1-3-5 Mineralization and Associated Alteration

Prior to the survey, the examination of existing geological information was made. Together with discussions with geologists of DMR and other organization, mineralization targets in the survey area were set up as follows:

① Primary gold mineralization mainly in the western area.
② Massive sulphide mineralization within Miocene pyroclastic rocks in the eastern area.
③ Porphyry copper-gold mineralization in the southwestern area.

In the course of regional survey in the first phase, no positive indication of massive sulphide mineralization has been come out, even though the extensive development of Miocene dacitic to andesitic pyroclastic rocks in the eastern area. An alteration zone, which is composed of silicification and pyritization accompanying with weak sericite and/or kaoline minerals, was found in dacite lava along S. Marampa near Limbong. No indication of basemetal mineralization, however, has been detected in the zone. The possibility of porphyry copper-gold mineralization similar to the Sassak deposit was negative too in the vicinity of the Mamasa granite body in the southwestern part of the survey area.

Whereas in the northwestern area, indications of primary gold mineralization were caught at several places. Occurrences of gold in pan concentrates were counted in many places. Floats of vein quartz are relatively common in some places along S. Karama and its major tributaries. Outcrops of quartz veins were located in Bau, Batuisi, and a few other places. In the Bau and Batuisi prospects, semi-detailed geological survey and geochemical sampling were carried out.

The following descriptions are based on the results of field observations (geology and panning prospecting) and some laboratory works such as ore assay, ore microscopy, and X-ray diffraction analysis. Assay results of ore samples in each area are shown in Table 2-1-7.

(1) Bau Prospect

The Bau prospect is located along S. Salole and its tributaries in the central northern part of the survey area. It covers an area of about 50 km^2. The area, situated in one of the most inland part of the central western Sulawesi, is surrounded by steep hills and mountains of more than 1,000 m above sea level. Altitudes of the prospect are in the proximity between 460 m (at the bridge of S. Salole) and 660 m (at Kp. Bau). Access from the outer world is very difficult.

In this prospect, one continuous zone of quartz veins was delineated from the junction of S. Salole and S. Belopi up to the vicinity of Kp. Bosokan in the first phase survey. Although the width of each quartz vein is not big, no wider than 30 cm, and the continuation of each vein has yet been confirmed, the zone extends more than 2.5 km to north-northwest. Quartz veins are hosted by slate, black shale, siltstone, andesite, and basalt/dolerite of the Latimojong Formation.

Near the junction of S. Salole and S. Belopi, several quartz veins were caught at four localities during the first phase geological survey. Each vein runs N10°W to N20°W and dips 35°W to 40°W. Their widths vary from few centimeters up to 30 cm. Pyrite, arsenopyrite, chalcopyrite and sphalerite were observed in quartz veins. Chalcopyrite is replaced by malachite and covelline. Pyrite is sometimes oxidized and replaced by iron-oxide minerals (limonite). Gold has not been observed under the microscope.

Both the northern and southern extensions of the zone were inaccessible because of the steep topography.

In the northern side of S. Salole, quartz veins again appear. Outcrops of quartz veins were found at 10 localities along the footpath from the bridge of S. Salole up to Kp. Bosokan. Strikes and dips change variously. Their widths are from few centimeters to 25 cm. A small amount of pyrite and limonite was observed in quartz.

Strong silicification and pyritization were observed in metasediments and dolerite adjacent to quartz veins. According to X-ray diffraction analysis, quartz, sericite, chlorite, calcite and pyrite were detected as alteration minerals in the country rocks. At the northern end of the mineralized zone, a siliceous clay vein of 1.2 m wide occurs within shale at a small creek. This vein is composed mainly of quartz and sericite. Pyrite is disseminated in the footwall side of vein. A small amount of gypsum was detected in this vein.

A couple of other mineralized zones was found within the prospect. A quartz float zone was identified around Kp. Salupoling. A small amount of pyrite and chalcopyrite was observed in some of the quartz floats.

A silicified zone occurs in black shale near the junction of S. Salole and S. Balimbing. The black shale is strongly silicified and pyrite is disseminated in this zone.

Quartz floats are widely distributed at the upper reaches of S. Balimbing. Some of them contain pyrite. Gold and chalcopyrite were detected in pan concentrates in this zone. These floats would be originated from the surrounding mountains.

A total of 11 samples of quartz veins and quartz floats was assayed within the Bau prospect. No significant value has been obtained.

(2) Batuisi Prospect

The Batuisi prospect is located between S. Karataun and the upper reaches of S. Pongo in the northwestern part of the survey area. The area is approximately 50 km^2. The altitude of S. Karataun is 150 m above sea level (at the bridge of Kp. Batuisi). A high ridge of more than 600 m above sea level extends northwestward, dividing the prospect into two. The prospect lies geologically among the area of metasediments of the Latimojong Formation. The Mamasa granite batholith occurs at the southeastern area adjacent to the prospect. Dacite lava and volcanic breccia of the Barupu Tuffs are distributed at the high elevations, forming very steep ridges.

Three zones of quartz veins/stockworks containing sulphide minerals were found within the prospect during the first phase survey:

① Middle reaches of S. Tarawa
② Upper reaches of S. Tarawa
③ S. Malela

At the middle reaches of S. Tarawa, 13 quartz veins were found in phyllitic black shale. At the middle reaches of S. Bone, which is located about 1,500 m northwest of S. Tarawa, 6 quartz veins were found in shale. One quartz vein and several quartz float zones were recognized at the hill between the two places. Strikes of veins range from N-S to N40°W, predominantly NNW. The veins steeply dip to the west in general.

Quartz veins at the middle reaches of S. Tarawa are generally wide, from 30 cm to 2 m in width. Whereas at S. Bone, widths of veins are comparatively thin, from few centimeters up to 25 cm. Vein quartz is generally massive and shows fine- to medium-grained and slightly chalcedonic. A small amount of sulphide minerals was observed in quartz veins. These sulphide minerals tend to concentrate towards one of the wallsides. Pyrite, arsenopyrite, chalcopyrite, sphalerite, galena, malachite, covelline and limonite were identified under the microscope. Strong silicification with pyrite dissemination was observed at wallrocks around veins. A small amount of chlorite and trace of pyrophyllite were detected in the alteration zone by X-ray analysis.

At several localities of the upper reaches of S. Tarawa and S. Bone, quartz veins/stockworks occur in bluish grey shale and siltstone. Strikes of veins change from place to place. They generally have gentle dip. Widths of veins vary from few centimeters up to 2 m. Pyrite, chalcopyrite and malachite were observed in quartz veins. Silicification, pyritization, chloritization and carbonatization were identified as wallrock alteration.

Another mineralized zone occurs at the other side of the dividing ridge (Tondoratte) in the northeastern part of the Batuisi prospect. Quartz veins were found at 10 localities along S. Malela (a branch creek of S. Pongo). Veins are hosted by bluish grey shale and basalt. The trend of veins changes variously. One of the representative veins for example, which was found just below the old Bobokan place, is a massive and about 5 m thick. It has a strike direction of N70°W and 35°N dip. A small amount of sulphide minerals -- pyrite, chalcopyrite, sphalerite, covelline -- is disseminated in quartz. Gold has yet been detected under the microscope. Silicification, chloritization and pyritization were observed in the wallrocks. A small amount of calcite and pyrophyllite was also detected in the alteration zone.

Indications of gold bearing quartz mineralization were found at other localities in the prospect. At several places along S. Mate, gold and sulphide minerals were detected in pan concentrates. They are situated at the northwestern extension of the mineralized zone found at the middle reaches of S. Tarawa. In the southeastern extension of this zone at the upper reaches of S. Beranak, quartz veinlets/stockworks and quartz float zones were found.

A total of 12 samples of quartz veins and quartz floats was collected for ore assay within the Batuisi prospect in the first phase survey. The results were disappointing. No significant gold value has been returned.

(3) Other Prospects

During the regional survey, gold and heavy mineral concentrations were detected by panning prospecting along S. Petangunan and its tributaries. The distribution of quartz floats was also observed. At the upper reaches of S. Taroto, strong pyrite dissemination was found in altered basalt of the Latimojong Formation. Old alluvial diggings are located in the area, and quartz and/or limonite float zone spread in the vicinity.

Quartz float zones were found in many places along the middle reaches of S. Lebutang and S. Lelating. The geology of the area is composed of black shale and andesite lava of the Latimojong Formation. Floats of vein quartz sometimes contain a small amount of pyrite, arsenopyrite, chalcopyrite, sphalerite, and galena. Chlorite and calcite were observed in quartz as gangue minerals.

Table 2-1-4 Summary of Microscopic Observation of Thin Sections (1)

Regional Survey (Phase I)

Sample No.	Locality	Rock Name	Formation	Texture	Phenocryst/Crystal Fragment									Groundmas/Matrix						Alteration
					Qz	Kf	Pl	Bi	Hb	Px	Ol	Ep	Op	Qz	Kf	Pl	Hb	Px	Gl	
A1R	S. Uroh	Crystal Tuff	Qt	Pycl	•		△	△		•						●			○	Bi·Px→Ch
A2R	S. Uroh	Crystal-lithic Tuff	Qt	Pycl	○		○	△	•										○	Sandstone fragment
A3R	S. Marampa	Dacite	Toml	Porp	○		△	△					•	•		△			△	Pl·Bi→Ch
A5R	S. Marampa	Dacite	Toml	Porp			●	○					•	•		○			•	Pl·Bi→Ch·Ca
A6R	S. Marampa	Andesite	Toml	Porp		•	○		△				•			○	△			Pl→Ch·Se, Hb→Ch
A10R	Kariango	Andesitic Tuff	Tmt	Lepb						○				○					△	Gl→Ch
A11R	S. Bituwe	Andesite	Dyke	Porp			●		○				•			○	△			
A12R	S. Bituwe	Andesite	Tmps	Porp	•		○		○				•			△	△			Pl·Hb→Se·Ch·Ca
A13R	S. Patoko	Andesite	Tmb	Glom-gr			△		○	○						△		•		Hb·Pl→Ch
A29R	S. Karataun	Andesite	Dyke	Porp			●		△				•			△				Pl→Ch·Se·Ca, Hb→Ch
A30R	S. Karataun	Qz Porphyry	Dyke	Hypd-gr	△		●			○			•							
B1R	Salutallang	Crystal Tuff	Qt	Pycl	△		△	△											○	
B9R	S. Uroh	Andesite	Dyke	Porp			●			△			•			△				Pl→Ch·Se·Ca, Px→Ch
B10R	S. Uroh	Andesite	Dyke	Porp			●	△		△			•	△		•				
B16R	S. Balimbing	Andesite	Kl	Porp			△						•			△				Pl→Se·Ch
B21R	S. Balimbing	Dolerite	Kl	Ophi			●			○		•	•							Pl→Ch
B25R	S. Petangunan	Andesite	Kl	Porp			●									○				Pl→Ca·Ch·Ep
B27R	S. Petangunan	Andesite	Kl	Porp			△			•			•			○				Pl→Se, Lithic frag
B30R	S. Taroto	Dolerite	Kl	Ophi			●		●			△	•							Qz vein
B31R	S. Taroto	Dolerite	Kl	Ophi			●		●				•							

Abundance of Minerals: ●;Abundant, ○;Common, △;Rare, •;Trace

Formation Names : Mw;Batuan Malihan metamorphic rocks, Kl;Latimojong Formation, Tet;Toraja Formation, Toml;Lamasi Volcanic Rocks, Tmb;Beropa Tuffs, Tmps;Sekala Formation, Tmt;Talaya Volcanic Rocks, Qt;Barupu Tuffs, Tmk;Kambuno granite, Tmg;Mamasa granite Tmd;Diorite, Kv;Andesite (volcanic neck), Tv;Andesite (dyke)

Textures : Pycl;Pyroclastic, Porp;Porphyritic, Lepb;Lepidoblastic, Glom-gr;Glomerophyric granular, Hypd-gr;Hypidiomorphic-granular Ophi;Ophitic, Int-gr;Inter-granular, Hol-gr;Holocrystalline-granular, Altm-gr;Allotriomorphic-granular

Minerals : Qz;Quartz, Kf;Potash feldspar, Pl;Plagioclase, Bi;Biotite, Hb;Hornblende, Px;Pyroxene, Ol;Olivine, Ep;Epidote, Op;Opaque

Table 2-1-4 Summary of Microscopic Observation of Thin Sections (2)

Regional Survey (Phase I)

Sample No.	Locality	Rock Name	Formation	Texture	Phenocryst/Crystal Fragment									Groundmas/Matrix						Alteration
					Qz	Kf	Pl	Bi	Hb	Px	Ol	Ep	Op	Qz	Kf	Pl	Hb	Px	Gl	
B35R	S. Lebutang	Basalt	Kl	Int-gr			●			○			•			△				
C4R	S. Rasasisi	Andesite	Toml	Porp			●		△							△				
C7R	S. Rasasisi	Andesite	Toml	Porp			●						•			△				Pl→Ch
C8R	S. Rasasisi	Dacite	Qt	Porp	△	△	△	△					•			△				
C9R	S. Marampa	Dacite	Toml	Porp	△		△									○				Pl→Se
C10R	S. Marampa	Andesite	Toml	Porp			●			△			•			△			△	Pl→Ch
C11R	S. Marampa	Qz Porphyry	Toml	Porp	△	△	•	○					•	○						
C12R	S. Marampa	Qz Monzonite	Tmk	Hypd-gr	△	○	○	△	△				•							
C13R	S. Kakea	Diorite	Tmk	Hypd-gr			●		•	△			•							
C14R	S. Kakea	Andesitic Tuff	Tmt	Pycl			△			△			•			△				Pl→Ch
C15R	S. Kakea	Andesite	Tmt	Porp			●			△			•			•			△	Px→Ch·Ca
C17R	S. Kakea	Andesite	Tmt	Glom-gr			●			△						○			△	
C23R	S. Bituwe	Granodiorite	Tmk	Porp			○	△					•	△		△				Pl→Ca
C24R	S. Bituwe	Granodiorite	Tmk	Hypd-gr			●	△		○			•	•		•				
C30R	S. Salore	Basalt	Kl	Int-gr			△			•						•				Pl·Px→Ch
C31R	S. Maki	Qz Monzonite	Tmg	Hypd-gr	○	●	○	△	△											
C32R	S. Maki	Dacite	Qt	Porp			●	△		△				•		△				
C34R	S. Karate	Qz Monzonite	Tmg	Hypd-gr	•	○	●	△	△											
C36R	S. Karataun	Qz Monzonite	Tmg	Hypd-gr	△	●	○	△	△											
C37R	S. Karataun	Pyroxenite	Dyke	Hol-gr	•					○			•							Px→Ch

Abundance of Minerals: ●;Abundant, ○;Common, △;Rare, •;Trace

Formation Names : Mw;Batuan Malihan metamorphic rocks, Kl;Latimojong Formation, Tet;Toraja Formation, Toml;Lamasi Volcanic Rocks, Tmb;Beropa Tuffs, Tmps;Sekala Formation, Tmt;Talaya Volcanic Rocks, Qt;Barupu Tuffs, Tmk;Kambuno granite, Tmg;Mamasa granite Tmd;Diorite, Kv;Andesite (volcanic neck), Tv;Andesite (dyke)

Textures : Pycl;Pyroclastic, Porp;Porphyritic, Lepb;Lepidoblastic, Glom-gr;Glomerophyric granular, Hypd-gr;Hypidiomorphic-granular Ophi;Ophitic, Int-gr;Inter-granular, Hol-gr;Holocrystalline-granular, Altm-gr;Allotriomorphic-granular

Minerals : Qz;Quartz, Kf;Potash feldspar, Pl;Plagioclase, Bi;Biotite, Hb;Hornblende, Px;Pyroxene, Ol;Olivine, Ep;Epidote, Op;Opaque minerals, Gl;Glass, Ch;Chlorite, Se;Sericite, Ca;Carbonates

Table 2-1-4 Summary of Microscopic Observation of Thin Sections (3)

Regional Survey (Phase I)

Sample No.	Locality	Rock Name	Formation	Texture	Phenocryst/Crystal Fragment									Groundmas/Matrix						Alteration
					Qz	Kf	Pl	Bi	Hb	Px	Ol	Ep	Op	Qz	Kf	Pl	Hb	Px	Gl	
D7R	S. Uroh	Andesite	Tmt	Porp			●			○			•			○		•	△	
D8R	S. Uroh	Andesite	Tmb	Porp			●	△		○			•			○		•	△	
D11R	S. Kasimpo	Basalt	Tmb	Int-gr			●			●	△		•			△		△		
D12R	S. Kasimpo	Granodiorite Porphyry	Dyke	Porp			●		△				•			△				Pl·Hb→Ch
D13R	S. Kasimpo	Andesitic Tuff	Tmb	Pycl			○						•			△				Lithic fragment
D18R	Kp. Bau	Andesite	Dyke	Porp			●		△				•			△	•			Pl·Hb→Ch
D24R	S. Karataun	Pyroxenite	Dyke	Hol-gr						△										Px→Ch, Qz vein
D25R	S. Matena	Biotite Gneiss	Mw	Lepb	●		○	○	○				•							
D26R	S. Matena	Aplite	Tmg	Altm-gr	○	●	○	△												
D27R	S. Matena	Qz Monzonite	Tmg	Hypd-gr	△	●	●	△	△											
D29R	S. Matena	Granodiorite Porphyry	Dyke	Hypd-gr			●	△		△						•				
D31R	S. Matena	Qz Diorite	Tmg	Porp	△		△	△								•				
D38R	S. Tarawa	Gabbro	Dyke	Porp			●			○	△		•			•				
D40R	S. Tarawa	Diorite	Tmg	Hypd-gr			●			○			•							Qz vein
D44R	S. Tarawa	Dolerite	Kl	Ophi		●	●			•			•							Kf·Pl→Ch
E1R	S. Rongkong	Qz Monzonite	Tmk	Hypd-gr	△	●	○	△												
E2R	S. Rongkong	Qz Monzonite	Tmk	Hypd-gr	△	○	●	△												
E3R	S. Rongkong	Qz Monzonite	Tmk	Hypd-gr	△	○	●	△	•											
E5R	S. Rongkong	Qz Monzonite	Tmk	Hypd-gr	○	○	●	•	•											Pl→Ch
E7R	S. Rongkong	Qz Monzonite	Tmk	Hypd-gr	△	•	●	△		△										

Abundance of Minerals: ●;Abundant, ○;Common, △;Rare, •;Trace

Formation Names : Mw;Batuan Malihan metamorphic rocks, Kl;Latimojong Formation, Tet;Toraja Formation, Toml;Lamasi Volcanic Rocks, Tmb;Beropa Tuffs, Tmps;Sekala Formation, Tmt;Talaya Volcanic Rocks, Qt;Barupu Tuffs, Tmk;Kambuno granite, Tmg;Mamasa granite Tmd;Diorite, Kv;Andesite (volcanic neck), Tv;Andesite (dyke)

Textures : Pycl;Pyroclastic, Porp;Porphyritic, Lepb;Lepidoblastic, Glom-gr;Glomerophyric granular, Hypd-gr;Hypidiomorphic-granular Ophi;Ophitic, Int-gr;Inter-granular, Hol-gr;Holocrystalline-granular, Altm-gr;Allotriomorphic-granular

Minerals : Qz;Quartz, Kf;Potash feldspar, Pl;Plagioclase, Bi;Biotite, Hb;Hornblende, Px;Pyroxene, Ol;Olivine, Ep;Epidote, Op;Opaque minerals, Gl;Glass, Ch;Chlorite, Se;Sericite, Ca;Carbonates

Table 2-1-4 Summary of Microscopic Observation of Thin Sections (4)

Regional Survey (Phase I)

Sample No.	Locality	Rock Name	Formation	Texture	Phenocryst/Crystal Fragment									Groundmas/Matrix						Alteration
					Qz	Kf	Pl	Bi	Hb	Px	Ol	Ep	Op	Qz	Kf	Pl	Hb	Px	Gl	
E9R	S. Punti	Qz Monzonite	Tmk	Hypd-gr	○	●	●	△												
E13R	S. Rongkong	Aplite	Tmk	Altm-gr	○	●	△	•							△					
E23R	S. Malas	Diorite	Tmg	Hypd-gr			●	•	•	○										Pl•Px→Ch
E24R	S. Salole	Granodiorite	Tmg	Porp			●	△		△		△				△				Pl→Ch
E43R	S. Pongo	Diorite	Tmg	Hypd-gr			●			•										
E44R	S. Pongo	Andesite	Dyke	Porp			●	△	△							△				Pl→Ch
E54R	S. Pongo	Shale	Kl	Clastic	○								△							
E55R	S. Pongo	Shale	Kl	Clastic			△													Andesite fragment
E69R	S. Malela	Dolerite	Kl	Ophi			●			●										Pl•Px→Ch
F37R	S. Kalutun	Diorite	Tmg	Hypd-gr			●			△			•							Pl→Se•Ch

Abundance of Minerals: ●;Abundant, ○;Common, △;Rare, •;Trace

Formation Names : Mw;Batuan Malihan metamorphic rocks, Kl;Latimojong Formation, Tet;Toraja Formation, Toml;Lamasi Volcanic Rocks, Tmb;Beropa Tuffs, Tmps;Sekala Formation, Tmt;Talaya Volcanic Rocks, Qt;Barupu Tuffs, Tmk;Kambuno granite, Tmg;Mamasa granite Tmd;Diorite, Kv;Andesite (volcanic neck), Tv;Andesite (dyke)

Textures : *Pycl;Pyroclastic, Porp;Porphyritic, Lepb;Lepidoblastic,* Glom-gr;Glomerophyric granular, Hypd-gr;Hypidiomorphic-granular Ophi;Ophitic, Int-gr;Inter-granular, Hol-gr;Holocrystalline-granular, Altm-gr;Allotriomorphic-granular

Minerals : Qz;Quartz, Kf;Potash feldspar, Pl;Plagioclase, Bi;Biotite, Hb;Hornblende, Px;Pyroxene, Ol;Olivine, Ep;Epidote, Op;Opaque minerals, Gl;Glass, Ch;Chlorite, Se;Sericite, Ca;Carbonates

Table 2-1-4 Summary of Microscopic Observation of Thin Sections (5)

Semi-Detailed Survey (Phase II)

Sample No.	Locality	Rock Name	Formation	Texture	Phenocryst/Crystal Fragment Qz	Kf	Pl	Bi	Hb	Px	Ol	Ep	Op	Groundmas/Matrix Qz	Kf	Pl	Hb	Px	Gl	Alteration
LEB1T	S. Lebutang	Trachy-andesite	Kv	Hol(fine)	•	△	△		●			•	•							Pl•Kf•Hb→Ch, Py-diss
LEB2T	S. Lebutang	Microdiorite	Tmg	Hypd-gr.			●		●	△		•	•			△				Pl•Hb→Ch•Se
LEB3T	S. Lebutang	Phyllite	Kl	Clastic	○			●					•			•				CH, Qz-veinlet
LEB4T	S. Lebutang	Siltstone	Kl	Clastic	○		△	○					•			•				Ch, Qz-veinlet, Py
LEB5T	S. Lebutang	Granite	Tmg	Hypd-gr.	△	●	•	△	△	•										Kf•Pl→Ch•Se
LEB8T	S. Lebutang	Andesite	Kv	Porp			○		△	•			•			○				Pl•Hb→Ch•Se
LEC12T	S. Peko	Qz•Ep vein	-	Fractured	●							○	•							
LED12T	S. Petangunan	Dacite	Qt	Porp	△		●		△	△			•			○	•	•		Pl→Ch
LED14T	S. Petangunan	Andesite	Klv	Brecciated			○			△						△			•	Pl•Px→Se•Ca
LED24T	S. Petangunan	Tuff breccia	Klv	Clastic		△	○			△		•		•		△				Pl→Ch
LED26T	S. Piku	Granite	Tmg	Hol-gr.	△	●	•	•	△				•							Kf→Ch•Se
LED28T	S. Malolo	Andesite	Qt	Porp			●		○	○			•			○	•	•		Px•Hb→Ch
KAD1T	S. Uroh	Tuffaceous sandstone	Tmb	Clastic	•	•	○					•	•			•				
KAD3T	S. Uroh	Andesite	Tv	Porp			●	△	•				•			○				Pl•Hb→Se•Ch
KAD8T	S. Kariango	Granodiorite	Tmg	Porp			●	△	•	•				•		○				Pl→Qz•Se•Ca, Px→Ch
KAD12T	S. Uroh	Andesite	Tmv	Brecciated			○	•		•						△			•	Pl→Se•Ch
KAG2T	S. Ruruh	Diorite porphyry	Tmd	Porp			△			○			•			○		•		Px•Pl→Ch•Ca
KAH7T	S. Kanan	Granodiorite	Tmg	Porp			●	△		△			•			○	•	•		Pl→Se•Ch•Ca
KAH9T	S. Kanan	Granodiorite	Tmg	Porp			○					•	•	•	△	○				Pl→Se•Ca
BAC16T	S. Salubongi	Qz vein	-		●	△														Kf→Se, Qz-veinlet

Abundance of Minerals: ●;Abundant, ○;Common, △;Rare, •;Trace

Formation Names : Mw;Batuan Malihan metamorphic rocks, Kl;Latimojong Formation, Tet;Toraja Formation, Toml;Lamasi Volcanic Rocks, Tmb;Beropa Tuffs, Tmps;Sekala Formation, Tmt;Talaya Volcanic Rocks, Qt;Barupu Tuffs, Tmk;Kambuno granite, Tmg;Mamasa granite Tmd;Diorite, Kv;Andesite (volcanic neck), Tv;Andesite (dyke)

Textures : Pycl;Pyroclastic, Porp;Porphyritic, Lepb;Lepidoblastic, Glom-gr;Glomerophyric granular, Hypd-gr;Hypidiomorphic-granular Ophi;Ophitic, Int-gr;Inter-granular, Hol-gr;Holocrystalline-granular, Altm-gr;Allotriomorphic-granular

Minerals : Qz;Quartz, Kf;Potash feldspar, Pl;Plagioclase, Bi;Biotite, Hb;Hornblende, Px;Pyroxene, Ol;Olivine, Ep;Epidote, Op;Opaque minerals, Gl;Glass, Ch;Chlorite, Se;Sericite, Ca;Carbonates

Table 2-1-4 Summary of Microscopic Observation of Thin Sections (6)

Drilling (Phase Ⅱ)

Sample No.	Locality	Rock Name	Forma-tion	Texture	Phenocryst/Crystal Fragment									Groundmas/Matrix						Alteration
					Qz	Kf	Pl	Bi	Hb	Px	Ol	Ep	Op	Qz	Kf	Pl	Hb	Px	Gl	
BD1-14T	MJT-1 57.28m	Qz vein	-	Fractured	●								•							Se•Ch•Op in matrix
BD1-22T	MJT-1 69.45m	Qz vein	-	Fractured	●								•							Se in micro-frac
BD1-26T	MJT-1 72.90m	Qz vein	-	Fractured	●	•							•							Ch in matrix
BD2-26T	MJT-2 39.90m	Qz stockwork	-		○								•							Silicified
BD3-13T	MJT-3 52.00m	Andesitic tuff	Kl	Clastic	○		△													Se•Ch in matrix, Qz veinlet
BD3-25T	MJT-3 15.15m	Qz veinlet	-		○	•							•							Se•Ch in matrix
BD4-22T	MJT-4 62.85m	Tuffaceous shale	Kl	Clastic	○								•							Qz•Se•Ch crosscut by Ca-Qz-Ch veinlet
BD5-3T	MJT-5 47.20m	Qz vein	-	Fractured	●								•							Se•Ch in matrix

Drilling (Phase Ⅲ)

Sample No.	Locality	Rock Name	Forma-tion	Texture	Qz	Kf	Pl	Bi	Hb	Px	Ol	Ep	Op	Qz	Kf	Pl	Hb	Px	Gl	Alteration
BD6-10T	MJT-6 109.65m	Qz vein	-	Fractured	●								•							Ch-Ca as veinlet
BD6-28T	MJT-6 135.70m	Qz veinlet	-	Fractured	●								•							Ch-Ca as veinlet
BD7-15T	MJT-7 91.20m	Qz stockwork	-	Fractured	●							•	•							Ch in matrix
BD7-31T	MJT-7 172.23m	Qz stockwork	-	Fractured	●								•							Ch-Ca as veinlet
BD8-19T	MJT-8 126.60m	Andesite	Kl	Hol	○		•						•							Crosscut by Qz-Ca-Op veinlet
BD9-1T	MJT-9 8.55m	Andesite Py spotted	Kl	Hol	△		•						•							Se-Ch crosscut by Qz-Ca veinlet

Abundance of Minerals: ●;Abundant, ○;Common, △;Rare, •;Trace

Formation Names : Mw;Batuan Malihan metamorphic rocks, Kl;Latimojong Formation, Tet;Toraja Formation, Toml;Lamasi Volcanic Rocks, Tmb;Beropa Tuffs, Tmps;Sekala Formation, Tmt;Talaya Volcanic Rocks, Qt;Barupu Tuffs, Tmk;Kambuno granite, Tmg;Mamasa granite Tmd;Diorite, Kv;Andesite (volcanic neck), Tv;Andesite (dyke)

Textures : Pycl;Pyroclastic, Porp;Porphyritic, Lepb;Lepidoblastic, Glom-gr;Glomerophyric granular, Hypd-gr;Hypidiomorphic-granular Ophi;Ophitic, Int-gr;Inter-granular, Hol-gr;Holocrystalline-granular, Altm-gr;Allotriomorphic-granular

Minerals : Qz;Quartz, Kf;Potash feldspar, Pl;Plagioclase, Bi;Biotite, Hb;Hornblende, Px;Pyroxene, Ol;Olivine, Ep;Epidote, Op;Opaque minerals, Gl;Glass, Ch;Chlorite, Se;Sericite, Ca;Carbonates

Table 2-1-5 Summary of X-Ray Diffraction Analysis (1)

Regional Survey (Phase I)

Sample No.	Remarks	Rock Unit	Locality	Clay Minerals							Sulfates			Carbonates			Silicates			Feldspar		Miscellaneous Minerals					
				Mo	Ch	Se	Mu	Ka	Ha	Mx	Al	Gy	Ja	Ca	Ak	Si	Cr	Tr	Qz	Pl	Kf	Py	Go	He	Im	Ho	At
A4R	Altered andesite		S. Marampa			○													◎			△					
A6R	ditto		S. Marampa			△		•							•				◎	○	△						
A16R	Argillaceous shale		S. Salole			△		△											◎	○	•	△					
A17R	ditto		S. Salole																◎	○							
A27R	White argillaceous rock		Kp. Bau			△						•							◎	△	△	△?					
A39R	Wall rock of Qz vein		S. Tarawa		○									•	△				○	◎							
B7R	Qz vein		S. Uroh																◎		△	△					
B13R	Altered andesite		S. Balimbing		•														◎								
B17R	Qz vein		S. Balimbing			•?									△				◎	•		•					
B18R	Gray altered andesite		S. Balimbing		△	•								•					◎	○		△					
B19R	ditto		S. Balimbing		△									△					◎	◎		•					
B20R	ditto		S. Balimbing		○										•				○	○		•					
B28R	Qz vein		S. Lebutang											•					◎	•		○					
B28AR	Green altered andesite		S. Lebutang		○									•					◎	○	•	○					
B33R	Qz vein		S. Taroto		△														•	○							
B34R	Wall rock of Py vein		S. Lebutang									•							○			○					
B36R	Qz vein		S. Lelating		○														△	○							
B37R	ditto		S. Lelating		△									△					○								
B38R	Country rock of bedded Py		S. Bone			•		△						○					◎	○		○					
B46R	Wall rock of Qz vein		Ridg of Bone		○														○								
C1R	Altered porphyritic dacite		S. Rasasisi		○	△								△					◎	○	○	△					
C2R	ditto		S. Rasasisi		△	•													◎	○	○						
C3R	ditto		S. Rasasisi		○	•													◎	◎	○						
C6R	Silicified rock with Py		S. Rasasisi			•													○								
C10R	Wall rock of Py veinlets		S. Marampa			△		○											◎	•	•						
C19R	Qz vein		S. Kakea																◎		•						
C20R	Silicified rock		S. Kakea																◎		△						
C21R	Qz veinlets		S. Kakea																◎								

Abundance of Minerals: ◎;Abundant, ○;Common, △;Few, •;Rare

Abbreviations : Mo;Montmorillonite, Ch;Chlorite, Se;Sericite, Mu;Muscovite, Ka;Kaoline, Mx;Mixed layer, Ha;Halloysite, Al;Alunite, Gy;Gypsum, Ja;Jarosite Ca;Calcite, Ak;Ankerite, Si;Siderite, Cr;α-Cristobalite, Tr;Toridymite, Qz;Quartz, Pl;Plagioclase, Kf;Potash feldspar, Py;Pyrite Go;Goethite, He;Hematite, Im;Ilmenite, Ho;Hornblende, At;Anatase

Table 2-1-5 Summary of X-Ray Diffraction Analysis (2)

Regional Survey (Phase I)

Sample No.	Remarks	Rock Unit	Locality	Clay Minerals							Sulfates			Carbonates			Silicates			Feldspar		Miscellaneous Minerals					
				Mo	Ch	Se	Mu	Ka	Ha	Mx	Al	Gy	Ja	Ca	Ak	Si	Cr	Tr	Qz	Pl	Kf	Py	Go	He	Im	Ho	At
C26R	Wall rock of Py vein		S. Belopi		○									△					◎								
C27R	ditto		S. Belopi		○														◎								
C29R	Qz vein		S. Salore		△	•?								•	○				◎	•	•	○					
E20R	ditto		S. Bituwe											○	○				△					△			
E21R	Gray argillaceous rock		S. Bituwe			•?								◎					△	•							
E22R	Green argillaceous rock		S. Bituwe	○															○	◎		△					
E36R	Qz vein		S. Bosokan																◎								
E38R	ditto		Kp. Bau		•														◎	○							
E45R	ditto		S. Pongo					△						◎	△				○								
E50R	Altered tuff		S. Malela		○									•?					△	◎	△						
E51R	Qz vein		S. Malela		△									△					◎	△							
E52R	ditto		S. Malela		•									•?					◎								
E64R	Silicified rock with Py		S. Malela		△														◎			•					
F13R	White argillaceous granite		S. Paku		○	△								△					◎	◎	◎						
F14R	ditto		S. Paku		○	△								○					◎	◎	◎						
F15R	ditto		S. Paku		○	•								△					◎	○	△						
F16R	ditto		S. Paku		○	•													◎	◎	○						
F20R	Altered porphyritic rock		S. Paku			△		○											◎		○						
F31R	Limestone with Py		S. Salole											◎					△	•		•					
F33R	Green altered rock		S. Salole		○	△								○					○	◎							
F35R	Qz vein		S. Salole											◎					◎								
F37R	Green altered diorite		S. Kalutun		○										•?					◎							
G5R	Gray silicified rock		Kp. Buakayu																◎		•						

Abundance of Minerals: ◎;Abundant, ○;Common, △;Few, •;Rare

Abbreviations : Mo;Montmorillonite, Ch;Chlorite, Se;Sericite, Mu;Muscovite, Ka;Kaoline, Mx;Mixed layer, Ha;Halloysite, Al;Alunite, Gy;Gypsum, Ja;Jarosite
Ca;Calcite, Ak;Ankerite, Si;Siderite, Cr;α-Cristobalite, Tr;Toridymite, Qz;Quartz, Pl;Plagioclase, Kf;Potash feldspar, Py;Pyrite
Go;Goethite, He;Hematite, Im;Ilmenite, Ho;Hornblende, At;Anatase

Table 2-1-5 Summary of X-Ray Diffraction Analysis (3)

Detailed Survey (Phase Ⅱ)

Sample No.	Remarks	Rock Unit	Locality	Clay Minerals							Sulfates			Carbonates			Silicates			Feldspar		Miscellaneous Minerals					
				Mo	Ch	Se	Mu	Ka	Ha	Mx	Al	Gy	Ja	Ca	Ak	Si	Cr	Tr	Qz	Pl	Kf	Py	Go	He	Im	Ho	At
BAA1X	Footwall(shale) of Qz vein	Kl	Old Dutch Pit		○														◎	△							
BAA5X	Hangingwall(shale) of Qz vein	Kl	Old Dutch Pit		△														◎	◎							
BAA59X	Qz stockwork in andesite	—	T-2, 78.0m					○									△		◎					·?			
BAA78X	Qz stockwork	—	T-1, 23.5~27.0m		△										·				◎				·?				
BAA82X	Qz stockwork	—	T-2, 76.3~79.7m					○											◎					·			
BAA83X	Qz stockwork	—	T-3, 36.7~40.0m					△											◎		·?						·?
BAA87X	Andesite	Kl	T-4, 77.7~78.7m			△		·											◎								△
BAA96X	Silicified zone	—	T-4, 112.0m		·														◎	○							
I44X	Qz vein in andesite	—	T-4, 107.5m																◎	·?							
I45X	Silicified zone in andesite	—	T-4, 112.0m																◎	○							
I47X	Silicified zone in andesite	—	T-4, 117.5m																◎		·?	·?					
BTC2X	Qz stockwork	—	T-1, 18.5m					△											○								△
BAB1X	Brown, soft saprolite	Kv	S.Balimbing	○				·											○	◎							
BAB2X	Qz vein with calcite	-	S.Balimbing											△	◎				○								
BAB4X	Brown, soft, limonitic	Kv	S.Mariku																○				△	△			
BAB6X	Qz vein, Py-diss	—	S.Balimbing					△						·?	◎				◎	△							
BAC95X	Silicified dyke rock	Tmd	S.Bau			△		·							○				◎	○		·					
BAC16X	Qz vein	—	S.Salubongi			·								○					◎								
BAD8X	Qz vein in andesite	Kl	S.Belopi		○									△					○	○	·?					·?	
BAF1X	Altered, silicified rock	Kl	S.Lipak	○				·											○	○							
BAF2X	Brown, soft saprolite	Kl	S.Balimbing	·				△											◎	◎							
BAF3X	Brown, limonitic	Kl	S.Balimbing	○				·											○	◎							
BAF1X	Qz veinlet in white rock	—	S.Lipak			○		△											◎	○		·					
LEB1X	Argillaceous andesite	Kv	S.Taroto		○															○						◎	
LEB5X	Saprolite/alluvial	Kv	S.Taroto					△			·?								○		○				·?		
LEB17X	Wall rock of shear zone	Kv	S.Taroto		○														△	○						◎	
LEC1X	Wall rock of Qz-Ca vein	Kl	S.Peko		○															◎	△					○	
LEC6X	Country rock of bedded Py	Kl	S.Talang		○														○	◎							

Abundance of Minerals: ◎;Abundant, ○;Common, △;Few, · ;Rare

Abbreviations : Mo;Montmorillonite, Ch;Chlorite, Se;Sericite, Mu;Muscovite, Ka;Kaoline, Mx;Mixed layer, Ha;Halloysite, Al;Alunite, Gy;Gypsum, Ja;Jarosite
Ca;Calcite, Ak;Ankerite, Si;Siderite, Cr;α-Cristobalite, Tr;Toridymite, Qz;Quartz, Pl;Plagioclase, Kf;Potash feldspar, Py;Pyrite
Go;Goethite, He;Hematite, Im;Ilmenite, Ho;Hornblende, At;Anatase

Table 2-1-5 Summary of X-Ray Diffraction Analysis (4)

Detailed Survey (Phase II)

Sample No.	Remarks	Rock Unit	Locality	Clay Minerals							Sulfates			Carbonates			Silicates			Feldspar		Miscellaneous Minerals					
				Mo	Ch	Se	Mu	Ka	Ha	Mx	Al	Gy	Ja	Ca	Ak	Si	Cr	Tr	Qz	Pl	Kf	Py	Go	He	Im	Ho	At
LED5X	Wall rock of Qz vein	Kl	S. Penaseang		○									○					◎	◎							
LEG11X	Altered porphyritic dacite	Kv	S. Peko		◎															○		△					
KAB1X	White argillaceous tuff	Tmb	S. Suluang					△											◎								
KAB2X	Pale green argillaceous tuff	Tmb	S. Suluang			△				△									◎								
KAB9X	Gasson	—	S. Suluang																◎					△			

Drilling (Phase II)

Sample No.	Remarks	Rock Unit	Locality	Mo	Ch	Se	Mu	Ka	Ha	Mx	Al	Gy	Ja	Ca	Ak	Si	Cr	Tr	Qz	Pl	Kf	Py	Go	He	Im	Ho	At
BD1-3	Qz in andesite	Kl	MJT-1, 9.20~10.20m	○				△											◎	○							
BD1-15	Silicified andesite (HW of Qz vein)	Kl	MJT-1, 53.90~59.60m	○	○														◎	○							
BD1-18	Silicified andesite (FW of Qz vein)	Kl	MJT-1, 60.85~61.05m		△														◎								
BD1-20	Qz vein	—	MJT-1, 66.65~67.40m		•														◎								
BD2-22	Qz veinlets in andesite	Kl	MJT-2, 33.80~33.84m	○															◎	△							
BD2-25	Qz stockwork in andesite	Kl	MJT-2, 38.00~38.40m	○											○				◎	△				•		•	
BD2-29	Qz stockwork in andesite	Kl	MJT-2, 49.20~50.00m	△	○														◎	○	△						
BD2-33	Qz vein	—	MJT-2, 59.25~59.50m					△						◎	◎				○	○							
BD2-35	Qz stockwork in andesite	Kl	MJT-2, 66.50~67.20m		○									○	○				○	◎							
BD3-1	Qz stockwork in tf-shale	Kl	MJT-3, 10.50~11.50m		•	△													◎								
BD3-4	Qz stockwork in tf-shale	Kl	MJT-3, 13.55~14.10m		△	△													◎	○							
BD3-6	Qz stockwork in andesite	Kl	MJT-3, 25.10~25.50m	△	△														○	○	△						
BD3-10	Qz stockwork in andesite	Kl	MJT-3, 29.75~29.90m		○														○	◎	△						
BD3-11	Py impregnated in bk-shale	Kl	MJT-3, 40.65~40.75m		○	○													◎	○		•					
BD4-6	Qz stockwork in tf-shale	Kl	MJT-4, 13.15~13.90m		△														◎	○							
BD4-8	Qz veinlets in bk-shale	Kl	MJT-4, 18.95m		△	○								△					◎	△							
BD4-14	Qz stockwork in andesite	Kl	MJT-4, 54.45~55.45m		○									◎					○	○							
BD4-19	Qz stockwork in andesite	Kl	MJT-4, 57.70~58.70m		○									◎					◎	△							
BD5-1	Silicified andesite	Kl	MJT-5, 8.55~8.80m	•	△									•	○				◎	○							
BD5-2	Silicified andesite	Kl	MJT-5, 46.5~47.20m		○									○					◎	•							

Abundance of Minerals: ◎;Abundant, ○;Common, △;Few, •;Rare

Abbreviations : Mo;Montmorillonite, Ch;Chlorite, Se;Sericite, Mu;Muscovite, Ka;Kaoline, Mx;Mixed layer, Ha;Halloysite, Al;Alunite, Gy;Gypsum, Ja;Jarosite
Ca;Calcite, Ak;Ankerite, Si;Siderite, Cr;α-Cristobalite, Tr;Toridymite, Qz;Quartz, Pl;Plagioclase, Kf;Potash feldspar, Py;Pyrite
Go;Goethite, He;Hematite, Im;Ilmenite, Ho;Hornblende, At;Anatase

Table 2-1-5 Summary of X-Ray Diffraction Analysis (5)

Drilling (Phase Ⅲ)

Sample No.	Remarks	Rock Unit	Locality	Clay Minerals							Sulfates			Carbonates			Silicates			Feldspar		Miscellaneous Minerals					
				Mo	Ch	Se	Mu	Ka	Ha	Mx	Al	Gy	Ja	Ca	Ak	Si	Cr	Tr	Qz	Pl	Kf	Py	Go	He	Im	Ho	At
			MJT-6																								
BD6-2	Qz veinlet in shale	K1	16.60~17.60m		•	•		•?											◎								
BD6-6	Qz vein	—	27.62~28.05m																◎					•?			
BD6-7	Qz stockwork in andesite	K1	79.80~80.23m					•?							△				◎	•							
BD6-12	Qz stockwork in andesite	K1	119.88~120.10m		•									○					◎	•							
BD6-18	Qz stockwork in andesite	K1	122.43~122.47m		△									△					△	○							
BD6-23	Qz stockwork in andesite	K1	124.44~124.51m		△									△					△	○							
BD6-27	Ca-Qz vein	—	130.30~130.45m		•									○					△	•							
			MJT-7																								
BD7-6	Qz stockwork in andesite	K1	38.10~39.10m		△									•	◎				◎	•							
BD7-10	Qz stockwork in andesite	K1	42.10~43.10m		•										○				◎	•				•?			
BD7-12	Clayey zone	K1	44.50~45.50m		•					•					○				◎			•?		•?			
BD7-20	Qz stockwork in andesite	K1	96.05~96.55m	•?	•									△					◎	•							
BD7-30	Qz stockwork in andesite	K1	165.60~166.10m	•?	•														◎	•							
BD7-33	Qz stockwork in andesite	K1	173.55~174.30m		△									•?					◎	•							
BD7-37	Qz stockwork in andesite	K1	192.05~192.65m		△									○					○	△							
			MJT-8																								
BD8-6	Qz stockwork in andesite	K1	109.30~110.30m	•?	•										•				◎	•	•						
BD8-9	Qz stockwork in andesite	K1	112.05~112.30m											•	•				◎		•?						
BD8-10	Qz stockwork in andesite	K1	112.30~112.85m												•				◎		•?						
BD8-18	Qz veinlet in shale	K1	125.00~125.05m		•										△				◎	•							
BD8-27	Andesite, altered	K1	190.84~190.94m		•									◎	△				△	•							
			MJT-9																								
BD9-1	Andesite, Py spotted	K1	8.50~8.65m		△									○					•	○							
BD9-2	Andesite, Py spotted	K1	9.10~9.30m		•									○					△	○							
BD9-3	Qz network in shale	K1	47.10~47.30m		△	•													◎	•							

Abundance of Minerals: ◎;Abundant, ○;Common, △;Few, •;Rare

Abbreviations : Mo;Montmorillonite, Ch;Chlorite, Se;Sericite, Mu;Muscovite, Ka;Kaoline, Mx;Mixed layer, Ha;Halloysite, Al;Alunite, Gy;Gypsum, Ja;Jarosite
Ca;Calcite, Ak;Ankerite, Si;Siderite, Cr;α-Cristobalite, Tr;Toridymite, Qz;Quartz, Pl;Plagioclase, Kf;Potash feldspar, Py;Pyrite
Go;Goethite, He;Hematite, Im;Ilmenite, Ho;Hornblende, At;Anatase

Table 2-1-6 Summary of Ore Microscopy (1)

Regional Survey (Phase I)

Sample No.	Locality	Minerals								Remarks
		Py	As	Cp	Sp	Ga	Bn	Cv	Io	
A31R	S. Tarawa	△		•	•			•		Qz float
A41R	S. Tarawa	△		•				•	•	Qz float
B23R	S. Salupoling	△		△				•		Qz float
B34R	S. Lebutang	○	△	•	•			•		Py(-Qz-Ep) vein
B46R	NW Tarawa	△	•	•	•	•		•		Qz vein (Wd=48cm)
C26R	S. Belopi	△		•					•	Qz(-Ch) block
C29R	S. Salore	△	•	•	•			•		Qz block
E51R	S. Malela	△		•				•		Qz network (Wd=80cm)
E66R	S. Malela	△		•	•					Qz vein (Wd=15cm)
E70R	S. Malela	•		•				•	•	Qz vein (Wd=200cm)

Semi-Detailed Survey (Phase II)

	S. Lebutang									
LEB11K	S. Taroto	•							•	Andesite boulder, Py disseminated
LEB17K	S. Taroto	•		•					•	Sulphide vein (Wd=35cm)
LEB25K	S. Lebutang	•		•				•	•	Sulphide dissemination near Qz vein
LEC13K	S. Peko	△	•	•	•					Qz vein (Wd=50cm)
LEF1K	S. Lebutang	○	○	•						Py ore float
LEG11K	S. Peko	•		•	•			•		Py veinlet/network
	Kariango									
KAB2K	S. Suluan	•							△	Py network, Io composed of hematite & limonite
KAB8K	S. Suluan								•	Py network
KAB9K	S. Suluan	•							△	Gossan float, Io composed of limonite & specularite
KAB10K	S. Suluan	△							•	Silicified zone near Qz vein

Detailed Survey (Phase II)

	Batuisi									
BAA53K	S. Tarawa	△	•	•	•				•	Qz float
BAA62K	T-2, 79m	•							•	Qz vein (Wd=12cm)
BAA75K	S. Bone	△	•	•				•	•	Qz vein (Wd=75cm)
BAA99K	T-6, 22m	•	•	•	•			•	•	Qz vein (Wd=24cm)
BAA103K	T-5, 47m	△		•				•	•	Qz vein (Wd=32cm)
BTB17K	S. Kayulalong	•		•				•	•	Qz float, Io composed of hematite & limonite
										Sulphide vein crosscut by Qz vein
BTC43K	S. Bone	•	•	•				•	•	Qz float
BTF16K	S. Malela	•	•	○			•	•	△	Qz stockwork (Wd=20cm), Trace of malachite
	Bau									
BAB2K	S. Balimbing	△	•	•		•	•	•	•	Qz veinlet (Wd=9cm), Trace of chalcocite
BAB5K	S. Mariku			•					•	Qz-Ep float
BAB18K	S. Balimbing	△	•	•					•	Sulphide dissemination in shale
BAB19K	S. Balimbing	•		•					•	Sulphide veinlet in diorite
BAC8K	S. Salore	•	•	•						Silicified andesite, Py disseminated
BAC16K	S. Salubongi	•	•	•	•					Qz vein (Wd=10cm)
BAC17K	S. Salubongi	•		•					•	Qz vein (Wd=15cm)

Abundance of Minerals: ○;Common, △;Rare, •;Trace

Abbreviations : Py;Pyrite, As;Arsenopyrite, Cp;Chalcopyrite, Sp;Sphalerite, Ga;Galena, Bn;Bornite
Cv;Covelline, Io;Iron Oxide

Table 2-1-6 Summary of Ore Microscopy (2)

Drilling (Phase II)

Sample No.	Locality	Minerals								Remarks
		Py	As	Cp	Sp	Ga	Cv	Cc	Io	
BD1-7K	MJT-1 38.60m	○							•	Qz stockwork
BD1-10K	52.45m	•		•					•	Qz stockwork. Trace of azurite
BD1-16K	60.15m	•		•			•	•	•	Qz vein (Wd=125cm)
BD1-20K	67.00m	•							•	Qz vein (Wd=75cm)
BD1-26K	72.90m	•							•	Qz vein (Wd=830cm)
BD2-2K	MJT-2 9.75m	•							•	Qz vein (Wd=80cm). Trace of azurite
BD2-5K	13.15m								•	Qz vein (Wd=40cm)
BD2-18K	20.25m	•							•	Qz vein (Wd=145cm)
BD2-24K	36.35m	•							•	Qz vein (Wd=11cm)
BD2-26K	39.90m	•		•			•		•	Qz stockwork
BD2-34K	61.25m	△	•	•						Qz stockwork
BD3-2K	MJT-3 11.85m	•							•	Qz stockwork
BD3-5K	15.15m	○							•	Qz stockwork
BD3-9K	27.50m	•		•	•		•			Qz vein (Wd=10cm)
BD3-11K	40.75m	•		•					•	Py imp in black shale. Trace of ilmenite
BD3-15K	67.45m	○	•	•	△		•			Qz stockwork
BD3-16K	77.85m	△	•							Qz stockwork
BD4-7K	MJT-4 14.05m	•							•	Qz vein (Wd=35cm)
BD4-13K	54.40m	•							•	Qz vein (Wd=10cm)
BD5-5K	MJT-5 49.05m	•		•			•	•	•	Qz vein (Wd=313cm)

Drilling (Phase III)

Sample No.	Locality	Py	As	Cp	Sp	Ga	Cv	Cc	Io	Remarks
BD6-6P	MJT-6 27.70m	•							•	Quartz vein (Wd=47cm)
BD6-9P	109.40m	○			•					Quartz veinlet (Wd=5cm)
BD6-13P	120.60m	△		•						Quartz stockwork (Wd=90cm)
BD6-16P	121.90m	△	•	•	•				•	Quartz stockwork (Wd=34cm)
BD6-22P	123.85m	•		•	•				•	Quartz stockwork (Wd=72cm)
BD6-26P	125.35m	•		•	•					Quartz vein (Wd=90cm)
BD7-7P	MJT-7 39.80m	•	•	•					•	Quartz stockwork (Wd=540cm)
BD7-21P	96.60m	•							•	Quartz vein (Wd=21cm)
BD7-24P	134.40m	•	•	•	•		•	•	•	Quartz stockwork (Wd=55cm)
BD7-27P	161.45m	△		△	•				•	Quartz stockwork (Wd=40cm)
BD7-30P	165.75m	•		•	•				•	Quartz stockwork (Wd=130cm)
BD7-34P	174.43m	•		△	•		•	•	•	Quartz stockwork (Wd=145cm)
BD7-35P	177.15m	○		•	•		•	•	•	Quartz stockwork (Wd=117cm)
BD7-36P	191.45m	•							•	Quartz stockwork (Wd=120cm)
BD8-1P	MJT-8 67.00m	○		•					•	Quartz stockwork (Wd=50cm)
BD8-5P	108.90m	△	•	△	•					Quartz stockwork (Wd=355cm)
BD8-8P	111.50m	•		△	•	•				Quartz stockwork (Wd=63cm)
BD8-9P	112.20m	•		•	•				•	Quartz stockwork (Wd=80cm)
BD8-14P	117.70m	○		•					•	Quartz stockwork (Wd=24cm)
BD8-21P	133.80m	△		•	•				•	Quartz stockwork (Wd=66cm)
BD8-24P	182.30m	•		•					•	Quartz stockwork (Wd=50cm)
BD8-26P	184.90m	△		○	•					Quartz vein (Wd=75cm)
BD9-1P	MJT-9 8.60m	•		•					•	Py spotted in andesite
BD9-2P	9.20m	•		•	•				•	Py spotted in andesite
BD9-8P	79.85m	•								Quartz-calcite network

Abundance of Minerals: ○;Common, △;Rare, •;Trace

Abbreviations : Py;Pyrite, As;Arsenopyrite, Cp;Chalcopyrite, Sp;Sphalerite, Ga;Galena, Cv;Covelline
Cc;Chalcocite, Io;Iron Oxide

Table 2-1-7 Assay Results of Ore Samples (1991)

Bau

Sample No.	Width (cm)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Fe (%)	Sample Type and Locality
A20R	12	<0.015	<0.3	0.02	<0.01	0.01		Qz vein, Bau footpath
A22R	25	<0.015	0.6	0.40	<0.01	0.01		Qz vein, Kp.Salupolin
A24R	30	<0.015	<0.3	0.03	<0.01	0.06		Qz vein, S.Belopi
B17R	-	<0.015	<0.3	0.03	<0.01	<0.01		Qz float, S.Balimbing
B18R	grab	<0.015	<0.3	0.04	<0.01	<0.01		Andesite, Py-diss, S.Balimbing
B20R	grab	<0.015	<0.3	0.02	<0.01	0.01		Andesite, Py-film, S.Balimbing
B23R	-	<0.015	<0.3	0.17	<0.01	0.01		Qz float, S.Salupolin
C26R	grab	<0.015	0.6	0.80	<0.01	0.02		Qz-sulphide, S.Belopi
C29R	-	<0.015	<0.3	0.30	<0.01	0.03		Qz float, S.Salole
E36R	20	<0.015	<0.3	0.02	<0.01	0.01		Qz vein, S.Bosokan
E38R	15	<0.015	<0.3	0.03	<0.01	0.01		Qz vein, Bau footpath

Batuisi

Sample No.	Width (cm)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Fe (%)	Sample Type and Locality
A35R	47	<0.015	<0.3	0.03	<0.01	0.07		Qz vein, S.Tarawa
A37R	33	<0.015	<0.3	0.01	<0.01	<0.01		Qz vein, S.Tarawa
A42R	35	<0.015	0.3	0.03	<0.01	<0.01		Qz vein, S.Bone
B43R	20	<0.015	0.3	0.01	<0.01	<0.01		Qz vein, S.Bone
B46R	48	0.015	<0.3	0.13	<0.01	0.20		Qz vein, NW Tarawa
C38R	-	<0.015	0.6	0.02	<0.01	0.15		Qz block, NW Tarawa
D34R	200	<0.015	<0.3	0.02	<0.01	0.01		Qz vein, S.Tarawa
D37R	100+	<0.015	<0.3	0.09	<0.01	0.06		Qz vein, S.Tarawa
E50R	grab	<0.015	<0.3	0.01	<0.01	0.01		Sil shale, S.Malela
E51R	80	<0.015	<0.3	0.32	<0.01	0.05		Qz network, S.Malela
E52R	280+	<0.015	<0.3	0.09	<0.01	0.01		Qz vein, S.Malela
E66R	15	<0.015	<0.3	0.05	<0.01	0.41		Qz vein, S.Malela

Regional Area

Sample No.	Width (cm)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Fe (%)	Sample Type and Locality
B7R	-	<0.015	<0.3	0.03	<0.01	<0.01		Qz float, S.Uroh
B32R	-	<0.015	<0.3	0.04	<0.01	<0.01		Qz float, S.Taroto
B34R	-	0.030	1.2	0.40	<0.01	0.02		Py float, S.Taroto
C5R	-	<0.015	<0.3	0.04	<0.01	0.01		Qz float, S.Rasasisi
C6R	-	0.030	0.3	0.01	<0.01	0.01		Sil-Py float, S.Rasasisi
C20R	-	0.015	<0.3	0.03	<0.01	0.01		Sil float, S.Kakea
C21R	-	<0.015	<0.3	0.02	<0.01	0.01		Qz float, S.Kakea
G5R	-	0.390	1.2	0.02	<0.01	0.01		Qz float, Rantedonga

Eight samples consisting of quartz floats were collected from various places within the regional survey area in the first phase. The assay results have shown no significant value of either gold or basemetals.

1-4 Geochemical Exploration

1-4-1 Survey Method

Regional geochemical exploration by means of stream sediment sampling was carried out in the first phase for the purpose of defining hidden mineralized zones which would otherwise be undetected by geological survey, as well as for clarifying the extension of mineral occurrences known through the geological survey.

Fine sand samples of -80 mesh were collected from sediments in major channels and some of the bigger tributaries. The number of stream sediment samples collected was more than one thousand (1,010), which corresponds to a sampling density of approximately one sample per 3 km^2. The samples, after being air-dried in the field, were analyzed at Chemex Labs Ltd. for 11 elements ; Au, Ag, As, Bi, Sb, Hg, Cu, Pb, Zn, Ba, and Mo.

1-4-2 Anomalies of Stream Sediment Geochemistry

(1) Statistical Data Processing

On the assumption that the distribution of geochemical data shows a close approximation to the logarithmic normal distribution, the natural logarithmic conversion of the respective analytical values was adopted in the statistical data processing. When an analytical value was less than the detection limit, a value half of the lower limit was substituted in the calculation.

At first, statistical properties of geochemical data were checked. Basic statistical figures were calculated. Distribution histograms of each element were drawn out. Correlation coefficients among eleven elements were examined.

Then, principal components analysis was practiced for extracting some statistically efficient combinations of elements.

Basic statistical figures

Table 2-1-8 shows the values of geometric mean, maximum and minimum, standard deviation, and proportion of samples less than the detection limit to the total number of samples for each element. The proportion of samples with values less than the lower detection limit to the total population is high for Au, Ag, and Hg.

The frequency distribution of analytical values for each element was checked. As, Bi, Cu, Pb, Zn, Ba and Mo show a distribution of close-to-normal. Whereas Au, Ag, Hg and Sb present an L-shape distribution.

Table 2-1-9 shows the matrix of correlation coefficients among eleven elements. Values of the correlation coefficient more than 0.5 were obtained only in As-Sb, Cu-Zn, and Pb-Ba. The remaining combinations of elements indicated very low level of correlation.

Principal components analysis

Four principal components were chosen based on the eigenvalues more than 1.0. Values of the eigenvector, factor loading, proportion, and cumulative proportion were calculated for the four principal components as listed in Table 2-1-10. Characteristics of each principal component are briefly described as follows.

① The first principal component : Values of the factor loadings more than 0.5 were obtained for As, Sb, Pb, Zn, and Mo. The result, together with Cu which showed the factor loading of slightly less than 0.5, may indicate that the first principal component has some association with the behavior of these basemetal elements. The proportion, however, is less than 0.27. It means that the component itself is not enough to account for the overall behavior of elements.

② The second principal component : This component is positively correlated, though weakly, to only Bi.

③ The third principal component : This component is positively correlated, though weakly, to only Ba.

④ The fourth principal component : This component is positively correlated, though weakly, to Ag and Hg.

Results of statistical analysis

Analytical values of Au do not show a logarithmic normal distribution at all. Au does not have any intimate correlation with the other elements. No element or a group of elements which behaved together with Au has been identified through the principal components analysis.

As for basemetal elements, some correlation was observed between As-Sb, and

Table 2-1-8 Basic Statistics of Stream Sediment Samples (1991)

	Au (ppb)	Ag (ppm)	As (ppm)	Bi (ppm)	Sb (ppm)	Hg (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Mo (ppm)
Log Mean (M)	3.2	0.028	6.1	0.6	0.2	0.06	15.7	18.9	60.8	938	0.2
Max Value	2660	0.70	255.0	70.0	160.5	17.1	160.5	155.5	273.0	4700	3.4
Min Value	<5	<0.05	<0.2	<0.2	<0.2	<0.1	0.4	1.0	8	20	<0.2
Std Dev (σ)	2.6	1.377	3.3	2.7	3.1	1.77	2.4	1.9	1.6	2	1.9
M+σ	8.2	0.038	20.2	1.6	0.8	0.11	38.1	35.2	98.7	1883	0.4
M+2σ	21.5	0.053	66.5	4.3	2.3	0.19	92.4	65.7	160.3	3780	0.7
No of Sample less D Lmt %	93.7	86.3	0.1	4.5	47.2	84.9	0	0	0	0	30.3

※ Number of Samples = 1,010

Table 2-1-9 Correlation Matrix of Stream Sediment Samples (1991)

	Au	Ag	As	Bi	Sb	Hg	Cu	Pb	Zn	Ba	Mo
Au	1.00	0.09	0.02	-0.02	-0.00	-0.01	0.18	-0.04	0.17	-0.06	0.16
Ag		1.00	0.28	0.26	0.14	0.10	0.05	0.24	0.11	-0.05	0.26
As			1.00	0.39	0.70	0.03	0.15	0.44	0.19	-0.03	0.41
Bi				1.00	0.14	0.04	-0.11	0.43	-0.06	0.14	0.06
Sb					1.00	0.04	0.16	0.25	0.17	-0.01	0.17
Hg						1.00	-0.00	0.06	0.02	-0.01	0.08
Cu							1.00	0.12	0.72	-0.06	0.33
Pb								1.00	0.39	0.60	0.30
Zn									1.00	0.09	0.43
Ba										1.00	-0.01
Mo											1.00

Table 2-1-10 Results of Principal Components Analysis of Stream Sediment Samples (1991)

	1		2		3		4	
	Eigen-vector	Factor Loading	Eigen-vector	Factor Loading	Eigen-vector	Factor Loading	Eigen-vector	Factor Loading
Au	0.089	0.152	-0.281	-0.376	-0.046	-0.055	0.376	0.392
Ag	0.257	0.440	0.109	0.146	-0.241	-0.287	0.504	0.526
As	0.443	0.759	0.177	0.237	-0.356	-0.424	-0.241	-0.251
Bi	0.237	0.405	0.446	0.597	-0.062	-0.074	0.204	0.213
Sb	0.342	0.586	0.100	0.134	-0.358	-0.426	-0.460	-0.479
Hg	0.064	0.109	0.043	0.057	-0.083	-0.099	0.495	0.516
Cu	0.288	0.494	-0.520	-0.695	0.125	0.149	-0.106	-0.110
Pb	0.419	0.718	0.290	0.388	0.392	0.467	0.014	0.015
Zn	0.370	0.634	-0.424	-0.567	0.269	0.321	-0.044	-0.046
Ba	0.133	0.228	0.299	0.401	0.655	0.781	-0.042	-0.044
Mo	0.373	0.640	-0.211	-0.282	-0.059	-0.070	0.181	0.189
Eigen	2.935		1.791		1.420		1.087	
Prop	0.267		0.163		0.129		0.099	
Cum Pr	0.267		0.430		0.559		0.658	

Cu-Zn. Weak associations among some of the basemetal elements such as As, Sb, Pb, Zn, Mo, and probably Cu were recognized in the first principal component.

Regarding the factor scores of each sample, they were calculated and plotted on the map. The results were verified with the distribution of geologic units. No significant correspondence has been recognized. Thereafter the analysis was undertaken only globally by treating the whole data set indiscriminately.

(2) Anomalies of Stream Sediment Geochemistry

Some elements such as Au and Ag did not show a neat log-normal distribution, as was mentioned above. A set of basemetal elements had a bare cross-relation. It was thus treated by rule to calculate thresholds of anomalies by values of twice the standard deviation added to the mean of each element.

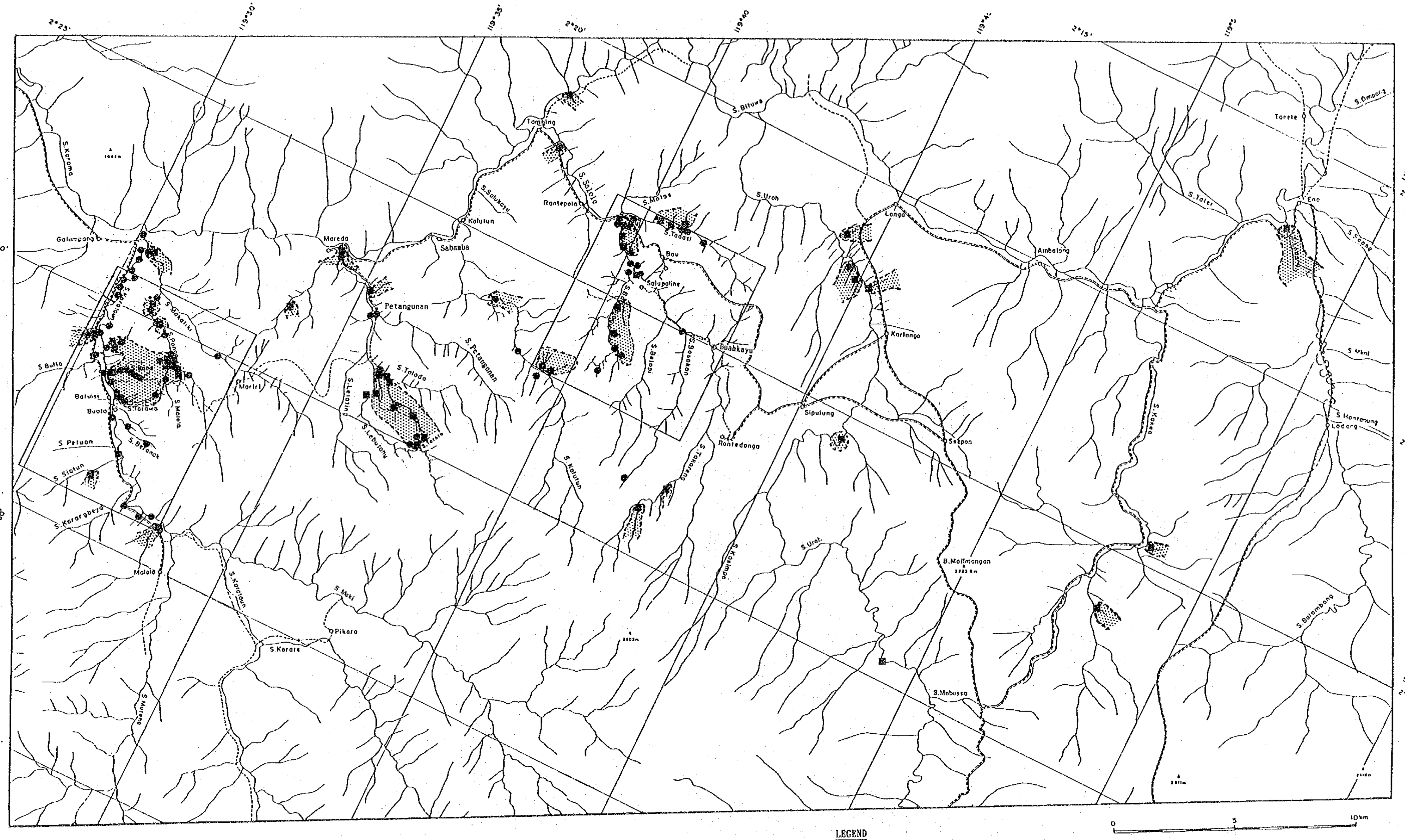
A series of maps showing geochemical anomalies of stream sediments for each element was produced. Geochemical anomalies for each element were cross-checked on the maps. The results of panning prospecting were taken into consideration. The results of geological survey, especially those of the distribution of quartz veins, quartz floats and hydrothermal alteration, were also referred.

These results were integrated together, and several significant anomalous zones were outlined. Six potential mineralized areas thus chosen are described as follows.

① Batuisi : Au anomalies of stream sediments and pan concentrates are densely arranged along S. Karataun and S. Pongo in the Batuisi prospect. Ag and As anomalies of stream sediments are located in the same area. Cu and Zn anomalies of the second order were also detected. These anomalies are positioned not far from the locations of quartz veins. Most of them are within a few kilometer distance. It suggests that the quartz veins and their surrounding alteration zones are most likely the origin of these geochemical anomalies.

② Bau : Au anomalies of stream sediments and pan concentrates are closely arranged along S. Salole, S. Balimbing, and S. Tadasi in the Bau prospect. Ag and Cu anomalies of stream sediments are located, and As and Zn anomalies of the second order were also detected within the area. Occurrences of quartz veins, quartz floats and alteration zones were recognized in the same area.

③ S. Lebutang : A series of strong Au anomalies of stream sediments was



LEGEND

Au Anomaly ≥ 21.5ppb of Stream Sediment Samples(Phase I)

Au Anomaly of Pan Concentrate Samples(Phase I)

Fig. 2-1-4 Distribution of Regional Geochemical Gold Anomalies in the Northern Part of the Survey Area

detected from the area which lies along S. Lebutang and its tributaries (S. Petangunan, S. Lelating, S. Talodo, and S. Taroto). The strongest one which was obtained near the junction of S. Lebutang and S. Karama was 2,660 ppb Au. Distinctive values of 1,250 ppb Au and 1,050 ppb Au were also returned from this area. Some significant Au anomalies of pan concentrates were observed in this area, although it has not been fully covered by the panning prospecting. Cu, Zn and Ag anomalies of stream sediments were scattered mainly along the upper reaches of S. Lebutang and S. Talodo. The geology of the area is composed mainly of black shale and dolerite of the Latimojong Formation. Quartz veins and pyrite dissemination were found in this area. This area is situated immediately at the north of the Mamasa granite batholith.

④ Kariango : Several Au anomalies of stream sediments were detected at the north of Kariango along S. Uroh and S. Betuwe. Cu, Pb, Zn and Ag anomalies of stream sediments were sparsely distributed in the area. The geology of the area is composed of andesitic tuff of the Beropa Tuffs and black shale of the Toraja Formation. Surface indication of mineralization has not known in the area.

⑤ S. Kakea : Sixteen Zn anomalies of stream sediments were detected along S. Kakea. The highest value was 273 ppm Zn. Pb and Cu anomalies of the second order were associated with the Zn anomalies. The geology is composed of andesitic to basaltic volcanic rocks of the Talaya Volcanic Rocks. The Zn anomalous zone was positioned several kilometers downstream of the occurrences of quartz floats with pyrite dissemination.

⑥ S. Rongkong : Distinctive Ag anomalies of stream sediments accompanying with Pb and As anomalies were observed along the upper reaches of S. Rongkong and its tributaries (S. Rasasisi, S. Marampa, S. Punti, and S. Paku). The absolute values of Ag anomalies, however, are generally low. The geology of the area is mainly composed of Miocene volcanic-pyroclastic series of the Lamasi Volcanic Rocks and the Kambuno granite.

On the basis of the results of regional geochemical exploration, six areas came to light as the potential mineralized areas. The results of panning prospecting and geological survey were the other points to have been considered in the evaluation. Semi-detailed survey was undertaken in two of the areas -- Batuisi and Bau -- during the exploration programme in the first phase. Among the remaining four areas, S. Lebutang and Kariango appeared to be interesting prospects of gold and basemetal mineralization.

Fig. 2-1-4 shows the distribution of regional geochemical gold anomalies in the northern part of the survey area (1991). Au anomalies of stream sediment samples, and gold occurrences in pan concentrates were integrated in the map. A sizable amount of geochemical anomalies was discovered at S. Lebutang. Moreover values of the Au anomalies were distinctive in the prospect. A considerable amount of Au anomalies was also found in the Kariango area.

1-5 Preliminary Works of Mercury Gas Geochemistry and Biogeochemistry

1-5-1 Mercury Gas Geochemistry

(1) Measuring Method

Mercury gas measurements were undertaken at the middle reaches of S. Tarawa in the Batuisi prospect.

Mercury contents in gas from soil were measured using portable-type mercury analyser. The instrument adopted was the Mercury Sniffer model PM-1A of Nippon Instruments Corp. The methodology is gold amalgamation: Mercury in soil gas is caught as a gold-amalgum in a ceramics-based collector. The mercury atoms are released through thermal decomposition. Mercury content is, then measured by cold vapor atomic absorption double beam photometer. The detection limit is 0.01 nanograms. The upper limit is 100 nanograms.

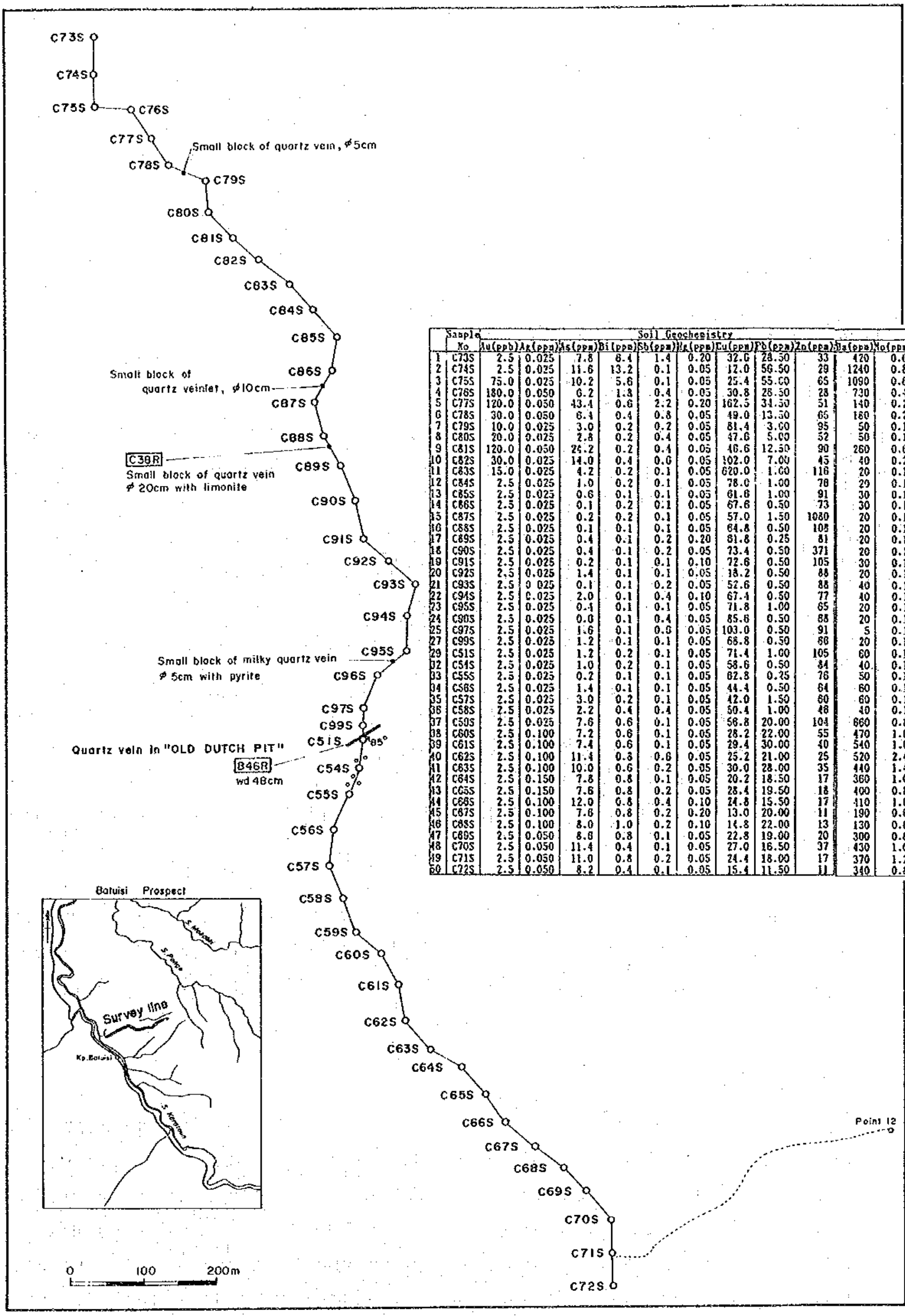
Holes of 45 mm in diameter and 50 cm deep were dug using hand-auger. PVC tube was then inserted to the depth of about 40 cm. The mouth of the hole was sealed.

Gas of 1.2 liters in soil was sucked out from hole, and analyzed at the point. Fifty measurements were made. The sample line tested for mercury measurements was running roughly east-west about 2 km long, and crosscutting to some of the major quartz veins in the Batuisi prospect (same line as plant leaf sampling). The average interval of the holes was 50 m along the line. While in the vicinity of the vein (within 35 m radius), holes were dug much closer -- about 10 m apart from each other. The map of mercury gas measurements is shown in Fig. 2-1-5.

(2) Results

The results of mercury contents in soil gas were examined together with the analytical results of soil geochemistry.

The correlation coefficients between mercury content in soil gas and analytical value of soil geochemistry were calculated for 11 geochemical elements. Correlation coefficient of less than 7 % was returned from the



	Sample No	Soil Geochemistry											Hg Gas Mes
		Au(ppb)	Ag(ppm)	As(ppm)	Bi(ppm)	Sb(ppm)	Hg(ppm)	Cu(ppm)	Pb(ppm)	Zn(ppm)	Ba(ppm)	Mo(ppm)	Hg(nanogr)
1	C73S	2.5	0.025	7.8	8.4	1.4	0.20	32.6	28.50	33	420	0.6	0.10
2	C74S	2.5	0.025	11.6	13.2	0.1	0.05	12.0	56.50	29	1240	0.8	0.08
3	C75S	75.0	0.025	10.2	5.6	0.1	0.05	25.4	55.00	65	1090	0.6	0.08
4	C76S	180.0	0.050	6.2	1.8	0.4	0.05	30.8	28.50	28	730	0.4	0.07
5	C77S	120.0	0.050	43.4	0.6	2.2	0.20	162.5	34.50	51	140	0.2	0.07
6	C78S	30.0	0.050	6.4	0.4	0.8	0.05	49.0	13.50	65	160	0.2	0.07
7	C79S	10.0	0.025	3.0	0.2	0.2	0.05	81.4	3.00	95	50	0.1	0.07
8	C80S	20.0	0.025	2.8	0.2	0.4	0.05	47.6	5.00	52	50	0.1	0.05
9	C81S	120.0	0.050	24.2	0.2	0.4	0.05	46.6	12.50	90	260	0.6	0.06
10	C82S	30.0	0.025	14.0	0.4	0.6	0.05	102.0	7.00	45	40	0.2	0.05
11	C83S	15.0	0.025	4.2	0.2	0.1	0.05	620.0	1.00	116	20	0.1	0.08
12	C84S	2.5	0.025	1.0	0.2	0.1	0.05	78.0	1.00	78	29	0.1	0.05
13	C85S	2.5	0.025	0.6	0.1	0.1	0.05	61.6	1.00	91	30	0.1	0.04
14	C86S	2.5	0.025	0.1	0.2	0.1	0.05	67.6	0.50	73	30	0.1	0.05
15	C87S	2.5	0.025	0.2	0.2	0.1	0.05	57.0	1.50	1080	20	0.1	0.04
16	C88S	2.5	0.025	0.1	0.1	0.1	0.05	64.8	0.50	108	20	0.1	0.03
17	C89S	2.5	0.025	0.4	0.1	0.2	0.20	81.8	0.25	81	20	0.1	0.05
18	C90S	2.5	0.025	0.4	0.1	0.2	0.05	73.4	0.50	371	20	0.1	0.04
19	C91S	2.5	0.025	0.2	0.1	0.1	0.10	72.6	0.50	105	30	0.1	0.05
20	C92S	2.5	0.025	1.4	0.1	0.1	0.05	18.2	0.50	88	20	0.1	0.04
21	C93S	2.5	0.025	0.1	0.1	0.2	0.05	52.6	0.50	88	40	0.1	0.05
22	C94S	2.5	0.025	2.0	0.1	0.4	0.10	67.4	0.50	77	40	0.1	0.04
23	C95S	2.5	0.025	0.4	0.1	0.1	0.05	71.8	1.00	65	20	0.1	0.03
24	C96S	2.5	0.025	0.6	0.1	0.4	0.05	85.6	0.50	88	20	0.1	0.04
25	C97S	2.5	0.025	1.6	0.1	0.6	0.05	103.0	0.50	91	5	0.1	0.04
27	C99S	2.5	0.025	1.2	0.1	0.1	0.05	68.8	0.50	68	20	0.1	0.04
29	C51S	2.5	0.025	1.2	0.2	0.1	0.05	71.4	1.00	105	60	0.1	0.09
32	C54S	2.5	0.025	1.0	0.2	0.1	0.05	58.6	0.50	84	40	0.1	0.09
33	C55S	2.5	0.025	0.2	0.1	0.1	0.05	62.8	0.25	76	50	0.1	0.08
34	C56S	2.5	0.025	1.4	0.1	0.1	0.05	44.4	0.50	64	60	0.1	0.08
35	C57S	2.5	0.025	3.0	0.2	0.1	0.05	42.0	1.50	60	60	0.1	0.08
36	C58S	2.5	0.025	2.2	0.4	0.4	0.05	50.4	1.00	48	40	0.1	0.08
37	C59S	2.5	0.025	7.6	0.6	0.1	0.05	56.8	20.00	104	660	0.8	0.08
38	C60S	2.5	0.100	7.2	0.6	0.1	0.05	28.2	22.00	55	470	1.0	0.08
39	C61S	2.5	0.100	7.4	0.6	0.1	0.05	29.4	30.00	40	540	1.0	0.07
40	C62S	2.5	0.100	11.4	0.8	0.6	0.05	25.2	21.00	25	520	2.4	0.07
41	C63S	2.5	0.100	10.0	0.6	0.2	0.05	30.0	28.00	35	440	1.4	0.07
42	C64S	2.5	0.150	7.8	0.8	0.1	0.05	20.2	18.50	17	360	1.0	0.06
43	C65S	2.5	0.150	7.6	0.8	0.2	0.05	28.4	19.50	18	400	0.8	0.08
44	C66S	2.5	0.100	12.0	0.8	0.4	0.10	24.8	15.50	17	410	1.0	0.04
45	C67S	2.5	0.100	7.6	0.8	0.2	0.20	13.0	20.00	11	190	0.6	0.06
46	C68S	2.5	0.100	8.0	1.0	0.2	0.10	14.8	22.00	13	130	0.6	0.04
47	C69S	2.5	0.050	8.8	0.8	0.1	0.05	22.8	19.00	20	300	0.8	0.04
48	C70S	2.5	0.050	11.4	0.4	0.1	0.05	27.0	16.50	37	430	1.0	0.02
49	C71S	2.5	0.050	11.0	0.8	0.2	0.05	24.4	18.00	17	370	1.2	0.04
50	C72S	2.5	0.050	8.2	0.4	0.1	0.05	15.4	11.50	11	340	0.8	0.03

Fig. 2-1-5 Location Map of Soil Samples and Mercury Gas Measurements at the NW of S. Tarawa

combination of Hg (nanogram) in soil gas and Hg (ppm) in soil. No significant correlation has been observed between Hg in soil gas and any other elements in soil.

Fig. 2-1-6 shows the geochemical profiles along the survey line schematically. An Au anomalous zone of about 200 m wide is clearly shown in the profile. Anomalies of Cu, Pb and Zn, though vague, appear within and around the Au anomaly. However, neither Hg in soil gas nor Hg in soil has shown any associated behavior.

1-5-2 Plant Leaf Biogeochemistry

(1) Sampling and Analysis

Test sampling of plant leaves for biogeochemistry was carried out in the Batuisi prospect. Samples were collected from 10 locations, positioned within a radius of 20 m from the soil sampled holes. Four out of 10 locations were set very close to the vein (within 50 m), 2 moderately close to the vein (100 to 150 m), and remaining 4 locations far from the vein (700 to 900 m).

Six kinds of grass leaves were collected. Two belong to a fernery order -- Kadak and Potok. One is a cogan grass -- Tille. The other three are herbs -- Reubombo, Lito, and Tilutilu. Plant names used here are local Indonesian names. Scientific names are cited in the sample list.

Photographs of leaves were taken on the place. Botanical specimens were also collected in the field. Scientific name was checked by a botanist from the Technical Institute of Bandung. Details of samples are explained in Table 2-1-14.

Stems and stalks were taken off. Only leaves were selected, washed by river water, and dried under the sun. Dried leaves of about 100 grams were sent to Chemex Labs for analysis. Seven elements were analyzed; Au, As, Sb, Cu, Pb, Zn, and Ba.

(2) Results

The results were disappointing. Most of the plant leaf samples showed quite low level of metallic element concentration. The maximum value of Au in leaves, for example, is only 0.8 ppb (28-⑥, Tilutilu). Significant concentration of any metallic elements in plant leaves has not been detected. Fig. 2-1-6 shows the schematic profiles of Au and some basemetal elements in plant leaves. The geometric mean of the analytical values is applied for the representative value of each point in the profiles. The line of the profiles is

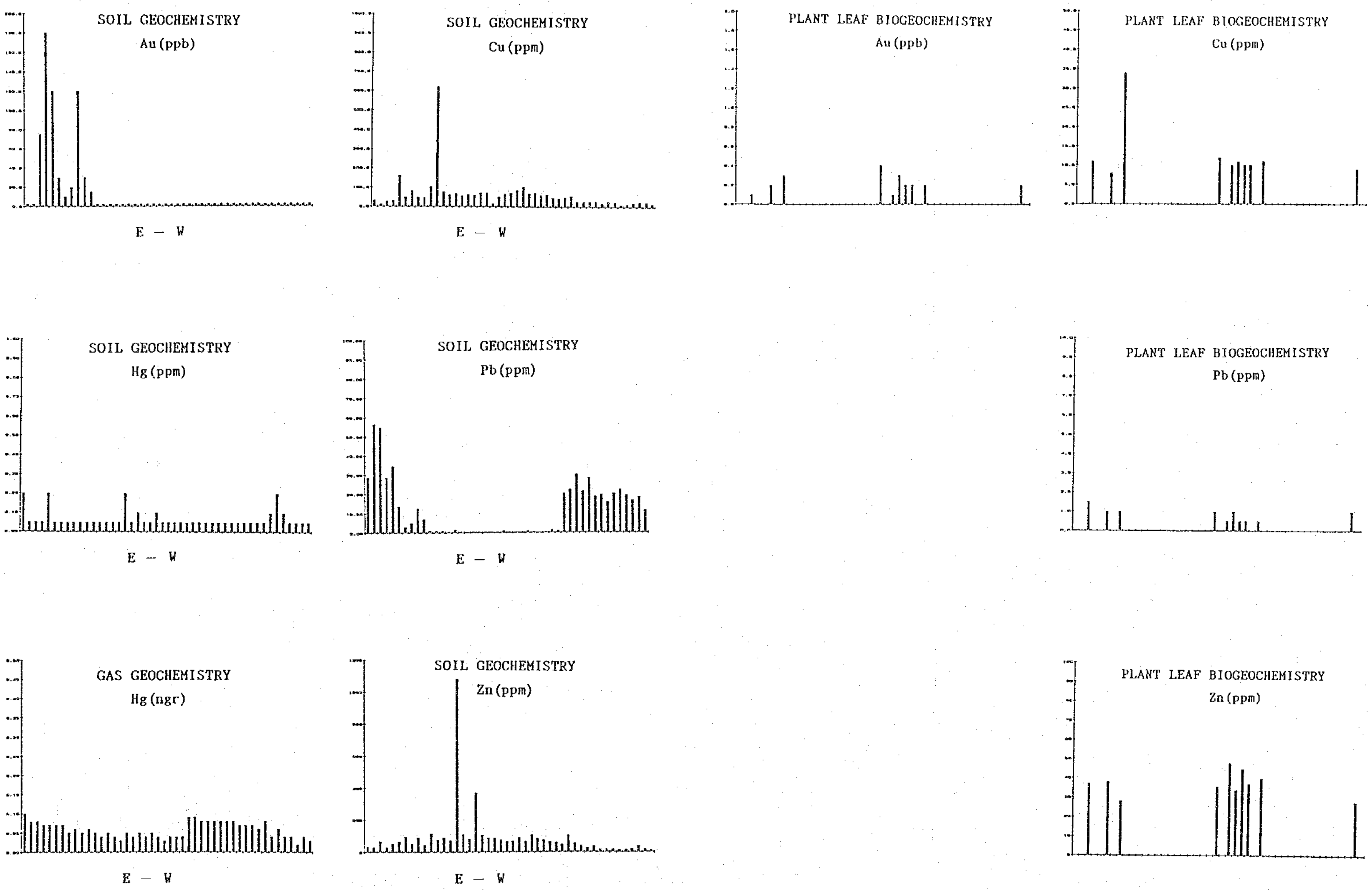


Fig. 2-1-6 Schematic Geochemical and Biogeochemical Profiles along the Soil Line at the NW of S. Tarawa, Batuisi Prospect

Table 2-1-11 Basic Statistics of Soil Samples (1991)

	Au (ppb)	Ag (ppm)	As (ppm)	Bi (ppm)	Sb (ppm)	Hg (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ba (ppm)	Mo (ppm)
Log Mean (M)	2.8	0.043	5.5	0.4	0.3	0.07	35.0	9.9	66.2	217	0.3
Max Value	180	0.40	330.0	21.2	12.6	3.2	620.0	70.5	1080	1600	4.4
Min Value	<5	<0.05	<0.2	<0.2	<0.2	<0.1	0.8	<0.5	5	<10	<0.2
Std Dev (σ)	1.7	1.801	3.1	2.2	2.8	1.81	2.1	3.0	1.8	3	2.4
M+σ	4.7	0.077	17.2	0.8	0.7	0.12	75.1	29.4	120.0	631	0.6
M+2σ	8.1	0.139	53.7	1.8	2.0	0.22	161.1	86.8	217.5	1831	1.5
No of Sample less D Lmt %	95.5	43.3	1.2	10.6	39.2	77.1	0	0.8	0	0.4	29.0

※ Number of Samples = 510

Table 2-1-12 Correlation Matrix of Soil Samples (1991)

	Au	Ag	As	Bi	Sb	Hg	Cu	Pb	Zn	Ba	Mo
Au	1.00	0.03	0.05	0.05	0.09	-0.00	0.17	0.02	0.11	-0.03	-0.06
Ag		1.00	0.30	0.24	0.20	0.07	0.11	0.32	0.16	0.33	0.37
As			1.00	0.36	0.41	0.07	0.00	0.56	0.01	0.45	0.56
Bi				1.00	0.06	0.05	-0.12	0.54	-0.01	0.52	0.35
Sb					1.00	0.09	0.24	0.07	0.18	-0.05	0.24
Hg						1.00	0.04	-0.00	-0.07	-0.02	0.07
Cu							1.00	-0.30	0.70	-0.21	-0.03
Pb								1.00	-0.07	0.80	0.55
Zn									1.00	0.07	-0.03
Ba										1.00	0.45
Mo											1.00

Table 2-1-13 Results of Principal Components Analysis of Soil Samples (1991)

	1		2		3		4	
	Eigen-vector	Factor Loading	Eigen-vector	Factor Loading	Eigen-vector	Factor Loading	Eigen-vector	Factor Loading
Au	0.006	0.010	0.212	0.299	-0.118	-0.127	0.927	0.919
Ag	0.286	0.525	0.211	0.297	0.011	0.012	-0.159	-0.158
As	0.408	0.749	0.130	0.183	0.242	0.261	0.038	0.038
Bi	0.366	0.672	-0.054	-0.076	-0.174	-0.188	0.165	0.164
Sb	0.140	0.256	0.383	0.541	0.487	0.526	0.027	0.027
Hg	0.039	0.072	0.048	0.068	0.581	0.628	0.109	0.108
Cu	-0.096	-0.177	0.623	0.880	-0.128	-0.138	-0.095	-0.094
Pb	0.479	0.879	-0.139	-0.196	-0.147	-0.159	0.063	0.063
Zn	-0.004	-0.007	0.566	0.799	-0.384	-0.415	-0.178	-0.177
Ba	0.440	0.808	-0.103	-0.145	-0.325	-0.351	-0.037	-0.036
Mo	0.405	0.744	0.059	0.083	0.177	0.191	-0.168	-0.166
Eigen	3.367		1.994		1.167		0.983	
Prop	0.306		0.181		0.106		0.089	
Cum Pr	0.306		0.487		0.594		0.683	

Table 2-1-14 Sample List of Plant Leaves

Sample No.	Name of Samples
3-① 25-① 28-① 30-① 32-① 34-①	ln:Reubombo sn:Asteraceae eupatorium inulifolium
3-② 6-② 8-② 23-② 25-② 28-② 30-② 32-② 34-② 49-②	ln:Tille sn:Poaceae imperata cylindrica
3-③ 6-③ 8-③ 23-③ 25-③ 28-③ 30-③ 32-③ 34-③ 49-③	ln:Kadak sn:Dovalliaceae nephiolepis sp.
6-④ 8-④ 23-④ 49-④	ln:Potok sn:Polypodiaceae dryopteris sp.
3-⑤ 6-⑤ 8-⑤ 23-⑤ 25-⑤ 28-⑤ 30-⑤ 32-⑤ 34-⑤ 49-⑤	ln:Lito sn:Schizaeaceae lygodium palmatum
3-⑥ 6-⑥ 8-⑥ 23-⑥ 25-⑥ 28-⑥ 30-⑥ 32-⑥ 34-⑥ 49-⑥	ln:Tilutilu sn:Taecaceae tacea pulmata

※1 ln=local name, sn=scientific name
※2 The first two digits of sample number show the hole number. The last digit (①~⑥) shows the kind of plant.

the same as in the mercury gas geochemistry.

1-6 Discussions

The photogeological interpretation has embossed the prominent direction of NNE to N-S system as a ruling structural factor in the western part of the regional survey area. The system comprises a bundle of smaller lineaments, less than several kilometers long, and swarms of fracture traces. This characteristic feature indicates that the structure does not represent a single fracture zone, but expresses a regional stress field possibly of tensional nature. The area from the vicinity of the Mamasa granite up to the north is the zone where the fractures of the NNE to N-S system is pervasively developed. Near Bau and Batuisi, the development of lineaments is especially dense. Since the distribution of NNE to N-S fractures spatially corresponds to the direction of elongation of the Mamasa granite, the formation of fractures may be related to the emplacement of granite batholith.

Prominent direction of vein systems in both Bau and Batuisi prospects is NW to NNW. An anticlinorium recognized in the northwestern part of the survey area, which has an axis of N-S, is probably the product of granite intrusion. Local fold structures also show the similar trend.

Indications of primary gold mineralization were caught at several localities in the northwestern part of the survey area, and semi-detailed survey was carried out in two prospects -- Bau and Batuisi. The indications which show primary gold mineralization are; ① occurrence of gold in pan concentrates, ② distribution of quartz floats, and ③ outcrops of quartz veins.

In these prospects, distribution of gold, cinnabar, and some sulphide minerals in pan concentrates are closely related to each other forming "panning anomalies". Distribution of quartz veins and quartz floats overlaps on these anomalies in a broad scale. Quartz veins generally contain a small amount of sulphide minerals such as pyrite, arsenopyrite, chalcopyrite, and galena. Gold and silver minerals have not been observed in quartz so far.

Based on these evidences, it was assumed that the gold in pan concentrates might come from quartz veins/stockworks intensively developed at the upper reaches of creeks in the prospects.

Thirty-one samples of quartz veins and quartz floats were collected from all over the area and provided for assay in the first phase. The results were disappointing. Almost all samples showed very low gold values.

Characteristic features of gold mineralization in the northwestern part of the survey area -- Bau, Batuisi, and S. Taroto -- are briefly summarized as follows:

① Metasediments hosted.
② Intensive development of massive quartz veins.
③ Associated with sulphide minerals.
④ Lack of silver mineral.
⑤ Hydrothermal alteration mainly composed of silicification and chloritization.

Many gold mineralizations are known in Sulawesi. But almost all of them are volcanic-hosted (Carlile et al., 1990). Gold mineralization in this area is exceptional in that it is hosted by metasediments of Cretaceous age. The prospects are located at the north of the Mamasa granite. It is spatially situated around the fringe part of the batholith. The emplacement of granite is inferred to be late Miocene. Intrusions of small stocks and dykes of granitic rocks occur in the prospects.

Quartz veins sometimes contain a small amount of sulphide minerals in every prospect. Primary sulphide minerals observed under the microscope are; pyrite, arsenopyrite, chalcopyrite, sphalerite, and galena. From the chemical aspect of mineralization, a distinctive feature of this area is lack of silver mineral in sulphide association. Silver content in ore is generally low.

Hydrothermal alteration mainly composed of silicification, pyritization, and chloritization occur in gangue minerals and wallrocks. Neither argillic alteration accompanying with quartz-adularia vein, nor advanced argillic alteration comprising alunite-kaoline-pyrophyllite assemblage resulting from acidic condition has been found in the prospects.

Considering these features, primary gold mineralization in the prospects may not fit with the category of standard epithermal gold mineralization. Mesothermal is probably the most suitable type for the chemical character of the mineralization.

Gold-bearing quartz veins were preliminary grouped as three mineralized zones trending NW in the Batuisi prospect. Individual vein, however, varies in its strike direction as was explained in the previous section. A couple of quartz float zones was found outside the Batuisi prospect. Indications of gold mineralization in panning prospecting also came out at the surrounding areas. Some of them lie at the extensions of known mineralized zones. The extent of mineralized zones could be somehow regional.

Chapter 2 Batuisi Prospect

2-1 Outline of the Prospect

The Batuisi prospect is located between S. Karataun and the upper reaches of S. Pongo in the northwestern part of the survey area. The altitude of S. Karataun is 150 m above sea level (at the bridge of Kp. Batuisi). A high ridge of more than 600 m extends northwestward in the prospect. The prospect lies geologically among the area of metasediments of the Latimojong Formation. The Mamasa granite batholith occurs at the southeastern area adjacent to the prospect. Dacite lava and volcanic breccia of the Barupu Tuffs occur at the high elevations. The distribution of these young volcanics forms very steep ridges.

Semi-detailed geological survey, panning prospecting and reconnaissance soil survey were conducted for the area covering approximately 50 km^2 in the first phase. Positive geological and geochemical results were returned in the first phase survey, although assays on some of quartz veins were disappointing. Two remarkable Au anomalous zones of soil samples were caught. One was distinctive Au soil anomaly at the hill northwest of the upper reaches of S. Tarawa. Another zone was found at the middle reaches of S. Malela. Several other anomalous zones were delineated in the prospect as well. These zones were composed of Au soil anomalies, panning and stream sediment anomalies, and occurrences of quartz veins/stockworks. The strike direction of each zone was interpreted to be NNW from the trend of quartz veins.

On the basis of the results of the first phase exploration, the central part was picked up for the detailed survey area. It consisted of about 15 km^2. The works in the second phase were composed of detailed geological survey, grid soil survey, geochemical rock-chip sampling and shallow trenching. A small scale drilling programme for the reconnaissance purpose was carried out at the hill northwest of the upper reaches of S. Tarawa.

In the third phase, drilling exploration was carried out at the Tondoratte and the middle reaches of S. Bone zones in the Batuisi prospect. Trenching was also conducted at the Malela-Pongo zone in the third phase.

2-2 Geological Survey

2-2-1 Survey Method

Detailed geological survey was undertaken together with grid soil survey and geochemical rock-chip sampling in the Batuisi prospect in the second phase. A base camp was settled in Kp. Batuisi for geological survey. A series of flying camps was also employed for a period of one to two weeks. A 1:5,000 scale route map was produced on the first phase map through grid surveying (200 m x 50 m) with fifty-meter tape and a Brunton-type compass. Major outcrops of quartz veins and trenches were studied in much details (sketches of 1:50 to 1:200 scale were drawn).

During the field work, geology and the degree of hydrothermal alteration were surveyed, and samples for assay and laboratory studies were collected at every major outcrop and quartz float zone. The degree of alteration -- silicification, chloritization, and pyritization -- was carefully judged and recorded on the field note by geologist.

Other features of mineralization and hydrothermal alteration such as sulphide dissemination, clay alteration and quartz networking were also checked in the survey.

The results of the geological survey were compiled on a 1:10,000 scale geologic map. Alteration map was produced and examined as well. A total of 75 km of survey length was achieved, and 80 ore samples were collected. Numbers of samples for polished sections and X-ray powder analysis were 5 and 4 respectively in the second phase.

2-2-2 Geology and Geologic Structure

Latimojong Formation (Kl) : The major part of the prospect consists of shale, siltstone, tuffaceous shale, andesite and dolerite of the Latimojong Formation.

Shale and siltstone commonly show dark grey to brown massive appearance. Some part of shale is weakly metamorphosed, and shows phyllitic features. The trend of shale and siltstone changes variously. In the broad scale, they have a general strike direction of N-S to NW and W dip. Generally speaking, the lower part of the sedimentary facies consists of shale, and the upper part of siltstone.

Andesite to basic lava facies occurs at the upper reaches of S. Tarawa and the middle reaches of S. Malela. It is slightly metamorphosed and some part shows doleritic texture. The volcanic facies of the Latimojong Formation overlies on the sedimentary facies in the Batuisi prospect. The transitional zone is composed of the alternation of tuffaceous shale, shale/siltstone, and lava.

Barupu Tuffs (Qt) : Andesite to dacite lava and volcanic breccia are developed at the high-altitude (about 600 m above sea level) in the prospect. These young volcanics of the Barupu Tuffs occur on the ridge between S. Karataun and S. Pongo. They form very steep, sometimes inaccessible topography.

Intrusive rocks : Small stocks of diorite and andesite dykes were observed in the prospect as for intrusive rocks. A stock of diorite occurs in shale at the middle reaches of S. Tarawa. It is chemically diorite to granodiorite, and is composed of plagioclase, orthoclase, biotite, quartz, and hornblende. Diorite stocks were also found at the area between S. Pongo and S. Makaliki. They show an elongation of the NW direction in common.

Several small dikes of andesite occur within shale at the area along S. Karataun. Most of them are hornblende andesite, and some are biotite andesite.

The Batuisi prospect is situated structurally on the western flank of an anticlinorium. The Mamasa granite batholith is exposed at the southeastern area adjacent to the prospect. The granite crypto-batholith is supposed to lie beneath the prospect area.

Two groups of faults -- E-W and NW-SE -- were recognized within the prospect. Faults of the E-W direction occur at S. Malela and S. Bone. Faults of the NW-SE occur at S. Bone. The latter is crosscut by the former.

The geology of the Batuisi prospect is shown in Fig. 2-2-1.

2-2-3 Mineralization and Associated Alteration

The extensive development of quartz veins and quartz stockworks was observed at the middle reaches of S. Tarawa, the upper reaches of S. Tarawa and the middle reaches of S. Malela.

More than 20 quartz veins were counted at the middle reaches of S. Tarawa and its branch creeks. They show massive features of up to 2.8 m wide. Their strike direction changes variously. The most common trend is NNW with steep E dip. N-S and NW systems are the next major trend. The quartz at the middle reaches of S. Tarawa generally contains a small amount of sulphide minerals such as chalcopyrite, pyrite, arsenopyrite, and sphalerite. Gold grade of quartz veins is generally very low. Shale and siltstone adjacent to quartz veins are strongly silicified. A moderate degree of chloritization was observed in the

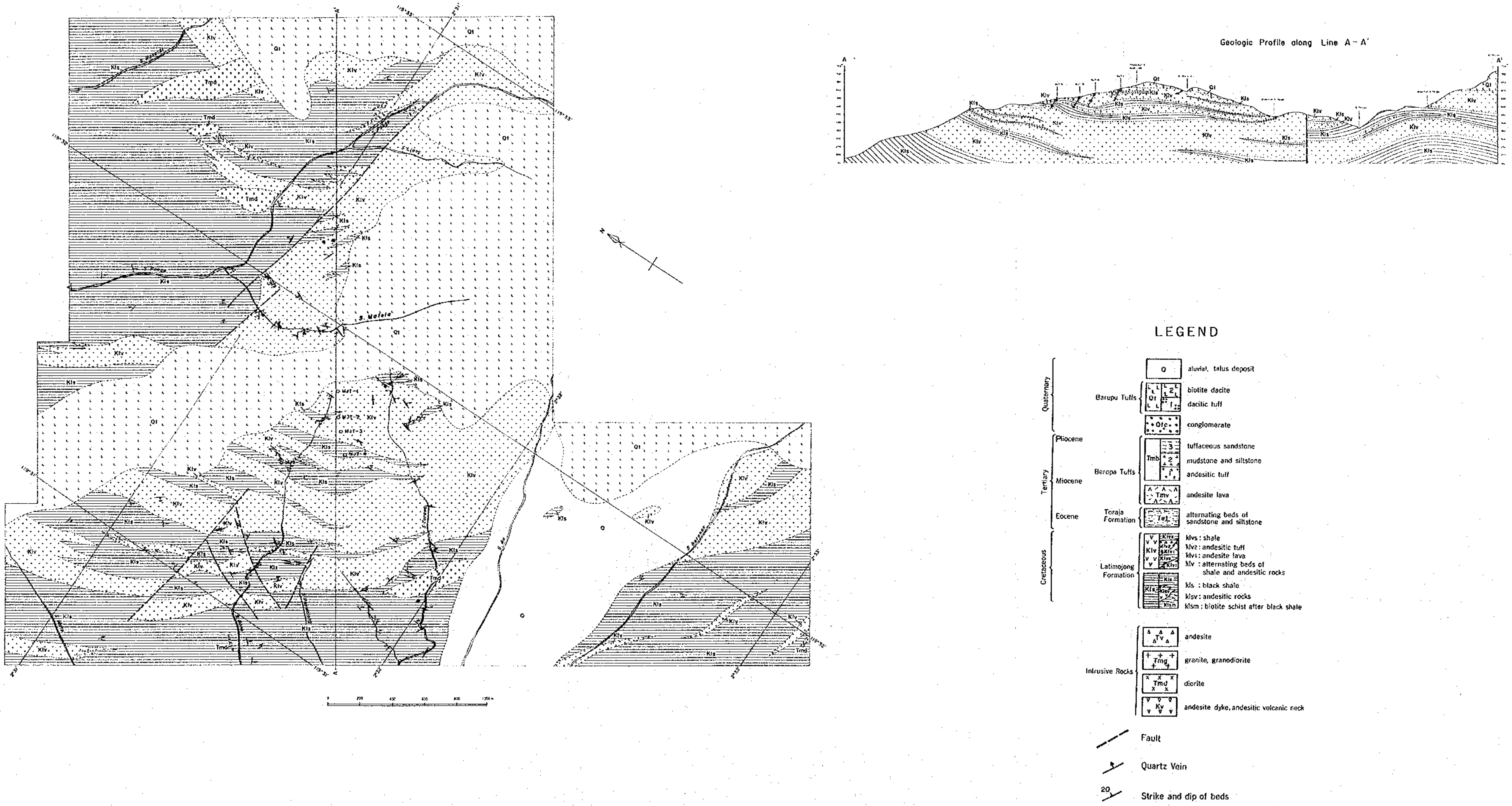


Fig. 2-2-1 Geology and Geologic Profile of the Batuisi Prospect

country rock near quartz veins. These quartz veins extend to the northwest and to the southeast. At the hill between S. Tarawa and S. Bone, a couple of massive quartz veins of 50 cm in width was observed at the "Old Dutch Pit" site. The northwestern extensions of these quartz veins were traced to the middle reaches of S. Bone. The southeastern extensions were caught at the middle reaches of S. Tarawa.

A group of quartz veins/stockworks is developed at the upper reaches of S. Tarawa and the upper reaches of S. Bone. Quartz of this group generally shows white to light grey color, translucent with resin-like brightness. The width is from a few centimeters to 70 cm. Each vein shows various trends, however they have gentle dipping and stockwork nature in common. The major trends recognized in this area are NNW and N-S～NNE. They crop out sporadically at the upper reaches of S. Tarawa and the upper reaches of S. Bone. Many flocks of quartz floats and gravels are distributed at the hill between the two creeks. They were interpreted to be the surface exposures of quartz of this group. Pyrite dissemination was observed in quartz. Some quartz samples of this group showed a significant value of gold from the geochemical point of view as listed in Table 2-2-1. Alteration in the surrounding rock is not so distinctive. Moderate silicification and weak chloritization were observed in this area during the field survey. This group of quartz veins/stockworks later became the main target of trenching and drilling exploration in the Batuisi prospect.

Gold mineralization was recognized in andesite and black shale at S. Malela. Andesite is crosscut by quartz veins, which are white, massive, and medium to coarse grain with pyrite and chalcopyrite. They have widths ranging from 10 cm up to 3 m. Andesite is also crosscut by quartz stockwork system. Quartz veinlets are developed in black shale as well. The trend of quartz veins changes variously. The dominant direction is NNW at S. Malela. Quartz veins were caught at the branch creeks of S. Pongo through the detailed geological survey in the second phase. Two kinds of vein systems were distinguished at the area -- NNE with W dip and E-W with N dip.

Vein quartz in S. Tarawa, S. Bone and S. Malela commonly shows massive appearance. Petrographic studies have indicated characteristic features of these quartz. It sometimes shows clastic (cataclastic) texture. Massive vein quartz is fractured. It is filled by microcrystalline quartz. Chlorite, clay minerals and opaque ore minerals were observed in fractures of the massive quartz. One of the opaque ore minerals which is associated with the later stage quartz is fine grain pyrite. It is partly oxidized to iron oxide minerals (limonite). Adularia was recognized to be associated with quartz in some massive quartz vein under the microscope. Calcite and anhydrite veinlets were observed to crosscut quartz vein in some cases.

Some characteristic association of sulphide minerals was observed in quartz stockwork at S. Malela. It is composed of pyrite, arsenopyrite, chalcopyrite, and bornite. Pyrite is partly replaced by iron oxide minerals (limonite), and chalcopyrite is replaced by covelline and malachite. The results of ore microscopy are listed in Table 2-1-6.

Silicification, chloritization and sericitization were distinguished through the X-ray powder diffraction analysis as for the wall rock alteration associated with quartz veins/stockworks. The results are shown in Table 2-1-5.

2-3 Soil Survey

2-3-1 Sampling and Chemical Analysis

Detailed soil sampling was carried out for the entire 15 km^2 area in the Batuisi prospect in the second phase. Soil samples were taken from the B-layer of residual soil at a depth of 40 to 80 cm from the surface using hand-auger. Sample lines were set systematically at line spacing of 200 m and sample intervals of 50 m. The base line, which was orientated at 54 degree (N54°E), was set up through surveying with transit and fifty-meter tape.

The sampling was carried out by a team generally composed of one geologist, one surveyor and several field hands. While a hole was dug and a soil sample was picked up by surveyor, the observation of samples was made and it was recorded on the field note by geologist. The record form for soil samples consisted of the following descriptions:

① Location (grid coordinates)
② Sample number
③ Sample type (residual, talus, alluvial or cultivated)
④ Site topography (hill top, slope, base of slope, valley floor or level)
⑤ Horizon (A, BF, BT, BM or C)
⑥ Depth
⑦ Color
⑧ Texture (organic, sandy, silty, clay or gravel)
⑨ Coarse fragment (lithic fragment, quartz, pisolite or others)
⑩ Bedrock.

Soil samples were air-dried at the base camp, then crashed to -80 mesh.

Chemical analysis was conducted at Chemex Labs Ltd. for eight elements; Au, Ag, As, Sb, Hg, Cu, Pb, and Zn. A total of 1,514 soil samples was collected and provided for chemical analysis in the second phase.

2-3-2 Statistical Data Processing

On the assumption that the distribution of geochemical data shows a close approximation to logarithmic normal distribution, natural logarithmic conversion of the respective analytical values was adopted in the statistical data processing. When an analytical value was less than the detection limit, a value half of the lower limit was substituted in the calculation.

At first, statistical properties of geochemical data were checked. Basic statistical figures were calculated. Distribution histograms of each element were drawn out. Correlation coefficients among eight elements were examined. Then principal components analysis was practiced for extracting some statistically efficient combinations of elements.

Basic statistical figures

The proportion of samples with values less than the lower detection limit to the total population is significantly high for Au and Sb. Elements such as Ag, As, Hg and basemetals show a distribution of close-to-normal. Whereas Au and Sb show an L-shape distribution. The basic statistical figures are listed in Table 2-2-2.

Table 2-2-3 shows the matrix of correlation coefficients among eight elements. Some kinds of correlation, though weak, were recognized between Ag-As, As-Pb and Cu-Zn.

Principal components analysis

Two principal components were picked up on the basis of the eigenvalues more than 1.0. Values of the eigenvector, factor loading, proportion and cumulative proportion were calculated for the two principal components. The results were shown in Table 2-2-4.

① The first principal component : Values of the factor loadings more than 0.5 were obtained for Au, As, Sb, Hg, Cu, and Zn. The proportion of the first principal component is 0.31. It is indicative that the first principal component has some association with the behaviour of Au and the other five basemetal elements.

② The second principal component : This component is positively correlated to only Cu.

The results of these analyses indicate the possibility of statistically significant correspondence among Au and some of the basemetal elements.

2-3-3 Anomalies of Soil Geochemistry

The threshold values were determined automatically through the calculation of ① the mean value of each element plus a value of the standard deviation, and ② the mean value plus twice the standard deviation. Values of each sample were expressed by one of three kinds of symbols on the map.

Three major anomalies and several minor anomalies of Au were distinguished in the prospect. Anomalies of Cu and Zn almost overlap on the Au anomalies. It is possible to explain this conformability by the mineral association of auriferous quartz veins/stockworks. The mode of distribution of the other elements such as As and Hg, whose weak correlation to Au were indicated through the principal components analysis, is different from that of Au.
These anomalies are located within an area of 2,500 m (NE-SW) × 1,500 m (NW-SE) centered at the Tondoratte (top of the ridge).

The anomalies of soil geochemistry, together with those of rock-chip geochemistry, are shown in Fig. 2-2-2.

Upper reaches of S. Tarawa

An outstanding Au anomaly appeared at the area extending over the upper reaches of S. Tarawa and the upper reaches of S. Bone. It forms an irregular shaped area of approximately 1,000 m (E-W) × 500 m (N-S). The core zone (Au > 37 ppb) is 400 m × 400 m. The soil anomaly found at the hill NW of S. Tarawa in 1991 is located inside this zone. The maximum value is 1,340 ppb Au. This anomaly is correlated to the area where the intensive quartz stockworking was found. Anomalies of Cu and Zn were also recognized at this area. Some part of the Tondoratte area is excluded in the anomaly, because the original geochemical condition has been disturbed by the slash-and-burn farming.

S. Malela

A narrow and long anomaly was caught along S. Malela. It is correlated to the area of intensive quartz veining.

A distinctive Au anomaly was found at the area between S. Malela and S.

Pongo. It spreads over an area of approximately 500 m (E-W) × 400 m (N-S). It is composed of significant Au anomalies up to 708 ppb. Anomalies of Cu and Zn also appear at this area.

Middle reaches of S. Bone

A group of Au anomalies was caught at the area extending over the middle reaches of S. Tarawa and the middle reaches of S. Bone. It has an area of approximately 600 m (E-W) × 400 m (N-S). Several quartz veins including the one at the Old Dutch Pit are located within this anomaly.

Middle reaches of S. Tarawa

Several Au anomalies were detected at the middle reaches of S. Tarawa. They are roughly correlated to the occurrences of quartz veins. These anomalies are sporadic and generally composed of low level Au values.

2-4 Geochemical Rock-Chip Sampling

2-4-1 Sampling and Chemical Analysis

Geochemical rock-chip sampling was conducted during the detailed geological survey in the Batuisi prospect. The samples were collected from most of the outcrops of quartz veins, mineralized/altered rocks and major quartz float zones within the prospect.

The observation for the degree of alteration was recorded on the field note by geologist during the survey. The description was made on the same criteria as in geological survey (refer to the previous section). A total of 214 rock-chip samples was collected in the prospect.

Geochemical rock-chip samples were provided for chemical analysis. The analysis was conducted at Chemex Labs Ltd. for eight elements; Au, Ag, As, Sb, Hg, Cu, Pb, and Zn. The major results of analysis are shown in Table 2-2-5.

2-4-2 Statistical Data Processing

The same methods and procedures as in soil samples were adopted in the data processing of rock-chip samples.

2-4-3 Anomalies of Rock-Chip Geochemistry

The sampling points are not sufficiently distributed for contour analysis. Therefore the rock-chip geochemistry was examined together with the results of ore assay samples and soil geochemistry. Several significant anomalies of Au were caught from the results of rock-chip sampling. Anomalies of Ag, Cu and Zn are intimately associated with Au anomalies.

Upper reaches of S. Tarawa

There are many outcrops of quartz veins and quartz float zones within and around this area. Some of them showed anomalous values of Au (up to 300 ppb), Ag (up to 9.58 ppm) and Cu (up to 4,250 ppm).

S. Malela

Anomalous values of Ag, Cu and Zn were obtained from silicified rocks and quartz floats in the soil anomaly stretching between S. Malela and S. Pongo.

Middle reaches of S. Bone

Au anomalies up to 1,685 ppb were returned from quartz floats at the middle reaches of S. Bone. Pyrite, limonite and malachite were observed in these quartz samples. An anomalous value of Au (172 ppb) was also obtained from the sub-outcrop of quartz vein extending from the Old Dutch Pit.

Middle reaches of S. Tarawa

Anomalous values of Au (227 ppb), Ag (9.40 ppm) and Cu (3,760 ppm) were found from a quartz float zone at S. Kayulalang.

An anomalous value of Au (127 ppb) was obtained from the outcrop of quartz vein at the middle reaches of S. Tarawa. It is only 100 m downstream from the outcrop of quartz vein from which a significant assay value of Au (1.34 g/t) was returned.

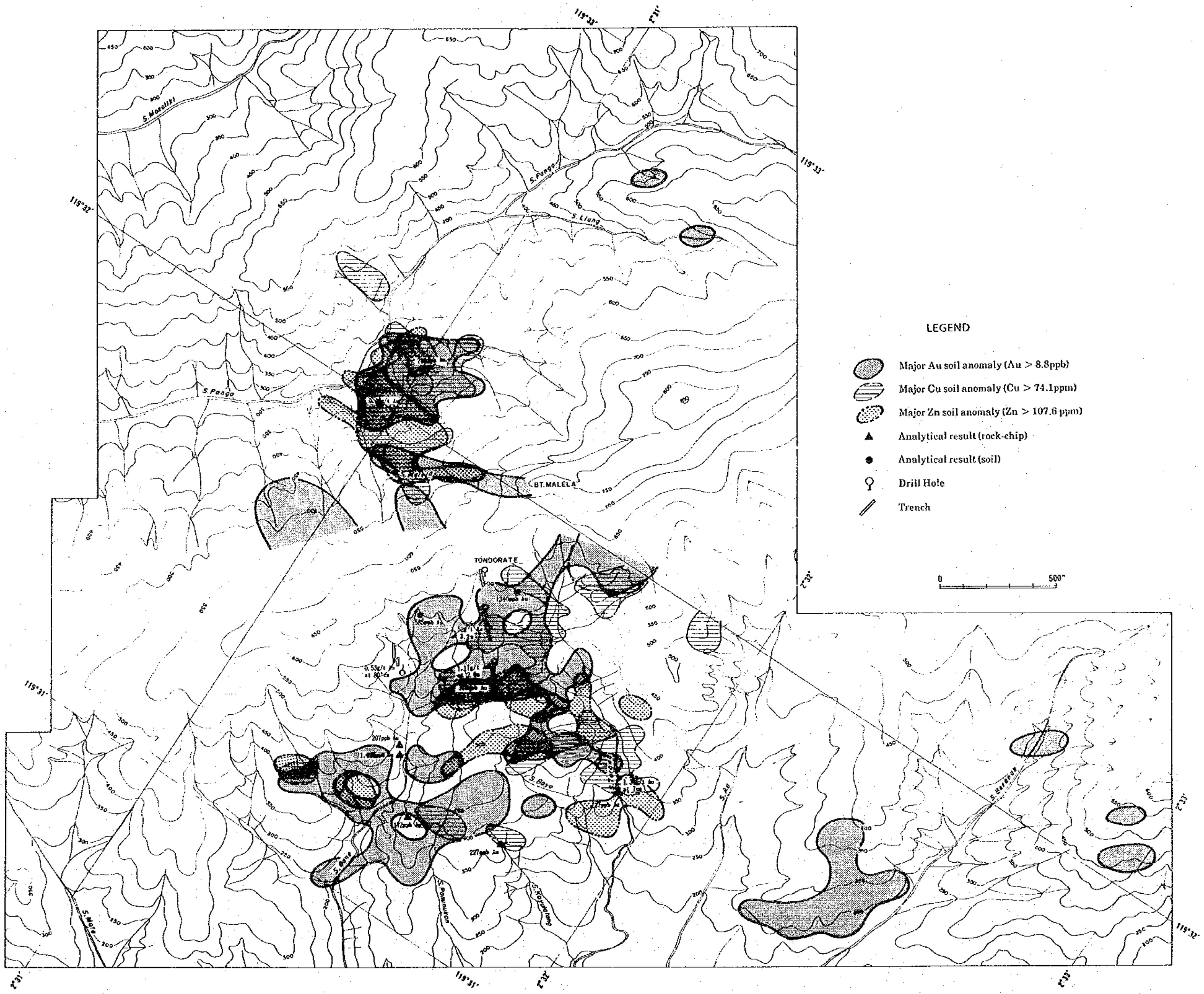


Fig. 2-2-2 Anomalies of Soil and Rock-Chip Geochemistry in the Batuisi Prospect

Table 2-2-1 Assay Results of Ore Samples in the Batuisi Prospect (1992)-1

Sample No.	Width (cm)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Fe (%)	Sample type and locality
BAA2A	12	<0.06	2	0.077	0.001	0.148	4.99	Qz vein, Old Dutch Pit
BAA7A	12	<0.06	<2	0.003	<0.001	0.007	4.92	Qz vein, Old Dutch Pit
BAA32A	5	0.19	2	0.014	0.004	0.010	11.70	Qz veinlet, T-1, 5.4m
BAA35A	25	0.19	<2	0.003	<0.001	0.001	0.87	Qz vein, T-1, 32.0m
BAA59A	42	<0.06	<2	0.015	0.003	0.007	4.97	Qz stockwork, T-2, 78.0m
BAA62A	12	<0.06	<2	0.019	0.002	0.010	5.32	Qz vein, T-2, 78.0m
BAA63A	230	0.12	<2	0.038	0.004	0.011	5.97	Qz stockwork, T-1, 23.7m
BAA64A	15	0.12	<2	0.028	0.003	0.008	4.15	Qz vein, T-1, 25.0m
BAA66A	200	0.09	<2	0.081	0.004	0.014	5.22	Qz stockwork, T-1, 24.0m
BAA68A	80*	0.53	<2	0.065	<0.001	0.025	4.12	Qz vein, S.Bone
BAA72A	200	<0.06	2	0.009	0.001	0.007	5.60	Qz stockwork, T-3, 37.0m
BAA77A	330	0.16	2	0.027	0.001	0.012	5.97	Qz stockwork, T-1, 17.2m
BAA79A	320	1.52	<2	0.024	0.002	0.011	7.98	Qz stockwork, T-1, 30.4m
BAA81A	200	<0.06	<2	0.016	0.002	0.006	5.96	Qz stockwork, T-2, 26.5m
BAA83A	330	<0.06	2	0.012	0.002	0.009	7.32	Qz stockwork, T-3, 36.7m
BAA84A	300	<0.06	2	0.005	0.002	0.007	4.93	Qz stockwork, T-3, 48.5m
BAA85A	16	<0.06	<2	0.009	0.004	0.008	5.08	Qz vein, T-4, 77.2m
BAA94A	28	<0.06	<2	0.153	0.001	0.025	5.36	Qz vein, T-4, 91.6m
BAA96A	200	0.72	<2	0.008	0.002	0.008	3.59	Sili zone, T-4, 111.0m
BAA99A	24	<0.06	2	0.045	0.002	0.014	4.95	Qz vein, T-6, 22.0m
BTB6A	--	0.19	16	>3.00	0.001	0.041	6.04	Qz float, N2, 22-23
BTB12A	--	<0.06	<2	0.088	<0.001	0.025	7.78	Qz float, N1, 12-13
BTB17A	--	0.16	8	1.735	<0.001	0.031	3.80	Qz float, S2, 10-11
BTB19A	20	<0.06	<2	0.147	0.001	0.063	5.29	Shear zone, S2, 10-11
BTB20A	60	<0.06	<2	0.037	<0.001	0.017	5.34	Qz vein, S2, 10-11
BTB22A	15	<0.06	2	0.511	<0.001	0.012	1.60	Qz vein, S2, 10-11
BTB23A	--	<0.06	2	0.558	<0.001	0.571	5.05	Qz float, S4, 3-4
BTB34A	--	<0.06	4	0.659	0.001	0.123	8.76	Sili float, S3, 21-22
BTB35A	--	0.16	4	0.232	<0.001	0.041	10.80	Qz float, S3, 24-25
BTB38A	40	<0.06	<2	0.039	<0.001	0.013	6.14	Qz vein, S3, 33-34
BTB45A	--	<0.06	6	0.956	0.001	0.023	3.31	Qz float, S4, 30-31
BTB54A	--	0.22	22	1.570	<0.001	0.100	9.85	Qz float, NS0, 23-24
BTC3A	50	<0.06	<2	0.041	0.001	0.780	6.38	Qz vein, N16, 7-8
BTK8A	7	1.34	8	1.460	0.002	1.255	13.00	Qz-Py-Cp vein, S.Tarawa

Table 2-2-1 Assay Results of Ore Samples in the Batuisi Prospect (1992)-2

Sample No.	Width (cm)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Fe (%)	Sample type and locality
BTK25bA	50	<0.06	2	0.527	<0.001	0.205	1.86	Qz vein, S.Kayulalong
BTK26A	200+	<0.06	4	0.926	0.002	0.061	3.13	Qz vein, S.Kayulalong
BTK27A	100+	<0.06	2	0.594	0.001	0.041	2.11	Qz vein, S.Kayulalong
BTF14A	--	<0.06	2	0.022	<0.001	0.010	6.76	Qz stockwork, S.Malela
BTF16A	70	<0.06	6	1.215	0.001	0.027	3.25	Qz stockwork, S.Malela
BTF18A	35	<0.06	2	0.501	0.001	0.008	1.82	Qz vein, N2,47-48
BTF18rA	40	<0.06	2	0.023	0.002	0.002	2.60	Qz vein, N4,44-45
BTF20A	--	<0.06	2	0.587	0.001	0.009	2.04	Qz float, N4-6,48-49
BTF22A	15	<0.06	<2	0.020	<0.001	0.142	7.56	Qz vein, NS0-N2,42-43
BTF25A	10	<0.06	4	0.446	0.001	0.009	1.39	Qz vein, NS0,42-43
BTG1A	--	<0.06	2	0.004	0.001	0.007	6.13	Qz veinlet, N4,49-50
BTG7A	--	0.40	8	1.740	<0.001	0.032	4.35	Qz float, N4-6,50-51
BTH36A	15	<0.06	2	0.010	0.001	0.007	4.79	Qz stockwork, S.Batupapan
BTH39A	20	<0.06	<2	0.007	0.001	0.010	6.05	Sili rock, S.Batupapan

Table 2-2-2 Basic Statistics of Soil Samples in the Batuisi Prospect (1992)

	Au (ppb)	Ag (ppm)	As (ppm)	Sb (ppm)	Hg (ppb)	Cu (ppm)	Pb (ppm)	Zn (ppm)
Log Mean (M)	2.1	0.05	4.2	0.2	57.6	30.8	9.6	66.8
Max Value	1340	0.50	71.0	12.8	1500	838	77.5	1185
Min Value	<1	<0.02	<0.2	<0.2	10	2.0	<0.5	10
Std Dev (σ)	0.6	0.34	0.5	0.4	0.2	0.4	0.6	0.2
M+σ	8.8	0.10	13.1	0.5	92.9	74.1	38.3	107.6
M+2σ	37.7	0.22	40.6	1.3	149.8	178.1	153.3	173.4
No of Samples less D Lmt %	36.0	7.0	1.7	44.2	0	0	1.5	0

※ Number of Samples = 1,514

Table 2-2-3 Correlation Matrix of Soil Samples in the Batuisi Prospect (1992)

	Au	Ag	As	Sb	Hg	Cu	Pb	Zn
Au	1.00	0.09	0.15	0.46	0.16	0.36	-0.14	0.20
Ag		1.00	0.52	0.11	0.33	-0.02	0.42	0.08
As			1.00	0.33	0.42	0.04	0.55	0.04
Sb				1.00	0.31	0.43	-0.04	0.26
Hg					1.00	0.17	0.28	0.07
Cu						1.00	-0.53	0.67
Pb							1.00	-0.28
Zn								1.00

Table 2-2-4 Results of Principal Components Analysis of Soil Samples in the Batuisi Prospect (1992)

	1		2	
	Eigen-vector	Factor Loading	Eigen-vector	Factor Loading
Au	0.379	0.600	0.128	0.196
Ag	0.273	0.432	-0.384	-0.588
As	0.353	0.559	-0.422	-0.646
Sb	0.470	0.745	0.056	0.085
Hg	0.358	0.568	-0.257	-0.392
Cu	0.425	0.673	0.394	0.603
Pb	0.008	0.012	-0.585	-0.894
Zn	0.358	0.567	0.302	0.461
Eigen	2.510		2.338	
Prop	0.314		0.292	
Cum Pr	0.314		0.606	

2-5 Trenching

2-5-1 Tondoratte Zone

(1) Survey Method

Six lines of shallow trenches (costeans) were excavated by hand-digging at the Tondoratte zone in the Batuisi prospect in the second phase. The total length is 438.0 m. Trenches were dug at the two most significant Au anomalous zones of soil samples -- at the hill NW of S. Tarawa and at the northern side of S. Bone. They aimed at; ① getting a series of continuous samples for weathered bed-rock geochemistry, and ② examining the mode of occurrence of gold in quartz vein and adjoining alteration zone. Details of the trenches are listed in the following table:

Trench No.	Locality	Elevation	Azimuth	Length	No. of Samples
T-1	Hill	560 m	40 °	43.8 m	11 pcs
T-2	Northwest	565	43	99.3	25
T-3	of S. Tarawa	600	44	47.7	13
T-4		555	51/44	120.8	29
T-5	N of S. Bone	480	44/60	95.6	23
T-6		470	56	30.8	8
Total				438.0	109

One side of trench walls was sketched by geologist at a scale of 1:100. The observation of vein quartz was made based on the following description criteria:

① Color
② Clearness (transparent, translucent, opaque or milky)
③ Glossiness (chalcedonic, resin bright or glossy)
④ Grain size (fine, medium, coarse or crystalline)
⑤ Texture (massive, fine banded, banded, granular or brecciated)
⑥ Appearance (compact, hard, vuggy or brittle)
⑦ Inclusions
⑧ Sulphides

When met a clay vein, its color, texture, softness (touch) and the degree of sulphide dissemination were observed and recorded on the field note.

Weathered bedrock samples were taken from trenches for analysis of geochemical level. A total of 109 samples was collected from trenches. Samples of quartz veins and adjoining alteration zones were taken for ore assay. Chip samples from some of quartz veins were provided for fluid inclusion studies. Samples of quartz veins and altered rocks were provided for X-ray diffraction analysis. Numbers of samples for ore assay, fluid inclusion study, ore microscopy and X-ray analysis were 44, 27, 3 and 8 respectively.

(2) Geologic Profile of Trenches

Trenches were dug by worker's hand. The depths are from 1.6 m to 2.8 m. The geologic profile is composed of soil layer and near surface weathered bedrock. Gravel zone (colluvium) occurs in the surface soil in some part of the trenches T-2 and T-3.

Soil layer consists of brown to khaki residual soil. It corresponds to the A- and B-layer of brown soil in the pedological classification. The A-layer is poorly developed in this area. The soil layer extends 20 to 60 cm below the surface.

Gravel zone was observed in the profiles in some part of T-2 and T-3. The zone is composed of various kinds of rock gravels -- shale/siltstone, dolerite, andesite, dacite (of the Barupu Tuffs), vein quartz -- and soil. They show from rounded (typical to andesite and dacite) to angular features (typical to quartz). The size varies from few centimeters up to 1 m (= boulder size). Fragments of vein quartz sometimes occur at the bottom of the gravel zone. The gravel zone was interpreted to be the talus deposit. The source of gravels could be the topographic high near the present location. The distance from the source to the place of accumulation is not likely to be so far, probably less than a few hundred meters, judging from the topography. One of the soil anomalies (180 ppb Au at C-76 in the first phase survey) has been found to be located within the gravel zone in T-2.

Weathered bedrock occurs below the soil and/or gravel layer. It is saprolite, and its original bedrock texture is kept. The geology in this area consists of shale, siltstone, tuffaceous shale and andesite of the Latimojong Formation. Saprolite shows brown to reddish brown color. Some part of the weathered bedrock, especially one which is close to the mineralized zone, shows limonitic. Weathering was observed pervasively in the trench profiles. Saprolite sometimes shows reddish lateritic property. Quartz veins in saprolite are broken and sugary. Pyrite is oxidized into limonite. It is only identical as a relict.

(3) Mineralization

Quartz veins and quartz stockworks were caught in several locations in trenches.

In T-1, three zones of intense quartz veining were found. Those are; 17.2 ~ 20.5 m (3.3 m in zone width), 23.5 ~ 27.0 m (3.5 m in zone width), and 30.4 ~ 33.6 m (3.2 m in zone width). Quartz veins and stockworks are developed in reddish brown strongly weathered andesite and tuffaceous shale. Quartz is generally white to light grey color with resin bright tint. Each quartz vein has lensy-shape, from a few centimeters up to 65 cm in width. They show gentle dipping and network/stockwork structure. Pyrite, most of it changed into limonite, is sometimes weakly disseminated in quartz veins. Saprolite adjacent to the lenticular quartz is silicified, and shows weak foliation. The plane of foliation is almost parallel to the quartz vein. A careful observation suggested that the foliation was the product of shearing. Thin fractures of millimeters thickness are often developed in the sheared saprolite. The fractures are filled by limonite (probably after pyrite) and quartz.

In T-2, also three zones of quartz veining were found. The most significant one was caught at 76.3 ~ 79.7 m (3.4 m in zone width). Quartz veins (up to 38 cm in width) occur in mottled saprolite of yellowish to reddish brown color below gravel zone. Quartz shows white color with resin brightness. It contains pyrite dissemination. Saprolite around quartz veins exhibits strongly limonitic features as observed in T-1. Quartz veins show NNW strike direction and dip E at 40 ~ 60°.

Two zones of quartz veining -- 36.7 ~ 40.0 m (3.3 m in zone width) and 48.5 ~ 51.5 m (3.0 m in zone width) -- were distinguished in T-3. Quartz shows lensy-shape of up to 42 cm in width. It has white color with slightly brownish tint. The surrounding rock is reddish brown limonitic saprolite (same as in T-1 and T-2). This zone crops out at the creek (the uppermost reaches of S. Bone) 20 m north of the trench.

T-4 was dug in the boundary between shale and andesite. The lower part of the trench profile consists of shale (partly tuffaceous). Andesite lava flow occurs over the shale member. Four distinctive quartz veins and one intensively silicified zone were caught between 75 m and the end of T-4 trench (121m). White quartz veins of up to 28 cm wide occur in brown to reddish brown mottled saprolite. Quartz veins strike NW-SE. Three of them dip NE. Whereas one dips

SW. A silicified zone develops at the NE end of the trench over 10 m. It consists of light grey strongly silicified rock (originally shale) and white to light grey quartz stockworks. Limonite veinlets of a few millimeters thick was observed in the silicified matrix.

Two lines of trenches, T-5 and T-6, were dug at the northern flank of S. Bone. Both trenches were aimed at catching the northern extension of a significant quartz vein outcrop at the north of S. Bone. The quartz vein, observed at the outcrop and in the trenches, is massive up to 230 cm wide. Pyrite of fine grain is strongly disseminated in some part of the vein. It strikes N to NNE, and dips W at 28 ~ 41°. The surrounding shale (black or dark grey) is partly silicified. This quartz vein is traced up to 150 m along the strike direction.

The occurrence of gold in quartz veins/stockworks was first recognized through panning examination. Bucketsful of samples from trenches were crashed and panned out at the site. Samples were collected from various parts of the geologic profiles. Gold grains were returned from some of the panned samples. This examination has revealed several characteristic features concerning the mode of occurrence of gold. ① Gold is fairly coarse -- up to 500 microns in diameter. ② Gold is closely associated with pyrite and limonite. ③ Gold is not only carried by quartz veins, but also found in the host rock adjacent to the quartz veins. Some of gold grains were discovered from the strongly limonitic saprolite in the quartz stockwork zone. These features were later confirmed by assaying and laboratory test. Some of the significant assay results of samples from trenches are shown in Table 2-2-5.

Under the ore microscope, a quartz sample from quartz stockwork in T-2 shows that very fine pyrite is disseminated. The pyrite is almost replaced by iron oxide. The other quartz samples from quartz veins in T-5 and T-6 show that a small amount of pyrite, arsenopyrite, chalcopyrite and sphalerite is contained. Covelline and iron oxide (limonite) were also observed in the quartz under the microscope.

One of the representative quartz of quartz veins/stockworks was examined petrographically. The sample was taken from a quartz vein at around 79 m in T-2. The thin section shows clastic texture. Quartz is medium grain (up to 2 mm in diameter). The vein quartz is fractured. The cracks are filled by fine grained quartz and opaque ore minerals (probably limonite).

X-ray diffraction analysis indicates that the alteration assemblage is mainly composed of quartz, chlorite, sericite, and carbonates. Kaoline, which was often observed in trenches, is interpreted as the product of strong weathering.

2-5-2 Malela-Pongo Zone

(1) Survey Method

Three lines of shallow trenches were excavated by traditional hand-digging method at the Malela-Pongo zone. They cross the Au anomaly area of soil samples for 159.9 m in total length. Two lines of trenches MT-1 and MT-2 were dug at the northeastern side of S. Malela. They aimed at testing some of the significant quartz veins cropped out along S. Malela. Another trench MT-3 was dug at the southwest of a branch creek of S. Pongo where distinctive Au anomalies of soil samples (708 ppb Au, etc.) were detected.

One side of trench walls was sketched at a scale of 1:100. Samples of quartz veins and adjoining alteration zones were collected, crashed, then panned out for examining sulphide minerals and gold in the field. Samples were taken for ore assay. A total of 21 samples for ore assay was obtained from trenches.

The details of the trenches are listed in the following table:

Trench No.	Locality	Elevation	Azimuth	Length	No. of Samples
MT-1	NE of S.Malela	485 m	320 °	55.7 m	8 pcs
MT-2	ditto	432	280	59.2	6
MT-3	SW of S.Pongo	430	345	45.0	7
Total				159.9 m	21 pcs

Samples were also taken from some localities along the wall of the new road construction sites in this area. The outline of such road cutting is as follows:

MT-4	Upper Reaches	595 m	350 °	17.2 m	4 pcs
MT-5	of	603	350	5.0	1
MT-6	S. Malela	610	350	25.5	6
Total				47.7 m	11 pcs

(2) Geologic Profile of Trenches

The geologic profile of trenches MT-1, 2 and 3 generally consists of thin

Table 2-2-5 Analytical Results of Geochemical Rock-Chip Samples in the Batuisi Prospect (1992)

Sample No.	Au (ppb)	Ag (ppm)	As (ppm)	Sb (ppm)	Hg (ppb)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Sample type and locality
BAA42Q	172	0.28	5.4	<0.2	820	543	19.0	2190	Qz float, S. Bone(J1)
BTB17Q	227	9.40	33.4	<0.2	460	3760	3.5	280	Qz float, S2, 10-11
BTB34Q	16	4.32	19.6	<0.2	420	4310	2.5	993	Sili float, S3, 21-22
BTB45Q	11	3.10	20.0	<0.2	70	4340	2.0	161	Qz float, S4, 30-31
BTB54Q	300	9.58	532	3.8	1700	4250	9.0	973	Qz float, NS0, 23-24
BTC43Q	1685	1.14	11.4	0.2	50	2050	1.0	105	Qz float, N3, 18-19
BTC44Q	207	0.22	4.2	0.2	30	359	0.5	130	Qz float, N3, 19-20
BTD36Q	127	0.04	353	1.8	10	37.2	1.8	17	Qz vein, S. Tarawa
BTF13Q	4	1.42	20.8	<0.2	740	4320	1.0	1805	Sili rock, N3, 46-47
BTG24Q	59	0.24	12	<2	<1000	3290	<2	6740	Qz float, N4, 46-47
BTH9Q	3	2.56	24.0	76.2	100	108.0	4.5	13	Qz float, N1, 52-53
BAA1T	146	0.02	20.6	0.8	80	56.2	25.0	110	T-1, 0.4-4.0m
BAA2T	109	0.02	25.4	1.0	80	56.6	31.0	84	T-1, 4.0-8.0m
BAA3T	154	0.02	21.8	0.8	70	57.4	25.0	77	T-1, 8.0-12.0m
BAA4T	368	0.06	20.2	1.2	70	96.4	20.0	70	T-1, 12.0-16.0m
BAA5T	246	0.02	44.4	1.4	80	140.0	25.0	100	T-1, 16.0-20.0m
BAA6T	184	0.02	40.8	1.6	100	187.0	34.5	117	T-1, 20.0-24.0m
BAA7T	163	0.02	44.4	1.6	110	398	85.0	120	T-1, 24.0-28.0m
BAA8T	570	0.08	108.5	1.6	130	170.0	50.0	95	T-1, 28.0-32.0m
BAA9T	987	<0.02	164.0	1.6	120	115.0	26.5	54	T-1, 32.0-36.0m
BAA10T	494	0.02	106.0	3.2	160	153.0	46.0	77	T-1, 36.0-40.0m
BAA11T	118	0.02	28.6	3.4	130	188.0	48.0	79	T-1, 40.0-44.2m
BAA12T	133	<0.02	40.0	5.2	150	152.5	40.0	79	T-2, 0.35-4.0m
BAA13T	139	0.02	28.6	3.8	170	163.0	33.0	65	T-2, 4.0-8.0m
I36T	479	0.08	108.0	1.0	100	73.2	20.5	90	T-4, 108.0-111.0m
I37T	1165	0.20	291	1.4	90	110.5	9.5	185	T-4, 111.0-113.0m
I38T	386	0.02	205	0.6	90	126.0	11.5	205	T-4, 113.0-115.0m

top soil, saprolite, and weathered andesite. Top soil layer is generally composed of brown to brownish grey soil with occasional thin humes on the top of the layer. It contains subangular to subrounded gravels of dacitic/andesitic rocks. Quartz gravels were sometimes found at the bottom of the soil. Saprolite and weathered andesite underlie the soil layer. Quartz veinlets and stockworks containing pyrite, chalcopyrite, limonite and malachite sometimes occur in weathered bedrock.

The geologic profile of road cutting consists of tuff and volcanic rock on the top, and weathered andesite at the bottom. Tuff had been eroded in some location, and volcanic rock just overlies the andesitic basement. The upper units belong to the Barupu Tuffs. Andesite below the Barupu Tuffs is highly fractured and weathered. Magnetite and limonite commonly fill the fractures.

(3) Mineralization

In MT-1, several quartz veins and quartz stockworks were caught in andesite. Two massive quartz veins occur in the trench; 0.25 ~ 0.7 m (0.45 m, N65°E, 53°NW) and 26.4 ~ 26.65 m (0.25 m, N70°E, 50°S). Veins are composed of massive, sugary quartz containing pyrite, chalcopyrite, limonite, and malachite. A quartz stockwork zone, which is accompanied by the dissemination of pyrite and chalcopyrite, occurs in the trench at 2.5 ~ 5.1 m (2.6 m). The surrounding andesite is strongly silicified. Kaolinization was recognized around this zone.Another zone of quartz veinlets and networks occur sporadically between 10 m and 20 m in the trench. They have various trends, but commonly show a gentle dipping.

Only few quartz veinlets were caught in MT-2. Pyritization was recognized within altered andesite in the trench.

Two minor zones of quartz veinlets were found in MT-3; 5.0 ~ 5.55 m, and 36.8 ~ 45.0 m. Both zones contain a small amount of limonite and malachite. The latter zone occurs in reddish brown earthy saprolite below weathered andesite.

A massive quartz, about 10 m wide, was caught at the wall of new road cutting named MT-4. White quartz is hosted by andesite. Quartz veinlets are developed in the surrounding altered andesite, in which limonite is strongly disseminated. A coarse carat of gold grain was found in the limonitic part collected from this zone.

Several quartz veins crop out along the road construction sites named MT-5 and MT-6 in the Malela-Pongo area. Most of these veins show flat dipping. Pyrite and limonite are disseminated in saprolite. Some significant gold values were obtained from these samples.

2-6 Fluid Inclusion Studies

2-6-1 Methodology

Quartz chips were collected, and provided for fluid inclusion studies. A total of 144 chips was sampled in the second phase in the Batuisi prospect. The breakdown was; 90 from outcrops and floats, 27 from trenches, and remaining 27 from drill cores. Four chips were collected at S. Taroto in the S. Lebutang prospect in the second phase. In the third phase, a total of 20 quartz chips was sampled from drill cores in the Batuisi prospect.

The observation of quartz chips was made in the field according to the description criteria explained in the previous section. The observation of fluid inclusions under the microscope was undertaken in the laboratory. The morphological observation of fluid inclusions may yield an important information regarding the environment under which fluid inclusions and their host minerals were formed. Therefore, it is better to conduct a careful work before going into thermometric study. General process of the microscopic observation consisted of the following contents:

① Distinction between primary/pseudosecondary inclusions and secondary ones
② Observation of size, shape and surface smoothness
③ Estimation of filling degrees (approximate liquid to vapour volumetric ratios of inclusions)
④ Identification of solid crystal in inclusions when exists
⑤ Search for any evidence indicating fluid boiling phenomena

Most of the important samples were micro-photographed on the microscopic observation.

Measurements of homogenization temperature of liquid-gas and polyphase inclusions were made with the heating-stage under the microscope. The measurement was made only for primary and pseudosecondary inclusions. Twenty measurements for each sample were made in average, and the result was statistically processed. An arithmetic mean was adopted as the representative value for each sample. The standard deviation among the values of homogenization temperature in each sample was checked. The result of homogenization temperature measurements was plotted on the map and examined geologically.

2-6-2 Results of Studies

Measurements of homogenization temperature were rather difficult because most of the fluid inclusions in quartz chips were very fine. Fluid inclusions of larger than 10 microns in diameter were seldom, if ever, found. As a result of this fine nature of fluid inclusions, 109 samples out of 168 have been measured in total under the heating-stage. The results of the measurements are listed in Table 2-2-6.

Morphology of fluid inclusion

The number of fluid inclusions which were investigated under the microscope amounted to nearly two thousand in the second and third phases. Ninety-eight percents of them are liquid-rich two-phase inclusions. Gas-rich two-phase inclusions are less than 2 % of them. The actual percentage of gas inclusions may probably be much less. The possibility of miss-identification still exists despite the careful observation. Because fluid inclusions are three-dimensional objects which are being observed in only two dimensions, inclusions having consistent liquid-to-gas ratios may appear to have variable phase ratios.
This result may indicate that the boiling of fluid has never occurred during the formation of quartz vein in the Batuisi prospect.

Polyphase inclusions were found in about 10 samples. Six of them are stockwork quartz from the upper reaches of S. Tarawa and the upper reaches of S. Bone. Halite and some opaque ore minerals were distinguished as daughter minerals. One of the opaque minerals is probably pyrite.

Homogenization temperature

Values of homogenization temperature of each fluid inclusion are distributed from 170°C up to 370°C. Most of them are settled within a range of 200 ~ 280°C.

Mean values of homogenization temperature of samples which showed a significant value of gold (for example; BD7-21F = 28.55 g/t) range from 200°C to

260°C.

The comparison of homogenization temperatures between massive quartz and stockwork quartz was made. Histograms of the temperature measurements were drawn in two categories. The peak temperature of frequency distribution is 240 ~ 250°C for the stockwork type quartz. Whereas that is 250 ~ 260°C for the massive type quartz. The difference is small.

The lateral distribution of homogenization temperature (arithmetic mean) of each sample was drawn and examined on a plan. No significant tendency is recognizable on this map, even if the altitude difference among the sample localities is considered.

No particular tendency of homogenization temperatures of fluid inclusions to the depths of samples has been recognized in the third phase measurements.

Fig. 2-2-3 shows the distribution of homogenization temperatures of fluid inclusions. All measurements -- samples from the surface, trenches, and drill cores in the second and third phases -- are included.

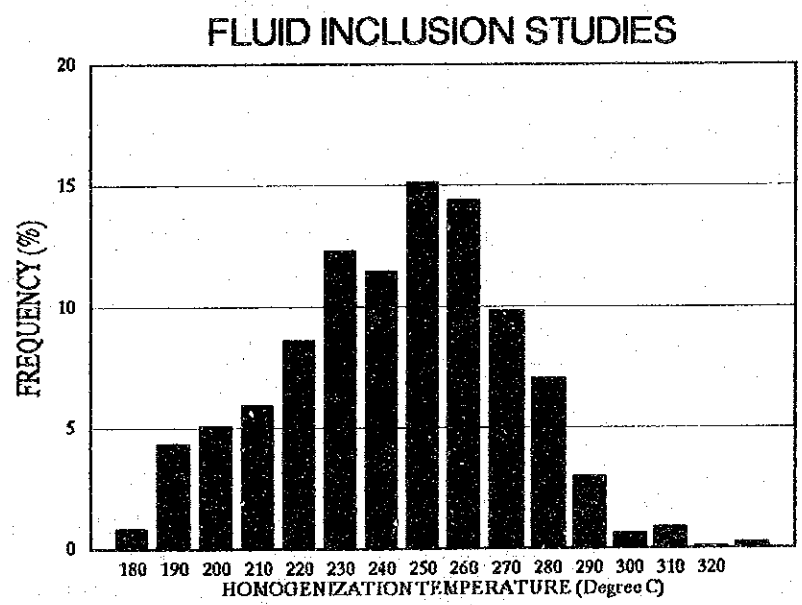


Fig. 2-2-3 Histograms of Homogenization Temperature of Fluid Inclusions

Table 2-2-6 Summary of Fluid Inclusion Studies (1)

Detailed Survey (Phase Ⅱ)

	Sample	Locality	n	Ave	SD	Remarks
1	BAA2F	Tarawa・Bone area	NA			
2	BAA3F		32	234	17.03	Gas Incl(+)
3	BAA4F		20	249	16.48	
4	BAA9F		16	235	24.78	Gas Incl(+)
5	BAA14F		17	241	17.24	
6	BAA18F		NA			
7	BAA19F		18	250	6.27	
8	BAA21F		26	249	19.60	Poly Incl(+)
9	BAA22F		3	274	5.44	Gas Incl(+)
10	BAA24F		14	235	42.69	Poly Incl(+),Gas Incl(+)
11	BAA27F		9	208	12.56	
12	BAA30F		30	245	20.24	Poly Incl(+),Gas Incl(+)
13	BAA47F		20	227	15.66	
14	BAA49F		NA			
15	BAA51F		24	230	25.88	
16	BAA52F		23	230	16.44	Gas Incl(+)
17	BAA67F		NA			
18	BAA68F		13	262	10.99	
19	BAA88F		NA			
20	BAA92F		17	276	16.24	Poly Incl(+)
21	BTB2F		10	216	20.85	
22	BTB3F		NA			
23	BTB4F		5	269	10.48	
24	BTB6F		6	206	18.79	
25	BTB8F		7	268	13.05	
26	BTB9F		21	271	16.04	
27	BTB10F		20	217	11.19	
28	BTB11F		NA			
29	BTB13F		15	246	7.70	
30	BTB15F		NA			
31	BTB16F		NA			
32	BTB17F		21	233	11.08	
33	BTB18F		NA			
34	BTB21F		13	191	9.63	
35	BTB22F		12	223	18.03	
36	BTB25F		NA			
37	BTB26F		23	236	18.77	
38	BTB27F		NA			
39	BTB30F		NA			
40	BTB31F		20	274	14.24	
41	BTB32F		NA			
42	BTB33F		30	252	10.54	
43	BTB35F		18	250	15.60	
44	BTB36F		NA			
45	BTB37F		23	224	32.31	Gas Incl(+)
46	BTB38F		NA			
47	BTB39F		9	255	10.89	
48	BTB40F		12	229	16.76	
49	BTB41F		NA			
50	BTB43F		22	244	20.22	

Table 2-2-6 Summary of Fluid Inclusion Studies (2)

Detailed Survey (Phase II)

	Sample	Locality	n	Ave	SD	Remarks
51	BTB44F	Tarawa•Bone area	14	250	22.94	
52	BTB45F		NA			
53	BTB46F		20	228	13.20	
54	BTB47F		NA			
55	BTB48F		16	220	14.97	Poly Incl(+)
56	BTB50F		32	229	16.38	
57	BTB51F		NA			
58	BTB56F		NA			
59	BTC1F		NA			
60	BTK7F		18	241	15.31	
61	BTK8F		NA			
62	BTK9F		16	244	14.07	
63	BTK10F		NA			
64	BTK20F		21	236	14.66	
65	BTK22F		NA			
66	BTK24F		14	269	12.45	Poly Incl(+)
67	BTK25F		24	275	13.57	
68	BTK26F		NA			
69	BTK27F		29	262	22.56	
70	BTK28F		32	263	17.58	
71	BTK29F		NA			
72	BTK30F		21	247	17.06	
73	BTK32F		NA			
74	BTK33F		23	247	20.75	
75	BTF19F	Malela•Pongo area	12	221	25.55	Gas Incl(+)
76	BTF20F		25	271	21.91	Poly Incl(+),Gas Incl(+)
77	BTF21F		NA			
78	BTF22F		13	260	25.21	Poly Incl(+),Gas Incl(+)
79	BTF23F		14	264	12.78	
80	BTF24F		NA			
81	BTF25F		17	270	15.09	
82	BTF26F		10	261	12.43	
83	BTG2F		20	248	14.79	
84	BTG3F		NA			
85	BTG5F		14	224	11.87	
86	BTG6F		33	220	11.32	
87	T13F		NA			
88	T16F		NA			
89	T26F		NA			
90	T35F		18	216	30.40	
91	BAA33F	T-1	NA			
92	BAA34F	T-1	6	218	15.66	Poly Incl(+)
93	BAA35F	T-1	13	250	16.16	
94	BAA37F	T-2	6	209	7.07	
95	BAA38F	T-2	35	236	29.13	Gas Incl(+)
96	BAA39F	T-2	11	238	26.77	
97	BAA43F	T-2	NA			
98	BAA54F	T-2	NA			
99	BAA56F	T-2	23	207	13.83	
100	BAA58F	T-2	28	252	15.95	

Table 2-2-6 Summary of Fluid Inclusion Studies (3)

Detailed Survey (Phase II)

	Sample	Locality	n	Ave	SD	Remarks
101	BAA63F	T-1	19	252	22.10	Gas Incl(+)
102	BAA64F	T-1	NA			
103	BAA65F	T-1	11	266	9.96	
104	BAA66F	T-1	NA			
105	BAA69F	T-3	29	243	12.12	
106	BAA70F	T-3	NA			
107	BAA71F	T-3	26	253	13.16	
108	BAA84F	T-3	17	245	9.39	
109	BAA85F	T-4	42	245	10.74	
110	BAA86F	T-4	14	284	16.53	
111	BAA94F	T-4	13	255	15.80	
112	BAA98F	T-5	12	206	14.06	
113	BAA99F	T-6	21	209	13.65	
114	I42F	T-4	NA			
115	I44F	T-4	NA			
116	I46F	T-4	NA			
117	I48F	T-4	25	267	13.63	
1	LEB3F	S. Taroto	30	286	20.49	
2	LEB10F	S. Taroto	21	264	18.81	Gas Incl(+)
3	LEB20F	S. Taroto	6	278	13.17	
4	LEC15F	S. Peko	33	243	14.41	

Drilling (Phase II)

1	BD1-6F	MJT-1, 30.72m	31	224	32.79	
2	BD1-17F	MJT-1, 60.27m	NA			
3	BD1-21F	MJT-1, 68.85m	21	237	11.96	
4	BD1-24F	MJT-1, 72.00m	23	236	16.82	
5	BD1-27F	MJT-1, 73.30m	NA			
6	BD1-29F	MJT-1, 75.10m	NA			
7	BD2-8F	MJT-2, 14.50m	28	225	15.02	
8	BD2-17F	MJT-2, 19.45m	17	214	13.19	
9	BD2-20F	MJT-2, 21.15m	NA			
10	BD2-23F	MJT-2, 35.06m	31	255	10.99	
11	BD2-28F	MJT-2, 48.95m	13	186	6.13	
12	BD2-33F	MJT-2, 59.45m	NA			
13	BD3-3F	MJT-3, 12.80m	NA			
14	BD3-4F	MJT-3, 13.90m	28	247	13.03	
15	BD3-7F	MJT-3, 25.50m	NA			
16	BD3-9F	MJT-3, 27.50m	NA			
17	BD3-12F	MJT-3, 51.30m	10	242	10.01	
18	BD3-17F	MJT-3, 80.05m	NA			
19	BD4-7F	MJT-4, 14.05m	28	235	14.55	
20	BD4-11F	MJT-4, 53.70m	24	238	18.92	
21	BD4-13F	MJT-4, 54.40m	19	211	11.52	
22	BD4-17F	MJT-4, 56.90m	20	224	13.40	
23	BD4-21F	MJT-4, 61.10m	22	229	17.84	
24	BD4-23F	MJT-4, 63.80m	24	238	13.59	
25	BD4-25F	MJT-4, 79.30m	13	222	12.36	
26	BD5-4F	MJT-5, 48.70m	22	220	13.65	
27	BD5-6F	MJT-5, 49.40m	15	189	13.08	

Table 2-2-6 Summary of Fluid Inclusion Studies (4)

Drilling (Phase III)

	Sample	Locality	n	Ave	SD	Remarks
1	BD6-6F	MJT-6, 27.80m	9	219	31.93	
2	BD6-7F	MJT-6, 79.80m	12	218	24.45	
3	BD6-8F	MJT-6, 103.80m	8	239	18.34	
4	BD6-11F	MJT-6, 116.40m	NA			
5	BD6-24F	MJT-6, 124.65m	16	202	14.46	
6	BD6-28F	MJT-6, 135.70m	NA			
7	BD7-6F	MJT-7, 38.70m	8	196	12.44	
8	BD7-10F	MJT-7, 42.95m	16	240	31.64	
9	BD7-17F	MJT-7, 93.10m	NA			
10	BD7-21F	MJT-7, 96.10m	4	252	5.12	
11	BD7-23F	MJT-7, 125.90m	NA			
12	BD7-29F	MJT-7, 165.30m	13	219	33.28	
13	BD7-33F	MJT-7, 174.20m	5	198	9.21	
14	BD8-2F	MJT-8, 91.00m	NA			
15	BD8-3F	MJT-8, 107.60m	9	204	19.83	
16	BD8-10F	MJT-8, 112.50m	NA			
17	BD8-26F	MJT-8, 184.90m	11	202	13.06	
18	BD8-28F	MJT-8, 192.40m	20	254	61.93	
19	BD9-4F	MJT-9, 69.00m	5	275	35.43	
20	BD9-11F	MJT-9, 69.80m	NA			

Abbreviations:
n;number of measured f-inclusions
NA;homo-temp not available
Ave;arithmetic mean of homo-temp (°C)
SD;standard deviation (°C)

2-7 Drilling

2-7-1 Outline of Drilling

A small scale diamond drilling programme for reconnaissance purpose was planned at the upper reaches of S. Tarawa in the Batuisi prospect in the second phase. The drilling area was situated over the most significant soil anomalous zone which was discovered during the preliminary soil survey in the first phase. The geology around the drill sites was composed of shale and andesite of the Latimojong Formation. Only small blocks of quartz float were observed on the surface. As was already explained in the previous chapter, six lines of shallow trenches were excavated in the anomalous zone at the early stage of the field work. Several indications of gold mineralization, such as occurrence of quartz veins/stockworks and silicified zones, were caught in the trenches. The targets of drilling were discussed on the basis of the result of trenching, then locations of drill holes were selected.

The drilling programme was directed toward; ① the lower extension of the surface indications, and ② the lateral extension of the gold anomalous zone. The programme consisted of five inclined holes of 80 m deep each. The total length was 400 m. The target depth was set at 50 m from the surface. Details of each hole are summarized in the following table.

Hole No.	Locality	Grid Coordinates		Eleva-tion	Azimuth	Incli-nation	Hole Length
		N	E				
MJT-1	Hill	55S	1,695E	605 m	235 °	-60 °	80.3 m
MJT-2	Northwest	55S	1,535E	580	235	-60	80.3
MJT-3	of S. Tarawa	65S	1,440E	560	235	-60	80.3
MJT-4		90S	1,290E	560	235	-60	80.3
MJT-5	N of S. Bone	290N	1,250E	455	55	-60	80.3
Total							401.5 m

A series of drill logs of 1:200 scale was prepared, and the whole drill cores were photographed in color. One hundred and five ore assay samples were obtained in the second phase. Twenty-seven quartz chips were taken for fluid inclusion study. Twenty polished sections for ore microscopy were produced from the cores. Twenty altered rock and clay samples were examined for X-ray powder analysis.

2-7-2 Drilling Method, Equipment and Progress

(1) Drilling method and equipment

Method

For surface soil and gravel layer (up to 8 m), drilling was done by NW casing shoe (92 mm in diameter) with inserting of NW casing pipes. Weathered bedrock was drilled by conventional drilling method with NX diamond bit (76 mm in diameter) and NX-STH core tube. The weathered bedrock continued down to 20 ~ 30 m deep, and BW casing pipes were inserted in this zone. For the bedrock zone, wireline method was adopted with BQ oversized diamond bit (62 mm in diameter) and BQ-WL core tube. Bentonite mud, lubricant chemical (Mud Oil) and CMC were usually mixed in the circulating drilling water. When the water was lost in the hole where fractures were developed, Tel-Stop and Seaclay (asbestos) were injected to recover the trouble. Borehole cementation was applied when water loss and the collapse of wall happened at the same time.

Equipment

The drilling site was located in the remote place. No vehicle road was available in the area. Transportaion was limited only by horses and labors. Specially made machine and equipment were brought into the operation because of this condition. The drilling machine was YBM-05DA of Yoshida Boring Machines, a special light-weight product of which the maximum weight of the dismantled parts was 55 kg. Other equipments for drilling such as drill rig, drilling pump, mud mixer, etc., were chosen up on the basis of the weight constraint. Specifications of drilling machine and equipment are shown in Table 2-2-7.

Working system

Drilling operation was carried out by three shifts per day (8 hours per shift), while the appurtenant works, such as rig construction, mobilization and demobilization, were done by one shift per day. A shift crew consisted of one drilling engineer and three workers normally. Additional fourteen workers (round figures) were involved in case of the appurtenant work. A base camp for drilling operation was built near the drilling sites. A series of footpaths was cleared from Kp. Batuisi to the hill-top on which the base camp and drilling sites were located.

Transportation

The machine and equipment were shipped from Yokohama to Ujung Pandang via

Table 2-2-7 Specifications of Drilling Machine and Equipment

Drilling machine ; Model OE-8L Capacity Dimensions (L x W x H) Weight Hoisting capacity Spindle speed Engine ; Model NFD-13K	1 set 400 m (AQ-WL nominal) 1,550 x 700 x 1,260 mm 530 kg (excl engine) 2,000 kg 100, 190, 320, 530 rpm 11.0 ps/2,400 rpm
Drilling machine ; Model YBM-05DA Capacity Dimensions (L x W x H) Weight Hoisting capacity Spindle speed Engine ; Model DY-41B	1 set 110 m (40.5 mmφ) / 50 m (65 mmφ) 1,040 x 550 x 950 mm 230 kg (excl engine) 500 kg 57, 110, 225 rpm 7.5 ps/1,750 rpm
Drilling pump ; Model MG-15h Piston diameter Stroke Capacity Dimensions (L x W x H) Weight Engine ; Model NFD-12K	1 set 89 mm 60 mm 200 ℓ/min (discharge) 2,314 x 800 x 1,130 mm 530 kg (excl engine) 10.0 ps/2,400 rpm
Drilling pump ; Model MG-5h Piston diameter Stroke Capacity Dimensions (L x W x H) Weight Engine ; Model NFAD7	1 set 68 mm 60 mm 70 ℓ/min (discharge) 1,630 x 470 x 680 mm 200 kg (excl engine) 6.0 ps/2,600 rpm
Wire line hoist ; Model WLH-4 Drum diameter Rope capacity Dimensions (L x W x H) Weight Engine ; Model NFAD6	1 set 120 mm 1,200 m (6 mmφ rope) 1,130 x 450 x 1,000 mm 110 kg (excl engine) 5.4 ps/2,600 rpm
Water supply pump; Model TA-800 Plunger type Capacity Dimensions (L x W x H) Weight Engine ; Model LA90ASES	3 sets 3 planger lateral 88 ℓ/min (discharge) 554 x 354 x 424 mm 29 kg (excl engine) 8.0 ps/1,800 rpm
Derrick ; Model PD-8.5 Height Maximum load capacity	1 set 8.5 m 12,000 kg
Derrick ; Model PD-5.5 Height Maximum load capacity	1 set 5.5 m 3,000 kg
Mud mixer ; Model MCE-100A Capacity Engine ; Model NSA40C	1 set 100 ℓ / 800 rpm 4.5 ps/2,400 rpm
Generator ; Model YDG-3005 Capacity	2 sets 2.7 KVA (100V,27A)
Generator ; Model YSG-2005 Capacity	2 sets 1.7 KVA (100V,17A)
Drilling tools Drilling rods Casing pipes Core tubes	 NQ-WL 3.0 m x 40 pcs BQ-WL 3.0 m x 76 pcs 40.5 mm 1.5 m x 20 pcs HW CP 1.5 m x 2 pcs NW CP 1.5 m x 25 pcs BW CP 3.0 m x 40 pcs NQ-WL 3.0 m x 2 pcs NX-STH 1.5 m x 2 pcs BQ-WL 3.0 m x 2 pcs

Surabaya. After landed, they were transported to Tarailu by trucks. The cargoes were once unloaded at Tarailu deposit, unpacked and dismantled for small transportation. Fuel, foods, and camping goods were also gathered to the depo. From Tarailu to Galumpang (about 60 km along S. Karama), they were carried by engine canoe whose loading capacity was up to 600 kg. From Galumpang to Batuisi (16 km), they were carried by horses and labors. From Kp. Batuisi a footpath (short-cut) was constructed up to the drilling site, and the machine and equipment were carried up on labors' back.

Supply for the camp was made at least once in four weeks. Fuel and foods were bought at Ujung Pandang and Mamuju, and were transported along the same route as described above.

Drilling water

Water for drilling was pumped up from the middle reaches of S. Bone to the hill-top. Two stages of pumping station were established for the water head of 300 m. Piping length installed was nearly 1,000 m.

Withdrawal

After the completion of drilling programme, the machine and equipment were stored in the drilling base camp for the next stage operation. The drill holes were capped, and drilling site was cleaned and reclaimed. The drilling cores, of which the half was taken for assay samples, were kept in the storage house.

(2) Progress of drilling

The progress of each drill hole is described below.

MJT-1 : For surface soil and saprolite zone, drilling was done by NW metal casing shoe, and NW casing pipes were inserted to 10.00 m deep. Saprolite down to 21.00 m deep was drilled by conventional drilling method with NX diamond bit and NX - STH core tube. Some of the water was lost at 7.20 m in the hole. BW casing pipes were inserted to 21.00 m. Very thick bentonite mud and core pack tube were adopted for strongly weathered zone to increase core recovery. From 21.00 m down to the end of hole (80.30 m), drilling was carried out by wireline method with BQ diamond bit and BQ-WL core tube. Bentonite, CMC, Libonite and Mud Oil were mixed with circulating water. The circulating water was lost at 69.60 m in the hole, where massive quartz veins with numerous micro-fractures were developed. Telstop and Seaclay were injected to recover the trouble. The overall core recovery of 99.0 % was achieved in this hole.

MJT-2 : Surface soil and gravel zone are deeply developed down to 8.00 m in MJT-2. Very thick, massive quartz veins were caught at rather shallow horizon (from 9.00 m until 21.30 m) in this hole. Some part of the quartz shows sugary features because of strong weathering. Only quartz fragments of sand size were returned from such a zone. Therefore, low recovery of drill core was produced in this zone. NW casing pipes were inserted to 10.00 m, and BW casing pipes to 20.0 m. The circulating water was lost at 16.00 m, where was right in the middle of the quartz vein. Telstop and Seaclay were injected for this zone. From 20.00 m down to the end of hole (80.30 m), drilling was done by wireline method with BQ diamond bit and BQ-WL core tube. Overall core recovery was 92.3 % in this hole.

MJT-3 : NW casing pipes and BW casing pipes were inserted to 10.00 m and 20.00 m respectively in this drill hole. The circulating water was lost at 12.70 m, where a quartz stockwork zone was developed. Telstop and Seaclay were injected into the circulating water together with bentonite and CMC. From 20.00 m down to the end of hole (80.30 m), drilling was done by wireline method with BQ diamond bit. Overall core recovery was almost 100 % in this hole, because of the thoughtful operation of drilling.

MJT-4 : Drilling for surface soil and saprolite zone was undertaken by NW diamond casing shoe, and NW casing pipes were inserted to 6.00 m deep. Saprolite down to 20.00 m deep was drilled by conventional drilling method with NX diamond bit and NX-STH core tube, and BW casing pipes were inserted. From 20.00 m down to the end of hole (80.30 m), drilling was done by wireline method with BQ diamond bit and BQ-WL core tube. Saprolite and black shale are very soft and easy to melt when mixed with water. Therefore drilling operation in these zones were carefully conducted. Poor core recovery has returned from some of these zones. The circulating water was lost at 54.50 m, which was correlated to quartz vein. Telstop and Seaclay were injected to recover the water loss. Overall core recovery was 89.0 % in this hole.

MJT-5 : For the near surface zone to 6.00 m, drilling was made by NW diamond casing shoe, and NW casing pipes were inserted. Numerous fractures were developed in silicified andesite from 6.00 m down to 30.00 m. BW casing pipes were inserted to 19.00 m. However, from 19.00 m to 30.00 m, the collapse of hole wall happened together with the total water loss. These troubles were controlled by inner hole cementation (two times -- at 25.50 m and 30.00 m). Overall core recovery was 95.6 % in this hole.