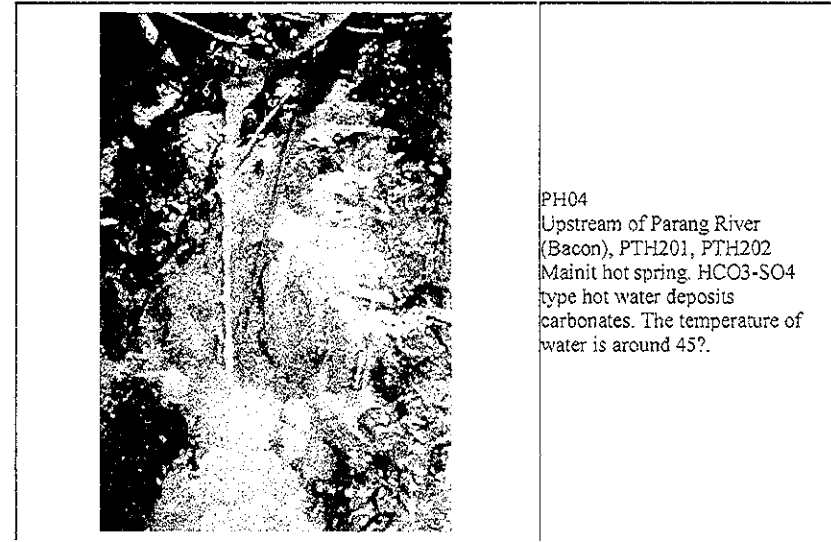
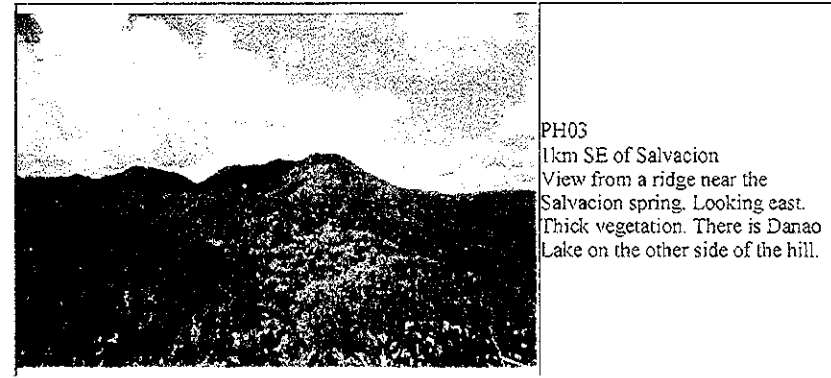
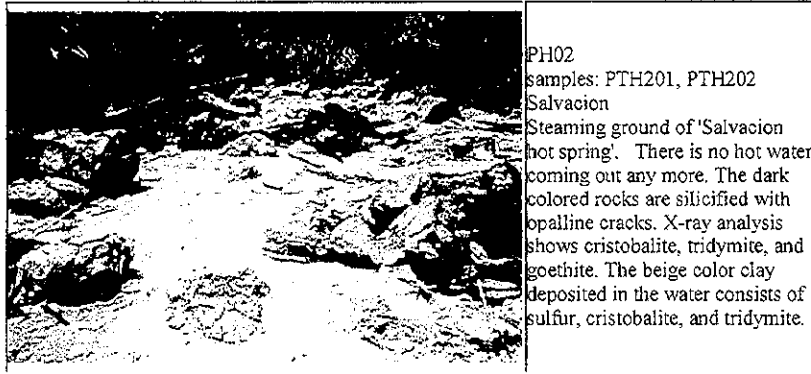
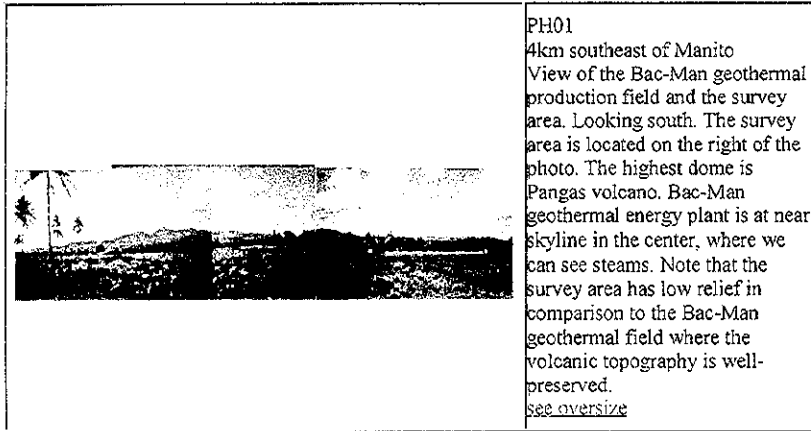
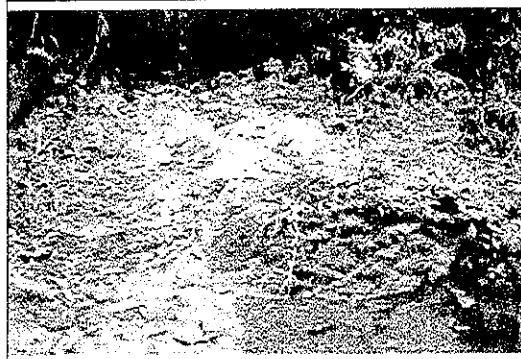


Appendix 14

Bicol Area Image Library

Bacon-Manito area

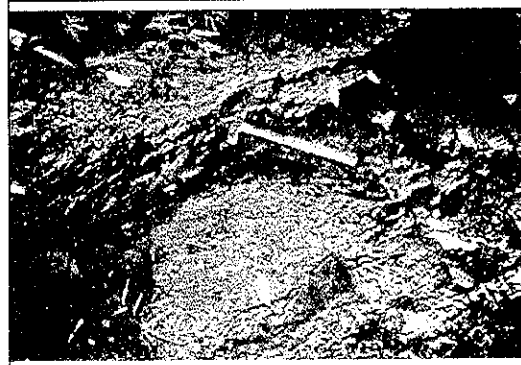




PM00
west of PSM209
Southern end of Cawayan river
alteration, Bacon-Manito area. It
looks like fairly straight line
separates a part of hydrothermal
alteration to fresh host rock,
probably reflecting some
structural control, such as faults.



PM01
sample: PSM209
Spotty smectite alteration, south-
east of Cawayan river alteration,
Bacon-Manito area. There are few
alteration outcrops beyond the
boundary of previously known
Cawayan river alteration, except
this small clay showing.



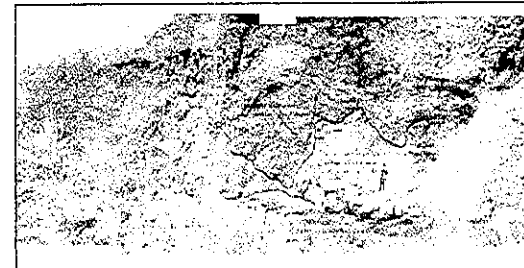
PM02
northwest of PSM216
Black charcoal fragment found in
ash fall tuff, upper portion of
Buyo creek, Bacon - Manito area.
This occurrence explains that
recent volcanic material widely
cover with the lower andesite
horizon and prevent further
ground mapping at the
topographically higher level.



PY07
sample: PKY204
Danao Lake, Pili-Cumadcad
View of outflow point of the
Danao Lake, the upper most part
of the Pili river. The front slope
was supposed to be ENE-WSW
lineament but any alteration zones
were not encountered.



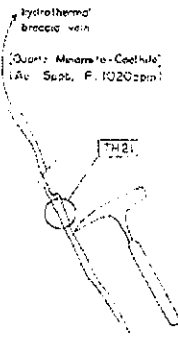
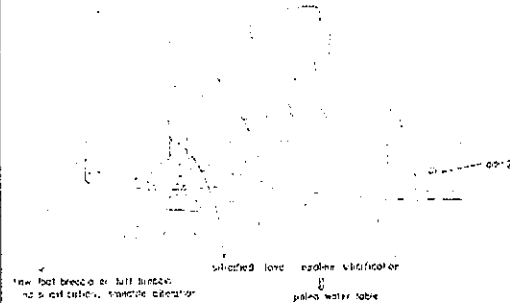
SM01
Cawayan Crater
Inang-Maharang hot spring and
steaming ground at the center of
Bacon-Manito area



SM03
Cawayan river
Outcrop of steam heated altered
rock along Cawayan River in
Bacon-Manito Area
see oversize



Calpi, Buyo river
Occurrence of steam-heated alteration at Calpi in the Buyo river, Bacon-Manito area



Calpi, Buyo river
Occurrence of hydrothermal breccia veins at Calpi, Buyo river, Bacon-Manito area

Balatan area



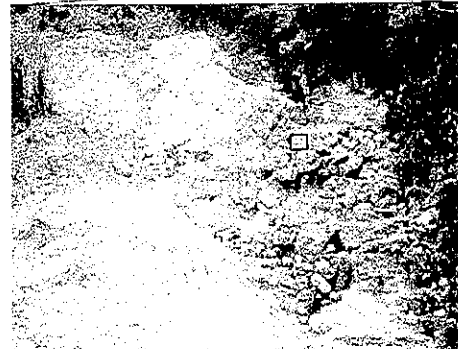
SM05a
Gypsum ore stockpile in Caorasan, northern Balatan



SM05b
Gypsum ore and altered volcanic rock with dark-grey pyrite band



Photograph of gypsum ore deposit



SM06
Gypsum ore deposit near
Cabananan, Northern Balatan

Photograph of gypsum ore deposit and close-up view



Calabanga-Tinembac area



Occurrence of hydrothermal
breccia pipe in Sibobo,
Calabanga-Tinembac Area
The Close-up portions are in
below

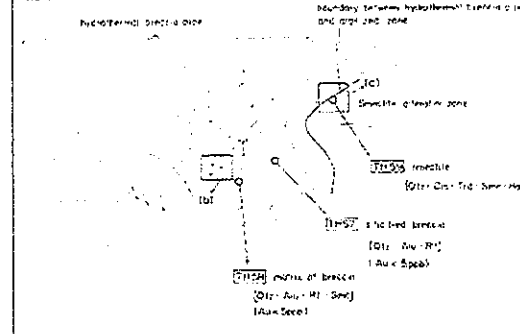
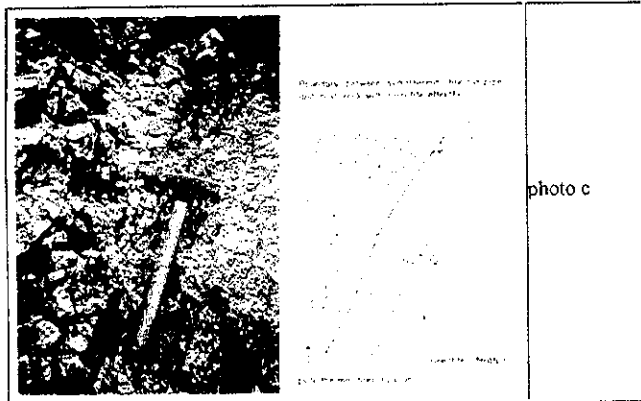
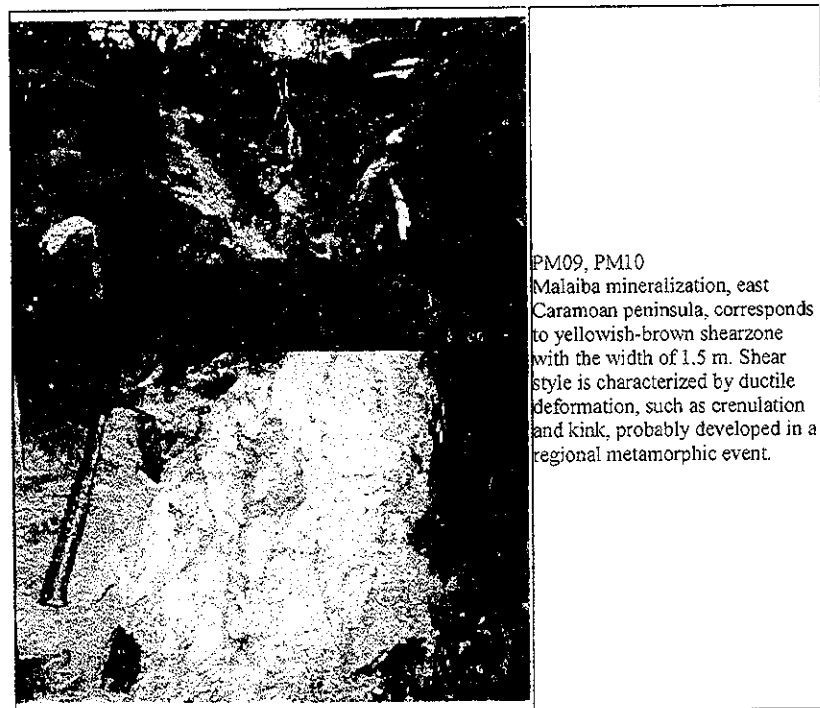


photo b
A close-up of the pipe.
Matrix is filled up with fine
fragments of silicified breccia

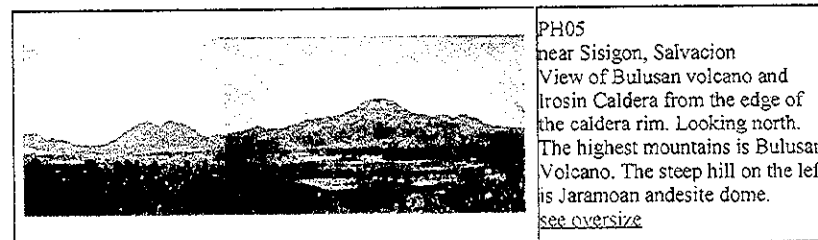


Eastern Caramoan area

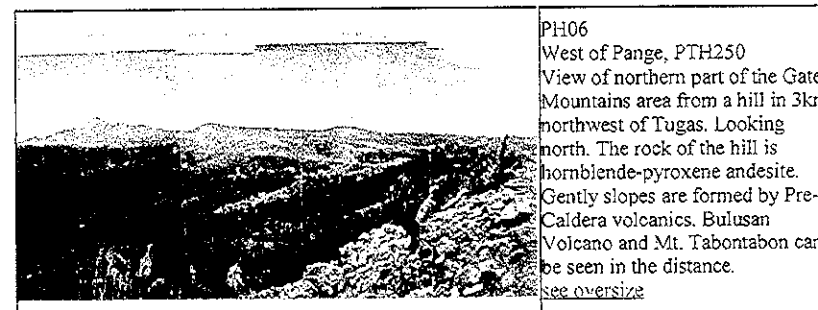


PM09, PM10
Malaiba mineralization, east Caramoan peninsula, corresponds to yellowish-brown shearzone with the width of 1.5 m. Shear style is characterized by ductile deformation, such as crenulation and kink, probably developed in a regional metamorphic event.

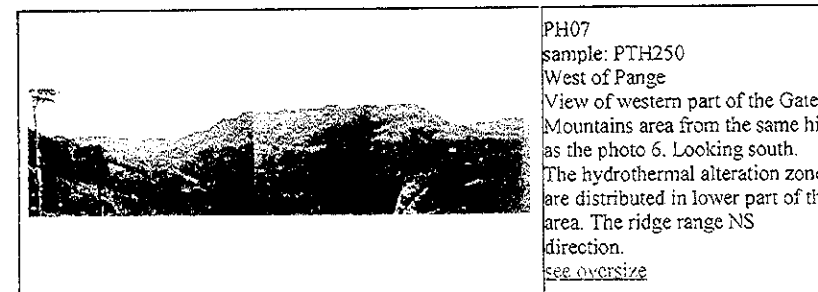
Gate Mountains area



PH05
near Sisigon, Salvacion
View of Bulusan volcano and Irosin Caldera from the edge of the caldera rim. Looking north. The highest mountains is Bulusan Volcano. The steep hill on the left is Jaramoan andesite dome.
see oversize



PH06
West of Pange, PTH250
View of northern part of the Gate Mountains area from a hill in 3km northwest of Tugas. Looking north. The rock of the hill is hornblende-pyroxene andesite. Gently slopes are formed by Pre-Caldera volcanics. Bulusan Volcano and Mt. Tabontabon can be seen in the distance.
see oversize



PH07
sample: PTH250
West of Pange
View of western part of the Gate Mountains area from the same hill as the photo 6. Looking south. The hydrothermal alteration zone are distributed in lower part of the area. The ridge range NS direction.
see oversize



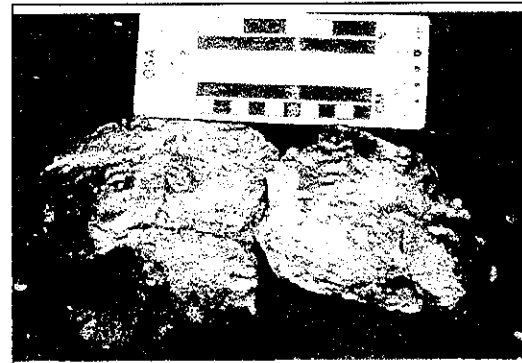
PM03
north of PSM285
Stratified tuffaceous alternation,
upper portion of Bonot creek,
Gate mountain area. The
alternation consists of coarse
grained tuff, lapilli tuff, and tuff
breccia, which partly include
lithic fragments.



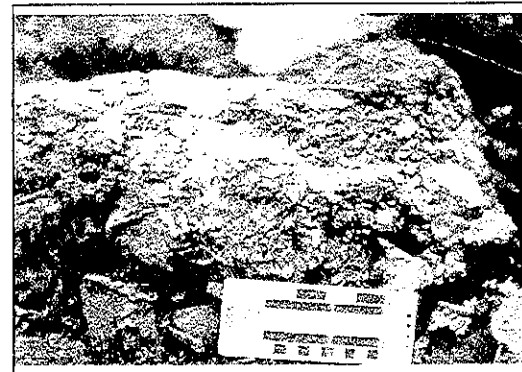
PY13
Horizontal argillic alteration zone
lies within least altered andesite
lava flow, uniformly with its platy
joint.



PY16
Quartz-pyrite veinlets lie within
andesite-dacite

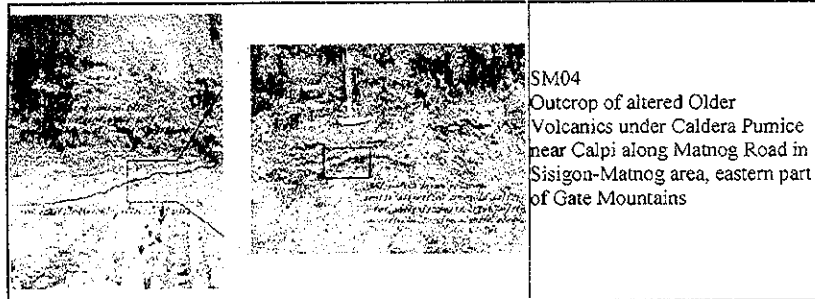


PY18
sample: PKY250
Culasi
Floating boulder of chalcedonic
quartz showing banding and
lenticular cavities are developed
uniformly along the banding.
These textures correspond to
stratiform texture of silica sinter
and shrink texture of the volume
by dehydration during
recrystallization of amorphous
silica into quartz respectively.



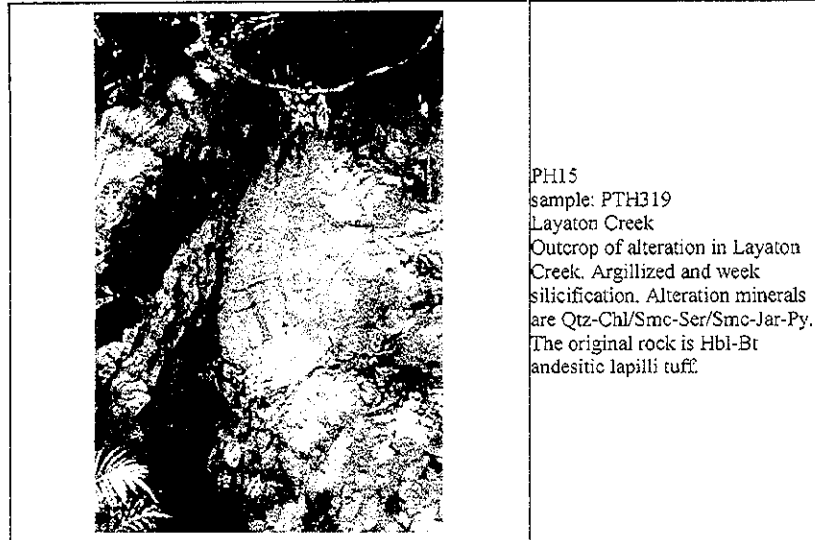
PY19
sample: PKY253
Culasi
Floating boulder of chalcedonic
quartz showing banding texture
and brecciation in places.

Irosin South area

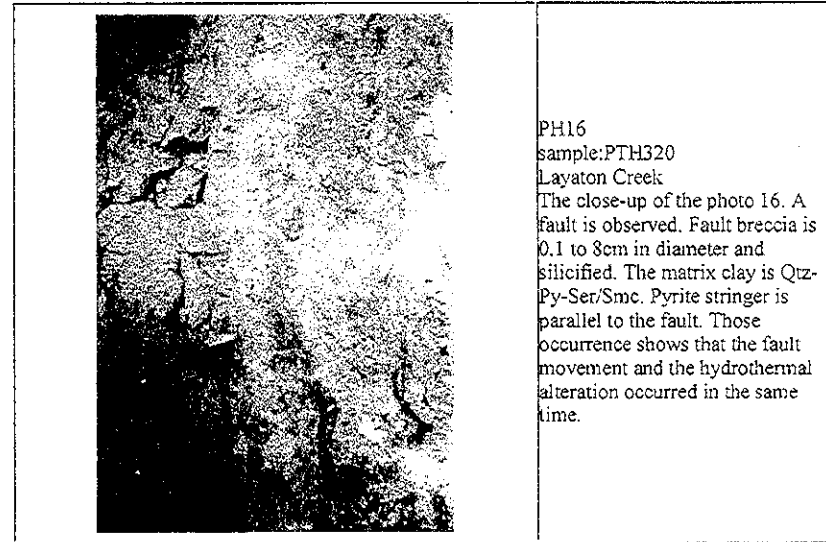


SM04
Outcrop of altered Older
Volcanics under Caldera Pumice
near Calpi along Matnog Road in
Sisigon-Matnog area, eastern part
of Gate Mountains

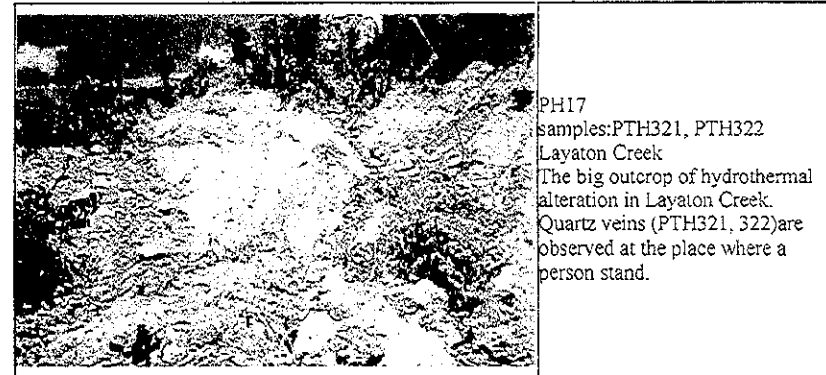
Kilbay area



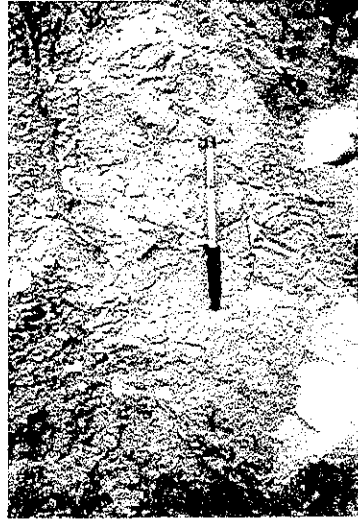
PH15
sample: PTH319
Layaton Creek
Outcrop of alteration in Layaton
Creek. Argillized and weak
silicification. Alteration minerals
are Qtz-Chl/Smc-Ser/Smc-Jar-Py.
The original rock is Hbl-Bt
andesitic lapilli tuff.



PH16
sample: PTH320
Layaton Creek
The close-up of the photo 16. A
fault is observed. Fault breccia is
0.1 to 8cm in diameter and
silicified. The matrix clay is Qtz-
Py-Ser/Smc. Pyrite stringer is
parallel to the fault. Those
occurrence shows that the fault
movement and the hydrothermal
alteration occurred in the same
time.



PH17
samples: PTH321, PTH322
Layaton Creek
The big outcrop of hydrothermal
alteration in Layaton Creek.
Quartz veins (PTH321, 322) are
observed at the place where a
person stand.



PH18
sample: PTH321
Layaton Creek
Chalcedonic quartz vein with very fine grained sulfides. The vein is 1 to 6mm in width and contains Au:275ppb and Cu:718ppm. It strikes N40°W and dips vertical.



PH19
sample: PTH322
Layaton Creek
Chalcedonic quartz vein with very fine grained sulfides. The vein contains Au:250ppb and Cu:727ppm. It strikes N32°W and dips vertical.



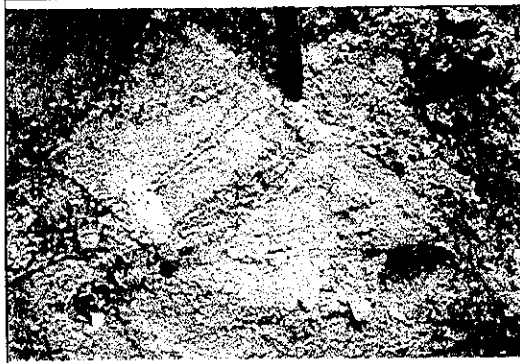
PH20
sample: PTH323
Layaton Creek
Outcrop of highly silicified alteration. Alteration zone is developed horizontally. Hydrothermal brecciation is also observed.
see oversize



PH21
samples: PTH324-PTH326
Layaton Creek
Outcrop of kaolinite alteration. Two kinds of quartz veins are observed. One is black color veins with 0.5 to 1.0cm in width. Other is light gray color veins with 0.5 to 3cm in width. Black color quartz veins are chalcedonic and have metal contents of Au:180ppb, Cu:828ppm, Mo:34ppm. The black color veins consist of quartz and minor pyrite, rutile, anatase, and kaolinite in X-ray diffraction.
see oversize



PH22
sample: PTH326
Layaton Creek
The close-up of the photo 21. The black colored vein is cut by the light gray colored veins. The black color veins strike N70°-80°E and dip 42°-50°N. The light gray color veins strike N60°W and dip 40°S.



PH23
 sample: PTH326
 Layaton Creek
 The light gray color veins are cut by a fault which strikes N65°W and dips 42°N. The light gray color vein has Au:215ppb, Cu:529ppm.



PH25
 samples: PTH335, PTH336
 Kilbay-Alawihaw Creek
 Occurrence of carbonate-silica sinter terrace adjacent to the hot spring of the photo 25. The thickness is around 1 m. Banding of carbonate and silica is observed. Carbonate bands are dominant.



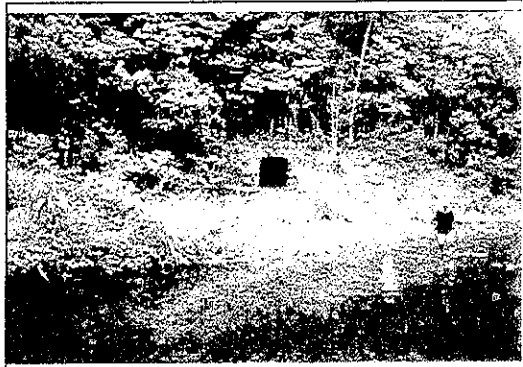
PH24
 PTH335
 Kilbay-Alawihaw Creek
 Hot spring in Kilbay-Alawihaw creek. The temperature could be more than 60°. According to Zeide-Delfin et al. (1995), the hot springs distributed in Kilbay-Alawihaw Creek are neutral chloride type. Those hot springs have around 70 to 300 ppm of SiO₂ and 1700 to 2700 mg/kg of Cl. The temperature ranges from 45 to 85°.



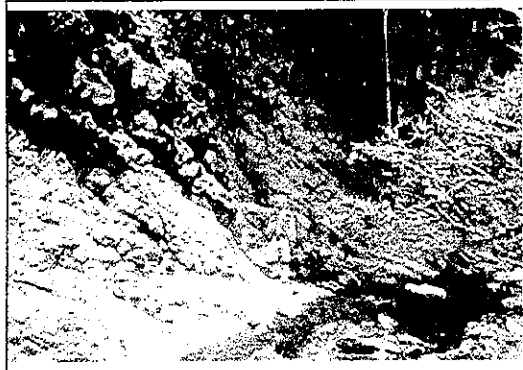
PH26
 sample: PTH337
 Kilbay-Alawihaw Creek
 Close-up of the carbonate-silica sinter terrace.



PH27
 sample: PTH334
 Kilbay-Alawihaw Creek
 Floats of the carbonate-silica sinter. Banding of carbonate and silica is observed. The Carbonates are calcite.



PH28
 sample: PTH338
 Kilbay-Alawihaw Creek
 Old adit in silicified rocks in the
 middle of Kilbay-Alawihaw
 Creek.



PH29
 sample: PTH358
 Tonton River
 Columnar joints developed in
 pyroxene andesite lava. This rock
 has large phenocrysts of
 plagioclase and aphanitic
 groundmass. Under the
 microscope, pyroxene
 microphenocrysts are observed in
 intersertal groundmass.



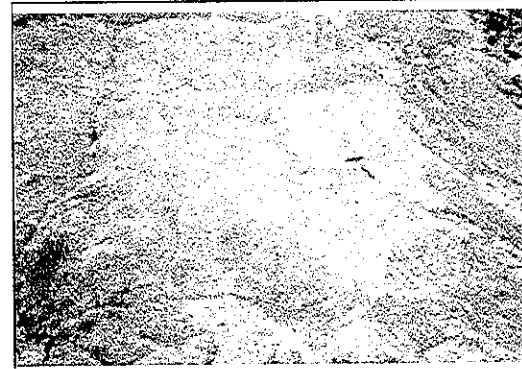
PY22
 sample: PKY285
 Tabion Munti
 A production pit for "bowl clay".
 White layer is thought to be a fall
 out ash unit.



PY25
 sample: PKY289
 Bacaco
 Fine quartz-pyrite veinlet
 (PKY289) in argillic -
 semicite/sericite mixed layer clay
 - altered andesite. The sample
 consists of the veinlet and the host
 rock shows 5ppb of Au.



PY27
sample:PKY294
Bacaco
Wide silicified-pyritized zone, 4m wide, with quartz vein (PKY294), 4cm wide. The quartz vein shows 340ppb of Au and the homogenization temperature of its fluid inclusions is 260.3 degree Cels. and the salinity is 0.05 wt% on average.



PH31
samples:PTH380-PTH382
Benguet Mine
Quartz veinlet stockwork in sericite alteration.



PY31
sample:PKY302
The south of Susundalaga mountains
An outcrop of highly silicified vein, 1.8m wide, with acid leached zone in periphery.



PH32
sample:PTH385
Matalang Prospect
Quartz veinlet stockwork in andesite which has potassic alteration with magnetite dissemination. The vein has 15 ppb of Au, 632 ppm of Cu, and 137 ppm of Mo. The vein interval is about 3 to 20 cm.

Larap-Exiban area



PH30
samples:PTH380-PTH382
Benguet Mine
Open pit of the Benguet mine. Now "Base Metal Mining Corporation" has this mine. Gold bearing quartz veins were in altered the Paracale Trondhjemite.
see oversize



PH33
sample: PTH387
Matalang Prospect
Outcrop of quartz vein stockwork
in andesite in Matalang Prospect.



PH35
sample: PTH391, PTH392
Igang Prospect
Quartz veinlet stockwork in
amphibolite which has dense
pyrite dissemination.



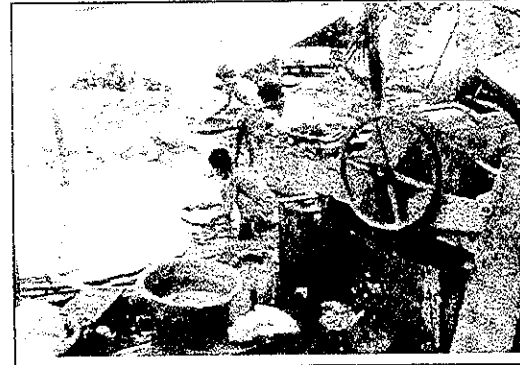
PH34
sample: PTH387
Matalang Prospect
Close-up of the outcrop of Photo
35. Quartz veinlet stockwork in
andesite which has potassic
alteration with magnetite
dissemination



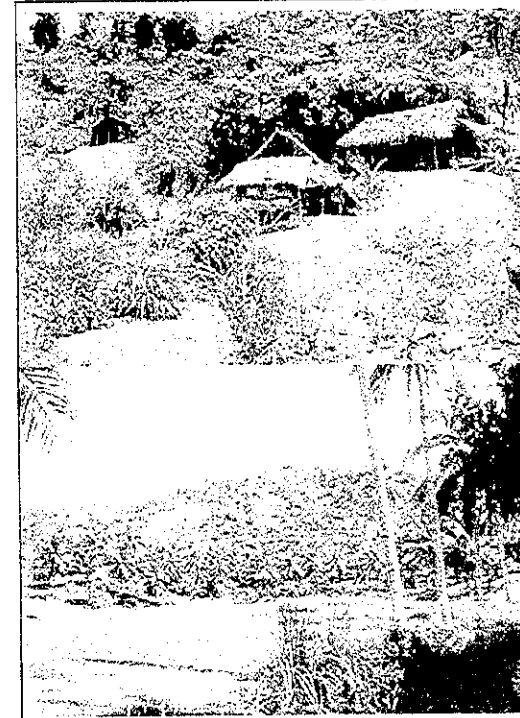
PH36
sample: PTH393
Igang Prospect
Occurrence of quartz veins in
dioritic rocks. The quartz vein is
20cm in width and it strikes
N60°W and dips 75°E. It is cut
and displaced by another quartz
vein which trends northeast and
dips steeply westward.



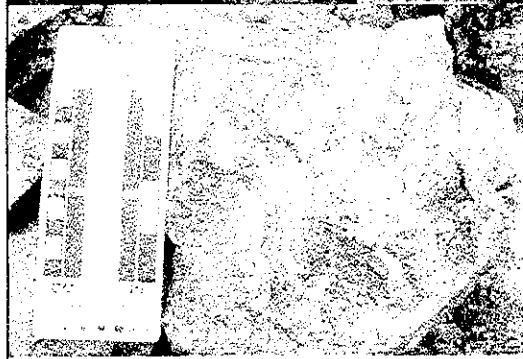
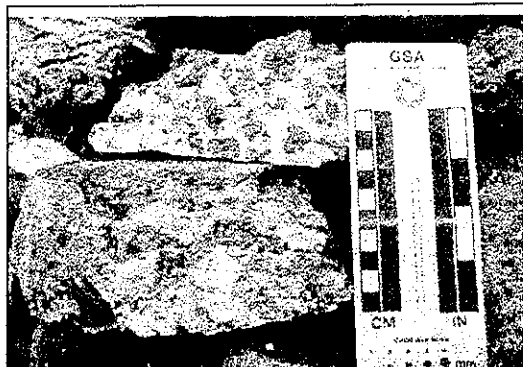
PH37
samples: PTH395, PTH396
Igang Prospect
Quartz vein stockwork in tonalitic rocks in the Igang Prospect. The vein has 10 ppb of Au, 436 ppm of Cu, and 126 ppm of Mo.



PY49, PY52
sample: PKY332
Tumbaga prospect
The pictures show some processes of treatment of auriferous ore and gold extraction. The ore, highly oxidized limonite-quartz vein, is crushed with hammer into less than 5mm diameter (a), then crushed again by motorized milling machine (b). Finally, gold particles are extracted by panning (b).



PY50, PY51
sample: PKY332
Tumbaga prospect
View of the small steep hill where several active mining pits are situated, in northwest of 304 peak. striped vegetation area, in the center, and foot of the hill are mining site (a). View of small huts on the hill. Dumped rock are mainly porphyritic andesite or andesite porphyry (b).



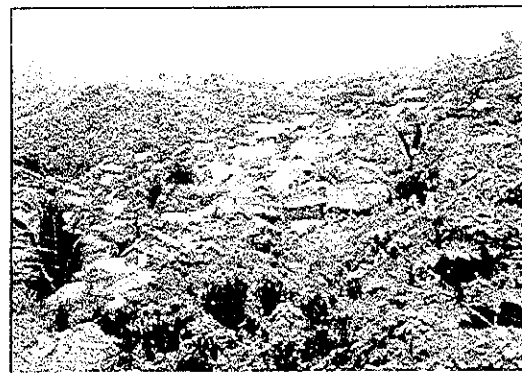
PY55, PY56
 samples: PKY335, PKY336
 Paracale National mine
 The samples showing relationship
 between pyrite-quartz vein and
 host rock, andesite (?).



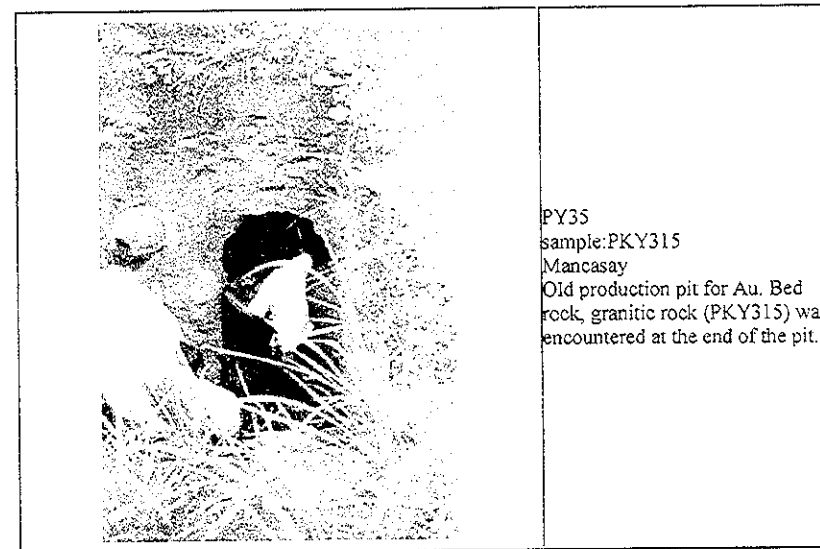
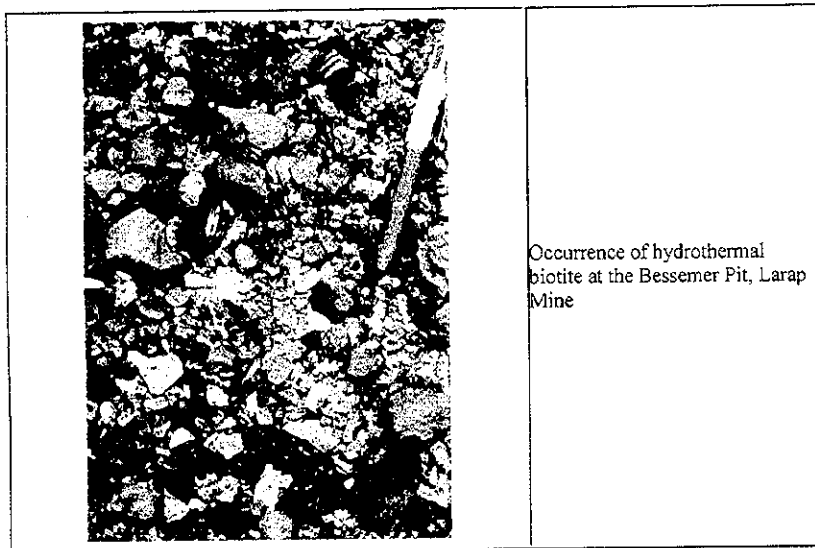
PY57
 sample: PKY337
 Paracale National mine
 Many dark gray chunks are
 ultramafic rocks. The waste dump
 including ultramafic rocks
 suggests that the andesite or
 andesitic tuff unit which is
 hosting pyrite-quartz vein system
 is underlain by them.



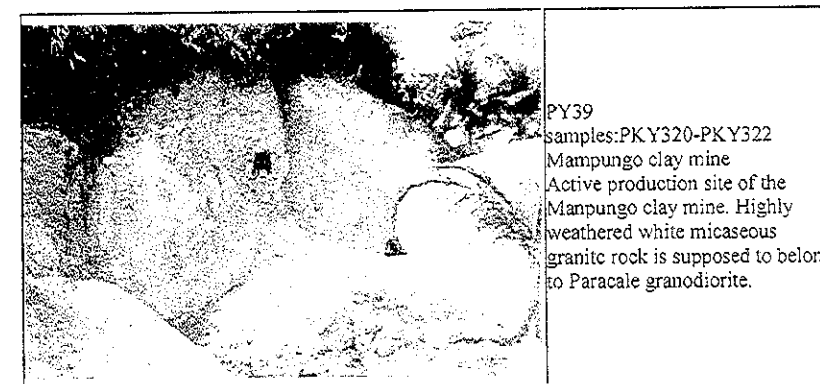
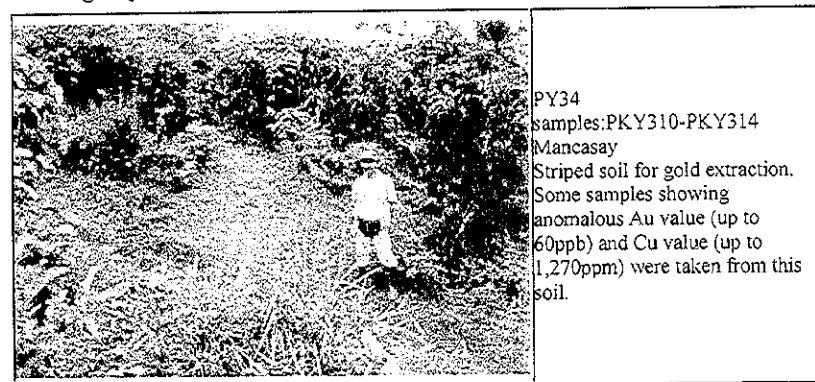
PY58
 sample: PKY339
 Capacuan mine site
 View of abandoned Capacuan pit.



PY60
 sample: PKY340
 Santa Barbara gold prospect
 View of Santa Barbara gold rush
 area. Whole area is owned by one
 owner but each hut which has one
 pit at least is been operating by
 different independent small scale
 miner team. Many huts, around
 one hundred are seen but more
 than half of them are abandoned
 at this moment.



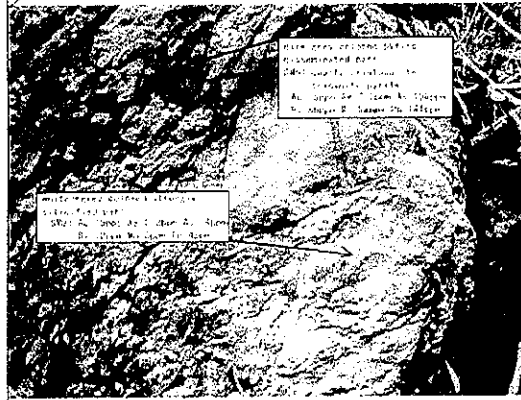
Mt. Bagacay area



Mt. Culasi area



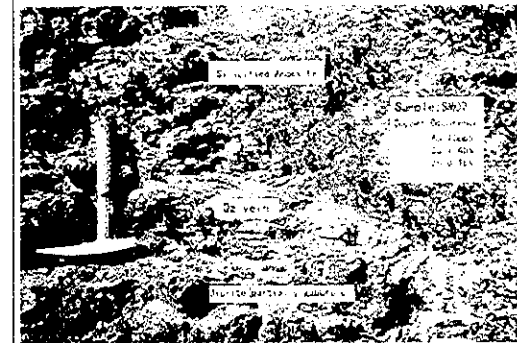
SM07
Big altered rock float at Upper Manasopre Creek



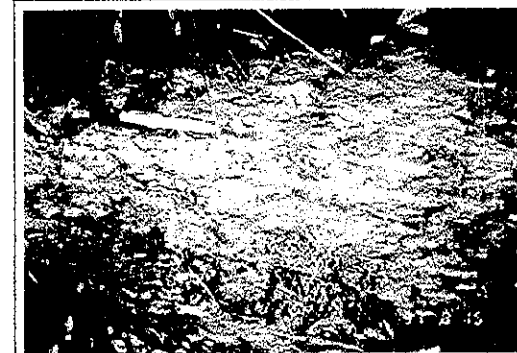
Pio Duran area



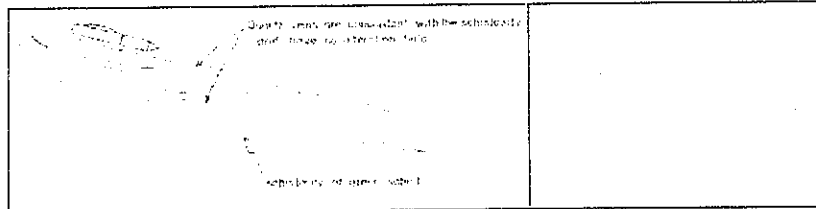
SM02
The copper occurrence in Nagas-Pio Duran Area (The outcrop at the south-eastern Catburawan)



Siruma Peninsula area



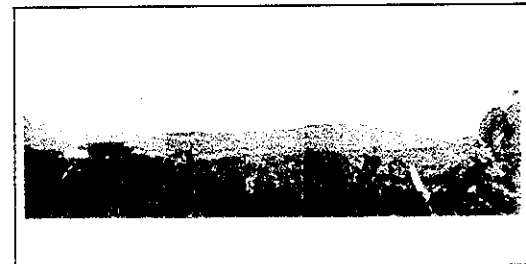
Occurrence of quartz veins in green schist in Siruma Peninsula



Tiwi-Mt. Malinao area



PH08
 Bulalacao in Caramoan Peninsula
 View of the Northwestern part of
 Tiwi-Mt. Malinao area. Looking
 south from Bulalacao in
 Caramoan Peninsula. Mt. Mayon
 can be seen on the left. Mt.
 Malinao can be seen in the center.
 At the foothill of Mt. Malinao the
 steam from Tiwi geothermal
 energy plant can be seen. Low
 relief area on the right of Mt.
 Malinao is our survey area.



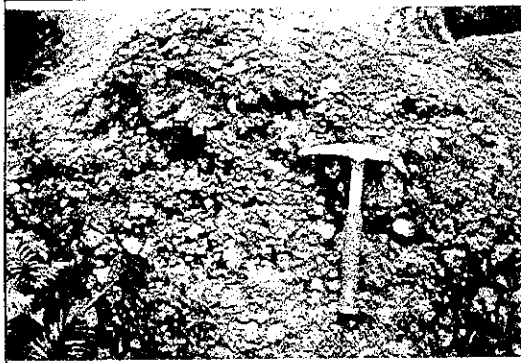
PH09
 On the south ridge of Cayohoson
 Creek View of the Northwestern
 part of Tiwi-Mt. Malinao area.
 Looking north. Thick
 vegetation. The ridges and creeks
 range toward NE direction.
 Eastern slope of Mt. Iriga and
 Lake Buhi can be seen on the left.
 see_oversize



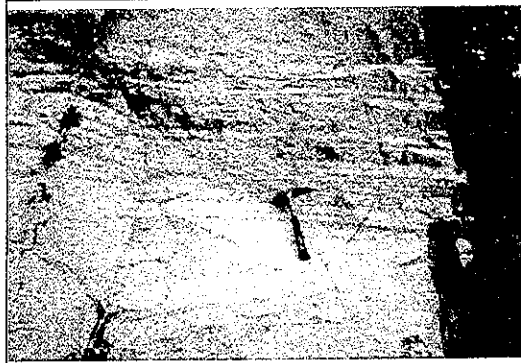
PH10
 samples: PTH274, PTH275,
 PTH276
 Upstream of Inalait River
 Chalcedonic quartz vein with
 alteration halo of mixed layer clay
 in propylitic andesite in upstream
 of Inalait River. Quartz vein is 3
 to 6mm in width and strikes
 N24°E and dips 75°E. It has no
 gold anomaly.



PH11
 sample: PTH280
 Upstream of Inalait River
 Big boulder of highly silicified
 rock in the upstream of Inalait
 River. It consists of quartz and
 minor of anatase and goethite.
 There are many silicified boulders
 in this river. It has no gold
 anomaly.



PH12
sample: PTH304
Upstream of Cayohoson Creek
Hydrothermal breccia in upstream
of Cayohoson Creek. Highly
silicified. Breccia size ranges
from 1cm to 8cm. Those are
coated by silica and limonite.
Au<5ppb, Cu:134ppm.



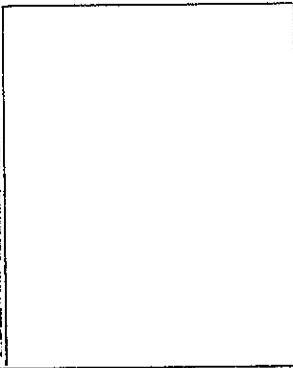
PH13
sample: PTH296
Along coast line. near Mayon
Flow banding in pyroxene-
hornblende dacite can be seen at
outcrop near Balangai Mayon. A
dark band has darker glassy
matrix than a light color band.
This dacite has many cognate
inclusions.



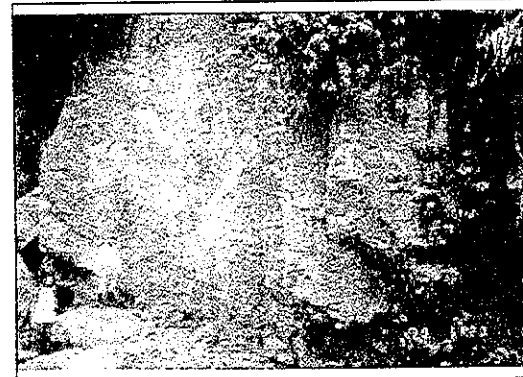
PH14
sample: PTH298
Along coast line. near Mayon
Occurrence of Hbl bearing Px
andesite near Balangai Mayon.
Columnar joints can be seen. The
rock is aphanitic and has many
vesicles. Pyroxene is
microphenocryst in size.
Hornblendes are anhedral and
completely changed to opacites.



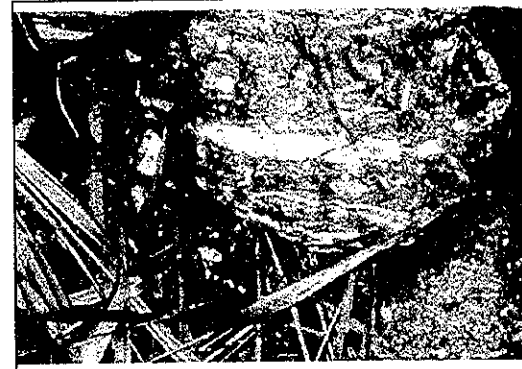
PM04, PM05
samples: PSM238a,b
Smectitized andesite occurs in a
vein-like form trending N80E, at
the Buhi lake north, Tiwi-Mount
Malinao area. Altered part
contains larger amount of
smectite and tridymite than
surrounding portion.



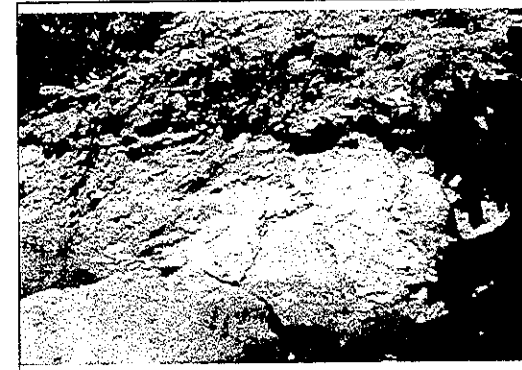
PM06
sample: PSM242
Argillic (some siliceous) alteration outcrops in the north-eastern outer rim of intensely silicified zone, north-east Tiwi-Mount Malinao area. At the outer argillic portion, cristobalite and/or tridymite are dominant silica forms, unlike quartz dominance in silicified zone. Alunite is also deficient.



PM07
sample: PSM244
Silicified wall in the north-east Tiwi - Mount Malinao area. Rocks in this wall are totally altered to intensely silicified rock. X-ray analyses describe that such silicified rock includes natroalunite.



PM08
sample: PSM261
There are some small quartz vein floats observed along the Cayohasin creek, east side of Buhi lake, Tiwi-Mount Malinao area. This boulder consists of numerous small fragments of silicified rock and a larger white quartz vein fragment with silicified host rock which densely disseminated by fine grained pyrite.



PY20
sample: PKY262
Mayong
Highly silicified outcrop. The texture of upper portion is not clear due to strong oxidation but pyrite vein lets are able to be observed in lower portion.

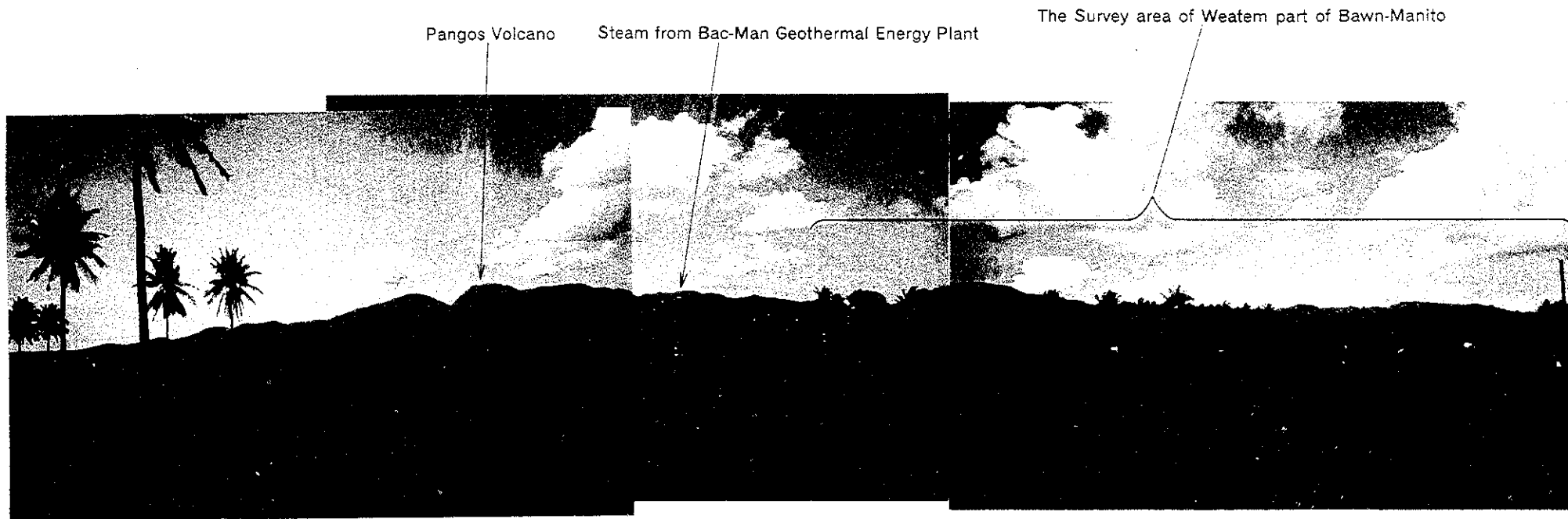


Tiwi
View of the Tiwi geothermal electricity plant, looking from sinter terrace

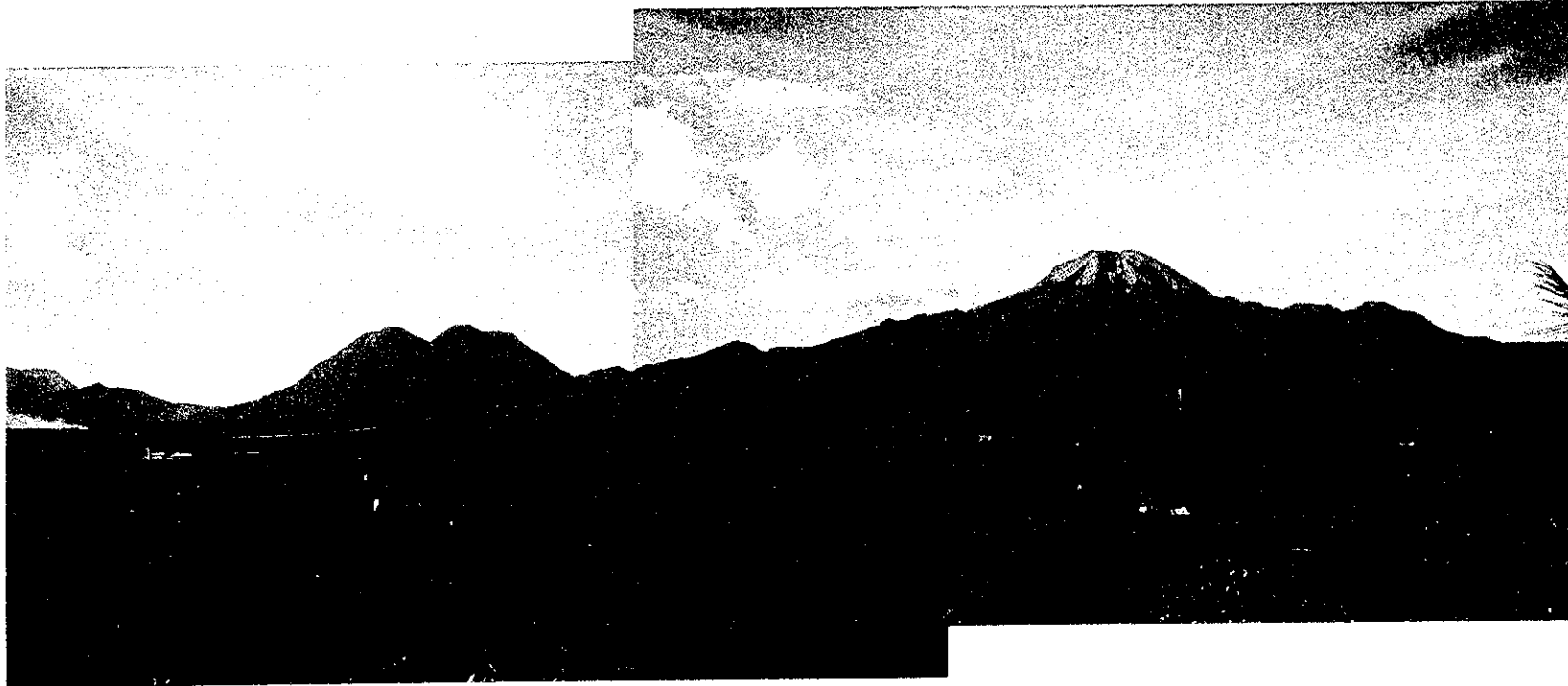


Tiwi
Occurrence of sinter cone and
sinter terrace in the Tiwi
geothermal field

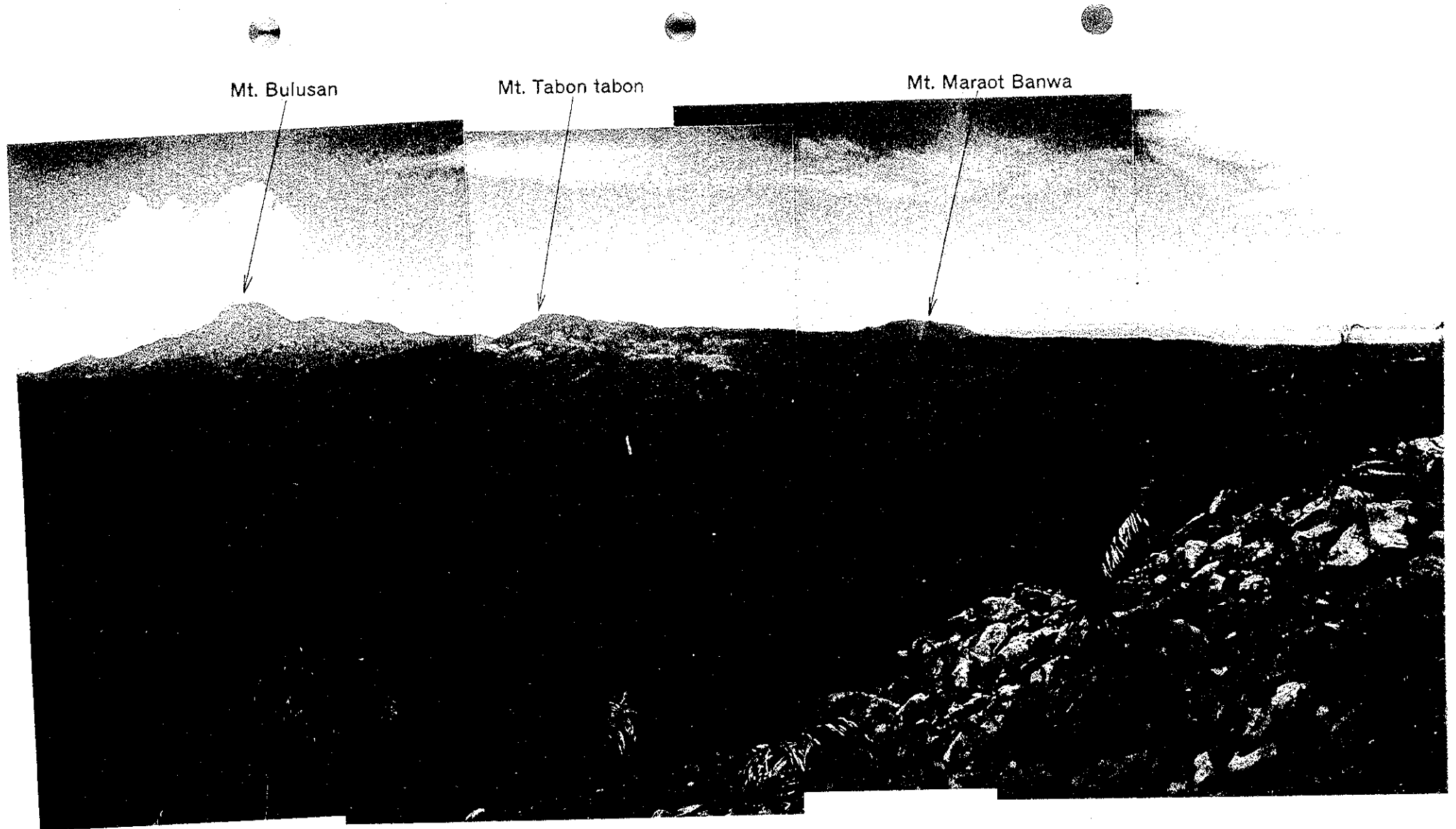
prepared by JMEC 1999 **JMEC**
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PH01 View of the Bac-Man geothermal production field and the survey area. Looking south. The survey area is located on the right of the photo. The highest dome is Pangas volcano. Bac-Man geothermal energy plant is at near skyline in the center, where we can see steams. Note that the survey area has low relief in comparison to the Bac-Man geothermal field where the volcanic topography is well-preserved..



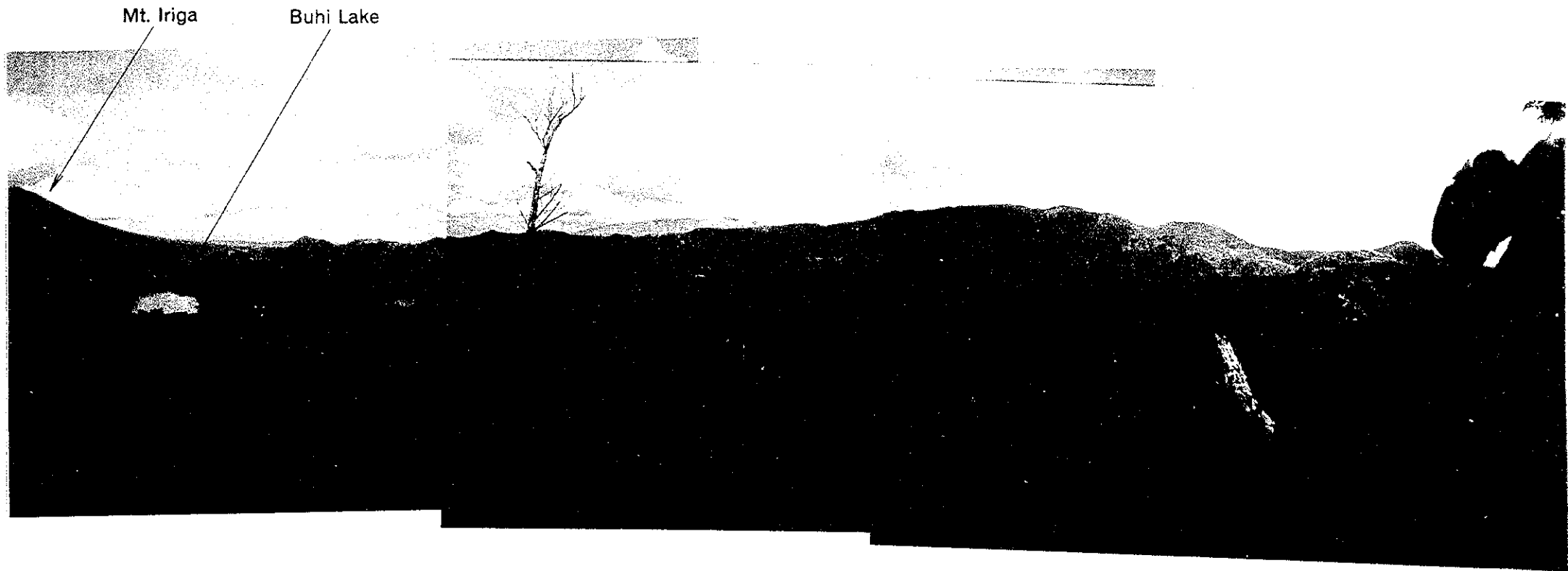
PH05 View of Bulusan volcano and Irosin Caldera from the edge of the caldera rim.
Looking north. The highest mountains is Bulusan Volcano. The steep hill on the
left is Jormajam andesite dome.



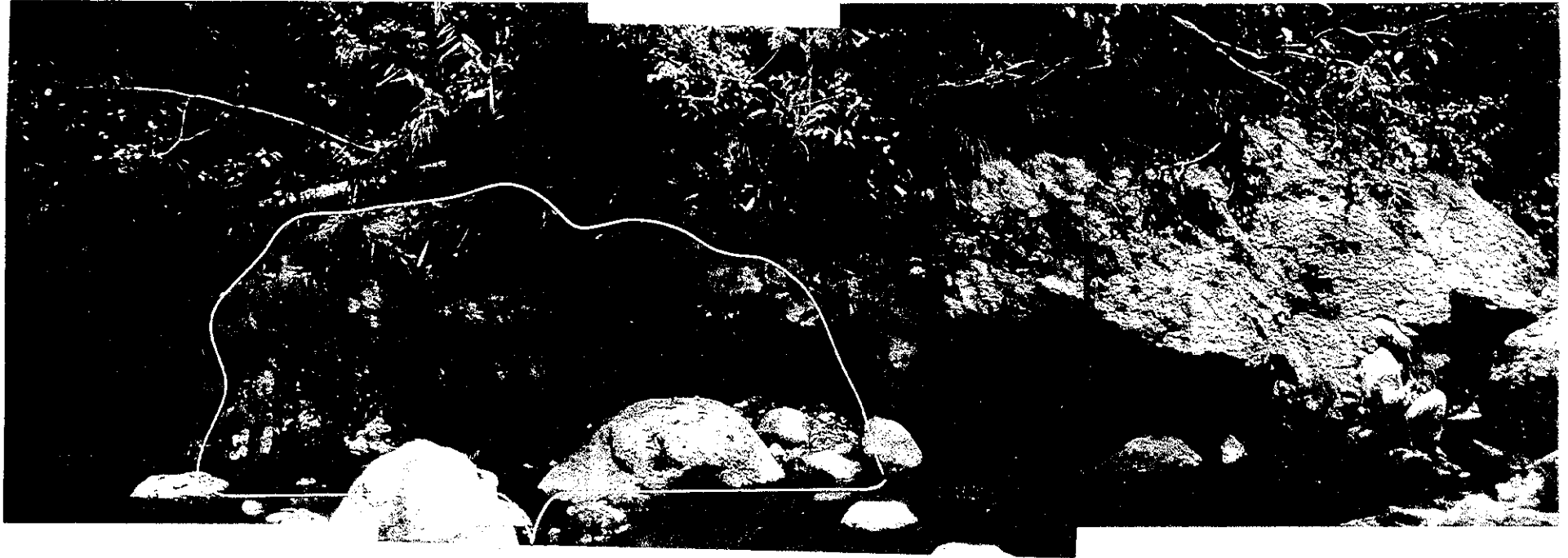
PH06 View of northern part of the Gate Mountains area from a hill in 3km northwest of Tugas. Looking north. The rock of the hill is hornblende-pyroxene andesite. Gently slopes are formed by Pre-Caldera volcanics. Bulusan Volcano and Mt. Tabontabon can be seen in the distance.



PH07 View of western part of the Gate Mountains area from the same hill as the photo 6. Looking south. The hydrothermal alteration zone are distributed in topographic low area. The ridge range NS direction.



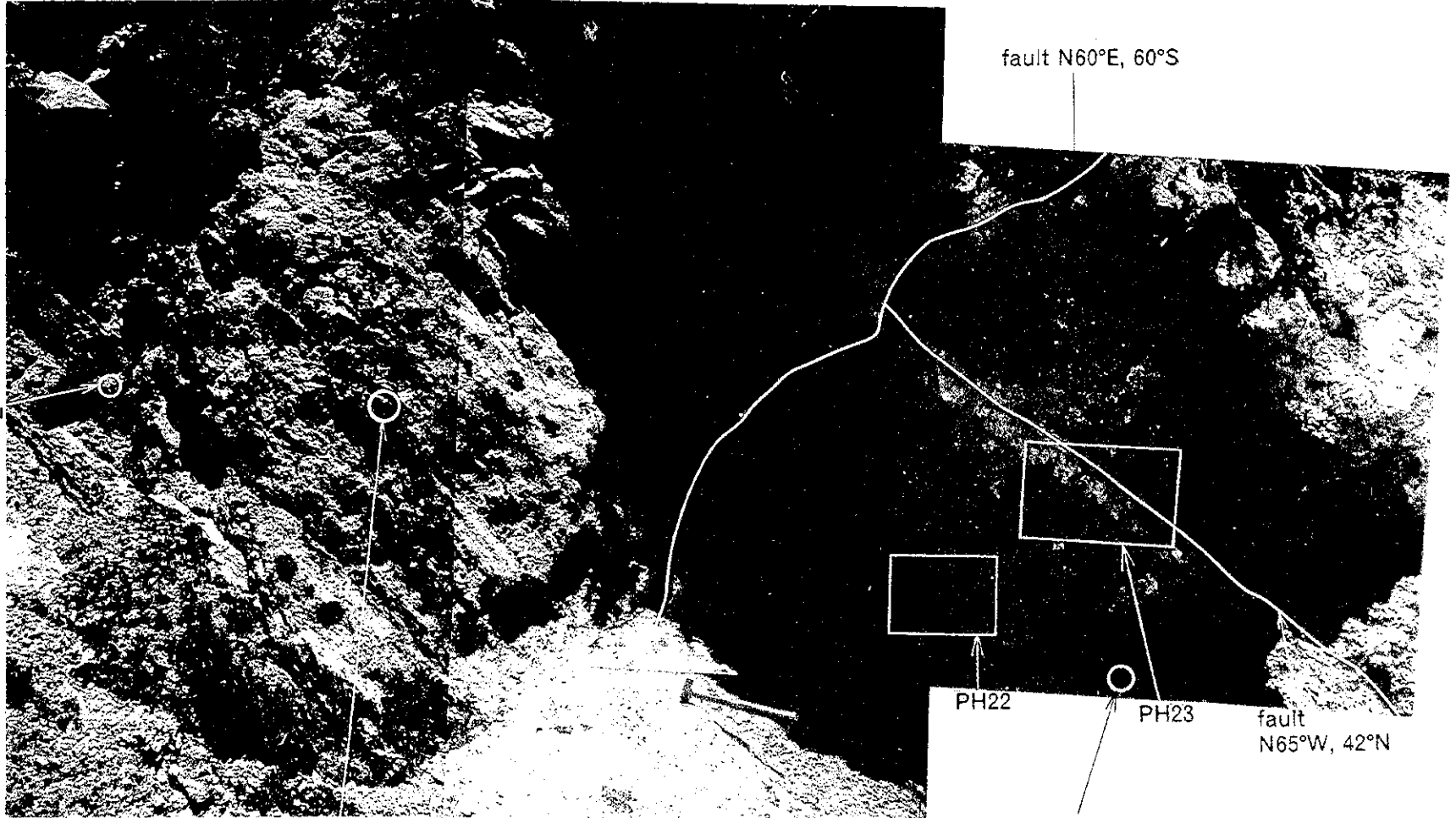
PH09 View of the Northwestern part of Tiwi-Mt. Malinao area. Looking north. Thick vegetation. The ridges and creeks range toward NE direction. Eastern slope of Mt. Iriga and Lake Buhi can be seen on the left. Most front valley is the Caychoson Creek.



hydrothermal brecciation zone

PH20 Outcrop of highly silicified alteration. Alteration zone is developed horizontally. Hydrothermal brecciation is also observed.

PTH324
 Qtz > Kln >> Alu
 Au : 45ppb
 Cu : 860ppm



Black Color chalcedonic Qtz vein
 N70 ~ 80°E, 42 ~ 50°N
 PTH325 : Qtz >>> Py, Rt, Aut, Kln
 Au : 180ppb, Cu : 868ppm, Mo : 34ppm

Light gray color vein
 N60°W, 40°S
 PTH326 : Au : 215ppb, Cu : 527ppm

fault
 N65°W, 42°N

PH21 Outcrop of kaolinite alteration. Two kinds of quartz veins are observed. One is black color veins with 0.5 to 10cm in width. Other is light gray color veins with 0.5 to 3cm in width. Black color quartz veins are chalcedonic and have metal contents of Au:180ppb, Cu:828ppm, Mo:34ppm. The black color veins consist of quartz and minor pyrite, rutile, anatase, and kaolinite in X-ray diffraction.



PH30 Open pit of the Benguet mine. Now "Base Metal Mining Corporation" has this mine. Gold bearing quartz veins were in altered the Paracale Trondhjemite. The Pit elongate along the structure of $N40^{\circ}E$ direction of major quartz vein. The town of Jose Panganiban and Larap Mine are seen on the left.