Legend

Coastline or Lake

Project Boundary

STRUCTURAL SYMBOLS

Lithological boundary

Linear magnetic trends

Major Fault - Confident, Inferred

Minor Fault - Confident, Inferred

Sense of lateral movement along fault

Sense of normal displacement on fault

Circular structure, possible volcanic vent or intrusion

MAGNETIC SYMBOLS

Zone of reduced magnetic signature, may correspond to areas of demagnetisation of volcanic rocks due to hydrothermal alteration.

RADIOMETRIC SYMBOLS

Areas of increased potassium signature, may correspond to areas of alunite - kaolin alteration.

AIRBORNE-MAGNETIC UNITS

RECENT

Qal — Low magnetic signature and flat texture. Topographic low. Very low to moderate Total Radiometric Count. Distribution partially coincident with accumulations of terrace gravels and alluvial deposits.

QUATERNARY

Qvp — Low to moderate magnetic signature and weak to chaotic sub-linear texture. Low Total Radiometric Count. Partially coincident with unit Qvp from the Geological map of the Buhi-western Mt. Malinao area by the BMG Regional Office V (see JMEC report 1998), pyroclastic agglomerate, tuff, pumice and volcanic debris.

LATE TERTIARY TO EARLY QUATERNARY

TQv4 — High magnetic signature and moderate, broad-wavelength, sub-linear, to undulating rounded texture. May represent a gently dipping, sub-horizontal unit, possibly coincident with andesitic and dacitic flows.

TQv3 — Moderate magnetic signature and a flat to weak, sub-linear texture. Due to the muted linear texture, this unit may represent a thin weakly magnetic unit stratigraphically higher than unit TQv2.

TQv2 — Low to moderate magnetic signature and well-defined strong, linear texture. Possibly coincident with pyroclastic deposits and andesitic and dacitic flows.

TQv1 — Moderate to high magnetic signature and strong, broad-wavelength, linear texture. Moderate to high Total Radiometric Count. May correspond to andesitic and dacitic flows.

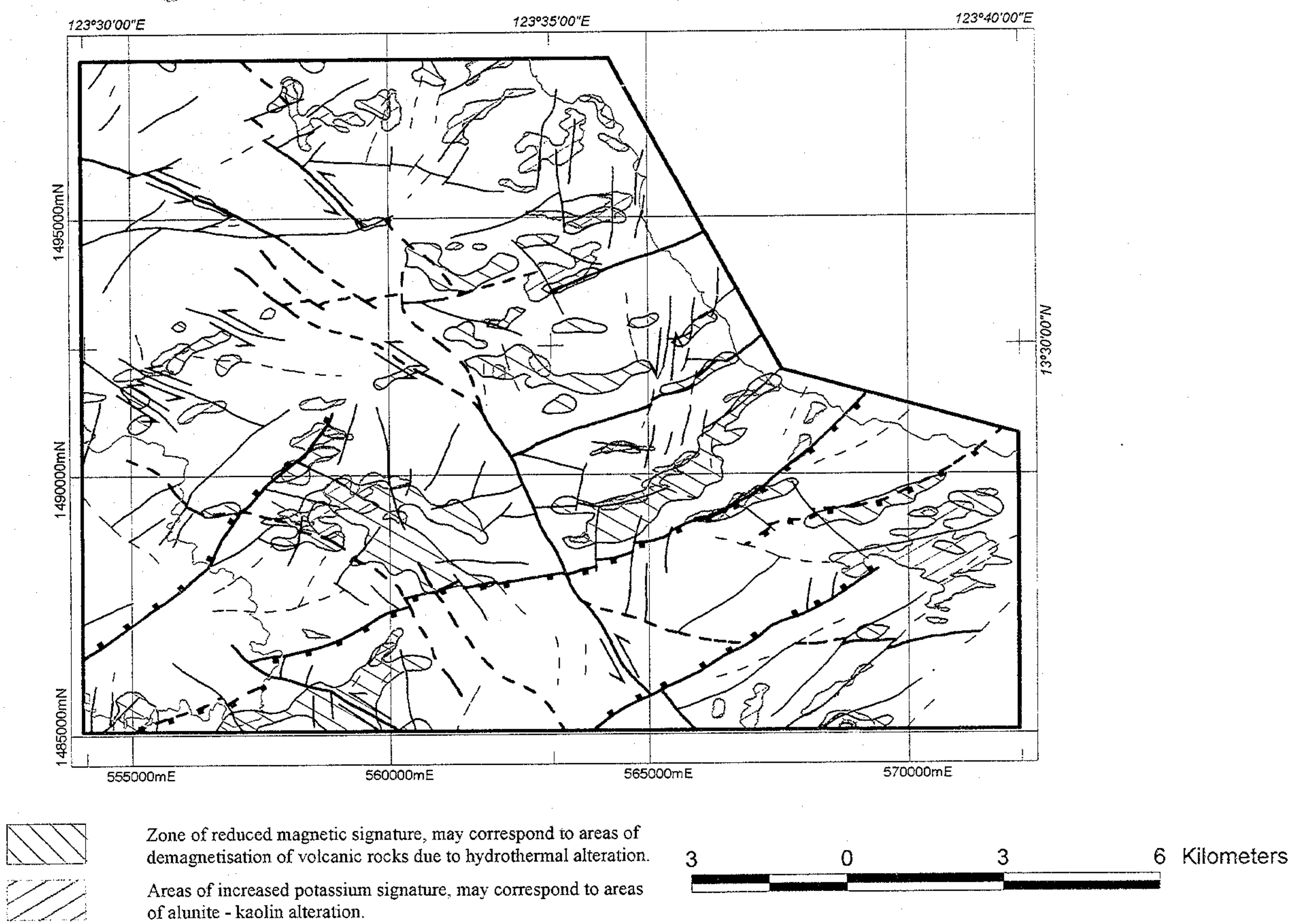

Fig. II-1-8 : Tiwi project area - Philippines. Magnetic lows and Potassium highs combined with faults from aeromagnetic interpretation.

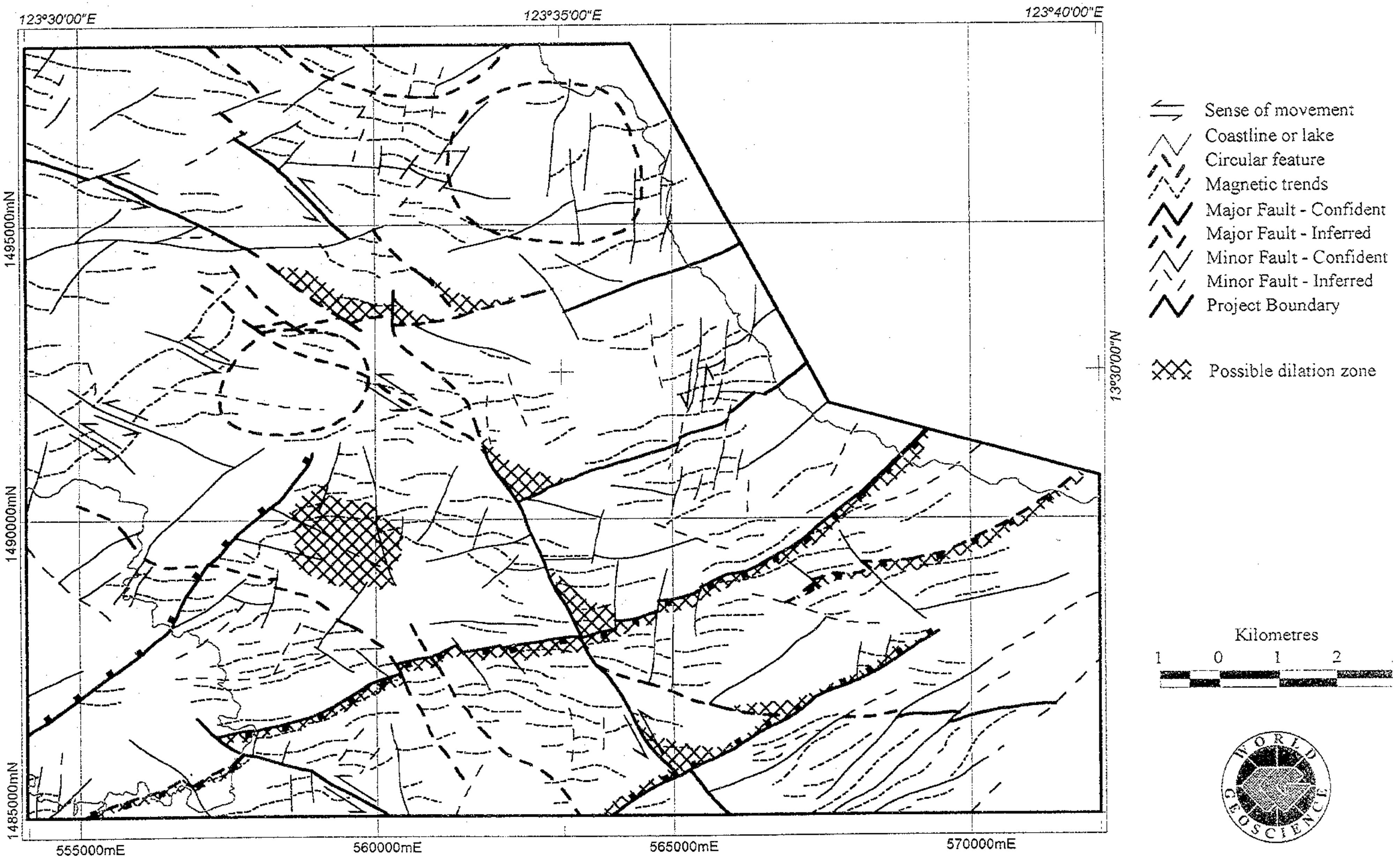

Fig. II-1-9: Structural Interpretation with possible zones of dilation

reactivation by successive volcanic activity or movement of fluids.

❖ Areas of Reduced Magnetic Response

Areas of demagnetisation are evident from the airborne geophysical data and are included on the final interpretation maps. It is proposed that these may reflect large-scale alteration of the volcanic rocks associated with an extensive episode of hydrothermal fluid movement. Potentially these fluids may have been mineralised. Further work is required in order to understand the relationship between the areas of demagnetisation and the alteration associated with the mineralisation. Proximity to NW or N trending structures is considered important, as these appear to act as conduits for the regional movement of the fluids.

❖ Specific areas of interest include:

- The zone of demagnetisation, potassium enrichment and structural complexity at 1488000mN, 559000mE. Which could be a well-developed dilational zone, between two left-lateral strike-slip faults.
- The sub-circular radiometric anomaly at 1497000mN, 563000mE, which may represent an old volcanic vent.

1-9 Summary

The interpretation maps produced from this study and constructed from the geophysical and remote sensed images have successfully reviewed and updated the regional geology and structure of the area. The final maps at the scale of 1:50,000 should form the basis for further exploration in the area. The key conclusions are:

❖ Several large magnetic anomalies and associated structures have been identified that warrant further exploration. The structures within the area could provide ideal conduits for fluid movement.

❖ The structural model proposed for the area complies with a left-lateral, transtensional stress regime. The exact orientation of the stress regime is however, difficult to constrain as the fault geometries are extremely variable. However, this model indicates excellent potential for dilation zones (possible mineral traps) to be developed throughout the study area. More careful analysis of the recognised fault structures is required in conjunction with field-checking.

- ❖ A number of small, isolated magnetic, radiometric and Panchromatic SPOT anomalies have been identified. These may represent intrusive plugs/ stocks with possible mineral potential.

Although generally difficult to accurately map the volcanic rocks using airborne geophysical data, the interpretation of the data provides valuable structural information, as well as identifying potential areas of alteration. These maps should be refined and expanded as further geological mapping and geochemical sampling is undertaken to prioritise targets for further exploration. In addition, this work has highlighted several areas of interest for gold mineralisation, based on the analysis of regional structural and lithological controls of the known mineralisation.

In order to understand the radiometric signatures evident in the area, further field investigation and/ or correlation with available geochemistry is required. The survey should consist of spot checking areas with high Potassium signature. Areas where potassium is low should not be ignored during the initial survey but reasons sort as to why values are low. Factors to consider are:

- ❖ Initially target anomalies that may correspond with faults. Check that if anomalies occur in closely spaced streams with no apparent anomaly between them, do the anomalies coincide with a fault mapped from the magnetics or other data source.
- ❖ Check any anomaly that occurs in close proximity to features such as anomalous areas of magnetic high or low, topographic/ Panchromatic SPOT circular features.
- ❖ If the anomalies are along streams do they correspond with outcrops, boulders, thick sand or gravel accumulations, areas with good exposure/shallow cover.

- A number of factors are likely to be responsible for what appear to be similar radiometric anomalies. Only careful study in the field is likely to resolve these factors. However, once a series of controls have been determined, it may be possible to re-image the radiometric imagery to enhance the key factors identified in the field. At this stage if mineralised controls have been identified it would be beneficial to review the data in close association with the field-data and geochemistry to try and identify further areas of interest. Areas with low magnetic signature have the potential to have been pathways for fluid movement and appear to have been subject to demagnetisation by hydrothermal fluids. In order to resolve some of the ambiguity and categorise the different magnetic low areas, field-checks are required. Several different causes may be observed and a review of the interpretation may have to be made. However, the potential for positive mineralised zones is evident. Field checks should initially be restricted to areas where areas of magnetic low and faults are in close proximity.

Chapter 2 Field Survey

2-1 Selection of survey site

2-1-1 Details on selection of survey site

The charts of the front page show the selection process of the field survey areas and promising area.

The following conditions were set as selection criteria for the Phase I field survey site. A total of 24 areas were selected.

* Places where a deposit, mineral showing, or alteration zone is found from the existing data.
* Areas with observed dense lineations and intersecting two or more lineations based from the satellite image analysis.
* Anomaly zone found through regional air-borne magnetic survey
* Areas with open Mining Rights (Especially, areas where no foreign firm has either obtained or applied for a mining claim.)

After undertaking a general analysis of the results of the Phase I survey, the following areas were selected as possible Phase II field survey areas (see Fig. I-1-2). The areas were selected As a result of the Phase I survey, areas with a high potential for existence of a deposit and areas where a foreign company has not yet been obtained a mining claim were selected. Detailed criteria for selection of each area are described in their respective.

Western part of Bacon-Manito
Gate Mountains
Northwestern part of Tiwi - Mt. Malinao
Eastern part of Caramoan Peninsula
Kilbay
Tuba
Mt. Bagacay
Larap - Exiban

2-2. Results of field survey

The field survey was conducted with base camp set up at Legazpi, Irosin, Baao, and Daet. The survey was conducted by three teams. Basically, the one survey team was composed of one or two Japanese geologist(s), one or two Philippine geologist(s), a four-wheel drive car, and a driver. Each survey team proceeded in their respective survey sites daily and back at the camp in the evening. (For the detailed field survey schedule, see Appendix 8.)

Each surveyed area is described below according to the field survey schedule.

Each area is described under such headings as reasons for selection, location and transportation, survey route, survey point, geology, alteration and mineralization, potential, and mine claim. In the geological description, existing data is also used to describe the outline of a specified area. Under the headings of alteration and mineralization, a simple transportation and geology were also described according to each survey route. In the description of alteration and mineralization, an attempt was also made to describe the results of the laboratory test on samples that were collected from the surveyed area. The evaluation of potential is not relative, but the potential of a specified area was described mainly from the viewpoint of expected mineralization. The mining claim status was described according to the data obtained from the BMG offices and was compiled during the stay in Philippines. In addition, a geological map in each area also shows the sampling point locations.

The sample list, the results of X-ray diffraction analyses, geochemical grade assay results, ore grade assay results, and fluid inclusion thermometrics are shown in Appendix 9, 10, 11, 12 and 13 respectively.

2-2-1. Bacon-Manito western area

1) Reasons for selection

The Phase I survey revealed that a steam heated acid alteration zone developing in this area is characterized by the occurrence of alunite. The existence of alunite in the steam heated acid alteration may show the area is close to a hydrothermal upflow region. There are also silicified rock and/or hydrothermal brecciated vein, which are composed of quartz-alunite or quartz-minamiite. These are considered to be a higher-temperature acid alteration and can be formed by a condensation of gaseous fluid coming from the volcanic gases. Under this environment, it is quite possible that a mineralization of a high sulfidation system has occurred at depth.

Base from the occurrence of the alteration zone, magnetic and radiometric anomaly from the airborne geophysical exploration, we assumed that an older hydrothermal upflow region, which was different from that of the Bac-Man geothermal system, existed at the vicinity of Danao Lake (Appendix 14: PH01). On the other hand, the electric survey conducted by PNOC revealed that there is a shallow low resistivity zone in the southwest of Danao Lake and that a possible hydrothermal system exist (e.g. Los Banos and Oliver, 1997). Therefore, a mineralization, accompanied by an older hydrothermal system, has occurred in this area.

Furthermore, a diorite body and a potassic alteration were discovered at depths evidently manifested by a core from a drillings located at the Bac-Man geothermal field, which suggests the existence of a porphyry type of mineralization. In shallower places than this, an alteration of a high sulfidation system can be observed. Base from the analysis of the current geothermal system, a similar mineralization can be expected at depth of this area.

2) Location and Transportation

The area is located along the border of Albay and Sorsogon Provinces in southeastern part of the Bicol Peninsula. The area is situated in the western part of the Bac-Man geothermal field. Northern and southern accesses from the City of Legazpi are available. The northern access is a paved road extending from Legazpi to Manito. In approximately an hour drive, the mouth of the Buyo-Calpi River can be reached. The southern access is also an hour drive along the Legazpi – Sorsogon paved national road. The exact location of the field survey area is only accessible by foot from both northern and southern access.

3) Survey routes and points (Fig. II-2-1)

Major alteration zones were surveyed in Phase I and their occurrences and characteristics were clarified. In Phase II, survey routes were selected bases from the following specific survey points:

Survey Route	Survey Point
Danao Lake and the upstream of Pili-Cumadcad River	This area is assumed a hydrothermal upflow region. Existence of low magnetic anomaly, a high potassic anomaly, and a "flat region" along a inferred NE-trending fault. The north and south sides of the Danao Lake are situated in the northern and southern ends of the WNW- trending Bac-Man fault zone, respectively. Existence of a low magnetic anomaly and a "flat region" along this fault system.
Salvacion hot spring area	The area is assumed a hydrothermal upflow region. Existence of low magnetic anomaly and a "flat region" along a inferred NE-trending fault.
Upstream of the Cawayan River	This is assumed a hydrothermal upflow region. Existence of a low magnetic anomaly, a high potassic anomaly, and a "flat region."
Upstream of Malobago River	Check if there is an alteration zone.
The Balasabas River	The PNOC report on alteration zone description.
Upstream of the Calpi River	Base from the geology and airborne geophysical survey data, there exist a low magnetic anomaly and a high potassic anomaly along a fault of the WNW system.
Upstream of the Parang River	This region is situated on the east of the Bac-Man geothermal zone and is outside of this survey area. According to the PNOC report, Rangas intrusive rocks

	occur along this route. These intrusive rocks are considered the heat source of the Bac-Man geothermal system. This route was surveyed and collected samples for dating purpose.

4) Outline of survey results

Figure II-2-2 shows the geology, distribution of alteration zones, and sampling points.

Outcrops in the area is few due to thick pile of landslide debris and thick vegetation. Near the Danao Lake and in the northeastern part of Salvacion, where an expected hydrothermal upflow region is considered to exist base from the Phase I survey and the electrical survey of PNOC, a hydrothermal alteration zone could not be found. An alteration zone accompanied by alunite was observed to occur along a WNW-trending fault of the upstream portion of Calpi alteration zone and in the upstream portion of the Cawayan River alteration zone. Along the WNW-trending fault, floats of quartz veinlets were found. Both alteration zones present shallow alterations near an paleo-water surface. The result of the altered rock analysis revealed no indication of gold mineralization.

5) Geology

The geology of this area was described in detail by the PNOC surveys. The geology of this area is shown in Fig.II-2-2 and Table II-2-1. The geology shown in Fig. II-2-2 was compiled based on Alincastre and Panem (1985).

Basically, two-pyroxene andesite and pyroclastic rock are distributed in this area. Near Danao Lake, especially, in the upstream portion of Pili-Cumadcad River, andesite has hornblende phenocryst. The stratigraphic relationship between them is not known because of limited outcrops. The K-Ar age of the andesite was measured as 0.32+/-0.04 (PTH205), 0.28+/-0.03 Ma (PTH208), and 0.29+/-0.03 Ma (PSM217), indicating Late Pleistocene (the results of radiometric age dating are shown in Appendix 15 and 16).

4) Alteration and mineralization

The result of the survey of each route is described below.

< Danao Lake and the upstream of Pili-Cumadcad River >

The two-pyroxene andesite lava crops out in the middle reaches of Pili River, it is least altered. Generally, a weak argillic alteration is observed in the hornblende pyroxene andesite in the upper reaches of this river (PKY203: halloysite; PSM203: cristobalite, halloysite; PSM207: cristobalite, halloysite; PSM209: cristobalite, gibbsite). However, since sulfide mineral was not observed, it is difficult to distinguish between argillic alteration and weathering alteration. Although landslide sediment (PSM205) including kaolin clay was observed within "flat region", neither outcrop was discovered nor alteration zone was identified in the most part of the "flat region". An anomalous value of Cu: 625 ppm was

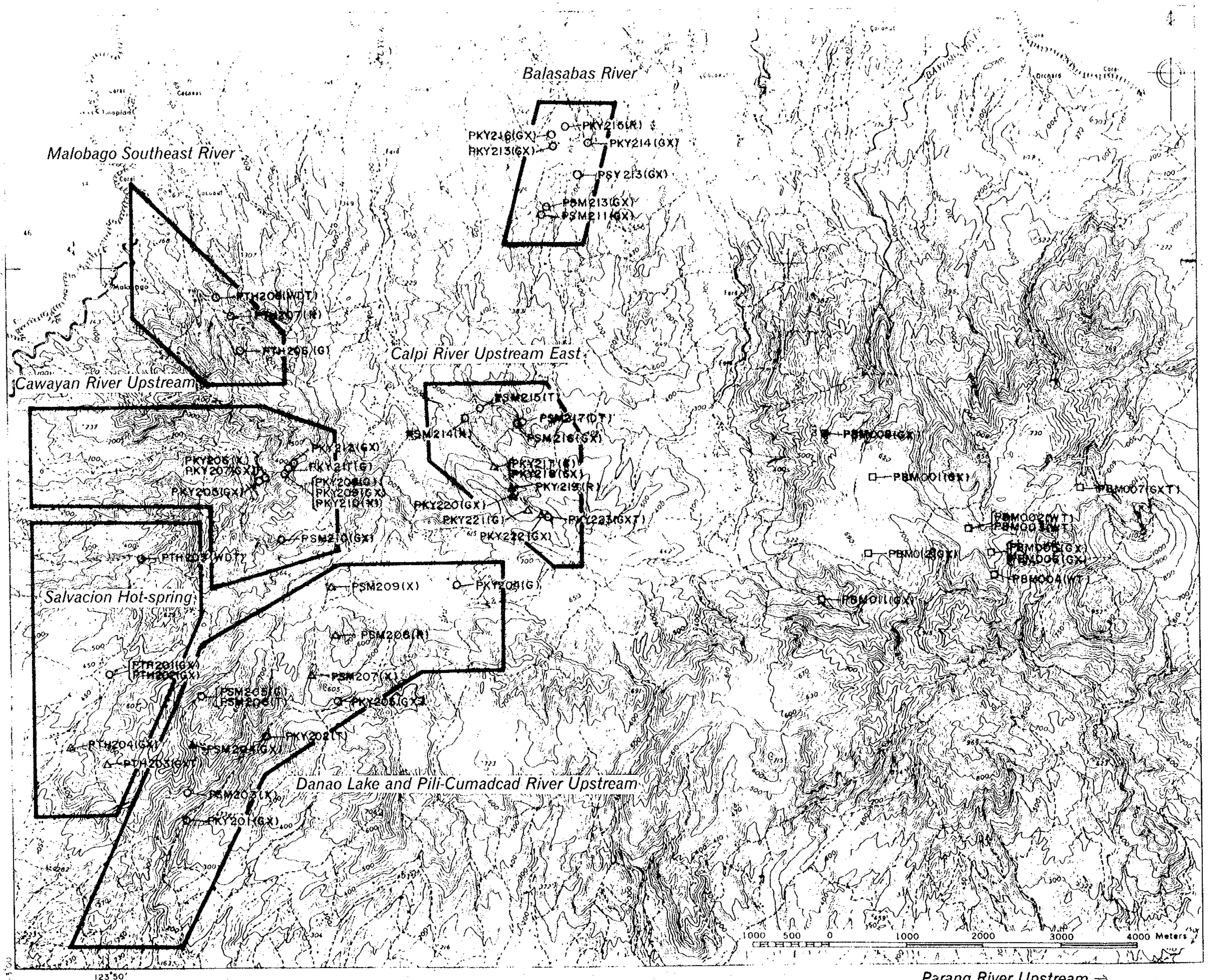

Fig. II-2-1 Root map of Western Bacon-Manito area

Parang River Upstream → →PTH209(R)

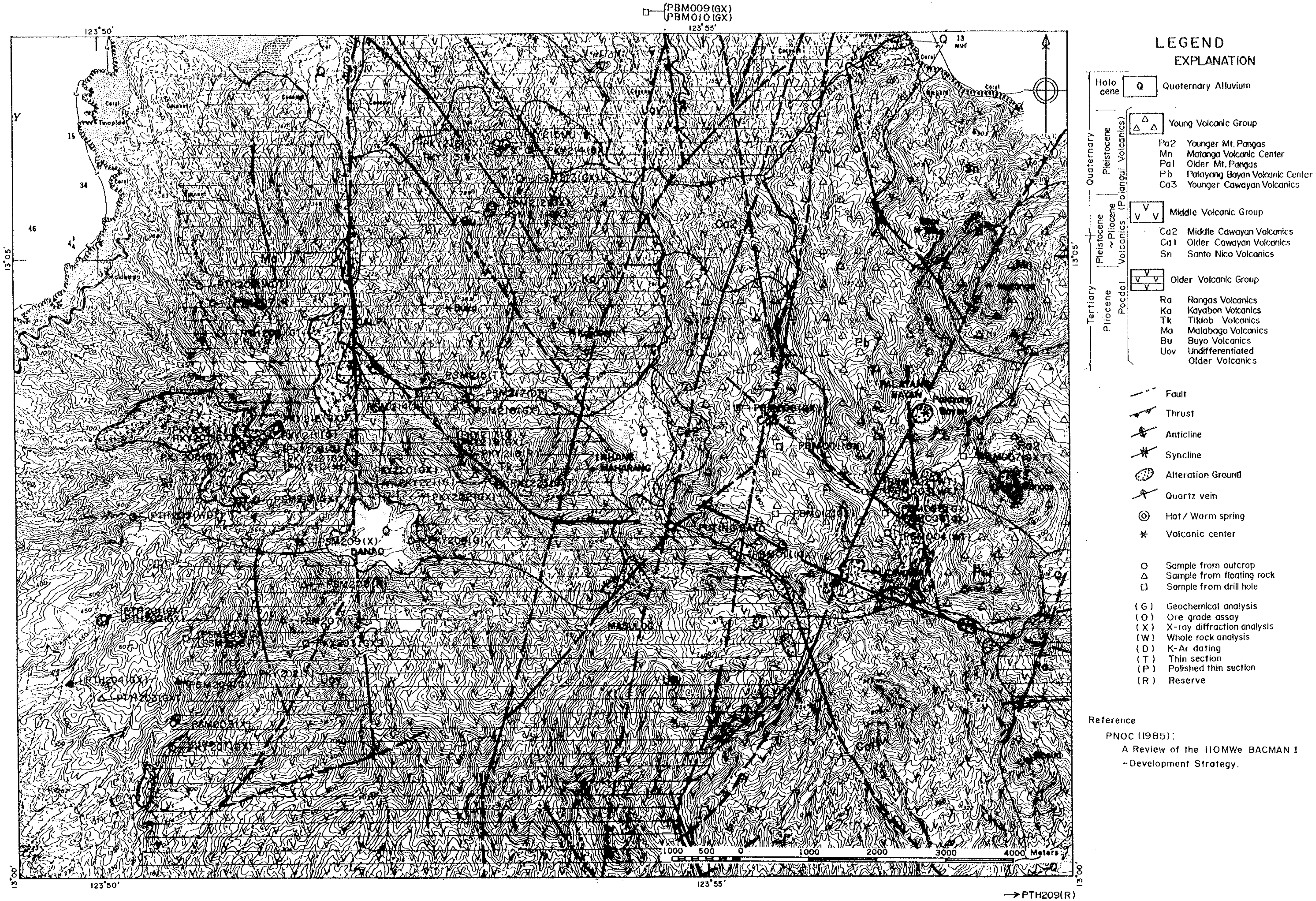

Fig. II-2-2 Geological Map of Western Bacon-Manito area

Table II-2-1 Geology of Western part of the Bac-Man area

From Alincastre and Panem(1985); and Los Banos and Oliver (1997)

stratigraphy			*lithology*	*age*
the San Lorenzo sedimentary rocks			limestone, calcareous sediments, calcarrenites	Late Miocene ～Early Pliocene
the Rangas Intrusive			hb-two-px micro quartz diorite porphyry	?
the Pocdol Volcanic Complex			lava and pyroclastics	Pliocene?～Pleistocene
	MoVp	Manitohan Volcanics	andesitic tuff breccia	
	Mv/MVp	Malobago Volcanics	2 Px andesite, Ol-bearing 2 Px andesite	
	LD	Lison Dome	Hbl-2 Px andesite	
	MgV/MgVg	Magaho Volcanics	2 Px andesite lava and pyroclastics	
	SV/SVp	Sagpon Colcanics	2 Px andesite lava and tuff breccias	
	TkV	Tikolob Volcanics	2 Px andesite	
	KV/KVp	Kayabon Volcanics	2 Px andesitic lava and pyroclastics	

detected in the silicified boulders (PSM204: quartz, natroalunite, goethite) with a diameter of 50 cm rich in limonite. However, gold is below the detection limit for all the samples.

It is highly possible that a fault zone near the Danao Lake is covered with fine-grained ash fall deposits, and the WNW-trending fault system could not be identified on the surface (Appendix 14: PY7). The intensity of magnetic susceptibility was measured in the route in low magnetic anomaly zone through the airborne geophysics, and the result revealed that andesite indicating a high magnetic susceptibility occurs, except in the alteration zone. It turned out that a low magnetic anomaly observed through the airborne geophysical survey does not necessarily correspond with the intensity of rock magnetism.

< Salvacion hot spring >

The Salvacion hot spring has neither a high temperature no steam (Appendix 14: PH02). Occurrence of opaline silicified rock and hydrothermal breccia was identified by laboratory test (PTH202: X-ray diffraction: goethite, tridymite, cristobalite). The beige clay deposited with sulfur in the stream (PTH201: X-ray diffraction: sulfur, cristobalite, tridymite). An anomalous value of Cu: 126 ppm was detected from silicified rock (PTH202). This is a typical steam heated type of silicified alteration zone.

Silicified boulders are located at elevations of 400 to 500 m of the ridge situated on the southeastern side of the stream where the Salvacion hot spring is located. The degree of silicification is from weak to medium. The X-ray diffraction reveals that PTH203 consists of quartz, natroalunite (including a small amount of minamiite), and halloysite. Base from the field data, a lot of similar boulders are distributed around area, and this area is considered to be very close to outcrops, but, there is no geochemical anomaly found in the area. PTH204 is a boulder found on the ridge, which is 1 km away from the place where PTH203 was collected. The X-ray diffraction shows that it is composed of natroalunite, goethite, and tridymite and a high possibility that it underwent a steam heated type acid alteration. An anomalous value of Cu: 118 ppm was detected.

No outcrops could be found on the upper reaches of the Salvacion hot spring. 2 km north-northeast of the Salvacion hot spring, on the upper portion of Cawayan side drainage system, two-pyroxene andesite outcrops continuously into the drainage (PTH205). The whole rock analysis revealed a High-K series andesite containing SiO_2 of 58.17% (unhydrous basis) (Appendix 17 and 18). The K-Ar age value of the whole rock is 0.32+/-0.04 Ma (PTH205), indicating Late Pleistocene.

< Upstream of the Cawayan River >

The geology of this area is composed of black-colored two-pyroxene andesitic lava, two-pyroxene andesitic pyroclastic rocks, and volcanic mud flow sediment. Dacitic andesite with minor biotite was also observed (host rock of PKY205).

An argillized alteration zone was observed widely in the middle reaches (at elevation of 130 m) and in the middle and upper reaches (at elevation of 320 m) of the Cawayan river. An argillized alteration zone was also observed along the northeastern tributary. In addition, a collapsed cliff with argillized alteration can be observed on the hillside of the slope in the lower reaches. Apparently, the alteration zone extends approximately 1.5 km in a north-south direction and 1 km in an east-west direction, but the continuity in the vertical direction is estimated at about 100 m at its longest. A silicified alteration with large amount of pyrite occurs along the southern limit of the alteration zone, which was found during the Phase I survey, and continues up to about 100 m south. From there on, unaltered pyroxene andesite occur. An argillized alteration with a diameter of several meters reappears sporadically within the pyroxene andesite, 350 m east of the southern limit of the alteration zone.

An argillized alteration is mainly composed of smectite with fine-grained pyrite dissemination (PKY205, 206; PSM210: smectite, gypsum, pyrite; Au<5ppb). A pyrite dissemination is partly strong. A strong argillized alteration zone often appears in close relation with the silicified rock with pyrite dissemination (argillized rock: PKY210, quartz-pyrite silicified rock: PKY209). Its structure is vertical or has a SE dipping, indicating a NE-SW to ENE-WSW strike. The silica mineral in the argillized alteration zone is an amorphous silica, it shows that the alteration was caused by a relatively low-temperature hydrothermal activity. The limonite stain caused by resolution of pyrite was found in some altered rocks, wherein kaolinite is often observed. Some silicified veins/quartz-pyrite veins were observed (PKY207, 209). Judging from the fact that these veins contain natroalunite and rutile, they are considered to be formed by an acid fluid. The result of the analysis indicated no mineralization.

< Upstream of Malobago River >

Outcrops of pyroxene andesite extends into the river. Platy joints were developed. The strike of joints is NS and sharply inclines eastward. The direction of this river is controlled by the joint direction and is not caused by a fault. Dark gray pyroxene andesite has a strong magnetism. Therefore, volcanic rock which is judged to belong to a low magnetic anomaly area by the airborne magnetic survey has not necessarily lost its magnetism. The result of the whole rock analysis shows that this pyroxene andesite contains SiO_2 of 53.58% and is classified as basaltic andesite of High K series (Appendix 18). This rock has a slight anomalous composition with Al_2O_3 contents of 28.88%. Microscopic observation shows that this rock does not differ from other volcanic rocks, in its assemblage and quantity of phenocryst, but it takes a different trend from those of other volcanic rocks from various types of variation diagram (Appendix 18 and 19). The K-Ar age is 0.28+/-0.03 Ma), indicating Late Pleistocene.

< The Balasabas River >

PNOC reported that two small-scale alteration zones were distributed in this river, Balasbas and Burabod alteration zones. The Burabod alteration zone is located ustream of the river and the Balasbas alteration zone is in the downstream portion. Both of them have halloysite alteration (PSM211, 212, 213, PKY216: cristobalite, halloysite). The altered host rock is an andesitic pyroclastic rock. As for metallic mineral, faint pyrite dissemination can only be observed in an argillized-altered section, and the result of the analysis showed no mineralization.

The scale of the alteration zone is small and their mineralization is extremely feeble. There is no promising mineralization.

< Upstream of the Calpi River >

The existence of a hydrothermal alteration zone was expected in this area as manifested by the airborne geophysical survey. It is characterized by a low magnetic anomaly and a high potassic anomaly that are distributed along a fault in with a WNW direction. The survey confirmed that an argillized alteration zone is distributed with andesite as a host rock. Since the outcrop condition was bad, the distribution of the argillized alteration zone could not be observed in detail. Judging from the topographical features, its scale seems to be small and limited.

Natroalunite was detected as alteration mineral from the sample (PKY222), taken from an outcrop of with argillic alteration. Silicified alteration (PKY218) accompanied by a great amount of natroalunite is often observed in floats.

Throughout the survey, two pieces of weakly altered andesite containing a quartz veinlet were found in floats on the riverbed (PKY217, 221). Gold is below the detection limit and no accompanying gold mineralization was observed.

A low magnetic anomaly area is distributed in the drainage of the EW system, and a small "flat region" was found. Unaltered pyroxene andesitic lava (PSM215) and pyroclastic rock (PSM214) are distributed up to 350 m above sea level. At elevations above 350 m is a distribution of fine-grained brown unaltered pyroclastic rock. This pyroclastic rock contains carbonized wood and is presumed to be close-to-the recent ejecta. Accidental andesite fragments (green color) rich in hornblende and plagioclase phenocryst is distributed in small scale in the volcanic breccia. The central part of this andesitic rock mass consists of non-altered rock (PSM217), while the peripheral part is weakly argillized (halloysite) (PSM216: cristobalite, halloysite). Since the contact with pyroxene andesite cannot be observed, the relationship between the two cannot be determined. Hornblende andesite is considered to be a dike. The microscopic observation revealed that PSM217 has many pyroxene phenocrysts. Hornblende phenocryst has opacite rim. Minute phenocryst of iddingsited olivine can also be observed.

< Upstream of the Parang River >

The purpose of the survey of this river is to discover floats of diorite reported by PNOC and to determine their radiometric age. As things turned out, those floats were not found, but the two hot springs which had been already reported were identified. It seemed that these hot springs are high in weak-acid HCO_3 with developed travertine (Appendix 14: PH04). Floats consist of pyroxene andesite, hornblende andesite, and calcareous sedimentary rocks. There are two types of pyroxene andesite: basaltic type and andesitic type. Some of the hornblende andesite has relatively coarse-grained hornblende phenocryst and the other has fine-grained hornblende phenocryst.

7) Observation of geothermal drilling cores

Through the courtesy and cooperation of PNOC, the survey team had an opportunity to observe the geothermal drilling core stored in a core hause located within the PNOC Bac-Man camp. Prior to the core observation, the survey team read the drilling reports stored in the PNOC's office and selected core portions (with defined depth) having quartz veins or sulfide mineral descriptions (Appendix 21). Not all of the selected cores were observed. Some cores are not available due to the collapse of the old core house during the previous typhoons. Nevertheless, some samples were collected, through the courtesy of PNOC, for laboratory tests. Collected samples were shown in Appendix 22.

Three types of rock regarded as Cawayan Intrusive Complex (PNOC, internal report) were collected. All of these three samples are basic rocks and have 52% or less SiO_2. On the Spider diagram, their composition have features of a subduction-related magma (Appendix 20). On the different types of variation diagram, these intrusive rocks take same trends as those of volcanic rocks on the surface and the basic end member's position (Appendix 18 and 19). However, fine-grained diorite (PBM003) collected from depths of approximately 2770 m of Pal-2D underwent alteration, producing chlorite, epidote, sericite, and pyrite. For this reason, since this rock does not retain the primary chemical composition, it takes trends slightly different from those of volcanic rock on the ground surface. This is clearly reflected on the different types of Variation and Spider diagrams (Appendix 18, 19, and 20).

Molybdenite was observed at depth in the core of MO-1. The value of Mo is 1655 ppm and Au is 65 ppb. The Mo value was the highest from all the surveyed samples. An acid alteration zone at a relatively shallow point of MO-1 is composed of a combination of quartz, dickite, and alunite, showing slightly high temperatures. However, it cannot be judged whether this is caused by an acid solution from depths or by a drain back of steam heated type of acid solution.

In most cases, an alteration zone accompanied by quartz veins consists of a mixed layer of sericite and smectite or sericite. A propylitic alteration is also observed around this zone. An anhydrite vein is observed at depths of PB-1A and Pal-5D. At PB-1A, pyrite and fine-grained molybdenite in bleached andesite are accompanied by quartz veins. A sericite alteration is also observed there, with Au and Mo value of anomalous level.

The temperature estimated from the alteration at the depth of the drills is rather high. However, we could not find potassic alteration and stockwork veining, which are typically found in porphyry copper system. The drill core observations revealed that mineralization at depth is weak as a whole.

8) Potential

The combination of altered minerals and the manifestation of the alteration zone suggest that the majority of alteration zones observed in this area are steam heated type in the "vadose zone." Veins and hydrothermal breccia veins composed of quartz and alunite (minamiite) are distributed in some steam heated type acid alteration zones. They were likely formed by the condensation of volcanic gas. Based on such features of the alteration zones, the alteration zone distributed in this area can be located on the conceptual model of magma-hydrothermal system as shown in Fig.II-2-18 and Fig. II-2-19.

Since gold is seldom carried by steam, lack of gold mineralization in the steam heated type altered rock always does not indicate that gold mineralization is poor at depths. Some gold may be transported by volcanic gas which is considered to have been carried from a deeper place (Hedenquist, 1995). If the altered rock which made by the volcanic gas (ex. quartz-minamiite hydrothermal breccia vein) does not have any anomalous gold content, the gold mineralization could not be expected at depths. The analysis of almost all the samples collected from this area including minute quartz vein floats showed that gold is below the detection limit, and no sample suggests any gold mineralization.

Furthermore, as mentioned above, among the drilling cores from the Bac-Man geothermal field , some cores have gold and molybdenum concentration at a geochemical anomaly level, but no result suggested any mineralization at the depths. From the above-mentioned explanation, there is little possibility that a gold mineralization have occurred at depths.

The host rock of the alteration is dated as Late Pleistocene. Since the hydrothermal system is very young, it is thought that the hydrothermal system is too immature to cause a mineralization. The Cretaceous basement rocks include Miocene intrusives do not occur at the depth of the bottom of the geothermal drills. This quite deep occurrence of the basements might be minus factor for the transportation and deposition of gold.

9) Mine claim

A geothermal reservation is established by PNOC in the survey area. It is required to obtain PNOC's approval (clearance) for mining activities.

2-2-2. Gate Mountains area

1) Reasons for selection

An extensive hydrothermal alteration zone was discovered of Tugas (north of Mt. Sujac) during the Phase I survey. The distribution of both alteration zone and silicified rock floats suggested that these hydrothermal activities were controlled by a fracture with a WNW-ESE direction. Some silicified rock floats had an anomaly of Au: 120 ppb and Mo: 36 ppm and an anomaly of copper (Maximum Cu: 212 ppm). Consequently, it is quite possible that an upflow region from deeper fluid can be found along the WNW-ESE-trending fault system. It is necessary to conduct a survey along this fracture. In addition, a lot of floats of silicified and altered rocks were observed along the coast (southeastern part of the Gate Mountains area). To clarify the fracture system that controls the alteration-producing hydrothermal system, it is necessary to conduct a survey in the upstream portion of the river, considered to be the source of these floats.

The airborne geophysical survey carried out in Phase I revealed that this area belongs to a zone with a magnetic anomaly relatively higher than that of the Irosin caldera and its western side. A low magnetic anomaly is distributed in the Tugas alteration zone, and a structure with a NW-SE direction can be also observed. A small-scale low magnetic anomaly zone can also be observed in the upper reaches of the drainage (southwestern part) where a lot of silicified rock floats were observed.

2) Location and transportation

This area, situated at the southernmost end of the Bicol Peninsula, is located south of Mt. Bulusan, an active volcano. Pliocene volcanic rocks, which are prior to the formation of the Irosin Caldera, are distributed in this area (Appendix 14: PH05). There are two approaches from Irosin to the survey site. The survey site can be reached through the national road from Irosin to Matnog. It is also accessible from the sea by boat from Matnog or Butag.

3) Survey routes and points (Fig. II-2-3)

Survey Route	Survey Point
Mt. Sujac East	This area corresponds to the southeastern side of the Tugas south alteration zone that was discovered during the in Phase I survey, and it is expected that an alteration zone is distributed along the WNW-ESE-trending fault system. The purpose of this route is to locate alteration and mineralization zones, which are possible sources of the silicified floats, indicating an Au mineralization (120 ppb Au, SM55), collected during the Phase I survey. There is a magnetic

	anomaly area along a inferred fault of the WNW direction.
Upstream of the Sua River	In the Phase I survey, silicified rock floats were collected at the mouth of this river (SM60). The purpose of this route is to locate possible alteration and mineralization zones in the upstream of the area. Parallel to the fault of the WNW-ESE system passing through the southern portion of Tugas, a lineament having the same trend occurs. The airborne magnetic survey revealed the occurrence of a magnetic anomaly area. From these two facts, the existence of an alteration zone was expected.
Marinab-Taromata area	Silicified rock floats were collected at the mouth of the river along Marinab during the Phase I survey. The purpose of this survey is to locate alteration and mineralization zones upstream. Since Taromata corresponds to the intersection of the extended WNW-ESE system lineament accompanied by an alteration zone and the NWN-SES system lineaments, the existence of alteration and mineralization zones was expected.
Sagurada – Aguinaldo area	In the Phase I survey, floats of altered rock were collected at the mouth of the tributary having a NE direction. The purpose of this survey is to locate alteration and mineralization zones located upstream of the area.
Tugas West	Since this area corresponds to the WNW extension of the WNW-ESE-trending fault system that passes through south of Tugas and the occurrence of a magnetic anomaly within the area, the existence of alteration and mineralization zones was expected.
Tugas North	A continuity of an alteration zone around Tugas (western and southern parts) was expected.
Upstream of the Bonot River The Culasi River	This area is the ESE extension of the WNW-ESE-trending fault accompanied by alteration, and the existence of an alteration zone was expected.

4) Outline of survey results

The geology, the distribution of alteration zones, and sampling points in this area are shown in Fig. II-2-4.

As presumed from the Phase I survey, it was made clear that a large scale hydrothermal alteration zone occurs along the WNW-ESE-trending fault system that passes near Tugas.

5) Geology

The Pre-Caldera volcanic rocks of the Pliocene are distributed in this area (Delfin et al., 1988, 1993). The geology of this area is shown in Fig.II-2-4 and Table II-2-2. The geology shown in Fig.II-2-4 was compiled based on (Delfin et al., 1988, 1993).

Generally, pyroxene andesitic lava and pyroclastic rock are widely distributed in this area. Basaltic andesite is also locally distributed. Most of andesites belong to the High K series. The result was similar as reported by Delfin et al. (1993). However, some andesite belongs to the Medium K series (Appendix 18). Rhyolitic pyroclastic flow deposits erupted from the Irosin Caldera are extensively distributed in a low relief area of the WNW-ESE-trending from Sisigon to Matnog. The airborne geophysical exploration revealed that the Gate volcanic rocks (Delfin et al., 1993) correspond to a relatively high magnetic anomaly area (See Appendix 1). The K-Ar age determination of rocks indicates 2.47+/-0.28 Ma (PTH250). This value is almost the same as the age value obtained in the Phase I survey (2.6+/-0.3 Ma: TH54; 1.6+/-0.1 Ma: SM39). Rock distributed in this area belongs to Late Pliocene age.

6) Alteration and mineralization

< Mt. Sujac East >

The survey area is a basin of the river flowing down through the eastern part of Mt. Sujac towards Matnog River. Vehicles can pass approximately 1 km from the national road. From this place, the other areas can only be accessed by foot trails.

Pyroxene andesitic lava and pyroclastic rock are widely distributed. Most andesite are aphyric and glassy (PKY225, 227, 229; PTH213). Lava has well-developed platy joints, which gently inclines toward the west. A flowfoot breccia is observed on and under the lava and two or more flow units are recognizable. Plagioclase laths and pyroxene are generally observed as phenocrysts. Some pyroclastic rocks have portions indicating a facies with a volcanic conglomerate. The microscopic observation revealed that PTH213 has an olivine micro phenocryst and is composed of basaltic andesite of Medium K series (Appendix 18). PKY225 and 227 consist of andesite of High K series.

Alteration is hardly observed in the tributary located in the south and west of this area. There are a few floats of opaline silicified rock and limonite-stained silicified rock (PKY224). Alunite and cristobalite are detected from silicified and altered floats (PKY224), suggesting involvement of low-temperature acid fluid. The analysis showed that this sample has no mineralization.

Altered floats were observed at elevations above 200 m along the WNW-NW-trending drainage southwest of this area. Altered outcrops were also identified. Almost all the altered zones consist of halloysite, cristobalite, pyrite (goethite), and alunite. There is no gold anomaly. Arsenic tends to be high (PTH214: As: 48 ppm; PTH215a: As:54 ppm; PTH215b:

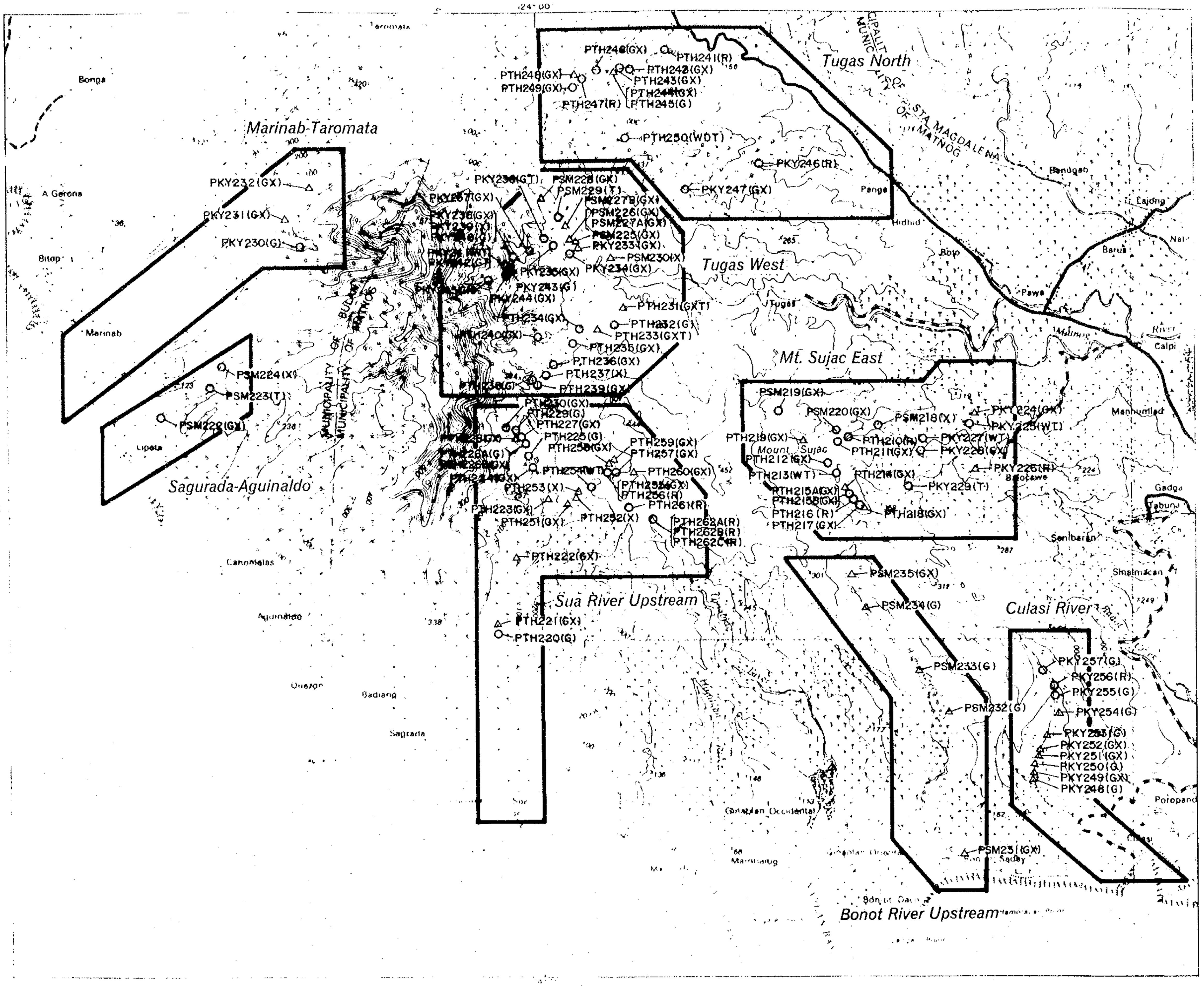

Fig. II-2-3 Root map of Gate Mountains area

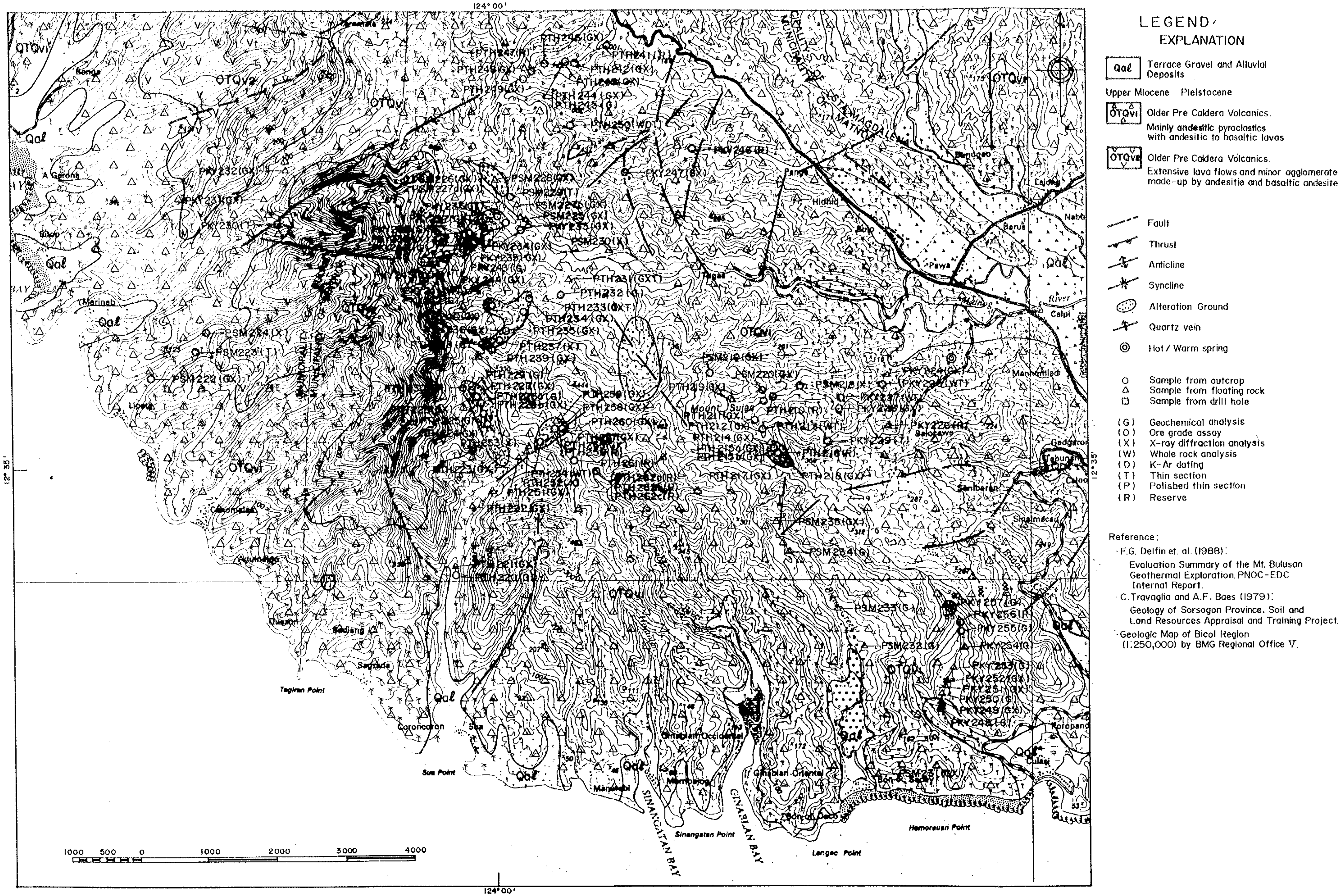

Fig. II-2-4 Geological Map of Gate Mountains area

Table II-2-2 Geology of Gate Mountains area
From Delfin et al. (1993)

stratigraphy	*litology*	*age*
Post caldera Volcanics	Medium K series	Late Pleistocene～Holocene
Caldera Group		Late Pleistocene
Pre caldera Group		Late Pleistocene?
Pre-Bulusan	High K series	Pliocene

Post caldera volcanics	*litology*	*age*	basis
Bulusan Volcanics		Present—>6 Ka	Historic activity and C-14
Talatak Dome	Hbl-Px andesite	～10 Ka	Stratigraphic and geomorphic correlation
Jormajam Dome	2 Px andesite,	～10-20 Ka	Stratigraphic and geomorphic correlation
Taripungso Andesite	(Hbl) 2 Px andesite	～10-20 Ka	Stratigraphic and geomorphic correlation
Agoho Andesite	2 Px andesite	～10-20 Ka	Stratigraphic and geomorphic correlation
Sharp Peak Volcanics	basalt～2 Px andesite	～25-30 Ka	Stratigraphic and geomorphic correlation
Caldera Group			
Irosin Ignimbrite	Pl, Hbl, Bt, Py, Qtz	35～40 Ka	C-14
Malobago Dome	Hbl-Bt dacite	35～41 Ka	Petrologic and geochemical correlation
Pre caldera volcanics			
Bintacan Volcanics	2 Px basalt, dacite	>0.04-<0.4 Ma	Stratigraphic and geomorphic correlation
Homahan Basalt	basalt～2 Px andesite	～0.4 Ma	K-Ar
Calaunan Andesite	2 Px andesite	～1.1 Ma	K-Ar
Tabontabon Volcanics	2 Px andesite	>1.1-<2.14	Stratigraphic correlation
Pre-Bulusan Volcanics			
Gate Volcanics	Px andesite	2.14 Ma	K-Ar

As: 48 ppm). Silica minerals having silicified and argillized alterations are cristobalite and tridymite. PTH219 is a possible e extension on the northwestern side of the above-mentioned drainage. Yellowish brown colloidal sediments are observed at the mouth of the drainage. Floats of altered rock (PTH219) consist of goethite and hematite. The analysis of this sample indicates an anomaly level for As, P, and V (As: 1760 ppm, P: 4640 ppm, V: 1115 ppm). Gold is below the detection limit. Goethite tends to have concentrations of P.

< Upstream of the Sua River >

It takes about one hour from Butag to Sua by boat. After landing, one has to walk for about 4 km to reach the inner portion of the river. The Sua tributary is dissected by a presumed NW-SE direction fault. Two routes were surveyed: a route in the NW-SE direction on the west side of the tributary and a branch tributary in the NE direction on the eastern side of the river.

Rocks within this area is pyroxene andesitic lava and pyroclastic rocks. Both strata alternate each other for several meters thick. PTH254 is pyroxene andesite with well developed platy joints. The whole rock chemical analysis revealed that PTH254 has SiO_2 of 58.07% and consists of andesite of the High K series. This andesite is an aphyric rock.

There are continuous outcrops of an argillized alteration zone in the drainage in the NW-SE direction, and a lot of floats of strongly silicified rock were observed. X-ray diffraction revealed that floats of silicified rock consists of quartz + alunite +/-natroalunite + hematite +/- goethite +/- jarosite +/- rutile (PTH221 and 222). Neither gold anomaly nor other remarkable geochemical anomalies are found. Both acid alteration and neutral alteration exist. Silicified rock underwent acid alteration and is characterized by alunite, natroalunite, and quartz. Neutral alteration took place in most of argillized alteration zones, which is characterized by quartz and mixed layer clay of sericite/smectite. All of them have Au<5 ppb and no remarkable geochemical anomalies are found.

Opaline substances are seen in the silicified hydrothermal breccia (PTH223). However, X-ray diffraction showed that it contains alunite, natroalunite, and quartz, and the silica minerals are not cristobalite but quartz. PTH226b has intermediate – strong silicification and is accompanied by pyrite dissemination. The X-ray diffraction revealed that PTH226b contains plagioclase, chlorite, quartz, smectite, and pyrite and underwent neutral alteration. PTH230 found in the uppermost reaches has a strong argillization, and it underwent smectite alteration. The X-ray diffraction showed that PTH230 contains quartz, albite, sericite/smectite mixed layer, and pyrite and underwent neutral alteration.

Since the smectite alteration is predominant in this drainage and a little mixed layer clay is also observed, there is a possibility that a slightly high-temperature (say 150℃) epithermal system has cropped out. Possibly it may continue to the alteration zone occurring in the western part of Tugas and will be described later. Many floats of highly silicified rock with a diameter of 2 m to 6 m are observed in a branch tributary in the NE direction on the east side of the depths of the drainage. Almost all the silicified rock floats consist of quartz, alunite +/- rutile, pyrite, and goethite. A little sericite/smectite mixed layer clay is observed in a weakly argillized alteration zone recognized as an outcrop and indicates neutral alteration (A supergene deposit may have caused kaolinite). Both silicified rock and rock composing argillized alteration have Au of 5 ppb or less and neither of them has remarkable geochemical anomalies.

The PNOC report map describes an alteration zone in the upper reaches of the drainage on the southeast side of the Mt. Sujac. The Phase I survey on the lower reaches of this drainage revealed there is little possibility that an alteration zone exists in the upper reaches of this drainage due to the absence of altered rock floats. In order to confirm this, the survey team went down to the upper reaches of the drainage on the southeast side of the Mt. Sujac. PTH261 is a float collected in a place corresponding to the southeast side of the watershed, consisting of rhyolite. Floats of altered rock cannot be found on the southeast side of the ridge. The outcrop in the upper reaches of the drainage consists of unaltered volcanic breccia, and floats are also unaltered pyroxene andesite or hornblende andesite. In other words, the altered zone described on the PNOC map was not observed and the result presumed from the Phase I survey was confirmed.

<Marinab – Taromata area>

There is no roadway leading to Marinab. Marinab is accessible by boat from Butag. Andesitic volcanic conglomerates are generally observed, and essentially andesitic pyroclastic rock partially including pyroxene hornblende phenocryst as well as lava (PKY230) are sandwiched between the layers of andesitic volcanic conglomerates.

Silicified andesite accompanied by limonite stain is observed as floats (PKY231, 232). No other alteration than this can be recognized. Quartz, natroalunite (A trace of minamiite is also detected from PKY232), and rutile was observed as silicified alteration. No mineralization can be recognized.

The idea of surveying the Taromata area was abandoned because the area has some problem of peace and order.

<Sagurada – Aguinaldo>

This area is accessible by boat from Butag.

A survey was conducted about 1.5 km upstream from the coast in Sagurada. Unaltered gray non-porphyritic to microporphyritic andesite is distributed in this area. Andesite mainly consists of volcanic breccia. A weak alteration mainly composed of halloysite is observed in andesite occuring at elevations 70 to 100 m above the sea level, but it is difficult to distinguish between this alteration and the alteration by weathering.

A survey was conducted about 1.5 km upstream from the coast of Aguinaldo. Andesite with the same quality as that of Sagurada is distributed in this area. Unaltered, compact and solid, aphyric andesite appears among outcrops of volcanic breccia at an elevation of 60 m above sea level along the drainage. Halloysite can be observed at elevations 20 to 30 m above sea level (PSM222: halloysite) and at elevations of 80 m above sea level. But at this level it is difficult to distinguish between this alteration and the alteration caused by weathering.

< Tugas West >

This area is located in the western part of Tugas and is situated on the extension of the WNW-ESE-trending fault. This area is about 3 km distant from Tugas and is only accessible on foot. Pyroxene andesite (PKY236) is widely distributed. It partially consists of aphyric to microporphyritic rock. Lava has developed tabular joints with a gentle dip. Andesitic lava containing biotite (PKY241) can also be observed.

The survey party separated into three groups to conduct a survey. One group surveyed a drainage of the NE-SW system located on the southwest side of this area, another group a drainage of the NE-SW system located on the west side of this area, and the other a drainage of the NW-SE system located on the west side of this area.

Drainage of the NE-SW system located on the southwest side of Tugas West area: The value of the analysis of altered rock distributed in this drainage is Au<5 ppb and no gold mineralization can be observed. Floats of silicified rock are distributed at the mouth of the drainage (PTH231). Minute platy alunite in a vug is visible even with the naked eye. The X-ray diffraction revealed quartz, natroalunite, kaolinite, and pyrite. Another floats of highly silicified rock underwent acid alteration and a pyrite dissemination is found. The X-ray diffraction revealed quartz, natroalunite, pyrite, kaolinite, and pyrophyllite. PTH234 is an outcrop having a strong argillization, which underwent a smectite alteration (smectite, quartz, plagioclase, kaolinite, and pyrite). An outcrop of a smectite alteration continues up to a diverging point of the drainage (PTH235: Quartz, smectite, plagioclase, and kaolinite). Some argillized outcrops indicate acid alteration (PTH236: Quartz, kaolinite, pyrophyllite, natroalunite, and pyrite).

Outcrops from PTH237 through PTH239 underwent smectite alteration. The alteration may continue to the ridge. It is anticipated that the alteration zone may further cross the ridge and continue to the depths of the upstream of the Sua River. Namely, it is presumed that the smectite alteration extends to this river as well as the drainage in NNW direction surveyed from Sua. Basically, PHT240 underwent the same alteration (quartz, kaolinite, smectite, sericite/smectite mixed layer, barite, pyrite, and anatase).

Drainage of the NE-SW system located on the west side of Tugas West area: A sericite/smectite mixed layer clay mineral alteration zone is distributed intermittently in andesitic lava. Some alteration zones which are several meter thick and are sandwiched between platy joints (PkY235 and others, Appendix 14: PY13) and others which are several meter wide or narrower and are controlled by a near vertical fracture system (PKY237) are observed. In many cases, the latter indicates a sharp dip toward the east in the NNW-SSE direction. A large amount of pyrite dissemination can be partially observed in the argillized alteration. Many boulders of highly silicified rock (for example, PKY233: quartz, pyrite, kaolinite, alunite, and rutile) were observed locally as float, but their supply source could not be located. The argillized alteration zone of the type controlled by a near vertical fracture system has developed quartz veinlets and also has quartz – pyrite veinlets (PKY242) developed sparsely in network form in andesite containing biotite (Appendix 14: PY16). However, the analysis revealed that neither altered rock nor quartz veins has mineralization.

Drainage of the NW-SE system located on the west side of Tugas West area: Mafic phenocryst of andesite at elevations of 120 to 200 m above the sea level is replaced with chlorite. It is thought that the andesite underwent a low-temperature propylitic alteration. Many hydrothermal altered rock can be observed as floats. Floats of altered rock include both silicified rock and argillized rock, and relatively large floats are distributed in great volume in a range from the survey start point to about 200 to 300 m above the sea level. PSM225 (quartz, plagioclase, and smectite) is a float with a diameter of 50 cm. It is remarkably silicified rock composed almost of white silica. It presents a ceramic appearance. A white fine-grained mineral (smectite) is generated in amorphous cavity. No sulfide mineral can be recognized. PSM226 (pyrite, kaolinite, and tridymite) is silicified and argillized rock accompanied by an aggregate of massive fine-grained pyrite, and indicates a copper content on the anomaly value level (Cu: 165 ppm). However, no other value of analysis including that of gold reached the anomaly level.

PSM227a (quartz) and PSM228 (quartz, anatase) are remarkably silicified floats with hematite stained. A float (PSM227b) with a diameter of 3 m, is white silicified and argillized rock. The X-ray diffraction revealed that it contains a trace of sericite/smectite mixed layer clay (quartz, plagioclase, and sericite/smectite mixed layer).

< Tugas North >

This is a hill country sandwiched between the national road extending from Sisigon to

Matnog and a drainage of the east-west system distributed from Tugas to the western part of Tugas, and ridges in the east-west system are distributed around a 437 m high peak.

There is a 265-m high peak in the north of Tugas.

An alteration zone is hardly observed on a route along a drainage extending from Pange to the east-west system. However, a very weak smectite alteration outcrop and silicified floats are found, and an acid alteration of quartz-alunite can be recognized. All the values of chemical analysis are Au<5ppb.

Pyroxene andesitic lava and pyroxene pyroclastic rock are distributed. Some pyroxene andesite containing hornblende is also observed (PTH247), and pyroxene-hornblende andesite is distributed in a ridge of 400 m above sea level (PTH250) (Appendix 14: PH06). This pyroxene-hornblende andesite is andesite of the High K series, containing 61.1% of SiO_2, 3.43% of Na_2O, and 2.88% of K_2O (Appendix 18). The K-Ar age determination result of this rock is 2.47+/-0.28 Ma. This is almost the same K-Ar age value as that, 2.6+/-0.3 Ma, of pyroxene andesite on the south of the Gate Mountains determined the previous fiscal year, indicating Late Pliocene age.

In an outcrop of volcanic breccia, pyrite and halloysite alteration are recognized in the matrix (PTH242: plagioclase, quartz, potassium feldspar, and halloysite). Pyroxene andesite partially presents light greenish gray and a weak smectite alteration is observed (PTH243: smectite, plagioclase, and calcite; PTH246: plagioclase, cristobalite, potassium feldspar, smectite, and tridymite). The assemblage of altered minerals suggests that these alteration underwent a very low-temperature propylitic alteration. PTH248 is a float of silicified rock and the X-ray diffraction showed that it is quartz, natroalunite, and rutile.

Unaltered aphyric andesite is mainly distributed in a north-northeast ridge of a 437-m high peak and an east drainage. On the western ridge, no outcrop is found and floats of unaltered aphyric – microporphyritic (pyroxene) andesite are distributed. Floats (unaltered) of lapilli tuff – tuff breccia with a diameter of 5 m are observed at an elevation of 300 m on the east ridge. Floats of tuff have a matrix-supported texture with a clear stratification. Unaltered massive and brecciated andesite is distributed in an east drainage.

< Upstream of the Bonot River >

It takes about 30 minutes to reach the Bonot village from the Matnog village by boat. The upper reaches of the Bonot River from there to the Mt. Sujac were surveyed. Since outcrops are missing up to an elevation of 60 m for 2.5 km from the coastline, floats are observed in the lower reaches of the river. Almost all floats distributed from here to the upper reaches consist of unaltered pyroxene andesite, and coarse-grained tuff – tuff breccia having partially developed stratification are observed. Outcrops distributed over 500 m between elevations of 60 m and 70 m consist of unaltered andesitic volcanic breccia. This andesitic volcanic breccia is similar to andesite distributed in Mt. Sujac area and Tugas area, and the breccia is consists of only essential fragments. There are many waterfalls near the source of the Bonot River between elevations of 120 m and 200 m, and the rock crops out in a good condition. The geology of this area is tuffaceous, and an alternation of beds composed of coarse-grained tuff, lapilli tuff, and tuff breccia is observed.

Altered rock can be recognized only as floats on this survey route. Highly silicified floats with a diameter of about 1 m are distributed near the coast (PSM231: quartz, rutile). Such silicified rock is distributed near the coast only. Argillized and altered rock is observed in an area about 1.8 km inland from the coastline.

All of the altered rock (PSM232, PSM233, PSM234, PSM235: halloysite, tridymite) underwent halloysite alteration, which are accompanied by hematite stain. Almost all rocks have the diameter of about 30 cm or less, and it is presumed that they are carried a long distance. A sample has a high arsenic content (PSM234: As: 102 ppm).

< The Culasi River >

The Culasi village is accessible from Matnog by boat.

Andesitic lapilli stone and tuff breccia, between which pyroxene andesite lava is sandwiched, are mainly distributed.

The rock is unaltered, although a portion which underwent a feeble argillized alteration can be observed on an outcrop (PKY255). A lot of floats of silicified rock (PKY249, 251, 254) and chalcedonic quartz (veins) (PKY248, 250) were recognized. Part of chalcedonic quartz has a structure similar to silica sinter (PKY250, Appendix 14: PY18) or a breccia texture (PKY253, Appendix 14: PY19). White quartz veinlets were also observed in weakly altered pyroxene andesite (PKY256). In addition to tridymite, a trace of smectite was also detected in silicified rock. Those sample have no anomalous Au content.

7) Potential

It was made clear that silicified alteration and argillized alteration zones are widely distributed around the Mt. Sujac. These alteration zones are distributed along the WNW-ESE-trending fault as was presumed at the Phase I, and it was confirmed that the fault in the same direction controlled the hydrothermal activity. In many cases, a silica mineral of altered rock is not cristobalite but quartz. Argillized alteration is often neutral alteration and smectite alteration, and a sericite/ smectite mixed layer clay mineral is also detected partially.

Based on such features of the alteration zones, the alteration zone distributed in this area can be located on the conceptual model of magma-hydrothermal system as shown in Fig.II-2-18 and Fig. II-2-19. In other words, it is thought that a steam heated alteration zone to a hydrothermal alteration zone somewhat below it crops out, and a slightly deeper portion than the western Bacon-Manito area mentioned above.

Since a silica mineral of steam heated alteration contains more quartz than cristobalite, it is possible that an alteration zone distributed in this area is slightly older than that in the western Bacon-Manito area. This possibility can be also presumed from a difference in age of volcanic rock distributed in both areas. Namely, the volcanic rock distributed in the western Bacon-Manito area indicates 0.3 Ma or so, corresponding to Late Pleistocene, while the volcanic rocks distributed in this area belong to Late Pliocene.

From the facts that quartz-pyrite veins were recognized in the western part of Tugas and a near vertical fracture system accompanied by argillized alteration and quartz veinlets develops systematically, it is presumed that this area was one of hydrothermal upflow region. In addition, because of the existence of mixed layer clay minerals, this area indicates that somewhat higher temperature zone of epithermal system may crop out in this area. Such a part is thought to be an upper part of Au mineralization zone in the epithermal system. But the analysis of the quartz vein in the mixed layer clay zone showed that there is no Au mineralization. Therefore, there is little possibility that an Au deposit may exist. However, the distribution range of hydrothermal alteration zones is considerably wide. Under the present situation, not all these hydrothermal alteration zones have been made clear.

The Monte Calvario area surveyed in Phase I is situated on the NW extension of the NW-SE-trending fault system distributed in this area. It is thought that this area is a product of the same series of hydrothermal activities. The Phase I survey revealed that a mixed layer clay zone is also distributed. When the Gate Mountains area is surveyed, it is desirable that the survey project area be expanded to the Monte Calvario area.

8) Mine claim

MPSA is established in the western part of Tugas. The application for exploration permit in many other areas is being made, and also there are blank areas.

2-2-3. Tiwi-Mt. Malinao northwestern area

1) Reasons for selection

Chalcedonic veins and floats of steam heated type altered rock were discovered at the mouth of the river on the east side of the Buhi Lake through the Phase I survey. On the other hand, the geothermal boring revealed that a mineralization of a low sulfidation system has occurred in the depths in the Tiwi geothermal field situated in the southeastern part of this area. Since volcanic rocks may be older than those in the Tiwi geothermal field are distributed in this area, it is possible that a fossil geothermal system of a low sulfidation system developed.

From the distribution condition of altered rock discovered in the Phase I survey, it is presumed that an alteration zone is distributed in the Santa Cruz River and in the upper reaches of the Cayohoson Creek. A main geothermal reservoir in the Tiwi geothermal area is accompanied by such faults of ENE-WSW-trending faults system as the Kagumihan fault, Tiwi fault, and Naglagbong fault and the Putsan-Bolo fault of the NW-SE direction. Since lineaments of the NW-SE system and NE-SW system develop in this area and the intersection of these two lineaments almost corresponds to the Santa Cruz River and the upper reaches of the Cayohoson Creek, it is though that the area where these fracture systems are distributed is important.

The above-mentioned is supported by the results of the airborne geophysical exploration. That is, low magnetic anomaly zones are distributed along a fracture in the direction of N60° E and NW. These zones have the same direction as that of the fracture distributed in the Tiwi geothermal zone described above. In addition, the distribution of high potassium response zones almost overlaps with that of low magnetic anomaly zones. From these matters, it is thought that many low magnetic anomaly zones correspond to hydrothermal alteration zones. In particular, the distribution area changes to the NW direction from some midpoint in the upper reaches of the Cayohoson Creek, and low magnetic anomaly zones stretch widely along creeks on the northeast and southwest sides, between which a ridge in the same direction is placed.

2) Location and means of transportation

This area is situated in the center of the Bicol Peninsula and is located in the northwest of Mt. Malinao and in the east of Buhi Lake.

3) Survey routes and points

Survey Route	Survey Point
The Inalait River	Floats of quartz veins were discovered at the mouth of the river in the Phase I survey. Alteration zones and mineralization zones were expected in the upper reaches. Low magnetic anomaly overlaps with high potassic anomaly. The ENE lineament is distributed.
Buhi Lake North Buhi Lake Southeast	Floats of quartz veins were discovered at the mouth of the river in the Phase I survey. Alteration zones and mineralization zones were expected in the upper reaches. Low magnetic anomaly, "flat region", high potassic anomaly, and the intersecting area of WNW lineament and ENE lineament.
East coast of the area	This area was selected for the purpose of surveying the geology, alteration and mineralization conditions on the east side where no information had been obtained so far.

Mayon-Mislbis West Mayon Southwest	These areas were selected for the purpose of surveying the geology, alteration and mineralization conditions on the east side where no information had been obtained so far. Low magnetic anomaly, "flat region", high potassic anomaly, and ENE lineament.
The Cayohosan River	Floats of quartz veins were discovered at the mouth of the river in the Phase I survey. Alteration zones and mineralization zones were expected in the upper reaches. Low magnetic anomaly overlaps with high potassic anomaly. WNW lineament.
SW branch of Cayohoson River	Floats of quartz veins were discovered at the mouth of the river in the Phase I survey. Alteration zones and mineralization zones were expected in the upper reaches. A "flat region" exists in low magnetic anomaly. Low magnetic anomaly overlaps with high potassic anomaly, and alteration zones were expected. The intersecting area of WNW lineament and ENE lineament.

4) Outline of survey results

The geology, distribution of alteration zones, and sampling points are shown in Fig.II-2-6. This area has been seldom surveyed so far. Practically, this is the first survey conducted in this area. The present survey showed that hydrothermal alteration zones are widely distributed in this area, too. A steam-heated type alteration zone also develops, and chalcedonic quartz veins were discovered in a mixed layer clay zone at an outcrop. However, the chemical analysis revealed that these quartz veins are not accompanied by gold mineralization.

5) Geology

There is no existing geological and geochronological data on this area except for the geological map that BMG Region V made. The present survey revealed that pyroxene-hornblende dacite – andesite and pyroxene andesite are distributed in this area.

Pyroxene andesite is distributed on the south side of this area, and pyroxene-hornblende dacite are mainly distributed on the north side of this area. The K-Ar age of pyroxene andesite is 0.42+/-0.05 Ma (PKY258), 0.41+/-0.05 Ma (PTH296). That of pyroxene-hornblende dacite is 0.29+/-0.03 Ma (PTH285), 0.28+/-0.03 Ma (PTH287). Pyroxene-hornblende dacite is produced in the form of a dome from the topographical point of view. The dome-like topography was also observed in the central part of this area. From nearby floats, it is thought that these domes are composed of pyroxene-hornblende dacite – andesite. The airborne geophysical exploration revealed that pyroxene andesite is equivalent to TQv2