REPORT ON THE COOPERATIVE MINERAL EXPLORATION
GOELOGICAL AND GEOCHEMICAL SURVEY IN PANAY
AREA, THE REPUBLIC OF PHILIPPINES

PHASE II

MARCH 1992

MJ

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ON
THE COOPERATIVE MINERAL EXPLORATION
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IN
PANAY AREA, THE REPUBLIC OF PHILIPPINES

(PHASE II)

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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 Philippines, the Japanese Government decided to conduct a Mineral Exploration in Panay Area and entrusted the survey to Japan International Cooperation Agency(JICA) and the Metal Mining Agency of Japan(MMAJ).

The JICA and MMAJ sent to the Philippines a survey team headed by Mr.Koji Hashimoto from November 17th to December 25th,1991.

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

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

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

March, 1992

Kensuke Yanagiya
President
Japan International Cooperation Agency

Gein-ichi Fukuhara
President
Metal Mining Agency of Japan

SUMMARY

Detailed geological and geochemical exploration works were implemented in 1991 in four prospective areas,i.e.,Mt. Upao, Madarag, Nipa and Binanan, which were selected by the geological and geochemical surveys executed in 1988 in Panay Sara Area, eastern Panay Island, Republic of Philippines.

General geology in the areas mostly consist of andesitic volcanics of the Sibala Formation of late Cretaceous to Palaeocene-Tentiary ages, which is overlain by andesite beds of Odiongan Volcanics of Pliocene-Tertiary age in higher elevated mountainous regions. It is possible to assume that the Odiongan Volcanics in the areas are actually a highly altered variety of andesite of the Sibala Formation.

Vein-type mineralization of copper, lead and zinc, associated with some gold and silver, observed in Sibala Formation in Nipa Area, has been known to had been explored by tunnelling in a period of time before the World War II. It however is evaluated to be of small scale, low-graded and subeconomical.

Acidic high temperature alterations featured by abundant alunite, are predominantly observed in above four areas, and the quartz vein specimens in Nipa Area show the homogenization temperature of the fluid inclusions of around 270 C.

Soil geochemistry, composed of 927 soil samples to implement chemical analyses of gold, silver, arsenic, bismuth, copper, mercury, molybdenum, lead, antimony, zinc and manganese, has been carried out. The data were analysed using R mode principal component analysis. Varied types of geochemical anomalies, chiefly of gold, have been located in each of the surveyed area.

A prominent gold anomaly associating the highest value of 162ppb Au extends north-southerly for more than 800m with the threshold value of 31ppb Au (1300m long with the threshold value of moderate anomaly, 11 ppb), has been located in Mount Upao area.

The gold anomaly with the highest value of 133ppb Au in the southern part of Mount Apiton in Nipa Area shows a broad areal extension although it needs further delineation. A potential for a porphyry molybdenum-copper type mineralization may exist in north-western part of the gold anomalies, to the west of Puntales village.

Although the gold anomaly in Madarag area with the highest gold value of 76ppb, is not as extensive nor

prominent as compared with that located in Mt. Upao area, being in a higher background situation of gold and base metals, its association with high molybdenum values is noticeable and interesting.

Soil geochemistry in Binanan Area shows overall higher contents of metallic elements, particularly of arsenic,the highest value being 807ppm, and the threshold of the strong anomaly, 297ppm. Geochemical anomaly of molybdenum, bismuth and copper, associated with gold, was located in north-eastern part of Binanan Island. Although the highest gold value is as high as 116ppb, the gold anomalies lack the continuation.

Interesting geochemical anomalies have been located in all of the surveyed areas as stated above. Although all of them may worth further investigation, the gold anomaly in Mt. Upao area is considered to have the first priority.

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PART I GENERAL

PART I GENERAL

Chapter 1 Introduction

1-1 HISTORY & THE OBJECTIVE OF THE SURVEY

The current Cooperative Mineral Exploration Works, 1991, in Panay Area, Republic of the Philippines, were carried out in accordance with the Implement Arrangement, dated July 1990, between the Mines and Geosciences Bureau: MGB, Republic of the Philippines, and Japan International cooperation Agency: JICA and Metal Mining Agency of Japan: MMAJ, Japan.

As for the present project area, eastern Panay, it has been selected from the results of the survey, 'Cebu, Panay and Ronblon Areas, the Supra Regional Survey in the Philippines', executed in 1987, and the succeeding further detailed survey, the'Survey in Panay-Sara Area', implemented in 1988.

The current works consist of geological and geochemical surveys in four areas delineated from the preceding work done in 1988. The objective of the survey is to contribute to the finding of unknown mineralization in the project area.

1-2 CONCLUSION & RECOMMENDATION OF THE PRECEDING WORKS

The survey executed in 1988 concluded that the four areas, i.e., Mt. Upao, Madarag, Nipa and Binanan were anomalous in gold, and copper etc., hence they were very prospective and needed follow up. Consequently the execution of further detailed works in these four areas were recommended.

1-3 OUTLINE OF THE CURRENT SURVEY WORKS

1-3-1 Areas of the Works

Four areas, i.e., Mt. Upao, Madarag, Nipa and Binanan, are shown in Figure I-1-1.

1-3-2 Objectives of the Works

The objectives of the current works in 1991 are to provide geological and geochemical cooperation works in four areas stated above, to contribute to the new discovery of mineralization of economic significance by establishing an elucidation of geological setting and mode of mineral occurrence.

1-3-3 Method and Procedure of the Survey

Geological and geochemical surveys have been implemented in the areas. Regional soil samples were collected in each of the specified four areas, and the smaller area in each of the area considered to be most prospective were subjected to the sampling along the grid lines; soil samples were collected at every 50m interval sites on the lines, the line interval were 200m.

The contents and quantities of field works are shown in Table I-1-1, and those of laboratory works are in Table I-1-2 respectively.

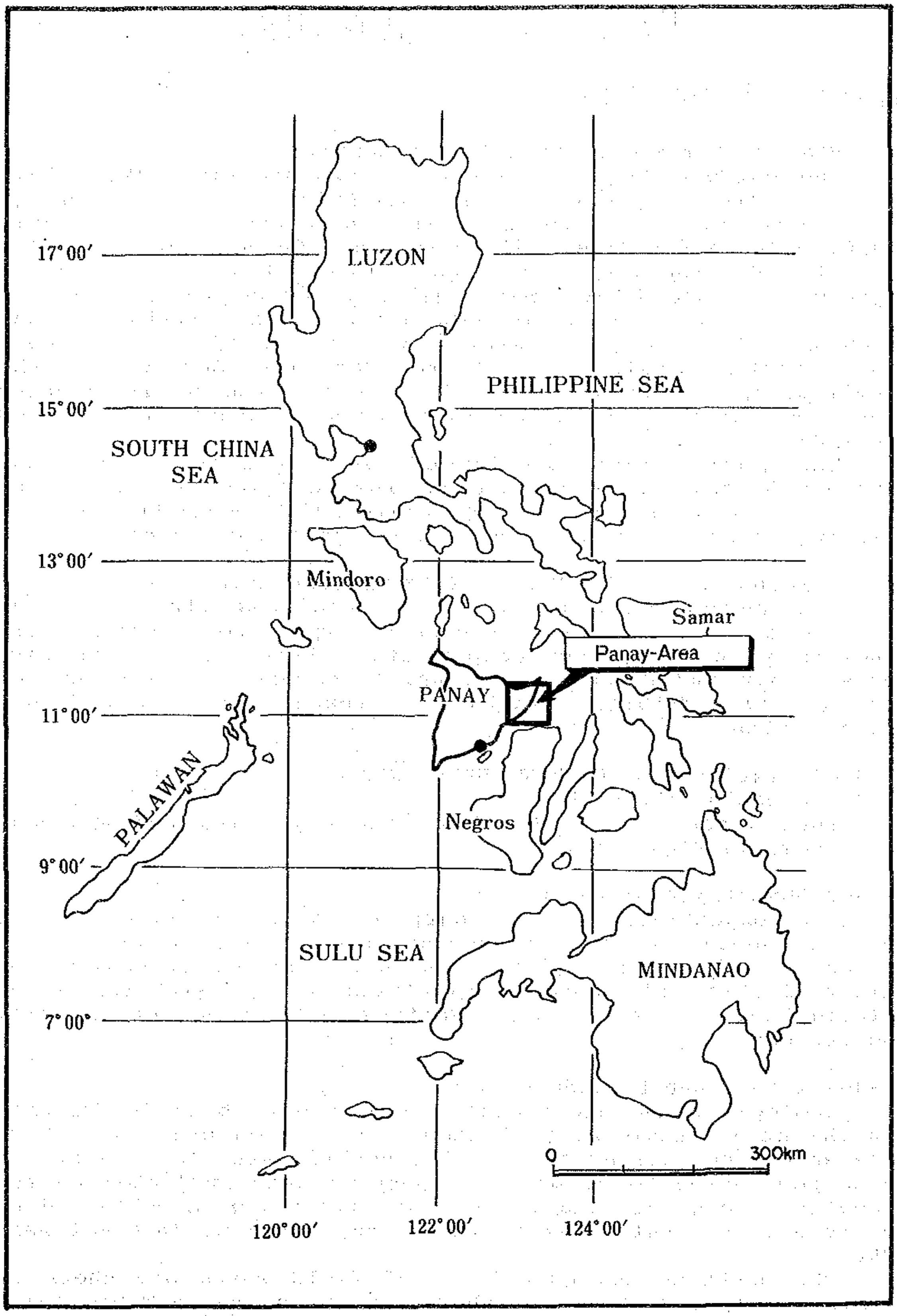

Fig. I–1–1 (a) Location of the Project Area

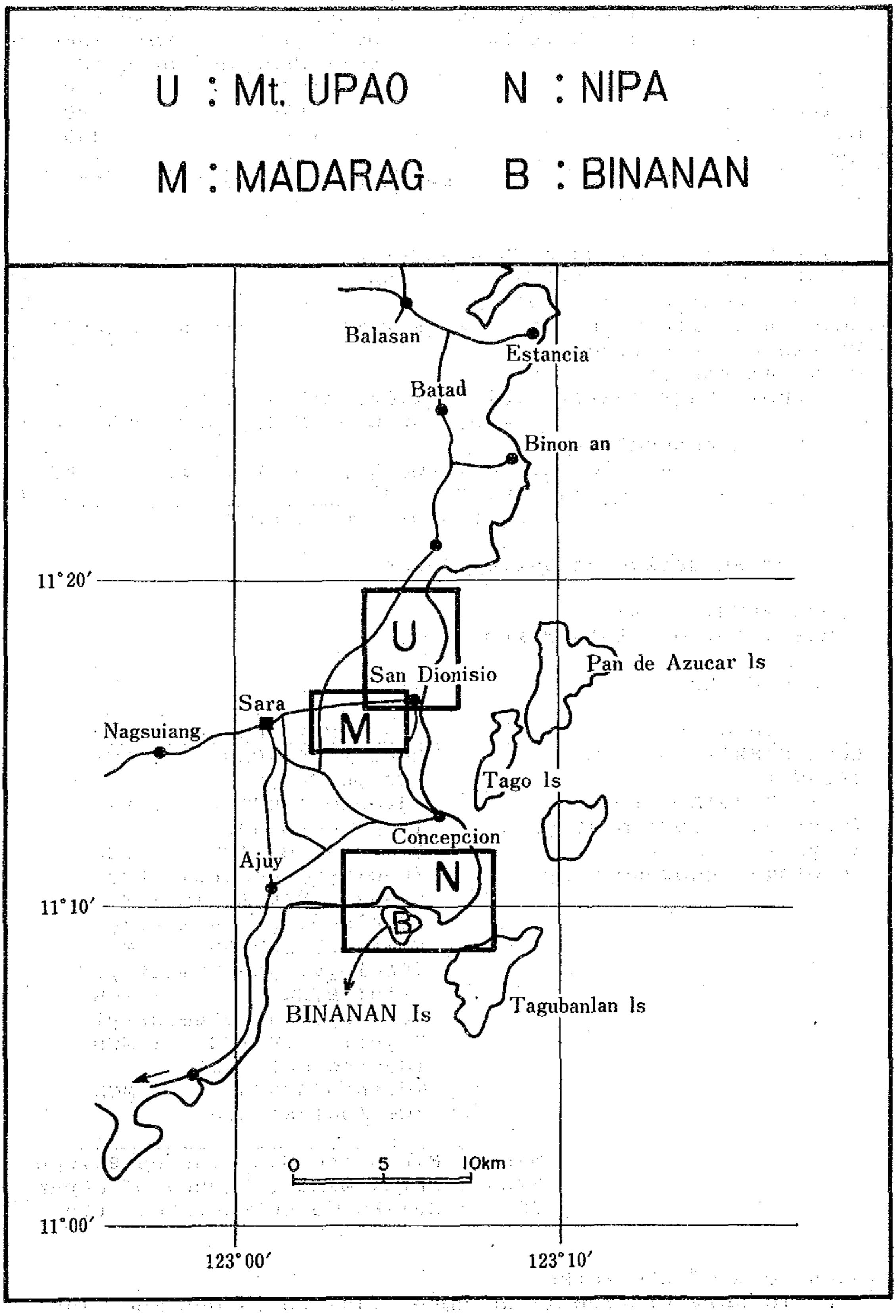

Fig. I–1–1 (b) Location of the Project Area

Area Name	Area, sq.km	Total Traverse Length in km	Number of Regional Soil Samples	Number of Soil Samples on Grid
Mt.Upao	15	22	104	200
Madarag	6	13	67	100
Nipa	12	21	116	200
Binanan	4	8	40	100

Table I-1-1 Works done in Panay Area, 1991

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5.Potash-Argon Dating	2
6.Chemical Analyses	
Whole Rock Analysis(SiO2, TiO2, Al2O3, FeO,Fe2O3, MnO, MgO,CaO, Na2O, K2O,P2O5, LOI)	21
Soil Geochemistry (Au, Ag, As, Sb, Hg, Cu, Pb, Zn, Bi, Mo, Mn)	927
Ore Assay (Au, Ag, Cu, Pb, Zn)	42

Table II-1-2 Laboratory works done, 1991

1-3-4 Organization of Survey Teams

Kenzo MASUTA : MMAJ
Supervisor of Field Works

Field Works

Japanese	Philippine
Koji HASHIMOTO : SC (Leader)	Noel V. FERRER : MGB (Co-Leader)
Fumio KUBOTA : SC (Geology, geochemistry)	Antonio APOSTOL : MGB (Vice Co-Leader)
Seiya MORITA : SC (Geology, geochemistry)	Claro J. MANIPON : MGB (Geology, geochemistry)
	Eleazar MANTARING : MGB (Geology, geochemistry)
	Emmanuel SANTOS : MGB (Geology, geochemistry)
	Ariel BIEN : MGB (Geology, geochemistry)
	Reynaldo VECINO : MGB (Geological aid)
	Melanio DONES : MGB (Geological aid)

MGB : Mines and Geosciences Bureau
MMAJ : Metal Mining Agency of Japan
SC : Sumiko Consultant Co., Ltd.

1-3-5 Term of the Works

Field Survey: from 17 November 1991 to 25 December 1991.
Reporting: from 26 December 1991 to 28 February 1992.

Chapter 2 General Geography

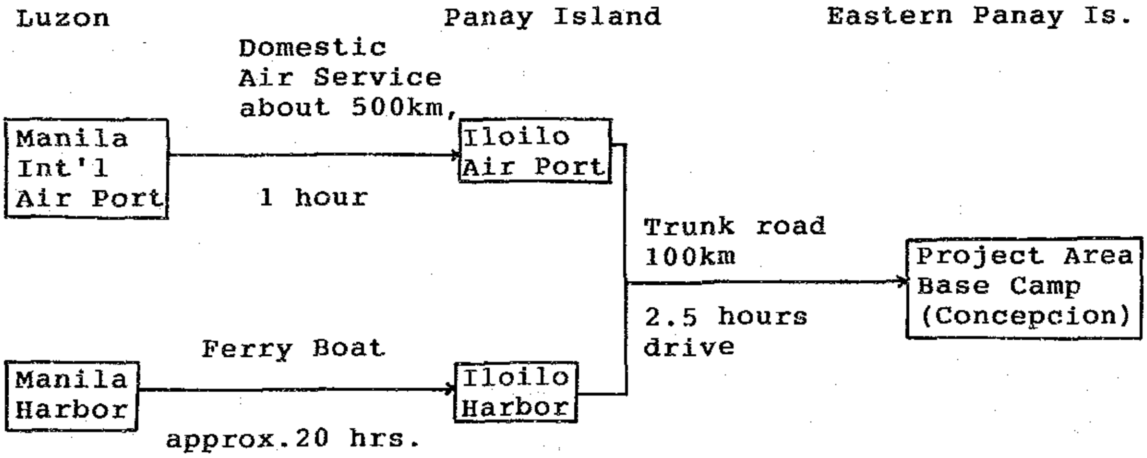
2-1 LOCATION & ACCESS

The four project areas of the current work, i.e., Mt. Upao, Madarag, Nipa and Binanan, are situated at the latitude of 11 14 north and 123 05 of east longitude, to the east of Sara in eastern Panay Island. The areas are under the administration of the Iloilo Province: Mount Upao is located in Municipality of San Dionisio, northern and eastern Madarag in San Dionisio, southern and western Madarag in Municipality of Sara, Nipa in Municipality of Concepcion, and Binanan in Municipality of Ajuy, respectively.

The access from Iloilo City to Ajuy,which is located in the south-western part of the project area, is connected by sealed road. The roads beyond Ajuy are not sealed, however, usual traffic can be made with no trouble.

Sara, being the most populated town in the region, was the most preferred candidate site for the base camp. However, since there were no houses available for the rent, the camp was based in Concepcion instead. Concepcion, located approximately at the center of the four project areas, was found to be the most appropriately situated for the base camp of the current work.

Hiring of the slender boat, called banca, equipped with outriggers on both sides of the boat, is required for the works in Binanan Area, an isolated island. General traffic access from Manila to the project area is outlined below :



2-2 TOPOGRAPHY & WATER SYSTEM

General topography of the Panay Island is largely divided into two regions, i,e., the flat land in the east and the mountainous region in the west. The project areas are situated in the eastern flat land.

The four project areas are respectively located in small mountainous to hilly regions elevated from the above mentioned flat land, the highest elevation in each area are shown below;

Mount Upao Area	340m Above Sea Level
Madarag Area	280m ASL
Nipa Area	432m ASL (Mt. Apiton)
Binanan Area	135m ASL

There are no large river systems in the project areas due to the low to moderate hilly topography of the region along the eastern coast of the Island where the areas are located. There are several smaller water systems such as the Pinantan River, which flows down from western Sara into Ajuy Bay, are utilized for agricultural purposes.

2-3 CLIMATE & VEGETATION

The project area is located in the tropical monsoon climate zone in western Pacific Ocean, and the wet season prevails generally from June to October, and the dry season from November to the next May.The period of the lowest temperature is during November to the next February. The annual average temperature in the project area is around 25 Celsius.

Paddy fields are chiefly cultivated in the flat land, partly associated with sugar cane fields. Lower to middle parts of the hills in the area are mostly covered by coconut and bamboo trees while shrubs and grass are exuberant in higher parts of the mountainous areas. The flat land, less than 30m high above sea level,is widely cultivated for paddy fields, where three to four crops of rice annually are the norm due to the warm and favourable climatic condition for the growth.

Chapter 3 General Geology

General geology in Panay Island, details of which are shown in the Cooperative Mineral Exploration Report, Panay Island 1988, by the MGB, JICA, And MMAJ is outlined as follow.

3-1 GEOLOGY & STRATIGRAPHY

The eastern hilly region of Panay Island, including the current project areas, is geologically characterized by the upheaval zone formed after the sedimentation of Sibala Formation, which is chiefly comprised of volcanic rocks and sediments of Palaeocene-Tertiary to late Cretaceous ages.
Sibala Formation is barely overlain by the Tertiary beds of later than palaeocene age or lacks completely of that in the project areas. Guimaras Zone, which is composed of granitoids of Palaeogene age, is extending north-southerly in the eastern mountainous region of Panay Island. Sara Diorite exposed in the northern part of Sara is considered to compose a part of Guimaras Zone.

A volcanic zone of Pliocene to Quaternary ages, called the Negros Zone, is situated along the eastern periphery of Guimaras Zone. The project areas are located in northern part of Negros Zone and consist mostly of volcanic rock.

The stratigraphy of Panay Island is summarised in Table I-3-1. The geology of the project areas of the current work mostly consists of Sibala Formation of Palaeocene age which is mainly composed of basic to intermediate volcanic rock, partly intercalating mudstone-sandstone beds, and Odiongan Volcanics of Pliocene age. The former is distributed in lower portions of hilly regions and is unconformably overlain by the latter. Odiongan Volcanics are always distributed in higher portions of hilly regions extending in NNE-SSW direction. Odiongan Volcanics are intensely altered in general by silicification and argillization, which are estimated to be caused by a autometamorphic process associated with the volcanic eruption. It is quite possible however, based on the result of the current work to assume that the rocks of the two units belong to the same Sibala Formation, Odiongan being more intensely altered portion of the formation. However, since there are no decisive evidence to support the above hypothesis, the altered rocks occupying the higher elevation are assigned to Odiongan Volcanics in accordance with the preceding report. The Odiongan Volcanics described in the current report, are those of reddish limonite stained, highly altered andesitic rocks occupying the higher portion of the mountains.

3-1-1 Mount Upao Area (PL.1-1)

The andesite unit, weathered and reddish purple stained by disseminations of hematite and limonite, subjected also to silicification and argillization, supposedly equivalent of the Odiongan Volcanics, is observed in higher portion of Mt.

Table I–3–1 Stratigraphic Correlation of Geological Units in the Panay Island

GEOLOGICAL TIME			WESTAN PANAY	PANAY CENTRAL PLAIN (Iloilo Basin)	GUIMARAS IS.	EASTERN PANAY	SURVEY AREA
QUARTERNARY	HOLOCENE		ALLUVIUM	ALLUVIUM	ALLUVIUM	ALLUVIUM	ALLUVIUM
QUARTERNARY	PLEISTOCENE		PANCICUIAN PYROCLACTIC FLOW SANTA CRUZ FORMATION	CABATUAN F.: STA BARBARA SILT M., MARAGET Ss. M., BALIC CLAY M.	GUIMARAS LIMESTONE	CABATUAN F. MARAGET Ss. M.	PAN DE AZUCAL VOLCANICS; BOTLOG VOLCANICS
TERTIARY	PLIOCENE	LATE	APDO FORMATION	ULIAN FORMATION	GUIMARAS FORMATION	ULIAN FORMATION; ODIONGAN VOLCANICS	ODIONGAN VOLCANICS
TERTIARY	PLIOCENE	EARLY	PAMLUPAN CONGLOMERATE	IDAI FORMATION; TARAO F.: GUIMBAL MUDSTONE M. N21 – TUBUNGAN SILTSTONE M. N17		DINGLE F.: STO. THOMAS Ls. MEMB., SUMMIT CLASTICS M., AGLALANA Ls. M.	
TERTIARY	MIOCENE	LATE	MAMLACBO FORMATION; MAKATO FORMATION	SINGIT FORMATION: BARASAN Ss. MEMB., IGTALONGON SH M. N17 – N14	BATUSO VOLCANICS	PASSI F.: ASSISIG M.; BAYUSO VOLCANICS	
TERTIARY	MIOCENE	MIDDLE	LAGDO FORMATION MALIAO WACKES; PACOL DIORITE; ANTIQUE OPHIOLITE	SINGIT FORMATION: TANIAN Ls. M; LEPIDOCYCLINA MIOSYPSINA N9 – N3		PASSI F.: SALNGAN MEMB.	
TERTIARY	MIOCENE	EARLY	IGSAWA PYROCLASTICS; LIBACAO FORMATION	SINGIT FORMATION: SEWARAGAN MEMB.		?	
TERTIARY	OLIGOCENE		PANPANAN BASALT; MT. BALOG VOLCANICS				
TERTIARY	EOCENE		LUMBYAN FORMATION IGBAO SEDIMENTS				
TERTIARY	PALAEOCENE				SIBALA FORMATION; GUIMARAS DIORITE 59 m.y. (K-Ar)	SIBALA FORMATION; PIRLAR MONZONITE; SARA DIORITE	SIBALA FORMATION TAGUBANHAN MEMB.
PRE-TERTIARY			BURUANGA METAMORPHICS	BASEMENT		? MASONSON SCHIST	

This stratigraphic correlation is based on BMG (1982) and Hashimoto, W. (1982) .

Upao, Mount Buraay and etc.. More Intensely silicified portion seems to extend to NNE-SSW direction.

Andesite lava, tuff breccia, tuff and mudstone beds, which have so far been designated to the Sibala Formation are distributed in the middle to lower terrains of hilly area.

The result of whole rock analysis of one fresh specimen of the andesite lava shows less than 50 percent of silica content, the composition of basalt. Andesite lava had attained white colour due to the argillization and hence fresh specimen are rare. Most of the andesite lava are composed of fine and coarse grained porphyritic massive rocks and intercalate agglomerate beds.

Geological structure of the area, only with few outcrops available to provide reliable measurement of strike/dip of the beds, is presumed to have a monoclinic structure with strike/dip of NNW-SSE/20 -30 W from the measurement obtained in the western part of the area. Andesite lava beds, extending in NW-SE to NNW-SSE direction are observed predominantly in the eastern side of the center of the area, both side being predominated by andesitic pyroclastic beds.

The mudstone bed, exposed in southern end of the Area, *shows a strike/dip of NNW-SSE/10 N.*

3-1-2 Madarag Area (PL.2-1)

Madarag area, is situated only about 3km SSW of Mt.Upao area and hence consists of similar geology. The preceding geological survey executed in 1988 has revealed a synclinal structure that extends NNW-SSE direction along the eastern part of the area. The structure was envisaged from the structure of the mudstones observed in the localities, outside of the project area, to the east and west of the area. There is a dacite dyke in the southern part of the area. The highly altered andesite of Odiongan Volcanics occupies the higher portion of the hill and extends NNE-SSW direction.

3-1-3 Nipa and Binanan Areas (PL.3-1)

Genaral geology in Nipa and Binanan areas is collectively reported in this section, since two areas are so closely situated. Nipa Area is located about 9km southerly from Mount Upao. Binanan Island is a small isle, about 2km long, adjacently located south-westerly from Nipa Area.

Andesite units, weathered and intensely silicified and argillized, correspond to Odiongan Volcanics, are observed in higher portion of hilly regions in the areas.

Sibala Formation in the areas chiefly consists of pyroclastic rocks, such as andesite lava, agglomerate beds and etc..

Alternation of andesite lava and agglomerate beds, that of mudstone, sandstone and tuff beds, with strike/dip of NNW-SSE/30 -40 W, are observed in south-western Binanan Island. There are fewer andesite lava and more pyroclastics *in Binanan Island. Small dykes of quartz porphyry is observed* in southern part of the Island.

The central part of Nipa area is dominantly covered by the andesite lava while andesitic pyroclastics dominates in the eastern and western portion. Basalt lava beds, relatively unaltered and dark green, are observed along the coast in eastern and southern parts of Nipa Area.

Along the coast north of Nipa village, there is an outcrop of quartz diorite with a very irregular shape that has been interpreted as an equivalent to Sara diorite. The quartz diorite appears to be intruded by andesite and the previous survey interpreted the occurrence that the andesite here is a dyke swarm, different from the andesite belonging to Sibala Formation. However, the andesite is quite similar to the basaltic andesite of Sibala and seems to continue to the typical Sibala Formation. Although a similar quartz diorite is only known to exist in the southern part of Pan de Azucar Island, there is a possibility that the rock is the basement of Sibala Formation and may have wide distribution beneath the sea floor.

Since there is no documented isotopic age determination data for rock in the area and the ages of the quartz diorite and andesite of Sibala Formation may have some implication for the evaluation of the prospectivity of the area,one quartz diorite and one andesite specimen were subjected to the age determination by K-Ar. The results are as follow.

Andesite, (sample No.A 013R)	25.7±1.9Ma
Quartz diorite (sample No.A 021R)	30.1±1.5Ma

It is therefore reasonable to consider that the quartz diorite is the older basement rock for the Sibala if the andesite dated were genuine representative of the Sibala Formation.
However, if the andesite belongs to a later dyke system as interpreted in the preceding report, there is no contradiction on the ages of the both.

3-2 INTRUSIVE ROCKS

Quartz porphyry, dacite are observed in project areas, and granodiorite or quartz diorite described above is observed in Nipa area.

3-3 ALTERATION & MINERALIZATION

3-3-1 Alteration

Andesite units in Sibala Formation are widely propylitized,while, relatively unaltered facies of those are observed along the coast in the areas. Altered rocks overlappedly formed after argillization by weathering and silicification and argillization associated with the hydrothermal alteration are widely observed in the areas. Odiongan Volcanics are widely subjected to intense weathering and silicification-argillization in general. Ubiquitous disseminations of limonite and hematite asssociated with intense silicification-argillization are observed along the joints and cracks in the rock. Such a weathering-alteration of rocks is estimated to be limited to the superficial part of the ground-serveral meters to serveral tens of meters deep at most-, and to be of an inherently different type of alteration from that of mineralzation-associated one. Howerver, the distinction between them is very difficult. As stated above, the rocks designated in this report as Odiongan Volcanics are noted to carry the above mentioned characteristics and only distributed in the higher portions of the mountainous terrain.

Intensely silicified zones tend to extend in a N-S to NNE-SSW direction throughout the four areas.

A small hill, composed of gossanous materials with a very poor vegetation, is observed in southern part of Puntales village in Nipa area. Sulfides such as pyrite and chalcopyrite might have orginally been contained in the hill-forming materials, however, only very minor green copper minerals were noticed in the limonitic gossanous rock that was presumably formed by oxidation and leaching processes.

Abundant alunite, associated with quartz, were identified by X-Ray powder Diffraction in Mount Upao and Madarag Areas.

In Mt. Upao area, the occurrences of alunite were confirmed by the current work in the southern part of the gold anomalous zone, and in the vicinity of the summit of Mt. Buraay, both locations being covered by the Odiongan Volcanics. Consequently, the acidic alteration associating abundant alunite is the characteristic alteration feature of the entire body of the Odiongan Volcanics, located around the crests of the mountain. A small quantity of dickite, associated with alunite, was found in some samples. Minor amounts of hematite were found to be ubiquitous in the samples tested.

In Madarag area, abundant alunite together with a small to very minor amount of pyrophyllite are frequently obseved and small to a very minor quantity of diaspore are obseved in few samples suggesting the prominence of a higher temperature hydrothermal alteration in the area.

An abundant quantity of alunite, associated with quartz is obseved in southern part of Nipa Area. Abundant amount of kaolinite, associated with alunite, but entirely lacking quartz, was observed in the sample,numberd EO13R in the area. The sample, numberd FO15R, contains abundant dickite. Alunite,with sparse association of kaolinite, and chlorite/ montmorillonite mixed layered clay, is considered to be the representative alteration mineral in the project area.

3-3-2 Mineralization

Old workings, excavated for the exploration for copper by Japanese in the Second World War time, have been known in the northern part of Nipa village. Ores obseved in the disposals are of vein type and are chiefly composed of pyrite and chalcopyrite, associating minor lead and zinc minerals.

Veins in the old workings are with narrow widths, low-graded and of subeconomical significance. The higest assay values of ore specimens by the current work show 0.31 gram of gold per ton, 13.4grams of silver per ton and 0.76 percent copper, against the highest values of these by the 1988 work of 4.08 grams of gold per ton,115 grams of silver per ton and 2.61 percent copper. A specimen of silicified andesite in Madarag area shows to carry 0.34 gram of gold per ton. Other than the above mentioned, there are no significant assay values and it has been demonstrated difficult to find ore materials on the surface.

The results of homogenization temperature measurement of primary fluid inclusions for five specimens showed the peak around 270 C.

Chapter 4 Comprehensive Analysis of Survey Results

4-1 GEOLOGICAL STRUCTURE, CHARACTERISTICS OF MINERALIZATION & MINERALIZATION CONTROL

Intensely weathered and altered andesite beds,correlated to the Odiongan Volcanics, estimated to be formed by the volcanic activities during Pliocene to Quaternary, are distributed in higher portions and/or on the crests of hilly regions of the four project areas, i.e., Mt. Upao,Madarag, Nipa and Binanan. Sibala Formation, on the other hand, chiefly composed of andesite lava and pyroclastic beds, has been reported to be distributed in lower terrains of the area. However, a geological possibility is envisaged by the current work that both of Odiongan Volcanics and Sibala Formation belong originally to an identical group,i.e., Sibala Formation. Only difference between them are that of the alteration and weathering. The rock belong to "Odiongan" being highly silicified, is more resistant to the weathering and hence occupies the present higher portion of the areas.

Sibala Formation also have been subjected to intense weathering and alteration excepting the coastal area, making the distinction between them very difficut. However, an altered rock facies, associating disseminations of limonite, is observed characteristically in Odiongan Volcanics.

Odiongan Volcanics are formed obviously under the structural control of north-southerly direction,since the volcanics are distributed mostly on the hill crests scatteredly, showing a north-southerly extension.

Only known base metal ore veins, chiefly of copper minerals, had been located in Nipa area. The veins have been reported to show the strike of NNE-SSW and EW, while, the widths of the veins and the ore grades are economically insignificant.

Varied types of geochemical anomalies of different directions have been delineated by the current geochemical works, i.e., north-southerly in Mount Upao, east-westerly in Madarag,NS, EW, NE-SW, NW-SE and NNE-SSW in Nipa. Gold anomalies are most prominent ones throughout the four areas, while those of copper, lead and zinc are less significant and /or spotty.

Those geochemical anomalies are estimated to have been generated in connections with the major northsoutherly and associated structures and the accompanying hydrothermal activities to form alunite and etc.

4-2 MINERAL POTENTIAL

4-2-1 Mount Upao Area

A gold anomaly with the threshold value of 31ppb Au has been detected and confirmed to stretch northsoutherly for more than 800m, the highest gold value being 162ppb Au.

The existence of two types of gold anomalies have been clarified by the principal component analysis of the

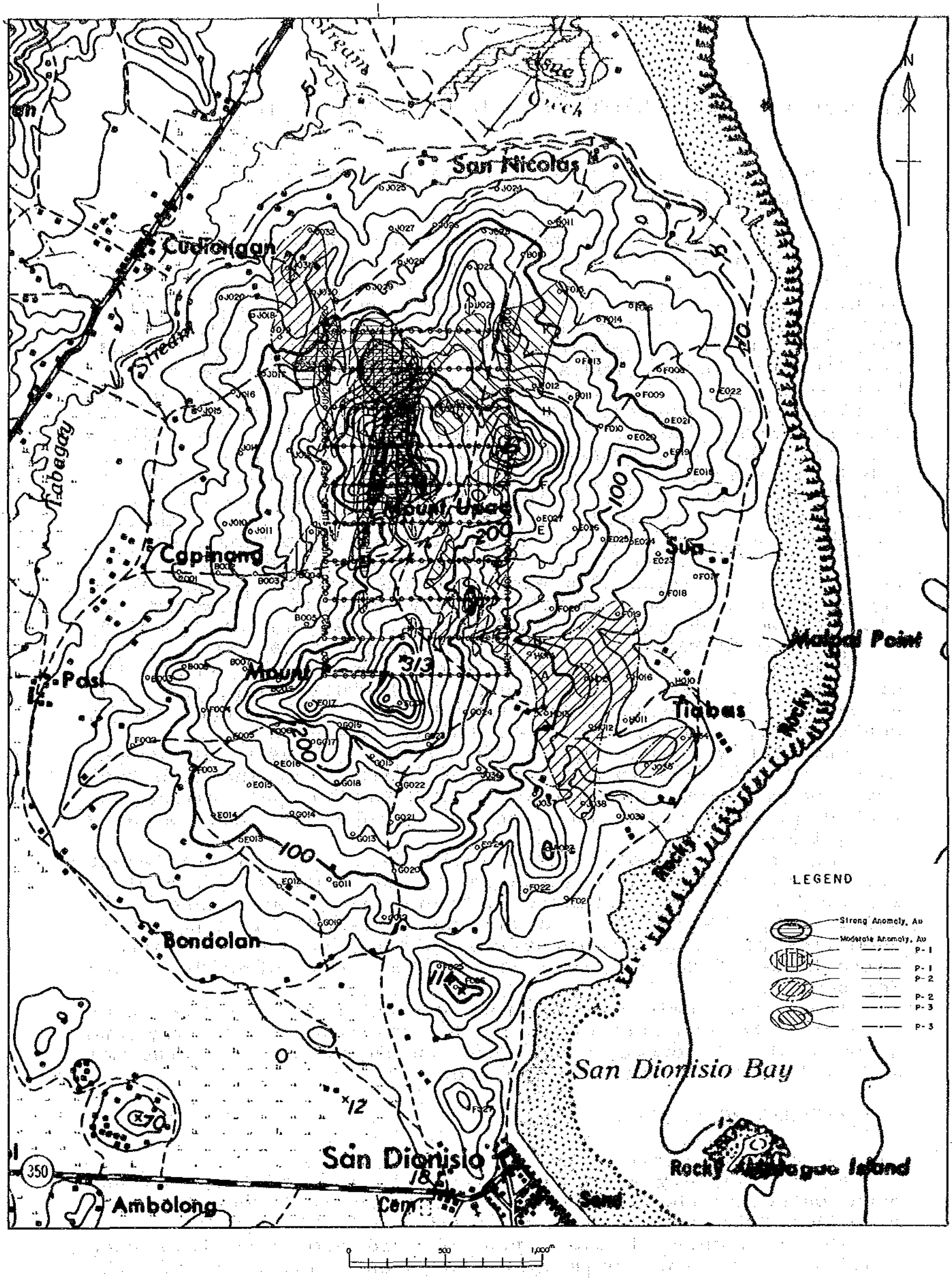


Fig. I–4–1 Comprehensive Geochemical Anomaly Map, Mt. Upao Area geochemical data,i.e., the one, associated with arsenic and molybdenum, but not with copper, and the other one,associated with base metals. The assay results of seven altered/silicified rock samples from the area were shown to be barren in all the metals, but the sampled sites of these samples were from the outside of the newly discovered gold anomaly.

Gold anomaly detected in the area is a prominent one within a low gold background situation and deserves to be investigated further by trenching and/or diamond drilling. The possibility to find an unknown gold mineralization there is considered to be excellent.

The metal concentrations other than that of gold, are low in comparison with those in other areas, consequently the mineral potentials of base metals in the area are evaluated as rather low.

4-2-2 Madarag Area

The background of gold in Madarag area is higher in contrast with those in Mt. Upao area, however, the highest gold value, 76 ppb is considerably lower than that of Mt. Upao area. Most significant gold anomaly,extending for more than 250m eastwesterly,was detected in the vicinity of a crest in the area. The geochemical highest values of molybdenum, lead and silver are higher than those in other areas, while, the average copper value,35 ppm,is considerably higher. Two types of gold anomalies have been detected by the principal component analysis, i.e., the one, associated with arsenic and molybdenum, and the other one, associated with base metal elements. Possibilities of gold and molybdenum mineralizations can be expected, however, the extension of the gold anomaly in the area is less significant in comparison with that of Mt. Upao area.

4-2-3 Nipa Area

Noticeable gold anomaly of significance has been shown to exist in the northwestern part of the grid-sampled area, to the south of Mt. Apiton, although the samples collected were rather sparse and hence the continuity and the shape of the anomaly has not yet been known clearly. The anomaly needs further detailed geochemical and geophysical works to evaluate its potentiality for gold mineralization.

Geochemical anomalies of base metal elements, such as copper, lead and zinc, are concentrated in the vicinity of the old workings and further toward north from there. They are distributed independently from the gold anomaly; a moderate lead anomaly shows certain overlapping with the gold anomaly.

Since the strong base metal anomalies lack the continuities, the possibility to host a significant base metal mineralization in the area is rather remote. This assumption could also be enhanced by the past performance records of the exploration shown by the old adits.

although the molybdenum and copper anomaly located to the west of Puntales village, does not show very high values, it is associated with a gossanous hill and hence may indicate

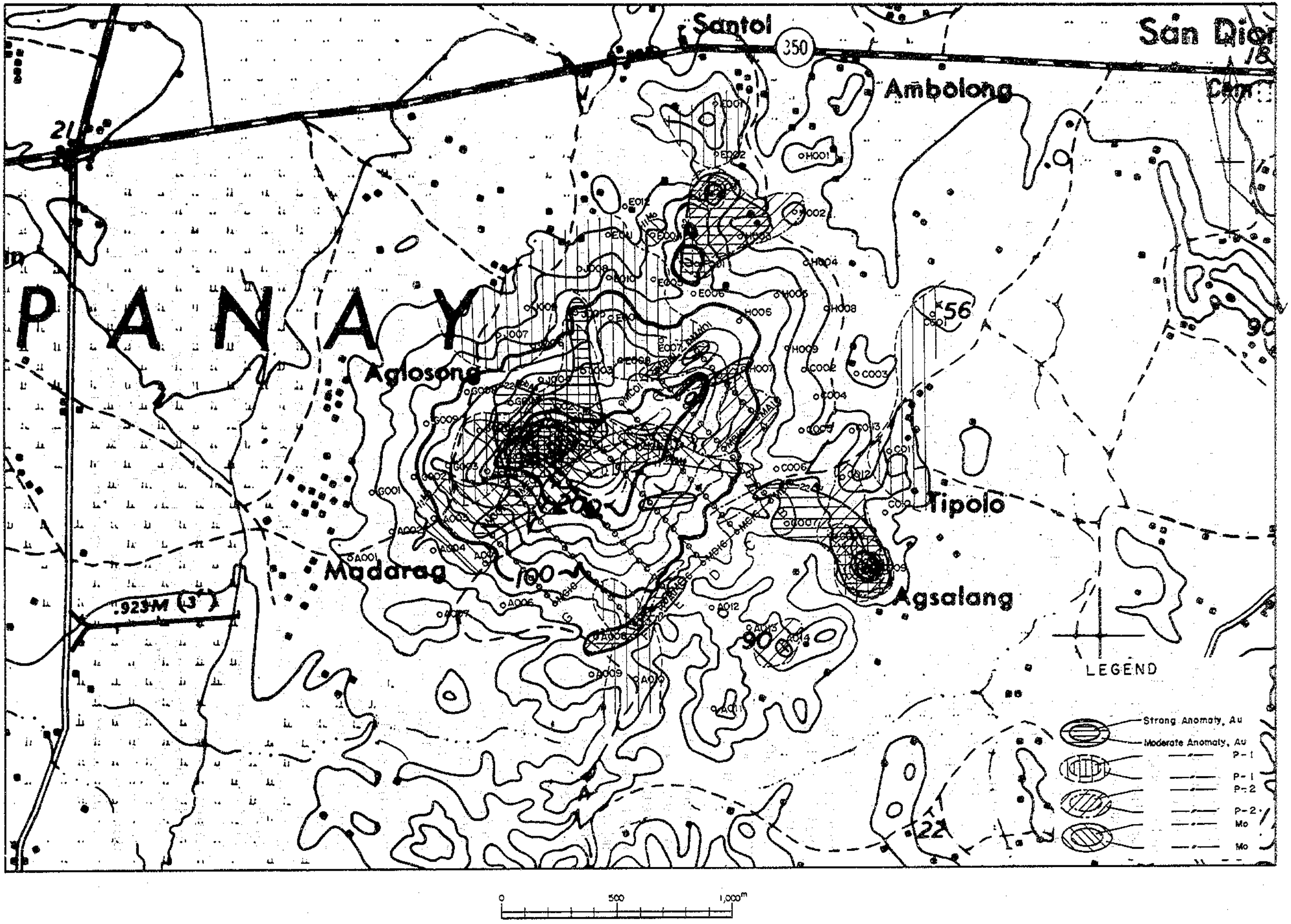


Fig. I–4–2 Comprehensive Geochemical Anomaly Map, Madarag Area possible porphyry Mo-Cu type mineralization in the depth.

4-2-4 Binanan Area

There exist gold anomalies in the northern half of the Binanan Island, albeit lacking continuities and in higher background situation. Anomalous zone of molybdenum, bismuth and copper is shown to exist in the northastern part of the island. This zone may be of some interests although the anomalous values themselves are not very high. The background value of arsenic in the area , 27 ppm, is extraordinarily high.

4-3 RELATION BETWEEN GEOCHEMICAL ANOMALY & MINERALIZATION

As stated in the above sections, geochemical gold anomalies of significance have been detected in all of the four project areas by current work. Consequently gold is considered to be the most likely commodity to be found in the area. There are two types of gold anomalies; one being associated with molybdenum and arsenic, and the other, with the base metals, both are possibly suggesting certain vein type gold mineralizations related to a rather high temperature acidic hydrothermal alteration.

Base metal mineralization in Nipa area had been explored since the Second World War time,and was evaluated to be of small-scale and low-grade hence with not much economical significance. The base metal anomalies, detected in the vicinity of old workings and toward north from there, both are considered to be insignificant, the former having no further extensions on both sides, and the latter is only moderately anomalous in base metals.

The geochemical anomaly of molybdenum and copper located to the west of Puntales village, does not have very high values of either elements, but it is situated on a gossanous zone, hence the anomaly may be suggesting the existence of such a mineralization beneath the gossan.

Arsenic anomalies with the highest value of 807ppm,were located in Binanan area although they did not have much association with those of gold.

Chapter 5 Conclusion and Recommendation

5-1 CONCLUSION

Four prospective areas delineated by the preceding survey executed in 1988 were further studied geologically and geochemically with the objective to contribute to the new finding of hitherto unknown mineralization in the four specified project areas.

The project areas are widely covered by Sibala formation of Paleocene to Cretaceous age, and Odiongan Volcanics of Pliocene to Quaternary age being distributed in higher portions of the areas. The Odiongan Volcanics in the surveyed areas has acquired intense silicification,higher temperature acidic hydrothermal alteration characteristics featured by abundant existence of alunite and hence has a different appearance from the andesitic volcanics of Sibala Formation. Hence, it is a possibility that the Odiongan here is actually a highly altered variety of andesite of the Sibala Formation.

The only known metallic mineral occurrence is the small scaled and low grade copper, lead, and zinc veins associating minor gold and silver, located near Nipa village. Acidic alterations associating alunite are characteristically observed in all of the four project areas, particlularly in Mt. Upao and Madarag areas.

The soil samples collected as the regional representatives, and on the grid lines, totalling 927 were analysed for gold, silver, arsenic, bismuth, copper, mercury, molybdenum, lead, antimony, zinc, and manganese. The geochemical data were analysed using R mode PCA. Each of the surveyed areas showed up various interesting anomalies, the most important ones being summarized as follows:

1. Gold anomaly stretching N-S for more than 800m in Mt.Upao area
2. Gold and Mo anomalies in Madarag area streching for more than 250m
3. Gold anomaly and Mo-Cu, and base metal anomalies in Nipa area
4. Gold anomaly,Mo-Bi-Cu,and As anomalies in Binanan area

The gold anomaly in Mt. Upao area is the most prominent and well defined one.The gold anomaly in Nipa area is also considered to be prospective, although it needs further delineation by more detailed works.

The anomalies detected in Madarag and Binanan areas have lesser priority for any further follow up works in comparison with those found in Mt. Upao and Nipa areas.

5-2 RECOMMENDATION FOR THE THIRD YEAR PROGRAMME

The gold anomaly in Mt.Upao area is a well defined and very prominent one localized in the lowest gold background situation among the four areas investigated, and definitely deserves further follow up by trenching and/or drilling. The gold anomaly in Nipa area needs further delineation and definition using systematic geochemistry and geophysical method prior to any confirmation by trenching and/or drilling.

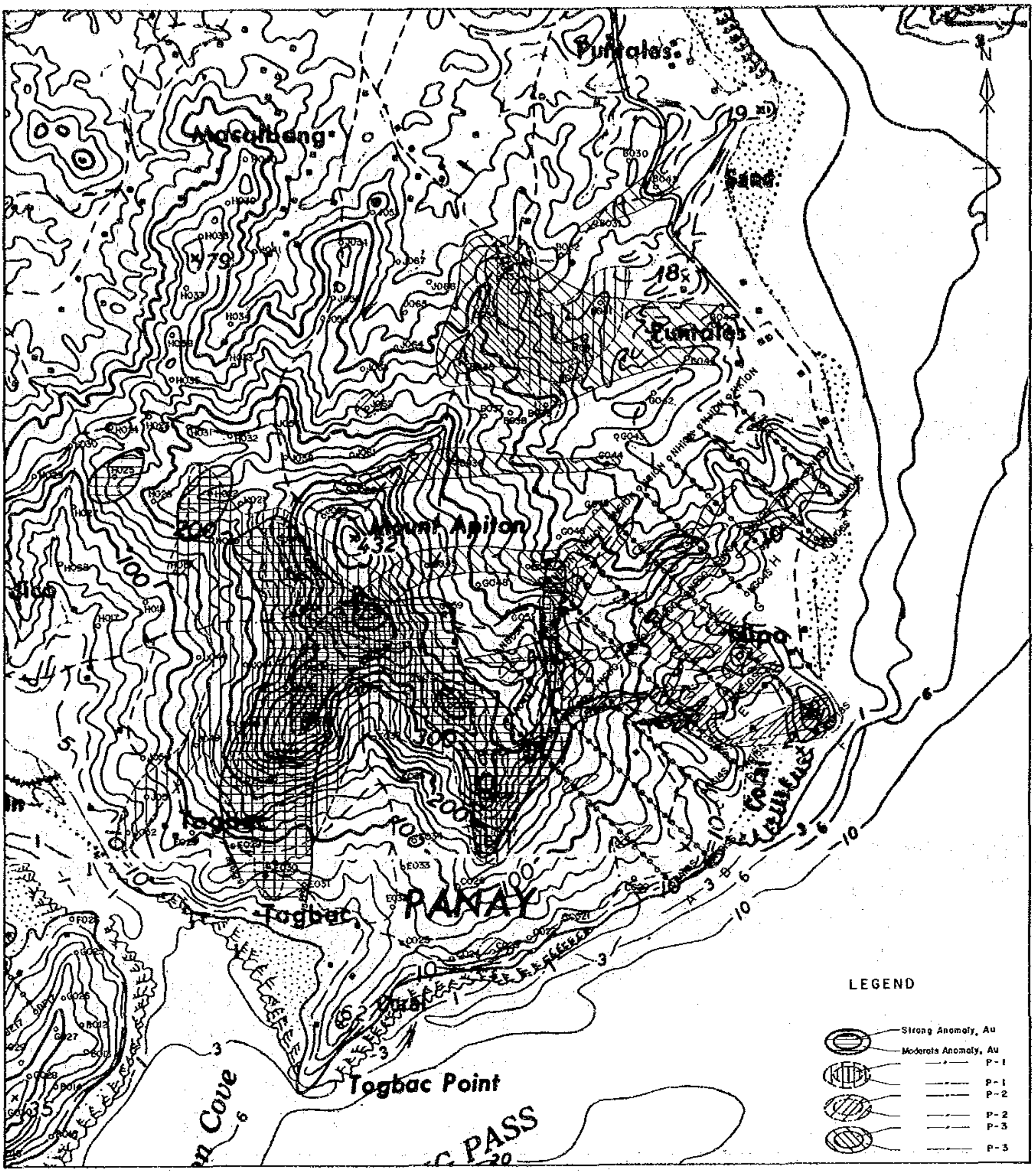


Fig. I–4–3 Comprehensive Geochemical Anomaly Map, Nipa Area

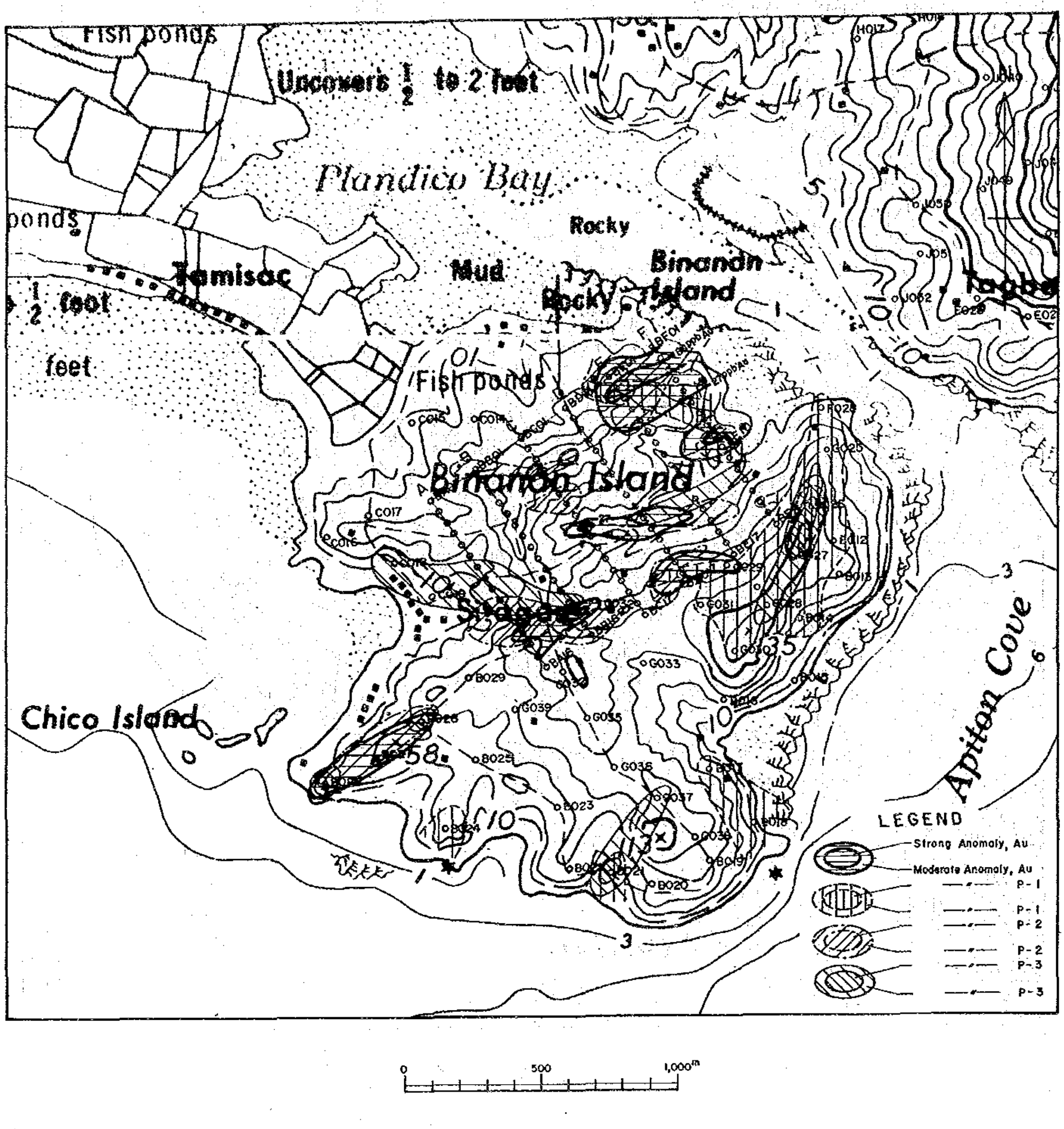


Fig. I–4–4 Comprehensive Geochemical Anomaly Map, Binanan Area

PART Ⅱ　DETAILED REPORT

PART II DETAILED REPORT

Forword on Geochemical Analysis

Soil samples were collected in four specified areas which were selected utilizing the results of previous investigation executed in 1988 by the Mines and Geoscience Bureau of the Republic of Philippines and Metal Mining Agency of Japan.

Soil samples collected were dried, sieved to under 80 mesh and halved to two at the base camp, one for analysis at PETROLAB, and one for CHEMEX. Each sample weighs approximately 50 grams.

The soil samples collected were analysed by CHEMEX LABS of Vancouver,B.C.,Canada for Au,Ag,As,Bi,Cu,Hg,Mo,Pb,Sb and Zn while the PETROLAB of Philippines did for Cu,Pb,Zn and Mn.

It is evident from the previous works executed in 1988 that the detection limit of Pb at the PETROLAB(10ppm) was not sufficient for geochemical exploration, particularly in such a field like Sara area where the background value of Pb is well below 10ppm. Consequently analyses for Pb, Zn, and Cu were done in CHEMEX LABS also where several packages including these elements were available.

The analytical values for Cu and Zn reported from the both laboratories were compared utilizing Linear Regression. All the analytical values for Cu and Zn totalling 927 were used for the regression.

The results are;

Cu: $Y = 7.37 + 0.99X$, $r = 0.929$
Zn: $Y = 4.40 + 0.84X$, $r = 0.946$
(r:correl.coeffic.)

where Y stands for analytical values of PETROLAB,and X for that of CHEMEX.

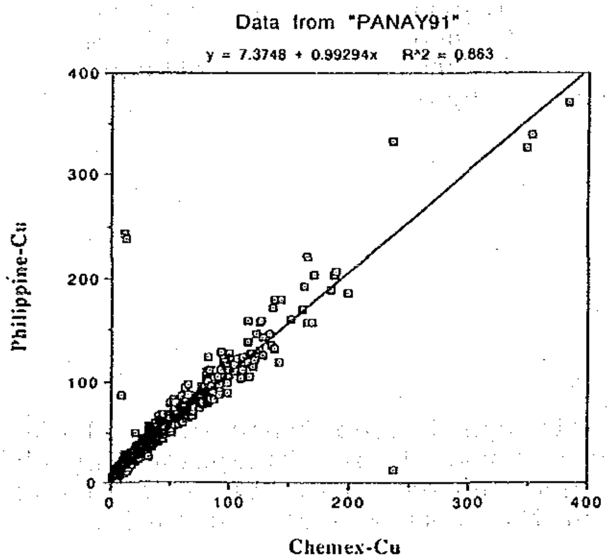


Fig.II-1-1 Scatterogram of Cu

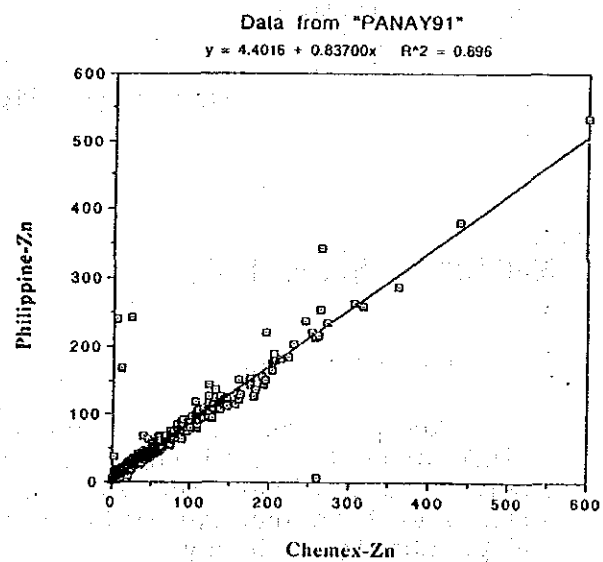


Fig.II-1-2 Scatterogram of Zn

Apparently the matching of the both are good and either of the analytical values could be used for the following analysis of

the data. However, since the Pb values from PETROLAB can hardly be utilized due to their abundant 'less than 10ppm' values, it was considered more appropriate to use the data from CHEMEX solely, i.e., not only Pb, but Cu and Zn also to retain the better conformity of the data on these three elements.
Although there are no way to compare the Pb-values since most values from PETROLAB are under their detection limit of 10ppm, the reported Pb-values of samples with higher content of Pb, the values from the both are very similar suggesting same degree of good matching of the both as in case of Cu and Zn. The mean content of Pb for 927 samples calculated from the CHEMEX data was incidentally 6.1ppm.

The manganese values reported by PETROLAB were utilized in this report.

Although the analytical method and detection limit for gold are exactly same as in the previous report(1988), the quantity of the samples used for analysis of gold at CHEMEX were trippled to 30grams enabling to obtain more representative analytical values for each of the sample sites.

The detection limit for Mo was improved from 1ppm in the previous works to 0.2ppm.

The analytical methods and detection limits for each element are as follows:

Element	Method	Description	Detection Limit	Upper limit
Au	FA-NAA	Fuse 30g sample	1ppb	10000ppb
Ag	ICP	nitiric acid-aqua regia digestion	0.02ppm	200ppm
As	ditto		0.2ppm	5000ppm
Bi	ditto		0.2ppm	5000ppm
Cu	ditto		0.2ppm	5000ppm
Hg	ditto		0.1ppm	5000ppm
Mo	ditto		0.2ppm	5000ppm
Pb	ditto		0.5ppm	5000ppm
Sb	ditto		0.2ppm	1000ppm
Zn	ditto		1 ppm	5000ppm
Mn	AAS	aqua regia digest.	10ppm	

Chapter 1 Mt.Upao Area

1-1 SURVEY METHOD

The portion of the topographic map in the scale of 1:50,000 (SHEET 3653 IV) published by the Government of Philippines which covers the Mt.Upao Area was enlarged photographically to 1:10,000 scale and this map was utilized as the base map of the geological and geochemical surveys.

Since there were only very few exposures of rock in the area, the description of the floats encountered in the course of the traverses was also utilized as the basis for constructing the geological map.

Two categories of soil samples were collected;
104-samples widely covering the whole area(although each of the areas selected for this survey were small,this category of soil samples will be hereafter referred as "regional samples").
200-samples collected along the cut-line of the grid system with a spacing of 200m which extends east-westerly. The sample sites were marked by red flagging tape with 50m intervals.

16-rock samples among the rock samples collected were selected for various laboratory testings;
3 for whole rock analysis & thin sections
16 for X Ray Diffraction
7 for assaying for Au,Ag,Cu,Pb and Zn.

1-2 GEOLOGY

Intensely weathered, limonite stained, purplish coloured altered rock of andesitic composition occupies the higher portion of the Mount Upao and Mount Buraay. Strong to moderate silicification and argillization are seen ubiquitously with some strongly silicified zones stretching north-south direction. The previous survey correlated this rock to "ODIONGAN Volcanics" of Pliocene to Quarternary.

Andesitic lava,volcanic breccia,tuff breccia with very minor fine tuff and mudstone of SIBALA Formation occupies the lower part of the mountains. Whole rock analysis revealed that one specimen of exceptionally fresh looking andesite lava contained less than 50% of silica suggesting that at least some portion of the andesite in the formation are basaltic in composition. However,most exposures and floats are highly argillized and some are silicified hence it is difficult to distinguish them from the accompanying tuff,or from the "ODIONGAN" Volcanics. It is quite possible to assume that because the rocks of ODIONGAN and SIBALA Formation are very similar,they actually belong to SIBALA altogether,ODIONGAN being the representative of more intensely argillized, silicified and weathered portion of the formation now occupying the higher terrain resisting further weathering.

The mudstone located in the southernmost part of the area reveals a NWW-SEE strike and dip of 10 degrees to the north.Other than this outcrop,there is no rock exposures with any structural information. However,the previous survey executed in 1988 confirmed the general structure of the SIBALA Formation in the area surrounding Mt.Upao as having a monoclinal NNW-SSE strike with 20-30 degrees dip toward west.

1-3 GEOCHEMISTRY

1-3-1 Statistics

Since the number of the regional samples collected is only 104 while that of the grid samples is 200 totalling to 304,it would not be necessary to perform the statistical analysis separately for two groups, i.e.,the data in the grid only(n=200), and all the data in the area(n=304) if the statistical behaviour of the both are similar. To demonstrate the validity of this assumption, a comparison was done.

Tables II-1-1 and -2 show the statistical parameters for both the group. All the elements were assumed to follow log-normal distribution and the values were converted to logarithm.There are slight increases of the mean values of Au,As,Cu,Hg,Mo,Pb and Sb in the grid only data while the means of Bi,Zn and Mn show slightly lower values compared to that of the all data group. There are no significant differences in the correlation coefficient among the elements of the both group either(Tables II-1-3,4).The results of the principal component also revealed very similar behaviour and characteristics of the components. Consequently all the data in the area(n=304,for Mt.Upao) will be treated as one group and discussed in detail.

COMP. NAME	UNIT	NUM. DATA	MAXIMUM	MINIMUM	MEAN (M)	STD. DEV. (SD)	M-2*SD	M-SD	M+SD	M+2*SD
AU	ppb	160	162	1	4.7	0.487	0.5	1.5	14.3	44.0
AG	ppm	7	0.05	0.05	0.050	0.000	0.050	0.050	0.050	0.050
AS	ppm	200	103.0	1.6	14.42	0.313	3.41	7.01	29.66	61.01
BI	ppm	184	1.6	0.2	0.37	0.243	0.12	0.21	0.64	1.12
CU	ppm	200	125.0	3.6	18.91	0.304	4.66	9.39	38.09	76.74
HG	ppm	46	0.7	0.1	0.16	0.226	0.06	0.10	0.27	0.46
MO	ppm	200	8.4	0.6	1.82	0.229	0.63	1.07	3.09	5.23
PB	ppm	200	22.5	1.5	4.90	0.211	1.85	3.01	7.97	12.97
SB	ppm	31	4.4	0.2	0.49	0.385	0.08	0.20	1.20	2.91
ZN	ppm	200	63	1	4.2	0.362	0.8	1.8	9.7	22.4
MN	ppm	193	1636	10	42.3	0.453	5.2	14.9	120.1	341.2

STD. DEV. IS SHOWN IN LOGARITHMIC SCALE

Table II-1-1 Statistic parameters,Grid data only,Mt.Upao Area

COMP. NAME	UNIT	NUM. DATA	MAXIMUM	MINIMUM	MEAN (M)	STD. DEV. (SD)	M-2*SD	M-SD	M+SD	M+2*SD
AU	ppb	253	162	1	4.0	0.444	0.5	1.4	11.1	30.9
AG	ppm	13	0.05	0.05	0.050	0.000	0.050	0.050	0.050	0.050
AS	ppm	304	103.0	1.2	12.43	0.313	2.94	6.04	25.54	52.52
BI	ppm	285	2.2	0.2	0.40	0.283	0.11	0.21	0.77	1.48
CU	ppm	304	125.0	3.6	18.57	0.318	4.29	8.92	38.66	80.48
HG	ppm	88	0.7	0.1	0.15	0.215	0.06	0.09	0.25	0.40
MO	ppm	304	9.0	0.2	1.60	0.266	0.47	0.87	2.96	5.46
PB	ppm	304	22.5	1.5	4.70	0.194	1.93	3.01	7.34	11.47
SB	ppm	44	4.4	0.2	0.42	0.354	0.08	0.19	0.95	2.14
ZN	ppm	304	106	1	4.7	0.408	0.7	1.8	11.9	30.5
MN	ppm	297	3020	10	53.0	0.528	4.7	15.7	178.8	602.9

STD. DEV. IS SHOWN IN LOGARITHMIC SCALE

Table II-1-2 Statistic parameters,all data,Mt.Upao Area

Only 13, 44 and 86 samples contain the above the detection limits contents of Ag, Sb and Hg respectively. Ag in particular, all of 13 samples show 0.05ppm which is the detection limit of the Ag. 83% of the samples contain above the detection limit of gold, 1ppb. One note to the above tables:the mean and standard deviation are calculated using the analytical values of above the detection limits only. Hence the means thus calculated are obviously higher than the "real" values.

	AU	AS	BI	CU	HG	MO	PB	SB	ZN	MN
AU	---	160	149	160	40	160	160	28	160	156
AS	0.413	---	184	200	46	200	200	31	200	193
BI	0.190	0.449	---	184	44	184	184	29	184	177
CU	-0.123	0.019	-0.101	---	46	200	200	31	200	193
HG	0.202	0.278	-0.090	0.168	---	46	46	14	46	45
MO	0.375	0.536	0.426	-0.031	0.246	---	200	31	200	193
PB	0.519	0.432	0.441	0.063	0.245	0.532	---	31	200	193
SB	0.113	0.624	-0.013	0.506	0.238	0.423	0.350	---	31	31
ZN	-0.158	-0.248	-0.213	0.585	0.011	-0.180	-0.016	0.193	---	193
MN	-0.222	-0.430	-0.296	0.414	0.003	-0.343	-0.168	-0.254	0.724	---

*NOTE ; VARIANCES AND COVARIANCES ARE DIVIDED BY N-1
NUM. OF DATA IS WRITTEN IN RIGHT-UPPER PART
CORR. COEF. IS WRITTEN IN LEFT-BOTTOM PART

Table II-1-3 Correlation Matrix (Grid data only,Mt.Upao)

	AU	AS	BI	CU	HG	MO	PB	SB	ZN	MN
AU	---	253	241	253	74	253	253	40	253	249
AS	0.371	---	285	304	86	304	304	44	304	297
BI	0.147	0.344	---	285	82	285	285	42	285	278
CU	-0.054	-0.051	-0.043	---	86	304	304	44	304	297
HG	0.204	0.374	0.051	0.137	---	86	86	19	86	85
MO	0.296	0.538	0.216	-0.068	0.226	---	304	44	304	297
PB	0.491	0.404	0.287	0.094	0.336	0.400	---	44	304	297
SB	0.254	0.650	-0.046	0.491	0.279	0.431	0.421	---	44	44
ZN	-0.115	-0.297	-0.130	0.614	0.083	-0.331	0.044	0.195	---	297
MN	-0.206	-0.440	-0.165	0.447	0.064	-0.433	-0.088	-0.175	0.789	---

*NOTE ; VARIANCES AND COVARIANCES ARE DIVIDED BY N-1
NUM. OF DATA IS WRITTEN IN RIGHT-UPPER PART
CORR. COEF. IS WRITTEN IN LEFT-BOTTOM PART

Table II-1-4 Correlation Matrix (All data,Mt.Upao)

Interpolation of an artificial figure is a frequently used alternative, for example 0.5ppb in the case of gold replacing "under 1ppb" notation.Doing this procedure produces a lower mean value which is also not the real mean, and false correlation among the elements.

The highest value of gold, 162ppb is located at UH12 site in the grid system. Mean + 2SD(Standard Deviation)=30.9ppb will be used as the threshold value to the strongly anomalous gold, while M + SD=11.1ppb for the moderately anomalous gold. A very well defined strong gold anomaly was located at the northern halves of the grid area stretching NWW-SEE direction for more than 800m. The contouring of the moderate anomaly at 11ppb revealed more than 1300m extension in the same direction.

There are no significant anomalous values for any of the base metals. Moderate to weakly anomalous copper values are found to the northwest,south,and east of the gold anomaly.

Correlation(Table II-1-4)

The numbers of the samples utilized for the computation of the correlation coefficients are shown at the upper right portion of the matrix while the correlation coefficients are at the lower left of the matrix. Although only 44 samples contain the above the detection limit of 0.2ppm Sb, it can be seen that Sb has rather strong correlation with As, Cu and Mo.

Au has weak positive correlation with Pb(0.49),As(0.37) and Mo(0.30).

Arsenic shows rather strong positive correlation with Sb(0.65) and Mo(0.54), and negatively correlates with Mn(-0.44).

Cu has shown positive correlation with Zn(0.61),Sb(0.43), Mn(0.45) and has not shown any with Mo.

Mo has weak positive correlation with Sb(0.43),Pb(0.40).

Pb correlates positively with Au,Sb(0.43),Pb(0.40) and Mo.

Zn shows strong correlation with Mn(0.79) and also weakly correlated with Cu(0.45) while with As(-0.44) and Mo(-0.43) negatively.

1-3-2 Principal Component Analysis(PCA)

PCA is a very convenient and efficient method for the analysis of multivariate-data where there are many variables to be

*** RESULTS OF PCA ***

PRIN COMP	EIGEN VALUE	CONTRIB	CUM CONTRIB		AU	AS	BI	CU	MO	PB	ZN	MN
P 1	3.025	0.378	0.378	EIGENVECTOR	-.296	-.423	-.244	.249	-.407	-.271	.408	.455
				FACTOR LOADING	-.515	-.735	-.424	.433	-.709	-.470	.709	.791
				CONTRIBUTION	.266	.541	.180	.187	.502	.221	.503	.625
P 2	1.837	0.230	0.608	EIGENVECTOR	.318	.225	.207	.488	.171	.494	.448	.305
				FACTOR LOADING	.431	.305	.281	.662	.232	.669	.607	.414
				CONTRIBUTION	.186	.093	.079	.438	.054	.448	.369	.171
P 3	0.879	0.110	0.718	EIGENVECTOR	-.520	.120	.823	.093	-.041	-.163	.007	.023
				FACTOR LOADING	-.488	.113	.772	.087	-.039	-.153	.007	.021
				CONTRIBUTION	.238	.013	.595	.008	.001	.023	.000	.000
P 4	0.778	0.097	0.815	EIGENVECTOR	.444	-.282	.390	-.475	-.518	.225	.005	.161
				FACTOR LOADING	.392	-.249	.344	-.419	-.457	.198	.004	.142
				CONTRIBUTION	.154	.062	.118	.176	.209	.039	.000	.020
P 5	0.511	0.064	0.879	EIGENVECTOR	.427	.398	.049	.374	-.446	-.525	-.048	-.200
				FACTOR LOADING	.305	.285	.035	.267	-.319	-.375	-.034	-.143
				CONTRIBUTION	.093	.081	.001	.072	.102	.141	.001	.020
P 6	0.410	0.051	0.930	EIGENVECTOR	-.291	.710	-.234	-.393	-.310	.163	.175	.221
				FACTOR LOADING	-.187	.454	-.150	-.251	-.199	.104	.112	.141
				CONTRIBUTION	.035	.206	.022	.063	.039	.011	.013	.020
P 7	0.386	0.048	0.978	EIGENVECTOR	-.276	-.098	-.102	.357	-.488	.548	-.214	-.440
				FACTOR LOADING	-.171	-.061	-.063	.222	-.303	.340	-.133	-.273
				CONTRIBUTION	.029	.004	.004	.049	.092	.116	.018	.075
P 8	0.174	0.022	1.000	EIGENVECTOR	-.010	-.073	.028	-.209	.028	-.063	.744	-.626
				FACTOR LOADING	-.004	-.030	.012	-.087	.012	-.026	.310	-.261
				CONTRIBUTION	.000	.001	.000	.008	.000	.001	.096	.068

Table II-1-5 PCA,Mt.Upao

handled and the extraction of the most of the informations intermixed and concealed in the given data set are needed. PCA naturally assumes the variables in the data set to follow resonably good normal distribution(log-normal,in our case). The analytical values for Ag, Sb and Bi have very narrow ranges and many of the under the detection limit measurements and are hence not distributed log-normally. The existence of such variables will limit the validity of the PCA and should not put much confidence on the resultant apparent characteristics of these elements.

The PCAs executed here are based on the correlation matrice. Hence the analytical values of each element in the data set were converted to logarithm first, and are standardized to have the mean of 0,and variance of 1. Consequently the total sum of the variance is naturally equalled to the number of the variables, i.e., elements. In the case of Mt.Upao, the analytical values of 8-elements(Au,As,Bi,Cu,Mo,Pb,Zn and Mn) were utilized in the computation of the PCA.

The 1st Principal Component (P-1)

The eigen value of the 1st factor is computed as 3.03, hence the factor has a contribution of 38%(3.03/8=0.38) of the total variance,and this amount of variance would be explained in the 1st factor. The largest loading in the factor is that of Mn(0.79), which means that 62.5%(square of 0.79) of the variance inherent to Mn is contained in this factor. Zn also has a large loading(0.71), i.e.,50.3% of the variance of Zn is contained in the factor. As, Mo, and Au on the other hand, have their negative contribution of 54%, 50%,and 27% respectively in the factor.
Cu has a positive contributuion of 19%(hereafter the contribution of the element mentioned is shown in parentheses,i.e.,Cu(19%) etc.) while Pb(-22%), Bi(-18%) show negative contribution together with As etc.

The 1st principal component thus fundamentally indicates a measure of the maturity of the soil,a well developed "unpolluted" soil being enriched in Mn, Zn and Cu, while depleted in As, Mo, Au,and Pb.

Consequently the low anomalous score of this factor will indicate the whereabouts of the concentration of As,Mo and Au. The low anomalies of the 1st component score plotted on the map showed a fairly good match with the gold anomalies.

The 2nd Principal Component (P-2)

The contribution of the 2nd principal component is 23%,hence the cumulative contribution to P-2 reaches to 61%.
Pb(45%),Cu(44%),Zn(37%) show larger contribution together with a smaller contribution of Au(19%). Apparently this factor indicates the concentration of the base metals accompanied by some gold. The cumulative contribution of gold to the 2nd factor is mere 45.2%, while those of zinc,manganese and copper are 87%,80% and 63% respectively.

The 3rd Principal Component (P-3)

Bi(59.5%), and Au(-23.8%) show major contribution in the factor.
Since the contribution of gold is negative, the negative(lower) anomaly may suggest a concentration of gold which has no relation with Bi. The cumulative contribution of gold to the 3rd factor reaches to 69.0% while that of the population does to 71.8%.

Since the majority of the variances of the elements studied are thus explained, and the further lower ordered factor do not indicate much interesting features,the analysis to the 3rd factor is considered to be sufficient and adequate enough.

1-4 DISCUSSION

A well defined prominent gold anomaly stretching at least for 800m is detected in the central part of the surveyed area.

The concentration of copper, lead and zinc are not very significant compared to that of gold, hence the possibility to find any base metal mineralization in the shallower part of the area is minimal. The gold anomaly mentioned above, located around the summit of Mt.Upao stretching northsoutherly for 1300m, is worth further exploration by trenching and/or diamond drilling. XRD study suggests a higher temperature hydrothermal alteration environment in the area indicated by alunite, hence it is possible to expect gold mineralization associated with it.

UH20 site in the gridded area would be a good location for the drill site.

Chapter 2 Madarag Area

2-1 SURVEY METHOD

Similar procedure and method were applied; 67 regional, and 100 grid samples totalling to 167 soil geochemical samples,and 15 rock samples were collected. Fourteen of the rock samples were subjected to XRD, three for whole rock analyses,and one for polished section.

2-2 GEOLOGY

Madarag area is situated only about 3km SSW of Mt.Upao area and consists of similar geology. The previous geological survey executed in 1988 has revealed a synclinal structure extends NNW-SSE direction along the eastern part of the area. There is a dacitic dyke in the southern portion of the area. The highly altered andesite of "Odiongan Volcanics" occupies the higher part of the hill.

2-3 GEOCHEMISTRY

2-3-1 Statistics

Quite different from the Mt.Upao area, 72% of the population of 167 samples showed the above the detection limit of silver, 0.05ppm. The majority of Hg,Sb values showed the under the detection limits as in Mt.Upao.

The mean contents of Au,Ag,Bi,Cu,Zn and Mo are twice higher than those of Mt.Upao while the mean of Pb is three times higher. On the other hand,the mean values of As and Sb are lower than that of Mt.Upao, 0.4,and 0.7 times respectively.

COMP. NAME	UNIT	NUM. DATA	MAXIMUM	MINIMUM	MEAN (M)	STD. DEV. (SD)	M-2*SD	M-SD	M+SD	M+2*SD
AU	ppb	164	76	1	9.7	0.363	1.8	4.2	22.4	51.6
AG	ppm	120	0.55	0.05	0.091	0.298	0.023	0.046	0.180	0.358
AS	ppm	167	80.2	0.2	5.34	0.463	0.63	1.84	15.50	44.99
BI	ppm	162	13.2	0.2	0.47	0.314	0.11	0.23	0.97	1.99
CU	ppm	167	353.0	3.0	35.15	0.381	6.08	14.62	84.49	203.09
HG	ppm	55	0.4	0.1	0.14	0.208	0.05	0.09	0.23	0.37
MO	ppm	166	52.8	0.2	2.83	0.574	0.20	0.76	10.62	39.84
PB	ppm	167	361.0	2.5	13.84	0.364	2.59	5.99	31.98	73.87
SB	ppm	45	0.8	0.2	0.30	0.200	0.12	0.19	0.47	0.75
ZN	ppm	167	272	1	8.8	0.596	0.6	2.2	34.8	137.4
MN	ppm	160	2960	10	73.1	0.677	3.2	15.4	347.1	1649.5

STD. DEV. IS SHOWN IN LOGARITHMIC SCALE

Table II-2-1 Statistical parameters,Madarag Area

The highest value of gold(sample No.J001) of 76ppb is found at the northern extention of the E line of the grid system. Although the moderately anomalous gold (M+SD=22ppb) extends to NNE-SSW direction, strongly anomalous gold(M+2SD=52ppb) stretches to E-W direction.
Anomalous gold values were found also at the northern,and southern part of the area,although both of these were only one point anomalies represented by the regional soil samples.

The highest Mo value(52.8ppm) is located in this area.

The mean also is high(2.83ppm) compared with the regional value(N=927) of 1.54ppm.

The highest mean values of Pb and Cu, as well as the highest value of the Pb are found in the Madarag area.

Correlation

Au correlates positively with Pb(0.49), Mo(0.48), As(0.43), Sb(0.38),and Ag(0.37) and shows weak negative correlation with Mn,and Zn.

Arsenic correlates positively with Mo(0.46) and Au,and has weak negative correlation with Mn and Zn.

Cu shows rather high positive correlation with Zn(0.61) and Mn(0.57).

Zn shows strong positive correlation with mn(0.87) and negatively correlates with Mo(-0.57). Zn also has negative correlation with Mo(-0.50).

	AU	AG	AS	BI	CU	HG	MO	PB	SB	ZN	MN
AU	---	120	164	159	164	55	163	164	45	164	157
AG	0.366	---	120	117	120	42	120	120	37	120	113
AS	0.431	0.044	---	162	167	55	166	167	45	167	160
BI	0.333	0.221	0.351	---	162.	54	161	162	44	162	155
CU	-0.169	-0.039	-0.223	0.008	---	55	166	167	45	167	160
HG	0.223	-0.229	0.056	0.165	0.041	---	55	55	21	55	54
MO	0.477	-0.044	0.463	0.272	-0.171	0.203	---	166	45	166	159
PB	0.485	0.578	0.156	0.285	-0.070	0.184	0.137	---	45	167	160
SB	0.384	0.234	0.059	0.132	0.092	0.083	0.014	0.389	---	45	43
ZN	-0.239	0.112	-0.255	-0.090	0.614	-0.057	-0.501	0.040	0.120	---	160
MN	-0.265	0.075	-0.289	-0.047	0.567	-0.093	-0.565	-0.007	0.140	0.869	---

*NOTE ; VARIANCES AND COVARIANCES ARE DIVIDED BY N-1
NUM. OF DATA IS WRITTEN IN RIGHT-UPPER PART
CORR. COEF. IS WRITTEN IN LEFT-BOTTOM PART

Table II-2-2 Correlation Matrix,Madarag area

Although Sb correlates weakly with Pb(0.39) and Au(0.38),it does not have strong correlation with As and Cu, not like in the Mt.Upao area.

2-3-2 Principal Component Analysis(PCA)

9 elements excluding Hg and Sb were subjected to the PCA.

The 1st Principal Component (P-1)

36% of the total variance are contained in the 1st factor. The characteristics of the factor is similar to that of the Mt.Upao area.

Zn(60%),Mn(64%),together with Cu(35%) show large positive contribution, while Mo(-56%), Au(-43%), As(-38%) contribute negatively in the factor. The lowly scored anomalies suggests the concentrated zones of Mo,Au and As. When plotted on the map, the 1st component anomaly appears to overlap with the gold anomaly although it extends further to the north, and to the east. Since Mo has biggest negative contribution in the factor, it also appears to overlap with the high Mo anomaly.

PRIN COMP	EIGEN VALUE	CONTRIB	CUM CONTRIB		AU	AG	AS	BI	CU	MO	PB	ZN	MN
P 1	3.248	0.361	0.361	EIGENVECTOR	-.363	-.095	-.342	-.215	.329	-.415	-.183	.431	.443
				FACTOR LOADING	-.654	-.172	-.616	-.388	.593	-.748	-.330	.777	.798
				CONTRIBUTION	.428	.029	.380	.150	.352	.559	.109	.604	.636
P 2	2.091	0.232	0.593	EIGENVECTOR	.337	.500	.109	.325	.231	-.032	.507	.334	.309
				FACTOR LOADING	.488	.723	.158	.470	.334	-.046	.733	.483	.447
				CONTRIBUTION	.238	.523	.025	.221	.112	.002	.537	.234	.200
P 3	1.142	0.127	0.720	EIGENVECTOR	.043	-.447	.419	.378	.461	.353	-.306	.162	.150
				FACTOR LOADING	.046	-.478	.448	.404	.492	.377	-.327	.173	.161
				CONTRIBUTION	.002	.228	.201	.163	.242	.142	.107	.030	.026
P 4	0.702	0.078	0.798	EIGENVECTOR	-.345	.037	.202	.660	-.424	-.440	-.135	-.049	.097
				FACTOR LOADING	-.289	.031	.169	.553	-.355	-.369	-.113	-.041	.081
				CONTRIBUTION	.083	.001	.029	.306	.126	.136	.013	.002	.007
P 5	0.626	0.070	0.868	EIGENVECTOR	.151	-.052	.699	-.492	-.315	-.206	-.037	.240	.205
				FACTOR LOADING	.119	-.041	.553	-.389	-.250	-.163	-.030	.190	.163
				CONTRIBUTION	.014	.002	.306	.152	.062	.027	.001	.036	.026
P 6	0.408	0.045	0.913	EIGENVECTOR	-.224	.720	.222	-.091	.258	.086	-.519	-.070	-.160
				FACTOR LOADING	-.143	.459	.142	-.058	.165	.055	-.332	-.045	-.102
				CONTRIBUTION	.020	.211	.020	.003	.027	.003	.110	.002	.010
P 7	0.387	0.043	0.956	EIGENVECTOR	.730	.028	-.268	.105	-.133	-.205	-.551	-.013	.140
				FACTOR LOADING	.454	.017	-.167	.065	-.083	-.127	-.343	-.008	.087
				CONTRIBUTION	.206	.000	.028	.004	.007	.016	.118	.000	.008
P 8	0.277	0.031	0.987	EIGENVECTOR	.161	-.125	.205	-.021	.508	-.640	.143	-.349	-.325
				FACTOR LOADING	.085	-.066	.108	-.011	.268	-.337	.075	-.184	-.171
				CONTRIBUTION	.007	.004	.012	.000	.072	.114	.006	.034	.029
P 9	0.120	0.013	1.000	EIGENVECTOR	.048	-.046	-.045	.087	-.064	-.085	-.046	.699	-.695
				FACTOR LOADING	.017	-.016	-.015	.030	-.022	-.030	-.016	.242	-.240
				CONTRIBUTION	.000	.000	.000	.001	.000	.001	.000	.058	.058

Table II-2-3 PCA, Madarag Area

The 2nd Principal Component (P-2)

Pb(54%), Ag(52%), Au(24%), Zn(23%),and Bi(22%) have larger contribution in the factor. Obviously this factor indicates the concentration of the base metals mentioned above which also accompany Ag with some Au when the principal component score of the factor were calculated from the eigen vector and plotted on the map. There are no strong anomaly of the 2nd component coinciding with the central gold anomaly. Strong anomalies are seen at the southern extension of the B line, at the sample site MB01,and near AGSALANG village,all being one point anomaly.

The 3rd Principal Component (P-3)

Cu(24%), As(20%), Bi(16%),and Mo(14%) show positive contribution while Ag(-23%) contributes negatively. Although the contribution of the P-3 is mere 13%, the combination of copper and molybdenum may be of some interest,i.e., possibility to indicate the location of a porphyry copper type mineralization in the area if any.

The cumulative contribution to P-3 has reached to 72% and this considered to be adequate enough, but a brief comment follows just for information.

The 4th factor indicates the enrichment in Bi,which is not our major concern. In the 7th factor, the contribution of Au(21%) and Pb(-12%) are rather large; when the scores of this factor plotted on to the map, the moderate gold anomaly located around MF-15 and 16 overlap with the anomaly of the 7th component. Since lead has negative loading in this factor, not like in the 2nd factor, the anomalous area detected by the 7th component may suggest the potential existence of placer gold although the gold content there does not indicate any of economically viable one.

2-4 DISCUSSION

The highest gold value in the area is 76ppb, which is not very impressive in a higher background situation compared with that of Mt.Upao area. The gold anomaly found at the extension of the E line coincides with the anomaly of the 1st component and also with Mo anomaly although the extension of the gold anomaly is limited to 150m. One point gold anomalies near AGSALANG village and E003 site to the north from the gridded area do not seem to have any extension.

The Mo anomaly is fairly extensive and extends obliquely to the gold anomaly. Although the Mo values in the area is highest among the four areas, they are not significant enough to have an expectation to find a Mo deposit. Hence the gold anomalies should be the primary targets for further exploration like in Mt.Upao. The area has also a higher temperature alteration characteristics indicated by abundant occurrence of alunite and the existences of pyrophyllite, and diaspore.

Chapter 3 Nipa area

3-1 SURVEY METHOD

The major portion of the Nipa area is located in the southern most part of the Nipa Quadrangle while Binanan area being at the northern most area of the neighbouring Tagubanhan Island Quadrangle, both in the scale of 1:50,000. Photographically enlarged map to the scale of 1:10,000 was used as the base map for the survey. Nipa area is located approximately 9km to the south from Mt.Upao area.

104 regional,and 200 soil samples in the gridded area totalling to 304, and 42 rock samples were subjected to various testings; 19 for XRD, 15 for the whole rock analyses, 24 for assaying for gold,silver,copper,lead and zinc, 9 for polished sections, 5 for the homogenization temperature measurement of the fluid inclusion,and 2 for age determination.

3-2 GEOLOGY

Since the Nipa,and Binanan are so close to each other,the geology of the both areas will be described here altogether.

The higher portion of the mountaneous terrain are covered by extensively altered andesitic rocks of "Odiongan volcanics". Sibala formation here also are consisted of andesite lava, andesitic agglomerate,volcanic breccias. In the southwestern portion of the Binanan Island, there are good exposures of alternating lava and agglomerates, and of mudstone, sandstone, and tuff, striking NNW-SSE and dipping 30-40 degrees to the west. There are fewer andesite lava and more pyroclastics in Binanan island.

The central part of Nipa area is dominantly covered by the andesite lava while andesitic pyroclastics dominates in the eastern and western portion.

Along the coast north of Nipa village, there is an outcrop of quartz diorite that has been interpreted as an equivalent to Sara diorite. The quartz diorite appears to be intruded by andesite and the previous survey interpreted the occurrence that the andesite here is a dyke swarm, different from the andesite belonging to Sibala Formation. However the andesite is quite similar to the basaltic andesite of Sibala and seems to continue to the typical Sibala Formation. Although similar quartz diorite is only known to exist in the southern part of Pan de Azucar Island,there is a possibility that the rock is the basement of Sibala Formation.

Since there is no isotopic age determination data for the rock in the area, one quartz diorite and one andesite specimen are subjected to age determination by K-Ar. The results are:

Quartz diorite(sample A021R)	30.1 ± 1.5 Ma.
Andesite(sample A013R)	25.7 ± 1.9 Ma.

The sketch of the outcrop showing the occurrence and the sample locations is in Fig.II-3-2.

3-3 GEOCHEMISTRY

3-3-1 Statistics

There are 243 gold values above the detection limit of 1ppb out of 316 determinations, the mean being 5.3ppb, the highest value 133ppb(sample No.J047). The threshold for the strongly anomalous value(M+2SD) is 40ppb and that for moderate anomaly(M+SD) is 14.6ppb. There are no strong anomalies in the grid sampled area, they are concentrated in the southern part of Mt.Apiton.

Although the mean value of As is 5.4ppm, similar to that of Madarag area, the highest value reaches to 316ppm which is much higher than that of Madarag area.

The mean of copper is 25ppm, not far from that of Mt.Upao, the highest value far exceeds to 383ppm. The mean value for zinc of 27ppm is much higher than that of Mt.Upao and Madarag areas, being the highest value as high as 599ppm. This also applies to Pb, suggesting the occurrence of the concentration of the base metals in the area which has been explored before the World War II.

COMP. NAME	UNIT	NUM. DATA	MAXIMUM	MINIMUM	MEAN (M)	STD. DEV. (SD)	M-2*SD	M-SD	M+SD	M+2*SD
AU	ppb	243	133	1	5.3	0.441	0.7	1.9	14.6	40.4
AG	ppm	167	0.40	0.05	0.072	0.230	0.025	0.042	0.122	0.208
AS	ppm	316	236.0	0.2	5.41	0.517	0.50	1.65	17.80	58.55
BI	ppm	242	3.8	0.2	0.40	0.316	0.09	0.19	0.83	1.72
CU	ppm	316	383.0	1.2	24.82	0.428	3.45	9.25	66.55	178.45
HG	ppm	98	0.3	0.1	0.13	0.174	0.06	0.09	0.20	0.30
MO	ppm	311	44.0	0.2	1.22	0.390	0.20	0.50	3.00	7.38
PB	ppm	315	113.5	0.5	6.15	0.407	0.94	2.41	15.71	40.14
SB	ppm	44	4.4	0.2	0.78	0.370	0.14	0.33	1.83	4.29
ZN	ppm	313	599	1	27.2	0.609	1.6	6.7	110.6	449.7
MN	ppm	314	2376	10	345.0	0.577	24.2	91.3	1303.4	4924.2

STD. DEV. IS SHOWN IN LOGARITHMIC SCALE

Table II-3-1 Statistical parameters, Nipa area

Correlation

Au correlates positively with Sb(0.66), As(0.60), Bi(0.49), Pb(0.41), Mo(0.37) while negatively with Zn(-0.39)and Mn(-0.35).

Cu correlates positively with Zn(0.53),Pb(0.35)and Mn(0.30).

Mo has negative correlation with Mn(-0.47) and Zn(-0.35). The positive corelation with Au here is much weaker than that in Mt.Upao area.

Pb has strong positive correlation with Sb(0.77) and weaker ones with arsenic,gold and copper.

Arsenic shows moderately strong positive correlation with Sb(0.65), Au,and weakly with Bi(0.53) and Pb(0.49).

Zn correlates strongly with Mn(0.82), weakly negative with Au, Bi(-0.35) and Mo.

	AU	AG	AS	BI	CU	HG	MO	PB	SB	ZN	MN
AU	---	149	243	198	243	76	242	243	40	241	243
AG	0.274	---	167	126	167	56	167	167	22	167	166
AS	0.595	0.165	---	242	316	98	311	315	44	313	314
BI	0.491	0.130	0.530	---	242	71	238	242	44	239	240
CU	-0.054	0.281	0.014	-0.047	---	98	311	315	44	313	314
HG	0.121	0.096	0.086	-0.127	-0.080	---	98	98	12	97	96
MO	0.372	0.187	0.199	0.052	0.183	-0.032	---	310	42	308	309
PB	0.414	0.388	0.486	0.290	0.349	0.040	0.140	---	44	312	313
SB	0.658	0.061	0.647	0.704	0.192	-0.150	0.214	0.773	---	43	43
ZN	-0.386	0.079	-0.321	-0.352	0.531	0.008	-0.347	0.160	-0.273	---	311
MN	-0.349	0.024	-0.324	-0.249	0.299	0.041	-0.469	0.090	-0.290	0.816	---

*NOTE ; VARIANCES AND COVARIANCES ARE DIVIDED BY N-1
NUM. OF DATA IS WRITTEN IN RIGHT-UPPER PART
CORR. COEF. IS WRITTEN IN LEFT-BOTTOM PART

Table II-3-2 Correlation matrix,Nipa area

PRIN COMP	EIGEN VALUE	CONTRIB	CUM CONTRIB		AU	AG	AS	BI	CU	MO	PB	ZN	MN
P 1	3.152	0.350	0.350	EIGENVECTOR	.450	.145	.421	.366	-.093	.296	.215	-.404	-.399
				FACTOR LOADING	.800	.257	.748	.650	-.165	.526	.381	-.717	-.708
				CONTRIBUTION	.639	.066	.559	.422	.027	.277	.145	.515	.501
P 2	2.194	0.244	0.594	EIGENVECTOR	.145	.388	.180	.094	.501	.025	.502	.414	.334
				FACTOR LOADING	.215	.574	.267	.139	.743	.036	.744	.613	.494
				CONTRIBUTION	.046	.330	.071	.019	.552	.001	.554	.376	.244
P 3	1.184	0.132	0.726	EIGENVECTOR	-.073	.231	-.275	-.439	.332	.688	-.119	-.054	-.268
				FACTOR LOADING	-.080	.252	-.300	-.478	.361	.749	-.130	-.059	-.291
				CONTRIBUTION	.006	.063	.090	.228	.131	.560	.017	.003	.085
P 4	0.724	0.080	0.806	EIGENVECTOR	.044	.840	-.243	-.060	-.390	-.238	-.084	-.114	.026
				FACTOR LOADING	.037	.715	-.207	-.051	-.332	-.203	-.072	-.097	.022
				CONTRIBUTION	.001	.511	.043	.003	.110	.041	.005	.009	.000
P 5	0.556	0.062	0.868	EIGENVECTOR	-.263	.152	-.197	.700	.436	-.037	-.417	-.063	-.098
				FACTOR LOADING	-.196	.113	-.146	.522	.325	-.027	-.311	-.047	-.073
				CONTRIBUTION	.039	.013	.021	.272	.105	.001	.097	.002	.005
P 6	0.442	0.049	0.917	EIGENVECTOR	.659	-.129	-.356	.185	-.142	.287	-.282	.157	.426
				FACTOR LOADING	.438	-.086	-.237	.123	-.094	.191	-.187	.104	.283
				CONTRIBUTION	.192	.007	.056	.015	.009	.036	.035	.011	.080
P 7	0.347	0.039	0.955	EIGENVECTOR	-.230	-.138	-.585	.291	-.214	.171	.642	-.114	-.022
				FACTOR LOADING	-.135	-.081	-.345	.172	-.126	.101	.379	-.067	-.013
				CONTRIBUTION	.018	.007	.119	.029	.016	.010	.143	.005	.000
P 8	0.274	0.030	0.986	EIGENVECTOR	.461	-.105	-.384	-.178	.384	-.515	.108	-.094	-.406
				FACTOR LOADING	.241	-.055	-.201	-.093	.201	-.269	.056	-.049	-.212
				CONTRIBUTION	.058	.003	.040	.009	.040	.073	.003	.002	.045
P 9	0.127	0.014	1.000	EIGENVECTOR	.026	.014	-.008	.142	-.272	.056	-.046	.774	-.548
				FACTOR LOADING	.009	.005	-.003	.051	-.097	.020	-.017	.276	-.196
				CONTRIBUTION	.000	.000	.000	.003	.009	.000	.000	.078	.038

Table II-3-3 PCA, Nipa area

3-3-2 Principal Component Analysis (PCA)

9 elements excluding mercury and antimony were subjected to the PCA,same as in the case of Madarag area.

The 1st Principal Component (P-1)

Au shows the largest contribution in the component having 0.80 of positive loading, i.e., although the contribution of the 1st factor is 35%(=3.15/9), Au presents 64% of its variance here. Associating with gold, As(56%), Bi(42%) and Mo(28%) show positive contribution while Zn(-52%), and Mn(-50%) contribute negatively. Hence the factor has very similar meaning with the opposite polarity with the 1st factor of Mt.Upao and Madarag areas.

The anomalous values of P-1 distribute overlapping the gold anomaly as expected from the large loading of gold in the factor.

<u>The 2nd Principal Component</u> (P-2)

P-2 having 24% contribution, the cumulative contribution comes to 59%.

Pb(55%), Cu(55%), Zn(38%) and Ag(33%) show major contribution here, hence the factor clearly indicate the association of base metals which also accompanies some silver.

There are several anomalous zones stretching eastwesterly in the vicinity of Nipa village where several old exploratory tunnels are known to exist. However, the extension of the strong anomalies of the P-2 are very limited, suggesting that there would be no larger scaled base metal deposits in the vicinity, which have partly been demonstrated by the smallish and low grade nature of the mineralization seen in the old tunnels. The anomalous area located to the north of Nipa may be a better target for a base metal exploration.

<u>The 3rd Principal Component</u> (P-3)

The contribution of this factor is 13%, hence the cumulative contribution to P-3 reaches to 72.6%.

Mo(56%) and Cu(13%) contribute positively while Bi(-23%) does negatively. The anomalies of P-3 are located at the northern and southern parts of Mt.Apiton with a limited extension. The anomaly located at the gossaneous area west to Puntales village may cause some interest since the anomaly also overlaps a moderate anomaly of P-1.

The 4th principal component contains the largest contribution from silver(51%). However, considering the fact that only 52% of silver values have the above the detection limit content, having also very narrow range and insignificant highest value of 0.4ppm, this factor most definitely has no significance for the exploration in the area.

3-4 DISCUSSION

Prominent gold anomalies were located at the northwestern part of the gridded area and the southern part of Mt.Apiton, the latter being in need of more detailed geochemical testing due to its paucity of the number of samples taken.

Since the characteristics, occurrence and extension of the anomalies are not understood very clearly, further delineation by geochemistry together with some geophysical survey should be carried out.

The gossaneous hilly area west of Puntales village was indicated to be highly anomalous by P-3 and moderately by P-1. Since this area may have some potential for a porphyry molybdenum type mineralization, more detailed geochemical and geophysical testing should be considered.

Chapter 4 Binanan Area

4-1 SURVEY METHOD

Similar method and procedure were applied; 40 regional,and 100 grid soil samples totalling to 140 were collected and 2 rock samples were subjected to XRD,and for assaying. Although Plandico Bay is a very narrow channel dividing Binanan island from the main island of Panay, it is neccessary to hire bancas to get in to the island.

4-2 GEOLOGY

The geology of Binanan area is treated in Chapter 3(cf.3-2).

4-3 GEOCHEMISTRY

4-3-1 Statistics

The highest Au value is 116ppb,and 8.9ppb being the mean in the area. The threshold for the strong anomaly, 80.7ppb is the highest among the four areas. The highest Au value was detected at BB15 site seemingly stretching in E-W direction with a very limited extension. There are three highly anomalous values in the northern part of the area which stretch to northeastern direction. These show also only limited extension. One on the grid line F in particular faces unfortunately the sea on its eastern extension.

COMP. NAME	UNIT	NUM. DATA	MAXIMUM	MINIMUM	MEAN (M)	STD. DEV. (SD)	M-2*SD	M-SD	M+SD	M+2*SD
AU	ppb	136	116	1	8.9	0.479	1.0	3.0	26.8	80.7
AG	ppm	57	0.30	0.05	0.067	0.189	0.028	0.043	0.103	0.159
AS	ppm	140	807.0	2.6	26.92	0.521	2.44	8.11	89.36	296.61
BI	ppm	86	7.2	0.2	0.34	0.333	0.07	0.16	0.74	1.59
CU	ppm	140	99.8	2.8	19.47	0.365	3.63	8.41	45.08	104.36
HG	ppm	34	0.7	0.1	0.14	0.208	0.05	0.08	0.22	0.36
MO	ppm	140	16.8	0.2	1.13	0.412	0.17	0.44	2.92	7.55
PB	ppm	140	44.5	1.5	5.52	0.264	1.64	3.01	10.14	18.63
SB	ppm	59	10.6	0.2	0.64	0.448	0.08	0.23	1.79	5.02
ZN	ppm	140	101	1	23.2	0.460	2.8	8.0	66.8	192.7
MN	ppm	140	2506	22	439.8	0.472	50.1	148.4	1303.2	3862.1

STD. DEV. IS SHOWN IN LOGARITHMIC SCALE

Table II-4-1 Statistical parameters, Binanan Area

Arsenic values here are exceptionally high; the highest being 807ppm, and the mean of 26.9ppm(the respective values in Nipa area are 236ppm and 5.4ppm).

The mean values of lead,zinc and copper are only slightly less than those of Nipa area although the highest of these are significantly lower.

The mean value of Mn stands up as high as 440ppm,higher than that of Nipa area,and six, eight times higher than those of Madarag and Mt.Upao respectively.

Bi shows the highest value of 7.2ppm which is the highest among the four areas. 61% of the soil samples contain more than the detection limit of 0.2ppm of Bi.

Correlation

	AU	AG	AS	BI	CU	HG	MO	PB	SB	ZN	MN
AU	---	57	136	82	136	32	136	136	59	136	136
AG	0.366	---	57	35	57	15	57	57	29	57	57
AS	0.658	0.316	---	86	140	34	140	140	59	140	140
BI	0.032	0.193	0.156	---	86	21	86	86	40	86	86
CU	0.014	0.074	0.048	-0.066	---	34	140	140	59	140	140
HG	0.077	0.338	0.337	0.368	-0.089	---	34	34	19	34	34
MO	0.525	0.169	0.537	0.438	-0.137	0.125	---	140	59	140	140
PB	0.442	0.199	0.404	0.287	-0.161	-0.043	0.456	---	59	140	140
SB	0.227	0.400	0.612	0.592	-0.031	0.663	0.425	0.230	---	59	59
ZN	-0.187	-0.129	-0.224	-0.550	0.558	-0.114	-0.594	-0.241	-0.361	---	140
MN	-0.173	-0.143	-0.088	-0.543	0.397	-0.104	-0.586	-0.181	-0.325	0.765	---

*NOTE ; VARIANCES AND COVARIANCES ARE DIVIDED BY N-1
NUM. OF DATA IS WRITTEN IN RIGHT-UPPER PART
CORR. COEF. IS WRITTEN IN LEFT-BOTTOM PART

Table II-4-2 Correlation Matrix, Binanan Area

Au correlates positively with As(0.66),Mo(0.53),Pb(0.44) and Ag(0.37). The negative correlation with manganese and zinc are much weaker compared with those in Nipa area.

Cu shows positive corelation with Zn(0.56) and Mn(0.54).

Mo has positive correlation with Au,As,Pb(0.46) and Bi(0.44) and negative ones with Zn(-0.59) and Mn(-0.59).

Zn displays positive correlation with Mn(0.77) and Cu,and negative ones with molybdenum and bismuth.

Mn correlates positively with zinc and copper and negatively with molybdenum and bismuth.

4-4-2 Principal Component Analysis

8 elements excepting silver, bismuth and mercury were subjected to the PCA.

The 1st principal component(P-1)

43.4% of the total variance are contained in the first factor. The characteristics of the factor is similar to that of the other three areas discussed already: Mo displays very large negative contribution in the factor(-73%) together with Au(-31%) and As(-32%), Bi(-39%) and Pb(-34%) while Zn(67%) and Mn(57%) contribute positively. Since the contribution of molybdenum is far larger than those of gold or lead etc., the factor essentially indicates the condensation of molybdenum when the lower anomalies were plotted.
Unfortunately the highest value of molybdenum in the area is only 16.8ppm with the mean of 1.1ppm which discards the possibility to have any significant molybdenum mineralization. The most extensive low anomaly of the P-1 appears in the southwest of the gridded area stretching to NNE direction where no gold anomaly exists. The BB-14 site where the highest gold value has been detected is not anomalous in P-1 since the Mo value there is only 1ppm.

The 2nd principal component (P-2)

Au(44%), As(43%), Cu(27%), Zn(19%) and Pb(13%) contribute in the P-2. The cumulative contribution to P-2 reaches to 65.7% already. This factor suggests the concentration of Au associating the above mentioned elements. The plotted anomaly on the map roughly coincides with the gold anomaly.

The 3rd principal component (P-3)

The contribution of the P-3 is 12%, hence the cumulative contribution now stands at 77.5%.

Cu(50%) and Bi(36%) occupy the majority of the contribution. Although the highest value of copper in the area is only 99.8ppm, the northeastern part of the island including the G027 sample site where the highest value of Bi(7.2ppm) has been located is delineated as clearly anomalous. This anomaly overlaps with the P-1 anomaly and may have some potential for Mo-Bi mineralization.

Pb has displayed 48% of its variance in the 4th principal component. However, since the highest value of Pb in the area is only 44.5ppm, the chance to have any significant concentration of lead in the area is considered to be remote, hence no plot was made on the map.

PRIN COMP	EIGEN VALUE	CONTRIB	CUM CONTRIB		AU	AS	BI	CU	MO	PB	ZN	MN
P 1	3.471	0.434	0.434	EIGENVECTOR	-.298	-.301	-.333	.211	-.459	-.312	.438	.406
				FACTOR LOADING	-.556	-.561	-.620	.394	-.855	-.581	.816	.757
				CONTRIBUTION	.309	.315	.385	.155	.731	.338	.666	.572
P 2	1.782	0.223	0.657	EIGENVECTOR	.495	.491	-.216	.390	.129	.268	.328	.346
				FACTOR LOADING	*.660*	*.656*	*-.288*	*.520*	*.172*	*.358*	*.438*	*.461*
				CONTRIBUTION	.436	.430	.083	.270	.029	.128	.192	.213
P 3	0.947	0.118	0.775	EIGENVECTOR	-.203	-.045	.615	.728	.123	-.130	.078	-.102
				FACTOR LOADING	-.197	-.044	.599	.708	.119	-.126	.076	-.100
				CONTRIBUTION	.039	.002	.358	.502	.014	.016	.006	.010
P 4	0.699	0.087	0.862	EIGENVECTOR	-.240	-.207	.286	-.126	-.184	.830	.152	.237
				FACTOR LOADING	-.200	-.173	.239	-.105	-.154	.694	.127	.198
				CONTRIBUTION	.040	.030	.057	.011	.024	.481	.016	.039
P 5	0.429	0.054	0.916	EIGENVECTOR	.276	-.650	-.350	.252	.269	.221	.169	-.406
				FACTOR LOADING	.181	-.426	-.230	.165	.176	.145	.111	-.266
				CONTRIBUTION	.033	.181	.053	.027	.031	.021	.012	.071
P 6	0.307	0.038	0.954	EIGENVECTOR	-.649	.158	-.364	.067	.627	.097	-.026	.118
				FACTOR LOADING	-.360	.088	-.202	.037	.347	.054	-.014	.065
				CONTRIBUTION	.129	.008	.041	.001	.121	.003	.000	.004
P 7	0.199	0.025	0.979	EIGENVECTOR	.260	-.395	.277	-.215	.470	-.220	-.020	.620
				FACTOR LOADING	.116	-.176	.123	-.096	.209	-.098	-.009	.276
				CONTRIBUTION	.013	.031	.015	.009	.044	.010	.000	.076
P 8	0.167	0.021	1.000	EIGENVECTOR	-.047	.140	.225	-.379	.197	-.133	.801	-.294
				FACTOR LOADING	-.019	.057	.092	-.155	.080	-.055	.327	-.120
				CONTRIBUTION	.000	.003	.008	.024	.006	.003	.107	.014

Table II-4-3 PCA, Binanan Area

4-4 DISCUSSION

There exist gold anomalies in the area albeit in rather higher background. Major problem of these anomalies is that they do not exhibit much extension.

The anomalous area delineated by P-1 and P-3 on the hill in the northeastern part of the island suggests a concentration of molybdenum,bismuth and copper,and may worth further investigation.

Chapter 5 Laboratory Tests

The list of the rock samples subjected for various tests is shown in Table II-5-a. The tests performed are marked by circles.

5-1 X Ray Diffraction (cf. Table II-5-1)

51 altered rock samples were subjected to XRD. The results are summarized in Table II-5-1.

The identified alteration minerals can be classified according to the classification proposed by UTADA(1980);

Acidic Zone Group: pyrophyllite, dickite, kaolinite, alunite, haloysite

Intermediate Zone Group: K feldspar, sericite, chlorite, mixed layered clay, montmorillonite

Alkaline Zone Group: stilbite,analcime,albite

In addition to the above mentioned minerals,quartz, calcite,pyrite,marcasite,goethite,and hematite etc. were depicted. The minerals belonging to the acidic zone group were detected in almost all the samples tested together with quartz.

The minerals associated with the intermediate zone group were depicted in the one third of the samples while zeolites associated with the alkaline zone group were found to be exist only in two samples. Since the samples tested were all from andesitic volcanics,the absence of plagioclase in most of the samples suggests the influence of intense alteration in the area.

The acidic zone group of minerals represented by alunite were found to be distribute most abundantly in the area where the "ODIONGAN Volcanics" shows up. This particularly applies to Madarag area where pyrophyllite and diaspore which are the indicators for the highest temperature facies of the hydrothermal alteration are most abundant.

On the other hand,in Nipa area only one sample contained dickite and pyrophyllite,most abundant alteration mineral being kaolinite. The samples from Mt.Upao area contains more dickite and alunite suggesting the existence of high temperature alteration next to that found in Madarag area.

Due to the paucity of the number of the samples tested,the distribution of each zones are hardly known although in Mt.Upao area, it seems most probable that the high temperature alteration indicated by the existence of dickite predominates in the western side of the mountains while lower temperature zone indicated by kaolinite occupies the eastern part of the ridge,and the intermediate clay zone in the lowland further to the east.

In Madarag area,the northern half of the area seems to have more pyrophyllite and diaspore while the southern half is characterized by the existence of the intermediate zone group minerals.

MT. UPAO Area

		XRD	WRA	TS	ASY	PS	FI	AGE	CS
1	A006R	○			○				○
2	A009R	○			○				○
3	A008R				○				○
4	G008R	○			○				○
5	E006R	○			○				○
6	E007R	○	○	○	○				○
7	H007R	○			○				○
8	C003R	○	○	○					○
9	F007R	○	○	○					○
10	G006R	○							
11	G010R	○							
12	J007R	○							
13	E012R	○							
14	H005R	○							
15	J005R	○							
16	J003R	○							
17	G007R	○							

MADARAG Area

		XRD	WRA	TS	ASY	PS	FI	AGE	CS
1	G001R	○			○				○
2	G005R	○	○	○	○				○
3	H001R	○			○				○
4	H003R	○			○				○
5	J002R	○							
6	J001R	○			○				○
7	C001R	○			○				○
8	C002R	○			○				○
9	F005R	○			○	○			○
10	A003R	○	○	○					○
11	E002R		○	○					○
12	H002R	○			○				○
13	G002R	○							
14	E003R	○							
15	G004R	○							

BINANAN Area

		XRD	WRA	TS	ASY	PS	FI	AGE	CS
1	G011R	○			○				○
2	G012R	○			○				○

※ XRD:X Ray Diffraction
WRA:Whole Rock Analysis
TS:Thin Section
ASY:Assay
PS:Polished Section
FI:Fluid Inclusion
AGE:Age Determination
CS:Cut Sample

Table II-5-a List of the rock samples tested

NIPA Area

		XRD	WRA	TS	ASY	PS	FI	AGE	CS
1	E023R				○	○	○		○
2	E024R				○	○	○		○
3	E025R				○	○	○		○
4	E026R				○	○	○		○
5	E030R	○			○				○
6	E031R				○				○
7	E032R				○				○
8	E033R				○				○
9	F023R				○		○		○
10	G014R				○	○			○
11	A023R				○				○
12	A014R				○	○			○
13	A011R				○				○
14	A016R				○	○			○
15	F016R				○				○
16	F015R	○	○	○	○				○
17	F020R				○				○
18	F018R				○				○
19	E013R	○			○				○
20	F011R	○			○				○
21	H012R	○	○	○					○
22	H011R	○	○	○	○				○
23	F008R	○			○				○
24	C018R	○			○				○
25	C017R	○	○	○					○
26	C009R	○	○	○					○
27	A018R		○	○					○
28	C012R		○	○					○
29	A013R		○	○				○	○
30	A021R		○	○				○	○
31	A020R	○	○	○					○
32	C010R	○	○	○					○
33	H017R	○	○	○					○
34	H016R	○	○	○					○
35	H014R		○	○					○
36	F017R	○	○	○					○
37	F014R	○							
38	C013R	○							
39	G013R	○							
40	J016R	○							
41	J014R				○				○
42	A015R			○	○				○

※ XRD:X Ray Diffraction
WRA:Whole Rock Analysis
TS:Thin Section
ASY:Assay
PS:Polished Section
FI:Fluid Inclusion
AGE:Age Determination
CS:Cut Sample

Table II-5-a List of the rock samples tested

Table II–5–1 X Ray Diffraction

Phillippine Panai Area 51 Samples 2 – 1

◎ Abundant, ○ Moderate, o Minor, • Very minor

Silicate Minerals – Clay Minerals

Area	Ser. No.	Sample Number	Montmorillonite	Saponite	Chl/Mont Mixed	Ser/Mont Mixed	Chlorite	Sericite	Hydrohalloysite	Halloysite	Kaolinite	Dickite	Nacrite	Pyrophyllite	Diaspore
Mt. UPAO	1	A006R										○			
	2	009R													
	3	C003R													
	4	E006R						•							
	5	007R									•				
	6	012R				•?									
	7	F007R													
	8	G006R									o				
	9	007R										o			
	10	008R													
	11	010R									•				
	12	H005R													
	13	007R													
	14	J003R										o			
	15	005R									•?				
	16	007R									o				
MADARAG	17	A003R												o	o
	18	C001R													
	19	002R													o
	20	E003R													•
	21	F005R													
	22	G001R												•?	o
	23	002R				o									
	24	004R													•
	25	005R				o			•?						
	26	H001R													
	27	002R													
	28	003R												•	
	29	J001R									○			o	
	30	002R						○		o?					
N I P A	31	A020R													
	32	C009R													
	33	010R													
	34	013R													
	35	017R			•										
	36	018R													
	37	E013R							•?		◎				
	38	030R													
	39	F008R									◎				
	40	011R													
	41	014R	◎		○										
	42	015R										◎		•	
	43	017R													
	44	G013R									o				
	45	H011R					o								

Silicate Minerals – Zeolites and Silica Minerals

Ser. No.	Sample Number	Clinoptilolite	Heulandite	Stilbite	Mordenite	Analcite	Laumontite	Epistilbite	Wairakite	Opal	Cristobalite	Tridymite	Quartz
1	A006R												◎
2	009R												◎
3	C003R												o
4	E006R												◎
5	007R												◎
6	012R												◎
7	F007R												◎
8	G006R												◎
9	007R												◎
10	008R												◎
11	010R												◎
12	H005R												◎
13	007R												◎
14	J003R												◎
15	005R												◎
16	007R												◎
17	A003R												◎
18	C001R												◎
19	002R												◎
20	E003R												◎
21	F005R												◎
22	G001R												◎
23	002R												◎
24	004R												◎
25	005R												◎
26	H001R												◎
27	002R												◎
28	003R												◎
29	J001R												◎
30	002R												◎
31	A020R							•					◎
32	C009R												◎
33	010R												◎
34	013R												◎
35	017R												◎
36	018R												◎
37	E013R												
38	030R												◎
39	F008R												◎
40	011R												◎
41	014R												◎
42	015R												◎
43	017R												◎
44	G013R												◎
45	H011R					○							◎

Silicate Minerals – Others; Iron Mins.

Ser. No.	Sample Number	K-feldspar	Albite	Plagioclase	Biotite	Hornblende	Pyroxene	Olivine	Epidote	Pyrite	Goethite	Hematite	Magnetite	Marcasite
1	A006R											o		
2	009R											•		
3	C003R			◎										
4	E006R									o	•			
5	007R											o		
6	012R										•			
7	F007R		○	○						•?				
8	G006R											o		
9	007R											o		
10	008R										o	o		
11	010R										o	o		
12	H005R											•		
13	007R											•		
14	J003R										o	o		
15	005R										o			
16	007R											o		
17	A003R													
18	C001R													
19	002R										•			
20	E003R													
21	F005R											o		
22	G001R									•?		o		
23	002R											o		
24	004R											o		
25	005R											o		
26	H001R										o			
27	002R											◎		
28	003R											o		
29	J001R											o		
30	002R									○				
31	A020R			◎										
32	C009R		◎	◎										
33	010R	o		○		o								
34	013R											o		
35	017R		○							•				
36	018R										•	o		
37	E013R											○		
38	030R													
39	F008R											o		
40	011R										o			
41	014R									○				
42	015R									o				
43	017R													
44	G013R										•	o		
45	H011R		◎							•?				

Salfate Minerals; Others; Remarks

Ser. No.	Sample Number	Alunite	Gypsum	Anhydrite	Jarosite	Bassanite	Calcite	Siderite	Rutile	Anatase	Gibbsite	Zunyite	REMARKS
1	A006R									o			
2	009R								o				
3	C003R												
4	E006R	◎		•?	o				•				
5	007R	○											
6	012R	◎											
7	F007R												
8	G006R	o							•				
9	007R									•			
10	008R								o				
11	010R	○							•				
12	H005R	◎							•				
13	007R								o				
14	J003R	•											
15	005R	◎				o			•				
16	007R	•							o				
17	A003R												
18	C001R								o				
19	002R	◎		•					•				
20	E003R	◎		•					•				
21	F005R								•				
22	G001R	○							•				
23	002R								•				S/M:S>>M
24	004R	◎							•				
25	005R								•				S/M:S>>M
26	H001R	•							o				
27	002R								•				
28	003R	○							•			o	
29	J001R	◎							•				
30	002R								•				Sericite:2M1 type
31	A020R						o						
32	C009R												Ab≧pl
33	010R						•						
34	013R	◎											
35	017R												
36	018R	◎		•									
37	E013R	o							•	•			Qz=free
38	030R												
39	F008R		•?							o			
40	011R	o											
41	014R												
42	015R												
43	017R	◎											
44	G013R												
45	H011R						o						

Table II-5-1 X Ray Diffraction

Phillippine Panai Area 51 Samples 2 - 2

◎ Abundant, ◯ Moderate, ○ Minor, • Very minor

Area	Ser. No.	Sample Number	Silicate Minerals: Clay Minerals: Montmorillonite	Saponite	Chl/Mont Mixed	Ser/Mont Mixed	Chlorite	Sericite	Hydrohalloysite	Halloysite	Kaolinite	Dickite	Nacrite	Pyrophyllite	Diaspore	Zeolites: Clinoptilolite	Heulandite	Stilbite	Mordenite	Analcite	Laumontite	Epistilbite	Wairakite	Silica Min: Opal	Cristobalite	Tridymite	Quartz	Others: K-feldspar	Albite	Plagioclase	Biotite	Hornblende	Pyroxene	Olivine	Epidote	Iron Mins.: Pyrite	Goethite	Hematite	Magnetite	Marcasite	Salfate Minerals: Alunite	Gypsum	Anhydrite	Jarosite	Bassanite	Others: Calcite	Siderite	Rutile	Anatase	Gibbsite	Zunyite	REMARKS
NIPA	46	H012R			•?																						◎		◎																							
NIPA	47	016R																									◎		◎						○																	
NIPA	48	017R									○																◎																						○			
NIPA	49	J016R									•?																◎										○	○			◯											
BINA	50	G011R																									◎											○										○				
NAN	51	012R									•																◎										•	○										•				

5-2 WHOLE ROCK ANALYSIS (Table II-5-2a)

Twenty one rock samples were analysed. The norm were calculated for nine fresher samples(Table II-5-2b). The A21R sample has the field name of quartz diorite, but the norm shows that the rock actually belongs to the domain of granodiorite.

5-3 THIN SECTIONS

The salient features observed were summarized in Table II-5-3.

Fresher basaltic andesite naturally contains fresher plagioclase, clino-pyroxene, and rhombic pyroxene as the phenocrysts. Pyroxenes frequently show alteration to chlorite, and to epidote. The basaltic andesite sample C012R from Nipa area has less than 50 percent of silica, and contains clino- and rhombic pyroxenes but no olivine The sample also shows a weak flow structure. Strongly silicified andesite shows a texture similar to that of quartzite composed of equigranular quartz.

The sample of quartz diorite, A021R, subjected to the age determination, contains biotie as the mafic phenocryst which looks very fresh. However, most of them are chloritized under the microscope.

All of the specimens from the Odiongan Volcanics(E007R, G005R, H017R) show extensive argillization and silicification.Alunite after plagioclase is observed in G005R.

5-4 AGE DETERMINATION

One andesite and one quartz diorite sample were age determined by K-Ar method.Both samples were from Nipa area. The sketch showing the occurence is shown in Fig.II-5-4.

The age of the andesite determined is 25.7Ma,the uppermost Chattian(below the lowermost Miocene) while the age for the quartz diorite is 30Ma, an upper middle Chattian age. Detailed discussion on the results is out of the scope of this report.

SAMPLE NUMBER	POTASSIUM (K wt%)	Rad. ^{40}Ar (10^{-8}cc/g)	K-Ar AGE (Ma)	Air CONT. (%)	Av. Age
A013R	0.35	35.6±1.4	26.0±2.8	50.8	25.7±1.9
	±0.04	34.4±1.4	25.3±2.6	49.9	
A021R	0.90	104±3	29.4±1.9	42.4	30.1±1.5
	±0.05	108±3	30.8±2.0	41.5	

Notes

1 The decay constant used: after STEIGER and JAEGER (1977). $\lambda e = 0.581 \times 10^{-10}$ /Y $\lambda \beta = 4.962 \times 10^{-10}$ /Y

2 The error estimates for the determination:after NAGAO et al.,(1984).

3 The calculation of the error estimates for the average age were after TSUKUI et al.(1985).

4 The content of K40 in K=.01167 atm %.

Ser. No.	Sample number	Rock name	SiO2 %	TiO2 %	Al2O3 %	Fe2O3 %	FeO %	MnO %	MgO %	CaO %	Na2O %	K2O %	P2O5 %	BaO %	LOI %	TOTAL %
	MT. UPAO Area															
1	C003R	And	49.42	0.80	18.11	3.96	5.36	0.19	4.68	9.22	2.76	0.87	0.19	0.01	2.56	98.13
2	E007R	And	61.06	0.54	19.89	3.08	0.29	<0.01	0.10	0.20	0.36	1.16	0.22	0.06	14.01	100.97
3	F007R	And breccia	57.30	0.67	15.88	2.19	4.82	0.18	3.90	3.17	3.85	2.05	0.18	0.02	5.30	99.51
	MADARAG Area															
4	A003R	alt Dac	77.73	0.43	17.79	0.99	0.23	<0.01	0.06	<0.01	0.10	0.09	0.14	<0.01	3.74	101.30
5	E002R	And	49.20	0.78	19.12	3.77	5.08	0.18	3.99	8.76	2.24	0.45	0.22	0.03	4.18	98.00
6	G005R	alt And	63.36	0.57	18.41	7.93	0.34	<0.01	0.39	<0.01	0.43	3.37	0.10	0.03	4.78	99.71
	NIPA Area															
7	A013R	And	52.37	0.65	17.61	3.87	5.44	0.20	4.59	8.68	2.61	0.56	0.05	0.38	2.79	99.80
8	A018R	sil And	71.03	0.51	12.78	2.93	1.50	0.16	0.69	7.91	1.45	0.49	0.15	<0.01	1.75	101.35
9	A020R	And	51.39	0.59	18.97	2.24	5.39	0.16	2.99	6.63	4.26	1.44	0.09	<0.01	5.49	99.64
10	A021R	QD	69.03	0.36	14.72	1.75	1.63	0.06	0.96	3.32	4.26	1.45	0.09	0.02	1.14	98.79
11	C009R	sil And	71.89	0.43	12.28	1.40	1.74	0.07	1.30	1.60	2.86	0.85	0.15	0.02	4.04	98.63
12	C010R	And	71.51	0.30	14.04	2.57	0.42	0.02	0.60	1.39	5.23	0.59	0.11	<0.01	1.91	98.69
13	C012R	And	49.34	0.65	18.14	6.31	4.69	0.20	3.35	12.52	0.59	0.50	0.07	<0.01	0.72	97.08
14	C017R	VB	55.76	0.62	16.83	3.59	4.50	0.37	4.26	7.22	2.78	1.00	0.07	0.01	1.65	98.66
15	F015R	sil And	63.89	0.62	21.60	3.92	0.31	<0.01	0.07	<0.01	0.09	0.05	0.18	0.01	10.17	100.91
16	F017R	sil And	71.07	0.25	11.88	0.03	0.25	<0.01	0.12	0.20	0.68	1.98	0.10	0.03	13.90	100.49
17	H011R	And	53.14	0.61	17.41	1.93	5.95	0.15	3.71	4.83	4.79	0.84	0.06	0.01	6.12	99.55
18	H012R	And	68.73	0.56	13.58	2.67	3.67	0.11	2.28	1.26	4.03	1.20	0.14	0.02	2.89	101.14
19	H014R	And	56.74	0.74	16.75	2.84	5.14	0.12	2.46	5.00	2.81	2.76	0.19	0.02	3.43	99.00
20	H016R	And	59.80	0.75	16.54	4.63	2.38	0.12	1.89	5.24	5.37	0.32	0.22	<0.01	2.18	99.44
21	H017R	And (sil)	70.36	0.73	18.67	2.55	0.25	<0.01	0.05	0.08	0.06	0.42	0.04	<0.01	7.19	100.40

Table II-5-2a Whole Rock Analysis

※ And:Andecite Dac:Dacite alt:altered sil:silicified QD:Quartz diorite VB:Volcanic breccia

Norm Mineral	C003R	F007R	A013R	A020R	A021R	C010R	C012R	H011R	H014R
Q	3.45	12.09	8.56	0.18	29.91	35.27	14.66	2.44	13.20
C	0.00	1.98	0.00	0.00	0.31	2.53	0.00	0.00	0.49
or	5.14	12.11	3.31	8.51	8.57	3.49	2.95	4.96	16.31
ab	23.35	32.58	22.08	36.05	36.05	44.25	4.99	40.53	23.78
an	34.46	14.59	34.68	28.39	15.92	6.18	45.37	23.52	23.60
di	7.83	0.00	6.81	3.05	0.00	0.00	12.68	0.05	0.00
hy	12.29	14.48	12.91	11.64	3.20	1.49	4.52	15.76	10.77
mt	5.75	3.18	5.62	3.25	2.54	0.55	9.15	2.79	4.11
hm	0.00	0.00	0.00	0.26	0.00	1.49	4.52	15.76	10.77
il	1.52	1.27	1.23	1.12	0.68	0.57	1.23	0.72	1.41
ap	0.44	0.42	0.12	0.21	0.21	0.25	0.16	0.14	0.44
TOTAL	94.23	92.70	95.32	92.39	97.38	96.78	95.71	91.37	94.10

Table II-5-2b Norm minerals calculated for the fresher rock samples

Table II-5-3 Rock Thin Sections

No.	sample No.	rock name	texture	phenocryst or fragment	groundmass or matrix	altered minerals	remarks
1	A003R	altered dacitic tuff	porphyritic	Qtz:1~2mm	minute Qtz: ~0.05mm Opq	Ser: ~0.01mm Epi:0.05~0.1mm dissem.Lim	
2	A013R	Aug-andesite	porphyritic ophitic	Aug:0.6~1.2mm Pl :1.0~1.5mm Opx?	Pl Opq Apa Zir gls	Act(←Cpx) Cal(←Cpx,Opx?) Chl(←Cpx,gls) Epi(←Opx?) Zeo?	
3	A018R	quartzite	equigranular (mosaic)	Qtz:0.1~0.5mm	pool Pl Apa:0.05mm Zir: ~0.05mm	Epi:0.1mm~ Chl: ~0.2mm	
4	A020R	Aug-andesite	porphyritic	Aug: ~1mm Pl : ~1.5mm Opq	Pl Opq gls	Cal(←Pl,Cpx) Chl(←Cpx) Zeo? vein	
5	A021R	Biot-granite	holo-crystalline (mosaic)	Qtz: ~2mm Pl : ~2mm Or : ~2mm	Opq Apa Zir	Chl(←Biot?) Cal	
6	C003R	Hyp-Aug-andesite	porphyritic	Aug: ~4mm Hyp:0.2~0.4mm Pl :0.2~2mm Opq: ~0.2mm	Pl Cpx Opx? Opq Apa Zir	Chl(←Pl) Qtz(←Pl) Zeo vein	weak flow structure
7	C009R	silicified tuff?	tuff-structure (fine-grained)	Qtz Pl	Qtz:0.01mm Opq Apa Zir	Chl(←Pl) Ser(←Pl) dissem.Lim	silicification original rock…tuff
8	C010R	acidic tuff?	porphyritic	Pl	Qtz Pl Opq Apa	Qtz Epi Pum?	weak metamorphism
9	C012R	Hyp-Aug-andesite	porphyritic	Aug: ~0.3mm Hyp: ~0.2mm Pl :1.0~1.2mm	Pl Cpx Opx Opq Apa Zir gls	dissem.Lim idingsite?(←Cpx)	weak flow structure

Table II-5-3 Rock Thin Sections

No.	sample No.	rock name	texture	phenocryst or fragment	groundmass or matrix	altered minerals	remarks
10	C017R	dacite	aphyric	Pl	Qtz Pl Opq Zir:0.05~0.1mm	Cal(←Pl) Ser(←Pl) Epi Chl	
11	E002R	Aug-andesite	porphyritic	Aug: ~1.5mm Pl : ~2mm	Pl : ~0.01mm Opq gls	Cal(←Pl)	weak flow structure
12	E007R	silicified tuff?	tuff-structure			Qtz(←Pl) Ser: ~0.01mm Alu? Hem?(←Mgt-Ilm)	
13	F007R	welded tuff	welded structure	Qtz Pl Aug Opq gls basaltic fragment dacitic fragment	gls	Carbonate(←gls)	accidental fragment -rich
14	F015R	welded tuff	welded structure (weak welded)	Qtz crystal fragment	gls	silicious rock (←Chal.Qtz) kao?	
15	F017R	Alu-Qtz rock	mosaic fine-grained			Alu: ~0.4mm Chal.Qtz(←Pl)	original rock… andesite or dacite
16	G005R	silicified tuff?	tuff-structure (fine-grained) (mosaic)	Qtz	Qtz	Alu(←Pl) Chl(←Pl) Opq vein Lim vein	original rock… acidic tuff
17	H011R	welded tuff (andesitic)	welded structure (weak welded)	(crystal) Qtz, Aug, Pl K-feld, Opq (lithic fragment) basaltic rock dacitic rock glassy andesite volcanic glass silicified rock Qtz-Alu rock	Pl mafic mineral	Cal(←feld) Chl(←Pl,mafic)	

Table II-5-3 Rock Thin Sections

No.	sample No.	rock name	texture	phenocryst or fragment	groundmass or matrix	altered minerals	remarks
18	H012R	tuffceous sandstone (grywacke)	badly sorted graywacke with faint bedding	(crystal) Qtz, Aug, Pl K-feld, Opq Epi? (lithic fragment) dacitic rock silicified rock			
19	H014R	altered dacite (plagiophyre?)	porphyritic	Pl : ~1.2mm	Pl Qtz Opq gls	Chl(←Pl, Amp?)	
20	H016R	altered plagiophyre	porphyritic holo-crystalline	Pl : ~1.0mm	Pl :0.1~0.2mm Qtz Apa Opq	Epi(←Pl) Chl	
21	H017R	Kaolin-Qtz rock	porphyritic (fine-grained) (mosaic)		Qtz Opq	Kao(←Pl)	original rock… dacite or rhyolite

abbreviation : Act=Actinolite Alu=Alunite Amp=Amphibole Apa=Apatite Aug=Augite Biot=Biotite Cal=Calcite
Chal.Qtz=Chalcedonic Quartz Chl=Chlorite Cpx=Clinopyroxene Epi=Epidote gls=volcanic glass
Hem=Hematite Hyp=Hypersthene Kao=Kaolinite K-feld=K-feldspar Lim=Limonite Opq=Opaque mineral
Opx=Orthopyroxene Or=Orthoclase Pl=Plagioclace Pum=Pumpellyite Qtz=Quartz Ser=Sericite
Zeo=Zeolite Zir=Zircon
dissem.=dissemination

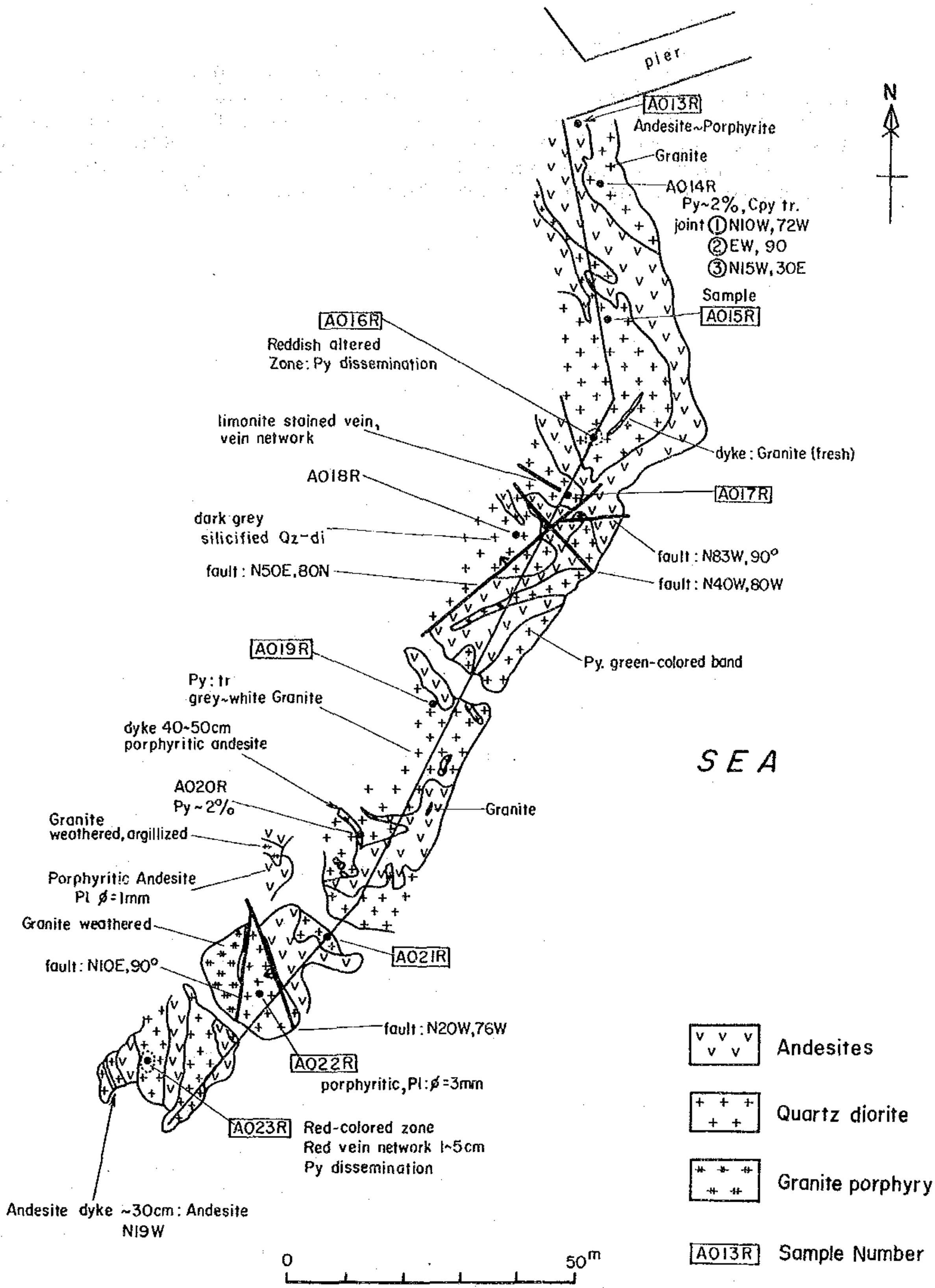


Fig. II–5–4 Occurence of Quartz diorite/Andesite, South of Puntales village, Nipa Area

5-5 ASSAYING (Table II-5-5)

The vein quartz materials in the dumps of old adits near Nipa village contain subeconomic base metal contents. Other than that, the vein quartz float(G014R) sampled near the intersection of E line and base line in Nipa area shows 0.34g/t gold. Highly silicified andesite sampled 300m east of A line of Madarag area also shows 0.34g/t gold.

Mt. UPAO Area

Sample number		Au g/t	Ag g/t	Cu %	Pb %	Zn %
A006R	hm. stained arg. And.	<0.07	<0.5	<0.01	<0.01	<0.01
A008R	py. imp. alt. And.	<0.07	<0.5	0.01	<0.01	<0.01
A009R	grn Cu bg arg. And.	<0.07	<0.5	0.01	<0.01	<0.01
E006R	arg. Silicif. And.	<0.07	<0.5	0.01	<0.01	<0.01
E007R	hm. stained arg. And.	<0.07	<0.5	0.01	<0.01	<0.01
G008R	weath. Silicif. And.	<0.07	<0.5	0.01	<0.01	<0.01
H007R	Silicif. And.	<0.07	<0.5	<0.01	<0.01	<0.01

MADARAG Area

Sample number		Au g/t	Ag g/t	Cu %	Pb %	Zn %
C001R	arg. And.	<0.07	<0.5	0.01	<0.01	<0.01
C002R	arg. And.	<0.07	<0.5	0.02	0.02	<0.01
F005R	Silicif. And.	<0.07	<0.5	0.01	<0.01	<0.01
G001R	Silicif. And.	<0.07	<0.5	0.01	<0.01	<0.01
G005R	arg. And.	<0.07	<0.5	0.02	<0.01	<0.01
H001R	Silicif. And.	<0.07	<0.5	<0.01	<0.01	<0.01
H002R	Silicif. And.	0.34	<0.5	<0.01	<0.01	<0.01
H003R	hm. bg Silicif. And.	<0.07	<0.5	<0.01	0.06	<0.01
J001R	arg. Silicif. And.	0.07	0.5	<0.01	0.02	<0.01

BINANAN Area

Sample number		Au g/t	Ag g/t	Cu %	Pb %	Zn %
G011R	Silicif. And.	<0.07	<0.5	0.01	<0.01	<0.01
G012R	arg. And.	<0.07	<0.5	0.01	<0.01	<0.01

Table II-5-5 Assay results of mineralized Rocks

NIPA Area

Sample number		Au g/t	Ag g/t	Cu %	Pb %	Zn %
A011R	limonite stained. Qd.	<0.07	<0.5	0.01	<0.01	<0.01
A014R	py. minor cp. bg. Qd.	<0.07	<0.5	0.02	<0.01	<0.01
A015R	Silicif. Qd.	<0.07	<0.5	0.01	<0.01	<0.01
A016R	Oxidized Qd.	<0.07	<0.5	0.01	<0.01	<0.01
A023R	py. imp. veinlet	<0.07	<0.5	0.01	<0.01	<0.01
C018R	alt. And.	<0.07	<0.5	0.01	0.02	<0.01
E013R	Silicif. And.	<0.07	<0.5	0.01	0.11	<0.01
E023R	cp. py. bg Qtz vein	0.31	12.5	0.29	0.01	<0.01
E024R	Qtz vein	<0.07	3.6	0.76	0.02	<0.01
E025R	Qtz vein	<0.07	<0.5	0.10	0.02	<0.01
E026R	Qtz vein	0.14	13.4	0.15	0.07	0.22
E030R	Qtz vein	<0.07	<0.5	0.01	<0.01	<0.01
E031R	Qtz vein	0.17	0.8	0.04	0.03	0.01
E032R	Qtz vein	0.21	1.0	0.03	0.02	0.03
E033R	Qtz vein	<0.07	0.9	0.04	0.01	<0.01
F008R	alt. volc.	<0.07	<0.5	0.01	<0.01	<0.01
F011R	hm. rich alt. volc.	0.10	<0.5	0.01	<0.01	<0.01
F015R	Silicif. And.	<0.07	<0.5	<0.01	<0.01	<0.01
F016R	Silicif. And.	<0.07	<0.5	0.01	<0.01	<0.01
F018R	vesicular Qtz vein	<0.07	<0.5	<0.01	<0.01	<0.01
F020R	py. imp. Qd.	<0.07	<0.5	<0.01	<0.01	<0.01
F023R	py. imp. Qtz vein	<0.07	<0.5	0.01	<0.01	<0.01
G014R	Qtz vein	0.34	1.5	0.07	<0.01	<0.01
H011R	py. imp. alt. And.	<0.07	<0.5	<0.01	0.01	<0.01

Table II-5-5 Assay results of mineralized Rocks

5-6 Homogenization Temperature Measurement of Fluid Inclusion (Table & Fig.II-5-6)

Five samples were subjected to the testing,but one was found to have no inclusion.

There are no information on the depths where the inclusions were trapped hence no correction on the pressure were made. Consequently the actual temperature when the inclusion were trapped would be slightly higher than the inferred temperature from the measurements.

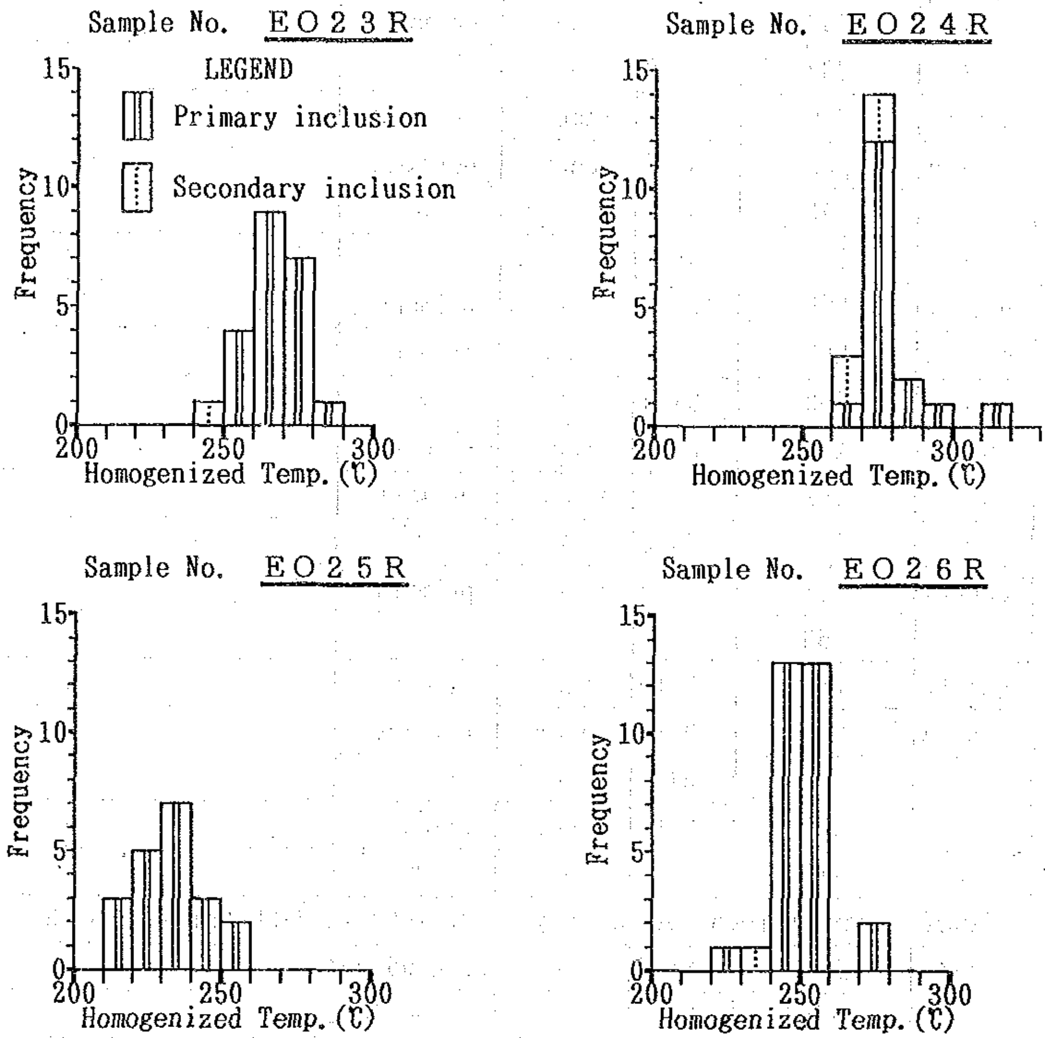


Fig.II-5-6 Histograms of Homogenized Temperature of Two phased Fluid Inclusion

Sample E023R

The measured homogenized temperature of the primary inclusions ranges from 241 to 287 C, the average being 267 C. As apparent from the histogram, the homogenization of the primary inclusion occurred at around 270 C.

Sample E024R

The temperature ranges from 265 to 311 C, averaging at 278 C. This and the tendency seen in the individual measured results of the

grain No.	mineral	homogenized temp. (℃)	size (μm)	location	occurrence	Remarks
Sample: E023R; Average temp. of primary inclusions is 267℃ (range:241～289℃)						
1	quartz	277	5X 5	inner	primary	
〃	〃	279	5X 5	〃	〃	
2	quartz	241	10X10	inner	secondary	
3	quartz	263	5X 5	inner	primary	
〃	〃	267	5X10	〃	〃	
4	quartz	255	5X 5	inner	primary	
5	quartz	263	5X10	inner	primary	
〃	〃	270	5X 5	〃	〃	
〃	〃	273	5X 5	〃	〃	
6	quartz	269	10X10	inner	primary	
7	quartz	252	5X10	inner	primary	
〃	〃	268	5X 5	〃	〃	
8	quartz	251	5X 5	inner	primary	
9	quartz	269	5X 5	inner	primary	
〃	〃	272	5X10	〃	〃	
10	quartz	261	5X10	inner	primary	
〃	〃	266	5X 5	〃	〃	
11	quartz	253	5X10	inner	primary	
12	quartz	270	10X10	inner	primary	
〃	〃	274	5X 5	〃	〃	
13	quartz	265	5X 5	inner	primary	
〃	〃	289	5X 5	〃	〃	
Sample: E024R; Average temp. of primary inclusions is 278℃ (range:265～311℃)						
1	quartz	268	5X10	inner	secondary	
〃	〃	275	5X 5	〃	〃	
2	quartz	311	5X 5	inner	primary	
3	quartz	272	10X20	inner	primary	
4	quartz	270	5X 5	inner	primary	
〃	〃	273	5X10	〃	〃	
5	quartz	275	5X 5	inner	primary	
〃	〃	289	5X10	〃	〃	
6	quartz	275	10X10	inner	primary	

Table II-5-6 Microthermometry of Two-Phased Fluid Inclusion

(continued from previous page)

grain No.	mineral	homogenized temp. (℃)	size (μm)	location	occurrence	Remarks
7	quartz	265	5X 5	inner	primary	
〃	〃	274	5X10	〃	〃	
8	quartz	273	5X 5	inner	primary	
9	quartz	294	5X10	inner	primary	
10	quartz	267	5X 5	inner	secondary	
〃	〃	277	10X15	〃	〃	
11	quartz	271	5X 5	inner	primary	
〃	〃	276	10X10	〃	〃	
12	quartz	272	10X15	inner	primary	
13	quartz	275	5X 5	inner	primary	
〃	〃	283	10X15	〃	〃	
14	quartz	274	5X 5	inner	primary	
Sample: E025R; Average temp. of primary inclusions is 233℃ (range:212～256℃)						
1	quartz	233	5X 5	inner	primary	
〃	〃	242	5X 5	〃	〃	
2	quartz	217	5X10	inner	primary	necking downed ?
3	quartz	239	5X 5	inner	primary	
〃	〃	242	5X 5	〃	〃	
4	quartz	230	5X 5	inner	primary	
〃	〃	251	5X 5	〃	〃	
5	quartz	256	5X10	inner	primary	
6	quartz	220	5X 5	inner	primary	
〃	〃	235	5X 5	〃	〃	
7	quartz	243	5X 5	inner	primary	
8	quartz	212	5X 5	inner	primary	necking downed ?
9	quartz	218	5X10	inner	primary	
〃	〃	220	5X 5	〃	〃	
〃	〃	229	5X 5	〃	〃	
10	quartz	231	5X10	inner	primary	
11	quartz	224	10X10	inner	primary	
〃	〃	238	5X 5	〃	〃	
12	quartz	243	5X 5	inner	primary	
13	quartz	229	5X 5	inner	primary	

Table II-5-6 Microthermometry of Two-Phased Fluid Inclusion