No. 33

REPORT
ON
THE COOPERATIVE MINERAL EXPLORATION
IN
THE TASIKMALAYA AREA, WEST JAVA
THE REPUBLIC OF INDONESIA

PHASE 1

FEBRUARY 1995

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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PREFACE

The Japanese Government, in response to a request extended by the Government of Indonesia, decided to conduct a mineral exploration in the Tasikmalaya area, West Java, and entrusted the survey to the Japan International Cooperation Agency (JICA) and the Metal Mining Agency of Japan (MMAJ).

The JICA and MMAJ sent to the Republic of Indonesia a survey team headed by Mr. Kohei Iida from October 1994 to January 1995.

The Japanese team exchanged views with officials of the Government of the Republic of Indonesia and carried out a field survey in the Tasikmalaya area with Indonesian experts sent from the Directorate of Mineral Resources. After the team returned to Japan, further studies consisting of laboratory and analytical works were made and the report has been prepared.

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

We wish to express our sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the team.

February 1995

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Geology and Mineral Resources,
Ministry of Mines and Energy,
Republic of Indonesia

Kimio FUJITA
President
Japan International
Cooperation Agency

Takashi ISHIKAWA
President
Metal Mining Agency of
Japan

SUMMARY

The exploration this year corresponds to the first phase of the three-year cooperative mineral exploration program in the Tasikmalaya area. The principal objective of this project is to find a new mineral deposit in the area through the exploration and the examination of geology and mineralization. The works conducted this year were composed of satellite image photogeological interpretation using 2 scenes of the JERS-1 SAR images, review of the existing geological information, geological survey and geochemical exploration (panning, stream sediment and soil surveys). The field survey was made in three areas -- Salopa, Sidamulih and Cisasah -- within the Tasikmalaya area. More than 680 km of survey length were traversed, and over 2,000 geochemical samples were collected altogether in the field survey this phase. As a result of these works, two attractive prospects of epithermal gold mineralization and one prospect of massive sulfide mineralization were delineated within the Tasikmalaya area. The former two, each has an area of about 40 km^2, are located in the Salopa area. The latter one prospect, still in a grass-root stage, has an area of 300 km^2 in the Cisasah area. The characteristic features and potential of mineralization were discussed on the basis of photogeology, petrology, mineralogy and hydrothermal alteration studies.

A total of 17 epithermal gold showings was found through geological survey and geochemical exploration in the Salopa area. Among them, the Ciniru-Cikuya prospect showed a significant potential of epithermal gold deposit. Several gold-bearing quartz veins and network veins occur at the junction of S. Ciniru and S. Cipanawar. Gold was recognized in a series of quartz veins/networks of mainly NW direction. Test samples taken from the quartz vein outcrops on the river-bed showed significant gold and silver values up to 2.76 g/t Au and 20 g/t Ag at 25 cm in width. Distinctive gold anomalies were caught by panning survey, stream sediment survey and reconnaissance soil survey in this prospect. A group of quartz veins/networks trending NW and NNE is developed at S. Cikuya. Significant gold and silver grades up to 4.67 g/t Au and 330 g/t Ag were obtained from grab samples of old workings. Small but solid geochemical gold anomalies were also found in this prospect. These two prospects are located in an area of 8 km (NW-SE) by 5 km (NE-SW) in the southern part of the Salopa area. Some anomalies of panning survey and stream sediment geochemistry were caught at the middle reaches of S. Cimedang where lay at the middle of these two prospects. Gold mineralization is expected to be continued in this zone.

One more attractive prospect -- Cikondang-Citambal-Ciseel -- was extracted in the northeastern part of the Salopa area. Numerous gold-bearing quartz veins and network veins of mainly NW trend are distributed, and remarkable results of gold assay were returned from outcrops and old workings in these prospects (35.31 g/t Au and 18 g/t Ag at 5 cm in width, etc.). Significant gold anomalies were outlined by panning survey and stream sediment geochemistry. These three localities are arranged

within an area of approximately 40 km^2 elongating NW-SE. Gold anomalies are expected to extend about 5 km more to the southeast until S. Cijurey.

Gold-bearing quartz veins in the Salopa area are hosted by andesitic and dacitic volcanic and pyroclastic rocks of the Jampang Formation, which are called "Old Andesites" and considered to be formed by the Oligocene to Miocene submarine tholeiitic volcanic activity. The NW system is dominant among the vein systems in this area. An area where quartz veins are developed is structurally situated on the wing of a regional anticlinorium (whose axis is WNW-ESE). On the basis of the results of photogeological interpretation on the JERS-1 SAR images, a series of complex circular structures of several tens of kilometers in diameter was distinguished near Salopa. It was interpreted to be a volcanic depression caused by the volcanic activity of the Upper Member of the Jampang Formation. No geologic evidence that may indicate the volcanic depression structure has been found during the field survey in the Salopa area. It must be further studied in the next phase survey.

Characteristic features of gold mineralization on ore and gangue mineral assemblages and hydrothermal alteration were examined. These features are basically of the characteristics of epithermal gold deposit. Gold-bearing quartz veins in the Salopa area are thought to belong to the adularia-sericitetype epithermal gold deposit. Compared with the well-known epithermal gold deposits such as Cikotok and Pongkor in West Java, two things -- the occurrence of As-Sb minerals (arsenopyrite and stibnite), and lack of adularia in the gangue mineral assemblage -- are different. They are probably caused from the differences of age and conditions of formation between them.

Structural analysis must be made on the area where indications of gold mineralization were extracted through the first phase survey by means of photogeology using airphotos. It is for the purpose of studying the relationship of structural factors to the gold mineralization, especially the circular structure observed on the SAR image. It is recommended that the major mineralized zones should be explored by the detailed geological survey and soil survey in the second phase. Reconnaissance drilling is also recommended to test the geochemical anomalies delineated by the soil survey. The promising prospects for the detailed survey and drilling are: (a) Ciniru-Cikuya prospect (40 km^2), and (b) Cikondang-Citambal-Ciseel prospect (40 km^2)

The distribution of dacitic pyroclastic rocks of the Upper Member of the Jampang Formation, so-called green tuff, was proved over an area from the eastern part to the east of the Cisasah area. The occurrences of two gypsum deposits and one barite bed are known within the area. Significant assay results for precious and base-metals were obtained from some samples in the Cibuniasih barite bed (2.17 g/t Au, 662 g/t Ag and 38.64 % Pb, etc.). It is a potential prospect of massive sulfide deposit. We have confirmed the following matters in this phase: (a) distribution of green tuff, (b) stratigraphic succession of massive sulfide mineralization, and (c) assemblage of hydrothermal alteration minerals.

The results of field surveys indicated that the size and magnitude of submarine dacitic volcanic activity in this area were comparatively smaller-scale and weaker than those of in the Hokuroku district in Japan. Some characteristic features of hydrothermal alteration around the massive sulfide ore zone were investigated. In the Cisasah and Cidadap gypsum mines, the quartz-sericite zone is distributed in the footwall -- including gypsum zone -- of the massive sulfide horizon. The alteration zone of the massive sulfide horizon is characterized by the quartz-sericite-chlorite assemblage. Montmorillonite, kaolin and mixed-layer mineral were detected in the massive sulfide horizon by X-ray diffraction analysis. Montmorillonitization was observed in the hanging-wall side of the horizon commonly. The distribution of alteration zones looks small from the observation at the sporadic outcrops of green tuff in the survey area. In order to catch the significant size of massive sulfide ore, we have to look for such conditions as: (a) thick development of green tuff, (b) intensive activity of dacite lava, (c) thick coverage by mudstone, and (d) occurrence of intensive hydrothermal alteration haloes.

It is recommended that the semi-detailed survey for massive sulfide deposit comprising geological survey and alteration survey should be made on an area of 300 km^2 in which Cisasah, Cidadap and Cibuniasih are included. Structural drilling will be necessary for the purpose of exploring the horizon of mineralization and catching the alteration halo. The gravity survey is also recommended over the prospect in order to investigate the basement structure and structural setting of massive sulfide mineralization.

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PART I OVERVIEW

PART I OVERVIEW

Chapter 1 Outline of the Project

1-1 Background and Objective

The Indonesia-Japan Cooperative Mineral Exploration has been carried out in seven areas of the Republic of Indonesia: Sulawesi (1970-1972), Kalimantan (1974-1977), West Kalimantan (1979-1981), North Sumatra (1982-1984), South Sumatra (1985-1987), Pegunungan Tigapuluh (1989-1990) and Toraja (1991-1993). As a result of these works, a large amount of information regarding metallic mineral resources was obtained. The exploration also contributed to the technical progress of the Geological Survey of Indonesia and the Directorate of Mineral Resources, as well as to the acquisition and accumulation of knowledge regarding geology and mineral deposits of the country.

The Ministry of Mines and Energy of Indonesia planned to conduct mineral exploration in the Tasikmalaya area, West Java, and requested the cooperation of the Japanese Government. In August 1994, the Japanese Government, responding to the request, sent a mission for discussing the Scope of Work and to make a program of the first phase survey. As a result of consultations with the Directorate of Mineral Resources, the counterpart of the Japan International Cooperation Agency and the Metal Mining Agency of Japan, an agreement was reached for cooperative mineral exploration in the Tasikmalaya area on August 25, 1994.

The principal objective of this project is to find a new mineral deposit in the Tasikmalaya area through the exploration and examination of geology and mineralization. It is also important to pursue technology transfer to the Indonesian counterpart organization in the course of the project.

In 1994, preliminary investigation and the first phase field survey were carried out for the purpose of assessing the potential of mineral resources in the Tasikmalaya area. The major works completed during the first phase were satellite image photogeological interpretation, review of the existing geological information, geological survey and geochemical exploration. The entire study area was 3,200 km^2, and the field survey was made in three areas -- Salopa, Sidamulih and Cisasah.

1-2 Survey Area

The regional study area in the first phase is approximately 3,200 km^2 surrounded by the coordinates listed below. It is located in the southeastern part of West Java Province. The field survey comprising geological survey and geochemical exploration was made in three areas -- Salopa, Sidamulih and Cisasah -- in the first phase. It is approximately 1,000 km^2 in total. The location map of the survey area is shown in Fig. 1-2.

No.	Latitude	Longitude
1	7°19.2'S	108°13.2'E
2	7°44.0'S	107°56.5'E
3	7°48.3'S	108°28.6'E
4	7°41.6'S	108°30.4'E
5	7°41.6'S	108°42.9'E
6	7°30.0'S	108°49.0'E
7	7°30.0'S	108°33.5'E
8	7°19.2'S	108°42.2'E

1-3 Exploration Theme

The exploration this year corresponds to the first phase of the three-year cooperative mineral exploration program in the Tasikmalaya area.

The works conducted this phase were satellite image photogeological interpretation, review of the existing geological information, geological survey and geochemical exploration in three areas within the Tasikmalaya area.

The major themes of the satellite image photogeological interpretation and review of the existing geological information were to investigate the mineral potential of the Tasikmalaya area and to select field survey areas within the study area.

The major exploration themes of the geological survey and geochemical exploration in the Salopa, Sidamulih and Cisasah areas were to survey mineral showings in the prospects, to catch geochemical anomalies and to define target mineralization for the next phase exploration.

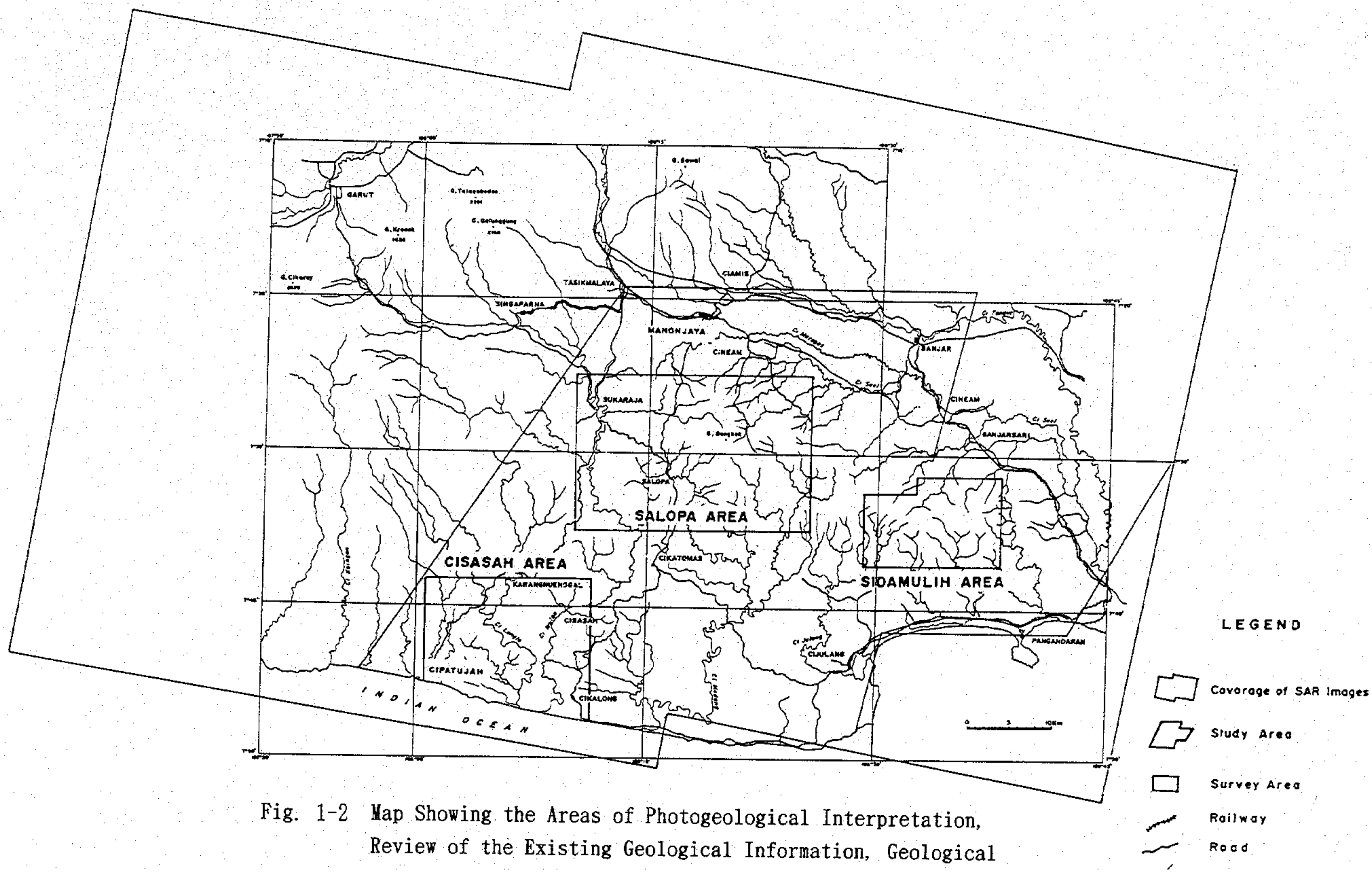


Fig. 1-2 Map Showing the Areas of Photogeological Interpretation, Review of the Existing Geological Information, Geological

1-4 Exploration Work

Satellite Image Analysis

The JERS-1 SAR data were processed and two scenes of monochrome image of 1:200,000 scale were prepared. The topography, drainage systems, geology and geologic structure were analyzed on these images. In the interpretation of photogeology, (i) the pattern and density of drainage systems, resistivity to the weathering and erosion, valley profile, ridge shape and other topographic features, and (ii) the image characteristics such as tone and texture were examined. Based on these details, geologic units were defined and structural demarcations were examined.

Review of the Existing Information

Prior to the field survey, the existing geological information for the regional study area of 3,200 km^2 was reviewed both in Tokyo and in Bandung under the cooperation of DMR personnel. The major materials studied were published geologic maps, topographic maps and DMR's survey reports in the area. On the basis of the results of this study, together with the results of satellite image analysis, field survey areas consisting of Salopa, Sidamulih and Cisasah were selected.

Field Survey

The field work in the first phase was composed of geological survey, stream sediment geochemistry, soil survey and panning survey. Geological survey and geochemical exploration were made in three areas: Salopa, Sidamulih and Cisasah. It amounted to approximately 1,000 km^2 in total area.

A series of 1:10,000 scale route maps was produced through surveying with fifty-meter tape and a Brunton-type compass. The results of the geological survey were compiled on 1:25,000 scale maps.

Geological survey, stream sediment sampling and panning survey were carried out along the major drainage systems at a sampling interval of approximately 1 piece per 500 m length in the Salopa, Sidamulih and Cisasah areas.

A preliminary soil survey was done in two promising prospects; one is the Ciniru prospect, and the other is the Cikuya prospect; both are situated in the Salopa area. The sampling interval was approximately 1 piece per 100 m length.

A survey length of 684 km was traversed, and 1,354 stream sediment samples, 179 soil samples and 473 pan concentrates were collected altogether in this phase.

The amount of works done this year is summarized as follows:

Survey	Area and Amount of Samples
Regional Study	
Satellite Image Analysis	3,200 km^2
Review of the Existing Information	3,200 km^2
Field Survey	
Salopa Area	518 km^2
Geological Survey	344 km
Stream Sediment Geochemistry	744 pcs
Panning Survey	315 pcs
Soil Survey	179 pcs
Sidamulih Area	170 km^2
Geological Survey	105 km
Stream Sediment Geochemistry	209 pcs
Panning Survey	54 pcs
Cisasah Area	312 km^2
Geological Survey	235 km
Stream Sediment Geochemistry	401 pcs
Panning Survey	104 pcs

The amount of samples for chemical analysis and laboratory work is as follows:

Chemical Analysis & Lab Work		Amount of Samples
Thin Sections		57 pcs
Polished Sections of Ore		55 pcs
X-Ray Diffraction Analysis		71 pcs
Chemical Analysis		
a) Whole Rocks	(12 Major Components)	53 pcs
b) Stream Sediments		
	(Au,Ag,Cu,Pb,Zn,As,Sb,Hg,P,Cr,Mn,Ba)	1,354 pcs
c) Soils		
	(Au,Ag,Cu,Pb,Zn,As,Sb,Hg,P,Cr,Mn,Ba)	179 pcs
d) Ores	(Au,Ag,Cu,Pb,Zn,Sb,Cr,Mn,Ba)	152 pcs

1-5 Survey Team

Mission for the Scope of Work

The Japanese preparatory survey team visited to Indonesia from August 22 to 27, 1994. The Scope of Work was concluded on August 25 among the Japan International Cooperation Agency, the Metal mining Agency of Japan and the Directorate General of Geology and Mineral Resources, Ministry of Mines and Energy of Indonesia.

The members participated in the discussion were as follows:

[Indonesian Side]

Dr. Adjat Sudrajat	Director General, Directorate General of Geology and Mineral Resources, Ministry of Mines and Energy (DGGMR)
Kingking A Margaridjaja	Director, Directorate of Mineral Resources
Yaya Sunarya	Head, Metallic Mineral Exploration Division

[Japanese Side]

Singoro TSUCHIYA	Metal Mining Agency of Japan
Yoichi IIDA	Ministry of International Trade and Industry
Yoshiaki IGARASHI	Metal Mining Agency of Japan
Tetsuo SUZUKI	Metal Mining Agency of Japan, Manila Office

Survey Team

The geological survey and geochemical exploration of the first phase were carried out during the period from October 31, 1994 to January 11, 1995. Laboratory work and reporting followed the field work. The organization of the survey team was as follows:

[Metal Mining Agency of Japan]

Atsuhiko MINOWA	Coordinator
Kiyomi FUJIWARA	Coordinator

[Members of Indonesian Team]

Deddy T Sutisna	(DMR)	Team Leader and Geologist
B Bandi	(DMR)	Geologist
Atok S Prapto	(DMR)	Geologist
Iwa Gartiwa	(DMR)	Geologist
Sahya Sudarya	(DMR)	Geologist
Supriadi	(DMR)	Surveyor

[Members of Japanese Team]

Kohei IIDA	(NED)	Team Leader and Chief Geologist
Hideya KIKUCHI	(NED)	Geologist
Kazuyo HIROSE	(NED)	Geologist
Kenji SATO	(NED)	Geologist
Saburo TACHIKAWA	(NED)	Geologist

*Note: DMR means Directorate of Mineral Resources
NED means Nikko Exploration and Development Co., Ltd.

Chapter 2 Geography of the Survey Area

2-1 Location and Access

Java is the fifth biggest island in Indonesia. The area is 127,000 km^2 and the population is nearly 100 millions. It forms a couple of island arcs stretching from northwest to east. One is the Greater Sunda Islands comprising Sumatra, Java, Kalimantan and Sulawesi. The other is the Lesser Sunda Islands branching from the former one at Java and continuing to Bali, Flores and Timor.

Java has its own traditional culture. It is a mixture of major three historical origins; a Hindu culture came in the 0th - 9th centuries, a local Java one born in the 10th - 14th centuries, and Islamic one introduced in the 15th century.

The survey area is located in the southeastern part of West Java, and is called the Tasikmalaya area. It is under the jurisdiction of West Java Province.

The access to the area is obtained either through sealed road or railway from Jakarta to Tasikmalaya via Bandung. The distance from Jakarta is approximately 250 km along the road, and it takes about 6 hours by motorcar. Tasikmalaya, which is the major city of the southeastern part of West Java, is located at the northwestern corner of the survey area.

The survey area (regional study area), shaped as a convex polygon of approximately 64 km by 50 km, is situated in a hilly land.

Access inland is rather easy. The road networks, connecting villages each other, are relatively well maintained in the area. Generally speaking, major roads are asphalt paved. While village roads, which are accounted for more than three fourths, are unsealed.

The estimated population of the Tasikmalaya area is something around 3 millions. Nearly 90 percent of the inhabitants are Sundanese and the remainder comes from other areas in Indonesia.

2-2 Topography and Drainage System

The survey area lies on the hilly southern flanks extending from the Java dividing range at the north down to the south coast of the island. The Java dividing range consists of a series of active volcanoes, running east-west to the north of the survey area. The closest volcano to the area is Gn.(Gunung) Sawal. It has a peak of 1,784 m above the sea. The topography of the survey area is mostly gentle. The greater part of the area stands between 100 and 500 m in elevation. There are several mountains of more than 1,000 m in the survey area. The altitude of the highest peak, Gn. Bongkok, is 1,144 m.

Rivers in the survey area flow down to south into the Indian Ocean. S.(Sungai) Cimedang and Ciwulan are the major drainage systems in the central to the western part of the survey area. Ciseel is the major drainage system in the eastern part of the survey area.

2-3 Climate and Vegetation

It is situated in a tropical monsoon climate zone. It has two seasons: rainy and dry. The rainy season generally starts from November and continues till February. The dry season begins in March and ends at October.

The mean temperature in the study area is between 23 and 30 °C. The annual rainfall ranges from 2,000 to 3,000 mm (climatological data for Tasikmalaya).

Some part of hilly land is covered by tropical rain forest. The highland area of the dividing range, however, belongs to the tropical highland forest -- broad leaved evergreen vegetation and coniferous vegetation. Most of alluvial plains and flanks of hills among the mountains are reclaimed, and paddy rice is cultivated. On steep hills among the mountains, a rubber plantation is developed as well as dry field rice and vegetables are planted.

Chapter 3 Geology of the Survey Area

3-1 Geological Setting of the Southeastern Part of West Java

The southeastern part of West Java belongs to the Neogene Sunda-Banda arc (Carlile and Mitchell, 1994). The Sunda-Banda arc was located on the southern margin of Sundaland which was constructed as a continental massif on the Paleogene or older basement.

The subduction of the Indian Ocean plate beneath the Sunda-Banda arc has been active since at least Eocene time. Available radioactive age determination data suggest that the magmatism related to this subduction took place in two distinct periods; the first was in late Eocene to early Miocene, and the second was in late Miocene to Pliocene. The early volcanic event produced the so-called "Old Andesites" (Van Bemmelen, 1949) which were exposed extensively along the south coast of Sumatra and Java islands. They are mostly composed of tholeiitic volcanic rocks. On the contrast, the later Neogene event yielded a series of volcanic and pyroclastic rocks of medium to high K calc-alkaline composition. The axis of the latter volcanism has shifted about 60 km to the north from the former one. It roughly coincides with a chain of the recent volcanic front.

3-2 Geology and Geologic Structure of the Tasikmalaya Area

The southeastern part of West Java is made up of two major physiographic belts: hilly southern to central belt and northern volcanic belt. The Tasikmalaya area (regional study area) corresponds to the former belt. The latter belt lies outside the study area.

The geology of hilly southern to central belt is composed mainly of a series of Oligocene-Miocene sedimentary and volcanic rocks of the Jampang Formation. The Jampang Formation is made up of volcanic/pyroclastic rocks and sediments. The volcanic members consist mainly of andesitic to basaltic rocks which is correlated to the "Old Andesites". Dacitic pyroclastic rocks occur at the upper portion of the Jampang Formation in some areas. The Jampang Formation is overlain uncomformably by a series of sedimentary and pyroclastic rocks of the middle Miocene to Pliocene age. They are called the Kalipucang, Bentang and Halang Formations. The Kalipucang Formation is mainly composed of reef limestone. The Bentang Formation is mainly composed of calcareous sandstone. The Halang Formation is mainly composed of turbidites and tuffaceous sediments. These rocks have been intruded by dykes and sills of dacite/andesite and granodiorite.

The northern belt of the district is mostly occupied by Quaternary andesitic to basaltic volcanic rocks. These volcanics consist of lava, agglomerate, tuff and lahar (volcanic mud flow) deposit of Pleistocene to Holocene. The Halang Formation also occurs sporadically within the northern belt.

The tectonic regime of this district is dominated by NW to WNW and E-W trending faults and folding axes. This district has experienced at least twice of intensive orogenies. The first phase occurred in middle Miocene which resulted in uplift and was followed by the intrusion of dacite and granodiorite. It was accompanied by strong faults and folding movements within the Jampang Formation.

The second phase of the orogeny took place during the Plio-Pleistcene time. It has produced a series of faults which exhibit either strike-slip or thrust nature.

3-3 Mineralization

There are three kinds of metallic mineralization known in the southeastern part of West Java. These are epithermal gold-bearing quartz veins, lead-zinc veins and massive sulfide deposit.

Epithermal gold-bearing quartz veins occur in the hilly central belt. The known deposits are Cikondang, Citambal and Ciniru. They are hosted mainly by moderately to steeply dipping NW to NNE faults within andesitic or dacitic volcanic rocks of the Jampang Formation. Gold veins show low sulfide content; gold occurs as electrum with some manganese minerals in a quartz ± calcite gangue. They belong to the low-sulfidation adularia-sericite type epithermal gold deposit.

Lead-zinc veins were found in the northern volcanic belt and southern coastal area. Gn. Sawal is one of these deposits.

Massive sulfide deposit is expected to occur in the southwestern part of the study area because several indications of massive sulfide mineralization are known. The indications include the occurrences of gypsum and barite ores, and sericite-chlorite-montmorillonite alteration in Miocene dacitic pyroclastic rocks.

In addition to these metallic mineral potentials, the occurrences of some important industrial minerals are known in the Tasikmalaya area. Among them, phosphate resources are currently exploited and significantly contributed to the nation's agriculture. Phosphorite is found near Sidamulih and Sukaraja in the eastern part of the study area.

Chapter 4 Discussion on the Results of the First Phase Survey

4-1 Geology, Geologic Structure and Mineralization

(1) Salopa Area

The extensive development of gold-bearing quartz veins and network veins was confirmed at many localities in the Salopa area through geological survey and geochemical exploration in the first phase. Gold-bearing quartz veins/networks occur in the volcanic-sedimentary series of the Oligocene-Miocene Jampang Formation. The host rock is composed mainly of andesitic to dacitic volcanic and pyroclastic rocks of the Jampang Formation. There is no gold mineralization which is hosted by the Kalipucang limestone or Bentang sandstone. From these evidences, the gold mineralization in the Salopa area can be interpreted to be related to the Miocene tholeiitic volcanism -- the so-called "Old Andesites" (Van Bemmelen, 1949).

Structurally, the gold occurrences are situated on the wing of a gentle anticlinorium whose axis is WNW-ESE. It is likely to be formed under regional lateral compression probably caused by the subduction of the Indian Ocean plate. This geologic environment is believed to be the most important factor for the formation of vein pattern in the Salopa area. The principal direction of the compressional stress field is considered to be NNW in this area. Although several vein systems were distinguished in the prospect, the NW system is outstanding within the study area. On the other hand, a complex circular structure centered at Salopa was recognized through the photogeological interpretation on the SAR images. This structure was interpreted as a kind of depression related to the volcanic activity of the Upper Member of the Jampang Formation. No field evidence connecting this photogeological structure to the vein systems has come out during the geological survey in the first phase.

The epithermal gold mineralization in the Salopa area shows the following four distinctive features;

(a) Gold is associated mainly with pyrite and arsenopyrite.
(b) Gold and sulfide mineralization consist of earlier quartz-pyrite-arsenopyrite stage and later galena-sphalerite-chalcopyrite stage.
(c) Gold occurs as electrum with some manganese minerals in a quartz ± calcite gangue.
(d) Hydrothermal alteration is mainly composed of silicification and sericitization.

Significant results of gold assay were returned from a part of quartz veins where a small amount of sulfide minerals was impregnated. Pyrite and arsenopyrite are the minerals most closely associated with gold. Galena, sphalerite and chalcopyrite were also found in the gold-bearing quartz veins. Traces of argentite, cinnabar and realgar were detected in the sulfide associations through the ore microscopy. Specularite and stibnite were recognized in some veins.

Gold and sulfide mineralization can be roughly classified into two stages: earlier pyrite-arsenopyrite-quartz stage and later galena-sphalerite-chalcopyrite stage. The junction of pyrite-arsenopyrite quartz vein and sphalerite-galena network vein sometimes forms a bonanza of gold.

The occurrence of As-Sb-sulfides seems to be a little difference from the common West Java epithermal gold deposits. However the presence of cinnabar and realgar directly shows that it was formed at the shallow portion of a hydrothermal system.

Quartz and calcite are accounted for the major part of gangue minerals. Adularia is seldom observed in quartz veins. No alunite has been identified. Hypogene alteration is composed mainly of silicification and sericitization. Weak and sporadic montmorillonitization and kaolinitization were detected by X-ray diffraction analysis.

Wall-rock alteration in a hydrothermal system changes commonly from silicification-propylitization in the deeper zone to argillic alteration in the upper part. Advanced-argillic alteration appears at the top of the system in some cases. The alteration in this area is similar to the middle to the upper facies of the hydrothermal system.

These evidences, in total, suggest that gold-bearing quartz veins in the Salopa area were formed under epithermal conditions, though slightly different from ordinary adularia-sericite type (Hayba et al., 1985) gold mineralization. The geology and mineralization have been studied well in several epithermal gold deposits in West Java such as Cikotok and Pongkor. These are also thought as the low-sulfidation adularia-sericite type deposits. The detailed comparison of the mineralization would be an interesting theme in this district.

(2) Sidamulih Area

Two styles of mineralization were observed in the Sidamulih area. One is gold-bearing silicified breccia contained in volcanic breccia of the Jampang Formation. The other one is pyrite dissemination in grey clay zones. The overall geologic environment is similar to that of the Salopa area; the Sidamulih area is structurally located on the eastern wing of the regional anticlinorium.

Auriferous breccia ores show a reworked nature of older gold mineralization. The original ores are probably derived from the pre-Miocene gold mineralization.

Pyrite dissemination in grey clay zones is thought to be a product of geothermal activity.

(3) Cisasah Area

Green tuff of the Upper Member of the Jampang Formation, probably Miocene, is widespread from the eastern part to the east of the Cisasah area. Two massive anhydrite-gypsum ores and a barite bed were found within the green tuff. These are: Cisasah (gypsum), Cidadap (gypsum), and Cibuniasih (barite). These stratabound deposits occur at a certain horizon within the green tuff member comprising dacitic pumice tuff, fine tuff and tuff-breccia. Dacite lava occurs within the pyroclastic member near Cisasah. The total thickness of green tuff is estimated to be something around 200 m. The structure of the horizon looks not complicated, rather simple and flat.

The Bentang calcareous sandstone, and Kalipucang limestone in some cases, occur above the green tuff. At Cidadap, gypsum ore is overlain directly by the Bentang fossil-rich sandstone. There is no mudstone layer covering the massive sulfide horizon. It suggests that the waning stage of mineralization is characterized by a shallow-water oxidation environment.

The stratigraphic succession of the massive sulfide mineralization can be categorized into several zones together with the footwall, intermediate and hanging-wall green tuffs in descending order as follows:

(a) Hanging-wall green tuff
(b) Manganese zone
(c) Intermediate green tuff
(d) Barite-galena bed
(e) Anhydrite-gypsum zone
(f) Footwall green tuff

Barite bed is composed of a sulfide assemblage of galena-sphalerite-pyrite-chalcopyrite-covelline with barite + quartz gangue. Significant results of gold and silver assays were obtained in the Cibuniasih barite bed.

Anhydrite-gypsum zone is mainly composed of massive anhydrite-gypsum ores with sericitic clay. Pyrite is strongly disseminated, and a small amount of chalcopyrite, galena and sphalerite are impregnated within anhydrite-gypsum zone. Colloform texture was observed in pyrite under the microscope.

Manganese zone is composed of rhodochrosite, manganese oxide minerals (such as pyrolusite and psilomelane) and pyrite. Patches of ferruginous chert consisting of hematite-rich silica materials were sometimes found within manganese ores.

The assemblages of alteration minerals in each of the above-mentioned six zones are as follows:

(a) Montmorillonite

(b) Montmorillonite-sericite

(c) Montmorillonite-chlorite-sericite-kaolin-mixed layer mineral (chlorite-montmorillonite mixed layer)

(d) Quartz-sericite-chlorite

(e) Quartz-sericite

(f) (Not examined)

The regional alteration of green tuff is characterized by an assemblage of montmorillonite-sericite-chlorite. Comparing to the Hokuroku district, the degree of hydrothermal alteration is weak in the Cisasah area.

The green tuff may be developed, though yet to be confirmed, over a wide area along the southern coast of Indian Ocean in West Java. The results of investigation on the geological setting and mode of massive sulfide mineralization could become an example for the other areas in this district.

Gold and base-metal mineralization was recognized in several places in the Cisasah area. These mineralization are spatially correlated to the outcrops of igneous bodies such as quartz-porphyry, andesite and dacite, which are probably affiliated from the Tenjolaut granodiorite stock.

Auriferous quartz veins in the Padawaras prospect show a mesothermal nature of mineralization: massive vein features and coarse-grained quartz morphology. It is different from the gold mineralization in the Salopa area.

Pyrite-chalcopyrite-sphalerite-galena mineralization along S. Cilangla accompanies silicification, chloritization and epidotization. It shows typical features of the lower facies of a hydrothermal system.

4-2 Geochemistry

(1) Salopa Area

In the first phase, panning survey, stream sediment survey and reconnaissance soil survey were carried out for an area covering approximately 518 km^2 in the Salopa area. The geochemical samples collected in the first phase amounted to 1,238 in total. Data were statistically processed. The results of geochemistry were examined together with the results of geological survey, and a couple of areas was highlighted for the further exploration.

Gold grains were found in nearly one-third of pan concentrate samples. Sulfide minerals such as pyrite, arsenopyrite, chalcopyrite, galena, cinnabar and realgar were often detected near mineralized zones. A total of 11 anomalous localities -- Ciniru, Cikuya, Cimaranten, Cigugur, Cijurey, Cibatungurung, Cipangesikan-Cijalu, Cibeunying, Cikondang, Citambal and Ciseel -- were picked up as a result of panning survey this phase.

As for stream sediment geochemistry, many anomalous values of Au up to 16.6 g/t (AT150ST, Nyalindung) were obtained. A weak but significant correlation was observed between some elements such as Au-Ag, Au-As and As-Sb. These associations can be explained by the occurrences of argentite, arsenopyrite and stibnite in gold-bearing quartz veins. A total of 10 anomalous localities -- Ciniru, Cikuya, Cibunter-Cibaregbeg, Cikondang, Citambal, Ciseel, Citembang, Cijurey, Gulingmuding and Ciwarak -- was obtained through the statistical analysis of stream sediment geochemical data.

Two distinctive Au anomalies and several minor anomalies were outlined from panning survey and stream sediment geochemistry. The major anomalies are located at: Ciniru, middle reaches of S. Cimedang, Cikuya, Cikondang, Citambal, upper reaches of S. Ciseel. The former three anomalies are distributed within an area of 8 km (NW-SE) by 5 km (NE-SW) in the southern part of the Salopa area. They are composed of significant Au values of stream sediment samples. Anomalies of Ag, As and Sb almost overlap on the Au anomalies (for example: 5,660 ppb Au, 47.00 ppm Ag, 1,750 ppm As and 249 ppm Sb, AD23ST).

The latter three anomalies are distributed within an area of approximately 40 km^2 elongating NW-SE in the northeastern part of the Salopa area. They are composed of significant Au values of stream sediment samples. Anomalies of Ag, As and Sb almost overlap on the Au anomalies (for example: 15.2 g/t Au, 99.40 ppm Ag, 1,415 ppm As and 443 ppm Sb, AK32ST).

The geochemical anomalies agree well with the areas where intensive quartz veins/networks were found.

Reconnaissance soil survey was carried out in two prospects: Ciniru and Cikuya. The values of Ag, As and Sb were statistically correlated with Au in the soil geochemistry. Thus the distribution of these elements was interpreted as the indicator of gold mineralization. A series of soil anomalies was caught at S. Ciniru and the surrounding ridges. They are arranged in the NW-SE direction over 3 km. It roughly coincides with gold anomalies of pan concentrates. Au anomalies at Cikuya are located about 6 km southeast of the Ciniru anomaly. They are composed of distinctive Au anomalies up to 410 ppb arranging roughly in the NW-SE direction.

(2) Sidamulih Area

Panning survey and stream sediment survey were conducted for an area covering approximately 170 km^2 in the Sidamulih area in the first phase. A total of 263 geochemical samples was collected. The results of geochemistry were examined together with the results of geological survey.

Au anomalies were obtained through the stream sediment geochemistry. They are low level anomalies, and are isolated each other. Only 9 samples exceed the second order anomalous value (13 ppb Au). The maximum value is 164 ppb Au at a branch of S. Cijulang-Wetan. These Au anomalies of stream sediment samples roughly correspond to either the outcrops of grey clay zones or the occurrences of silicified floats.

No significant gold anomaly has been found by panning survey in the Sidamulih area.

(3) Cisasah Area

Panning survey and stream sediment geochemistry were carried out in the Cisasah area during the first phase. A total of 505 geochemical samples was collected from an area of 312 km^2.

A couple of gold and cinnabar anomalies was detected at the Cisasah and Cidadap gypsum mines by panning survey.

Significant stream sediment anomalies (up to 708 ppb Au) were caught along S. Cisasah and the surrounding area. It roughly coincides with the panning anomalies.

Several significant gold and base-metal anomalies were found at the Padawaras, Darawati and Cilangla prospects by panning survey.

Some stream sediment anomalies (188 ppb Au and low level As) were caught along S. Citisuk and the upper reaches of S. Cipatujah. It roughly coincides with the zone of gold-bearing quartz veins at the Padawaras prospect.

Weak stream sediment anomalies (up to 54 ppb Au) were caught at the middle reaches of S. Cilangla and it's branches. They coincide with the panning anomalies.

Several other Au anomalies were detected in the Cisasah area. They are generally small in scale and isolated.

4-3 Potential of Mineral Resources

(1) Salopa Area

In the course of the first phase survey, a total of 17 localities of epithermal gold potential has been found in the Salopa area. They consist of the significant Au anomalies of stream sediment and panning geochemistry, outcrops of gold-bearing quartz veins and network veins, and hydrothermal alteration zones. It is interpreted that the type of mineralization is epithermal gold-bearing quartz vein deposit of probably Miocene age. Some part of these veins, where are high-grade but thin, are already mined by local people in a small scale by the traditional hand-mining, hydraulic crushing and mercury amalgamation method. Most of other places, however, remain untouched by the systematic exploration.

Among these gold occurrences, there are two attractive prospects -- (a) Ciniru-Cikuya, and (b) Cikondang-Citambal-Ciseel. The mineral showings and geochemical anomalies are distributed over an area of approximately 40 km^2 elongating NW-SE in both cases. The development of quartz veins/networks is rather intense. The geochemical anomalies occur densely. The size and magnitude of gold mineralization are estimated to be medium from the geochemical features.

(2) Sidamulih Area

Auriferous breccia ores were found within volcanic breccia of the Jampang Formation in the Sidamulih area. Some of the breccias showed significant assay results. However, they have a reworked nature and are discontinuous. Stream sediment Au anomalies in the area are of low level and sporadic. From these evidences, it is believed that the gold mineralization of this style has no sign of extensive development.

Pyrite dissemination in grey clay zones was found at the southern part of the survey area. Assay results were discouraging. Au anomalies of stream sediment samples found near the pyrite dissemination are of low level and patchy. This style of mineralization seems to have little potential.

(3) Cisasah Area

The potential of massive sulfide deposit was investigated in the first phase in the Cisasah area. The prospect is still in a grass-root stage; only the occurrences of gypsum and barite have been known. In this phase, we have studied: (a) distribution of green tuff, (b) stratigraphic succession of massive sulfide mineralization, and (c) assemblage of hydrothermal alteration minerals. Significant assay results (up to 2.17 g/t Au, 662 g/t Ag, 38.64 % Pb, etc.) were returned from grab samples in the Cibuniasih barite bed. It may show the possibility of massive sulfide deposits of economic grade.

In comparison with the Kuroko deposit in the Hokuroku district, several characteristic features of geology and mineralization in this area were extracted:

(a) Small magnitude of submarine dacitic volcanic activity.
(b) Weak regional hydrothermal alteration, mainly montmorillonitization.
(c) Lack of hanging-wall mudstone or basalt layer (as a cap or sealing rock of sulfide precipitates).
(d) Not reduction but oxidation environments (shallow sea) at the waning stage of mineralization.

The major part of the prospect is covered by the Kalipucang limestone or Bentang sandstone in the Cisasah area. The exploration for this kind of blind deposit must be followed by steady steps. On the basis of the past experiences in the Hokuroku district, the favorite conditions for significant massive sulfide mineralization may exist in such places as: (a) thick development of green tuff, (b) intensive activity of dacite lava, (c) thick coverage by mudstone, and (d) occurrence of intensive hydrothermal alteration haloes.

Gold and base-metal mineralization in the Cisasah area, which was interpreted to be genetically related to the igneous intrusions, showed the second-order anomalies by geochemical survey this phase. It may be small scale and of minor importance.

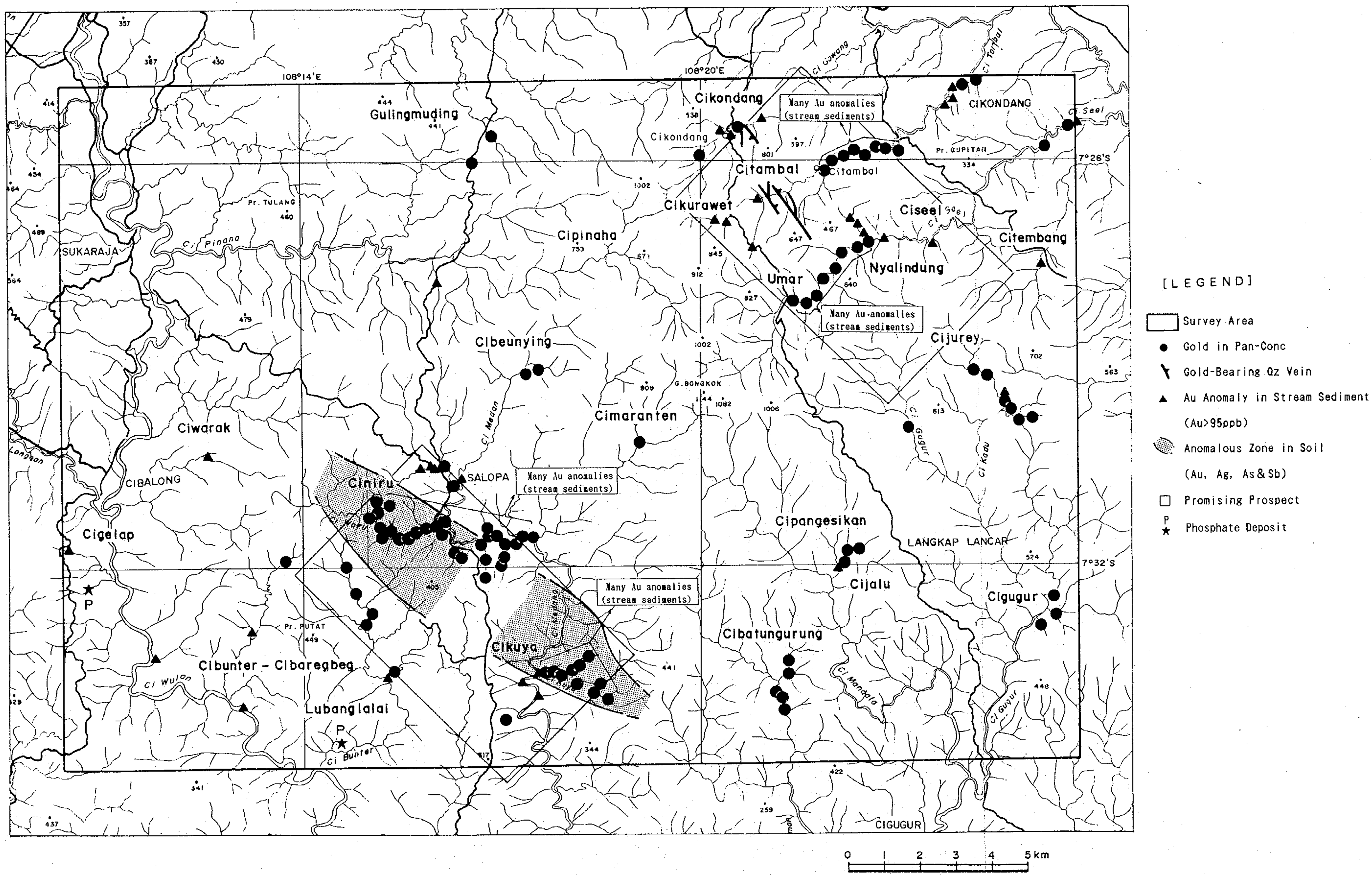


Fig. 1-3 Integrated Interpretation of the Survey Results in the Salopa Area

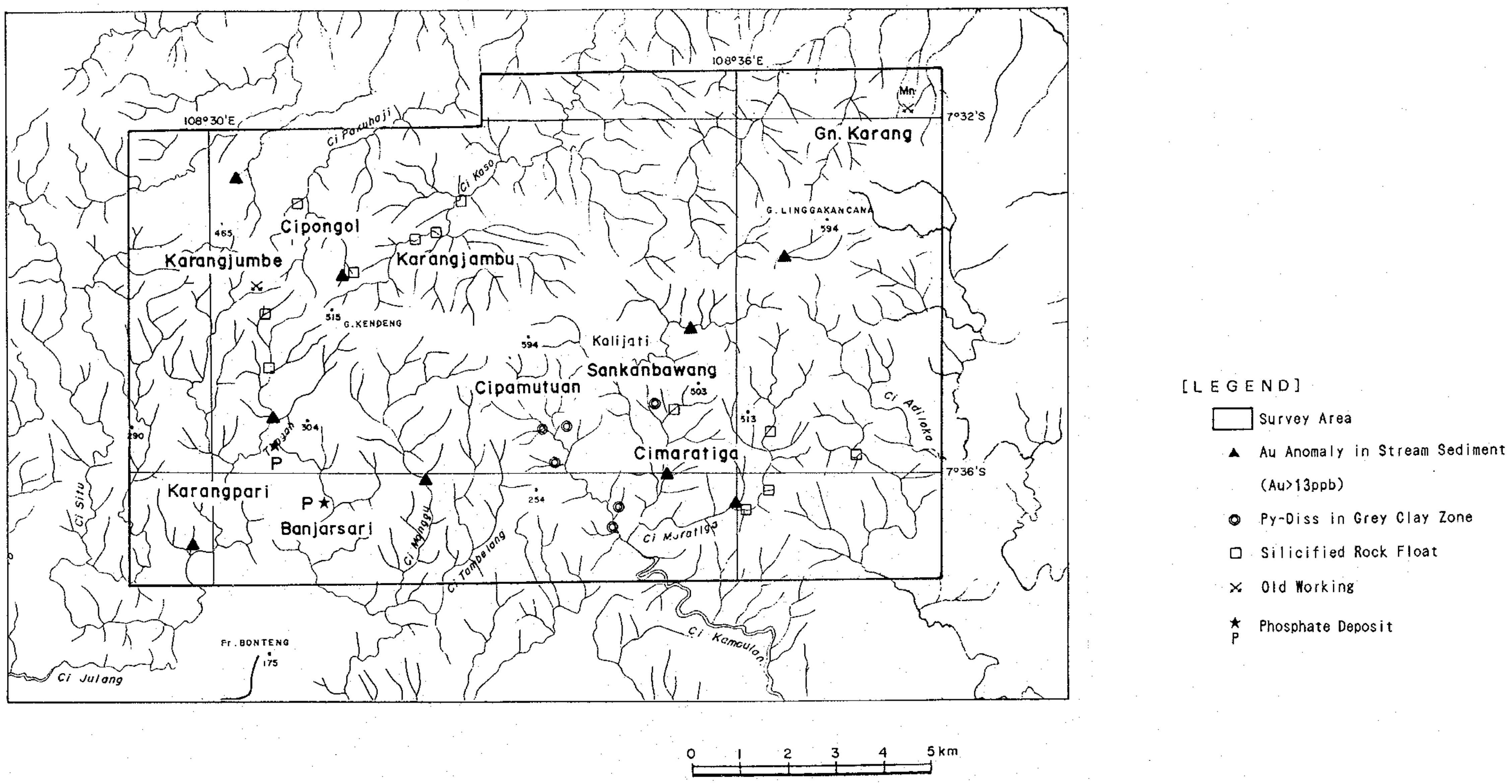


Fig. 1-4 Integrated Interpretation of the Survey Results in the Sidamulih Area

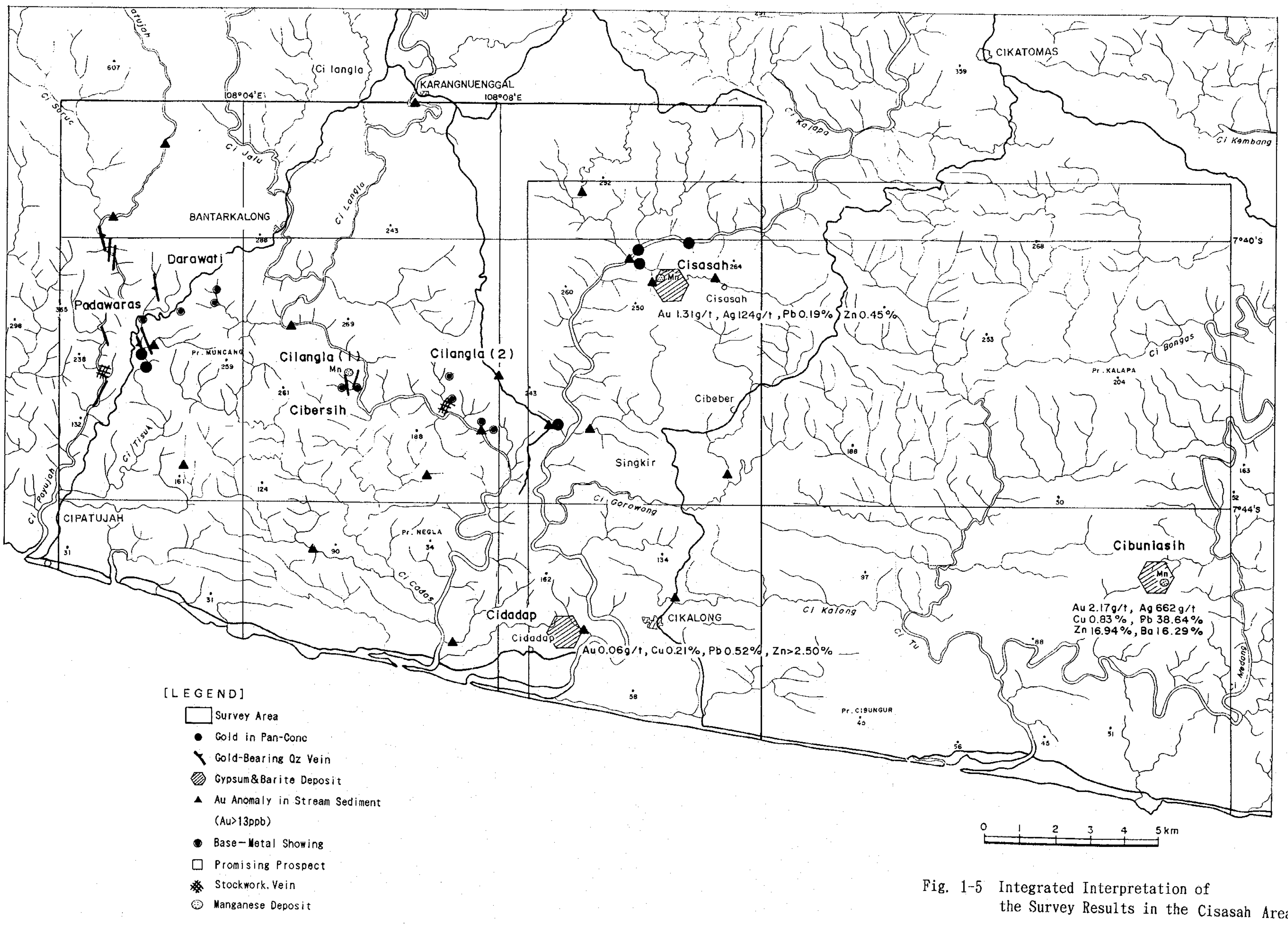


Fig. 1-5 Integrated Interpretation of the Survey Results in the Cisasah Area

Chapter 5 Conclusions and Recommendations

5-1 Conclusions

On the basis of the results of the first phase works comprising satellite image photogeological interpretation, review of the existing geological information, geological survey and geochemical exploration, the following conclusions are obtained.

5-1-1 Salopa Area

(1) The JERS-1 SAR data were processed and two scenes of monochrome image of 1:200,000 scale were prepared. The topography, drainage systems, geology and geologic structure were analyzed on these images. A total of eleven geologic units was classified and identified within the area. These photogeologic units were examined during the field survey, and relatively good correlation with the results of geological survey was obtained. Photolineaments and circular structures were extracted on the image in the survey area. Among them, a complex circular structure centered near Salopa was interpreted to be an old volcanic depression related to the volcanic activity of the Upper Member of the Jampang Formation. No field evidence connecting this photogeological structure to the vein system has been found during the field survey. It must be further studied in the next phase survey.

(2) A total of 17 epithermal gold showings was found through geological survey and geochemical exploration in the Salopa area. Among them, the Ciniru-Cikuya prospect showed a significant potential of epithermal gold deposit. Several gold-bearing quartz veins and network veins occur at the junction of S. Ciniru and S. Cipanawar. Gold was recognized in a series of quartz veins/networks of mainly NW direction. Test samples taken from the quartz vein outcrops on the river-bed showed significant gold and silver values. Distinctive gold anomalies were caught by panning survey, stream sediment survey and reconnaissance soil survey in this prospect. A group of quarzt veins/networks trending NW and NNE is developed at S. Cikuya. Significant gold and silver grades were obtained from grab samples of old workings. Small but solid geochemical gold anomalies were also found in this prospect. These two prospects are located in an area of 8 km (NW-SE) by 5 km (NE-SW) in the southern part of the Salopa area. Some anomalies of panning survey and stream sediment geochemistry were caught at the middle reaches of S. Cimedang which was situated at the middle of these two prospects. Gold mineralization is expected to be continued in this zone.

(3) One more attractive prospect -- Cikondang-Citambal-Ciseel -- was extracted in the northeastern part of the Salopa area. Numerous gold-bearing quartz veins and network veins of mainly NW trend are distributed in these prospects. Remarkable results of gold assay were returned from outcrops and

old workings in these prospects. Significant gold anomalies were outlined by panning survey and stream sediment geochemistry. These three prospects are arranged within an area of approximately 40 km^2 elongating NW-SE. Gold anomalies are expected to extend about 5 km more to the southeast until S. Cijurey.

(4) Gold-bearing quartz veins in the Salopa area are hosted by andesitic and dacitic volcanic and pyroclastic rocks of the Jampang Formation, which are called "Old Andesites" and considered to be formed by the Oligocene to Miocene submarine tholeiitic volcanic activity. The NW system is dominant among the vein systems in this area. An area where quartz veins are developed is structurally situated on the wing of a regional anticlinorium (whose axis is WNW-ESE). On the other hand, the photogeological study indicated the existence of a complex circular structure of several tens of kilometers in diameter around Salopa. Some connection between the vein system and circular structure is assumed. Detailed structural analysis using airphotos is expected to be performed in the next phase.

(5) Characteristic features of gold mineralization on ore and gangue mineral assemblages and hydrothermal alteration were examined. These features are basically of the characteristics of epithermal gold deposit. Gold-bearing quartz veins in the Salopa area are thought to belong to the aduralia-sericite type epithermal gold deposit. Compared with the well-known epithermal gold veins such as Cikotok and Pongkor in West Java, two things -- the occurrence of As-Sb minerals (arsenopyrite and stibnite), and lack of adularia in the gangue mineral assemblage -- are different. They are probably caused from the differences of age and conditions of formation between them.

5-1-2 Sidamulih Area

(1) It became clear through the survey that the gold ores which had been known at Karangjambe and other localities in the Sidamulih area were ore breccias contained in the volcanic breccia of the Jampang Formation. They are a kind of reworked ore. Geochemical gold anomalies which were deemed to be found in the past exploration in this area might come from such reworked origin. Therefore, they are empty ones.

(2) Grey to light grey clay zones with strong pyrite dissemination occur in the central-southern part of the survey area. The results of geochemical survey in the first phase showed that the level of Au anomaly was very low. It was interpreted that the clayey alteration was formed by a geothermal activity.

5-1-3 Cisasah Area

(1) The distribution of dacitic pyroclastic rocks of the Upper Member of the Jampang Formation, so-called green tuff, was proved over an area from the eastern part to the east of the Cisasah area. The occurrences of two gypsum deposits and one barite bed are known within the area. Significant assay results for precious and base-metals were obtained from some samples in the Cibuniasih barite bed. It is a potential prospect of massive sulfide deposit. In this phase, we have confirmed the following matters: (a) distribution of green tuff, (b) stratigraphic succession of massive sulfide mineralization, and (c) assemblage of hydrothermal alteration minerals.

(2) The structure of green tuff horizon is extremely monotonous and flat. The thickness is rather thin, around 200 m in the vicinity of the Cisasah gypsum mine. The results of field surveys indicated that the size and magnitude of submarine dacitic volcanic activity in this area were comparatively smaller-scale and weaker than those of in the Hokuroku district in Japan. Some characteristic features of hydrothermal alteration around the massive sulfide ore zone were investigated. In the Cisasah and Cidadap gypsum mines, the quartz-sericite zone is distributed in the footwall -- including gypsum zone -- of the massive sulfide horizon. The alteration zone of the massive sulfide horizon is characterized by the quartz-sericite-chlorite assemblage. Montmorillonite, kaolin and mixed-layer mineral were detected in the massive sulfide horizon. Montmorillonitization was commonly observed in the hanging-wall side of the horizon. The distribution of alteration zones looks not extensive from the observation at the sporadic outcrops of green tuff in the survey area. In order to catch the significant size of massive sulfide ore, we have to look for such conditions as: (a) thick development of green tuff, (b) intensive activity of dacite lava, (c) thick coverage by mudstone, and (d) occurrence of intensive hydrothermal alteration haloes.

(3) Gold and base-metal mineralization were found in several localities from the central to the western parts of the Cisasah area. Gold-bearing quartz veins in Padawaras show massive vein features. Silicification, chloritization and epidotization are accompanied by the base-metal sulfide mineralization at the middle reaches of S. Cilangla. Based on the vein morphology, mineral assemblage and the mode of alteration in these prospects, it was interpreted to be formed at the deeper portion of a hydrothermal system. Intrusive bodies of quartz-porphyry, andesite and dacite sometimes occur in the vicinity of these mineralized places. Some relation of mineralization to the igneous bodies is implied from their intimate occurrences. The second-order anomalies were detected by stream sediment geochemistry. They are probably small scale and of minor importance.

5-2 Recommendations for the Second Phase Exploration

Salopa Area

Structural analysis must be made on the area where indications of gold mineralization were extracted through the first phase survey by means of photogeology using airphotos. It is for the purpose of studying the relationship of structural factors to the gold mineralization, especially the circular structure recognized on the SAR image.

It is recommended that the major mineralized zones be explored by the detailed geological survey and soil survey in the second phase. Reconnaissance drilling is also recommended to test the geochemical anomalies delineated by the soil survey.

The promising prospects for the detailed survey and drilling are as follows:

(a) Ciniru-Cikuya prospect (40 km^2)

(b) Cikondang-Citambal-Ciseel prospect (40 km^2)

Sidamulih Area

No further work is recommended in the Sidamulih area.

Cisasah Area

It is recommended that the semi-detailed survey for massive sulfide deposit comprising geological survey and alteration survey be made on an area of 20 km (E-W) by 15 km (N-S) in which Cisasah, Cidadap and Cibuniasih are included. Structural drilling will be necessary for the purpose of exploring the horizon of mineralization and catching the alteration halo.

The gravity survey is also recommended over the prospect in order to investigate the basement structure and structural setting of massive sulfide mineralization.

PART II

DETAILED DISCUSSIONS

PART II DETAILED DISCUSSIONS

Chapter 1 Satellite Image Photogeological Interpretation

1-1 Methodology

(1) Introduction

The major purpose of photogeological interpretation is to obtain guidelines for geological survey and geochemical exploration by elucidating the geologic units and the regional geologic structure of the survey area. The results of photogeological interpretation, together with the studies of the existing geological information, were applied for selecting field survey areas.

The JERS-1 SAR data were provided from NASDA through ERSDAC as CCT. These are Level 2.1 digital data in which the initial topographic distortion has been corrected. The images used in the examination were two scenes of the JERS-1 SAR monochrome print of 1:200,000 scale. The studied images cover the area shown in Fig. 2-2. These two scenes were processed so well that neither significant ghost nor over-saturated noise was detected over the area at all. Details of the images are listed in the table below.

DATA	PATH	ROW	DATA ACQUISI-TION DATE	SCENE CENTER	ILLUMINATION DIRECTION
JERS-1 SAR LEVEL 2.1	104	313	Feb.21,1993	7°27'S 108°26'E	N81°W
	105	313	Aug.30,1992	7°28'S 107°58'E	N81°W

The synthetic aperture radar (SAR) has an advantage that it is possible to acquire a clear image even through a thick cloud and fog in the tropical rainforest areas such as Southeast Asia or South America. The topographic distortion of JERS-1 SAR images is smaller than that of European ERS-1 SAR images in general. It makes more convenient and easier for the interpretation of geology and topography on the images of JERS-1 SAR. The JERS-1 SAR adopts L Band (23.5 cm in wavelength), longer than C or X Bands which are used in the European ERS-1 SAR. The L Band has been turned out to be much effective in the discrimination between forest and grass lands. Moreover, topographic measurements and, in a certain condition, stereoscopic measurements are obtained by means of interfering two images of which orbits are adjoining each other.

The SAR usually possesses an anisotropic ability on detecting the topographic discontinuity because it discharges microwave at a fixed direction (i.e. illumination direction). Generally, a linear object on the surface orientated parallel to the illumination direction is less detectable than that is orientated at an angle of 20 to 30 degrees to the direction. This anisotropism has to be carefully treated in the interpretation of lineament on the SAR images. The correction of bias by the interpretation on the OPS images is a way to prevent this problem.

The interpretation of topography and geology of a certain area is made on the basis of specific signatures on SAR images such as -- dip slope, lineament, topographic texture and drainage pattern. The major criteria taken into the interpretation in this case are summarized as follows:

[Photographic features]

Tone	; light, medium, dark
Texture	; fine (smooth), medium, coarse

[Topographic features]

Drainage pattern	; dendritic, parallel, radial, zigzag
Drainage density	; low, moderate, high
Topographic relief	; (amount of relief is measured)
Resistivity	; very low, low, moderate, high
Ridge shape	; flat, gently sloping, steep, karst
Bedding	; developed, massive, poor

(2) Preparation of SAR Image

A JERS-1 SAR image is composed of 16-bit pixel data, each of them shows 65,536 gradations. The original 16-bit data must be converted into normal photo-image data of 256 gradations; this process is data compression. Generally, one way is to allocate one of the gradations which are calculated from the quotient of the difference of the largest - smallest by 256. Another way is to allocate one of the gradations calculated from the difference between mean plus a*sigma and mean minus b*sigma by 256. In the latter case, values a and b are obtained from a value between 2.5 and 3.5.

SAR data originally contain a significant amount of speckle noises which are produced by the interference of scattered electromagnetic waves. These speckle noises occur at random, and are usually large. Because of these random noises, the gradation value changes greatly even among the adjoining pixels. It causes a rough appearance of photo image. If the bit conversion (16-bit into 8-bit)

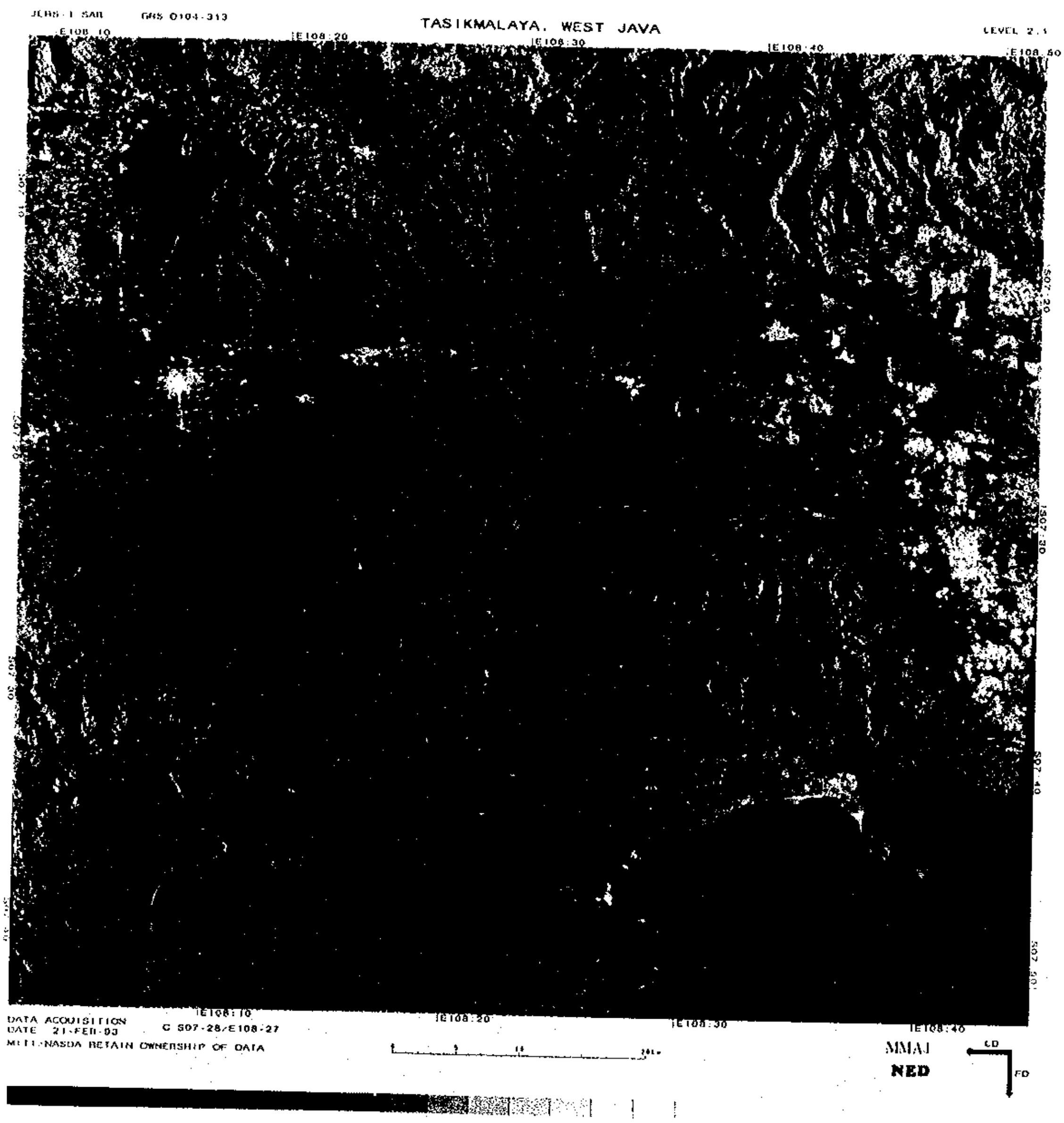


Fig. 2-1 JERS－1 SAR Images

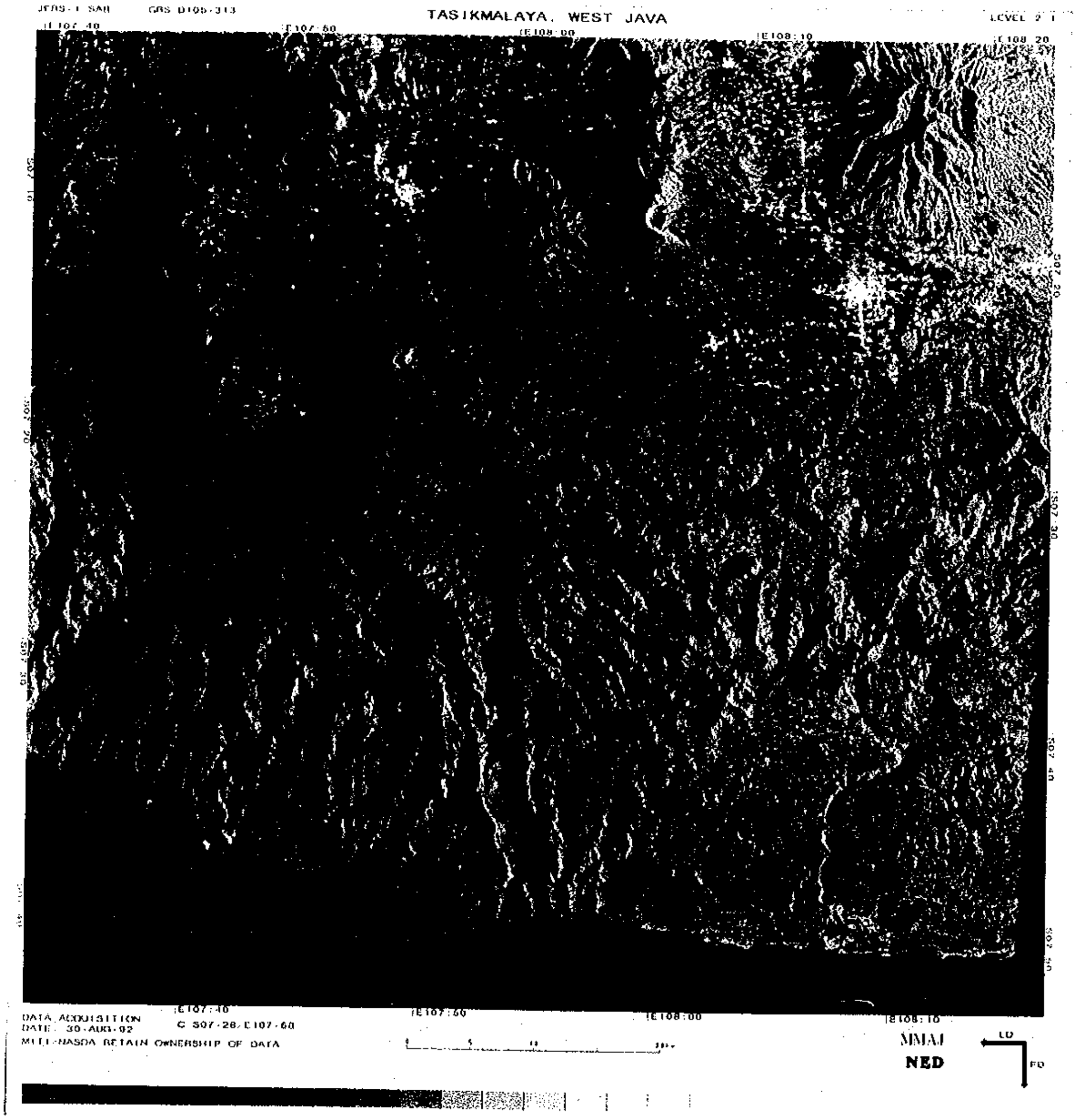


Fig. 2-1 JERS-1 SAR Images

is practiced on the data in which original noises are still included, the noise level would be enlarged as a matter of course, and the quality of image data would be deteriorated inevitably. For this reason, the bit conversion must be processed after filtering; this is a process of eliminating speckle noises. There are several filters usually used in this process as follows:

3 pixels x 3 pixels local smoothing filter
3 pixels x 3 pixels median filter
5 pixels x 5 pixels edge preserving filter
7 pixels x 7 pixels kernel filter

We have examined almost all filters. The best result which showed the smallest speckle noise was obtained from the kernel filter in this study. Following to it, the bit conversion was conducted on the range of P of the filtered data. As the result of these procedures, clear and well-gradated SAR images, with a plenty of topographic and geological information, were obtained in the study area where OPS images showed a cloud cover of 40 % -- that means it was practically impossible to see the land surface through the OPS.

1-2 Results of the Interpretation

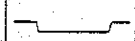
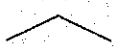
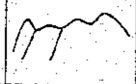
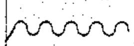
(1) Geologic Units

Based on the photogeological characteristics, eleven geologic units were classified and identified in the study area. It is composed of seven rock units correlated to the Tertiary members (T_1 to T_{5-2}), three Quaternary rock units (Q_1 to Q_3) and one igneous rock unit (I). Results of the photogeological classification are summarized in Table 2-1. The JERS-1 SAR images and interpretation map are shown in Figs. 2-1 and 2-2 respectively.

<u>Unit T_1</u>

Unit T_1 is a rock unit of very high resistivity, the highest in the study area. It is characterized by the massive morphology. It mainly occurs at three areas from the central to the northeastern parts of the study area. One of these distributions, located in the central part, forms an anticlinal structure stretching E-W for about 50 km. It corresponds to volcanic rocks of the lowest member of the study area. It was interpreted to be correlated to the Lower Member and some part of the Upper Member of the Jampang Formation.

Table 2-1 Summary of Photogeological Interpretation

Characte-ristics / Unit		Photo-Characteristics		Morphological Expression						Estimated Lithology
		Tone	Texture	Drainage System		Rock Property				
				Pattern	Density	Cross-section	Resis-tivety	Attitude	Bedding	
Q	Q_3	very dark to vary light	fine or smooth	meandering	very low		very low	horizontal	none	Unconsolidated Deposits (mainly Alluvium)
	Q_2	medium grey	fine to coarse	radial	high		low to high	steep, horizontal	massive	Volcanic Products (younger than Q1 Unit)
	Q_1	〃	medium to coarse	sub-parallel	low		〃	gentle	〃	Volcanic Products
T	T_{5-2}	〃	coarse	sub-dendritic	very low		high	〃	〃	Limestone
	T_{5-1}	〃	fine to medium, partly linear	dendritic	medium		low to moderate	〃	bedded, massive	Pyroclastic and Clastic Rocks
	T_4	〃	coarse	sub-dendritic	low		moderate	karst phenomena	massive	Limestone
	T_3	〃	fine to medium	parallel	very low		high	steep	bedded	Clastic Rocks (mainly Sandstone)
	T_{2-2}	〃	coarse	sub-dendritic	very low		high	gentle	massive	Limestone
	T_{2-1}	〃	medium to coarse, partly linear	dendritic parallel	medium to high		low to high	moderate	well bedded, massive	Pyroclastic and Clastic Rocks
	T_1	〃	medium to coarse	dendritic	medium to high		very high	steep	massive	Volcanic Rocks
	I	〃	fine or smooth	—	—		low or moderate	horizontal	〃	Intrusive Rocks

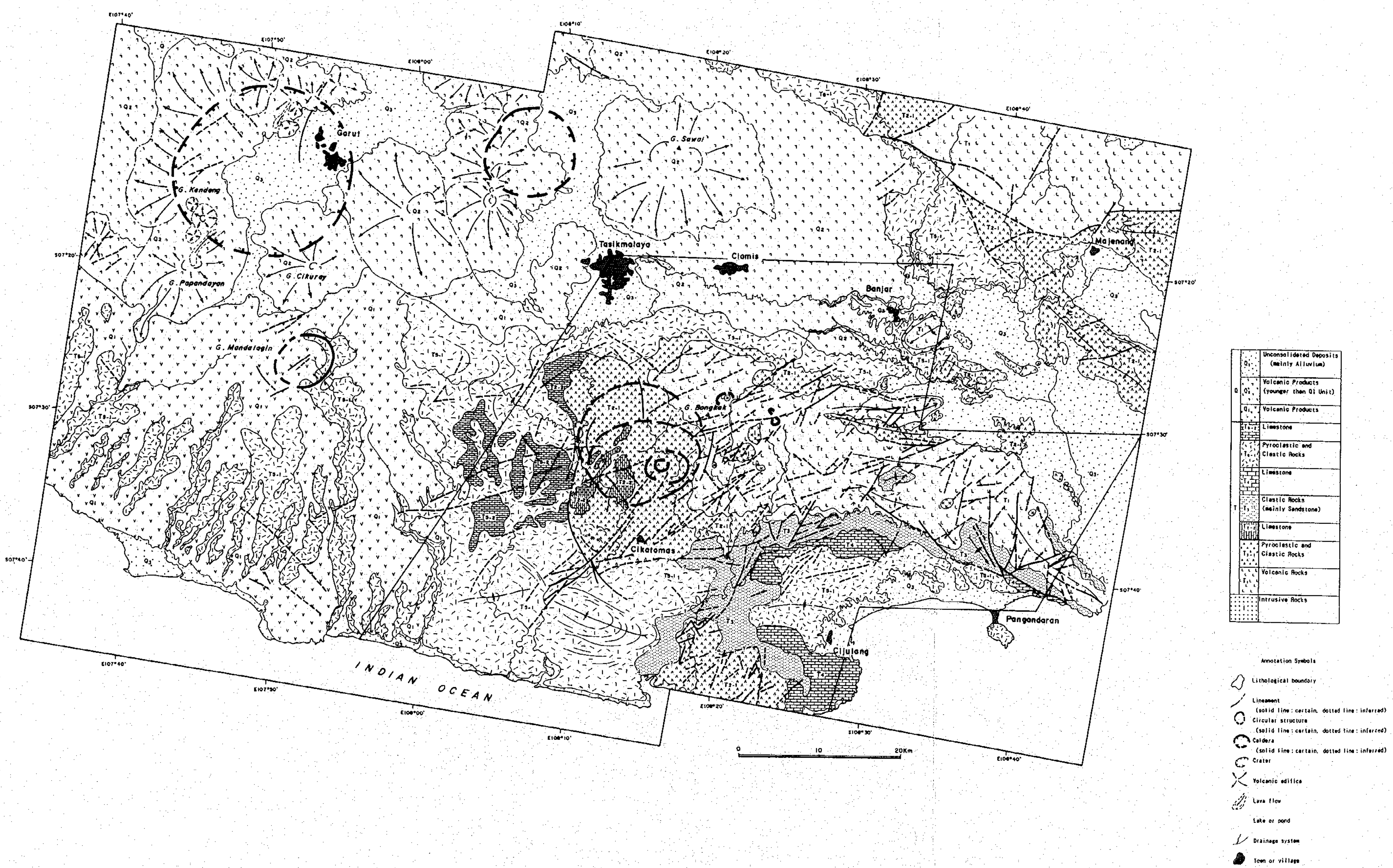


Fig. 2-2 Results of Satellite Image Photogeological Interpretation

Unit T_{2-1}

Unit T_{2-1} occurs from the central to the northeastern parts surrounding the Unit T_1. This unit shows a variety of photographic and topographic features; it is of low resistivity and massive in the central part, whereas in the northeastern part, it is of low - high resistivity and bedded. It also occurs locally in the southern part of the study area. It corresponds to either pyroclastic rocks or clastic rocks. It overlies conformably on the Unit T_1 in the central part of the area. In the northeastern part of the area, however, it shows a fault contact with the Unit T_1. It was interpreted to be correlated to some part of the Upper Member of the Jampang Formation.

Unit T_{2-2}

Unit T_{2-2} is a high resistivity, massive and irregularly orientated rock unit. It occurs locally within the distribution of the Unit T_{2-1} in the central part of the area. It was interpreted to be correlated to the Kalipucang limestone.

Unit T_3

Unit T_3 is characterized by fine to medium texture, parallel drainage pattern of very low density, high resistivity, and partly bedded morphology. It is distributed narrowly in the southern to the southeastern parts of the study area. It was interpreted to be composed of clastic rocks of the Bentang Formation, mainly sandstone.

Unit T_4

Unit T_4 shows coarse texture and massive morphology. It sometimes displays karst topography. It is developed along the Unit T_3 in the southern part of the area. This unit was interpreted to be composed of limestone of either the Kalipucang Formation or Bentang Formation.

Unit T_{5-1}

Unit T_{5-1} is a low to moderate resistivity rock unit. It is partly massive, whereas bedded in the other part. This rock unit is developed widely from the southwestern through central up to the northeastern parts of the study area. Among them, in the southwestern part, it occurs sporadically covered by the Unit Q_1.

It was interpreted to be composed of pyroclastic and clastic rocks of the Halang Formation. In some locality of the southern part, a karst-like topography was observed, and it was interpreted to be correlated to limestone.

Unit T_{5-2}

Unit T_{5-2} is, like the Unit T_{2-2}, a high resistivity, massive and irregularly orientated rock unit. It occurs within the Unit T_{5-1}. It was interpreted to be limestone of the Tapak Formation.

Unit Q_1

Unit Q_1 shows gentle ridge shape, although it has relatively high resistivity. It occurs along the mountain area. This unit was interpreted to be composed of lavas and volcanic ejectas of the Older Volcanic Rocks. It overlies unconformably on the Unit T_{5-1}.

Unit Q_2

Unit Q_2 occurs widely from the northwestern to the northern parts of the study area. This unit is characterized by the occurrences of volcanic land shapes such as cones, vents and lava flows. It was interpreted to be correlated to the Younger Volcanic Rocks. More than four cycles of volcanic eruptions were counted. Several independent volcanoes were distinguished in the area. This unit covers the Unit Q_1.

Unit Q_3

Unit Q_3 shows very low resistivity. It was interpreted to be composed of Holocene unconsolidated alluvial sediments. It occurs over flat lands near Tasikmalaya and Garut.

Unit I

This unit occurs sporadically at the central part and eastern part within the Unit T_1. It shows fine/smooth texture, low to moderate resistivity, and massive morphology. It was interpreted to be composed of intrusive rocks of dacite, andesite or granodiorite.

(2) Geologic Structure

Bedding and other sedimentary structures were generally obscure in the survey area. Successions and mutual relationship were distinguishable, though hardly, among the units. Photolineaments representing faults and fracture zones were observed in the area. Circular structures were recognized in the northern volcanic belt and in the central part of the study area. Small scale synclinal and anticlinal structures were recognized mainly within T_1 and T_{5-1} units.

Lineament

Lineaments were identified on the basis of (1) fault cliff, (2) steep linear valley (fault valley), and (3) linear arrangement of dip-slopes.

A total of more than 300 lineaments was counted throughout two scenes of images. The prominent direction of the lineaments is NNE. ENE, NE, N-S and NW are the next dominant directions. These lineaments were characteristically found in the Unit T_1 from the central to the eastern parts of the study area. Frequencies and total lengths of lineaments in each direction are counted as follows:

DIRECTION		FREQUENCY		TOTAL LENGTH	
		ct	%	km	%
E-W	S78.75°E - N78.75°E	31	10	97.0	7
ENE	N78.75°E - N56.25°E	44	14	158.9	11
NE	N56.25°E - N33.75°E	57	18	205.7	15
NNE	N33.75°E - N11.25°E	62	20	270.0	19
N-S	N11.25°E - N11.25°W	37	12	176.2	13
NNW	N11.25°W-N33.75°W	32	10	122.9	9
NW	N33.75°W - N56.25°W	29	10	261.7	19
WNW	N56.25°W- N78.75°W	19	6	103.6	7
TOTAL		311	100	1,396.0	100

The lineaments, which show big amount of topographic relief and which crosscut the general trend of formations, were interpreted to be faults. Such lineaments were recognized at the boundaries of T_1--T_{2-1} and T_1--T_{5-1} in the northeastern part, and T_{2-1}--T_{5-1} in the central-southern part of the study area.

Circular Structure

Seven circular and semi-circular structures were identified within two scenes of SAR images. The biggest one is 22 km in diameter, covering Gn. Kenden (1,694 m in altitude) and the eastern border of Garut city. The other significant circular structure, 11 km in diameter, is located at 25 km east of Garut. These two occur in the Unit Q_2, and were interpreted to be calderas. Only western parts of the calderas are remained; the other parts have been covered by younger volcanic rocks. One more significant circular structure occurs in the Unit Q_1 in the western part of the images.

Three circular structures were identified within T_1 and T_{2-1} units in the central part of the study area. Among them, the one which is located near Salopa forms complex circular structure. A total of four circular structures, which are nearly concentric, occur in this location. The diameter of the outer-most circle reaches to 15 km. The northern part of each circle is not clear. The centers of these four circles look not same. This structure is likely an old volcanic depression, probably related to the T_{2-1} activity.

Fold Structure

Fold structures were identified from the distribution of dip-slopes. Several anticlines and synclines were identified within the Tertiary Systems.

In the central part of the study area, an anticlinorium comprising a couple of synclines and anticlines was recognized within the Unit T_1. The general trend of folding axes is E-W.

In the southern part of the study area, three synclines with E-W axes were observed within the Unit T_{5-1}.

Chapter 2 Review of the Existing Geological Information

2-1 Introduction

The review of the existing geological information was made for the purpose of (1) grasping the outline of geology and known mineralization over the Tasikmalaya area, and (2) defining the potential mineralization(s) within the area and selecting target areas for field survey on the basis of the study together with the results of satellite image photogeological interpretation. This work was performed partly in Tokyo, and partly in Bandung under the cooperation with the personnel from the Directorate of Mineral Resources.

Since the Dutch time, several important studies on geology and ore deposits have been made over the southeastern part of West Java. The studies and surveys were conducted mainly by the government organizations such as the Geological Research and Development Center and Directorate of Mineral Resources. Most of these reports, however, were written in Indonesian.

The entire study area has been covered by a series of geologic maps of 1:100,000 scale. The topographic maps, though old, are available at a scale of 1:50,000 and 1:25,000. A precious- and base-metal survey program has been planned several years ago by the Directorate of Mineral Resources, and a couple of preliminary reports has been issued. The brief list of the existing geological information is shown in Table 2-2.

[Geologic Map]

Alzwar, M., Akbar, N., dan Bachri, S., 1974: Peta Geologi Lembar Garut dan Pameungpeuk, Jawa, sekala 1:100,000, Pusat Peneli tian dan Pengembangan Gelogi.

Kastowo, 1975: Peta Geologi Lembar Majenang, Jawa, sekala 1:100,000, Direktorat Geologi.

Supriatna, S., Sarmili, L., Sudana, D., dan Koswara, A., 1978: Peta Geologi Lembar Karangnunggal, Jawa, sekala 1: 100,000, Pusat Penelitian dan Pengembangan Geologi.

Simandjuntak, T.O., dan Surono, 1981: Peta Geologi Lembar Pangan-daran, Jawa , sekala 1:100,000, Pusat Penelitian dan Pengem bangan Geologi.

Budhitrisna, T., 1987: Peta Geologi Lembar Tasikmalaya, Jawa Bar at, sekala 1:100,000, Pusat Penelitian dan Pengembangan Geolo-gi.

[Topographic Map]

Direktorat Geologi, 1980-1984: Peta Topografi Jawa Barat, sekala 1:50,000 (A.M.S. U.S. Army 1943-1944).

U.S. Army Map Service, Far East, 1963: Topographic Map, West Java, scale 1:50,000. Direktorat Geologi, 19**: Peta Topografi, Jawa Barat, sekala 1:25,000 (pembesaran dari peta sekala 1:50,000).

[Exploration Report]

Hendro Wahjono dkk, 1992: Laporan Penyelidikan Pendahuluan Logam Mulia di daerah Pegunungan Selatan, Kabupaten Ciamis-Tasikma laya dan Garut, Jawa Barat, Direktorat Sumberdaya Mineral.

Hendro Wahjono dan Atok, S.P., 1993: Eksplorasi Pendahuluan Logam Mulia di daerah Cisurupan dan Karangjambe, Kabupaten Garut dan Ciamis, Jawa Barat, Direktorat Sumberdaya Mineral.

Deddy T. Sutisna dkk, 1993: Laporan Penyelidikan Lanjutan Logam Mulia di daerah Cipatujah dan Cikalong, Kab. Tasikmalaya, Jawa Barat, Direktorat Sumberdaya Mineral.

[Geological Report]

Koolhoven, W.C.B., 1933, Consideration on the occurrence, genesis and age of gold and precious metal bearing ores in Java and their exploration.

Van Bemmelen, R.W., 1949: The Geology of Indonesia, v.1A, Government Printing Office, The Hague.

Carlile, J.C., and Mitchell, A.H.G., 1994, Magmatic arcs and associated gold and copper mineralization in Indonesia: Jour. Geochem. Expl., 50, p.91-142.

Table 2-2 List of the Existing Geological Information

2-2 Geology

(1) Stratigraphy

According to the existing geologic maps, the geology of the Tasikmalaya area is composed of the Jampang, Kalipucang, Pamutuan, Bentang and Halang Formations in ascending order. These formations belong to the Tertiary sedimentary-volcanic series. The Pretertiary system is unknown. Quaternary volcanics consisting of the Younger and Older Volcanic Rocks overlie on the Tertiary formations. The stratigraphy is shown in Fig. 2-3. The geology of the Tasikmalaya area is shown in Fig. 2-4.

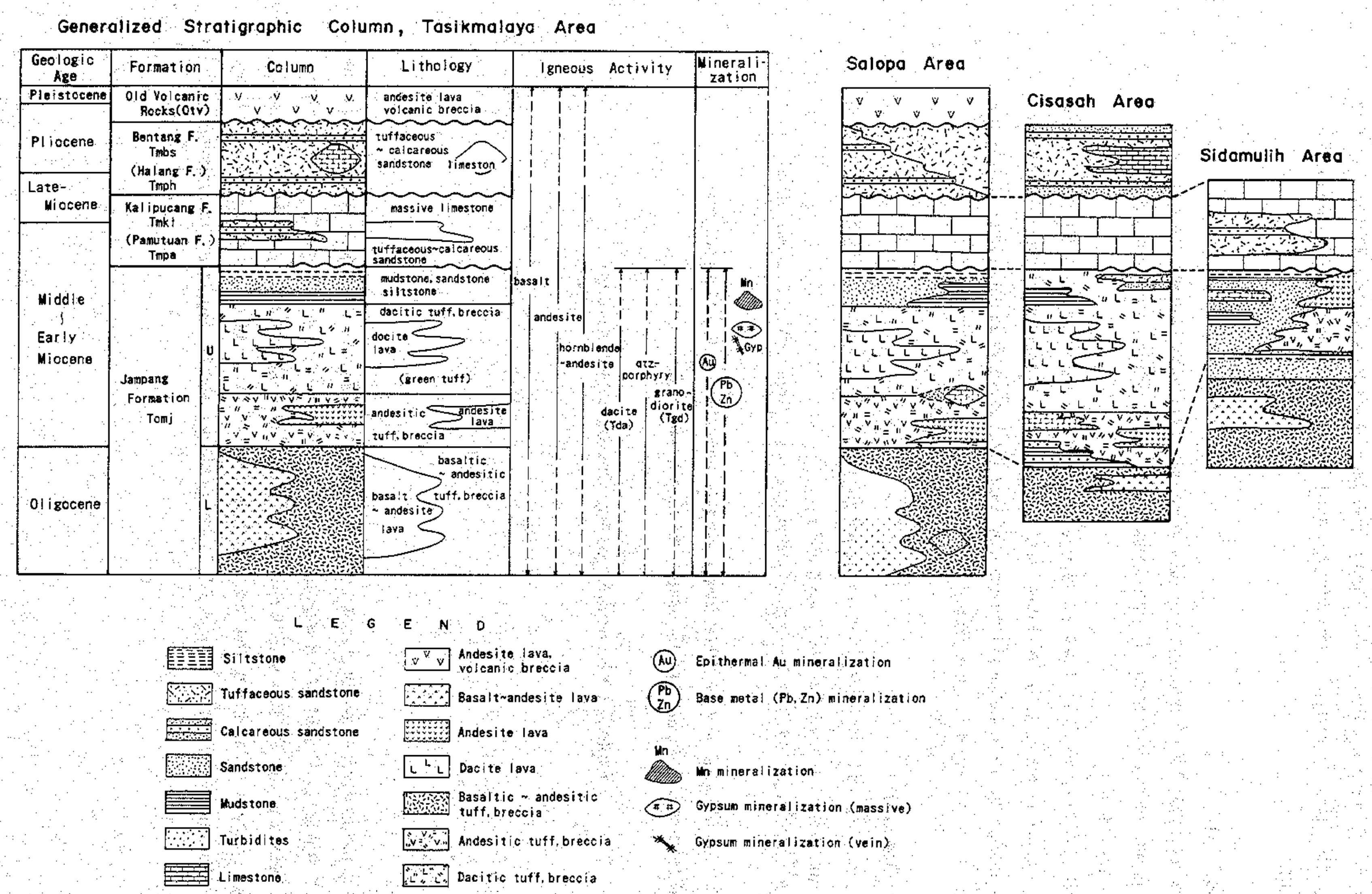
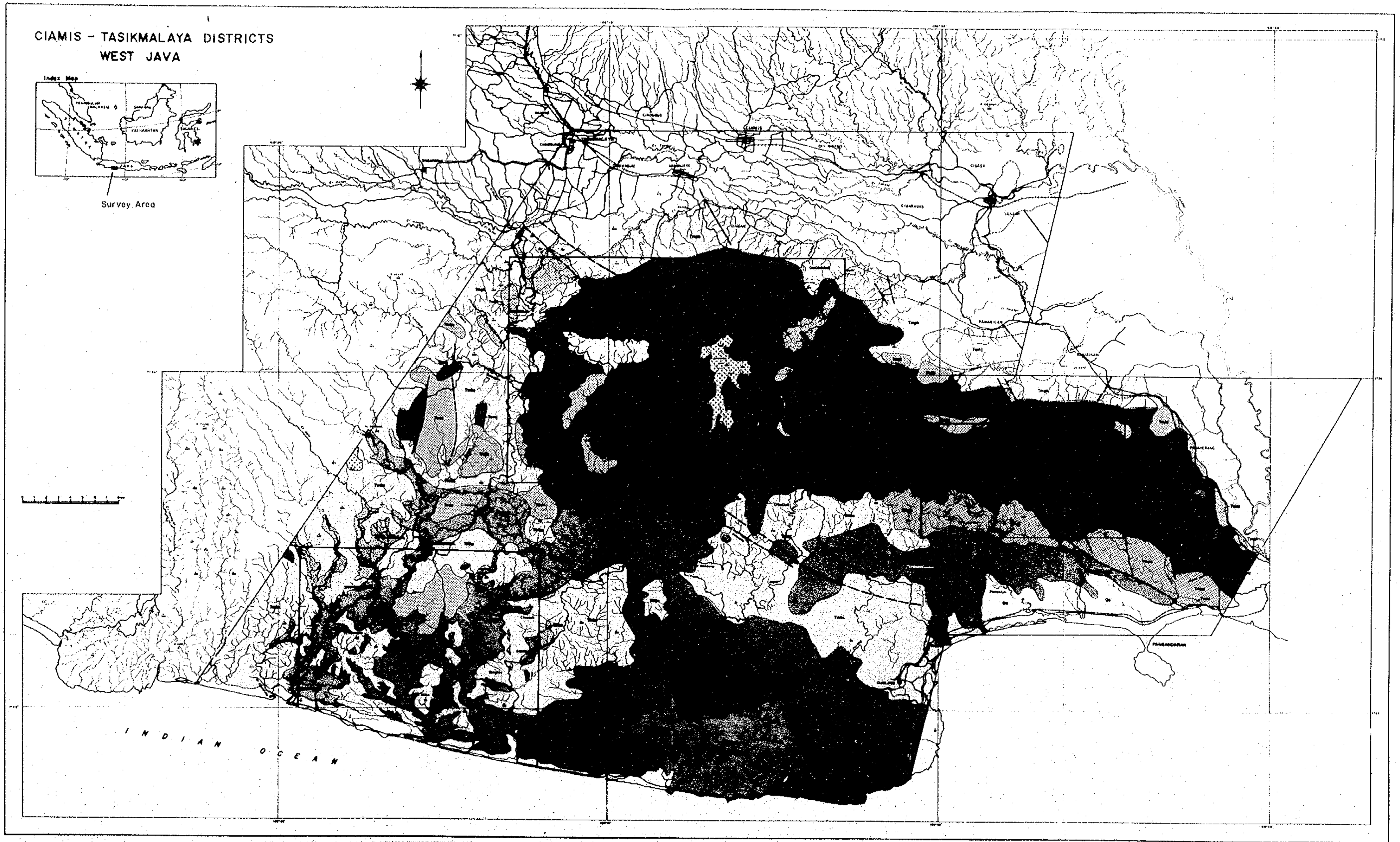


Fig. 2-3 Stratigraphic Columns of the Tasikmalaya Area



LEGEND

HOLOCENE	Alluvial Deposits	Qa	Silt, sand, gravel and pebble ~ Younger volcanic rocks
PLEISTOCENE	Older-Younger Volcanic Rocks	QTv	Volcanic breccia, lava and tuff
PLIOCENE	Bentang Formation	Tmpb / Tmbs	Tuffaceous sandstone, sandstone, calcareous sandstone and limestone lenses.
	Halang Formation	Tmph	Turbidites comprising alternations of sandstone, claystone and sandstone
LATE MIOCENE	Kalipucang Formation	Tmkl	Foraminiferal limestone and sandy limestone.
MIDDLE-EARLY MIOCENE	Pamutuan Formation	Tmpm	Sandstone, calcarenite, marl, tuff, claystone
			Calcarenite and clastic limestone intercalated with marl.
	Genteng Member (Jampang Formation)	Tmjg	Tuff intercalated with dacitic breccia and limestone lenses.
	Nusakambangan Formation		Tuff, lapilli tuff, sandstone and interbedded with mudstone.
OLIGOCENE	Jampang Formation		Andesitic to basaltic volcanic breccia, lava and tuff, tuffaceous sandstone, with intercalation of sandstone, siltstone, claystone and limestone.

Intrusives:
- Andesite
- Basalt
- Hornblende Andesite
- Dacite
- Quartz Porphyry
- Granodiorite

Fig. 2-4 Geology of the Tasikmalaya Area

Jampang Formation

The Jampang Formation is composed of alternations of volcanic breccia, lava and tuff with intercalations of tuffaceous sandstone, sandstone, siltstone, shale and limestone. The volcanic members of the formation are andesitic to basaltic in composition. They sometimes show propyritic features.

These rocks are widely distributed in the central part of the area.

This formation is correlated to the Oligocene to Early Miocene Series.

The Jampang Formation is overlain comformably by the Kalipucang Formation.

Kalipucang and Pamutuan Formations

The Kalipucang Formation is mainly composed of massive reef limestone with intercalations of fragmental limestone layers.

This limestone contains abundant benthonic and planktonic fossil forams, which indicate the Middle Miocene age.

This formation is distributed widely in the central to the southern parts of the Tasikmalaya area. A karst topography is sometimes formed over this limestone formation.

In the southeastern part of the area, alternations of calcareous sandstone and tuffaceous sandstone with sandy limestone lenses occur within this formation. These rocks are called the Pamutuan Formation in the Karangnunggal geological map.

The Kalipucang Formation is overlain uncomformably by the Bentang and Halang Formations.

Bentang Formation

The Bentang Formation is composed of alternations of calcareous sandstone and tuffaceous sandstone with intercalations of tuff-breccia, conglomerate, limestone, tuffaceous shale and shale. They are commonly well-bedded.

Fossils of foraminifera and molluscs are sometimes found in intercalations of calcareous facies. They show the Middle Miocene to Pliocene age.

This formation is mainly distributed in the southern part of the area.

The Bentang Formation is comformably overlain by the Halang Formation, and uncomformably by the Older Volcanic Rocks.

Halang Formation

The Halang Formation is composed of alternations of sandstone and shale with intercalations of calcareous sandstone. Graded bedding, parallel lamination, convolute lamination and load casts are sometimes observed in these rocks. It suggests that these rocks are formed by turbidity currents.

Planktonik foraminifera fossils are found in the calcareous part, indicating the Middle Miocene to Pliocene age.

This formation is widely distributed in the northern part of the area. This formation is thought to be a contemporaneous heterotopic facies of the upper member of the Bentang Formation.

Older Volcanic Rocks

This member of the Quaternary volcanics consists mainly of lava, volcanic breccia, tuff and lahar of andesitic to basaltic composition. It forms a series of older stratovolcanoes such as Mt. Cikuray, Mt. Careme, Mt. Cakrabuana, Mt. Sawal and Mt. Kukus. The volcanic activity of these mountains are thought to be during the Plio-Plistocene time.

Younger Volcanic Rocks

This member consists of lava, volcanic breccia, tuff and lahar of andesitic to basaltic composition. These are derived from younger (Pleistocene to Holocene) stratovolcanoes: Mt. Careme and Mt. Galunggung.

Alluvium

Alluvium deposits, comprising pebble, sand, silt and clay, occur along the major drainage systems.

(2) Intrusive Rocks

Dacite

Dacite intrusive bodies are found in the Salopa area. They area intruded into the Jampang Formation. Their age is estimated to be Miocene.

Granodiorite

Intrusive bodies of granodiorite to diorite are found near Cipatujah in the southern part of the area. They occur within the Miocene Jampang Formation up to the Bentang Formation. Other small intrusive bodies are also found within the Jampang Formation in the Salopa area.

(3) Geologic Structure

The Tertiary formations are moderately, or significantly in some places, faulted and folded in the Tasikmalaya area.

Faults are primarily NW-SE oriented although N-S and NE-SW are present as well. Normal faults are the dominant type of these faults. They are indicated by the linear arrangement of drainage systems, ridges or hot springs. These faults are thought to be formed during the Miocene tectonic movement.

The folding axes run NE-SW and E-W from the northern to the central parts of the Tasikmalaya area. These foldings are more or less crosscut by the regional faults in this area.

In the southern part of the Tasikmalaya area, the axes of foldings show the general trend of NE-SW to E-W, apparently continued from the Pangandaran area to the Karangnunggal area. In the southwestern part of the area, some different trends such as N-S or NW-SE occur locally. It is possibly as a result of the second order foldings within the main structure.

2-3 Mineralization

According to the existing geological information, six areas are known for the occurrences of either precious- or base-metal mineralization in the Tasikmalaya area. The names and mineralization known in those localities are: Salopa (epithermal gold), Sidamulih (epithermal gold), Cisasah (massive sulfide and/or epithermal gold), Cisurupan (epithermal gold), Cisompet (epithermal gold) and Gn. Sawal (Pb-Zn vein) areas. The latter three areas are located outside the first phase study area. So the former three areas were picked up for the studies of mineralization. The known mineral showings are listed in Table 2-3.

Salopa Area

The geology of the Salopa area is composed of the following units in ascending order -- Andesitic to basaltic lava, volcanic breccia, tuff breccia and tuff (Jampang Formation); massive limestone (Kalipucang Formation); calcareous sandstone with limestone lenses (Bentang Formation); sandstone (Halang Formation); and volcanic breccia (Older Volcanic Rocks). Intrusive bodies of andesite, dacite and granodiorite occur in these rock units.

Metallic mineralization and associated alteration are known in several localities.

·Cikondang: Pyrite, chalcopyrite, galena, sphalerite, native gold, electrum, argentite and stibnite were found. A small scale gold mining is underway by local people in Cikondang.

·Citambal: Pyrite, galena and gold were found. A small scale mining is underway.

·Ciniru-Cipanawar: Pyrite, arsenopyrite, galena, and gold were found. A small scale mining is underway.

·Jurago: The occurrence of pyrite is known.

·Cikuya: Pyrite, gold and argentite were found.

Along with these primary mineralization, occurrences of placer gold are known in many places within the area.

Sidamulih Area

The geology of the Sidamulih area is composed of the following rock units in ascending order -- Andesitic to basaltic lava, volcanic breccia, tuff, sandstone, shale and limestone (Jampang Formation);

calcareous and tuffaceous sandstone, tuff and alternations of limestone and sandstone (Pamutuan Formation); and massive limestone (Kalipucang Formation). Lava and tuff of the Jampang Formation are often silicified.

The known mineral showings and geochemical anomalies detected by panning survey and stream sediment sampling are as follows.

·Cijulang-Wetan (Karangjambe): There are old prospecting tunnels (three?) at the upstream of Cijulang-Wetan. Geochemical anomalies of gold were found.
·Cikawasen: Geochemical anomalies of gold were found.
·Ciputrapinggan: Geochemical anomalies of gold were found.
·Cinangkerok: Gold, chalcopyrite, sphalerite and galena were found.
·Cipakuhaji: Gold and chalcopyrite were found..

·Cikaso: Geochemical anomalies of gold were found.
·Cipamutuan: Geochemical anomalies of gold were found.

Cisasah Area

The geology of the Cisasah area is composed of the following units in ascending order -- Andesitic to basaltic lava, volcanic breccia, tuff breccia, pumice tuff and dacitic tuff (Jampang Formation); massive limestone (Kalipucang Formation); calcareous sandstone with intercalations of tuff and limestone (Bentang Formation). Volcanic breccia of the Jampang Formation is sometimes propylitized. Dacite and granodiorite intrusions occur in this area.

Mineralization in this area consists mainly of base metal one. It was interpreted to be a kind of massive sulfide mineralization hosted by Miocene dacitic volcanic/pyroclastic members.

·Cibengang: Pyrite, chalcopyrite, sphalerite and galena were found.
·Cibungur: The occurrence of pyrite are known.
·Cisasah: Pyrite, chalcopyrite and manganese were found. Gypsum was also found at Cisasah.
·Cidadap: Pyrite, chalcopyrite and sphalerite were found.
·Citisuk: Pyrite, sphalerite and galena were found.
·Cijambehaseum: Pyrite, chalcopyrite, sphalerite and galena were found.
·Cibersih: Pyrite, sphalerite and galena were found. These sulfide minerals occur in quartz veins

hosted in volcanic breccia.

Placer gold is also taken in some drainage systems within the Cisasah area.

Table 2-3 List of the Known Mineral Showings

Area	Locality	Mineralization & Alteration	Geochemical Anomaly	Remarks
Salopa	Cikondang	Py, Cp, Gn, Sp, Au, Ag, Sb	21.93ppm Au(R)	Gold mining by local people
	Citambal	Py, Gn, Au	5.59ppm Au(R)	Gold mining by local people
	Ciniru-Cipanawar	Py, Ap, Gn, Au, Mn		Gold mining by local people
	Jurago	Py	0.42ppm Au(R), 0.120ppm Au(S)	
	Cikuya	Py, Au, Ag	25.56ppm Au(R)	
Sidamulih	Cijulang Wetan (Karangjambe)	Py, Au, Mn	0.132ppm Au(R), 463ppb Au(SS)	Old prospecting tunnels (3?)
	Cikawasen		99ppb Au(SS)	
	Ciputrapinggan		405ppb Au(SS)	
	Cinangkerok	Cp, Sp, Gn	92ppb Au(SS)	
	Cipakuhaji	Cp, Au, Ag	4.225ppm Au(F)	
	Cikaso	Cp	2.063ppm Au(R)	
	Cipamutuan	Py	5.313ppm Au(?)	
Cisasah	Cibengang			
	Cibungur			
	Cisasah			
	Cidadap	Se, Gy, Si(sinter)	1.02ppm Au(R)	Qz veinlet
	Citisuk			
	Cijambe Haseum			
	Cibersih		0.156ppm Au(R)	

Abbreviations: Py;Pyrite, Cp;Chalcopyrite, Sp;Sphalerite, Gn;Galena, Ap;Arsenopyrite, Au;Electrum/Gold, Ag;Argentite, Sb;Stibnite
Se;Sericite, Gy;Gypsum, Mn;Mn-Mineral, Qz;Quartz R;Rock Sample, S;Soil, SS;Stream Sediment, F;Float