The Republic of Indonesia
Report on the Cooperative Mineral Exploration of Northern Sumatra

Phase II

June 1984

Japan International Cooperation Agency

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THE REPUBLIC OF INDONESIA

REPORT ON THE COOPERATIVE MINERAL EXPLORATION
OF
NORTHERN SUMATRA

PHASE II

JUNE 1984

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

PREFACE

The Government of Japan, in response to a request extended by the Government of the Republic of Indonesia, agreed to conduct a metallic mineral exploration survey in Northern Sumatra, and commissioned its implementation to the Japan International Cooperation Agency.

The agency, taking into consideration the importance of the technical nature of this survey, sought the cooperation of the Metal Mining Agency of Japan in order to accomppllsh the contenplated task.

The Government of the Republic of Indonesia appointed the Directorate of Mineral Resources to execute the survey as counterpart to the Japanese team. The survey is being carried out jointly by experts from both Governments.

The second phase of the collaboration survey consists of geological, geochemical, geophysical and drilling explorations for metallic minerals.

This report summarizes the results of the second phase of the survey, and will later form a portion of the final report on the results obtained through the survey.

We wish to take this opportunity to express our gratitude to all sides concerned in the execution of the Survey.

June 1984

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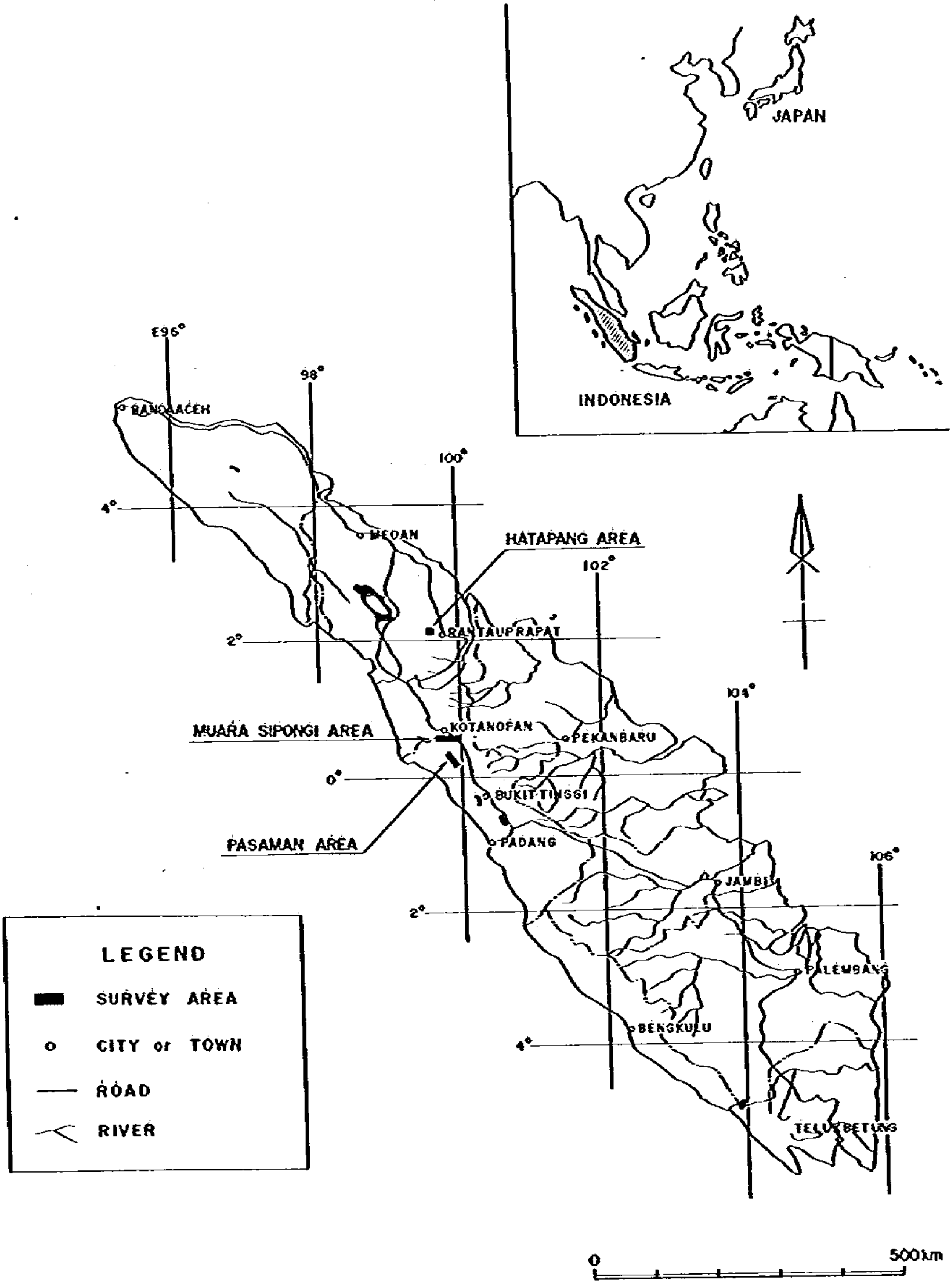


Fig. 1-1 Location Map of Survey Area

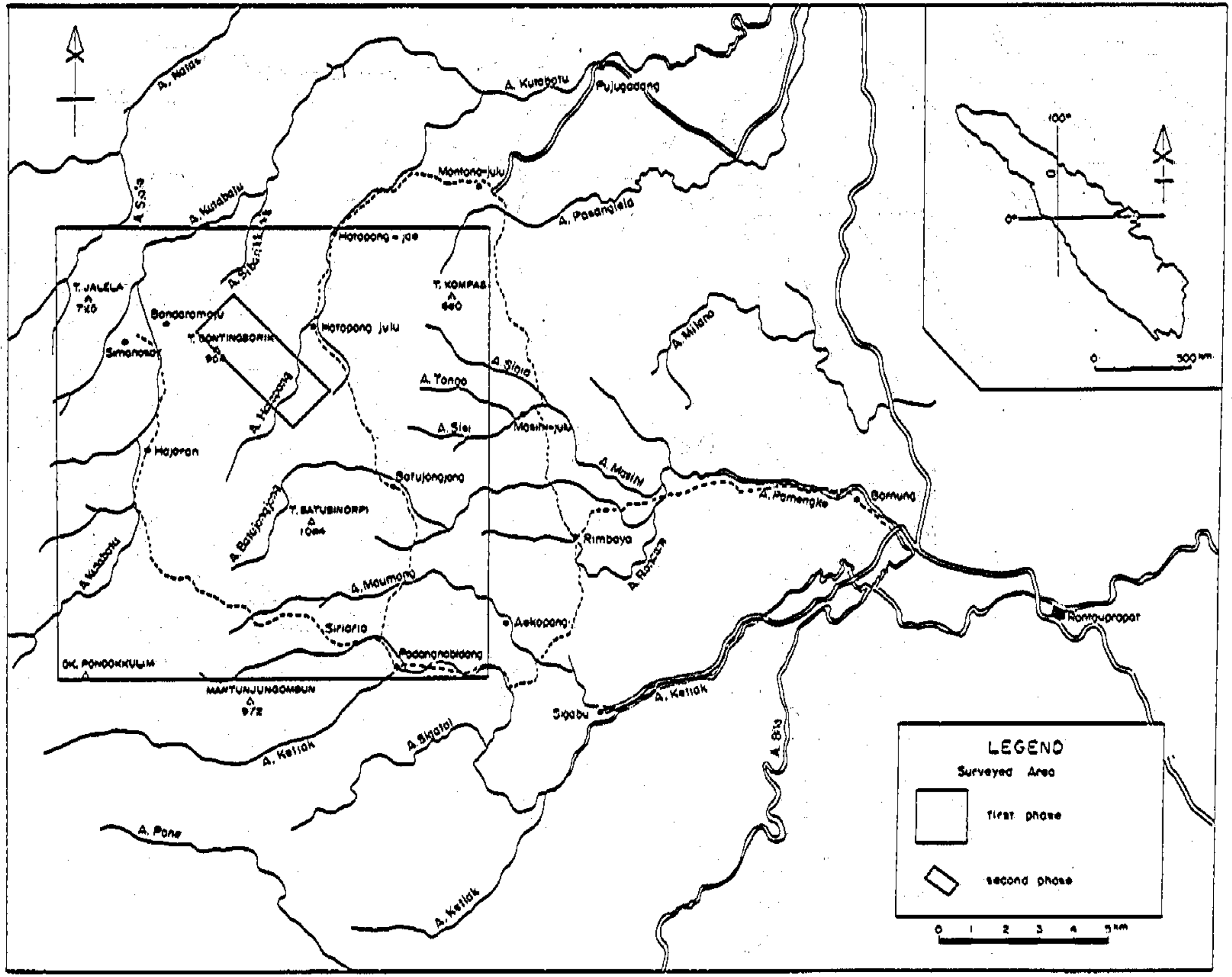
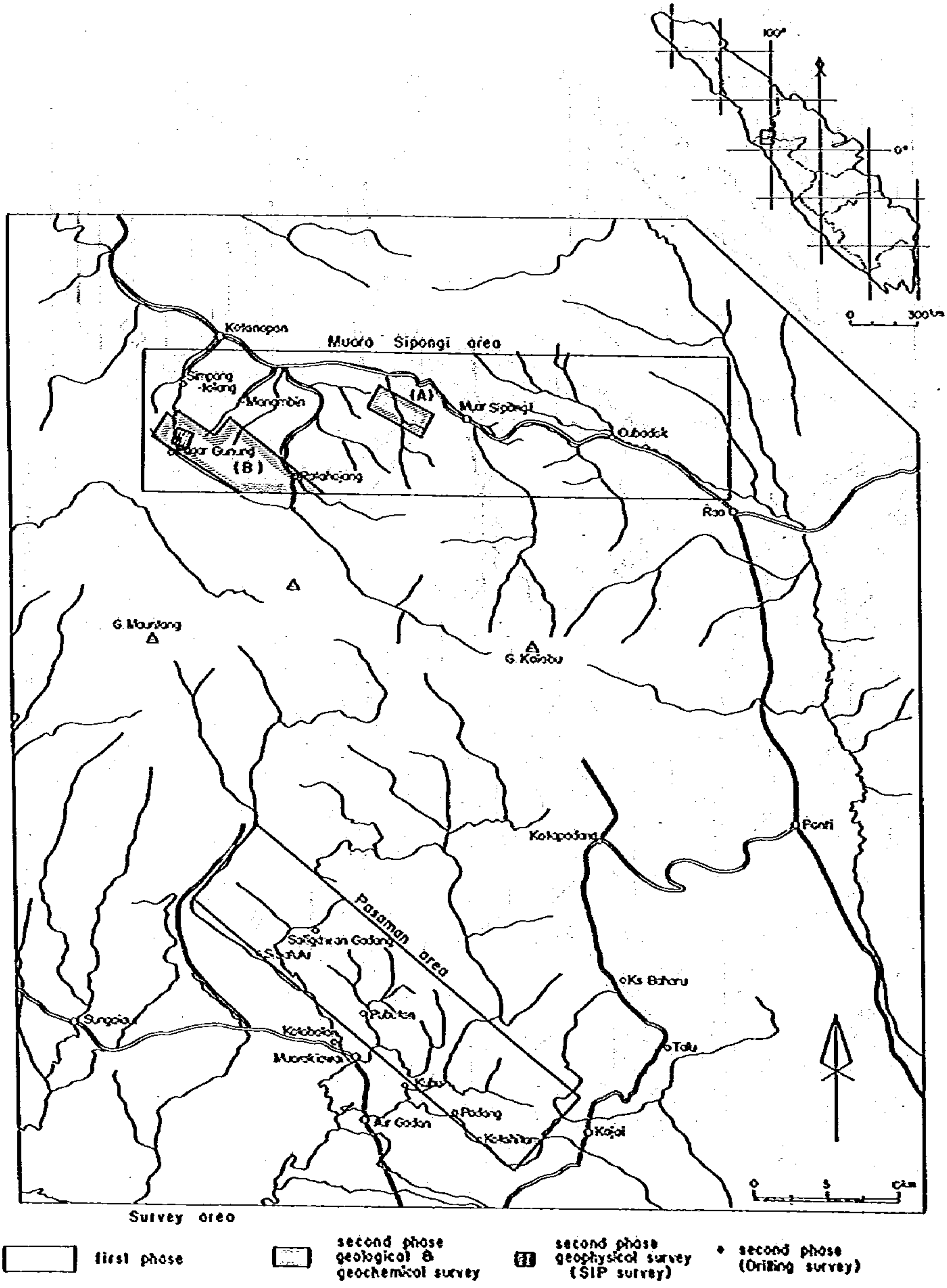


Fig. I-2 Location Map of Hatapang Area



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SUMMARY

The first phase survey of the Northern Sumatra Cooperative Mineral Exploration project in the Republic of Indonesia was carried out in three Areas, namely Hatapang Area (169 km^2) to unravel tin-tungsten mineralization, Muara Sipongi Area (400 km^2) to survey gold-silver bearing copper-lead-zinc ore deposits and Pasaman Area (200 km^2) to study into possibility of chromitite emplacement in ultramafic rock by means of reconnaissance survey consisting of geological, geochemical and heavy mineral placer surveys. As the results, three promising areas have been selected from these reconnaissance areas, and detailed survey or preliminary detailed survey consisting of geological, geochemical and geophysical surveys were conducted as follows:

1.	Hatapang Area	6 km^2	geological and geochemical surveys
2.	Muara Sipongi Area A	8 km^2	geological and geochemical surveys
3.	Muara Sipongi Area B	30 km^2	geological, geochemical and geophysical (SIP method) surveys

The survey results are summarized as follows.

1. Hatapang Area

The survey area which has been chosen as most prospective area of tin-tungsten mineralization through the first phase survey is situated at north marginal part of Hatapang Granite stock.

Geological survey and geochemical survey of soil in this phase revealed that geochemical anomalous area indicated by overlapping anomalous values of path-finder elements, namely tin, tungsten and fluorine, is distributed along boundary zone of Hatapang Granite stock and Hatapang Formation (hornfels), extending 800 m by 200 m ~ 300 m width. However within the geochemical anomalous area, no cassiterite and tungsten mineral bearing quartz vein and greisen alteration area were found, except an existence of a small amount of chalcopyrite dissemination in some quartz vein.

2. Muara Sipongi Area A

Gold bearing copper-(lead-zinc) ore deposits have been recorded by first phase survey at areas of A. Tabur, A. Simpang Manganpo, tributary of A. Muara Botung.

Geochemical survey of soil has been found in anomalous area of 600 m diameter overlapped by anomalous values of path-finder elements of gold, silver, copper; lead and zinc at Bt. Pionggu limestone area. Within the anomalous area, gold bearing copper skarn ore deposits accompanied with calcic skarn minerals such as clinopyroxene, garnet and epidote are distributed, however the ore deposits is not large in the scale.

On the other hand, several gold bearing copper-(lead-zinc) veins are distributed in meta-andesite, which stratum is lower than that of limestone, along A. Tabur and A. Simpang Mangampo. They are also narrow ore veins, small scale and sporadic distribution. No geochemical anomalous area is distributed in the meta-andesite area.

3. Muara Sipongi Area B

This survey unravelled that Pagar Gunung ore deposit is formed of Pagar Gunung West ore deposit and Pagar Gunung East ore deposit, the former continues east-west extension of 200 m, though its width is changed thick and thin, and the latter is an outcrop situating at 650 m east from the former.

The Pagar Gunung ore deposit is embedded along intertrappean layer of limestone in Alternative Member of Clastic Rock and Volcanic Rock of Patahajang Formation. It is massive - disseminated silver bearing copper-lead-zinc skarn ore deposit consisting of pyrite, pyrrhotite, chalcopyrite, galena and sphalerite of ore minerals and clinopyroxene, epidote, calcite and siderite of calsic skarn minerals.

As the result of geochemical survey of soil along geophysical survey line overlapped geochemical anomalous area of gold, silver, copper, lead and zinc path-finder elements shows to coincide clearly with distribution zone of outcrops of Pagar Gunung West and East ore deposits.

At east part of 6.5 km from Pagar Gunung ore deposit, Barute outcrop containing sphalerite dissemination and secondary oxide minerals of malachite and limonite, and Patahajang alteration area consisting of silicification and argillization with pyrite dissemination are distributed. By geochemical survey an anomalous area was discovered overlapping with anomalies of gold, silver, copper, lead and zinc path-finder elements in area of 3 km extension by 1 km wide including Barute and Patahajang outcrops. The anomalous area covers Alternative Member of Clastic Rock and Volcanic Rock similar to Pagar Gunung ore deposit.

Geophysical exploration was conducted in Pagar Gunung mineralization zone. Spectral IP method (9 survey lines with total line-length of 11,000 m) was adopted to know the sub-surface extent of the ore deposits, especially to investigate the lower zone of West ore deposit.

Consequently, Western ore deposit is interpreted to extend to the depth of 150 m judging from the characteristic pattern of the spectrum.

In northern part of each survey line strong phase and PFE anomalies were observed which are considered to be attributed to disseminated pyrite mineralization.

Those anomaly were detected in the contact zone of granodiorite and sandstone-mudstone, and the eminent PFE anomaly was detected over the Eastern ore deposit, which suggest that this mineralization extend further to eastward.

Comprehensive study of the results of geological, geochemical and geophysical surveys suggests that Pagar Gunung ore deposit should be confirmed its continuity from east to west and deep extention. Further investigation should be taken into consideration to unravel why the geochemical anomalous distribution came into existence at Barute-Patahajang - A. Mandagang area.

Drilling survey was successively carried out five holes (total drilling length : 1,200 m) to explore dawnward extention of Pagar Gunung West Ore deposit, selecting from two promissing areas, namely Pagar Gunung West and East ore deposits found by geological, geochemical and geophysical surveys. As the result of the survey, it seems possible that old adits group of Pagar Gunung West ore deposit No. I mineralization zone continues to outcrop B of Pagar Gunung East ore deposit, and lower horizoned mineralization (No. II mineralization zone) extends to outcrop A of Pagar Gunung East ore deposit. No. II mineralization zone is massive and disseminating silver bearing copper-lead-zinc ore deposit embeding in calcareous rock, while No. II mineralization zone is bedded and disseminationg pyrite rich ore deposit associating in siliceous rock and tuffaceous rock.

Complehensive study of the results of geological, geochemical, geophysical and drilling serveys suggests that Pagar Gunung ore deposit (West and East ore deposits) should be confirmed its continuity from east and west and dawnward extention. Further investigation should be taken into consideration to unravel why the geochemical anomalous distribution came into existence at Barute-Patahajang - A. Mandagang area.

PART I

INTRODUCTION

CHAPTER 1 OUTLINE OF SURVEY

1-1 INTRODUCTION

The Cooperative Mineral Exploration Project in Northern Sumatra of the Republic of Indonesia has been executed, in the first phase survey, and includes a preliminary-detailed survey of tin and tungsten mineralization in Hatapang area (169 km^2), a reconnaissance survey of gold-silver-copper-lead-zinc ore deposits in Muara Sipongi Area (400 Km^2), and a reconnaissance survey into the possibility of emplacement of chromite deposits accompanied with ultrabasic rock in Pasaman Area (200 km^2).

In each area, a geological survey, geochemical survey by stream sediment and a survey of heavy mineral placer (such as cassiterite, tungsten ore, gold and chromite) were conducted. As a result, the geology, geological structure and igneous activity of each survey area were made clear, as well as the distribution and emplacement mode of mineralization. Several places have been selected as prospective mineralized areas.

The ultrabasic rock in the Pasaman Area mainly consists of harzburgite and there is a small possibility of a distribution of chromitite developing into economical chrome resources. But geological, geochemical and heavy mineral placer surveys in the Hatapahg Area revealed anomalous areas suggesting tin-tungsten mineralization at the northern margin (upper stream of A. Hatapang) and the northeastern margin (middle stream of A. Batu Jongjong) of the Hatapang granite stock. In Muara Sipongi Area, distribution of gold and silver bearing copper-lead-zinc ore deposits was confirmed in three areas, (Subun-subun, Bt. Pionggu and Pagar Gunung-Patahajang areas), which are promissing area, as a result of discovery of outcrops and geochemical anomalies through the geological, geochemical and gold placer surveys.

On the basis of the results of the first phase survey, the project has selected three areas for the second phase survey: Hatapang Area (6 km^2, upper stream of A. Hatapang),, Muara Sipongi Area A (8 km^2, Bt. Pionggu area) and Muara Sipongi Area B (30 km^2, Pagar Gunung-Patahajang area) (Fig. I-1, I-2, I-3)

A geological survey and geochemical survey of soil were conducted in each of the survey areas to shed more light and details on the relationship between the geology, geological structure, igneous activity and mineralization, while surveying the continuity in mineralized zones. Moreover, a geophysical survey by means of the spectral IP method (SIP method) was conducted at Pagar Gunung ore deposit area, which is regarded as the most promising area in the survey areas, in order to investigate horizontal and deep extention of the ore deposit.

Taking the result of these surveys on Pagar Gunung ore deposit as above mentioned into consideration, drilling survey (five holes, total hole length : 1,200 m) was successively performed to explore deep extention of Pagar Gunung West ore deposit and SIP anomaly arranging parallel with northern part of Pagar Gunung West ore deposit.

1-2 SURVEY SCHEDULE AND SURVEY TEAM MEMBER

The second phase survey was carried out from May 26, 1983, to June 15, 1984, according to the following schedule.

(1) Period of field survey

a) Geological and geochemical surveys

Field survey	from May 30 1983 to Aug. 16 1983
Data processing in Indonesia	from Aug. 17 1983 to Oct. 15 1983

b) Geophysical survey	from May 30 1983 to Aug. 13 1983
c) Drilling survey	from Nov. 2 1983 to May 10 1984

(2) Members of survey team

a) Planning and consultation

Makoto Ishida	(MMAJ)	Ir. Salman Padmanagara Director	(DMR)
Ken Nakayama	(MMAJ)	Ir. P.H. Silitonga	(DMR)
Jiro Osako	(MMAJ)	Ir. Subandro	(DMR)
Takahisa Yamamoto	(MMAJ)	Ir. Yaya Sunarya	(DMR)
Shigeo Wada	(JICA)		

b) Survey Members

Japanese Members		Indonesian Members	
Survey Leader			
Sakae Ichihara	(MMAJ)	Yaya Sunarya	(DMR)
Geological and Geochemical Survey			
Sakae Ichihara	(MMAJ)	(Muara Sipongi Area)	
Hideya Kikuchi	(MMAJ)	Johny R. Tampubolon	(DMR)
Tetsuo Sato	(MMAJ)	Danny Z. Herman	(DMR)
		(Assistant)	
		Wahju III	(DMR)
		Mamat H.	(DMR)
		(Hatapang area)	
		Surjono	(DMR)
		Sebedjo	(DMR)
		Hotma Simangunsong	(DMR)
		(Assistant)	
		Atun Suryana	
Geophysical Survey			
Masao Yoshizawa	(MMAJ)	Marino	(DMR)
Tomio Tanaka	(MMAJ)	Rachmat Setiawan	(DMR)
Masatane Kato	(MMAJ)	Empon Ruswandi	(DMR)
		Hanaisal Hutagalung	(DMR)
		W. Suparmin	(DMR)
		Asngari	(DMR)
		Suparno	(DMR)

Drilling Survey

Survey leader

Koichiro Daimaru	(MMAJ)	Yaya Sunarya	(DMR)
		Surjono	

Member

Yukio Kawamura	(MMAJ)	Saksono	(DMR)
Isamu Nakayama	(MMAJ)	Suratman	(DMR)
Tatsuo Sawaguchi	(MMAJ)	Banny Johan	(DMR)
		Encep Sudjana	(DMR)
		Bambang Wahono	(DMR)
		(Geology)	
		Deddy T. Sutisno	(DMR)
		Johny R. Tampubolon	(DMR)
		Danny Z. Herman	(DMR)
		Hoe'tamar	(DMR)

During the geological, and geophysical field survey period, the following members of Medan Regional Office of the Ministry of Mines and Energy pariticipated in the field survey for the purpose of technical training.
Syamsurezal Syafei, Fachmi Rasyid, Johny Pane, Ngukurken Sembiring, Satin Tarigan, Herhad Ginting, Hakmun Nastion.

Many inhabitants of K. Pagar Gunung, K. Sibiobio, K. Uju Marisi and K. Simpang Tolang were engaged in these survey for the operation, transportation, and road construction. We are much indebted to the people for helpful support. We appreciate Camat Kotanopan, and Kepala Desa Pagar Gunung for kind cooperation.

Abbreviations

JICA : Japan International Cooperation Agency
MMAJ : Metal Mining Agency of Japan
DMR : Directorate of Mineral Resources

CHAPTER 2 OUTLINE OF SURVEY AREAS

2-1 SURVEY AREAS

(1) Hatapang Area

The Hatapang Area is situated approximately at 2° 10' North Latitude by 25° 39' East Longitude, and covers an area of 6 km^2 (4 km x 1.5 km). Tin and tungsten ores are the subject of the survey (Fig. I-2).

(2) Muara Sipongi Area A

The Muara Sipongi Area A is situated at 0° 36' North Latitude by 99° 49' East Longitude, and covers an area of 8 km^2 (2 km x 4 km) containing Bt. Pionggu and A. Simpang Manganpo mineralized areas. Gold-silver-copper-lead-zinc ores are the subject of the survey (Fig. I-3).

(3) Muara Sipongi Area B

The Muara Sipongi Area B is an area extending from Pagar Gunung ore deposit region to Patahajang mineralized region, and is situated approximately at 0° 15' North Latitude by 99° 40' East Longitude, and covers an area of 30 km^2. Gold and silver bearing copper-lead-zinc resources are the subject of the survey (Fig. I-3).

2-2 CONDITION IN THE SURVEY AREAS

2-2-1 Transportation

(1) Hatapang Area

This survey area is situated at a straight distance 22 km west-northwest from Rantau Prapat advanced southward by 285 km along Sumatra Travers Highway from Medan. The survey base camp, K. Hatapang Julu, is reached by four wheel driven vehicle as far as 16 km from Rantau Prapat through road of oil parm farm to K. Montong Julu and on foot for the remaining 8 km from K. Montong Julu (Fig. I-2).

(2) Muara Sipongi Area A

This survey area is situated 4 km south on foot along A. Muara Botung from K. Muara Botung located 15 km east-west-east of Kotanopan, a village by running along the Sumatra Travers Highway from Medan to Padan, while Kotanopan is about 600 km from Medan (Fig. I-3).

(3) Muara Sinpogi Area B

K. Patahajang situated at the east end of the survey area 30 km from Kotanopan, is accessible by automobile, and in the western area K. Pagar Gunung is reached by walking 8 km along a mountain road from K. Simpang Tolang, 7 km southwest of Kotanopan. The mountain road is 2 m wide and is always kept in good condition by inhabitants, because the road is important for the local people. However, the road surface, which is of laterite and is unpaved, may become muddy in the rainy season (Fig. I-3).

While the above mentioned main roads can be used to reach the town or village nearest to each survey area, various pieces of survey equipment, camping gear, food supplies and other articles must be carried along the footpath or mountain path that leads to the actual survey site.

2-2-2 Field Condition

Both the Hatapang Area and the Muara Sipongi Area are in the middle of the highland region at an altitude from 200 m to 1,500 m above sea level, lying within the Barisan Mountain Range which is a backbone mountain running through Sumatra Island.

In the middle to lowland regions, particularly along main rivers, there are well cultivated fields and developed villages which produce mainly rice corp and rubber. There are also extensively developed plantations of oil palms over hill areas in the east region of Hatapan Area which are grown for their oil. Mountain and upland regions are covered with dense tropical rain forest, which it is almost impossible to traverse except along roads, mountain paths and rivers.

The climate is of a tropical type with high temperatures and high humidity, in which the dry season continues from May to August and the rainy season from September to April according to the past record of rainfall. According to the record at Kotanopan, the monthly rainfall is 83 mm to 168 mm in the dry season and 195 mm to 283 mm in the rainy season. The rainfall during October and November is particularly heavy, reaching more than 300 mm per month.

While the temperature remains consistently high in the lower altitudes, the higher regions experience falling temperatures at night, and a sleeping bag is indispensable for camping.

CHAPTER 3 PREVIOUS SURVEYS

During the period of Dutch colonization, surveys were conducted in Northern Sumatra by Schürmann (1930), Westerveld (1947), Van der Marel (1941, 1947, 1984), Bemmelen (1932, 1939) and Druif (1932, 1934, 1939), mainly in the Aceh, Medan and Toba areas. The geology, geological structure and mineral resources of the areas are covered conprehensively by Bemmelen in his Geology of Indonesia (1949). Geological maps have also been compiled in 1/1,000,000 and 1/250,000 scale.

The first integrated geological survey of all of Northern Sumatra was conducted from 1975 to 1980 by a cooperative team composed of members from Indonesia (GSI/DMR : Geological survey of Indonesia/Directorate of Mineral Resources) and Great Britain (IGS : Institute of Geological Science). The team performed regional geological and geochemical surveys. The project shed light upon the geology and geological structure of Northern Sumatra and resulted in the discovery of a number of areas containing mineralizations. The results of the survey has been published in the form of a series of 1/250,000 scale geological maps by Geological Research and Development Center (formally the Geological Survey of Indonesia) of the Ministry of Mines and Energy.

Extensive research involving investigation of the geological structure of Northern Sumatra from the standpoint of the plate tectonics theory has been published by Katili (1968 - 1982), Hamilton (1978) Cameron et al (1980) and others. These efforts have resulted in an ever-increasing clarification of the history of geological tectonics of Northern Sumatra.

In 1970, the Overseas Mineral Resources Development Co. Ltd. (OMRDC) conducted survyes on the metallic mineral resources of the Kotanopan-Muara Sipongi area of the southern Tapanuli region, which have long been known for their gold-copper-lead-zinc ore deposits. Also known, among others, are the zinc mineralization areas of the Rokop region and porphyry copper deposit (Tangse) and tin-tungsten mineralization (Hatapang) discovered by the Indonesia-British Cooperative Survey Team.

The survey areas of the present Northern Sumatra Survey Project were selected after a thorough consideration of the results of previous surveys, particularly those obtained from the Indonesian-British Cooperative survey, the Overseas Mineral Resources Development Co. Ltd. survey and some others.

CHAPTER 4 GEOLOGICAL OUTLINE OF NORTHERN SUMATRA

From 1975 through 1980, the Indonesian - British Cooperative Survey team conducted on integrated geological survey over a wide expanse of Northern Sumatra covering some 190,000 km^2. The results of this survey have been reported in numerous research papers, and new material continues to be published in the form of a series of 1/250,000 scale geological maps. The following outline of the geology of Northern Sumatra is based on these materials (Fig. I-4).

The oldest strata known to exist in the Northern Sumatra are the Permian and Carboniferous System Tapanuli Group, which is made up of the Kluet Formation, which is intercalated with thin layers of mudstone and siltstone in quartz arenite, and the Bohorok Formation, composed of unsorted conglomerate wacke (pebble mudstone). The Bohorok Formation is contemporaneous heterotopic facis with the Kluet Formation. The Alas Formation consisting of limestone overlies the Kluet Formation. These Formations are distributed in the Barisan Mountains and their eastern environs.

The upper Permian - Triassic System Peusangan Group, which overlies the Tapanuli Group, is made up of the Silungkang Formation composed of semi-continental basic and intermediate volcanic rock and Fusulina limestone, and the Kuala Formation, consisting of Triassic limestone, radiolarian chert, wacke sandstone and siltstone. The Kuala Formation overlies unconformably the Tapanuli Group and the Silungkang Formation.

The Silungkang Formation is distributed along the Takengkan tectonic line in central Aceh as well as in the Muara Sipongi region, and correlative with the Silungkang Formation found south of the Equater (Silitonga and Kastowo 1975). The Kaula Formation is distributed within the slope of the Barisan Mountains from Rantau Prapat to Prapat.

The upper Jurassic - Cretaceous System Woyla Group is composed of wacke, slate and limestone in its lower member and basic and intermediate volcanic rock and ophiorite, which consists of ultrabasic rock and radiolarian chert regarded as products of a marginal sea, in its upper member. They are distributed in the Aceh and Natal regions.

During the Cenozoic Era, there were periodic volcanic activities and sedimentary basins were formed. Among these basins are the Central Sumatra

Basin, the North Sumatra Basin, the Northwest Aceh Basin and the West Sumatra Basin. In the Pleiocene Epoch, there were eruptions of large quantities of Toba tuff, mainly in the Toba subsidences where a great deal of magma had been discharged in the rift valleys that were formed by geoanticlinal movement. The Toba tuff is distributed over a wide area.

Igneous activities involved the intrusion of granitoid rock during the Paleozoic Era, the Triassic Era, the Jurassic-Cretaceous Period and the Tertiary Period, resulting in copper-lead-zinc replacement ore deposits by Jurassic granitoid rock, tin-tungsten mineralizations by Creteceous granites and porphyry copper deposits by Tertiary intrusion.

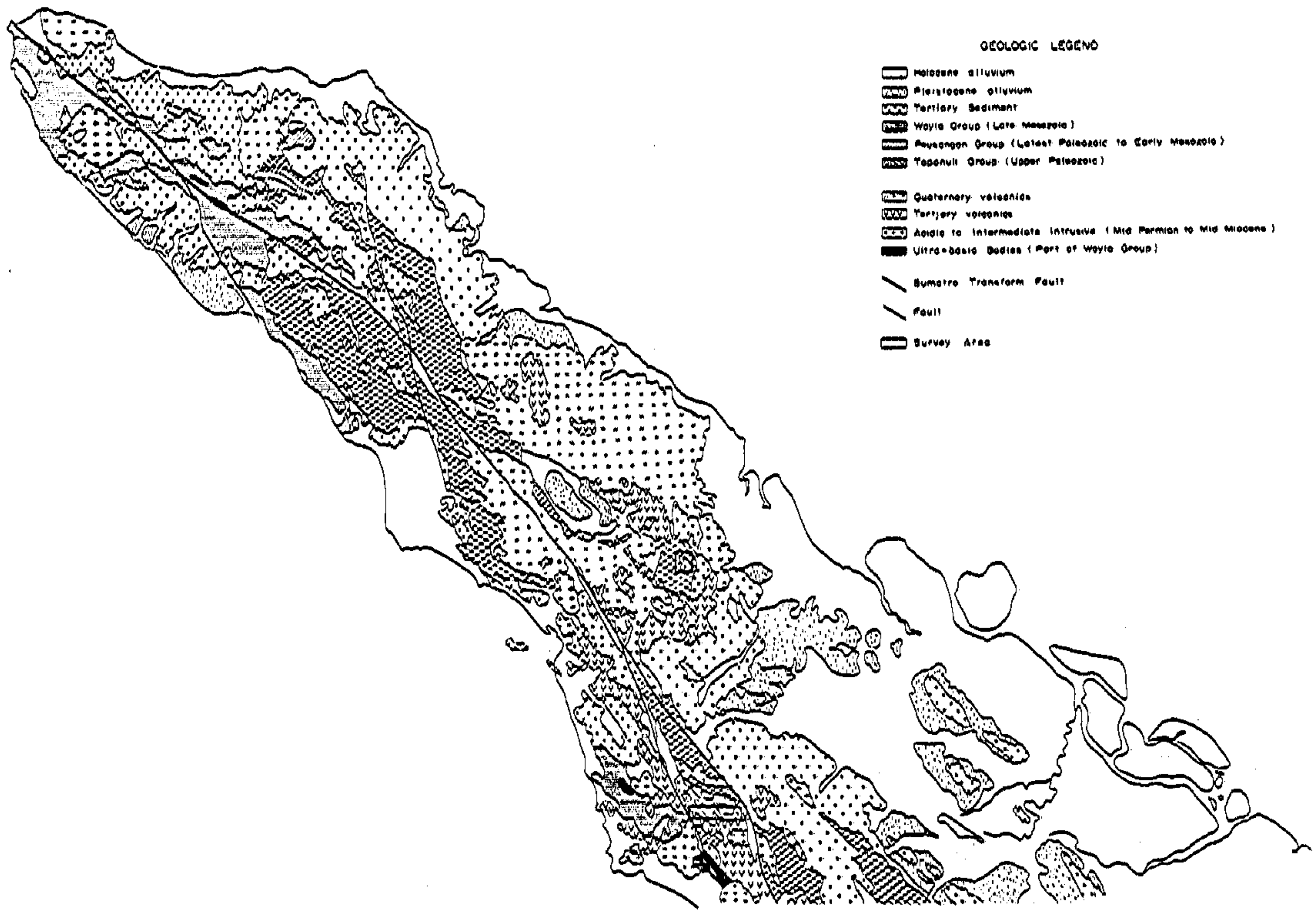


Fig. I-4 Geological Map of Northern Sumatra (DMR/IGS)

PART II

GEOLOGICAL AND GEOCHEMICAL SURVEYS

PART II-1

HATAPANG AREA

CHAPTER 1 OUTLINE

1-1 SUMMARY OF THE FIRST PHASE SURVEY

The geology of this survey area consists of Permian and Carboniferous Hatapang Formation which is correlative with Bohorok Formation, Tapanuli Group, composing of pebbly mudstone and sandstone, and Cretaceous Hatapang Granite has been intruded into the Hatapang Formation. The Hatapang Granite is coarse-grained biotite granite (adamellite) having large phenocrysts of feldspar, and fine-grained two mica granite, pegmatite and aplite have been intruded into the Hatapang granite. The fine-grained two mica granite is accompanied by tapaz and fluorite as accessory minerals and contains a higher value of tin as a minor element, such as 10 ppm to 98 ppm, in comparison with the coarse-grained biotite granite.

The anomalous area recognized through the heavy mineral placer survey and geochemical survey of stream sediment (path-finder element; Sn, W, F etc.) is distributed along the northern margin (upper stream of A. Hatapang) and northeastern margin (middle stream of A. Batu Jongjong) of the Hatapang Granites, and the area is overlapped by areas of fine-grained granite dikes and quartz veins. Accordingly, tin mineralization of the Hatapang Area was assumed to be embedded in those areas.

1-2 PURPOSE OF THE SECOND PHASE SURVEY

This survey was intended to elucidate the distribution of fine-grained granite, quartz vein and greizen alteration bringing and embedding tin and tungsten mineralization, and also to discovery any tin and tungsten concentrations in the upper stream area (6 km^2) of Hatapang Area, where a high possibility of the mineralization was considered possible based on the results of the first phase survey.

1-3 SURVEY METHODS AND QUANTITIES

(1) Topographic map

A topographic map of 1/10,000 scale was produced for use in compiling the geological map and other maps by using aerial photographs of approximately 1/120,000 scale. For the geological and geochemical surveys in the field, a 1/5,000 scale topographic map was prepared by enlarging the 1/10,000 topographic map.

(2) Geological survey

A geological survey was conducted along main rivers and the sampling line of geochemical survey and geological map was compiled in the 1/10,000 scale map. The total survey route reached 22.2 km.

(3) Geochemical survey

In the survey area, eleven sampling lines (line length 1.5 km each and spacing 400 m) were set in the direction of N 45° E measured by compass and measure tape and soil was collected from B-horizon at an interval of 70 m along each sampling line. The soil samples, 242 pieces total, were dried under the sun at Hatapang Julu base camp, and were divided into two portions to be kept for analysis by the Japanese and Indonesian teams.

Path-finder elements such as tin, tungsten and fluorine which were contained in those samples were chemically assayed, considering the close relation of tin-tungsten mineralization expected in the survey area.

CHAPTER 2 GEOLOGY

2-1 GEOLOGICAL OUTLINE

The survey area is located in the north-marginal part of the Hatapang Granite which runs 6 km east-west and 8 km north-south, and at the contact zone with Hatapang Formation and Hatapang Granite along A. Hatapang, A. Sosopan, A. Mabat and A. Mabar. Hatapang Formation which is correlative with Bohorok Formation of Permian-Carboniferous System investigated stratigraphically by the DMR/IGS team consists of pebbly mudstone, and has been altered into hornfels by intrusion of Cretaceous Hatapang Granites. A lot of fine-grained granite and aplite dikes and quartz veins are distributed in the Hatapang Granite (Figs. II-1-1, Fig. II-1-2).

2-2 GEOLOGY

2-2-1 Hatapang Formation

Distribution : The Hatapang Formation is distributed in the northern margin of the survey area, mainly north of A. Mabar. Contrary to the granite area which has a steep topography, the Hatapang Formation area has a gentle topography in the topographic map, so that the topographic feature serves to clarify the contact boundary between the Hatapang Formation and the Hatapang Granite stock on the map.

Rock facies : Hatapang Formation consists of black to dark gray colored mudstone and fine sandstone. Under microscopic observation (N17, 04, P6, P28), it is poor-sorted mudstone and sandstone, containing sub-rounded pebbles of granite, sandstone, quartz and so on, which is similar to the pebbly mudstone named in the survey of the DMR/IGS team. Near the contact part with the Hatapang Granites, the mudstone has been altered into hornfels, produced biotite and partly hornblende.

2-2-2 Hatapang Granites

This granite consists of coarse-grained porphyritic and equi-granular granites and has been intruded by fine-grained granite and aplite dikes.

(1) Coarse grained granite

This granite is classified into two types, namely porphyritic biotite granite with large phenocrysts of plagioclase and potash feldspar and equi-granular biotite granite. Both have the same mineral composition and are considered to belong to the same group. Under microscopic observation, idiomorphic to semi-ideomorphic plagioclase, biotite, potash feldspar and xenomorphic quartz, as well as a little muscovite, are observable as rock forming minerals, beside zircon, apatite, and fluorite found as accessory minerals.

(2) Fine-grained two-mica granite

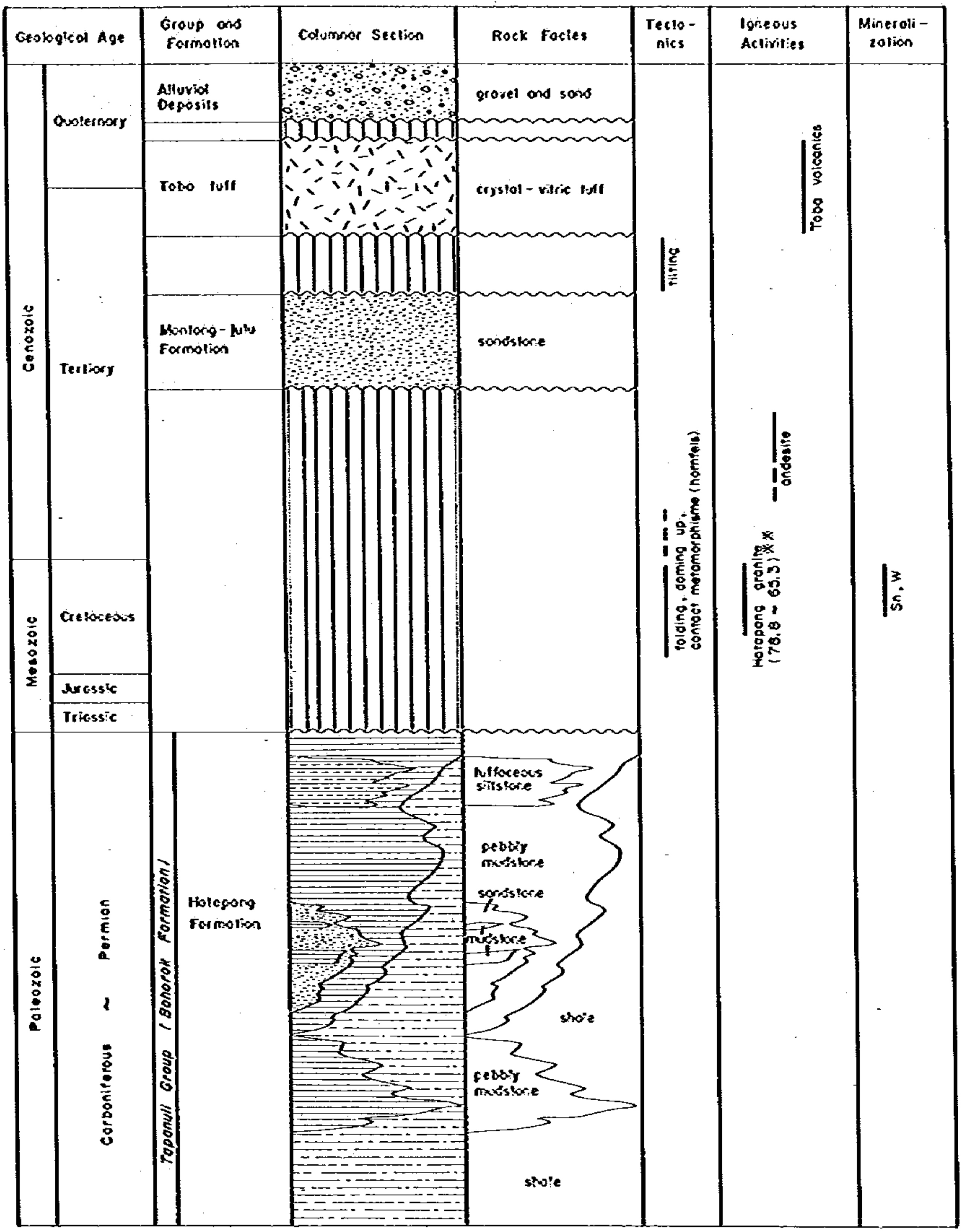
This granite is distributed along the margin of the Hatapang Granite stock in the form of dikes with strike of N 20° - 25° E, 80° - 90° W to N 65 - 90° W, dip of 65 - 70° S. It is of a fine-grained holocrystalline and under microscope (N-7, N-10, N-17, P-29) can be observed quartz, plagioclase, potash feldspar, and muscovite as the main rock-forming minerals, with topaz, zircon, and tourmaline contained as accessory minerals.

In the first phase survey, Hatapang Granite were chemically assayed minor elements such as of tin and tungsten, with the result that the fine-grained two-mica granite was found to be high in tin content in comparison with the coarse-grained granites. Namely, contrary to the coarse-grained granite level of 1 to 8 ppm of tin content, the fine-grained granite showed 10 to 98 ppm and, hence, is considered to be the granite which had brought tin in the Hatapang Area.

The mode of Hatapang Granite was measured to be projected in a triangular diagram of quartz, plagioclase, and potash feldspar, resulting in the classification into an adamellite in which the plagioclase and potash feldspar have their plotted ranges of quantity substantially equal to each other, as a result of the first phase survey (Fig. II-1-3).

(3) Time of intrusion

The Hatapang Granite has been intruded into the Permian - Carboniferous Hatapang Formation which has been altered into hornfels and is overlain by Toba tuff Formation of Tertiary System. According to the age determination performed by K-Ar method in the first phase survey, the intrusion has been dated as 78 and 65 Ma, thus being intruded in the late Cretaceous Period.



※※ K-Ar Age (Ma)

Fig. II-1-1 Generalized Stratigraphy of Hatapang Area

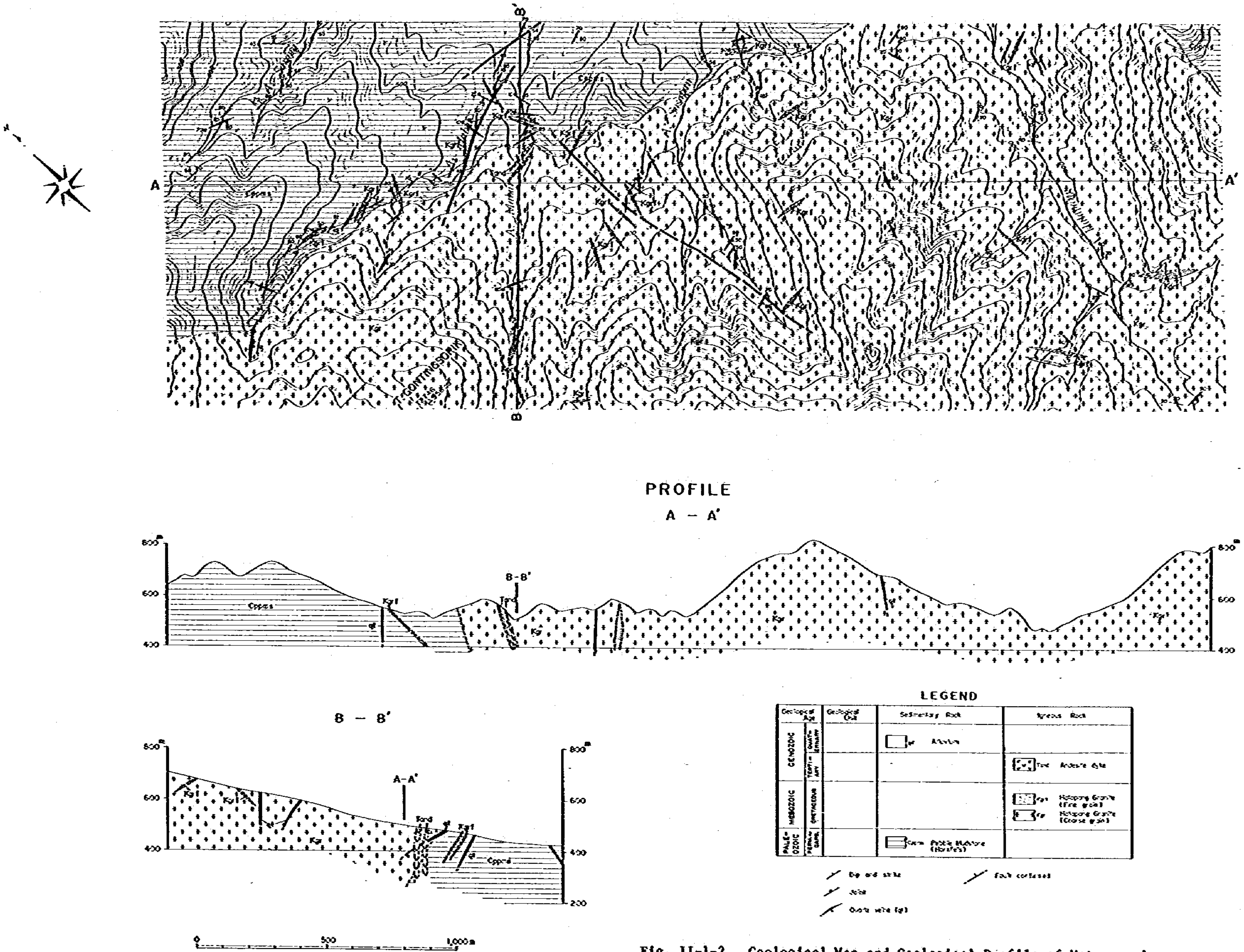


Fig. II-1-2 Geological Map and Geological Profile of Hatapang Area

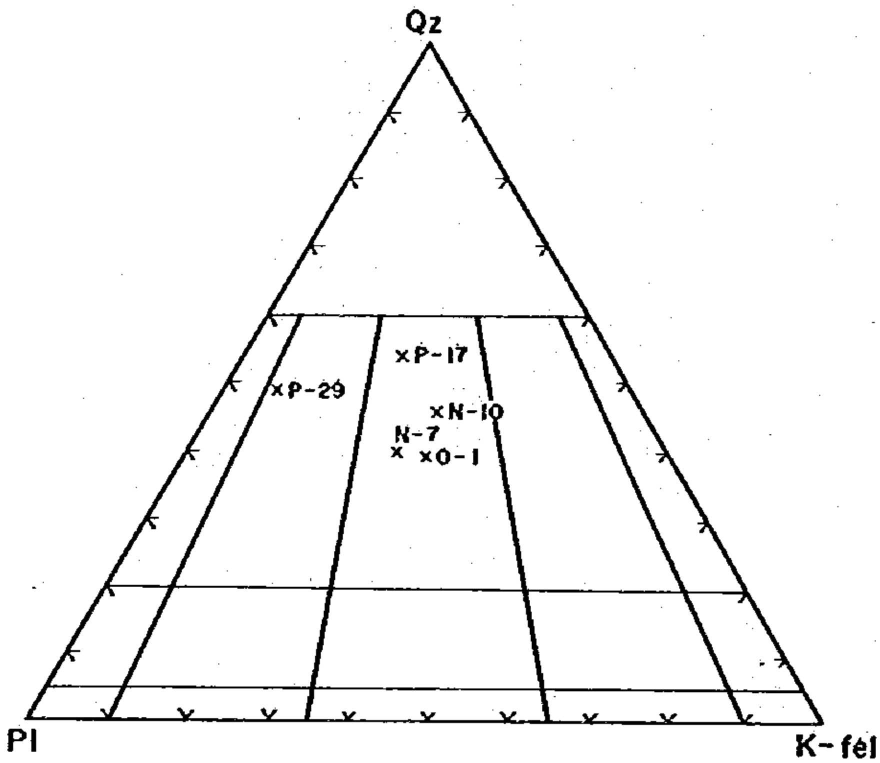


Fig. II-1-3 Modal Qz-Pl-Kfel Diagram of Hatapang Granite

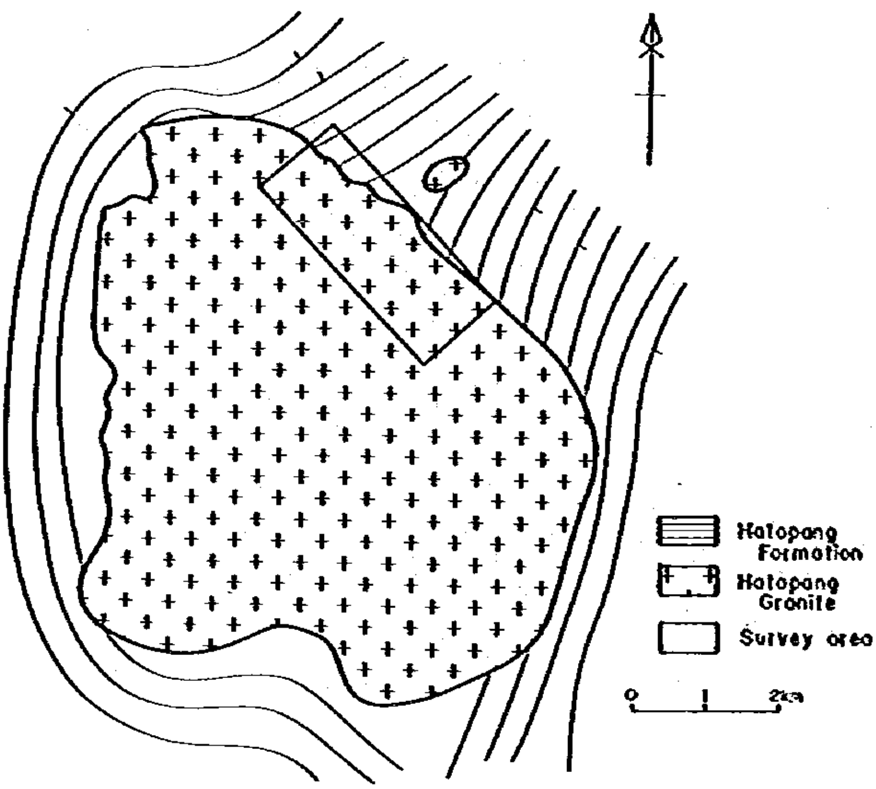


Fig. II-1-4 Illustration of Hatapang Granite Intrusion

Table II-1-1 Microscopic Observation of Thin Section, Hatapang Area

Sample No.	Rock Name	Texture	Phenocryst/Fragment													Groundmass/Matrix									Remarks
Hatapang Formation			q	kf	pl	bt	mu	ho	Fe	Zi	to	tp	ap	fl	Lithic	q	kf	pl	bt	ho	Fe	mu	tp	Zi	
N-17	Pelitic hornfels		○			o	◎		o	o															
O- 4	Pelitic hornfels		o			○	○		o																
P- 6	Sandstone hornfels		◎				o		o						o gr	○			○		o				
P-28	Sandstone (holnfels)		◎	o				o								◎			○	○					
Hatapang Granite																									
N-10	Coarse granite	hol cry	○	○	◎				o		o														
O- 1	Coarse granite	hol cry	○	○	◎	o	o		o	o			o	o											
P-29	Coarse granite	hol cry	◎	o	◎		o			o			o												
N- 7	Fine granite	hol cry	○	○	◎	o			o	o	o	o													
P-17	Fine granite	hol cry	○	○	◎		o		o	o		o													
O-10	Granite porphyry	por	◎	○	◎	o										◎	o	◎				o	o	o	

Abbreviation

q : Quartz
kf: Potash-feldspar
pl: Plagioclase
bt: Biotite
mu: Muscovite
ho: Hornblonde
Fe: Fe mineral

Zi: Zircon
to: Tourmaline
tp: Topaz
fl: Fluorite

◎ : Abundant ○ : Common o: Rare

CHAPTER 3 GEOLOGICAL STRUCTURE

The survey area is situated at a contacting portion between Hatapang Formation (sandstone, mudstone) and Hatapang Granite stock, including sedimentary rock of which strike and dip are, although partly irregular, in general N 70° E, 60° - 85° NW to N 50° W, 30 - 50° NE, while the contact line between the Hatapang Formation and Hatapang Granite stock has a direction of approximately N 70° W.

The first phase survey indicated that the Hatapang Formation has a dome structure along the west, south, and east-south margins of the Hatapang Granite stock, of which intrusion is thus forcefull. To the contrary, in the north and north-east marginal portions (A. Hatapang and A. Batu Jong-jong), irregularities were observed in the strike and dip of the Hatapang Formation, so that as shown in Fig. II-1-4 the granite intrusion is considered to be a stoping. This difference is considered to imply the dominant distribution of two-mica granite dikes and quartz veins in the Hatapang and Batu Jong-jong regions.

Although a fault of N-S system was found in the A. Sosopang region, no other remarkable fault was seen.

In the Hatapang Formation and coarse-grained biotite granite stock, quartz veins and dikes of fine-grained granite, aplite, and pegmatite were found. Their strikes and dips are N 20° - 25° E, 80° - 90° E; N 60° - 90° W, 65° - 70° N; and N 25° - 35° W, 65° - 90° S, when grouping roughly. The distribution density of these dikes tends to become large along the A. sosopang and A. Mabat to A. Mabar and small in the A. Hatapang region.

CHAPTER 4 MINERALIZATION

This survey area has many quartz veins and fine-grained two-mica granite and pegmatite dikes distributed in hornfels (sandstone, mustone) of Hatapang Formation and coarse-grained Hatapang biotite granite stock (Fig. II-1-5). The quartz veins and fine-grained granite dike are mostly of N 20° - 25° E; 90° - 80° E; N 65° - 90° W, 65° - 70° N; and N 25° - 35° W, 65° - 90° S systems and much distributed west of the A. Sosopan. However, no discovery was possible such as of dominant greisen alteration zone, cassiterite and tungsten mineral-bearing quartz vein, excepting chalcopyrite and sphalerite scattered in quartz veins (P-8 vein width 10 cm) lying at the middle stream of the A. Saraga in a hornfels region and in those (P-24 vein width 10 cm) lying near the contacting part between the coarse-grained granite and hornfels areas. Though impartially attended with topaz, fluorite, and tourmaline under microscope, the fine-grained two-mica granite was generally high in tin content in the first phase survey and, hence, is considered to be an igneous rock relating closest to the tin mineralization in this area. Some of the quartz veins and fine-grained granite dikes in the survey area were selected for chemical assay, which results are shown in Table II-1-2. As described later, the results of the geochemical survey of soil suggests the possibility that tin and tungsten mineralizations are concentrated at the contacting portion between the Hatapang Granite and hornfels.

Table II-1-2 Assay Result of Ore Samples in Hatapang Area

Sample No.	Location	Mode of Ore Deposit	Ore Mineral	Width (cm)	Element			
					Cu ppm	Mn ppm	W ppm	Sn ppm
N-14	A. Hatapang	Quartz vein		1		80	45	540
O- 9	A. Sosopan	Quartz vein	Fe ore	10		92	45	41
O-12	A. Mabar	Quartz vein		10		625	80	58
P- 2	A. Mabat	Quartz vein		8		106	11	3
P- 8	A. Saraga	Quartz vein	py cp cov	5	600	245	1	5
P-24	A. Mabat	Quartz vein	py cp sph cov	10	1,800	245	400	76

Fe ore: iron ore
py : pyrite
cp : chalcopyrite
cv : covelline
sph : sphalerite

Table II-1-3 Microscopic Observation of Ore Samples, Hatapang Area

Sample No.	Location	Ore Mineral					Gangue Mineral											Remarks
		py	sp	cp	cov	mag	q	mu	bt	ap	zi	to	pl	kf	se	chl	sph	
N-9	A. Sosopan					o?	◯						◯	o				
N-5	A. Sosopan					o?	◯	o	o				◯	o	o	o	o	
P-8	A. Saraga	◯		o	o		◎								o	o		dissemination
P-24	A. Mabat	o	o	◯	o		◎	◯		o	o	o						dissemination

Abbreviation

py :	Pyrite	q :	Quartz	to :	Tourmaline
sp :	Sphalerite	mu:	Muscovite	pl :	Plagioclase
cp :	Chalcopyrite	bt:	Biotite	kf :	Potash feldspar
cov:	Covelline	ap:	Apatite	se :	Sericite
mag:	Magnetite	zi:	Zircon	chl:	Chlorite
				sph:	Sphane

◎ : Abundant ◯ : Common o: Rare

Table II-1-4 List of X-ray Diffractive Analysis in Hatapang Area

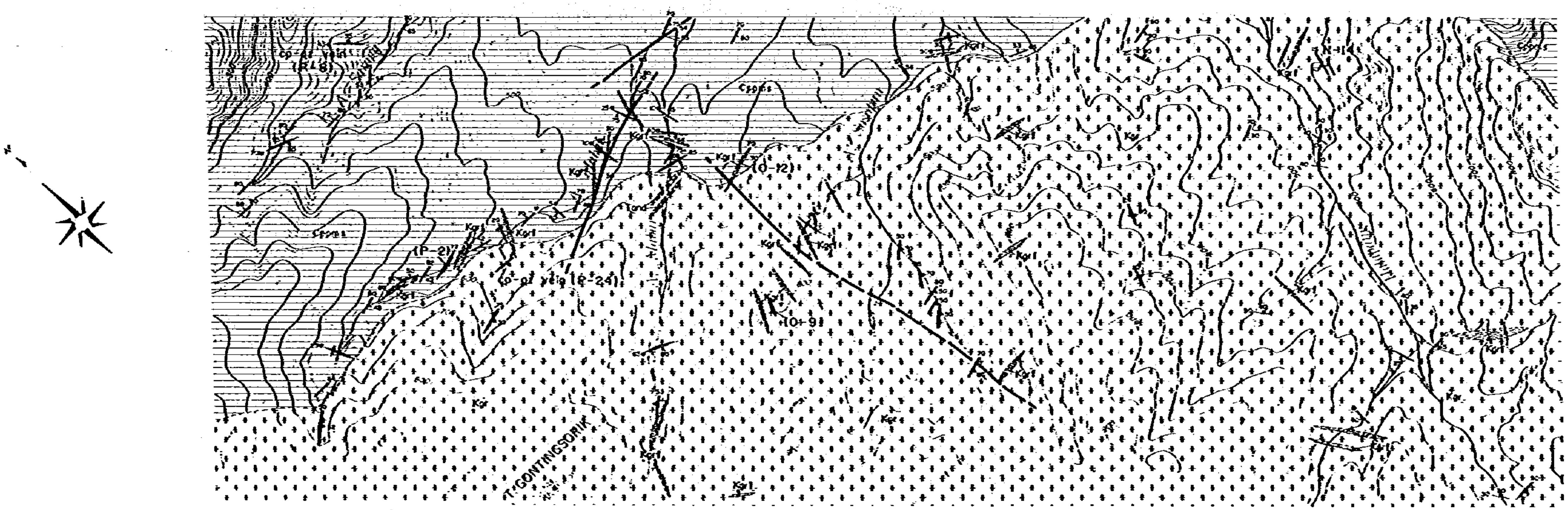
Sample No.		Occurence	m	mix	se	ch	k	la	ca	py	q	kf	pl
N- 2x	A. Hatapang	White clay			o						◎	○	◎
4x	A. Hatapang	Quartz vein			o	o?					◎		
19x	A. Sosopan	Quartz vein			o						◎		
O-11x	A. Mabar	White clay			○		○				◎	○	o
12ax	A. Mabar	Quartz vein			○				o		◎		○
12x	A. Mabar	Quartz vein	○		o		o				◎	○	
P- 2x	A. Mabat	Pagmatite vein			o		o				◎	○	◎
5x	A. Mabat	Argillaceous pegmatite			○				o		◎	○	o
8x	A. Saraga	Clay			o	○				o	◎		

Abbreviation

m : Montmorillonite
mix: Mixed-layer mineral
se : Sericite
ch : Chlorite
k : Kaoline mineral
la : Laumontite
ca : Calcite

py: Pyrite
q : Quartz
kf: Potash feldspar
pl: Plagioclase

◎ : Abundant ○ : Common o: Rare



Quartz vein

Fine grained granite Aplite

	Wd (cm)	Cu (ppm)	Mn (ppm)	W (ppm)	Sn (ppm)
N - 14	1		80	45	540
O - 9	10		92	45	41
O - 12	10		625	80	58
P - 2	8		106	11	3
P - 8	5	600	245	1	5
P - 24	10	1800	245	400	76

0 100 200 300 400 500m

Fig. II-1-5 Map of Mineralizations in Hatapang Area

CHAPTER 5 GEOCHEMICAL SURVEY

5-1 SAMPLING

In parallel with the geological survey, a geochemical survey of soil was conducted. Eleven sampling lines (line length: 1.5 km each, 16.5 km in total) were established at a spacing of 400 m in a direction N 45° E by measured by compass and tape, and soil samples were collected from B. horizon at intervals of 70 m along each sampling line. The soil samples, 242 pieces in total, were dried in the sun at base camp at A. Hatapang Julu and divided into two portions to be kept by the Japanese and the Indonesian teams. In accordance with the object mineral types of tin, tungsten, and fluorine, path-finder elements were selected for chemical assay.

5-2 DATA PROCESSING

The data resulting from the analysis were processed to have their values standardized by logarithmic conversion and calculated to obtain histogram, mean value, standard deviation, and coefficient of correlation between path-finder elements and to determine threshold values I (M + S.D.) and II (M + 2 x S.D.) of anomalous value (Table II-1-5).

5-2-1 Correlation between Path-finder Elements

Correlations and correlation coefficients of path-finder elements are given in Fig. II-1-7 and Table II-1-6. The correlation coefficients of tin to tungsten, tin to fluorine, and tungsten to fluorine were all larger than 0.5, thus indicating good correlations.

5-2-2 Histogram

Respective elements had maximum and minimum values ranging from 860 ppm to 2 ppm of tin, 350 ppm to 1 ppm of tungsten, and 2,700 ppm to 300 ppm of fluorine. Through logarithmic conversion, they were grouped into 15 classes for the preparation of histogram. For respective elements, the distribution in the histogram was substantially normal (Fig. II-1-6).

5-2-3 Anomalous Area

For respective path-finder elements, the mean value M and standard deviation S.D. were calculated to thereby determine threshold values (M + S.D.) and (M + 2 x S.D.), while letting the former and the latter be anomalous values of second class and first class. The anomalous area was defined as an area where at least two anomalous values are adjacent (Table II-1-5).

From the middle stream of the A. Mabat to those of the A. Mabar, there is a distribution of a second class anomalous area of fluorine (1,700 ppm or more) along the contacting portion between Hatapang Granite and Hatapang Formation, in a scale of 800 m extension by 200 to 300 m width. For tin, anomalous area of first and second classes (200 ppm, 76 ppm or more) are distributed substantially overlapping the anomalous area of luorine. In this region, quartz veins disseminated with chalcopyrite (Sample P-24) are observed. The anomalous area of fluorine is observed farther extending intermittently to the lower stream of the A. Sosopang. Besides the above, an anomalous area of tin and tungsten is observed in the lower stream of the A. Hatapang, along the north margin of the survey area, in a scale of 500 m length by 200 m width. In this anomalous area, the chemical assay of quartz vein sample (N 14) showed a Sn content of 540 ppm. Moreover, anomalous values of tin and tungsten are distributed in the N-S direction from sampling points YE 7 - 8 through YD 13 - 14 to YC 20. Since faults of N-S system are observed between the A. Sosopang and the A. Mabat, it may be possible to consider the Hatapang Area to be composed of certain geological structures, such as the faults of N-S system, governing the distribution of those dikes which have caused mineralization or mineral showing (Fig. II-1-10).

5-2-4 Fluorine Content

Tin, tungsten, and fluorine assay values of soil were shown in a graph along the sampling line, as in Fig. II-1-9. The analysis values of fluorine, of which mean value was 899 ppm in hornfels (e.g. on YK, YJ, and YI sampling lines) and 1,165 ppm in granite, were so high in comparison with other pathfinder elements at the contacting portion between the granite and hornfels, as to give anomalous values exceeding the mean value (1,165 ppm) of fluorine in granite, over a region stretching to both the granite and the hornfels (e.g. on YJ to YI sampling lines). Even in the granite stock, when compared with granites (500 to 900 ppm) on the YA to YC sampling lines, those situated further westward had the tendency of becoming high (over 900 ppm) of fluorine content. In the geological survey, the west region (the A. Sosopan and the A. Mabar) has a higher distribution frequency of quartz vein and fine-grained two-mica granite and aplite dikes compared to the east region (the upper stream of A. Hatapang. This difference in the distribution frequency seems to have appeared in the difference of the analysis value of fluorine in the granite stock as described above.

Table II-1-5 List of Mean Value, Standard Deviation, and Threshold Value on Geochemical Survey in Hatapang Area

	Max.	Min.	Mean	S.D. (log)	M+S.D.	M+2xS.D.	M+3xS.D.
Sn (ppm)	860	2	35	0.377205	85	203	484
W (ppm)	350	1	25	0.481666	76	231	
F (ppm)	2,700	300	1,086	0.187131	1,671	2,572	

Total Area (population: 242)

Sn (ppm)	860	6	41	0.334251	90	193	418
W (ppm)	350	7	40	0.238737	69	119	207
F (ppm)	2,700	300	1,165	0.171989	1,730	2,572	

Hatapang Granite Area (population: 177)

Sn (ppm)	150	2	24	0.427971	64	(171)	
W (ppm)	65	1	7	0.557983	26	(95)	
F (ppm)	2,200	380	899	0.201293	1,428	(2,271)	

Hatapang Formation Area (population: 65)

Table II-1-6 List of Coefficient of Correlation between Path-finder Elements on Geochemical Survey in Hatapang Area

	Sn	W	F
Sn		0.585668	0.554423
W			0.538544
F			

(population: 242)

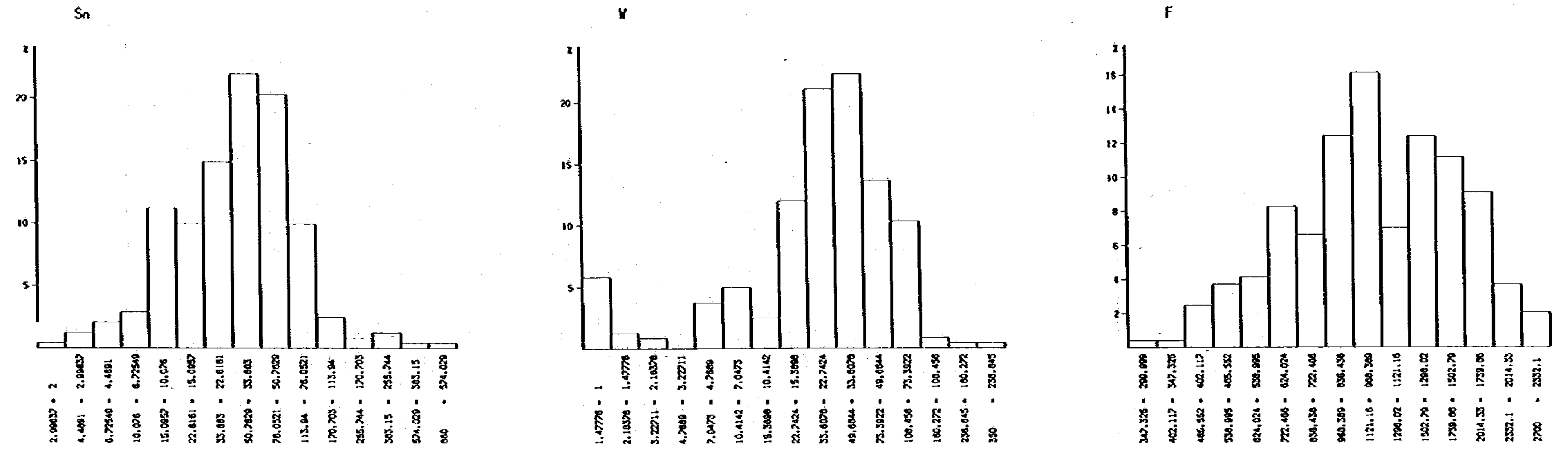


Fig. II-1-6 Histgram of Geochemical Analysis in Hatapang Area

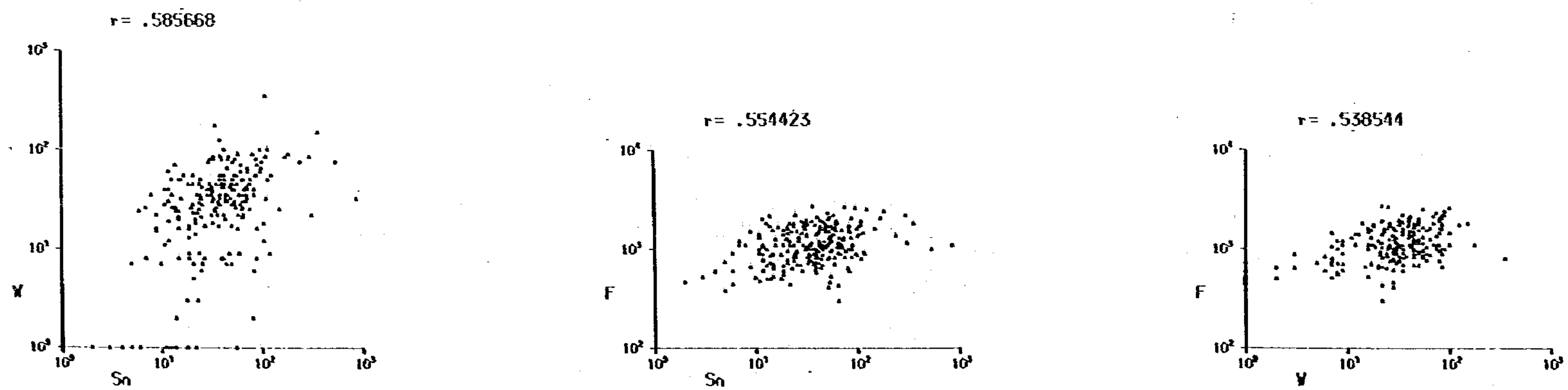


Fig. II-1-7 Coefficient of Correlation of Geochemical Path-finder Elements in Hatapang Area

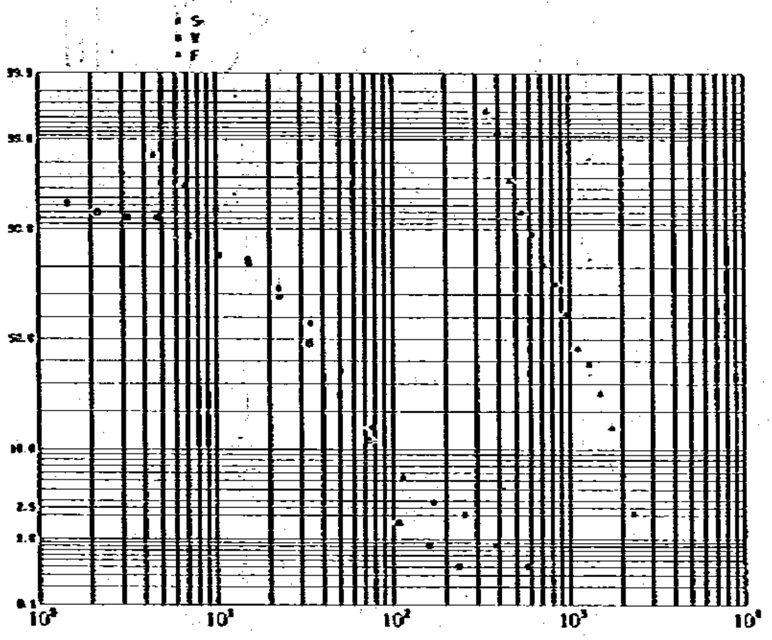


Fig. II-1-8 Cumulative Frequency Distribution of Geochemical Path-finder Elements in Hatapang Area

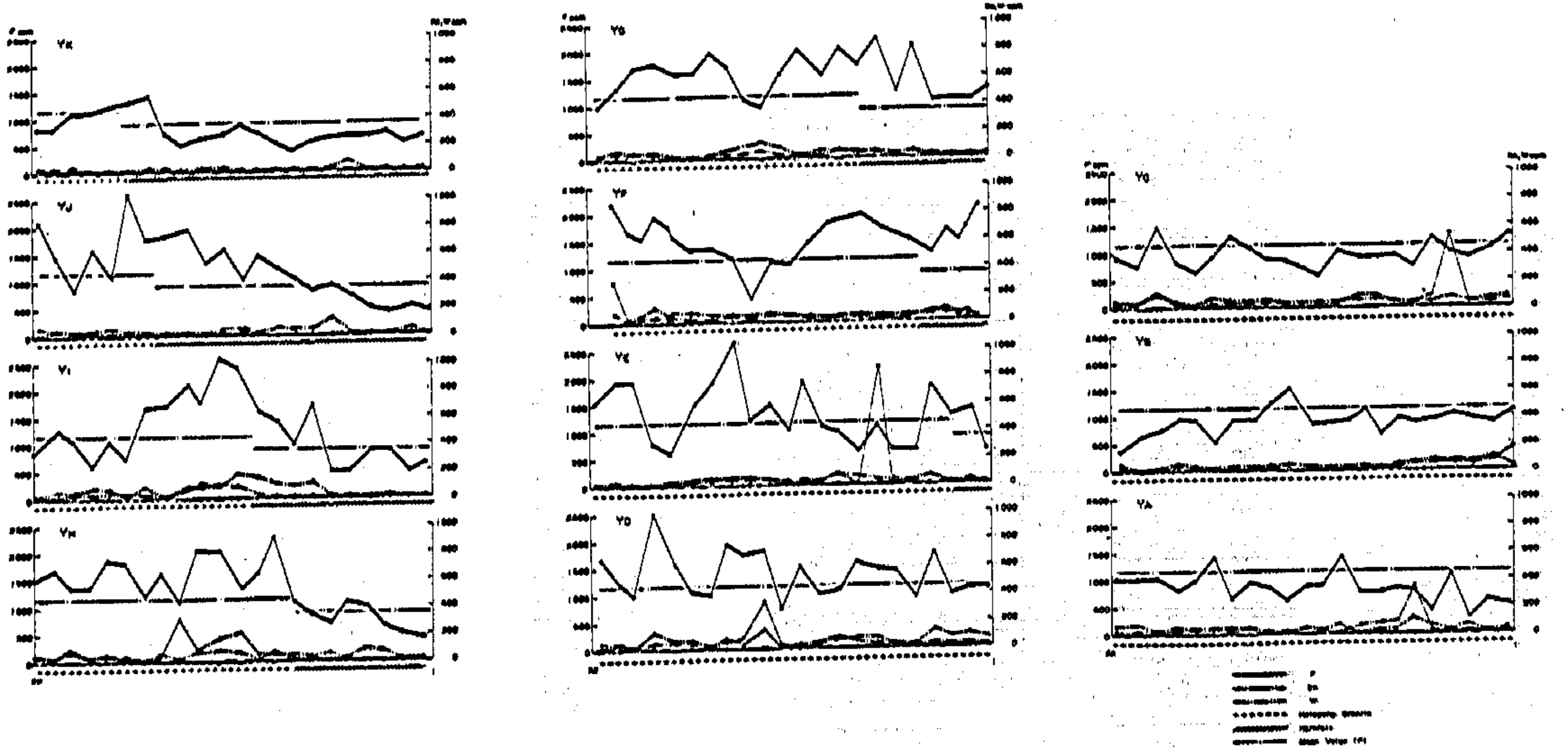


Fig. II-1-9 Geochemical Tendency of Each Survey Line in Hatapang Area

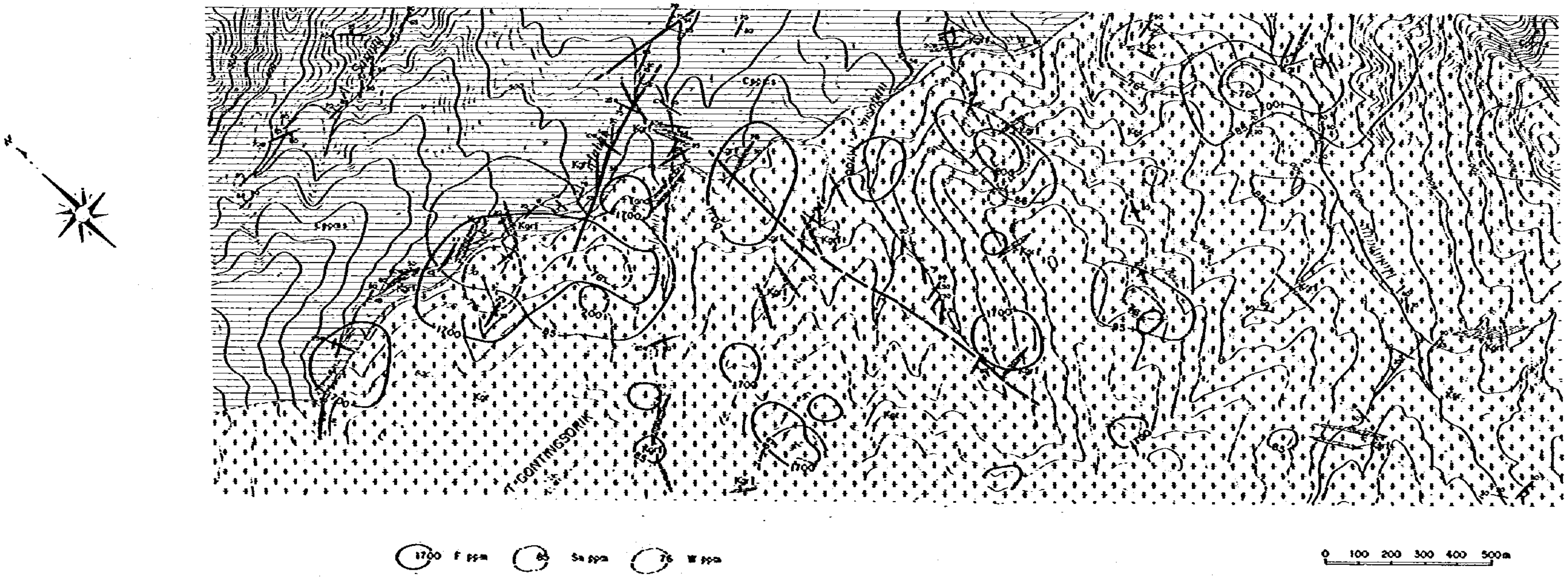


Fig. II-1-10 Map of Geochemical Anomaly in Hatapang Area (Sn, W and F)

CHAPTER 6 CONCLUSION

In the first phase survey anomalous areas promising tin and tungsten mineralization were selected at the margin of the Hatapang Granite stock, particularly in the upper stream region of the A. Hatapang and the middle stream of the A. Batu Jong-jong. Among these regions, in the upper stream region of the A. Hatapang (more particularly, the upper stream of the A. Hatapang and the regions of the A. Mabar, A. Mabat, A. Sosopan, and A. Saraga as branches of the A. Hatapang), the second phase survey has conducted a detailed geological survey and geochemical survey of soil, resulting in the clarification of the following points:

(1) In the Hatapang Granite stock and hornfels of Hatapang Formation large numbers of quartz veins and fine-grained two-mica granite dikes which may be considered having brought tin mineralization were observed.

(2) The fine-grained granite dike contains accessory minerals such as topaz, fluorite, and tourmaline. The analysis of quartz vein showed a maximum tin content of 540 ppm. But no quartz vein nor mineralization containing cassiterite or tungsten ore or a promising greisen alteration zone were discovered. At the A. Mabar and the A. Saraga, however, quartz veins accompanied by chalcopyrite were partially observed.

(3) In the geochemical survey of soil, near the boundary between Hatapang Granite and hornfels along the A. Mabar, fluorine was particularly high in analysis value, while also anomalous zones of tin and tungsten overlap the same region. The fluorine back-ground content in the granite area showed, compared to the upper stream of the A. Hatapang, higher values in the area of the A. Mabat and A. Mabar lying in the north-west part of the survey area. This is because the latter region has a denser distribution a fine-grained granite, pegmatite, and quartz vein.

Although no primary tin-tungsten ore deposits were discovered, an anomalous area of fluorine, tin, and tungsten were found in the upper-stream area of the A. Mabar by the geochemical survey, in addition to that, many fine-grained two-mica granite and quartz vein are distributed in this area.

Fig. II-1-11 Microscopic photograph of Thin Section and Ore Sample, Hatapang Area

Abbreviation

q : Quartz

pl : Plagioclase

kf : Potash feldspar

mu : Muscovite

bi : Biotite

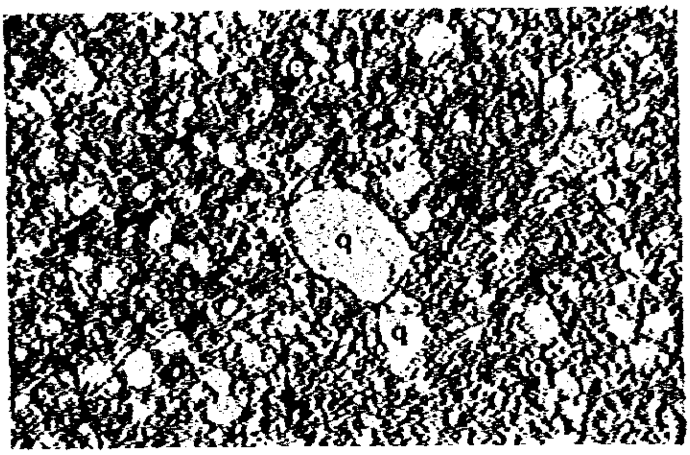
top: Topaz

to : Tourmaline

py : Pyrite

cp : Chalcopyrite

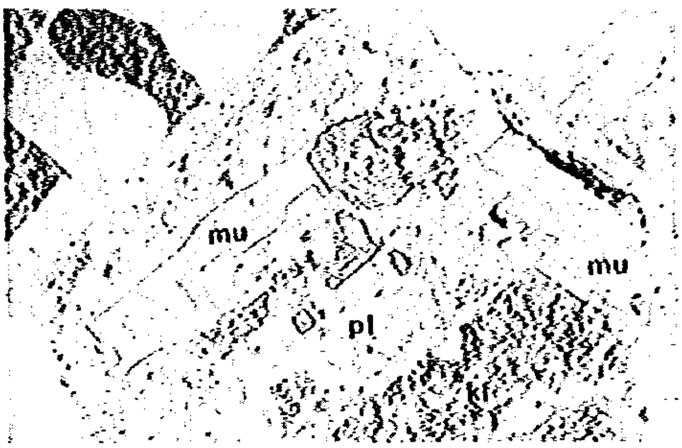
cov: Covelline



Sample No.: P-6
Location : A. Mabat
Rock name : Sandstone (hornfels)

cross polars

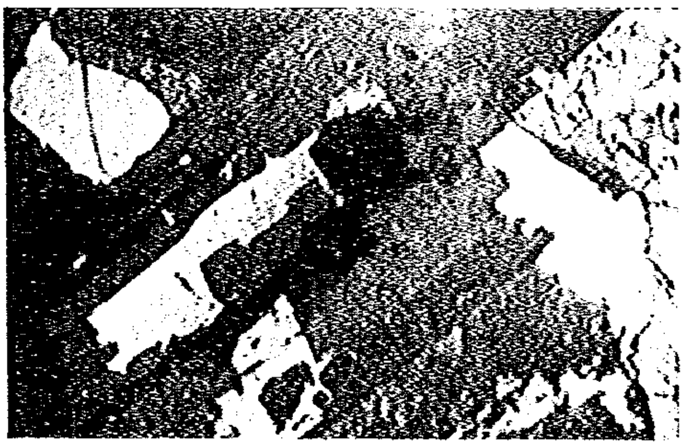
0 0.5mm



Sample No.: 0-1
Location : A. Sosopan
Rock name : Coarse grained granite

only lower polar

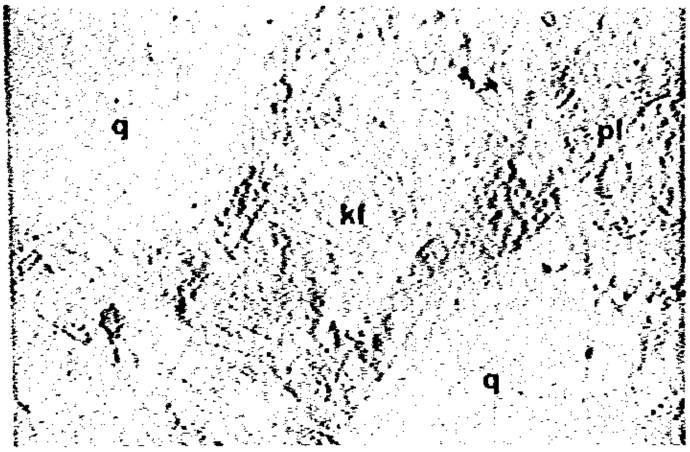
0 0.5mm



Sample No.: 0-1
Location : A. Sosopan
Rock name : Coarse grained granite

cross polars

0 0.5mm

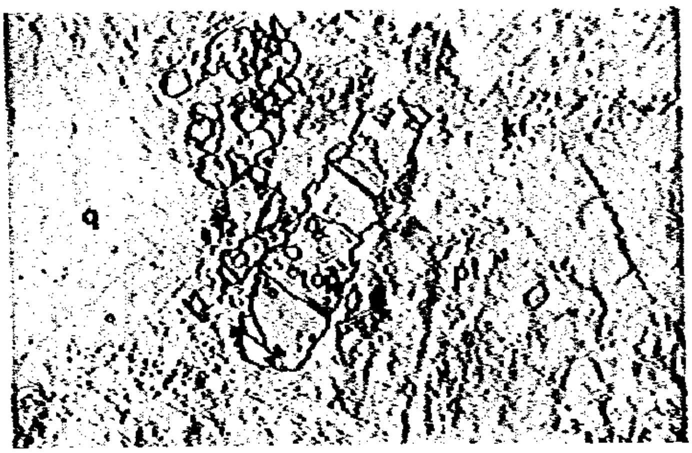


Sample No.: N-7
Location : A. Hatapang
Rock Name : Fine grained granite

only lower polar
0 0.5mm

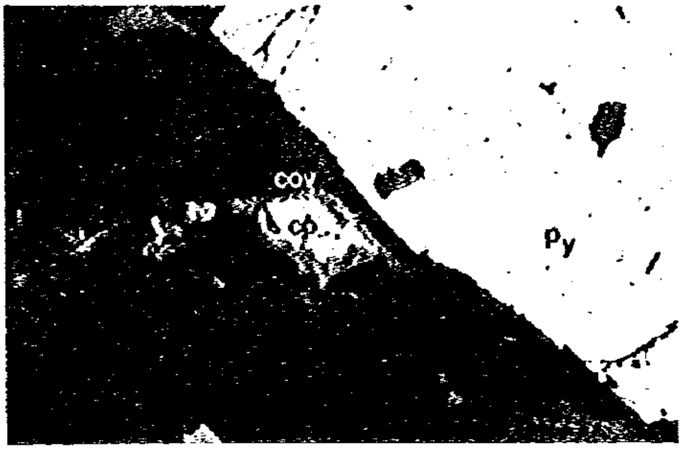
Sample No.: N-7
Location : A. Hatapang
Rock name : Fine grained granite

cross polars
0 0.5mm



Sample No.: N-7
Location : A. Hatapang
Rock name : Fine grained granite

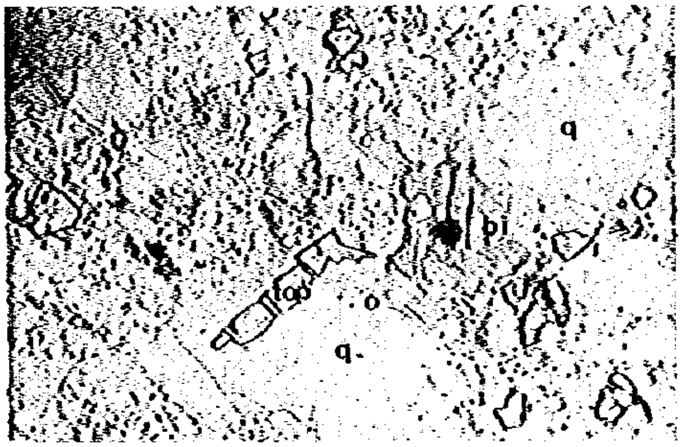
only lower polar
0 0.5mm



Sample No.: P-8
Location : A. Saraga
Ore name : Chalcopyrite bearing quartz vein

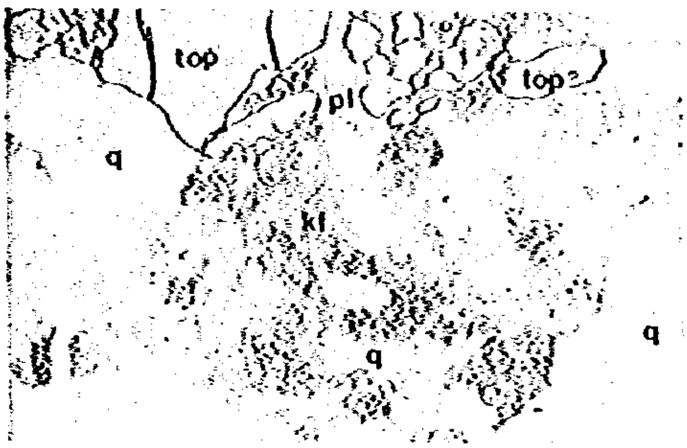
cp : chalcopyrite
py : pyrite
cov : coveline

0 0.2mm



Sample No.: O-10
Location : A. Sosopan
Rock name : Fine grained granite

only lower polar
0 0.5mm



Sample No.: P-29
Location : A. Mabar
Rock name : Coarse grained granite

only lower polar
0 0.5mm

Table II-1-7 Assay Result of Geochemical Survey, Hatapang Area

Sample No.	Coordinates X	Coordinates Y	Sn ppm	W ppm	F ppm
YA1	3280	735	40	8	580
YA2	3225	680	26	7	690
YA3	3180	635	66	22	300
YA4	3135	525	22	18	1100
YA5	3085	525	65	22	430
YA6	3040	480	110	350	800
YA7	2995	435	34	85	890
YA8	2950	390	34	30	750
YA9	2895	340	12	60	770
YA10	2845	285	59	22	1400
YA11	2795	245	25	32	840
YA12	2760	200	39	55	870
YA13	2705	150	9	22	660
YA14	2665	100	14	24	860
YA15	2610	35	42	55	960
YA16	2555	-15	46	35	690
YA17	2510	-60	32	40	1400
YA18	2460	-110	31	45	930
YA19	2415	-150	51	28	800
YA20	2360	-205	32	22	1040
YA21	2305	-265	72	32	1050
YA22	2250	-320	65	26	1050
YB1	2985	1030	35	175	1100
YB2	2925	930	100	65	870
YB3	2875	920	77	50	950
YB4	2830	870	73	60	1030
YB5	2780	825	55	80	960
YB6	2725	770	16	65	870
YB7	2680	730	21	55	950
YB8	2635	685	29	17	690
YB9	2590	640	36	45	1150
YB10	2550	585	26	28	940
YB11	2500	540	24	25	840
YB12	2450	485	33	38	840
YB13	2390	430	43	42	1500
YB14	2340	330	21	45	1250
YB15	2300	340	11	28	900
YB16	2240	230	38	29	900
YB17	2190	235	15	16	520
YB18	2140	175	25	21	930
YB19	2100	130	57	55	980
YB20	2060	90	34	32	770
YB21	2005	30	9	15	660
YB22	1950	-25	52	28	410
YC1	2700	1300	88	55	1300
YC2	2655	1255	67	40	1100
YC3	2595	1200	40	45	890
YC4	2550	1150	540	75	1000
YC5	2500	1100	85	40	1500
YC6	2440	1050	36	26	750

Sample No.	Coordinates X	Coordinates Y	Sn ppm	W ppm	F ppm
YC7	2395	1000	41	45	970
YC8	2350	940	98	60	890
YC9	2300	900	39	55	840
YC10	2250	845	44	30	1050
YC11	2200	795	39	28	610
YC12	2160	750	33	30	720
YC13	2105	705	54	55	820
YC14	2055	655	68	35	900
YC15	2015	610	54	30	1150
YC16	1960	565	54	30	1300
YC17	1920	510	65	30	920
YC18	1860	475	15	24	640
YC19	1810	425	76	45	830
YC20	1750	390	115	100	1450
YC21	1700	325	24	29	760
YC22	1645	265	25	50	900
YD1	2410	1575	30	75	1100
YD2	2360	1525	43	100	1100
YD3	2310	1475	39	85	1000
YD4	2260	1430	39	125	1750
YD5	2215	1380	6	24	900
YD6	2160	1325	32	35	1400
YD7	2115	1280	41	80	1450
YD8	2060	1225	48	85	1600
YD9	2010	1180	91	70	1100
YD10	1960	1125	46	30	1000
YD11	1910	1080	23	35	1500
YD12	1860	1020	38	17	700
YD13	1810	970	360	150	1800
YD14	1760	910	85	40	1700
YD15	1715	870	47	80	1900
YD16	1670	830	37	30	1000
YD17	1620	780	67	50	1150
YD18	1580	730	63	60	1550
YD19	1520	680	125	55	2500
YD20	.1465	630	11	28	1000
YD21	1430	595	43	50	1200
YD22	1380	545	17	55	1650
YE1	2120	1840	15	20	670
YE2	2080	1800	11	40	1400
YE3	2030	1755	9	16	1500
YE4	1970	1700	63	70	1800
YE5	1930	1660	29	35	800
YE6	1875	1600	19	45	630
YE7	1785	1620	860	32	1100
YE8	1740	1570	13	50	630
YE9	1725	1460	82	90	1000
YE10	1680	1415	46	35	1100
YE11	1635	1365	29	40	1900
YE12	1595	1320	13	35	1000

Sample No.	Coordinates X	Coordinates Y	Sn ppm	W ppm	F ppm
YE13	1545	1275	23	23	1500
YE14	1495	1225	54	29	1250
YE15	1440	1175	76	25	2650
YE16	1390	1130	63	35	1300
YE17	1340	1075	54	40	1500
YE18	1270	1020	44	20	650
YE19	1230	965	21	28	780
YE20	1170	920	13	26	1800
YE21	1135	865	31	35	1850
YE22	1080	820	19	17	1550
YF1	1890	2065	41	42	2100
YF2	1860	2035	83	40	1700
YF3	1835	2010	49	42	1500
YF4	1810	1975	99	65	1600
YF5	1750	1950	73	65	1250
YF6	1680	1900	26	42	1500
YF7	1600	1840	24	45	1700
YF8	1540	1790	32	40	1950
YF9	1430	1720	33	40	1800
YF10	1385	1665	29	35	1450
YF11	1330	1620	48	42	1050
YF12	1250	1590	71	42	1100
YF13	1190	1550	54	28	460
YF14	1135	1510	57	45	1200
YF15	1080	1455	55	28	1350
YF16	1015	1405	67	30	1300
YF17	970	1355	72	35	1550
YF18	920	1395	49	32	1750
YF19	860	1370	110	32	1900
YF20	800	1360	70	30	1550
YF21	745	1340	44	45	1700
YF22	685	1325	300	85	2200
YG1	1570	2405	20	26	1250
YG2	1520	2365	12	12	1100
YG3	1475	2315	7	26	1100
YG4	1420	2260	12	19	1050
YG5	1370	2215	54	40	2100
YG6	1315	2165	22	20	1200
YG7	1265	2115	25	35	2200
YG8	1215	2070	56	26	1700
YG9	1170	2020	52	50	2000
YG10	1120	1960	15	50	1550
YG11	1060	1900	12	40	2000
YG12	1005	1855	84	35	1550
YG13	960	1805	115	50	920
YG14	910	1755	8	35	1100
YG15	370	1710	52	40	1700
YG16	820	1675	44	32	1950
YG17	780	1625	21	28	1600
YG18	725	1580	21	23	1600

Sample No.	Coordinates X	Coordinates Y	Sn ppm	W ppm	F ppm
YG19	670	1525	39	50	1750
YG20	620	1470	50	45	1650
YG21	570	1425	74	40	1300
YG22	535	1370	34	25	1000
YH1	1270	2690	22	1	440
YH2	1215	2630	18	1	500
YH3	1170	2580	81	2	640
YH4	1115	2530	89	8	1000
YH5	1070	2480	24	9	1100
YH6	1025	2440	60	9	700
YH7	975	2390	42	22	820
YH8	930	2345	65	21	1150
YH9	880	2290	52	75	2300
YH10	835	2245	61	28	1650
YH11	790	2200	240	75	1350
YH12	730	2140	170	85	2050
YH13	670	2090	89	80	2050
YH14	620	2035	310	22	1150
YH15	575	1975	21	55	1650
YH16	530	1930	7	8	1200
YH17	485	1870	24	45	1300
YH18	440	1825	64	50	1850
YH19	390	1785	32	42	1350
YH20	340	1740	100	75	1350
YH21	300	1690	30	40	1700
YH22	250	1630	52	45	1500
YI1	970	2955	23	3	640
YI2	930	2915	11	1	480
YI3	880	2865	25	6	840
YI4	830	2810	18	3	820
YI5	780	2755	13	1	500
YI6	730	2705	14	2	500
YI7	685	2655	105	18	1700
YI8	630	2610	90	16	1000
YI9	585	2560	105	12	1400
YI10	540	2510	150	25	1600
YI11	480	2450	185	90	2400
YI12	435	2400	97	100	2600
YI13	390	2350	110	85	1750
YI14	370	2300	59	90	2200
YI15	335	2230	14	26	1700
YI16	275	2170	31	80	1600
YI17	220	2120	39	32	740
YI18	180	2080	34	80	1100
YI19	130	2030	40	85	660
YI20	90	1990	43	55	1150
YI21	30	1945	16	50	1250
YI22	25	1885	12	30	890
YJ1	700	3240	2	1	460
YJ2	650	3200	55	1	530

Sample No.	Coordinates X	Coordinates Y	Sn ppm	W ppm	F ppm
YJ3	580	3145	6	1	440
YJ4	545	3090	14	2	500
YJ5	500	3040	21	5	720
YJ6	440	2980	120	9	900
YJ7	390	2925	45	7	800
YJ8	350	2875	50	7	1050
YJ9	300	2830	48	9	1200
YJ10	245	2780	21	7	1450
YJ11	200	2740	64	25	1050
YJ12	155	2690	58	16	1600
YJ13	110	2645	27	17	1300
YJ14	60	2590	36	22	1900
YJ15	0	2530	22	14	1800
YJ16	-55	2480	33	18	1750
YJ17	-105	2440	37	22	2700
YJ18	-150	2385	51	17	1100
YJ19	-200	2340	44	35	1600
YJ20	-245	2290	35	24	850
YJ21	-300	2240	40	45	1400
YJ22	-340	2195	14	70	2150
YK1	400	3510	4	1	600
YK2	350	3460	3	1	520
YK3	300	3415	14	1	720
YK4	255	3365	6	1	600
YK5	200	3310	12	1	600
YK6	145	3265	84	6	600
YK7	100	3210	4	1	590
YK8	50	3170	5	1	380
YK9	10	3120	10	7	510
YK10	-30	3070	5	7	740
YK11	-80	3020	15	21	880
YK12	-100	2940	42	8	720
YK13	-180	2900	13	9	600
YK14	-235	2850	19	8	550
YK15	-280	2810	15	8	700
YK16	-330	2760	10	13	1400
YK17	-380	2705	11	11	1300
YK18	-425	2655.	27	8	1200
YK19	-480	2605	13	16	1100
YK20	-525	2560	16	32	1100
YK21	-575	2510	39	35	820
YK22	-615	2465	60	35	820

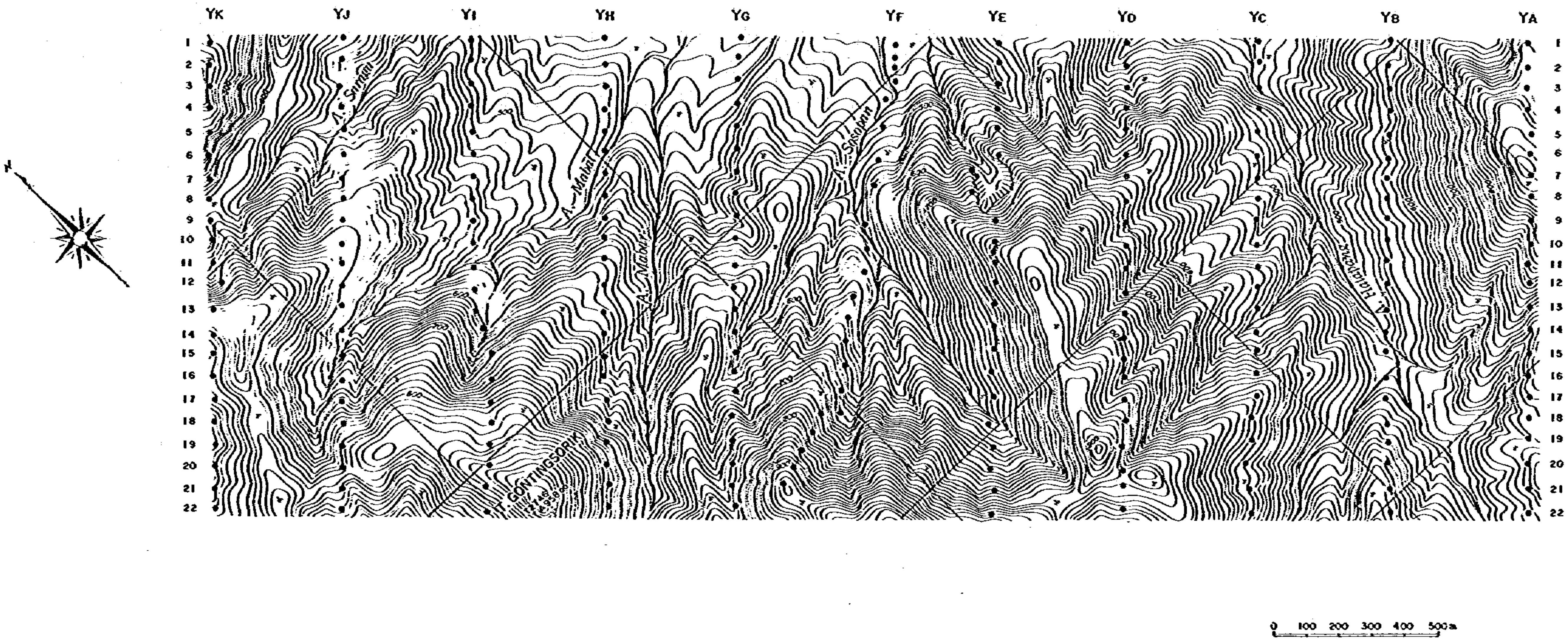
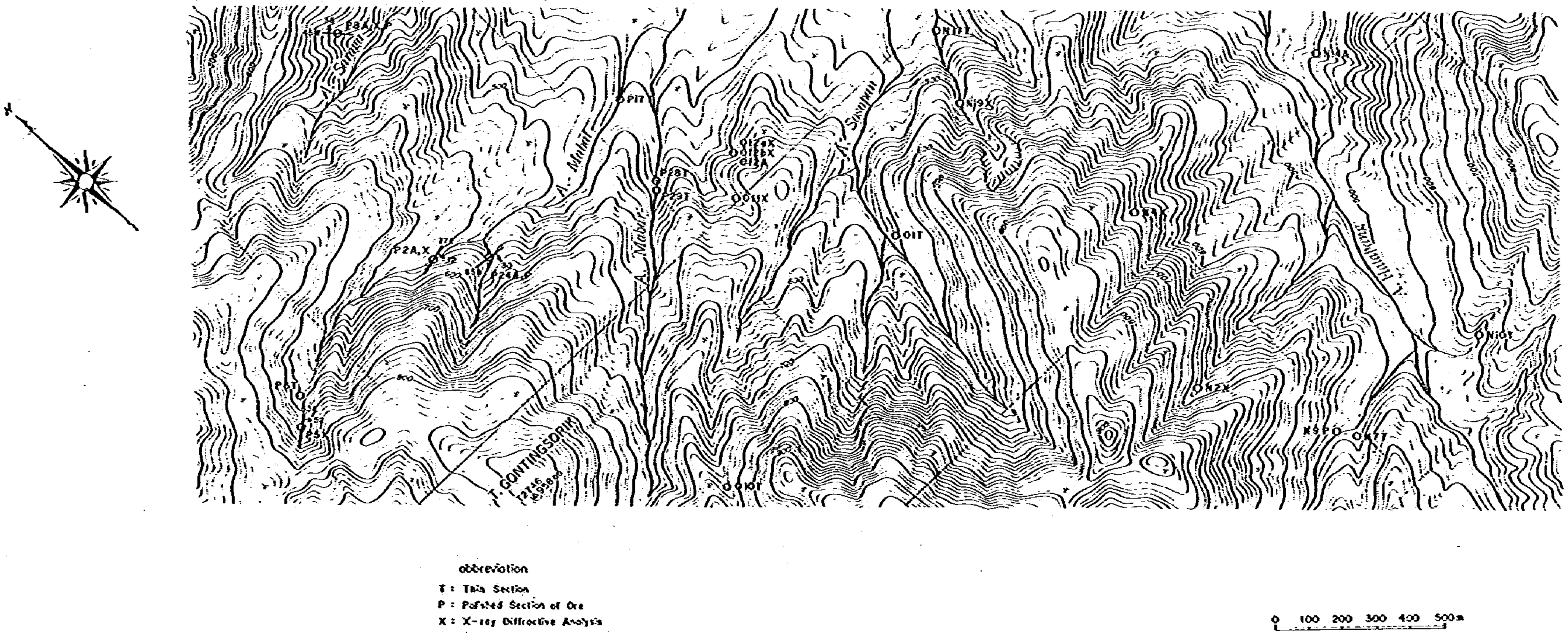


Fig. II-1-12 Location Map of Geochemical Samples in Hatapang Area



abbreviation

T : Thin Section
P : Polished Section of Ore
X : X-ray Diffractive Analysis
E : Electron Probe Micro Analysis
A : Chemical Assay of Ore

Fig. II-1-13 Location Map of Rock and Ore Samples in Hatapang Area

PART II-2

MUARA SIPONGI AREA A

CHAPTER 1 OUTLINE

1-1 SUMMARY OF THE FIRST PHASE SURVEY

The first phase survey has conducted a reconnaissance survey over an area of 400 km extending from Kotanopan to Lao, resulting in the indication that the geology of this survey area consists of massive green meta-andesite (Muara Botung Formation), white saccharoidal crystalline Limestone (Bt. Janjang Formation), and sandstone and mudstone strata (Patahajang Formation). These Formations are correlative with SilungKang Formation of Permian - Carboniferous Peusangan Group which is dominated by andesite and is distributed in the Barisan mountain range, in which the Formation has been intruded by quartz diorite as part of Jurasic Muara Sipongi Granitoid rock.

As ore deposits, there are skarn type copper deposits embedded in limestone and copper-lead-zinc deposits filled in fissures of meta-andesite. These ore deposits, particularly those of metalliferous vein type, are embedded in fissures formed by the main geological structure (in the direction N 60° W) caused by intrusions of the granitoid rock in Muara Sipongi Area.

1-2 PURPOSE OF THE SECOND PHASE SURVEY

This second phase survey aimed at shedding light on features of the gold and silver-bearing, copper-zinc mineralizations of this survey area which were found through the first phase survey, while studying the relationship between the geological structure and the mineralizations. Particularly at pursuing the continuity of those ore deposits found to be distributed in area of the A. Tabur and A. Simpang Mangampo through the first survey.

1-3 SURVEY METHODS AND QUANTITIES

(1) Topographic map preparation

By using aerial photographs of 1/120,000 scale, a topographic map of 1/10,000 scale was produced and prepared for the use in compiling a geological map and other maps. For the geological survey and geochemical survey of soil, 1/5,000 scale topographic map was prepared for use in the field by enlarging the 1/10,000 topographic map.

(2) Geological survey

By use of the 1/5,000 topographic map, a geological survey was conducted along principal rivers and roads, compiling a 1/10,000 geological map. The total survey route was 30 km.

(3) Geochemical survey

At sampling points selected and evenly distributed at a rate of 10 points per 1 km^2, soil was collected from the B-horizon N. The soil samples, 83 pieces in total, were dried in the sun at the base camp and divided into two portions to be kept by the Japanese and the Indonesian teams.

In consideration of the gold-silver-copper-lead-zinc ore deposits anticipated to be distributed in this survey area, a chemical assay was made by selecting gold, silver, copper, lead, and zinc as path-finder elements.

CHAPTER 2 GEOLOGY

2-1 GEOLOGICAL OUTLINE

In this survey area, there are distributed massive green meta-andesite in altitudes higher than 900 m above sea level and limestone and calcareous sandstone strata above the same altitude. The first phase survey had classified the meta-andesite to Muara Botung Formation, the limestone to Bt. Tangang limestone, and the sandstone to Patahajang Formation, to thereby correlate them with SilungKang Formation of Peusangan Group according to the stratigraphy for Northern Sumatra (DMR/IGS, 1980).

In the second phase survey, there being no improvement particularly needed from the results, the limestone of the Bt. Tanjang Formation was assumed to be a member of the Patahajang Formation in the correlation of the Formation with the Muara Sipongi area B, since these Formations have intruded therein stocks of quartz diorite belonging to the Muara Sipongi granitoid rock (Fig. II-2-1, Fig. II-2-2).

2-2 GEOLOGY

2-2-1 Sedimentary Rock and Volcanic Rock

(1) Muara Botung meta-andesite Formation

Distribution:
This Formation is distributed in the region below an altitude of 900 m above sea level, mainly in the region of the A. Muara Botung, A. Simpang Mangampo, and A. Tabur.

Rock facies:
This Formation is composed of dark-green colored massive andesitic lava and accompanied by andesitic pyroclastic rock of which distribution is not extensive in this survey area. Microscopic observations (G6, H7, H15, J55) have revealed that this rock consists of phenocrysts of plagiclase, and hornblende which is embedded in a groundmass consisting of silicate minerals, plagioclase, iron minerals and a small amount of sphane. The plagioclase has been altered into sericite, and the hornblend into chlorite, epidote, and calcite.

Stratigraphic relation:
This Formation as well as the Patahajang Formation (an altered strata of andesite, mudstone, sandstone, and limestone) there is an overlying

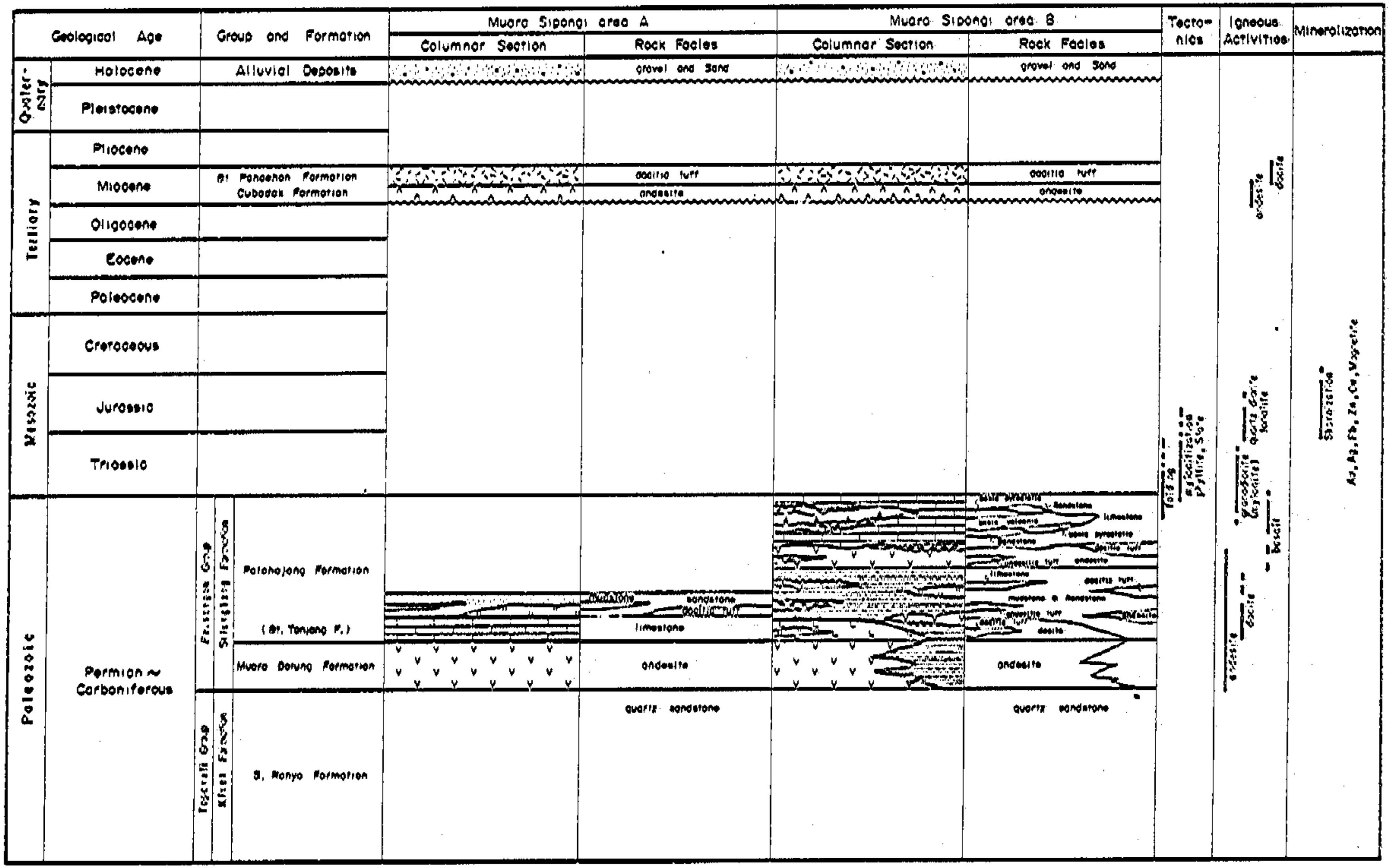


Fig. II-2-1 Generalized Stratigraphy in Muara Sipongi Area

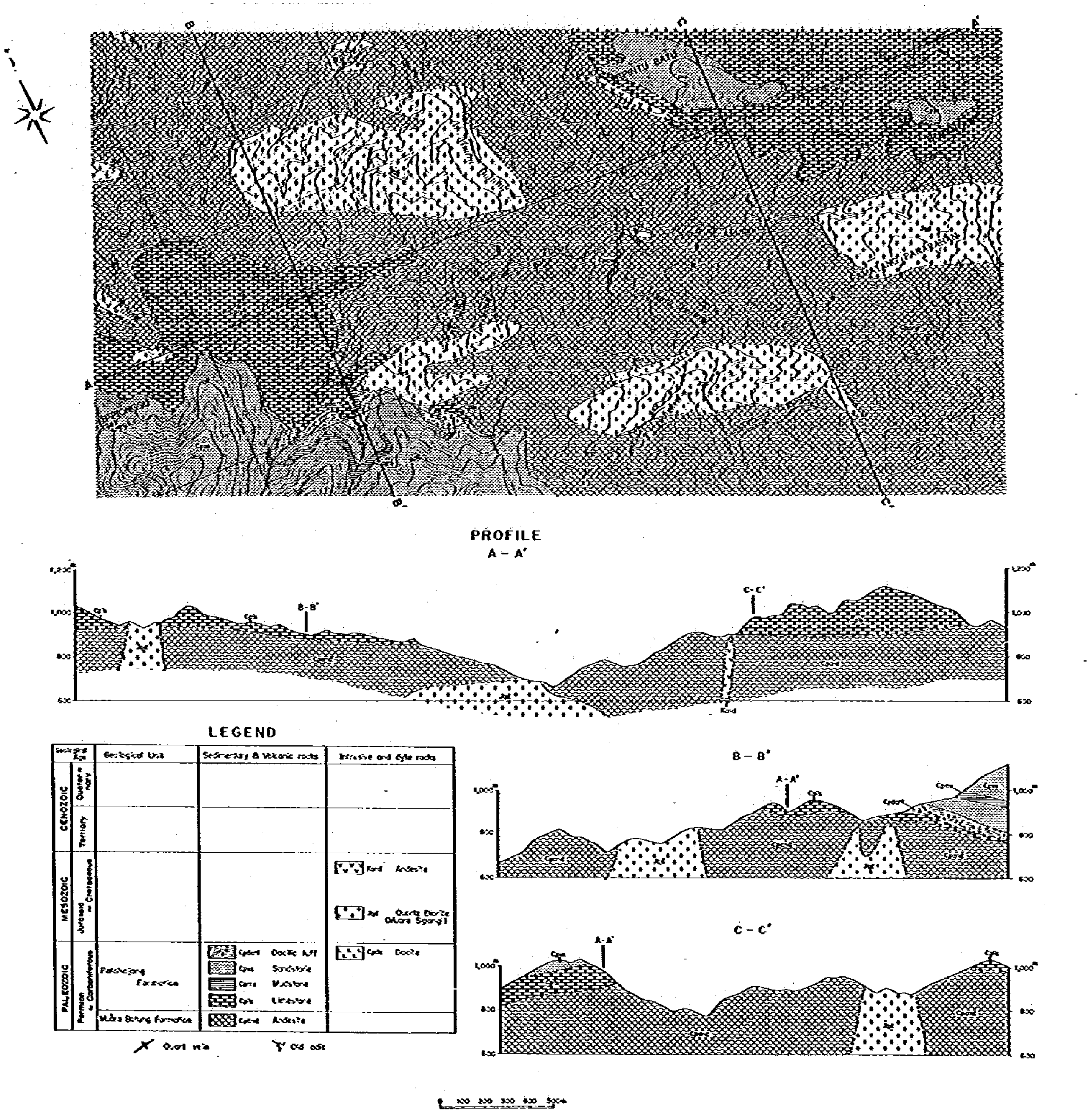


Fig. II-2-2 Geological Map and Geological Profile of Muara Sipongi Area A

correlative with the SilungKang Formation (Katili 1968, Silitonga and Kastowo 1971) of the Peusangan Group mainly composed of Permian - Carboniferous volcanic rocks (andesite, disite) and limestone.

Formation thickness: 300 m ±

(2) Bt. Tanjang limestone

Distribution:
This is distributed in regions higher than 900 to 1,000 m above sea level, such as Bt. Pionggu situated in the south-west part of the survey area and Bt. Pintu Batu and Bt. Mantawe in the north-east part.

Rock facies:
A saccharoidal crystalline limestone recrystallized in white to milk white colors.

Stratigraphy:
Without conglomerate or fault observed at the boundary, this Formation seems to be in a conforming relation with the Muara Botung Formation, though there is no direct contact in between. The limestone is massive and, though indistinct, the bedding is implied to have gentle dip by its distribution. No fossil is obtained from the limestone.

Formation thickness: Max. 200 m ±

(3) Patahajang Formation

Distribution:
This Formation is distributed in summit regions (higher than 1,000 to 1,100 m above sea level) of Bt. Pionggu, Bt. Mantawe, and Bt. Pintu Batu.

Rock facies:
This Formation consists of sandstone, with intercalated mustdone bed. At the boundary between the limestone and sandstone, dacitic tuff stratum is observed in the upper-stream area of the A. Tabur. The sandstone is of a calcareous rock (J21) composed of quartz, plagioclase, and rock fragments cemented with calcite. The dacitic tuff (J26) consists of dacite, hornfels, and puniceous fragments, quartz and plagioclase fragments in a groundmass containing quartz, plagioclase, iron minerals, and clay minerals.

Stratigraphy:
This Formation has gentle dip within 15° and conformably overlies the limestone.

Formation thickness: 300 m ±

2-2-2 Igneous Rocks and Dikes

(1) Tonalite and quartz diorite

Distribution:

In this survey area, tonalite and quartz diorite stocks are distributed at four regions in the scales from 1 km x 0.5 km as maximum to 0.6 km x 0.3 km as minimum, and their dikes have intruded into the Patahajang Formation.

Rock facies:

The rocks are of medium-grained equi-granular holocrystalline and consists of microscopically plagioclase and hornblende as rock forming minerals (H9, J47, H22), while including a small amount of quartz. Some are accompanied, though only a few, with biotite as well and some having a porphyritic texture. According to the mode analysis of typical sample (J47), the rock is plotted in the range of quartz diorite (Fig. II-2-3).

Intrusion structure:

The intrusive stocks have their forms extending in N 60° W, and are arranged to be distributed in the same direction. This direction stands alongside the general structure of this area corresponding with the intruding direction of Huara Sipongi Granitoid rock, which was made clear in the first phase survey.

Time of intrusion:

The quartz diorite collected at the A. Simpang Mangampo has been dated as 166 ±20 Ma by K-Ar method in the first phase survey, indicating it is intrusion of the Jurasic Period.

(2) Dacite

Distribution:

This is distributed in the upper-stream of the A. Muara Botung, in the form of small dikes striking N 90° W.

Rock facies:

A gray-colored aphanitic dacite composing, under microscope (R-1), a groundmass mainly consisting of silicate minerals and plagioclase, accompanied with not so many phenocrysts of plagioclase. With the plagioclase strongly altered to sericite, the dacite has undergone a strong alteration, which seems to have been caused by the thermal alteration of intrusion of the quartz diorite stocks in contact.

Time of intrusion:
The time of intrusion of dacite seems to be earlier than that of the quartz diorite because of its thermal alteration, and the dacite is assumed to be correlation with the dacitic tuff which to intercalated in the sandstone of the Patahajang Formation.

(3) Andesite

Fresh rock boulders observed in Bt. Pintu Batu, consisting of under microscope (G6), a micrographic groundmass consisting of plagioclase, hornblende, and silicate minerals, accompanied with phenocrysts of plagioclase and hornblende.

In a valley north of Bt. Ponggu, a somewhat dacitic andesite (J43) of similar lithologic character was observed, while having phenocrysts of quartz. Though the time of intrusion, is uncertain, the rock is assumed to be an intrusive dike of the Tertiary period, because of the goelogical circumstances therearound.

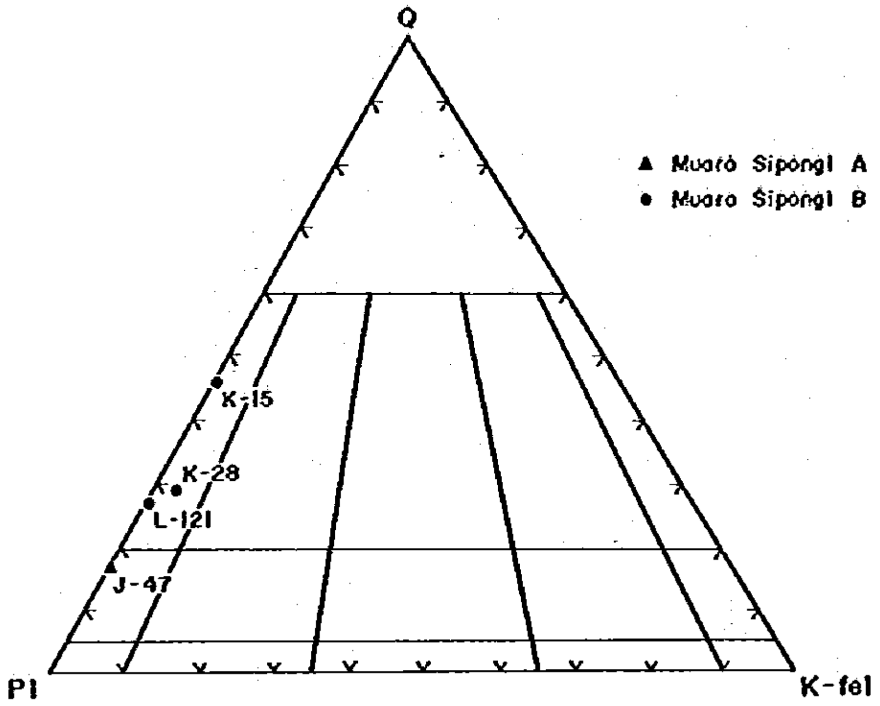


Fig. II-2-3 Model Qz-Pl-Kfel Diagram of Granitoid Rock in Muara Sipongi Area

Table II-2-1 Microscopic Observation of Thin Section, Muara Sipongi Area A

Sample No.	Rock Name	Texture	Fragment/Grain											Groundmass/Matrix											Secondary Mineral										Remarks
			q	kf	pl	bi	ho	hy	au	Fe	ca	he	Others	q	kf	pl	bi	ho	hy	au	Fe	sp	ca		q	Se	ch	ca	ep	bi	Ka	Py	m	(ho)	
Parahajang Formation																																			
J-21	Sandstone	m. gr	◎	o	o								si-r o	o							o		◎	clay o											
J-26	Dacitic tuff		o		o								cla o pu o hf o	○		o					o			maf o clay o	o	○									m ~ s, alt
C-11	Hornfels		○		○	○					o																								
Muara Botung Formation																																			
G-6	Andesite	hol			○		○							o		◎		o			o	o				o	o								w alt
K-7	Andesite	cla			○		○			o				o		○		o			o					o			o						w ~ m alt
K-15	Andesite				○		○			o				o		○		○			o				o	o			o					o	m alt
J-55	Andesite				○		○		o	o						◎	o	o			○			se o		○		o							w alt
Muara Sipongi Granitoid Rocks																																			
K-9	Quartz Diorite	m-g	o		◎		○			o																									
J-47	Quartz Diorite	f-g	o		◎	o	o			o			ap o													○	o		o		o?				w ~ m alt
K-22	Diorite Pophyry		o		◎		o			o				o		◎		○			○	o				o									w alt
Dyke																																			
K-1	Dacite	hol			o									○		○					o					○									w ~ m alt
J-43	Andesite	hol	o		○		○			o				o		◎		o			o					o		o	o						
K-30	Skarn		o								○	○	ga o sph o																						

Abbreviation

q : quartz
kf : potash feldspar
bi : biotite
ho : hornblende
hy : hypersthene
au : augite
Fe : ferric mineral
ga : galena
sph : sphalerite

ca : calcite
he : hedenbergite
sp : sphane
se : sericite
zi : zircon
ap : apatite
ch : chlorite

ep : epidote
ka : kaoline
mu : muscovite
m : montmorillonite
ap : apatite
py : pyroxene
hol : holocrystalline

cla : clastic
poik: poikilitic
an : andesite
da : dacite
pu : pumice
maf : mafic mineral
si-r: siliceous rock

alt-w,m,s: alteration weak, medium strong

◎ : Abundant ○ : Common o : Rare

CHAPTER 3 GEOLOGICAL STRUCTURE

Since the meta-andesite (Muara Botung Formation) that covers most of the survey area is massive and unstratified, the geological structure cannot be easily analyzed. However, judging from the strike and dip of the limestone and sandstone that conformably overlies the meta-andesite, it seems that the Formation has a syncline or upheaval structure along the direction by arrangement of quartz diorite stocks that are continuously distributed in the strike of N 60° W, as shown in the geological profile.

The ore veins distributed in this area show the strike and dip of N 0° W – N 45° W, 50° – 80° W or E. Based on the results of the first phase survey in which the strike and dip of fissures in meta-andesite of this area were projected onto a Schmidt net, the veins concentrate into N 30° W 50° W, N-S 80° E. These fissures appear in the distribution area of quartz diorite and they are the fissures resulting from intrusion of the quartz diorites distributed in the N 60° W direciton, and they provided places to form these ore veins. Also, it is considered that the skarn type deposit in the north of Bt. Pionggu has been receiving similar structural control since the deposit has been skarnized in metasomatism along these fissures of N 5° W strike and 50° E dip, as shown in Adit C.

CHAPTER 4 MINERALIZATION

4-1 GENERAL OUTLINE

Prospecting has been conducted much as evidenced by numerous old tunnels existing along A. Muara Botung, A. Tabur and A. Simpang Mangampo which flow through the central part of the survey area. However, many of these tunnels have collapsed and the condition of the ore deposits in the tunnels is not clear. Also, there is hardly any outcrop of deposits in places other than the neighborhood of old tunnels. Therefore, the mineralization were studied in this survey area based on the results of surveys of mine entrances and tunnels that we could enter. These tunnels are given the same alphabetical names by the first phase survey and new tunnels which were discovered during the current survey are named in continuing alphabetical sequence. Any minerized area that could be recognized as an outcrop is given an outcrop name. The following describes the mineralization state of these tunnels and outcrops (Fig. II-2-4).

4-2 MINERALIZATION

4-2-1 A. Tabur Area

(1) Adit A

Adit A is situated along A. Tabur 400 m west of K. Muara Botung. There is a silicification zone (1.00 m wide) along with the shear fissure of N 18° W strike and 80° W dip which is observable within meta-andesite of the Muara Botung Formation, and in the shear fissure some pyrite, chalcopyrite and sphalerite are recognizable. The analysis results of ores obtained from the silicification zone (15 cm wide) at the mine entrance indicate Au 35.4 g/t, Ag 19.4 g/t, Cu 0.04%, Pb 0.01% and Zn 0.03%, indicating that the deposit contains a high content of gold.

(2) Adit B

Adit B is situated along A. Tabur 100 m west of Adit A. This tunnel is drifted for 10 m in the N 30° E direction through meta-andesite, and at the end face there is a shear fissure (30 cm wide) of N 10° W strike and 70° NE dip. This fissure has been disseminated by pyrite and connects itself with the 30 cm wide fissure observed at the east outcrop of the tunnel entrance, and a part of it contains spotted massive ores consisting of pyrite and spahlerite. Pyrite has been oxidized and altered into limonite. The analysis results of ores from this part are vein width 12 cm, Au 13.9 g/t, Ag 13.9 g/t, Cu 0.38%, Pb 0.13% and Zn 15.30%.

(3) Adit C

Adit C is situated at the A. Tabur upstream 1 km from K. Muara Sipongi. The geology of this tunnel consists of limestone. This tunnel has been cut for 12 m through limestone in the N 10° E to N 0° E direction, but after that the tunnel has completely collapsed (Fig. II-2-5). There is a fissure (15 cm wide) of N 5° W strike and 50 E dip at the tunnel end, and there are skarn minerals. Under minescopic observation of these skarn minerals they contain clinopyroxene, calcite, quartz and axinite, and garnet. Because of the paragenetic relation of these minerals, minerals of early crystallization are clinopyroxene and a weak anisotropic xenomorphic garnet containing small graines of clinopyroxene. Late crystallization minerals are anisotropic idiomorphic garnet and quartz, calcite and axinite replaced clinopyroxene and garnet.

The results of analyzing clinopyroxene and garnet by EPMA are shown in Table II-2-6. As shown in it, the clinopyroxene is component of (Di $_{85.5}$, Hd $_{13.5}$ Jo $_{1}$) or (Di $_{87.7}$, Hd $_{12.2}$ Jo $_{0.1}$), indicating that it has a high ratio of dioside. The garnet of early crystallization has components such as (Gr $_{86.5}$, Ad $_{13.5}$) and (Gr $_{69}$, Ad $_{31}$), indicating that it has a rich content of grossularite. The garnet of early crystallization has high TiO content.

Fig. II-2-6 and Fig. II-2-7 show the plotted results of clynopyroxene onto the Di-Hd-Jo triangular diagram and garnet onto the Sps·Alm-Gr-Ad triangular diagram (Finaudi, 1982). The components of clinopyroxene of the Pagar Gunung East deposit in Pagar Gunung Area B are also shown in the table for reference. From these results, it is judged that the skarn of Bt. Pionggu deposit is similar in type to a deposit that commonly accompanies an iron ore deposit. The mineral ores collected at the mine entrance and in the tunnel have low grades as shown below.

	Wd cm	Au g/t	Ag g/t	Cu %	Pb %	Zn %
H-47	200	0.5	5.5	0.17	<0.01	0.01
H-48	10	0.1	4.8	0.01	<0.01	0.01
H50	boulder	2.7	2.7	0.11	<0.01	0.01

(4) Adit D

The entrance of Adit D is in the south slope of Bt. Pionggu east ridge. This is an area where Sinar Mas Co. explored from 1974 to 1975 but the entrance has already collapsed. The surrounding area consists of limestone and in the outcrop of the tunnel area a large amount of malachite is adhering to the limestone exposures. The results of checks and analysis of boulders by the first phase survey team are as follows.

Au 3.5 g/t Ag 3.3 g/t Cu 1.28% Zn 0.09% Pb 0.05%

(5) Adit E

Adit E is situated at the left bank of A. Tabur (20 m up from the river bed). Although skarnized limestones were observed at the tunnel entrance and there are boulders adhered with malachite in the entrance area, since the tunnel has completely collapsed, the deposit state in the tunnel is not clear.

(6) Adit F

The entrance of Adit F is situated at the left bank of A. Tabur upstream, and the tunnel is 60 m long running in the S 25° E direction. Geologically, the tunnel area consists of meta-andesite and white limestone, and there are dikes (N 45° E and N 60° W) of fine-grained granodiorite and aplite. Some malachite is adhering to the aplite dike, but there is no predominant mineralization in the tunnel (Fig. II-2-8).

(7) Adit G

There is a mine entrance in the west bank of a branch of A. Tabur and there is another mine entrance towards the west and facing the first entrance. According to inhabitants, the two entrances are connected but it is not clear because both entrances have collapsed. There are boulders accompanying malachite in these entrances, and analysis indicates that they have a high gold grade as follows.

	Au g/t	Ag g/t	Cu %	Pb %	Zn %
J-11	11.3	148.1	11.20	<0.01	0.04
J-13	10.5	44.6	4.68	<0.01	0.04

4-2-2 A. Simpang Hangampo Area

(1) Adit I

Adits I and J are situated along A. Simpang Hangampo 1 km east of K.

Muara Botung, and there are veinlets accompanied by pyrite of N 40° W strike and 57° Ne dip in meta-andesite.

The analyzed results are vein width 10 cm, Au less than 0.1 g/t, Ag 1.4 g/t, Cu 0.21%, Pb less than 0.01% and Zn 0.02%, thus the grades are low. Some ore boulders containing much pyrite were found in the downstream (Fig. II-2-9).

(2) Adit K

Adit K is situated along A. Benkel, a tributary of A. Simpang Mangampo. This tunnel was drifted in the S 40° W direction but it has collapsed. In the mine entrance area, there is some malachite along the joint in silicified meta-andesite. The analysis results of samples are chipped width 10 cm, Au 1.4 g/t, Ag 14.4 g/t, Cu 2.48%, Pb 0.01% and Zn 0.01%.

4-2-3 A. Lilian Area

(1) Adits L and M

Old Adits L and M are situated in the A. Lilian upstream north of Bt. Pionggu. Adit L was drifted for 4 m in the N 70° E direction but it has collapsed. The meta-andesite in the tunnel entrance has much argillized, through X-ray analysis, into montmorillonite, a small amount of chlorite or kaolinite, and laumonite. It is considered that these have undergone hydrothermal alteration. There are boulders accompanied by green copper (malachite), which are analysed to contain Au 2.7 g/t, Ag 16.4 g/t, Cu 2.56%, Pb less than 0.01% and Zn 0.05%, indicating that the gold content is slightly high.

4-2-4 Other Area

There are weak alteration zones and quartz veins in several other outcrops, as described in the following (Fig. II-2-4).

(a) A. Silelet, A. Tambang Durigan Area

There is a quartz vein in the A. Tabur upstream about 700 m east from Muara Botung, which is also upstream of A. Silelet and A. Tambang Durigan that join A. Tabur at the south. One is a quartz vein in meta-andesite of Silelet outcrop (Outcrop A) having a N 45° W strike and 90° dip, but the grades are low (vein width 25 cm, Au 0.1 g/t, Ag 2.1 g/t, Cu 0.09%, Pb 0.11% and Zn 0.04%). A microscopic observation (M-16) indicates that