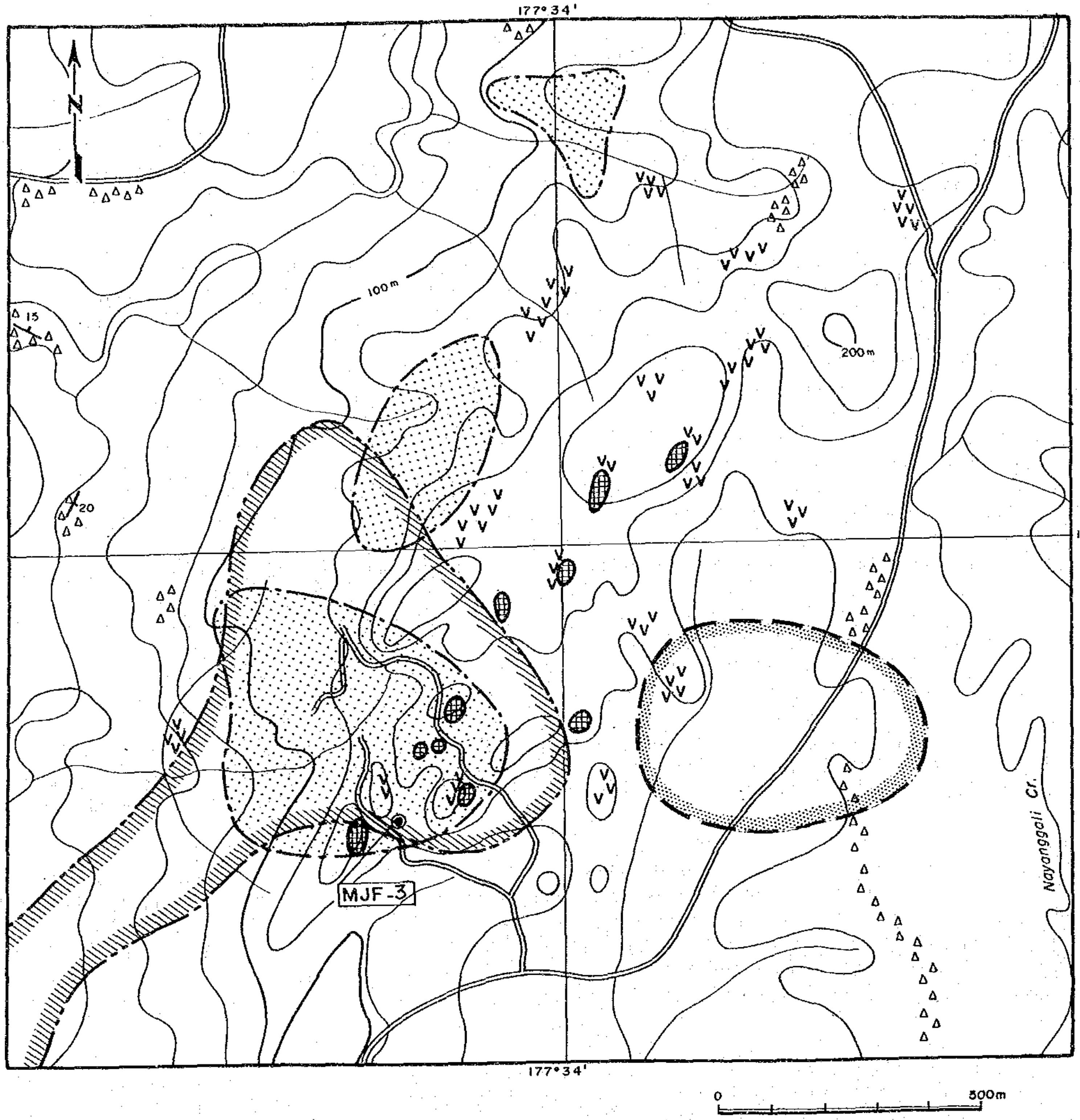
[MJF-3](Appendix-columns, Table 2-3-7, Table 2-3-10, 2-3-11 and 2-3-13, Photo 3)

Geology: The geologic units constituting this hole are: Basaltic lava (hyaloclastite); pyroclastics (tuff breccia ≥ lapilli tuff ≥ volcanic breccia ≥ tuff, fine tuff); sedimentary rocks (siltstone-sandstone alternation) of Saru Formation (depth; 63.8-201.0m); olivine-augite basalt; basaltic pyroclastics (tuff breccia ≥ fine tuff) of Namosau Volcanics (9.2-63.8m); and basalt dykes (170.5-174.5m). In this hole, depth 0 to 26.0m is the weathered zone, but reddish color due to primary oxidation is observed at 26-31.4m, 58.2-124.2m, and 141.9-169.5m.

Alteration and mineralization: Neither mineralization nor vein-type hydrothermal alteration was observed in this borehole. Weak green alteration (124.2-187.8m), weak to medium propyritization (187.8-201.0m) and patches and veinlets of yellow clay and calcite occur sporadically.

1-5 Discussions

Evidences of significant hydrothermal mineralization were not observed by drilling in this area. Thus, the occurrence of subsurface alteration zone with horizontal extent in this geochemical anomalous zone is considered to be not probable. The existence of compact volcanic rocks in the NE-SW trending topographic highs of the geochemically anomaly zone



L E G E N D

Compact volcanic rocks

Brecciated lava flows / Pyroclastic rocks

Anomaly of geochemical Analysis

Au ≧ 10ppb

As ≧ 2ppm

Hg ≧ 85ppb

Iron – oxide stockwork

Drilling hole

Fig. 2-1-1 Mineralization Map (Nayanggali Cr.)

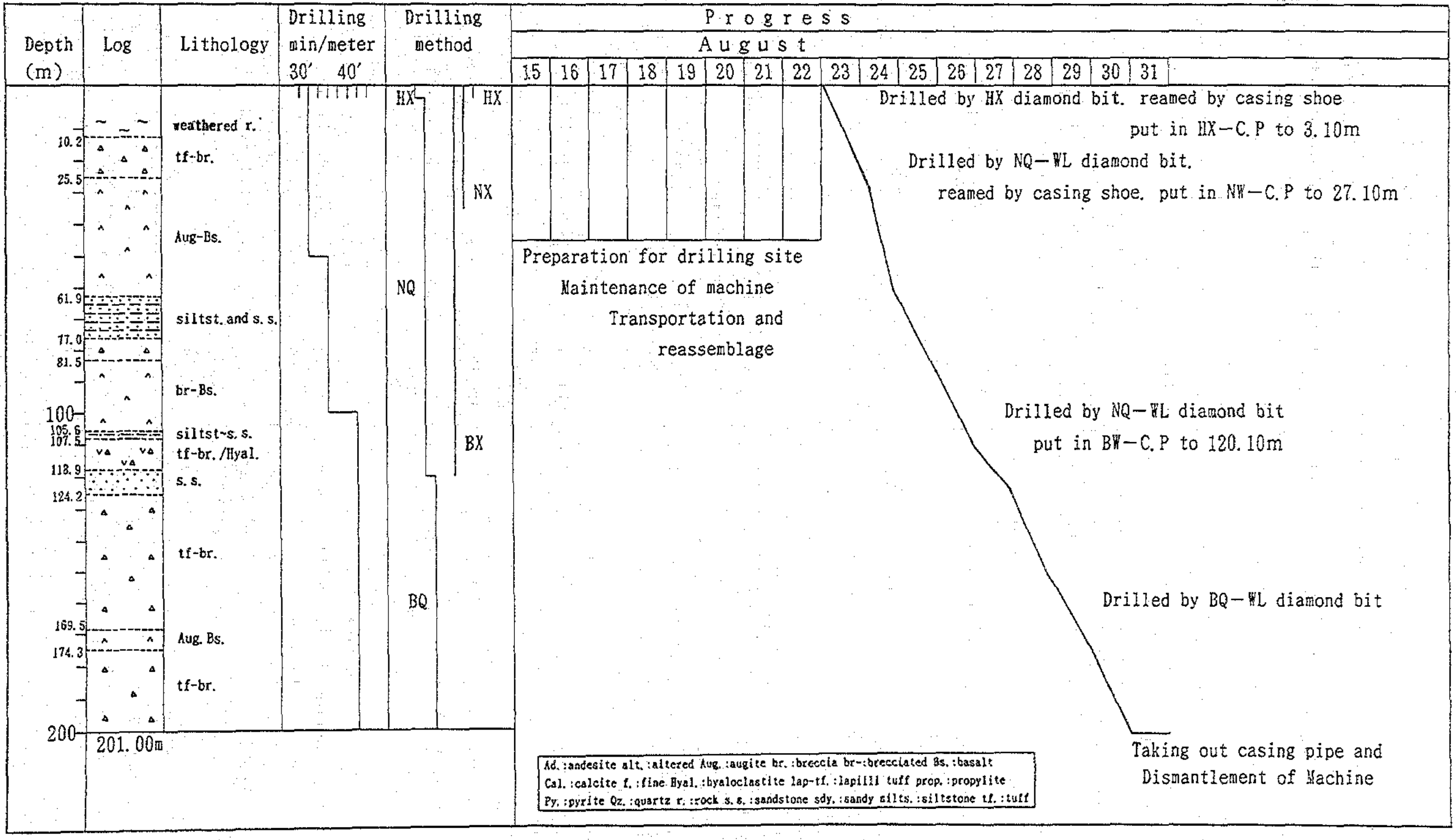


Fig. 2-1-2 Drilling Progress of MJF-3

Table 2-1-1 Summary of the Drilling Operation on MJF−3

Operation	Survey Period: Period	Days	Work day	Off day	Total Men: Engineer	Worker
			days	days	men	men
Preparation	15.08.1992~22.08.1992	8	8	0	29	76
Drilling	23.08.1992~30.08.1992	8	Drilling 8	0	32	96
			Recovering 0	0	-	-
Removing	31.08.1992	1	1	0	4	10
Total	15.08.1992~31.08.1992	17	17	0	65	182

Drilling length			
Length planed	200.00m	Overburden	9.20m
Increase or Decrease in length	-m	Core length	185.50m
Length drilled	201.00m	Core recovery	% 96.7

Core recovery of 100 m hole

Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0.00 ~ 100.00	93.0	93.0
100.00 ~ 201.00	100.0	96.7

Working hours	h	%	%
128°40′	67.0	47.5	
Other working	63°20′	33.0	23.4
Recovering			
Total	192°00′	100.0	70.9
Reassemblage	70°00′		25.8
Dismantlement	9°00′		3.3
Water transportation			
Road construction and transportation			
G.Total	271°00′		100.0

Drilling Efficiency of Drilling

Total m/work period(m/day)	201.00m/8 days (25.13m/day)
Total m/work shift (m/shift)	201.00m/23 shifts (8.74m/shift)

Drilling length/bit(each sized bit)

Bit size	HX	NQ	BQ
Drilled length	4.10m	116.90m	80.00m
Core length	-	105.50m	80.00m

Casing pipe inserted

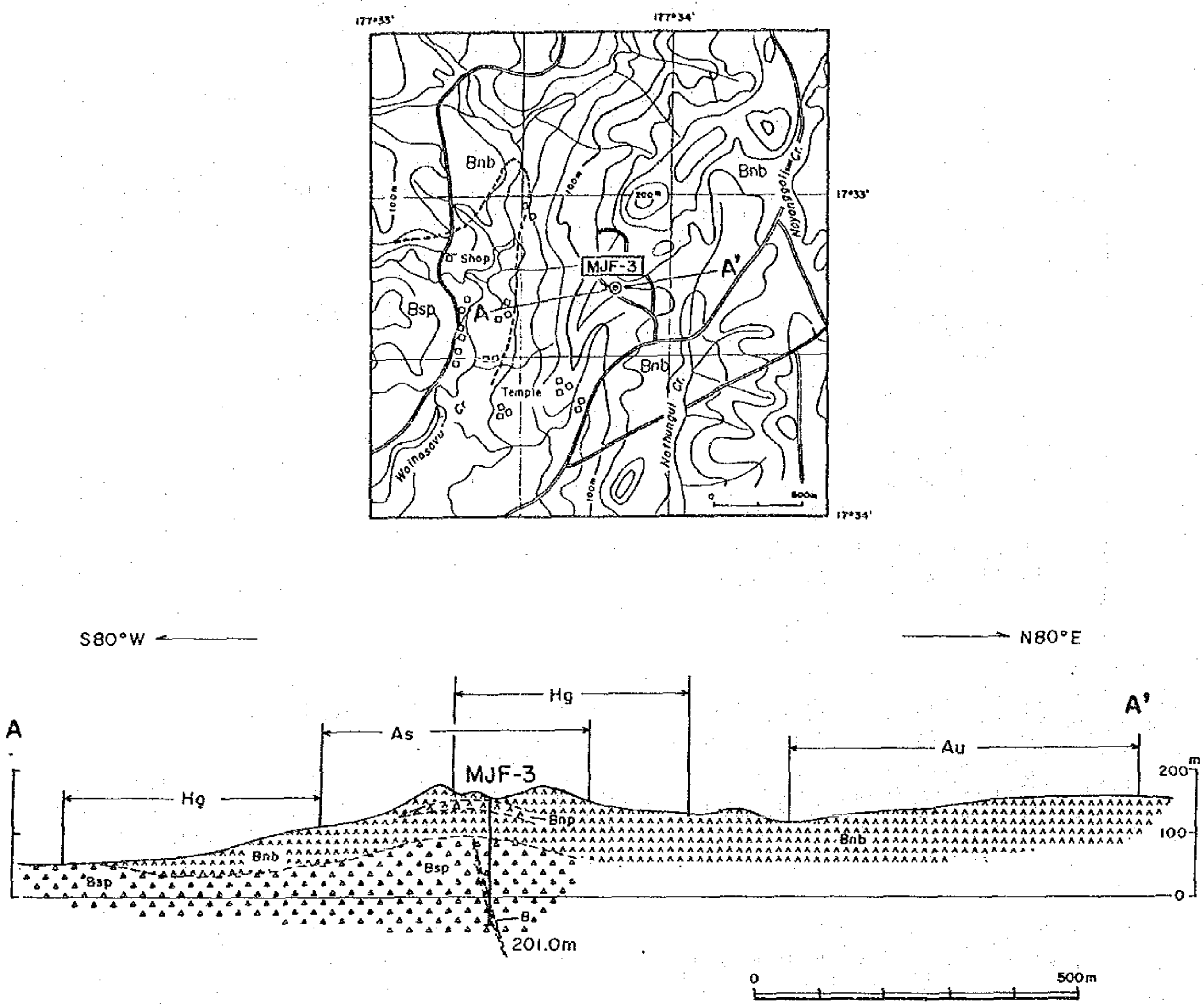
Size	Meterage (m)	Meterage drilling length × 100 (%)	Recovery (%)
H W	3.10	1.6	100
N W	27.10	13.6	100
B W	121.00	60.5	100

Table 2-1-2 Record of the Drilling Operation on MJF-3

	Drilling length			Total		Shift		Working Men	
	shift 1	shift 2	shift 3	Drilling	Core length	Drilling	Total	Engineer	Worker
August	m	m	m	m	m	shift	shift	men	men
15	Pds						1	4	12
16	Main-mac								
17	Tra-Reas								
18	Tra-Reas								
19	Tra-Reas								
20	Tra-Reas								
19	Tra-Reas								
21	Reassmb								
22	Reassmb						7	25	64
23	10.80	7.80	8.50	27.10	11.90				
24	8.60	13.20	11.50	33.30	33.00				
25	7.40	9.00	9.00	25.40	25.40				
26	9.00	8.90	8.60	26.50	26.50				
27	8.70	Ins-C.P	3.10	11.80	11.80				
28	9.20	9.30	9.00	27.50	27.50				
29	9.00	9.00	8.10	26.10	26.10	20	21	28	84
30	8.70	9.30	5.30	23.30	23.30				
31	Dismant					3	4	8	22
Total	71.40	66.50	63.10	201.00	185.50	23	33	65	182

Abbreviation

Pds	: Preparation for drilling site	Ins-C.P	: Inserting casing pipe
Trans	: Transportation	Out-C.P	: Taking out casing pipe
Tra-Reas	: Transportation and Reassemblage	Road-con	: Road construction
Reassemb	: Reassemblage	Repair	: Repair work on a road
Dismant	: Dismantlement	With-cyc	: Withdrawal suspension due to the cyclone
Main-mac	: Maintenance of machines	Tra-pack	: Transportation and packing of equipment



L E G E N D

Namosau Volcanics	Bnb	Basalt Lava
	Bnp	Pyroclastic Rocks
Saru Formation	Bsp	Pyroclastic Rocks
Koroyanitu Volcanic Products	Bkb	Basalt Lava
	Bkp	Pyroclastic Rocks
Sabeto Volcanics	Ksa	Andesite Lava
	Ksp	Pyroclastic Rocks
	Ksb	Basalt Lava
Intrusive Rocks	A	Pyroxene Andesite
	HA	Hornblende Andesite
	B	Basalt
	Au	Geochemical Anomaly

cp : chalcopyrite
py : pyrite
gn : galene
q : quartz
cl : clay
ca : calcite
gyp : gypsum
lim : limonite
dol : dolomite
wd : width
v. : vein
st-w : stockwork
diss.z. : disseminated zone
sil : silicification
veins projected from attitudes measured at outcrops

Fig. 2-1-3 Geological Profile of Drilling Hole (MJF-3) indicate that this zone is located in the center of former igneous activity. Network of iron oxides occurs in the above highs. It is not clear whether these iron oxides are secondary product from hydrothermal mineralization or weathered product from basalt, but they do indicate that fractures are developed.

From the above observation, it is believed that the geochemical anomalies are the product of vein-type hydrothermal activity subsequent to volcanism. But it is most probably very difficult to confirm because of the lack of surface manifestations and alteration.

Chapter 2 Nalotawa Alteration Zone

2-1 Objectives and Methods of Survey

Detailed geological survey over an area of $6km^2$ was carried out in order to clarify the nature of the surface mineral showings and to determine the most appropriate drilling site for the Nalotawa Alteration Zone. One borehole was drilled in order to clarify the state of subsurface gold mineralization (Figs. 1-3 & 1-4). The locality and length of the drill hole is shown below.

Drill No.	Locality	Coordinates		Elevation	Direction	Inclination	Drilled length
		Latitude	Longitude				
MJF-4	Nalotawa	S17°37.61'	E177°37.21'	442m	135°	-40°	401.00m

2-2 Geology and Mineralization of the Survey Area

Basalt lava of the Koroyanitu Volcanic Products belonging to the Pliocene Mba Volcanics is distributed throughout this area. This lava is intruded by basalt and hornblende andesite dykes (Fig. 1-7).

There is a weakly argillized zone extending in the NE-SW direction in the eastern part and another stronger argillized zone trending NW-SE in the western part. The former comprises kaolinite-montmorillonite mixed-layered minerals, sericite-montmorillonite mixed-layered minerals, and sericite;

and the latter mainly of smectite-pyrite dissemination.

There are many white clay veins (5-100cm wide) associated with pyrite dissemination. These veins can be grouped into the following three systems; NNE-SSW to NNW-SSE, NE-SW to ENE-WSW, and NW-SE to WNW-ESE. The Au grades of these veins are very low (0.005-0.024g/t:Table 2-3-12).

There are mineral springs with limonite precipitation in the eastern and southern parts, and limonite is widely deposited in the creeks trending in the NW-SE direction in the southern part. Along these creeks, there are lineaments extending in the same direction.

There are soil geochemical anomalies of Au, As, and Te (Au≥15ppb, As≥3ppm, Te≥0.2ppm) in this zone. The two samples constituting the gold anomalies contain 110 and 95ppb Au (Fig. 2-2-1, Table 2-3-9 & 2-3-11).

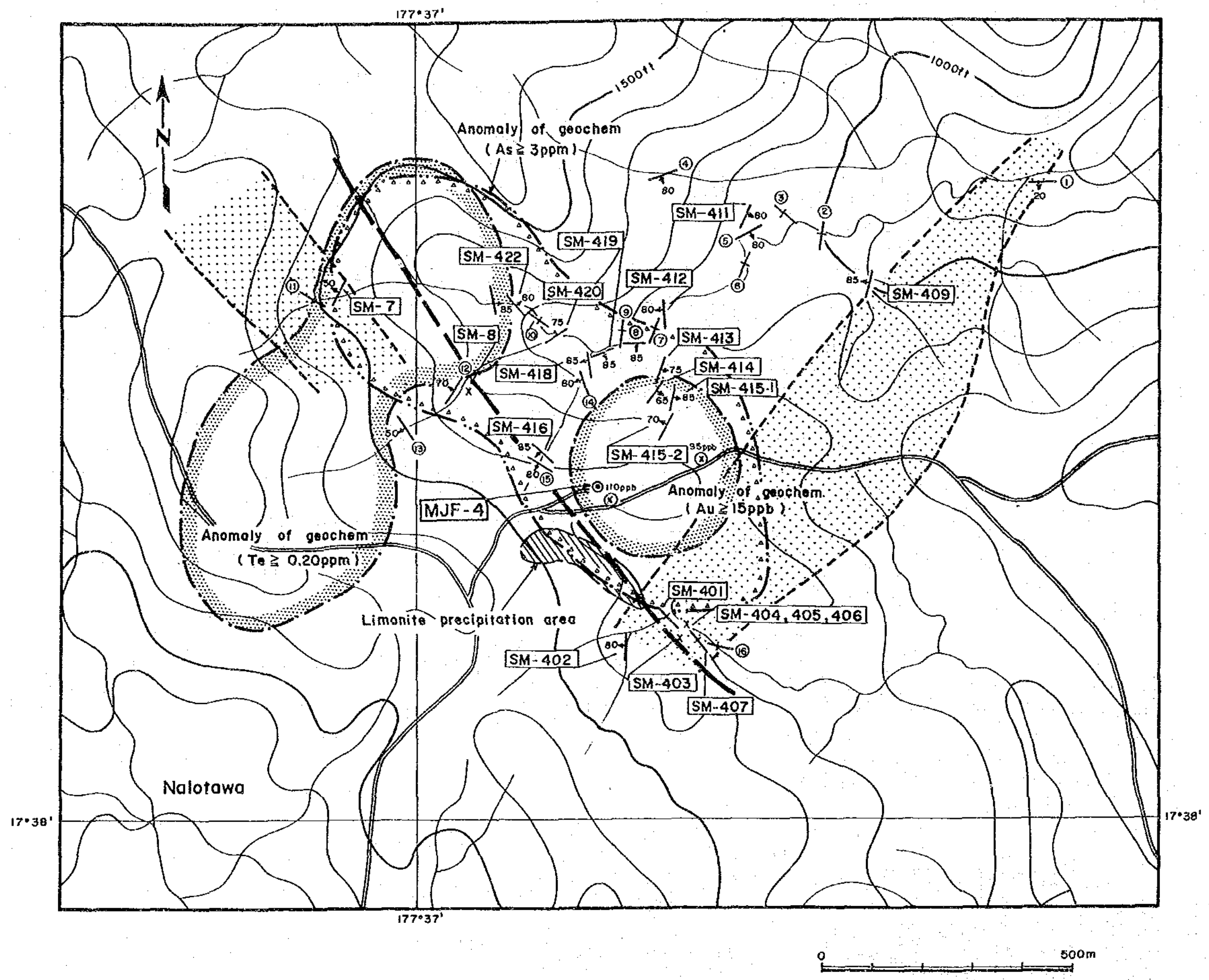
2-3 Drilling

HX single bit was used to the depth of 5.70m through surface soil and weathered zone, HX casing pipe was inserted after reaming to 4.10m by HX casing metal shoe. Further drilling to 180.30m was done by NQ wireline method and bentonite BX mud. Simultaneously reaming was done by NX casing diamond shoe and NX-NW casing pipe was inserted at 33.10m. All circulation was lost at 144.80m. Insertion of concentrated mud mixed with Tel-stop and Multi seal was attempted three times and finally succeeded in arresting the leak. BX casing pipe was inserted to 180.30m. To the target depth of 401.00m, BQ wireline was used with bentonite mud and mud oil. There were many fractures and circulation was lost frequently and entire circulation was lost at 279.20m. Tel-stop was inserted under pressure repeatedly, but could not be arrested completely and the loss was 20 lit/minute. It was drilled further to 401.00m by adding mud and the work was completed.

The recovery of casing pipe of this borehole was extremely difficult. It took three days to recover the whole pipe by hydraulic jack and knocking (Fig. 2-2-2, Table 2-2-1 & 2-2-2).

2-4 Geology, Mineralization, and Alteration of the Drill Hole

[MJF-4] (Appendix-columns, Table 2-3-7, 2-3-8, 2-3-10, 2-3-11 and 2-3-13, Photo 2 to 3)



Sample No.	Description	Width (cm)	Ore Grade						
			Au g/t	Ag ppm	Cu ppm	Pb ppm	Zn ppm	Te ppm	Mo ppm
SM401	Py-Sil vein	40	<0.005	<2	90	10	80	1.0	–
SM402	Clay-Py vein	20	0.005	<2	120	<5	115	0.2	–
SM403	Py-Clay alt. r.	100	<0.005	<2	105	10	115	0.1	–
SM404	Py-Clay alt. r.	300	<0.005	<2	75	15	55	1.4	–
SM405	Py-Clay alt. r.	300	<0.005	<2	95	15	90	0.6	–
SM406	Py-Clay alt. r.	300	0.022	<2	90	10	100	0.3	–
SM407	Clay-Py vein	30	<0.005	<2	35	40	35	1.4	–
SM409	Clay-Limo vein	40	<0.005	<2	80	<5	135	<0.1	–
SM411	Clay-Py vein	60	<0.005	<2	55	10	60	<0.1	–
SM412	Py-Clay vein	20	<0.005	<2	65	10	85	<0.1	–
SM413	Clay-Py vein	50	0.009	<2	120	15	75	<0.1	–
SM414	Clay-Py vein	40	0.016	<2	80	10	35	1.8	–
SM415-1	Clay-Py vein	100	0.007	<2	95	30	85	1.2	–
SM415-2	Clay-Py vein	100	0.006	<2	120	20	100	0.8	–
SM416	Clay-Py vein	5	0.024	<2	135	15	280	<0.1	–
SM418	Clay-Py vein	30	<0.005	<2	55	15	55	<0.1	–
SM419	Clay-Py vein	80	<0.005	<2	45	10	60	<0.1	–
SM420	Clay-Py vein	30	<0.005	<2	80	10	90	0.5	–
SM422	Clay-Py vein	100	<0.005	<2	45	10	125	0.4	–
SM-7	Limo network	100	<0.005	<2	30	10	75	1.7	–
SM-8	Limo network	100	<0.07	<0.5	100	<100	100	<10	<10

Sample	Description	Width(cm)
①	Limo-Clay vein	10
②	Clay-Py vein	1
③	Clay-Py vein	20
④	Clay vein	120
⑤	Clay-Py vein	20
⑥	Clay-Py vein	10
⑦	Clay-Py network	300
⑧	Clay-Py vein	20

Sample	Description	Width(cm)
⑨	Clay-Py network	300
⑩	Clay-Py vein	100
⑪	Clay-Limo-Py network	100
⑫	Clay-Limo-Py vein	30
⑬	Py vein	1
⑭	Clay-Py vein	10
⑮	Clay-Py vein	5
⑯	Clay-Py vein	170

L E G E N D

- ⊗ Sampling point of Au-Geochem · Anomaly
- ◉ Drilling hole
- Lineament
- Argillization
- Vein

Fig. 2-2-1 Mineralization Map (Nalotawa)

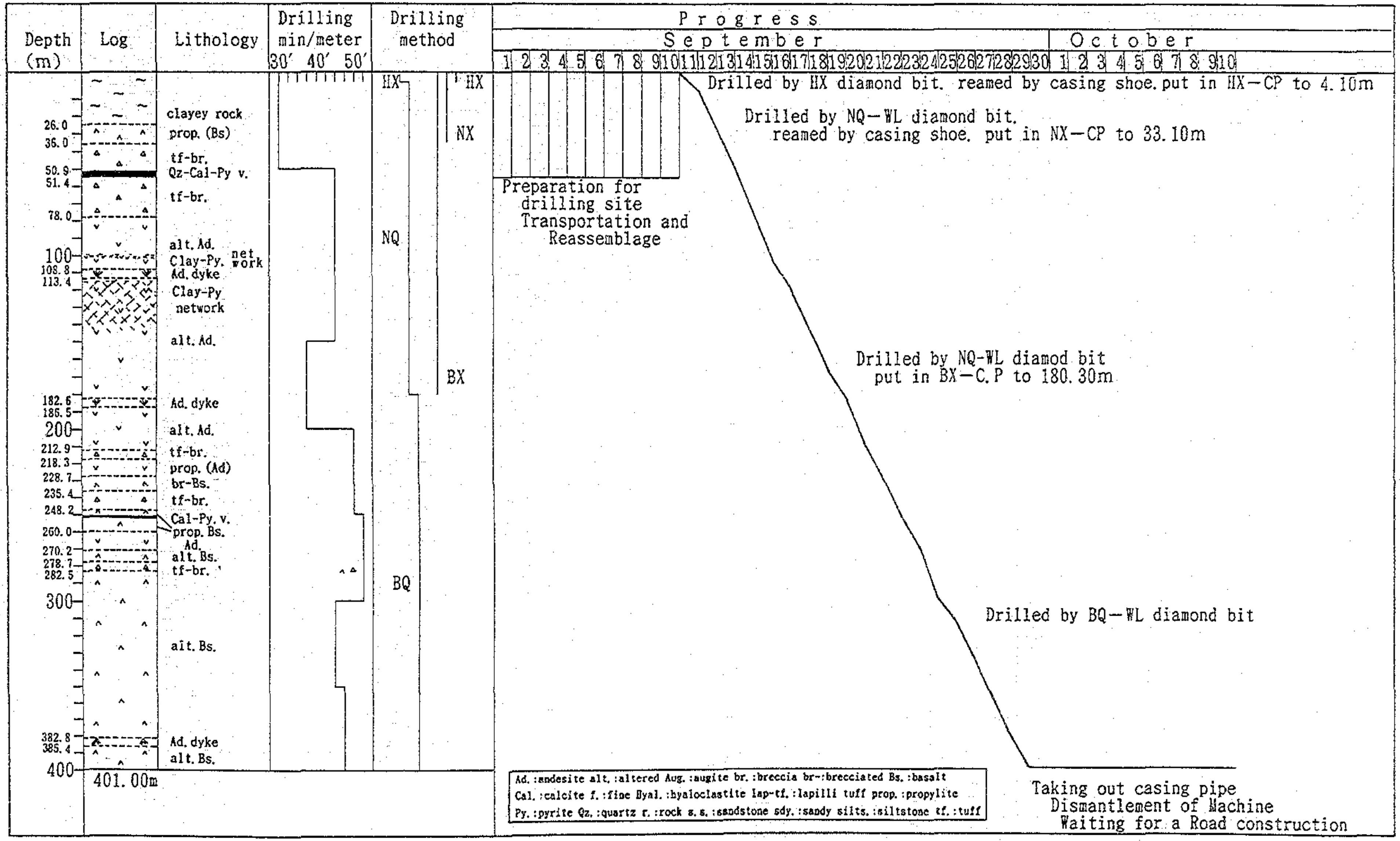


Fig. 2-2-2 Drilling Progress of MJF-4

Table 2-2-1 Summary of the Drilling Operation on MJF-4

	Survey Period				Total Men	
	Period	Days	Work day	Off day	Engineer	Worker
Operation			days	days	men	men
Preparation	01.09.1992~10.09.1992	10	10	0	36	128
Drilling	11.09.1992~29.09.1992	19	Drilling 19	0	76	228
			Recovering 0	0	-	-
Removing	30.09.1992~10.10.1992	11	10	1	40	58
Total	01.09.1992~10.10.1992	40	39	1	152	414

Drilling length			
Length planed	400.00m	Overburden	5.80m
Increase or Decrease in length	-m	Core length	376.80m
Length drilled	401.00m	Core recovery	% 95.3

Core recovery of 100 m hole

Depth of hole (m)	Core recovery (%)	Core recovery cumulated (%)
0.00 ~ 100.00	80.4	80.4
100.00 ~ 200.00	100.0	90.5
200.00 ~ 300.00	100.0	93.7
300.00 ~401.00	100.0	95.3

Working hours	h	%	%
Drilling	297°30′	64.1	49.0
Other working	164°30′	35.5	27.0
Recovering	2°00′	0.4	0.3
Total	464°00′	100.0	76.3
Reassemblage	91°30′		15.1
Dismantlement	12°00′		2.0
Water transportation			
Road construction and transportation	40°00′		6.6
G.Total	607°30′		100.0

Efficiency of Drilling

Total m/work period(m/day)	401.00m/19 days (21.11m/day)
Total m/work shift (m/shift)	401.00m/54 shifts (7.43 m/shift)

Drilling length/bit(each sized bit)

Bit size	HX	NQ	BQ
Drilled length	5.70m	174.60m	220.70m
Core length	-	156.10m	220.70m

Casing pipe inserted

Size	Meterage (m)	Meterage drilling × 100 length (%)	Recovery (%)
H W	4.10	1.0	100.0
N W	33.10	8.3	100.0
B W	180.30	45.0	100.0

Table 2-2-2 Record of the Drilling Operation on MJF-4

	Drilling length			Total		Shift		Working Men	
	shift 1	shift 2	shift 3	Drilling	Core length	Drilling	Total	Engineer	Worker
September	m	m	m	m	m	shift	shift	men	men
1	Tra-Reas								
2	Tra-Reas								
3	Tra-Reas								
4	Tra-Reas								
5	Tra-Reas						5	16	68
6	Tra-Reas								
7	Tra-Reas								
8	Tra-Reas								
9	Reassemb								
10	Reassemb								
11	5.70			5.70	-				
12	9.70	11.70		21.40	5.70	3	8	28	84
13	7.50	8.20	7.50	23.20	20.60				
14	7.20	9.50	9.80	26.50	26.30				
15	8.30	9.90	8.00	26.20	26.20				
16	3.10	6.00	7.40	16.50	16.50				
17	6.90	8.50	5.20	20.60	20.60				
18	6.00	10.10	9.20	25.30	25.30				
19	8.50	6.40	1.20	16.10	16.10	21	21	28	84
20	8.10	9.30	9.10	26.50	26.50				
21	8.20	6.40	6.80	21.40	21.40				
22	7.90	6.20	6.80	20.90	20.90				
23	6.70	6.10	6.20	19.00	19.00				
24	5.50	7.20	7.40	20.10	20.10				
25	7.30	6.70	7.90	21.90	21.90				
26	6.20	7.80	7.90	21.90	21.90	21	21	28	84
27	7.10	7.50	7.20	21.80	21.80				
28	8.00	7.90	8.50	24.40	24.40				
29	6.90	7.80	6.90	21.60	21.60				
30	Out-C.P	Out-C.P							
October									
1	Out-C.P								
2	Out-C.P								
3	Main-mac					9	14	28	76
4	Holi day								
5	Dismant								
6	Road-con								
7	Road-con								
8	Road-con								
9	Road-con								
10	Road-con						6	24	18
Total	134.80	143.20	123.00	401.00	376.80	54	75	152	414

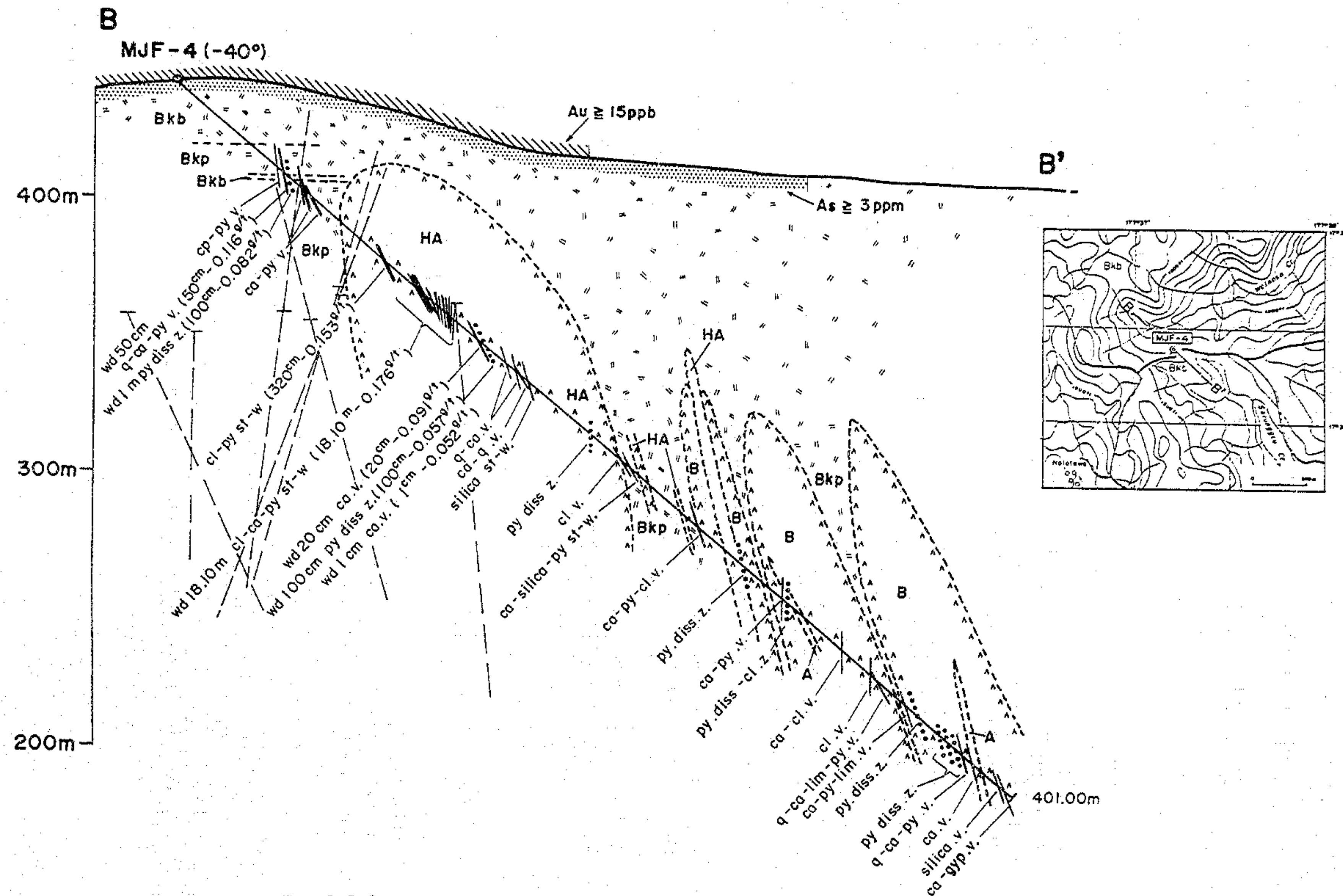


Fig. 2-2-3　Geological Profile of Drilling Hole (MJF-4)

Geology: The geologic units of this borehole consists of Koroyanitu Volcanic Products and intrusive rocks (hornblende andesite, altered andesite, basalt) intruded therein.

The Koroyanitu Volcanic Products comprises basalt lava and basaltic pyroclastics (tuff breccia ≥ tuff) and at times pebbles of hornblende andesite are included in the basaltic tuff breccia (235.4-248.2m).

Basaltic intrusive bodies are intruded by hornblende andesite, and both are intruded by small dykes of altered andesite.

Mineralization and alteration: Many veins were encountered in this borehole. They are; calcite veins, quartz-calcite veins, clay-pyrite-(calcite) network veins, and clay veins. Also many pyrite disseminations were observed. The ores which were confirmed in this borehole to have Au grade over 0.05g/t are as follows.

Depth(m)	Width(m)	Au g/t	Description
50.9- 51,4	0.5	0.116	Quartz-calcite vein
51.4- 52.4	1.0	0.082	Alteration zone along vein
100.2-103.4	3.2	0.153	Clay-pyrite veinlet
115.6-119.6	4.0	0.368	Clay-pyrite-calcite veinlet
119.6-127.6	8.0	0.152	ditto
127.6-133.7	6.1	0.083	ditto
144.8-145.0	0.2	0.091	Calcite vein
145.0-146.0	1.0	0.057	pyrite dissemination
158.1-158.11	0.01	0.052	Quartz-calcite vein

X-ray diffraction studies (XRD) of the veins showed that quartz, pyrite, and calcite are common, at times associated with smectite, sericite, dolomite and gypsum. Potash feldspar was identified in many of the veins (48.5-396.3) by sodium cobaltinitrite staining test. Polished section studies showed the common ore mineral to be pyrite associated in places with magnetite, ilmenite, goethite, chalcopyrite, sphalerite.

Bleached zones of several centimeters to several meters width were often observed along the margin of the veins and the constituent minerals were found to be quartz, calcite, pyrite and smectite. Similar alteration is found in the host rocks of the pyrite dissemination and network veins, and quartz, calcite, pyrite, smectite, sericite and adularia were confirmed by XRD.

Propylitization is another important host rock alteration and weak ones are confirmed at 33.0-182.6m, 234.4-270.2m, and 389.0-401.0m; medium to strong propylitization confirmed at 182.6-234.4m and 270.6-389.0m. XRD showed that quartz, calcite, pyrite, and smectite occur commonly and that chlorite and adularia are associated in places.

2-5 Discussions

Many of the veins confirmed in this borehole occur within the intrusive bodies (hornblende andesite, basalt, altered andesite) or along fractures formed nearby. Therefore, it is considered that factors of primary importance in the formation of the veins of this zone are the existence of fractures which control the distribution of the intrusive bodies and also the existence of compact and hard rocks in which these fractures are formed.

The veins with Au content exceeding 0.05g/t occur in zones shallower than 158.11m and although there are veins deeper than the above, the grade is low. The zone of higher gold content is directly below the surface soil Au anomaly (Au≥15ppb)(Fig.2-3-8). From the above, it is considered that the gold concentration is controlled by the depth and extends horizontally.

It is not possible to determine the type of mineralization from the ore minerals because only a few kinds of ore minerals occur in the veins. Occurrence of magnetite in epithermal veins is rare, but it is reported to occur in the deposits of the Emperor Mine.

The assemblage of the major gangue minerals (quartz, calcite, potash feldspar, smectite, sericite) and of the major alteration minerals near the veins (quartz, calcite, pyrite, smectite and adularia) is closest to that of the low sulfidation epithermal veins.

Chapter 3 Yaloku Alteration Zone

3-1 Objectives and Methods of Survey

Three boreholes were drilled in order to clarify the state of subsurface gold mineralization. Also detailed geological survey was carried out in the zone. The localities and lengths of the drill holes are shown below.

Drill No.	Locality	Coordinates Latitude	Longitude	Elevation	Direction	Inclination	Drilled length
MJF-5	Yaloku (Rara)	S17°40.58'	E177°38.44'	570m	90°	-50°	301.00m
MJF-6	Yaloku	S17°40.94'	E177°37.51'	686m	270°	-50°	300.90m
MJF-7	Yaloku	S17°40.94'	E177°37.51'	686m	0°	-55°	301.00m

3-2 Geology and Mineralization of the Survey Area

The geology of this zone comprises widely distributed andesite lava, andesitic pyroclastics (volcanic breccia, tuff breccia, lapilli tuff, tuff) of the Sabeto Volcanics which belong to the Pliocene Koroimavua Volcanic Group. These volcanic rocks are intruded by basalt and andesite dykes (Fig.1-7).

There are three propylitic alteration belts (smectite-chlorite) extending in the NE-SW to ENE-WSW direction and many veins occur in these altered belts.

There are two systems of veins in this area. One system is distributed in the west near Nasala Creek while the other occur around the Nggalinambulu Creek in the east. These veins are all rich in quartz and some clay-pyrite veins and calcite veins also occur in these zones. The veins are thin at several to 25cm. The dominant trends of the veins in the west are N-S, 80°E-80°W, and ENE-WSW, 60-80°S, with smaller number of NE-SW and NW-SE. For those in the east, NNW-SSE, 70-80°W, is predominant with some NW-SE strike.

The results of the chemical analysis of the samples from the above veins are laid out in Table 2-3-12 and Fig. 2-3-1. Those with gold content exceeding 0.1g/t are listed below.

Many of the quartz veins contain chalcedony and cavities are often developed. Brecciated structure is observed in the quartz vein in Nasala Creek with the highest gold content. Potash feldspar was detected by staining test from the ENE-SWS quartz veins in the same locality.

Location		Strike, Dip	Width(cm)	Au g/t	Ag g/t	Cu %
Nasala Cr.	quartz vein	N-S, 80°E	15	12.10	2.7	0.03
Nasala Cr.	quartz vein	N63°W, 75°S	15	12.10	2.7	0.03
Nasala Cr.	quartz vein	N88°S, 70°S	15	12.10	2.7	0.03
Nasala Cr.	quartz vein	N13°E, 80°E	15	12.10	2.7	0.03
Nasala Cr.	quartz vein	N87°W, 60°S	15	12.10	2.7	0.03
Nggalinambulu Cr.	quartz vein	N30°W, 70°W	15	12.10	2.7	0.03

The auriferous quartz veins in the Nggalinambulu Creek did not produce clear bleached zones in the adjoining host rocks. The propylitized host rocks near the veins contain quartz, calcite, smectite, chlorite, and sericite as their alteration minerals. The clay veins of the locality comprises quartz, sericite, calcite, and chlorite.

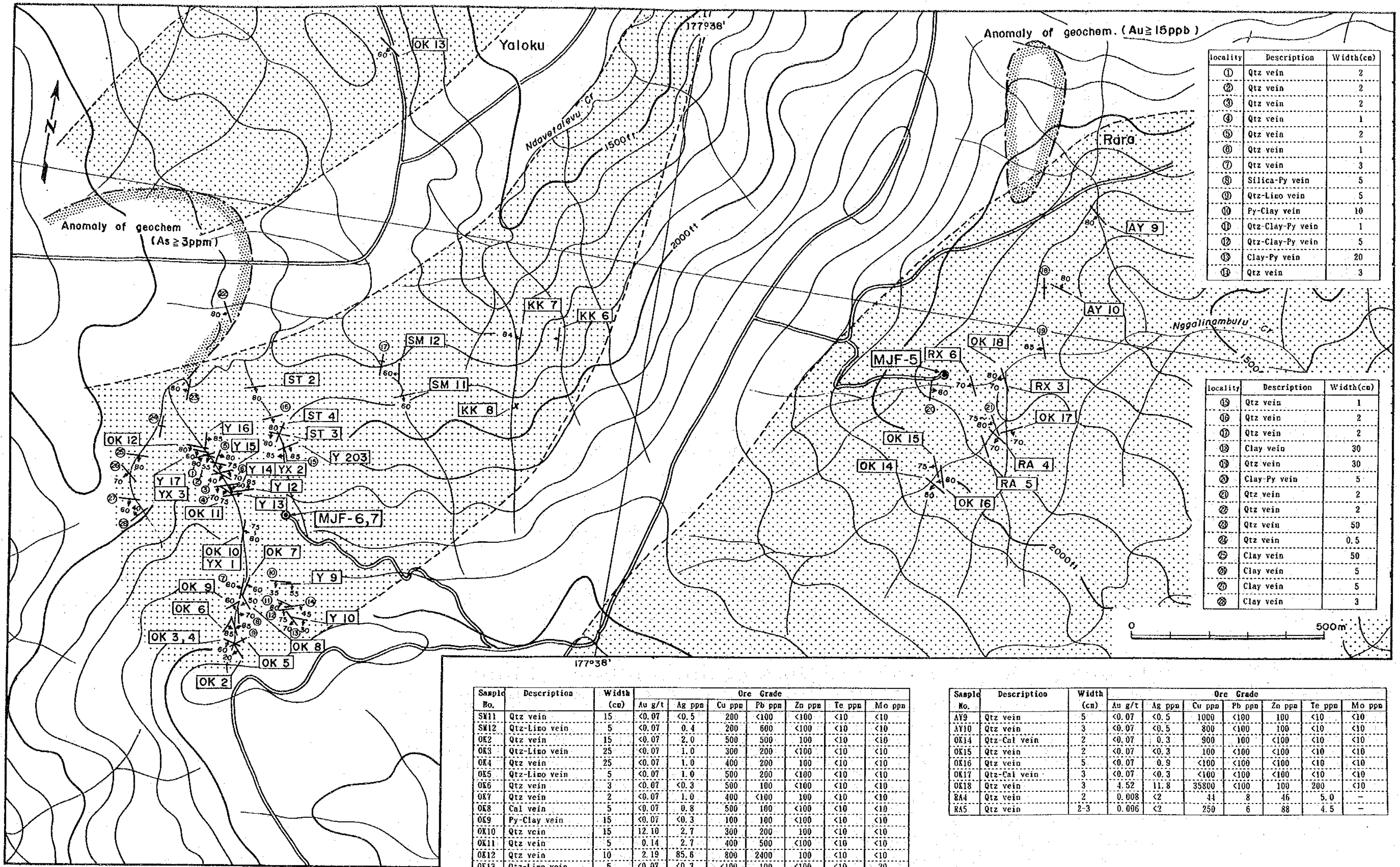
The bleached zone (several centimeters wide) occurs adjacent to the Nasala Creek quartz vein with the highest gold content. This alteration zone consists of quartz, smectite, adularia, calcite, and chlorite. A 15m wide bleached zone is formed where chalcedony veinlets (ENE-WSW) are concentrated densely and the constituent minerals are quartz, adularia, dolomite, chlorite and sericite. The clay veins of the locality contain quartz, adularia, chlorite, and sericite.

Soil geochemical anomaly of Au (Au≥15ppb) are distributed in the northern part of the quartz vein swarm in the east and As soil anomalies (As≥3ppm) occur in the northern past of the Nasala Creek quartz swarm in the west (Fig. 2-3-1, Table 2-3-9, 2-3-11 and 2-3-12, Photo 1 to 4).

3-3 Drilling

[MJF-5]

HX single bit was used to the depth of 5.10m through surface soil and weathered zone, HX casing pipe was inserted after reaming to 5.10m by HX casing metal shoe. Further drilling to 15.10m was done by NQ wireline method with bentonite mud and mud oil. Simultaneously reaming was done by NX casing diamond shoe and was NX casing pipe inserted at 15.10m. Further drilling was done with some loss of circulation to 150.20m and BX casing pipe was inserted. To the target depth of 301.00m, BQ wireline with bentonite mud and mud oil were used and the work was completed (Fig. 2-3-2, Table 2-3-1 and 2-3-4).



locality	Description	Width(cm)
①	Qtz vein	2
②	Qtz vein	2
③	Qtz vein	2
④	Qtz vein	1
⑤	Qtz vein	2
⑥	Qtz vein	1
⑦	Qtz vein	3
⑧	Silica-Py vein	5
⑨	Qtz-Limo vein	5
⑩	Py-Clay vein	10
⑪	Qtz-Clay-Py vein	1
⑫	Qtz-Clay-Py vein	5
⑬	Clay-Py vein	20
⑭	Qtz vein	3

locality	Description	Width(cm)
⑮	Qtz vein	1
⑯	Qtz vein	2
⑰	Qtz vein	2
⑱	Clay vein	30
⑲	Qtz vein	30
⑳	Clay-Py vein	5
㉑	Qtz vein	2
㉒	Qtz vein	2
㉓	Qtz vein	50
㉔	Qtz vein	0.5
㉕	Clay vein	50
㉖	Clay vein	5
㉗	Clay vein	5
㉘	Clay vein	3

Sample No.	Description	Width (cm)	Ore Grade						
			Au g/t	Ag ppm	Cu ppm	Pb ppm	Zn ppm	Te ppm	Mo ppm
SM11	Qtz vein	15	<0.07	<0.5	200	<100	<100	<10	<10
SM12	Qtz-Limo vein	5	<0.07	0.4	200	600	<100	<10	<10
OK2	Qtz vein	15	<0.07	2.0	500	500	100	<10	<10
OK3	Qtz-Limo vein	25	<0.07	1.0	300	200	<100	<10	<10
OK4	Qtz vein	25	<0.07	1.0	400	200	100	<10	<10
OK5	Qtz-Limo vein	5	<0.07	1.0	500	200	<100	<10	<10
OK6	Qtz vein	3	<0.07	<0.3	500	100	<100	<10	<10
OK7	Qtz vein	2	<0.07	1.0	400	<100	100	<10	<10
OK8	Cal vein	5	<0.07	0.8	500	100	<100	<10	<10
OK9	Py-Clay vein	15	<0.07	<0.3	100	100	<100	<10	<10
OK10	Qtz vein	15	12.10	2.7	300	200	100	<10	<10
OK11	Qtz vein	5	0.14	2.7	400	500	<100	<10	<10
OK12	Qtz vein	10	2.19	85.6	800	2400	100	<10	<10
OK13	Qtz-Limo vein	5	<0.07	<0.3	<100	100	<100	<10	20
KK6	Qtz vein	1	<0.07	<0.3	200	100	<100	<10	<10
KK7	Qtz vein	5	<0.07	<0.5	100	<100	100	<10	<10
KK8	Sil. rock	10	<0.07	<0.3	100	200	<100	<10	<10
ST2	Qtz vein	2	<0.07	<0.5	100	<100	100	<10	<10
ST3	Qtz vein	3	<0.07	<0.5	700	<100	100	<10	<10
ST4	Qtz vein	15	<0.07	<0.5	400	<100	100	<10	<10
Y9	Qtz-Limo-Py vein	8	0.022	<2	130	9	210	1.9	–
Y10	Qtz-Limo-Clay vein	15	0.011	<2	120	<5	400	5.0	–
Y12	Qtz-Py vein	3	0.041	<2	270	330	900	3.9	–
Y13	Qtz vein	3	0.020	<2	270	450	120	3.1	–
Y14	Clay-Py vein	10	0.030	<2	180	23	49	3.1	–
Y15	Qtz vein	3	0.021	<2	210	17	70	6.0	–
Y16	Qtz vein	20	0.186	<2	270	40	2000	10	–
Y17	Qtz vein	3	0.104	<2	160	20	71	3.8	–
Y203	Qtz vein	5	0.047	<2	190	12	39	4.6	–

Sample No.	Description	Width (cm)	Ore Grade						
			Au g/t	Ag ppm	Cu ppm	Pb ppm	Zn ppm	Te ppm	Mo ppm
AY9	Qtz vein	5	<0.07	<0.5	1000	<100	100	<10	<10
AY10	Qtz vein	3	<0.07	<0.5	800	<100	100	<10	<10
OK14	Qtz-Cal vein	2	<0.07	0.3	900	100	<100	<10	<10
OK15	Qtz vein	2	<0.07	<0.3	100	<100	<100	<10	<10
OK16	Qtz vein	5	<0.07	0.9	<100	<100	<100	<10	<10
OK17	Qtz-Cal vein	3	<0.07	<0.3	<100	<100	<100	<10	<10
OK18	Qtz vein	3	4.52	11.8	35800	<100	100	200	<10
RA4	Qtz vein	2	0.008	<2	44	8	46	5.0	–
RA5	Qtz vein	2-3	0.006	<2	250	6	88	4.5	–

LEGEND

- ◉ Drilling hole
- Propylitization
- Vein

Fig. 2-3-1 Mineralization Map (Yaloku)