

**REPORT  
ON  
THE MINERAL EXPLORATION :  
SUPRA-REGIONAL SURVEY  
IN  
CENTRAL SABAH, MALAYSIA**

**(PHASE I)**

**(Data Compilation)**

**FEBRUARY, 1991**

**JAPAN INTERNATIONAL COOPERATION AGENCY  
METAL MINING AGENCY OF JAPAN**

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METAL MINING AGENCY OF JAPAN**

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## PREFACE

The Government of Japan, in response to the request of the Government of Malaysia, has decided to conduct a mineral exploration programme in the State of Sabah, Malaysia and has entrusted the survey work to the Japan International Cooperation Agency. The Agency, considering the importance of technical nature of the survey work, in turn, has sought the cooperation of the Metal Mining Agency of Japan to accomplish the work.

The survey work in the survey area will be carried out within a period of four years commencing from 1990.

Metal Mining Agency of Japan dispatched the survey mission consisting of five members to the Sabah from October, 1990 to March, 1991 as a part of the survey work in the first fiscal year.

The survey work in Sabah was carried out successfully with cooperation of the Malaysian Government authorities, the Geological Survey Department (Geological Survey of Malaysia), Ministry of Primary Industries.

This report summarizes the results of the analysis of the existing data among the survey work carried out in the first fiscal year and also forms a part of the final consolidated report which will be submitted to the Government of Malaysia after completion of the survey work.

We wish to take this opportunity to express our heartfelt gratitude to the officials of the Government of Malaysia, Ministries of Foreign Affairs and International Trade and Industry of Japan, the Embassy of Japan in Malaysia, the Consulate of Japan in Kota Kinabalu, Sabah, and the authorities concerned.

February, 1991



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Kensuke Yanagiya

President

Japan International Cooperation Agency



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Genichi Fukuhara

President

Metal Mining Agency of Japan

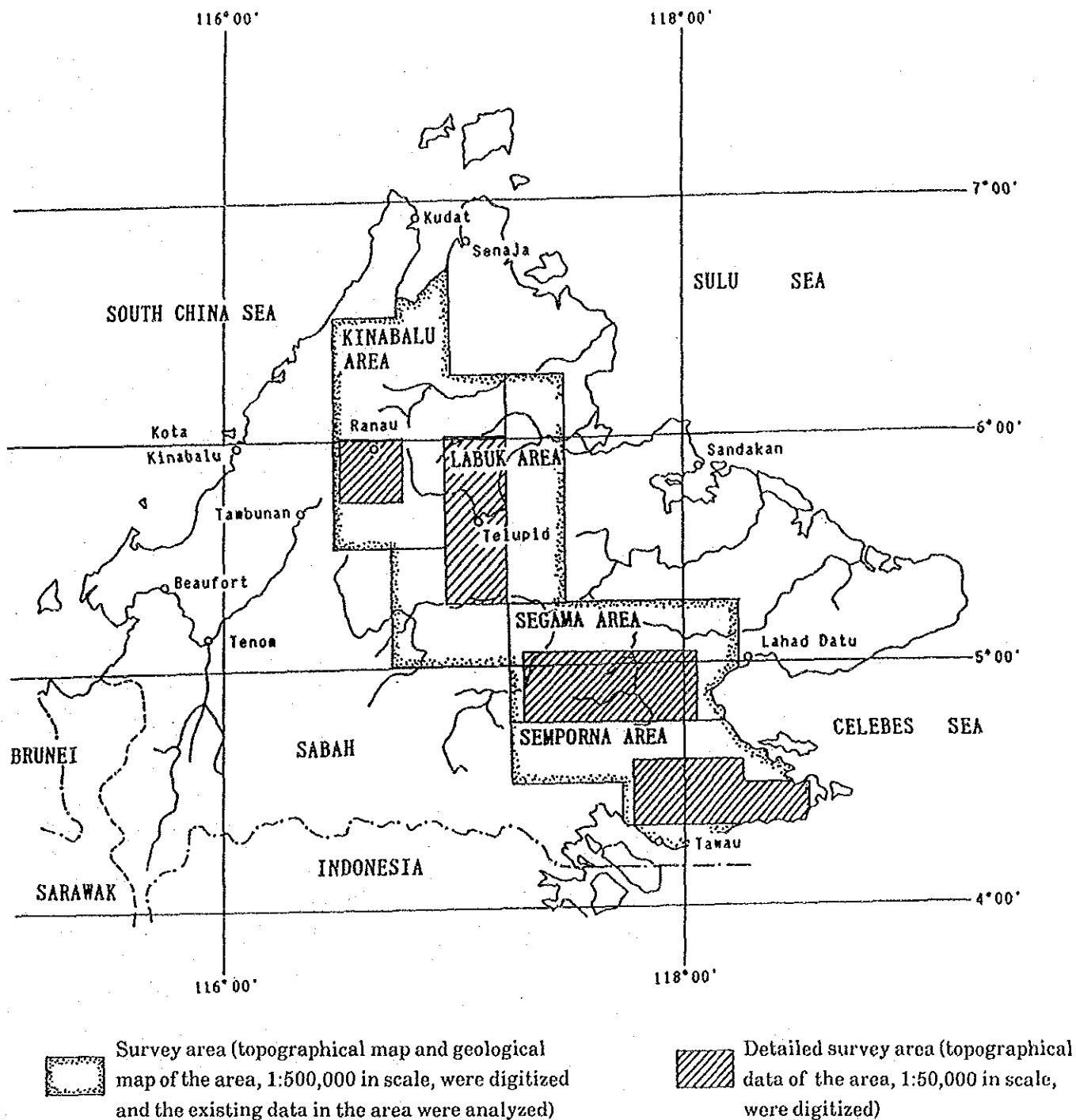


Figure 1 Location Map of the Survey Area





## ABSTRACT

The Japanese Government have decided to conduct a mineral exploration programme which will be carried out within a period of four years commencing from 1990, in the State of Sabah, Malaysia, in response to the request of the Government of Malaysia.

The collection, compilation and analysis of the existing data on geological survey, investigation of mineral occurrence or mineral deposit and prospecting which have been carried out in the survey area up to date as well as digitizing of the topographical and geological maps of the survey area in the scale of 1 to 500,000 and topographical data of the detailed survey area in the scale of 1 to 50,000 were carried out from October, 1990 to February, 1991 as a part of the survey work in the first fiscal year.

The work for collection, compilation and analysis of the existing data was carried out at the Sabah office of Geological Survey of Malaysia in Kota Kinabalu, Sabah, from October 7, 1990 to December 5, 1990 by one Japanese geologist.

The existing data collected, together with the data collected in Japan, were divided into nine groups in accordance with the source of the data and the nine lists of the existing data divided according to the source of the data were made respectively.

Subsequently, all the existing data collected were classified into three categories, namely, (A) general geology, (B) mineral resources, mineral occurrence and mineral deposit and (C) prospecting or exploration, in accordance with the contents of the data and three lists of the existing data of each category were made respectively.

List of known mineral deposits and mineral occurrences and List of prospecting results of mineral deposits and mineral occurrences were made from the existing data belonging to the categories (B) and (C) mentioned above. In addition, the mineral occurrences and mineral deposits which were discovered after 1976 were plotted on the mineral distribution map of Sabah in the scale of one to 500,000 made by Geological Survey of Malaysia as of 1976.

Digitizing of the topographical data and geological data was carried out as follows in Japan.

- (1) The topographical map of the survey area (about 26,500 square kilometers) with every 500 feet contour line in the scale of 1 to 500,000 was digitized.
- (2) The geological map of the survey area in the scale of 1 to 500,000 was digitized.
- (3) The main topographical data (1:50,000 in scale) of the detailed survey area (approximately 8,000 square kilometers) in the survey area were digitized by means of 500 meters mesh.
- (4) The main topographical data (1:50,000 in scale) of the specified area (2,250 square kilometers) in the detailed survey area were digitized by means of 50 meters mesh.
- (5) The superimposed bird's-eye view synthesized by the topographical data digitized in the above (1) and geological data digitized in the above (2) was made.
- (6) The superimposed bird's-eye view synthesized by the topographical data digitized in the above (4) and Landsat image data digitized was drawn.

As the result of the investigation of the existing data collected, it seems that the base metal deposit with high possibility of its existence in Sabah is, firstly, Cyprus type cupriferous massive sulfide deposit similar to the West-Sualog deposit, which was discovered by drilling in 1982 and is associated with ophiolitic rocks belonging to the Chert-Spilitic Formation of the Cretaceous to Eocene age in the Bidu Bidu Hills area, and, secondarily, is the porphyry copper type deposit, which might be emplaced underground together with the related acidic to intermediate intrusive rock, in the G. Pock area and the Bukit Mantri-G. Wullersdorf area, Semporna Peninsula.

Although many prospectings have been conducted in the survey area up to date and have resulted in discovery of many encouraging prospects, it is difficult to evaluate all the survey area synthetically because method and precision of prospecting are various.

Consequently it is recommended, firstly, that geochemical prospecting based on the same standard should be conducted in the survey area in order to evaluate all the area synthetically. It is desirable to carry out simultaneous geological survey with geochemical prospecting to analyze the result of geochemical prospecting effectively.

As the next step, detailed prospecting in the encouraging prospect found by geochemical prospecting is desirable. We would guess that the are, in which Chert-

Spilite Formation accompanied by ophiolite is distributed, and Gunung Poek and Bukit Mantri-Gunung Wullersdorf areas are promising at present.



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## **Part I The General**



## **PART I THE GENERAL**

### **CHAPTER 1 INTRODUCTION**

#### **1-1 Objective of the Survey**

The main objective of the survey in the first fiscal year-1990 is to collect, compile and analyze the existing data on geological survey, investigation of mineral occurrence or mineral deposit and prospecting, which have been carried out in the survey area up to date, in order to grasp occurrence of the mineral deposit in Sabah and to digitize the topographical data in the scale of 1 to 500,000 and 1 to 50,000 and geological data in the scale of 1 to 500,000 in the survey area for the purpose of providing effective data for the succeeding surveys.

#### **1-2 Contents of the Survey**

##### **1-2-1 Collection, Compilation and Analysis of the Existing Data**

The work for collection, compilation and analysis of the existing data was carried out at the Sabah office of Geological Survey of Malaysia in Kota Kinabalu, Sabah, during 60 days from October 7, 1990 to December 5, 1990.

The various kinds of the literatures, in which the results of the geological surveys, investigations of the mineral occurrences or mineral deposits and prospecting carried out in the survey area are reported such as the published reports, memoirs, bulletins and so on as well as the unpublished reports, theses and so on, were collected in the library of the Sabah office of Geological Survey of Malaysia for the collection, compilation and analysis of the existing data.

In addition, the literatures on geology and tectonics of Sabah which was collected mainly at Geological survey of Japan were added to the existing data collected in Sabah for the supplement of compilation of the existing data.

The existing data collected, together with the data collected in Japan, were divided into nine groups in accordance with the source of the data. The nine lists (Table 3 to Table 11) of the existing data classified according to the source of the data were made respectively.

Subsequently, all the existing data collected were classified into the three categories, namely (A) General geology, (B) Mineral resources, mineral occurrence and mineral deposit and (C) Prospecting or exploration, in accordance with the contents of the data and three lists (Table 12 to Table 14) of the existing data classified into the aforementioned three categories were made respectively.

List of known mineral deposits and mineral occurrences (Table 15) and List of prospecting results of mineral deposits and mineral occurrences (Table 16) were made from the existing data belonging to the categories (B) and (C) mentioned above.

In addition, the positions, together with metal components and prospect names, of the mineral occurrences and mineral deposits which were discovered after 1976 were plotted on the mineral distribution map of Sabah in the scale of one to 500,000 made by geological Survey of Malaysia as of 1976.

#### 1-2-2 Digitizing of the Topographical and Geological Data

Digitizing of the topographical and geological data was carried out as follows in Japan.

- (1) The topographical map of the survey area (about 26,500 square kilometers) with every 500 feet contour line in the scale of 1 to 500,000 was digitized.
- (2) The geological map of the survey area in the scale of 1 to 500,000 was digitized.
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- (6) The superimposed bird's-eye view synthesized by the topographical data digitized in the above (4) and Landsat image data digitized was drawn.

### 1-3 Members of the Survey Mission

Participants in planning and negotiation and survey members for the first fiscal year are as follows.

#### 1-3-1 Participants in Planning and Negotiation

##### (1) Malaysian members

Yin Ee Heng	Geological Survey of Malaysia , Kuala Lumpur
Fateh Chand	" , "
Wong Yew Choong	" , Ipoh
Shu Yeoh Koon	" , Kuala Lumpur
Lim Peng Siong	" , Sabah
Wan Mazlan	Ministry of Primary Industries , Kuala Lumpur
Mohd Irwan Serigar	Economic Planning Unit , "

##### (2) Japanese members

Takashi Isobe	Ministry of International Trade and Industry
Yukitoshi Kawasaki	"
Ritsuo Kita	Ministry of Foreign Affairs
Hajime Ikeda	Japan International Cooperation Agency
Nobuyuki Okamoto	"
Kyoichi Koyama	Metal Mining Agency of Japan
Nobuyuki Masuda	"
Yuji Kajitani	"
Toru Nawata	"
Hiroshi Shimotori	"
Kenzo Masuta	"

#### 1-3-2 Survey Members

##### (1) Malaysian member

Lim Peng Siong	Project manager, Geological Survey of Malaysia
----------------	--

##### (2) Japanese member

Shuro Matsushashi	Overseas Mineral Resources Development (OMRD)
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1-4 Schedule of the Survey in Malaysia

The survey work in Malaysia was carried out as follow.

Table 1 Brief Schedule of the Survey Work in Malaysia

	1990		
	October	November	December
Travelling	3 6 └─┘		
Data collection, compilation and analysis in Sabah	7 └─┘		5 └─┘
Travelling			6 9 └─┘

## CHAPTER 2 GEOGRAPHY AND EXISTING INFORMATION OF THE SURVEY AREA

### 2-1 Topography and Climate of Sabah

#### 2-1-1 Topography

Sabah can be divided into 4 main physiographic regions, namely the Western Lowlands, the Western Cordillera, the Central Uplands and the Eastern Lowlands (Collenette, 1963). The Western Lowlands include the foothills, plains and islands to the west of the Crocker Range. The Western Cordillera comprises a belt of mountainous country about 80 km (50 mi) in width parallel to the west coast. It includes the Crocker, Trusmadi, Witti and Maligan Ranges and associated intermontane plains and valleys. The Crocker Range is one of the main geographical features of the country and it culminates in Gunong Kinabalu, which at 4,101 m (13,455 ft) is the highest mountain in south-east Asia. The Central Uplands comprise extensive tracts of mountainous country to the east of the Western Cordillera, including the Labuk, Kuamut, Segama and Tawau Highlands. The Eastern Lowlands stretch from the Bengkoka Peninsula in the north to the Semporna Peninsula in the south and include extensive tracts of moderate to low hills, the broad valleys of the Sugut, Labuk, Kinabatangan and Segama rivers and extensive deltas.





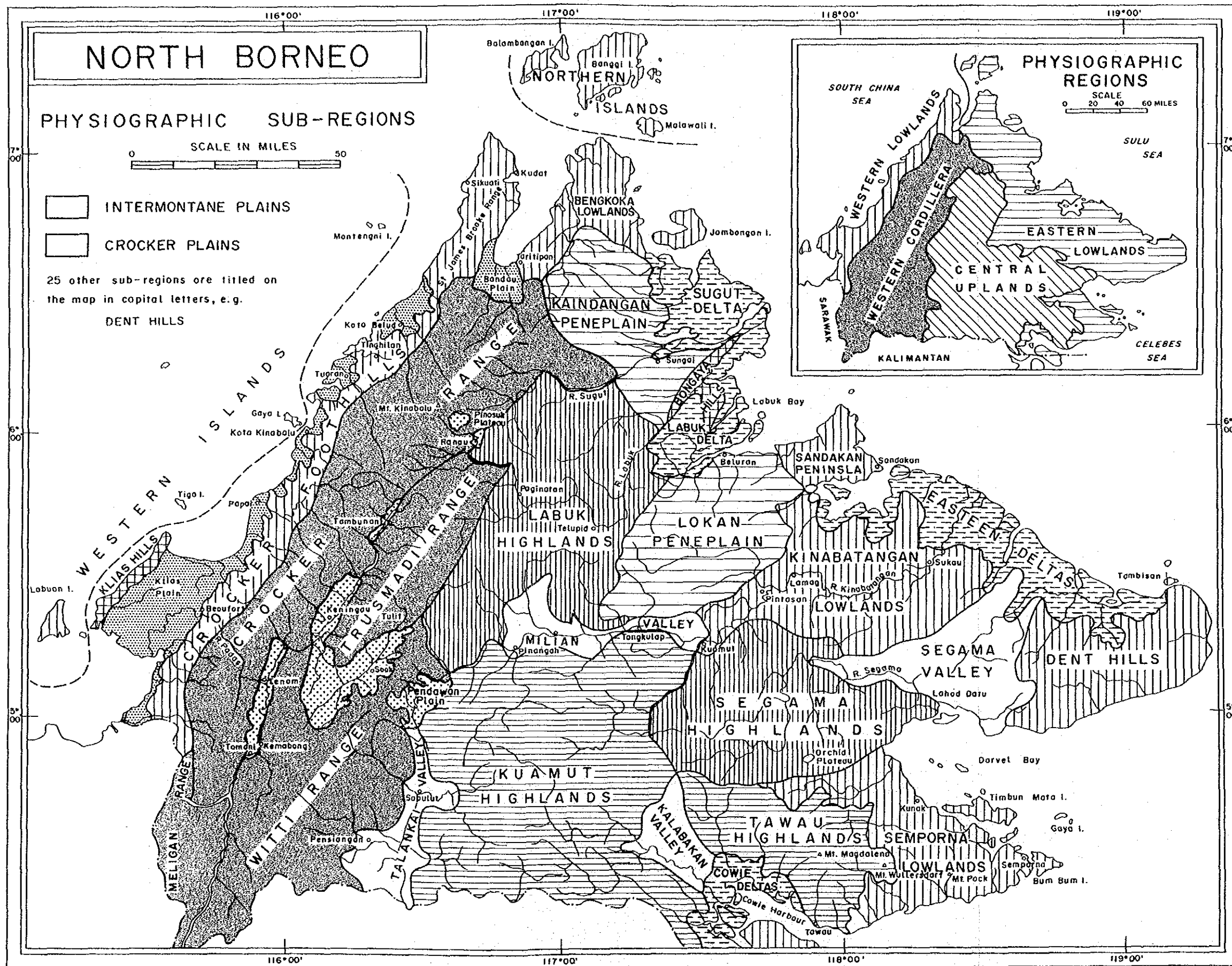


Figure 2 Physiographic Sub-regions of Sabah (After Collett P., 1962)



## 2-1-2 Climate

The climate is hot and humid throughout the year and although Sabah lies outside the typhoon belt the coastal areas are occasionally affected by severe tropical storms. The average annual rainfall ranges from about 1,780 mm (70 in) to about 3,800 mm (150 in). The highest rainfall is in the south-west (Beaufort and Labuan) and the lowest is in the interior (Tenom, Keningau and Tambunan) and at Tawau on the south-east coast. The contrasts in regional rainfall reflect the occurrence of 2 main seasons; the north-east monsoon begins in November and lasts until March and it is during this season that the north-east coast experiences its heaviest rainfall; the south-west monsoon prevails from May until September. The temperature varies little with the season and averages about 27°C (80°F) near sea level. Surface temperatures inland fall at a rate of about 1.5°C (3°F) for every 300 m (100 ft) increase in altitude so that above about 1,200 m (4,000 ft) there is a change from Tropical Rainy Climate to Warm Temperate Rainy Climate (Trewartha, 1954); the latter affects much of the Crocker and Trusmadi Ranges above 1,200 m (4,000 ft). Climatic data are very limited, but records of a reasonable length are available for Labuan, Kota Kinabulu, Kudat, Beaufort, Tenom, Sandakan, Tawau and Tambunan.

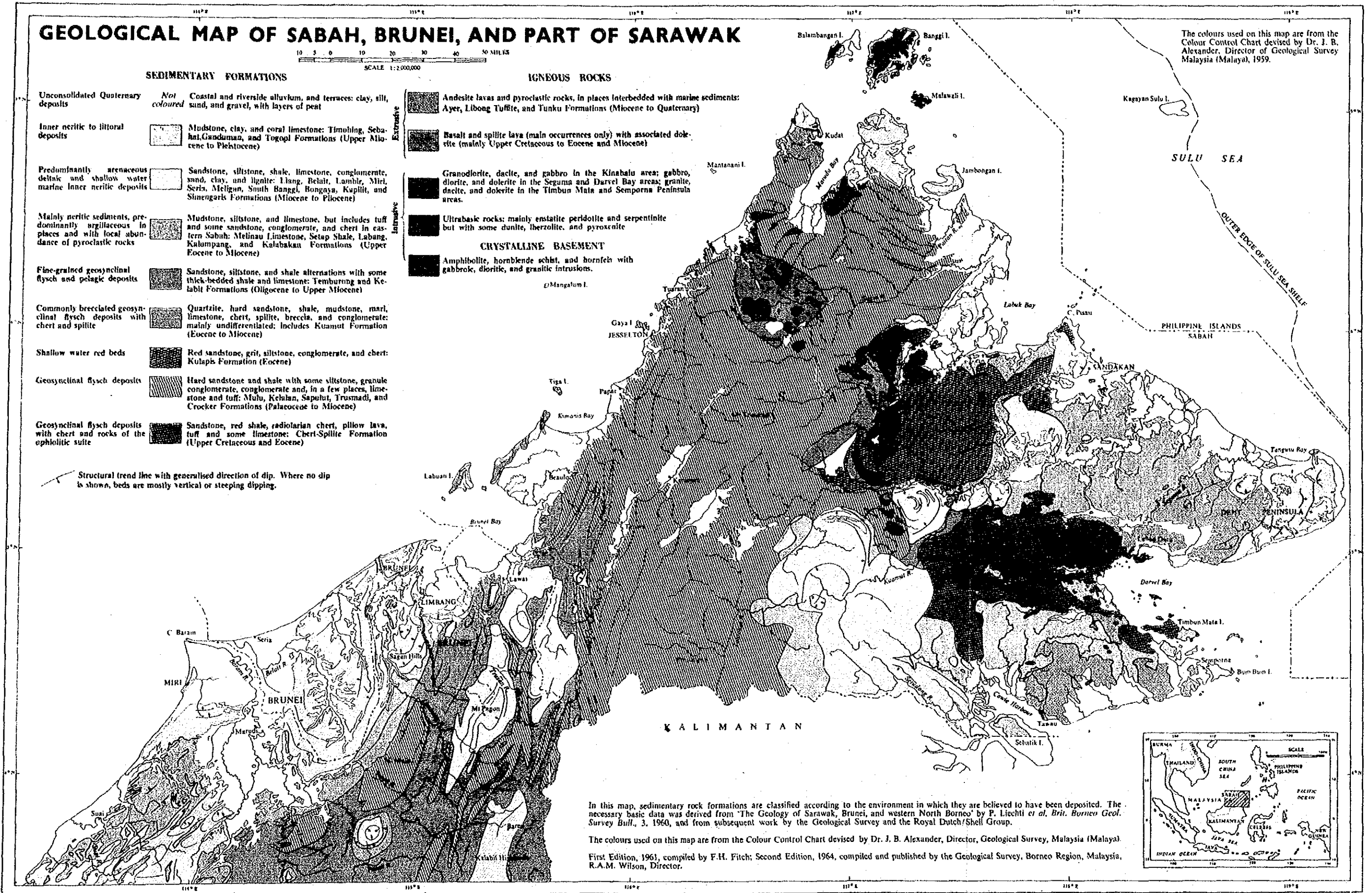
## 2-2 Geology of Sabah

### 2-2-1 Introduction

Sabah, situated in the northern part of Borneo, has a complex geological history. Several regional tectonic trends converge in this region. The northeast trend of the Palawan-Balabac Island arc stops at the northern islands of Banggi and Balambangan. The northeast trending crescent of the "Northwest Borneo Geosyncline" appears to bend to southeast at Gunung Kinabalu. The Sulu Archipelago volcanic trend links to the Semporna Peninsula in southeastern Sabah. The oldest rocks which form the so-called Crystalline Basement occur in the east coast. Basic and ultrabasic rocks and associated chert, spilite, gabbro of the ophiolite suite, occur along an arc stretching from Darvel Bay on the east coast through the upper Sungai Segama valley to the upper Labuk valley, Gunung Kinabalu and swinging northeast to Marudu Bay and to the northern islands. Acid to basic igneous rocks, the products of at least three periods of igneous activities, are exposed in the Semporna Peninsula, and the upper Segama and Gunung Kinabalu area.



FIGURE 3





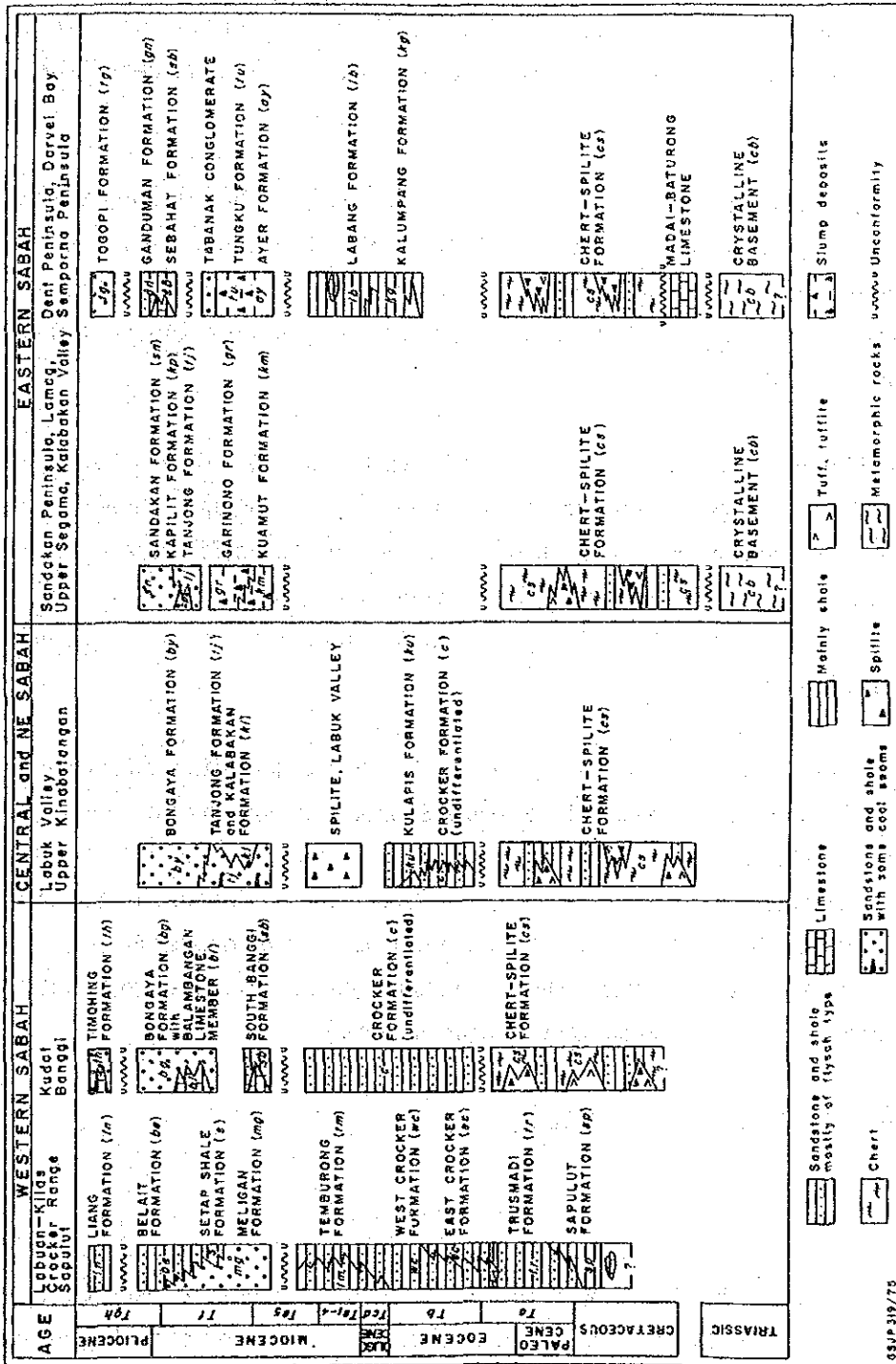


Figure 4 Stratigraphy of Sabah

(Taken from "Regional Geology of Sabah" in "Annual Report of Geological Survey of Malaysia, 1988")

## 2-2-2 Summary of Sedimentary Basins and Tectonics

Pre-Cretaceous sedimentation history that culminated in the formation of the Crystalline Basement is little known. Some pelitic and calcareous sediments intercalated with volcanic rocks were probably deposited under a volcanic island arc environment.

During Early Cretaceous time, limestone was deposited in several localities on an emerging basement in eastern Sabah. By Late Cretaceous time, thick clastic and calcareous sediments, chert, limestone and volcanic rocks were deposited over a large part of eastern, central, and southwest Sabah and part of northern Sabah. Deposition was continuous up to Eocene time.

There is no evidence of Cretaceous deposition in western and southwest Sabah but by early Tertiary, an elongated northeast trending marine trough already existed extending from the Kalimantan border into western and northern Sabah, and deposition of thick sequences of sandstone and mudstone occurred uninterrupted into the Upper Miocene when it was terminated by folding and uplift, accompanied by the intrusion of the Kinabalu Batholith.

During this major Late Miocene tectonic event, slump deposits and pyroclastics accumulated in several deep basins in eastern Sabah, followed by the deposition of sandstone and mudstone with minor amounts of limestone and coal in a chain of circular to sub-circular shallow basins. Rapid uplift in Late Miocene time resulted in the formation of conglomerate at Lahad Datu and cessation of deposition in the area, except in the easternmost part—the Dent Peninsula—where Pliocene sediments were deposited in coastal swamps and shallow-marine waters.

## 2-2-3 General Geology and Stratigraphy

### (1) Triassic

The oldest rocks in Sabah are the metamorphic rocks of the Crystalline Basement found in eastern Sabah. These rocks occur in the upper Segama valley over an area of about 500 km<sup>2</sup>. Small outcrops occur also in the Labuk valley, Gunung Kinabalu area, and in Taritipan and the northern islands. In the Segama area, the rocks have a strong prominent east-west foliation trend. The metamorphic rocks are mainly amphibolites, gneisses, skarns, quartzites, meta-



tuffaceous and meta-volcanic rocks, as well as meta-gabbro and meta-dolerite. They have been subjected to at least two periods of folding and deformation. Large bodies of granite, granodiorite, tonalite, ultramafic and mafic rocks intruded the metamorphic rocks. The ultramafic bodies are distinctly elongated and commonly aligned east-west along the general metamorphic foliation trend.

There are diverse opinions regarding the origin of the Crystalline Basement. The more recent opinion was advanced by Hutchison (1975) who considered that the basement represents oceanic crust that had been thrust over older continental rocks which are not exposed. Coleman (1977) suggested that the metamorphic rocks as well as the ultrabasics represent a metamorphic belt formed under an old island arc, and later exposed by obduction.

Radiometric dates of metamorphic and igneous rocks indicate that the formation of these rocks could be as early as Early Triassic time (210+3 Ma).

## (2) Cretaceous-Eocene

Cretaceous to Eocene rocks are quite widespread in eastern and south-central Sabah, and large outcrops occur in the Segama valley, bordering the Crystalline Basement, and in the Pensiangan-Pinangah area. Smaller outcrops are also found in the Labuk valley, near Gunung Kinabalu, at Taritipan and in the northern islands. The Cretaceous-Eocene rocks are represented by two formations, the Chert-Spilite and the Sapulut Formations. The Chert-Spilite Formation is characterised by limestone, radiolarian chert, sandstone, conglomerate, spilite, volcanic breccia, agglomerate, pillow basalt and associated dolerite and keratophyre. The varied rock types suggest a complex environment of deposition, perhaps in several unstable troughs, in a block-faulted emerging basement. The recrystallised limestone at Baturong and Madai contains both shallow- and deep-water type foraminifers and algae. Shallow-water gastropods are also found in abundance. The radiolarian cherts generally suggest a deeper marine environment. The Sapulut Formation consists mainly of argillaceous strata and minor amounts of argillaceous limestone, conglomerate, chert, and sandstone.

The rock assemblage of the Chert-Spilite Formation with ultramafic and mafic rocks has been considered to be part of an ophiolite sequence, whereas the

Sapulut Formation is believed to have been deposited in the centre of a marine trough.

In the past, there has been some confusion regarding the age of the Chert-Spilitic Formation. The age was resolved through the finding of Cretaceous foraminifera in the limestone and the finding of Upper Cretaceous foraminifera in the argillaceous sequence in the Agob-Dabalan area. The Sapulut Formation contains abundant calcareous benthic pelagic foraminifera of Late Cretaceous to late Eocene age. Other fossils include arenaceous foraminifera, algae, ostracods, bryozoa and some molluscs.

### (3) Eocene-Oligocene

Rocks of Eocene to Oligocene ages occupy the whole of western and northern Sabah and consist of great thicknesses of flysch-type sequence of interbedded sandstone, siltstone, mudstone and shale, and rare limestone (Crocker Formation), and slate, phyllite, quartzite, limestone, chert and tuff (Trusmadi Formation). Individual bed ranges from a few cm to 10 m with rare beds up to 50 m thick. The sandstone (of the Crocker Formation) is grey and consists of poorly-sorted, angular to subangular quartz, lithic fragments, feldspar and mica. Primary structures such as graded bedding, cross bedding, ripple marks, and sole markings are common, indicating that the rocks were partly deposited by turbidity currents. Some of the thicker beds may have been deposited by mass-movement mechanisms.

The Eocene rocks are well exposed along the shore of the west coast, and along the numerous rivers which cut across the strike of the strata. Fossils are few; some shale samples contain arenaceous foraminifera including species of *Ammodiscus*, *Bathysiphon*, *Haplophragmoides*, *Trochammina*, and *Cyclamina* of Eocene to Early Miocene age. One limestone sample contains a good fossil assemblage indicating an age of Middle Eocene.

The Eocene rocks in parts of central Sabah consist of reddish and purplish sandstone, siltstone, and shale (Kulapis Formation). Eocene age of these rocks has been established by their association with Eocene rocks to the west.

Rocks of Oligocene to Early Miocene ages are of limited extent and are found only in southwest Sabah at the border with Sarawak. There, Oligocene strata are

mainly shale and mudstone (Temburong Formation) and contain abundant arenaceous foraminifera.

#### (4) Miocene-Pliocene

Rocks of Miocene-Pliocene age occur mainly in eastern Sabah, but are also found in the north and southwest.

##### A. Eastern Sabah

In eastern Sabah, the Early Miocene deposits consist mainly of argillaceous materials, pyroclastics and slump breccias reflecting unstable conditions of deposition. The argillaceous marine sediments occur in the southeast in the Kalabakan valley (Kalabakan Formation), and mudstone, shale, tuff and tuffite (Kalumpang Formation) in the Binuang area and Kalumpang valley. The slump deposits referred to by Hamilton (1979) as a melange or broken formations occur in the Sandakan Peninsula (Garinono Formation), Dent Peninsula (Labang and Ayer Formations), and in the upper Kinabatangan area (Kuamut Formation). Large blocks of older rocks such as chert, limestone, gabbro, sandstone, and serpentinite are included in a massive grey mud matrix of the slump deposits. Well-bedded sequences of tuff, tuffite, and tuffaceous sediments also occur. Fossil assemblages in the bedded sequence indicate that deposition took place in deep marine conditions. Foraminifera of Late Miocene age have been found in the argillaceous beds.

The Early Miocene age of these slump deposits is indicated by foraminiferal fauna.

Late Miocene rocks consist of well-bedded sequences of sandstone and mudstone along the Kalabakan-Kuamut-Kinabatangan valleys (Tajung and Sandakan Formations). These sandstone-mudstone sequences form prominent basin structures. The depositional environments are shallow marine, lagoonal and deltaic to littoral. The argillaceous beds are rich in foraminifera as well as molluscs and plant fragments. Thin coal beds are also present.

Miocene to Pliocene deposits (Dent Group) are represented by a shallow marine sequence of predominantly sedimentary rocks with minor limestone

beds. Outcrops are found mainly in the eastern part of the Dent Peninsula. This group of rocks range in age from Late Miocene to Pliocene and are rich in foraminiferal fauna. The upper part of the sequence is believed to be of Pliocene-Pleistocene age as indicated by molluscan and foraminiferal fauna.

#### B. Northern Sabah

Miocene strata also occupy the Kudat and Bengkoka peninsulas, Banggi island as well as on the coastal part of the Sungut peninsula. The lower sequence comprises thick massive sandstone, siltstone and minor shale, limestone and calcarenite. The argillaceous beds as well as the limestone and calcarenite contain rich Miocene foraminiferal fauna, including a large percentage of reworked Eocene fauna.

The upper sequence consists of thick-bedded, light-blue, quartzose sandstone and shale (Bongaya and Kudat Formations). The argillaceous beds contain foraminiferal fauna of late Tf (Late Miocene) age.

#### C. Southwest Sabah

In the southwest, adjacent to Sarawak, the Miocene rocks (Meligan Formation) are very similar to the Miocene rocks of the Kudat peninsula in that the sandstone is quartzose, light-blue in colour, and massive with minor shale beds and limestone.

### (5) Pliocene and Quaternary

By Pliocene time, the greater part of Sabah was fully uplifted and volcanism was active in the east coast. Sedimentation was confined to the coastal areas. In the Dent and Semporna peninsulas, sediments comprising mainly limestone, calcareous sandstone, clay and lignite accumulated.

The sediments contain rich Pliocene-Pleistocene foraminiferal and molluscan fauna as well as echinoids. In the southwest in the Sipitang and the Klias peninsulas, Pliocene deposits (Liang Formation) consists of clay, sand, lignitic clay and conglomerate, resting unconformably on older formations.

Quaternary deposits, consisting of coarse gravel, sand, silt, clay, peat and coral accumulated along the coasts and are now found in raised terraces and in inland plains in Tenom, Klias, Padas valley, and the Sook-Keningau plains.

#### 2-2-4 Metamorphism

The most intensely metamorphosed rocks are those of the Crystalline Basement. They have been regionally metamorphosed to the grades of the greenschist and the amphibolite facies. Thermal metamorphism also took place around major granite intrusions in the basement, for example, at Litok Klikog and Babais where hornfelses were developed in contact aureoles.

Potassium-Argon dating of the metamorphic rocks gave ages from 210±3 Ma (Early Triassic) to as young as 87±2.5 Ma (Late Cretaceous). They show that the earliest metamorphism took place in Early Triassic and that subsequently the rocks had been partially affected by thermal metamorphism.

Metamorphism has also affected a thick sequence of Palaeocene-Eocene sedimentary strata of the Trusmadi Formation in western Sabah. The metamorphic rocks consist of slates, phyllites, and quartzites. Slaty cleavages and quartz veining are developed in these rocks. The low-grade metamorphism is probably a regional phenomenon due to deep burial.

Hornfelses were developed around the Kinabalu batholith which was intruded into the thick sedimentary cover in Miocene time.

#### 2-2-5 Structure

The major structural feature of Sabah is the large bend, around Gunung Kinabalu, of the prominent northeasterly trend in western Sabah to a southeasterly direction in central and eastern Sabah. Two sets of major faults are apparent - a north - northeast set and a northwest to north-northwest set (Wilford, 1967; Tokuyama & Yoshida, 1974; Lee, 1980). In western Sabah, the north-northeast set is generally parallel or oblique to the main strike of the sedimentary strata, whereas the northwest to north-northwest set cuts across the strata. In southern Sabah both sets of faults occur.

A large strike-slip fault, the "Kinabalu fault", cuts across Sabah from the northwest coast through Gunung Kinabalu and the Labuk valley to the southeast coast between Cowie Harbour and Darvel Bay (Tokuyama & Yoshida, 1974). This fault belongs to the northwest set and is probably the older of the two sets as its topographic expression is generally obscured.

In the Crystalline Basement, major east-west trending faults are evident. These faults are parallel or sub-parallel to the main schistosity that developed in the Crystalline Basement rocks, and are probably developed in Miocene time when major uplifts of the Segama valley area took place.

The sedimentary strata in the western part of Sabah folded during Late Miocene with varying degrees of intensity, from concentric folds in the thick, interbedded sandstone and shale to isoclinal folds in the thinner strata. Minor folds are quite prevalent but major folds are not observed. In the coastal area the fold axes generally trend northeast, but in the Trusmadi area the fold axes trend northwest. In the Kudat Peninsula, minor fold axes generally trend southeast. In the Dent Peninsula, the Miocene and Pliocene strata are folded on an east-west axis whereas in the Semporna Peninsula and Kalabakan area, the strata are folded on a southeast trend.

#### 2-2-6 Igneous Activities

The igneous rocks of Sabah are varied in composition and origin. At least 3 main periods of igneous activity can be identified. The earliest period gave rise to the tonalite, granodiorite, trondhjemite and granite intrusions which are associated with the pre-Triassic basement rocks. The second period is represented by the basic-ultrabasic rocks, spilite and basalt association and related to the Upper Cretaceous Chert-Spilite Formation. The third period occurred in Late Miocene to Quaternary times and is represented by post-orogenic intrusives and extrusives which occur at Gunung Kinabalu and in the Semporna Peninsula.

In the Darvel Bay-upper Sungai Segama area, granodiorite, trondhjemite, granite and tonalite were emplaced in Early Triassic time followed by late-stage pegmatite and aplite intrusions. Some foliated meta-gabbro, dolerite and ultramafic rocks were probably emplaced before the Early Triassic metamorphic event.

The ophiolite suite, consisting of serpentinite, harzburgite, pyroxenite, gabbro and dunite with associated chert and spilite occurring both in the Darvel Bay-Upper Segama area as well as in the Labuk valley-Gunung Kinabalu area and the northern islands, probably represents a complex or multiple tectonic episode rather than a simple arcuate ophiolite belt. The suite in the Darvel Bay-upper Segama area is associated with the metamorphic basement and is therefore at least Triassic in age, whereas those in the Labuk valley and Gunung Kinabalu area are associated with Late Cretaceous to Miocene events and their emplacement ages may be Eocene or Miocene.

From the Late Miocene to Quaternary time, extensive volcanism and associated shallow intrusions along the Semporna Peninsula and a batholith-size granitic intrusion at Gunung Kinabalu occurred. The post-tectonic volcanic rocks that erupted in the Semporna Peninsula are typical of the calc-alkaline Pacific island arc type, being rich in soda-lime feldspar and generally low in potash. The early eruptions are mainly andesite, dacite and basalt. Several volcanic cones are still recognizable, and hot springs - remnants of volcanism, occur at several places in the peninsula.

The large granite batholith and several minor apophyses at Gunung Kinabalu intruded into thick flysch sediments during Late Miocene time. The intrusive rocks are markedly high in potash compared with the volcanic rocks of equivalent composition in the Semporna Peninsula. (Modified from "Regional Geology of Sabah" in "Annual Report of Geological Survey of Malaysia, 1988")

### 2-3 Mineral Deposits in Sabah

Most metallic mineral deposits and occurrences in Sabah occur along a central belt stretching from the northern islands of Banggi and Malawali, through Taritipan, Gunung Kinabalu and the Labuk valley to the upper Segama valley - Darvel Bay area and Semporna Peninsula. The only operating mine, the Mamut Porphyry Copper, is situated along this belt. Industrial minerals consisting mainly of limestone, silica, clay, and constructional stones are mainly found outside this belt. Oil and gas are found offshore of the east and west Coasts. Coal is found in some Tertiary sedimentary basins.

Mineralization is associated with four main groups of rocks, namely, the old Crystalline Basement, the ophiolite suite, the young volcanic and associated hypabyssal rocks, and the granitic intrusions.

Copper sulphides have been found in the pre-Triassic Crystalline Basement schists in the upper Segama area, and silver mineralization is found associated with schistose and doleritic rocks of the basement. Alluvial gold occurs in several rivers, especially the Segama and Diwata rivers which drain areas underlain by the basement rocks. The auriferous alluvium in the Segama valley also contains detrital native platinum. The sources of gold are thought to be the acidic intrusives of the Crystalline Basement.

Nickel, chromium, iron, pyrrhotite, and chalcopyrite are associated with the Cretaceous-Miocene ophiolitic rocks which are found in the upper Segama - Darvel

Bay area, the Labuk valley, around Gunung Kinabalu, in Taritipan, and in the northern islands. Platinum group metals occur as inclusions in chromite found associated with the basic igneous rocks of the ophiolite suite. Bauxite is developed from these rocks in places; in Sungai Mansan it is formed from gabbro.

Lead-zinc-copper mineralization is found in the Pliocene volcanic rocks and associated hypabyssal rocks in the Semporna Peninsula. Porphyry copper deposits at Mamut and Gunung Nungkok are closely associated with Miocene-Pliocene granitic intrusions in the Kinabalu area.

Montmorillonitic clay is found in the Miocene volcano- sedimentary strata in the Sandakan, Dent Peninsula and Tawau areas. (From "Mineral Resources of Sabah" in "Annual Report of Geological Survey of Malaysia, 1988")

#### **2-4 Present Situation of Metal Mining in Sabah**

At Present, the only operating metal mine is the Mamut Mine operated by Mamut Copper Mining Sdn. Bhd.

The production of copper, gold and silver since 1975 shown on the Table 2-1 has been yielded by the Mamut Mine only.

As shown in the Table 2-1, the mining products of Sabah are only oil and copper concentrate, which contains copper, gold and silver, yielded by the Mamut Mine, but the output of oil is remarkably larger than that of copper, gold and silver.

For example, in 1988, the output of oil is M\$ 1,362.4 million, on the other hand, the output of copper, gold and silver of the Mamut Mine is M\$ 173.2 million and is one eighth of that of oil.



Table 2 Mineral and Constructional Material Production in Sabah, 1974 to 1988

Product Year	Oil (Crude)		Copper		Gold		Silver		Stone		Sand		Coral		Clay Brick		Total
	Production	Value	Production	Value	Production	Value	Production	Value	Production	Value	Production	Value	Production	Value	Production	Value	Value
	Barrels	M\$	Tonnes	M\$	Grams	M\$	Grams	M\$	yds <sup>3</sup> , m <sup>3</sup>	M\$	yds <sup>3</sup> , m <sup>3</sup>	M\$	yds <sup>3</sup> , m <sup>3</sup>	M\$	Pieces	M\$	M\$
1974	214,000	6,420,000*	Nil	Nil	-	-	-	-	371,600	8,840,000	-	-	-	-	4,231,800	680,000	15,940,000
1975	3,561,276	76,838,000*	21,190	18,572,000	-	-	-	-	800,000	8,780,600	-	-	-	-	10,600,000	1,110,000	105,250,000
1976	16,672,843	533,946,800*	18,369	59,797,624	1,686,467	17,326,485	8,658,987	3,093,090	601,845	6,047,450	-	-	-	-	3,175,500	415,860	620,627,309
1977	26,999,170	930,962,000*	23,148	64,018,683	1,940,904	23,598,412	10,854,577	4,014,422	1,265,335	11,773,000	13,651	105,470	5,698	55,990	7,752,340	970,740	1,035,498,717
1978	29,781,499	964,466,000*	24,977	57,636,567	1,999,649	26,270,133	4,014,422	4,974,035	1,176,000	10,331,878	83,402	349,858	6,519	59,422	9,568,134	1,231,847	1,065,319,720
1979	28,460,413	1,311,902,934	24,370	96,254,500	1,842,807	41,938,400	12,273,011	10,313,200	1,852,855	12,807,118	85,693	482,720	5,990	54,100	7,454,890	1,139,644	1,474,892,616
1980	23,356,012	1,803,514,650	27,073	99,133,973	1,897,245	76,050,967	13,645,944	17,060,294	1,509,427	11,771,269	64,379	475,825	3,493	38,040	12,130,023	2,382,767	2,010,427,785
1981	18,233,901	1,504,568,000	28,522	87,000,700	2,163,660	68,365,700	14,462,600	9,882,200	1,880,000	8,370,000	160,000	780,000	N.A.	N.A.	6,450,000	1,830,000	1,680,796,600
1982	27,364,802	981,026,070	30,907	80,408,420	2,631,786	69,353,348	16,202,169	8,429,563	1,170,200	19,592,070	95,100	538,230	2,000	12,680	8,815,930	1,900,390	1,161,260,771
1983	30,504,520	2,013,321,000	29,019	79,109,000	2,225,039	72,063,000	13,755,433	11,246,000	1,549,300	35,568,600	149,300	538,200	3,000	12,680	25,425,500	1,900,400	2,213,758,880
1984	30,747,430	2,092,900,000	29,112	67,773,050	2,521,732	64,124,680	14,602,957	7,845,900	1,267,400	23,225,240	187,100	348,910	N.A.	N.A.	11,371,900	2,341,680	2,258,559,460
1985	28,494,540	1,951,685,100	30,513	77,843,000	2,451,024	57,940,000	16,213,241	6,955,000	970,500	15,218,240	156,650	1,063,232	1,800	14,400	3,326,100	532,176	2,111,251,148
1986	30,613,500	1,178,274,000	28,304	64,833,380	2,216,513	64,219,470	14,064,890	5,630,980	837,000	12,160,000	N.A.	N.A.	300	2,700	10,178,000	596,800	1,325,717,330
1987	31,900,000	1,465,800,000	29,855	93,615,060	2,712,990	93,459,030	15,479,928	7,903,250	555,300	9,571,030	60,930	522,710	1,497	13,250	9,496,580	1,881,640	1,672,765,970
1988	34,100,000	1,362,400,000	22,097	106,421,400	1,772,510	61,704,870	10,490,460	5,080,100	1,629,200	25,570,000	N.A.	N.A.	N.A.	N.A.	6,287,800	897,560	1,562,073,930

(Taken from "Mineral Resources of Sabah" in "Annual Report of Geological Survey of Malaysia," 1974-1988)

Note \* : Estimated value

-, N.A. : Not available

Unit of Stone, Sand and Coral: 1974~1979 - cubic yards (yds<sup>3</sup>)1980~1988 - cubic metres (m<sup>3</sup>)



The production statistics of the Mamut Mine as of April, 1990 are as follows:

Crude Ore mined	540,000 tons per month
Waste: Ore Ratio	3.7:1
Milled Grade	Cu 0.460%
Cu Recovery	86%
Amount of Concentrate	8,838 tons per month
Amount of Cu in Concentrate	2,077 tons per month
Grade of Concentrate	Cu 23.5%, Au 15g/t, Ag 120 g/t
Total Tonnage since Inception	
Ore	83 million tons
Grade	Cu 0.57%
Waste	53 million cubic meters
Waste/Ore Ratio	1.74
Remaining Minable Ore Reserves	45 million tons
	(Cu 0.5%, Au 0.5 g/t)
Total Number of Employees	1,094
Average Annual Rainfall (since 1976)	2,823 mm

The exploration works by private mining companies for metallic ore deposit have been carried out only in Bidu Bidu Hills, Labuk Valley area for Cyprus type cupriferous massive sulfide deposit and in Gunung Wullersdorf and Gunung Pock areas, Semporna Peninsula for Zn · Pb · Cu mineralization.

## **2-5 Governmental Mining Organization of Malaysia**

### **2-5-1 Governmental Organization of Malaysia**

Ministry of Primary Industries (marked by \* in Figure 5), out of 23 ministries of the cabinet of Malaysia, takes charge of mining industry.

(See Figure 5 Governmental Organization Chart of Malaysia)

### **2-5-2 Organization of Ministry of Primary Industries**

Geological Survey Department (marked by \*1 in Figure 6) takes charge of the survey and study of the mineral resources and is the counter part of the mineral exploration programme in the state of Sabah. Mines Department (marked by \*2 in Figure 6) takes charge of a part of permission and approval concerning the mining activity, technical assistance, statistics regarding the mining and so on.

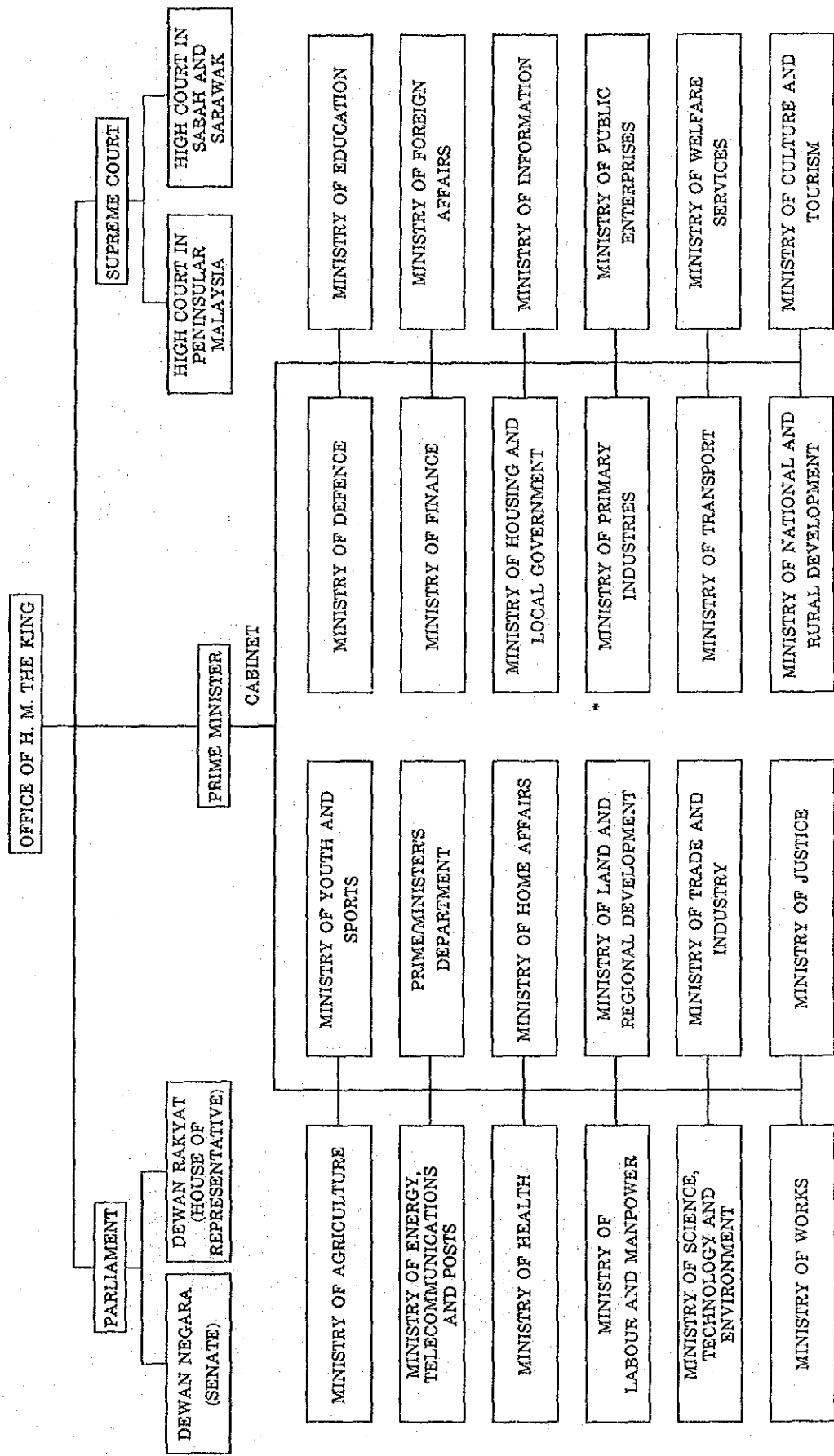
(See Figure 6 Organization Chart of Ministry of Primary Industries)

### **2-5-3 Organization of Geological Survey Department**

Geological Survey Department of Malaysia is also called Geological Survey of Malaysia (GSM). The head office of GSM is in Kuala Lumpur and the operation center and laboratory is located in Ipoh, Peninsula Malaysia, in Kuchin, Sarawak and in Kota Kinabalu, Sabah respectively. The head office plays a role of the headquarters of the administration and the practical survey and study is conducted at the each operation center and laboratory in Ipoh, Kuchin and Kota Kinabalu.

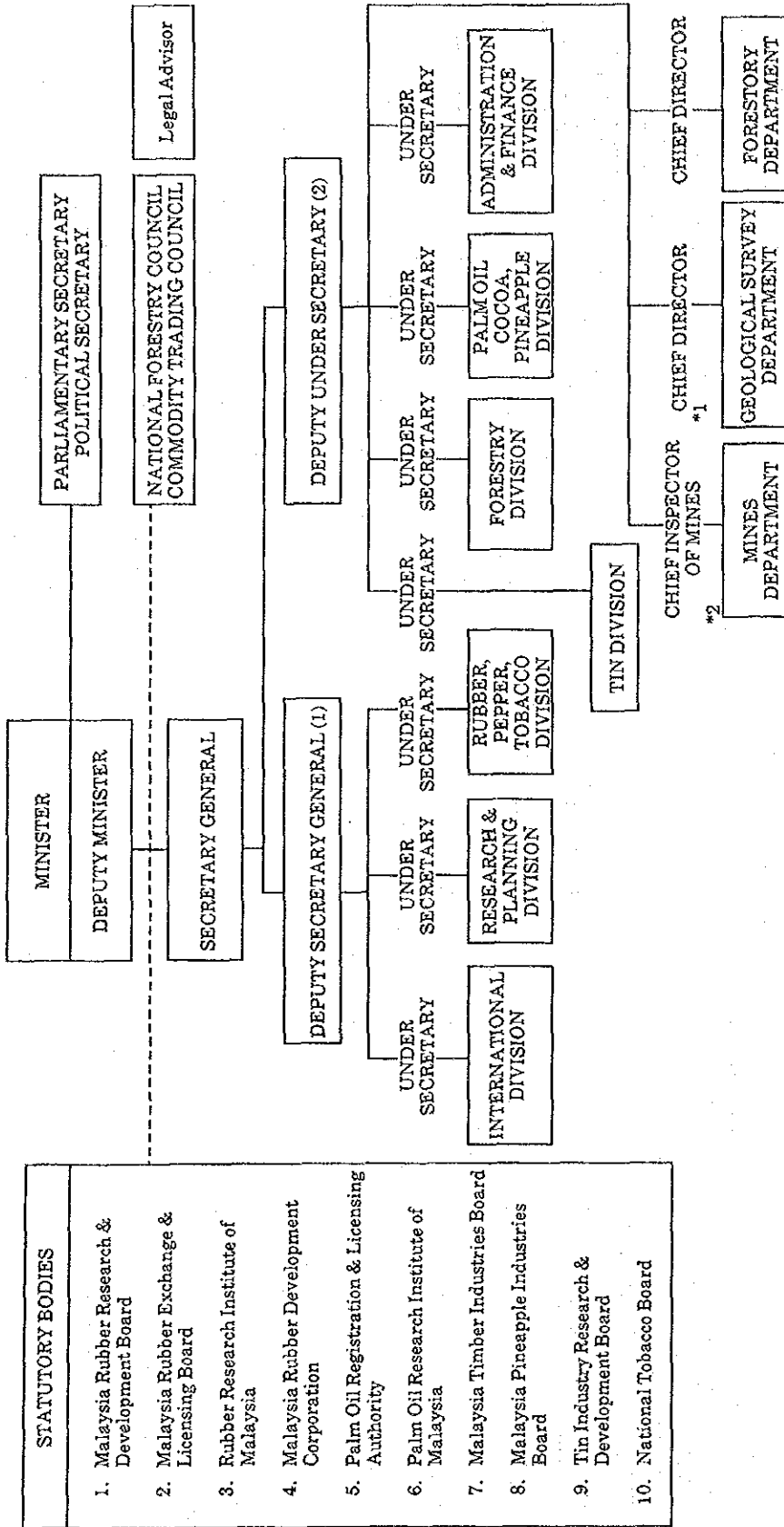
(See Figure 7 Organization Chart of the Geological Survey Department and Figure 8 Location of Head Office, Operation Centers & Laboratories and Branch Offices)

Figure 5 Governmental Organization Chart of Malaysia



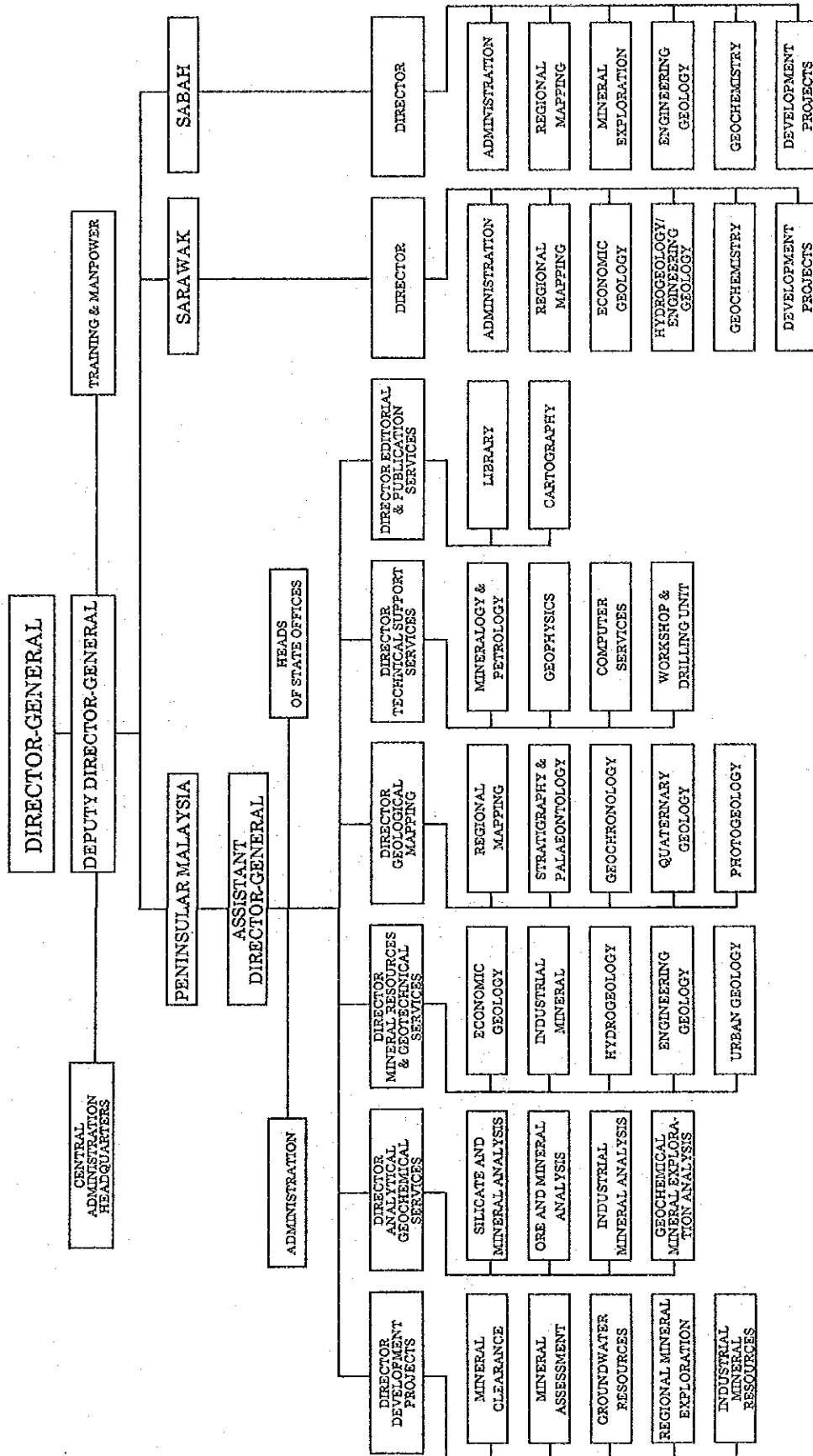
(Modified from "Overseas Mining Information, July, 1990, P 14" edited by Metal Mining Agency of Japan)

Figure 6 Organization Chart of Ministry of Primary Industries



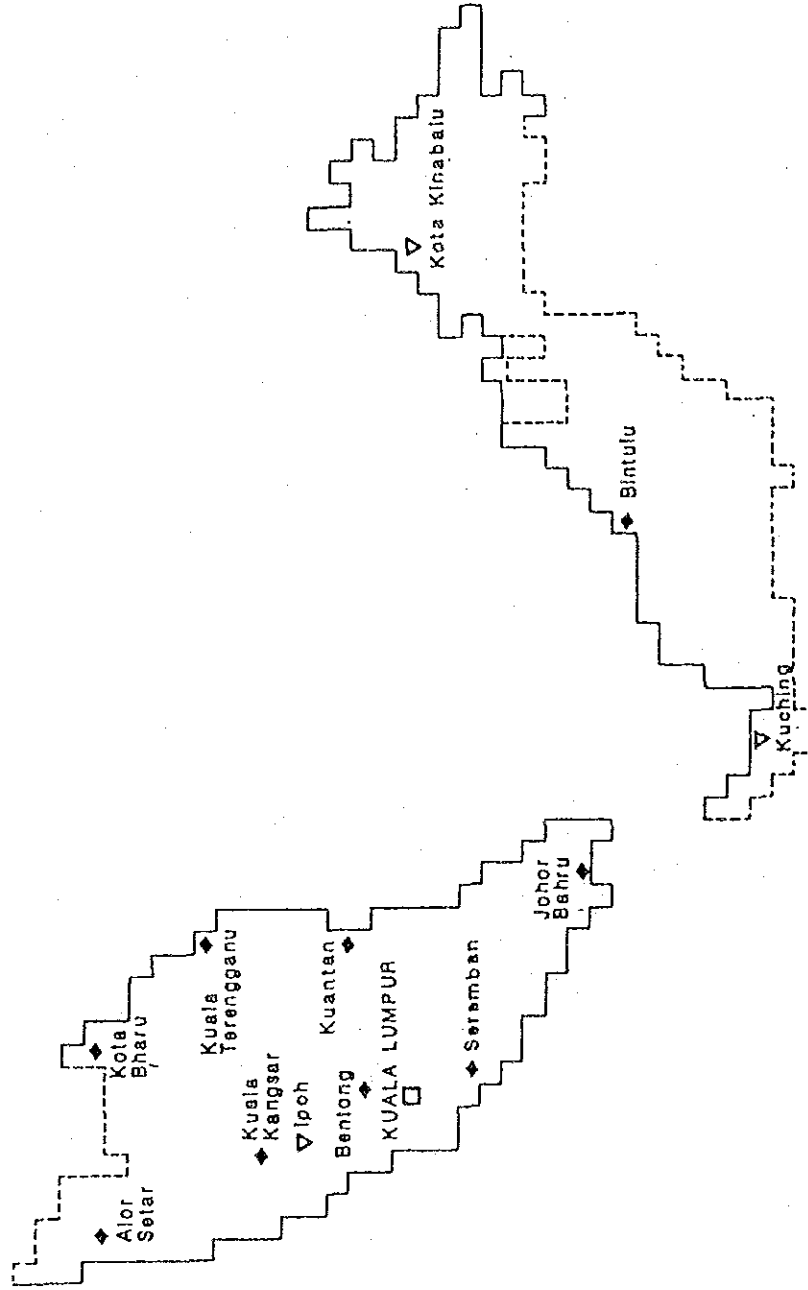
(Modified from "Overseas Mining Information, July, 1990, P 15" edited by Metal Mining Agency of Japan)

Figure 7 Organization Chart of the Geological Survey Department



(Taken from "Overseas Mining Information, July, 1990, P 17" edited by Metal Mining Agency of Japan)

Figure 8 Location of Head Office (□), Operation Centers & Laboratories (▽) and Branch Offices (◆)



(Taken from "Overseas Mining Information, July, 1990, P 18" edited by Metal Mining Agency of Japan)



## CHAPTER 3 SYNTHETIC STUDY ON THE RESULT OF THE SURVEY

### 3-1 Characteristics of Geological Structure and Mineralization and Control of Mineralization

#### 3-1-1 Characteristics of Geological Structure

Major structural feature of Sabah is that a belt consisting of Crystalline Basement, Chert-Spilitic Formation, and basic and ultrabasic rocks trends northeasterly in western Sabah, and bends largely around Gunung Kinabalu to a southeast direction in central and eastern Sabah. It seems that this belt represents a melange resulting from oceanic crust which had been thrust by obduction accompanying subduction of the plate and exposed on the surface.

Two sets of major faults, namely a north-northeast set and a northwest to north-northwest set, are found in Sabah. A large strike slip fault belonging to the northwest set, "Kinabalu fault" cut across Sabah from the northwest coast through Gunung Kinabalu and the Labuk valley to the southeast coast between Cowie Harbour and Darvel Bay.

In the Crystalline Basement which is mainly distributed in the Upper Segama Valley-Darvel Bay area, major east-west trending faults are evident. These faults are parallel or sub-parallel to the main schistosity of metamorphic rocks.

#### 3-1-2 Characteristics of Mineralization and Control of Mineralization

Main mineralizations in Sabah are associated with main igneous activities. Namely, Cyprus type cupriferous massive sulphide deposits accompany ophiolite in Chert-Spilitic Formation in the Bidu Bidu Hills area in central Sabah. Porphyry copper deposits around Gunung Kinabalu are found associated with granitic intrusive rock of late Miocene to early Pliocene in age. Small veins-veinlets consisting of chalcopyrite, sphalerite, galena and quartz around Gunung Poek and Gunung Wullersdorf in the Semporna peninsula are related to the intrusion of the acidic to intermediate hypabyssal rocks or dacitic to andesitic volcanic activity of Pliocene in age.

Cyprus type cupriferous massive sulphide deposit at West Sualog in the Bidu Bidu Hills area is strata-bound massive sulfide deposit and is found between overlying shale and underlying hydrothermally altered pillow basalt in ophiolite.

Copper-zinc-lead mineralization around Gunung Pock and Gunung Wullersdorf in the Semporna peninsula is associated with silicified zone and other hydrothermal alteration zone in dacite and andesite.

### **3-2 Possibility of Existence of "Expected Ore Deposit"**

It seems that the base metal deposit with high possibility of its existence in Sabah is, firstly, Cyprus type cupriferous massive sulfide deposit similar to the West-Sualog deposit in the Bidu Bidu Hills area in central Sabah. West-Sualog deposit accompanies ophiolite. As ophiolite is distributed along a belt stretching from the northern islands of Banggi and Malawali, through the Taritipan area, the Gunung Kinabalu area and the Labuk valley area to the upper Segama valley-Darvel Bay area, it is possible that Cyprus type cupriferous massive sulfide deposit might be discovered in ophiolite along this belt in the future.

Secondarily, it is possible that porphyry copper type deposit might be emplaced underground in the Gunung Pock and Gunung Wullersdorf areas, where small veins to veinlets consisting of chalcopyrite, sphalerite, galena and quartz as well as silicified zone and other hydrothermal alteration zone in dacite and andesite are exposed, in the Semporna peninsula.

## CHAPTER 4 CONCLUSION AND RECOMMENDATION

### 4-1 Conclusion Based on the Results of the Analysis of the Existing Data

As the result of the analysis of the existing data collected, it seems that base metal deposit in Sabah with high possibility of discovery in the future is, firstly, Cyprus type cupriferous massive sulfide deposit similar to West-Sualog deposit in the Bidu Bidu Hills area, associated with ophiolitic rocks belonging to the Chert-Spilite Formation of the Cretaceous to Eocene age, and, secondarily, is the porphyry copper type deposit which might be emplaced underground in the Gunung Pock and Gunung Wullersdorf areas, where small veins to veinlets consisting of chalcopyrite, sphalerite, galena and quartz as well as silicified zone and other hydrothermal alteration zone in dacite and andesite are exposed, in the Semporna peninsula.

### 4-2 Recommendation for the Future Surveys

Although many prospectings have been conducted in the survey area up to date and have resulted in discovery of many encouraging prospects, it is difficult to evaluate all the survey area synthetically because method and precision of prospecting are various.

Consequently it is recommended, firstly, that geochemical prospecting based on the same standard should be conducted in the survey area in order to evaluate all the area synthetically. It is desirable to carry out simultaneously geological mapping in the same area as covered by geochemical prospecting to analyze the result of geochemical prospecting effectively.

As the next step, detailed prospecting in the encouraging prospect found by geochemical prospecting is desirable. We would guess that the area, in which Chert-Spilite Formation accompanied by ophiolite is distributed, and Gunung Pock and Bukit Mantri-Gunung Wullersdorf areas are promising at present.



## **Part II The Particular**



## PART II THE PARTICULAR

### CHAPTER 1 COLLECTION, COMPILATION AND ANALYSIS OF THE EXISTING DATA

#### 1-1 Collection of the Existing Data

The various kinds of the literatures, in which the results of the geological surveys, investigations of the mineral occurrences or mineral deposits and prospecting carried out in the survey area up to date were reported, such as the published reports, memoirs, bulletins, and so on as well as the unpublished reports, theses and so on, were collected in the library in the Sabah office of Geological Survey of Malaysia for collection, compilation and analysis of the existing data.

In addition, the literatures on geology and tectonics of Sabah which were collected mainly at Geological Survey of Japan were added to the existing data collected in Sabah for the supplement of compilation of the existing data.

The existing data collected, together with the data collected in Japan, were divided into the following nine groups in accordance with the source of the data. The nine lists (Table 3 to Table 11) of the existing data classified according to the source of the data were made in chronological order respectively.

- |      |  |                         |
|------|--|-------------------------|
| I    | Annual report of Geological Survey of Malaysia;                                      | Number of the data: 200 |
| II   | Memoir, report or bulletin of Geological Survey of Malaysia;                         | Number of the data: 11  |
| III  | Proceedings and geological papers of Geological Survey of Malaysia;                  | Number of the data: 25  |
| IV   | Bulletin of Geological Society of Malaysia;  | Number of the data: 11  |
| V    | Thesis (unpublished);  | Number of the data: 23  |
| VI   | Joint Malaysian-German mineral exploration project in Sabah (unpublished);           | Number of the data: 13  |
| VII  | Joint Malaysia-Japan mineral exploration program in the Kinabalu area (unpublished); | Number of the data: 4   |
| VIII | Other unpublished reports;   | Number of the data: 2   |

IX The others (collected in Japan); Number of the data: 12

Total numbers of the data: 301



Table 3 I. Annual Report of Geological Survey of Malaysia

Number	Author(s)	Title of Report	Page	Year
I-1	Fitch F.H.	The mineral resources of the Colony of North Borneo	57~ 69	1949
I-2	"	The mineral resources of North Borneo	49	1950
I-3	"	The geology of North Borneo	50~ 55	"
I-4	"	Progress report: Geological reconnaissance of the Segama River and Darvel Bay region	68~ 87	1951
I-5	"	Mineral resources of North Borneo	96~ 99	1952
I-6	"	Progress report: Cataclasis, thermal metamorphism, and metasomatism in the Segama River area	100~102	"
I-7	Collenette P.	Progress report on work in the Brantian River area	103~108	"
I-8	Stephens E.A.	Geology of the Kota Belud area	114~119	"
I-9	Roe F.W.	An outline of the geology of British Borneo	6~ 22	1954
I-10	Fitch F.H.	Mineral resources of North Borneo	88~ 94	"
I-11	"	Progress report: Geology of the Diwata Valley	95~ 97	"
I-12	"	Progress report: Notes on Tingkayu River and Ulu Segama geology	97~101	"
I-13	"	Progress report: Geological Reconnaissance of the Labuk Valley	101~105	"
I-14	"	Progress report: Vulcanicity in North Borneo	106~110	"
I-15	Collenette P.	Progress report: Geological reconnaissance of the Kinabalu area	110~125	"
I-16	Stephens E.A.	Progress report: The manganese deposits at Taritipan, Marudu Bay, with an account of the regional geology	125~166	"
I-17	Roe F.W.	Geology of North Borneo	129~130	1956
I-18	"	Mineral resources of North Borneo	130~133	"
I-19	Fitch F.H.	Geology of the Sandakan area and parts of the Kinabatangan and Labuk valleys	134~167	"
I-20	Collenette P.	Geology and mineral resources of the Jesselton - Kinabalu area	167~177	"

Number	Author(s)	Title of Report	Page	Year
I-21	Stephens E.A.	Geology and mineral resources of the Kota Belud and Kudat area	177-182	1956
I-22	Kirk H.J.C.	A preliminary account of Cretaceous to Recent volcanic activity in relation to the geological structure of British Borneo	23~ 29	1957
I-23	Roe F.W.	Geology of North Borneo	125-127	"
I-24	"	Mineral resources of North Borneo	127-130	"
I-25	Fitch F.H.	Geology of the Sandakan area and parts of the Kinabatangan and Labuk valleys; Memoir 9	130-151	"
I-26	Collenette P.	Jesselton-Kinabalu area survey; Notes on the geology of the headwaters of the Labuk, Sugut and Karamuak rivers	151-163	"
I-27	"	Chromite deposit at Paranchangan near Ranau	164-168	"
I-28	Roe F.W.	Geology of North Borneo	143-146	1958
I-29	"	Mineral resources of North Borneo	146-150	"
I-30	Fitch F.H.	Geology of the Sandakan area and parts of the Kinabatangan and Labuk valleys, Memoir 9	150-153	"
I-31	Collenette P.	Pensiangan and upper Kinabatangan survey; Memoir 12	154-170	"
I-32	Wilson R.A.M.	Banggi island and Sugut river area; Memoir 15	170-190	"
I-33	Kirk H.J.C.	Geology and mineral resources of the Semporna peninsula; Memoir 14	191-206	"
I-34	Paton T.R.	A geological reconnaissance of the Semporna peninsula	206-224	"
I-35	Roe F.W.	Geology of North Borneo	88~ 92	1959
I-36	"	Mineral resources of North Borneo	92-102	"
I-37	"	Geochemical prospecting for copper and chromium	102-104	"
I-38	Collenette P.	Pensiangan and upper Kinabatangan area; Memoir 12	134-154	"
I-39	Wilson R.A.M.	Banggi island and Sugut river area; Memoir 15	154-181	"
I-40	Kirk H.J.C.	Progress report on the Semporna peninsula survey; Memoir 14	182-195	"
I-41	Collenette P.	Mineral resources of North Borneo	68~ 76	1960
I-42	Willson R.A.M.	Geology of North Borneo	80~ 83	"

Number	Author(s)	Title of Report	Page	Year
I-43	Fitch F.H.	Aeromagnetic profile, Banggi island to Labuan	96~ 98	1960
I-44	Collenette P.	Pensiangan and upper Kinabatangan area, North Borneo (Memoir 12)	99-106	"
I-45	Kirk H.J.C.	Semporna peninsula, North Borneo; (Memoir 14)	106~123	"
I-46	Wilson R.A.M.	North Borneo mineral resources	59~ 70	1961
I-47	Kirk H.J.C.	North Borneo geology	78~ 83	"
I-48	"	Semporna peninsula, North Borneo; (Memoir 14)	88~ 92	"
I-49	Wilson R.A.M	Geology of the region	17~ 19	1962
I-50	Kirk H.J.C.	Igneous rocks of North Borneo and Sarawak (Bulletin 5)	20~ 36	"
I-51	Brondijk J.F.	Sedimentological investigations in North Borneo and northern Sarawak	61~ 74	"
I-52	Kirk H.J.C.	North Borneo mineral resources	141-152	"
I-53	Wilson R.A.M.	Nickeliferous laterite in the Taguuk area, Labuk valley, North Borneo	152-155	"
I-54	Kirk H.J.C.	Cinnabar near Ranau, North Borneo	155-157	"
I-55	Halle N.S.	North Borneo geology	162-169	"
I-56	Collenette P.	Pensiangan and upper Kinabatangan area, North Borneo; Memoir 12	170-173	"
I-57	"	Mineral resources of Sabah	30~ 40	1963
I-58	"	Chromite prospecting in Sabah: 1959-63	47~ 58	"
I-59	Kirk H.J.C.	Regional geology: Eastern Sabah	78~ 81	"
I-60	"	Igneous rocks of Sabah and Sarawak	82~ 94	"
I-61	Collenette P.	Progress report: Pensiangan and Upper Kinabatangan area (Memoir 12)	103~104	"
I-62	Brondijk J.F.	The Danau formation in northwest Borneo	167~178	"
I-63	Kirk H.J.C.	Summary of geological results of prospecting by Borneo Mining Limited	188-198	"
I-64	Collenette P.	Mineral resources of Sabah	44~ 56	1964
I-65	"	Prospecting in Sabah by Borneo Mining Limited; 1959-1963	56~ 61	"
I-66	Wilson R.A.M.	Regional geology: Northwest Borneo geosyncline	79~ 82	"
I-67	"	Regional geology: Eastern Sabah	82~ 86	"

Number	Author(s)	Title of Report	Page	Year
I-68	Kirk H.J.C	Igneous rocks of Sabah and Sarawak	87~ 93	1964
I-69	Newton-Smith J.	Progress report: Bidu-Bidu Hills, Sabah	114-121	"
I-70	Lewis D.E.	Case history of a geochemical anomalous copper zone at Pinanduan, Sabah	163-175	"
I-71	Cooper R.A., Woolf D.L., Tooms J.S.	A geochemical reconnaissance survey of part of the Labuk Valley, Sabah	176-185	"
I-72	Newton-Smith J.	Copper mineralization in River Mamut area, Kinabalu, Sabah	88~ 96	1965
I-73	Wilson R.A.M.	Regional geology: Northwest Borneo geosyncline and eastern Sabah	110-115	"
I-74	Kirk H.J.C	Igneous rocks of Sabah and Sarawak	116-119	"
I-75	Newton-Smith J.	Progress report: Bidu-Bidu Hills, Sabah	134-140	"
I-76	Dhonau T.J., Hutchison C.S.	Progress report: The Darvel Bay area, Sabah	141-160	"
I-77	Collenette P.	The Garinono Formation, Sabah	161-167	"
I-78	Kirk H.J.C.	Mineralogy of the Pinanduan copper deposit, Sabah	196-204	"
I-79	Winkler H.A.	Geophysical prospecting in the Kiabau and river Sualog areas, Labuk Valley, Sabah	205-211	"
I-80	Woolf D.L., Tooms J.S., Kirk H.J.C.	Geochemical surveys in the Labuk Valley, Sabah, 1965	212-226	"
I-81	Collenette P.	Mineral resources of Sabah	23~ 32	1966
I-82	Wong N.P.Y.	Regional geology: Eastern Sabah	43~ 45	"
I-83	Kirk H.J.C.	Regional geology: Igneous rocks	46~ 48	"
I-84	Newton-Smith J.	Progress report: Bidu-Bidu Hills area	58~ 62	"
I-85	Wong N.P.Y.	Progress report: Mount Silam area	62~ 68	"
I-86	Collenette P.	Labuk Valley mineral investigation and consequent development	68~ 71	"
I-87	Wilford G.E.	Mineral resources of Sabah	22~ 32	1967
I-88	Kirk H.J.C.	Regional geology: Eastern Sabah	43~ 47	"
I-89	Wong N.P.Y., Leong K.M.	Progress report: Segama-Darvel Bay area	48~ 52	"
I-90	Newton-Smith J.	Progress report: Bidu-Bidu Hills	52~ 53	"

Number	Author(s)	Title of Report	Page	Year
I-91	Kirk H.J.C.	Igneous rocks of Sarawak and Sabah	62~ 64	1967
I-92	Wong N.P.Y.	Geochemical prospecting, Segama area	66	"
I-93	Newton-Smith J.	Geochemical prospecting in the Semporna peninsula	66~ 70	"
I-94	Wong N.P.Y.	Mineral resources of Sabah	43~ 52	1968
I-95	Wong N.P.Y., Lee D.T.C.	Regional geology: Eastern Sabah	74~ 75	"
I-96	Kirk H.J.C.	Regional geology: Igneous rocks	75~ 78	"
I-97	Leong K.M.	Progress report: Segama Valley-Darvel Bay area	120-124	"
I-98	G.J.	Progress report: Gunung Kinabalu area	126-130	"
I-99	Wong N.P.Y.	Geochemical prospecting in Sabah	130-133	"
I-100	Wong N.P.Y., Lee D.T.C.	Mineral resources of Sabah	35~ 44	1969
I-101	Leong K.M.	Regional geology: Eastern Sabah	66~ 67	"
I-102	"	Regional geology: Igneous rocks	68~ 70	"
I-103	"	Progress report: Upper Segama-Darvel Bay area (Memoir 4 revised)	186-189	"
I-104	Lee D.T.C.	Progress report: Semporna area	190	"
I-105	G.J.	Progress report: Gunung Kinabalu area	190-194	"
I-106	Wong N.P.Y.	Geochemical prospecting in Sabah	194-195	"
I-107	Lee D.T.C.	Mineral resources of Sabah	33~ 42	1970
I-108	Leong K.M.	Regional geology: Eastern Sabah	64~ 65	"
I-109	"	Regional geology: Igneous rocks	66~ 68	"
I-110	"	Progress report: Upper Segama and Darvel Bay area, Sabah (Memoir 4 revised)	170-180	"
I-111	Lee D.T.C.	Progress report: Semporna area, Sabah	180-183	"
I-112	"	Geochemical prospecting in Sabah	200-202	"
I-113	"	Search for mercury, Kenipir Valley, southeast of Ranau	202-203	"
I-114	"	Mineral resources of Sabah	38~ 48	1971
I-115	Leong K.M.	Regional geology: Eastern Sabah	70~ 71	"
I-116	"	Regional geology: Igneous rocks	72~ 74	"
I-117	Lee D.T.C.	The geology and mineral resources of the Semporna area	145-147	"

Number	Author(s)	Title of Report	Page	Year
I-118	Leong K.M.	Introduction to the geology of the Ranau-Paranchangan area, Sabah	148~154	1971
I-119	Nicholas P.Y.W.	Geochemical prospecting in the Semporna Peninsula, Sabah	154~159	"
I-120	Lee D.T.C.	Mineral resources of Sabah	40~ 50	1972
I-121	Leong K.M.	Regional geology: Eastern Sabah	72~ 74	"
I-122	"	Regional geology: Igneous rocks	75~ 77	"
I-123	"	Progress report: Ranau-Paranchangan area (Report 12)	239~241	"
I-124	Lee D.T.C.	Progress report: Semporna, eastern Sabah	241~242	"
I-125	"	Mineral resources of Sabah	47~ 55	1973
I-126	Leong K.M.	Regional geology: Eastern Sabah and Igneous rocks	77~ 81	"
I-127	Johnston P.J., Walls J.C.	Geology of the Telupid area, Sabah	213~220	"
I-128	Leong K.M.	Progress report: Ranau-Paranchangan area (Report 12)	220	"
I-129	Lee D.T.C.	Mineral resources of Sabah	56~ 65	1974
I-130	Leong K.M.	Regional geology: Eastern Sabah	87~ 88	"
I-131	"	Regional geology: Igneous rocks	89~ 91	"
I-132	Lim P.S.	Progress report: The Gunung Wullersdorf area, Semporna, Sabah	228~232	"
I-133	Walls P.J., Johnston J.C.	Progress report: Telupid area, Sabah	232~236	"
I-134	Lee D.T.C.	Mineral resources of Sabah	61~ 70	1975
I-135	Leong K.M.	Regional geology: Eastern Sabah	92~ 94	"
I-136	"	Regional geology: Igneous rocks	94~ 96	"
I-137	Lim P.S.	Progress report: Gunung Wullersdorf area	231~236	"
I-138	Walls P.J., Johnston J.C.	Progress report: Telupid area	236~238	"
I-139	Leong K.M.	Miocene chaotic deposits in eastern Sabah: Characteristics, origin and petroleum prospects (Abstract)	238	"
I-140	Lee D.T.C.	Mineral resources of Sabah	62~ 70	1976
I-141	Leong K.M.	Regional geology: Eastern Sabah	92~ 94	"
I-142	"	Regional geology: Igneous rocks	94~ 96	"
I-143	Lee D.T.C.	Progress report: Note on Semporna area	213	"

Number	Author(s)	Title of Report	Page	Year
I-144	Lim P.S.	Preliminary notes on the Balung formation, Wullersdorf area, Sabah	213~220	1976
I-145	Lee D.T.C.	Mineral resources of Sabah	55~ 63	1977
I-146	"	Regional geology: Eastern Sabah	82~ 84	"
I-147	Leong K.M.	Regional geology: Igneous rocks	84~ 86	"
I-148	Lim P.S.	Progress report: The geology of the Wullersdorf area, eastern Sabah	191~193	"
I-149	Lee D.T.C.	Mineral resources of Sabah	67~ 77	1978
I-150	"	Regional geology: Eastern Sabah	102~105	"
I-151	Leong K.M.	Regional geology: Igneous rocks	105~108	"
I-152	Lim P.S.	Geochemical prospecting in the Wullersdorf area, Sabah	295~297	"
I-153	"	Preliminary notes on the major element chemistry and chemical affinity of the Semporna volcanics, Sabah	298~305	"
I-154	Lee D.T.C.	Mineral resources of Sabah	68~ 79	1979
I-155	"	Regional geology: Sabah	119~129	"
I-156	"	Mineral resources of Sabah	70~ 81	1980
I-157	"	Regional geology: Sabah	121~131	"
I-158	Lee D.T.C., Kwan H.E.	Bauxite deposit at Sungai Mansan and Sungai Wasai, Telupid, Labuk Valley, Sabah	298~306	"
I-159	Lee D.T.C.	Segama Valley alluvial gold, Sabah	307~316	"
I-160	"	Mineral resources of Sabah	70~ 80	1981
I-161	"	Regional geology: Sabah	119~128	"
I-162	Weber H.S.	Joint Malaysian-German mineral resources investigation in Sabah-some results of the first project year	356~368	"
I-163	Hoppe P., Liau D.K.H. Weber H.S.	Photogeological investigation of the Gunung Wullersdorf area	369~386	"
I-164	Yan A.S.W.	Geochemical exploration in the Gunung Pock area	386~400	"
I-165	Lee D.T.C.	Mineral resources of Sabah	62~ 71	1982
I-166	"	Regional geology: Sabah	106~114	"
I-167	Lim P.S.	Geology of the Mankadau area, Merungin, Sabah	251~254	"

Number	Author(s)	Title of Report	Page	Year
I-168	Markwich H., Weber H.S.	Joint Malaysian-German mineral resources investigation in Sabah-Selected results of the second project year	254~259	1982
I-169	Lee D.T.C., Weber H.S.	Discovery of Cyprus-type massive sulfide mineralization in the Sualog area, Bidu-Bidu Hills, Sabah	260~267	"
I-170	Lee D.T.C.	Mineral Resources of Sabah	65~ 75	1983
I-171	"	Regional geology: Sabah	112~121	"
I-172	"	Malaysian-German mineral exploration project in Sabah	331~334	"
I-173	Muff R, Mylius H.G., Weber H.S.	Cupriferous massive sulfide occurrences in the Bidu-Bidu Hills, Sabah	334~346	"
I-174	Lim P.S.	History of earthquake activities in Sabah, 1897-1983	350~357	"
I-175	Lee D.T.C.	Mineral resources of Sabah	69~ 79	1984
I-176	"	Regional geology: Sabah	116~126	"
I-177	Tungah S.	Brief geology of the Karamuak area, Sabah	330~333	"
I-178	Lee D.T.C.	Exploratory drilling at West Sualog copper prospect, Bidu-Bidu, Sabah	333~353	"
I-179	"	Mineral resources of Sabah	73~ 83	1985
I-180	"	Regional geology: Sabah	122~131	"
I-181	Tungah S.	Iron prospecting at Tavai plateau south, Sabah	444~451	"
I-182	Lee D.T.C.	The occurrence of massive sulfides at Kiabau, Labuk valley, Sabah	451~465	"
I-183	Lim P.S.	Seismic activities in Sabah and their relationship to regional tectonics	465~480	"
I-184		General review 1986: Sabah	19~ 21	1986
I-185	Lee D.T.C.	Regional geology: Sabah	66~ 75	"
I-186	"	Mineral resources: Sabah	115~126	"
I-187	"	Occurrences of platinum group minerals in Sabah and their possible source rocks	569~577	"
I-188	Tungah S.	Controlled source audio-frequency magneto telluric survey of the Bambang-Kundsang area, Sabah (abstract only)	577~578	"
I-189	Mohd Y.R., Lim P.S.	Detailed geochemical survey of the Lingangaa area, Sabah (abstract)	579~580	"



Number	Author(s)	Title of Report	Page	Year
I-190	Yan A.S.W.	Progress report: Geological mapping, Gunung Meliau area, Sheet 5/117/1, Sabah	580-590	1986
I-191		General Review 1987: Sabah	13~ 14	1987
I-192		Regional geology: Sabah	51~ 59	"
I-193		Mineral resources: Sabah	93-104	"
I-194	Muda J.	Alluvial gold investigation, middle Segama valley, Lahad Datu, Sabah	364-375	"
I-195	Yan A.S.W.	Follow-up geochemical exploration for base metals in the Bukit Luminitong area, Labuk valley, Sabah	375-386	"
I-196	Lim P.S.	Porphyry copper mineralization in the upper Bambang valley, Sabah	387-402	"
I-197	"	Geology and geothermal potential of the Tawau area, Sabah	402-413	"
I-198		Mineral exploration: Sabah	16	1988
I-199		Regional geology: Sabah	67~ 75	"
I-200		Mineral resources: Sabah	111-121	"

Table 4 II. Memoir, Report or Bulletin of Geological Survey of Malaysia

Number	Author(s)	Title of Report	Page	Year
II-1	Fitch F.H.	The Geology and mineral resources of part of the Segama Valley and Darvel Bay area, Colony of North Borneo. (Memoir 4)	1~142	1955
II-2	Fitch F.H.	The geology and mineral resources of the Sandakan area and parts of the Kinabatangan and Labuk valleys, North Borneo. (Memoir 9)	1~202	1958
II-3	Wilson R.A.M.	The geology and mineral resources of the Banggi Island and Sugut River area, North Borneo. (Memoir 15)	1~143	1961
II-4	Kirk H.J.C.	The geology and mineral resources of the Semporna Peninsula, North Borneo. (Memoir 14)	1~178	1962
II-5	Collenette P.	The geology and mineral resources of the Pensiangan and Upper Kinabatangan area, Sabah, Malaysia. (Memoir 12)	1~150	1965
II-6	Newton-Smith J.	Bidu-Bidu Hills area, Sabah. (Report 4)	1~109	1967
II-7	Kirk H.J.C.	The igneous rocks of Sarawak and Sabah (Bulletin 5)	1~210	1968
II-8	Jacobson G.	Gunong Kinabalu area, Sabah. (Report 8)	1~111	1970
II-9	Leong K.M.	The geology and mineral resources of the Upper Segama Valley and Darvel Bay area, Sabah, Malaysia. (revised Memoir 4)	1~348	1974
II-10	Lim P.S.	Wullersdorf area, Sabah, Malaysia. (Report 15)	1~106	1981
II-11	Lee D.T.C.	Gunung Poek area, Semporna Peninsula, Sabah, Malaysia. (Report 9)	1~120	1988

Table 5 III. Proceedings and Geological Papers of Geological Survey of Malaysia

Number	Author(s)	Title of Report	Page	Name of Bulletin	Year
III-1	Fitch F.H.	Possible role of continental core movement in the geological evolution of British Borneo	31~ 46	Proceedings of the British Borneo geological conference 1961	1961
III-2	Collenette P.	The Miocene backdeep in North Borneo	47~ 60	"	"
III-3	Wilson R.A.M.	Chert-Spilite Formation of North Borneo	61~ 78	"	"
III-4	Adams C.G., Kirk H.J.C.	The Madai-Baturong limestone member of the Chert-Spilite Formation, North Borneo	79~ 90	"	"
III-5	Walker P.B., Tooms J.S.	Secondary dispersion of copper from the Karang lode, North Borneo	91~118	"	"
III-6	Kirk H.J.C.	Pliocene and Quaternary volcanic activity in British Borneo	137~152	"	"
III-7	Stauffer P.H.	Studies in the Crocker Formation, Sabah	1~ 13	Geological Papers, 1966	1966
III-8	Koopmans B.N.	Deformation of the metamorphic rocks and the Chert-Spilite Formation in the southern part of the Darvel Bay area, Sabah	14~ 24	"	"
III-9	Koopmans B.N., Stauffer P.H.	Glacial phenomena on Mount Kinabalu, Sabah	25~ 35	"	"
III-10	Wilford G.E.	Notes on rock weathering at Bukit Kukusan, Tawau, Sabah	41~ 42	"	"
III-11	Kirk H.J.C.	Hydrothermal mineralization and igneous rocks in East Malaysia	53~ 61	"	"
III-12	Lewis D.E.	The Karang copper prospect, Karamuak valley, Sabah	62~ 67	"	"
III-13	Kirk H.J.C.	The Mamut copper prospect, Kinabalu, Sabah	68~ 80	"	"

Number	Author(s)	Title of Report	Page	Name of Bulletin	Year
III-14	Wong N.P.Y.	Geology and copper mineralization of the Bambangan valley, Kinabalu, Sabah	81~ 88	Geological Papers, 1966	1966
III-15	Wilford G.E.	Notes on the geomorphology of Sabah	1~ 22	Geological Papers, 1967	1967
III-16	"	Notes on the geology of the Karabakan area	23~ 31	"	"
III-17	Wong N.P.Y., Leong K.M.	Unconformity between the Chert-Spilite Formation and Crystalline Basement around Sungai Agob and Sungai Sabalan, east Sabah	32~ 33	"	"
III-18	Wong N.P.Y.	Orchid Plateau, Segama area, Sabah	34~ 35	"	"
III-19	Newton-Smith J., Wilford G.E.	Radiocarbon age determination on wood from Kambarangoh, Sabah	36~ 37	"	"
III-20	Wilford G. E.	Iron and nickel prospecting at Tavai Plateau, Sabah, 1962-64	80~ 87	"	"
III-21	Newton-Smith J.	Geology and mineralization at the Mamut copper prospect, Sabah	55~ 65	Geological Papers, Vol. 2, 1977	1977
III-22	Myers L.C.	A weathering profile developed on ultrabasic rocks at Telupid, Sabah	66~ 71	"	"
III-23	Lim P.S.	The evaluation, assessment and calculation of ore reserves of the Mamut Mine-a case history	114~125	Geological Papers Vol. 3, 1980	1980
III-24	Lee D.T.C.	Application of Landsat images to regional geologic studies, with reference to the geology of central and west coast Sabah and adjacent areas	126~133	"	"
III-25	Muda J., Yan A.	Base metals exploration in the Ulu Marasimsim area, Marudu Bay, Sabah	83~ 92	Proceedings of the 20th geological conference, 1989-Technical papers Vol. 1	1989

Table 6 IV. Bulletin of Geological Society of Malaysia

Number	Author(s)	Title of Report	Bulletin	Page	Year
IV-1	Stauffer P.H.	Glaciation of Mount Kinabalu	No.1	63	1967
IV-2	Hutchison C.S.	Tectogene hypothesis applied to the Pre-Tertiary of Sabah and Philippines	"	65~ 79	"
IV-3	Leong T.K.	Bouldery mudflow deposit at Ranau, Sabah, East Malaysia	No.3	139-146	1970
IV-4	Leong K.M.	New ages from radiolarian cherts of the Chert-Spilitite Formation, Sabah	No.8	109-111	1977
IV-5	Bol A.J., Hoorn B.V.	Structural styles in western Sabah offshore	No.12	1~ 16	1980
IV-6	Holloway N.H.	The north Palawan block, Philippines: its relation to the Asian Mainland and its role in the evolution of the South China Sea	No.14	19~ 58	1981
IV-7	Levell B., Kasumajaya A.	Slumping at the late Miocene shelf-edge offshore west Sabah: a view of a turbidite basin margin	No.18	1~ 29	1985
IV-8	Wood B.G.M.	The mechanics of progressive deformation in crustal plates- A working model for Southeast Asia	"	55~ 99	"
IV-9	McManus J., Tate R.B.	Mud Volcanoes and the origin of chaotic deposits in Sabah	No.19	193-205	1986
IV-10	Lee D.T.C., Weber H.S.	Base metal exploration in Sabah	"	405-419	"
IV-11	Levell B.K.	The nature and significance of regional unconformities in the hydrocarbon-bearing Neogene sequence offshore west Sabah	No.21	55~ 90	1987

Table 7 V. Thesis (unpublished)

Number	Author(s)	Title of Report	Page	Year
V-1	Walker P.B. (M Sc.)	Secondary dispersion of copper and chromium from mineral deposits in North Borneo	1-253	1960
V-2	Sevillano A.C. (M Sc.)	Secondary dispersion of copper, molybdenum, tungsten and nickel in Mount Nungkok area, Sabah, Malaysia	1-125	1961
V-3	Bailey P.S. (M Sc.)	The chromiferous ultrabasic rocks of the Silam-Beeston Range, North Borneo	1-108	1963
V-4	Hancock W.G. (D Ph.)	The Mount Tawai peridotite, North Borneo	1-369	1964
V-5	Tan B.K. (B Sc.)	Studies on the ultrabasic and gneissic complex of Silam and Darvel Bay area, Sabah, Malaysia	1-109	1965
V-6	Hutchison C.S. (D Ph.)	Tectonic and petrological relations within three rock associations of orogenic zones in Malaysia	1-270	1966
V-7	Toh S.C. (B Sc.)	Geology of the Lihak Lihak area, Sabah, East Malaysia	1-128	"
V-8	Choo M.K. (B Sc.)	A petrological study of the Ranau-Luhan area, Sabah, East Malaysia	1-128	1968
V-9	Newton-Smith J. (D.I.C)	Geology and mineralization at the Mamut copper prospect, Sabah, Malaysia	1-142	"
V-10	Tan T.H. (B Sc.)	Geology and soils of the Ranau-Luhan area, Sabah, East Malaysia	1- 89	1969
V-11	Quah P.H. (B Sc.)	Ultrabasics, metabasites and sedimentary rocks of the Morouporou area, southeast of Ranau, Sabah, East Malaysia	1-162	"
V-12	Wong C.B. (B Sc.)	Geology and pedology of the Quoin Hill olivine-basalt and associated volcanic areas, Sabah, East Malaysia	1- 87	1970
V-13	Lim P.S. (B Sc.)	Geology and copper mineralization of the Mamut area, Sabah, East Malaysia	1-116	1973
V-14	Nagano K.	On the mineralization and ore-forming fluids of porphyry copper deposits, with special reference to the Mamut Mine, Sabah	1-135	1976
V-15	Bull P.F. (M Sc.)	The Gunung Nungkok copper prospect	1-137	"
V-16	Goh K.T.K. (B Sc.)	Petrology of the ophiolitic rocks of Sungai Kawag area, Sabah	1- 67	1979
V-17	Lai H.K. (B Sc.)	Geology of the Upper Bole River, Segama Valley, Sabah, East Malaysia	1- 68	"

Number	Author(s)	Title of Report	Page	Year
V-18	Yan A.T.W. (B Sc.)	Petrology and geochemistry of the ophiolite suite, Lower Bole area, lahat Datu, eastern Sabah	1~ 59	1979
V-19	Gasah L. (B Sc.)	Petrology and petrochemistry of the volcanic rocks of the eastern region of north Tawau area, Tawau, Sabah	1~ 30	"
V-20	Tan G.J. (B Sc.)	The geology of lower Umas Umas and Merotai Besar valley, Tawau, Sabah	1~ 82	"
V-21	Tungah Surat (B Sc.)	Petrology and geochemistry of the ophiolitic rocks of the upper Mailo area, Telupid, Sabah	1~ 39	1982
V-22	Osman R.M. (B Sc.)	Geology of Telupid, Sabah, with emphasis on the ophiolite	1~ 59	"
V-23	Tan H.M. (B Sc.)	Petrological studies of the ophiolitic rocks of upper Taliwas area, Sabah	1~263	1989

Table 8 VI. Joint Malaysian-German Mineral Exploration Project in Sabah  
(unpublished)

Number	Author(s)	Title of Report	Page	Year
VI-1	Hoppe P., Lee D.T.C., Stövesand G., Weber H.S.	Report on geochemical exploration in Gunung Pock area/Semporna Peninsula	1~ 29	1981
VI-2	Lim P.S., Stövesand G., Weber H.S.	Report on geochemical prospecting in Tawau area/Semporna Peninsula	1~ 21	"
VI-3	Hoppe P., Yan A., Weber H.S.	Report on geochemical exploration in Kinabalu-Ranau-Paranchangan area/Sabah	1~ ?	"
VI-4	Lee D.T.C., Weber H.S.	Report on geochemical exploration in the Bidu Bidu Hills/NE-Sabah	1~ 34	1982
VI-5	Hoppe P.	Report on photogeology of the Paranchangan-Sungai Paliu ara	1~ 10	"
VI-6	"	Reconnaissance photogeology of Trusmadi area	1~ 12	"
VI-7	"	Report on Photogeology of Kinabalu and Bidu-Bidu Hills	1~ 13	"
VI-8	Yan A.S.W., Grissemann C.	Geophysical survey in west Sualog, Kiabau and Ulu Pari areas, Bidu-Bidu Hills, northeast Sabah	1~ 8	1983
VI-9	Weber H.S., Yan A.	Report on geochemical prospecting in the Labuk Valley area/NE-Sabah	1~ 46	"
VI-10	Lim P.S., Markwich H., Weber H.S.	Report on base metals prospecting in Gunung Wullersdorf area/Semporna Peninsula, Sabah; 1981-1983	1~ 35	"
VI-11	Weber H.S., Yan A.	Report on geochemical prospecting in the Segama-Darvel Bay area/SE Sabah	1~ 31	"
VI-12	Grissemann C., Muff R., Mylius H.G., Weber H.S., Yan A.S.W.	Report on base metals prospecting in the Bidu Bidu Hills/NE Sabah; 1982-1984	1~262	1985
VI-13	Weber H.S.	Final report on investigation of mineral resources in Sabah; 1980-1984	1~128	"



Table 9 VI. Joint Malaysia-Japan Mineral Exploration Program in the Kinabalu Area  
(unpublished)

Number	Author(s)	Title of Report	Page	Year
VII-1	JICA & MMAJ (*1) (*2)	Report on the collaborative mineral exploration of Sabah area; Phase I	1~302	1986
VII-2	"	Report on the mineral exploration in Sabah, Malaysia; Phase II	1~136	1987
VII-3	"	Report on the mineral exploration in Sabah, Malaysia area; Phase III	1~ 80	1988
VII-4	"	Report on the mineral exploration in Sabah, Malaysia; Consolidated report	1~168	"

Note; (\*1): Japan International Cooperation Agency  
(\*2): Metal Mining Agency of Japan

Table 10 VIII. Other Unpublished Reports

Number	Author(s)	Title of Report	Page	Year
VIII-1	United Nations	Natural resources survey of the Labuk Valley, Malaysia (United Nations Development Program)	7~100	1968
VIII-2	Hunting Geology and Geophysics Ltd.	Aeromagnetic survey of the Kinabalu-Tambuyukon area, Sabah, Malaysia	1~ 35	1970
VIII-3	Overseas Mineral Resources Development Co., Ltd.	Report on prospecting survey in Mamut prospecting licence area	1~ 11	"

Table 11 IX. The Others

Number	Author(s)	Title of Report	Journal	Year
IX-1	Ben-Avraham Z., Uyeda S.	The evolution of the China Basin and Mesozoic paleogeography of Borneo	Earth and planetary science letters 18, 365-376	1973
IX-2	Tokuyama A., Yoshida S.	Kinabalu fault, a large strike-slip fault in Sabah, East Malaysia	In Kobayashi T. and Torizawa R., eds., "Geology and paleontology of southeast Asia": Univ. Tokyo Press, V. 14, 175-188	1974
IX-3	Kosaka H., Wakita K.	Geology and mineralization of the Mamut Mine, Sabah, Malaysia (Abstract in English)	Mining Geology, 25, 303-320 (in Japanese)	1975
IX-4	"	Some geologic features of the Mamut porphyry copper deposit, Sabah, Malaysia	Economic Geology, Vol. 73, 618-627	1978
IX-5	Haile N.S.	Rotation of the Borneo microplate completed by Miocene; paleomagnetic evidence	Warta Geologi 5, 19-22	1979
IX-6	Hamilton W.	Tectonics of the Indonesian region	USGS Professional Paper 1078, 348P	"
IX-7	Uyeda S., Nishiwaki C.	Stress field, metallogenesis and mode of subduction	In "The continental crust and its mineral deposits", edited by D.W. Strangway, Geological Association of Canada Special Paper 20, 323-339	1980
IX-8	Nishiwaki C.	Tectonic control of porphyry copper genesis in the southwestern Pacific island arc region (Abstract in English)	Mining Geology, 31, 131-146 (in Japanese)	1981
IX-9	Holloway N.H.	The north Palawan block, Philippines-Its relation to the Asian mainland and its role in the evolution of South China Sea	The American Association of Petroleum Geologist Bulletin, Vol. 66, No. 9, 1355-1383	1982
IX-10	Jolivet L., Huchon P., Rangin C.	Tectonic setting of Western Pacific marginal basins	Tectonophysics, 160, 23-47	1989
IX-11	Rangin C.	The Sulu Sea, a back-arc basin setting within a Neogene collision zone	Tectonophysics, 161, 119-141	"

Number	Author(s)	Title of Report	Journal	Year
IX-12	Gower R.J.W.	Early Tertiary plate reconstructions for the South China Sea region: constraints from northwest Borneo	Journal of Southeast Asian Earth Sciences, Vol. 4, No. 1, 29-35	1990

## 1-2 Classification of the Collected Data

All the existing data collected were classified into the following three categories in accordance with the contents of the data collected.

- (A) General geology (Table 12, number of the data: 184)
  - (B) Mineral resources, mineral occurrence and mineral deposit (Table 13, number of the data: 94)
  - (C) Prospecting or exploration (Table 14, number of the data: 72)
- (total numbers of the data: 350)

Subsequently, the three lists (Table 12 to Table 14) of the existing data classified into the aforementioned three categories were made in chronological order respectively. Some data, contents of which consist of two or three categories, are placed on the list of the each category respectively and pages of the data relating to the category concerned are shown in bracket.

Table 12 A. General Geology

Number	Author(s)	Title of Report	Bulletin	Page	Year
I-3	Fitch F.H.	The geology of North Borneo	Annual Report of GSM, 1950	50~ 55	1950
I-4	"	Progress report: Geological reconnaissance of the Segama River and Darvel Bay region	Annual Report of GSM, 1951	68~ 87	1951
I-6	"	Progress report: Cataclasis, thermal metamorphism and metasomatism in the Segama River area	Annual Report of GSM, 1952	100~102	1952
I-7	Collenette P.	Progress report on work in the Brantian River area	"	103~108	"
I-8	Stephens E.A.	Geology of the Kota Belud area	"	114~119	"
I-9	Roe F.W.	An outline of the geology of British Borneo	Annual Report of GSM, 1954	6~ 22	1954
I-11	Fitch F.H.	Progress report: Geology of the Diwata Valley	"	95~ 97	"
I-12	"	Progress report: Notes on Tingkaya River and Ulu Segama geology	"	97~101	"
I-13	"	Progress report: Geological reconnaissance of the Labuk Valley	"	101~105	"
I-14	"	Progress report: Vulcanicity in North Borneo	"	106~110	"
I-15	Collenette P.	Progress report: Geological reconnaissance of the Kinabalu area	"	110~125	"
II-1	Fitch F.H.	The geology and mineral resources of part of the Segama Valley and Darvel Bay area, Colony of North Borneo	Memoir of GSM (Memoir 4)	1~142 (1~ 95)	1955
I-17	Roe F.W.	Geology of North Borneo	Annual Report of GSM, 1956	129~130	1956

Number	Author(s)	Title of Report	Bulletin	Page	Year
I-19	Fitch F.H.	Geology of the Sandakan area and parts of the Kinabatangan and Labuk valleys	Annual Report of GSM, 1956	134~167 (134~149)	1956
I-21	Stephenes E.A.	Geology and mineral resources of the Kota Belud and Kudat area	"	177~182	"
I-22	Kirk H.J.C	A preliminary account of Cretaceous to Recent volcanic activity in relation to the geological structure of British Borneo	Annual Report of GSM, 1957	23~ 29	1957
I-23	Roe F.W.	Geology of North Borneo	"	125~127	"
I-25	Fitch F.H.	Geology of the Sandakan area and parts of the Kinabatangan and Labuk valleys; Memoir 9	"	130~151	"
I-26	Collenette P.	Jesselton-Kinabalu area Survey; Notes on the geology of the headwaters of the Labuk, Sugut and Karamuak rivers	"	151~163	"
I-28	Roe F.W.	Geology of North Borneo	Annual Report of GSM, 1958	143~146	1958
I-30	Fitch F.H.	Geology of the Sandakan area and parts of the Kinabatangan and Labuk valleys; Memoir 9	"	150~153	"
I-31	Collenette P.	Pensiangan and upper Kinabatangan survey; Memoir 12	"	154~170 (154~166)	"
I-32	Wilson R.A.M.	Banggi island and Sugut river area; Memoir 15	"	170~190	"
I-33	Kirk H.J.C.	Geology and mineral resources of the Semporna peninsula; Memoir 14	"	191~206 (191~199)	"
I-34	Paton T.R.	A geological reconnaissance of the Semporna Peninsula	"	206~224	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
II-2	Fitch F.H.	The geology and mineral resources of the Sandakan area and parts of the Kinabatangan and Labuk valleys, North Borneo	Memoir of GSM (Memoir 9)	1~202 (1~114)	1958
I-35	Roe F.W.	Geology of North Borneo	Annual Report of GSM, 1959	88~ 92	1959
I-38	Collenette P.	Pensiangan and upper Kinabatangan area; Memoir 12	"	134~154	"
I-39	Wilson R.A.M.	Banggi island and Sugut river area; Memoir 15	"	154~181 (154~171)	"
I-40	Kirk H.J.C.	Progress report on the Semporna peninsula survey; Memoir 14	"	182~195	"
I-42	Wilson R.A.M.	Geology of North Borneo	Annual Report of GSM, 1960	80~ 83	1960
I-43	Fitch F.H.	Aeromagnetic profile, Banggi island to Labuan	"	96~ 98	"
I-44	Collenette P.	Pensiangan and upper Kinabatangan area, North Borneo; (Memoir 12)	"	99~106	"
I-45	Kirk H.J.C.	Semporna peninsula, North Borneo; (Memoir 14)	"	106~123	"
I-47	"	North Borneo Geology	Annual Report of GSM, 1961	78~ 83	1961
I-48	"	Semporna peninsula, North Borneo; (Memoir 14)	"	88~ 92	"
II-3	Wilson R.A.M.	The geology and mineral resources of the Banggi Island and Sugut River area, North Borneo	Memoir of GSM (Memoir 15)	1~143 (1~106)	"
III-1	Fitch F.H.	Possible role of continental core movement in the geological evolution of British Borneo	Proceedings of the British Borneo geological conference 1961	31~ 46	"
III-2	Collenette P.	The Miocene backdeep in North Borneo	"	47~ 60	"
III-3	Wilson R.A.M.	Chert-Spilitite Formation of North Borneo	"	61~ 78	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
III-4	Adams C.G., Kirk H.J.C.	The Madai-Baturong limestone member of the Chert-Spilitic Formation, North Borneo	Proceedings of the British Borneo geological conference 1961	79~ 90	1961
III-6	Kirk H.J.C.	Pliocene and Quaternary volcanic activity in British Borneo	"	137~152	"
V-2	Sevillano A.C.	Secondary dispersion of copper, molybdenum, tungsten and nickel in Mount Nungkok area, Sabah, Malaysia	Unpublished Report (Thesis for MSc.)	1~125 (1~18)	"
I-49	Wilson R.A.M	Geology of the region	Annual Report of GSM, 1962	17~ 19	1962
I-50	Kirk H.J.C.	Igneous rocks of North Borneo and Sarawak (Bulletin 5)	"	20~ 36	"
I-51	Brondijk J.F.	Sedimentological investigations in North Borneo and northern Sarawak	"	61~ 74	"
I-55	Haile N.S.	North Borneo geology	"	162-169	"
I-56	Collenette P.	Pensiangan and upper Kinabatangan area, North Borneo; Memoir 12	"	170~173	"
II-4	Kirk H.J.C.	The geology and mineral resources of the Semporna Peninsula, North Borneo	Memoir of GSM (Memoir 14)	1~178 (1~136)	"
I-59	"	Regional geology: Eastern Sabah	Annual Report of GSM, 1963	78~ 81	1963
I-60	"	Igneous rocks of Sabah and Sarawak	"	82~ 94	"
I-61	Collenette P.	Progress report: Pensiangan and Upper Kinabatangan area; (Memoir 12)	"	103-104	"
I-62	Brondijk J.F.	The Danau formation in northwest Borneo	"	167~178	"
I-63	Kirk H.J.C.	Summary of geological results of prospecting by Borneo Mining Limited	"	188~198	"



Number	Author(s)	Title of Report	Bulletin	Page	Year
I-66	Wilson R.A.M.	Regional geology: Northwest Borneo geosyncline	Annual Report of GSM, 1964	79~ 82	1964
I-67	"	Regional geology: Eastern Sabah	"	82~ 86	"
I-68	Kirk H.J.C	Igneous rocks of Sabah and Sarawak	"	87~ 93	"
V-4	Hancock W.G.	The Mount Tawai peridotite, North Borneo	Unpublished Report (Thesis for D Ph.)	1~369	"
I-73	Wilson R.A.M.	Regional geology: Northwest Borneo	Annual Report of GSM, 1965	110~115	1965
I-74	Kirk H.J.C	Igneous rocks of Sabah and Sarawak	"	116~119	"
I-76	Dhonau T.J.	Progress report: The Darvel Bay area, Sabah	"	141~160	"
I-77	Collenette P.	The Garinono Formation, Sabah	"	161~167	"
II-5	"	The geology and mineral resources of the Pensiangan and Upper Kinabatangan area, Sabah, Malaysia	Memoir of GSM (Memoir 12)	1~150 (1~ 118)	"
V-5	Tan B.K.	Studies on the ultrabasic and gneissic complex of Silam and Darvel Bay area, Sabah, Malaysia	Unpublished Report (Thesis for B Sc.)	1~109	"
I-82	Wong N.P.Y.	Regional geology: Eastern Sabah	Annual Report of GSM, 1966	43~ 45	1966
I-83	Kirk H.J.C.	Regional geology: Igneous rocks	"	46~ 48	"
I-84	Newton- Smith J.	Progress report: Bidu- Bidu Hills area	"	58~ 62	"
I-85	Wong N.P.Y.	Progress report: Mount Silam area	"	62~ 68	"
III-7	Stauffer P.H.	Studies in the Crocker Formation, Sabah	Geological Papers of GSM, 1966	1~ 13	"
III-8	Koopmans B.N.	Deformation of the metamorphic rocks and the Chert-Spilitite Formation in the southern part of the Darvel Bay area, Sabah	"	14~ 24	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
III-9	Koopmans B.N., Stauffer P.H.	Glacial phenomena on Mount Kinabalu, Sabah	Geological Papers of GSM, 1966	25~ 35	1966
III-10	Wilford G.E.	Notes on rock weathering at Bukit Kukusan, Tawau, Sabah	"	41~ 42	"
V-6	Hutchison C.S.	Tectonic and petrological relations within three rock associations of orogenic zones in Malaysia	Unpublished Report (Thesis for D Ph.)	1~270	"
V-7	Toh S.C.	Geology of the Lihak Lihak area, Sabah, East Malaysia	Unpublished Report (Thesis for B Sc.)	1~128	"
I-88	Kirk H.J.C.	Regional geology: Eastern Sabah	Annual Report of GSM, 1967	43~ 47	1967
I-89	Wong N.P.Y., Leong K.M.	Progress report: Segama- Darvel Bay area	"	48~ 52	"
I-90	Newton- Smith J.	Progress report: Bidu- Bidu Hills	"	52~ 53	"
I-91	Kirk H.J.C.	Igneous rocks of Sarawak and Sabah	"	62~ 64	"
III-15	Wilford G.E.	Notes on the geomorphology of Sabah	Geological Papers of GSM, 1967	1~ 22	"
III-16	"	Notes on the geology of the Karabakan area	"	23~ 31	"
III-17	Wong N.P.Y., Leong K.M.	Unconformity between the Chert-Spilitic Formation and Crystalline Basement around Sungai Agob and Sungai Dabalan, east Sabah	"	32~ 33	"
III-18	Wong N.P.Y.	Orchid Plateau, Segama area, Sabah	"	34~ 35	"
II-6	Newton- Smith J.	Bidu-Bidu Hills area, Sabah	Report of GSM (Report 4)	1~109 (1~ 67)	"
III-19	Newton- Smith J., Wilford G.E.	Radiocarbon age determination on wood from Kamarangoh, Sabah	Geological Papers of GSM, 1967	36~ 37	"
IV-1	Stauffer P.H.	Glaciation of Mount Kinabalu	Bulletin of Geological Society of Malaysia, No.1	63	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
IV-2	Hutchison C.S.	Tectogene hypothesis applied to the Pre- Tertiary of Sabah and Philippines	Bulletin of Geological Society of Malaysia, No.1	65~ 79	1967
I-95	Wong N.P.Y., Lee D.T.C.	Regional geology: Eastern Sabah	Annual Report of GSM, 1968	74~ 75	1968
I-96	Kirk H.J.C.	Regional geology: Igneous rocks	"	75~ 78	"
I-97	Leong K.M.	Progress report: Segama Valley-Darvel Bay area	"	120~124	"
I-98	G.J.	Progress report: Gunung Kinabalu area	"	126~130	"
II-7	Kirk H.J.C.	The igneous rocks of Sarawak and Sabah	Bulletin of GSM (Bulletin 5)	1~210 (1~93) (108~ 118)	"
I-101	Leong K.M.	Regional geology: Eastern Sabah	Annual Report of GSM, 1969	66~ 87	1969
I-102	"	Regional geology: Igneous rocks	"	68~ 70	"
I-103	"	Progress report: Upper Segama-Darvel Bay area (Memoir 4 revised)	"	186~189	"
I-104	Lee D.T.C.	Progress report: Semporna area	"	190	"
I-105	G.T.	Progress report: Gunung Kinabalu area	"	190~194	"
V-10	Tan T.H.	Geology and soils of the Ranau-Lukan area, Sabah	Unpublished Report (Thesis for B Sc.)	1~ 89	"
V-11	Quah P.H.	Ultrabasics, metabasites and sedimentary rocks of the Morouporou area, southeast of Ranau, Sabah, East Malaysia	"	1~162	"
I-108	Leong K.M.	Regional geology: Eastern Sabah	Annual Report of GSM, 1970	64~ 65	1970
I-109	"	Regional geology: Igneous rocks	"	66~ 68	"
I-110	"	Progress report: Upper Segama and Darvel Bay area, Sabah (Memoir 4 revised)	"	170~180 (170~ 175)	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
II-8	Jacobson G.	Gunong Kinabalu area, Sabah	Report of GSM (Report 8)	1~105 (1~98)	1970
I-111	Lee D.T.C.	Progress report: Semporna area, Sabah	Annual Report of GSM, 1970	180~183 (180~182)	"
IV-3	Leong T.K.	Bouldery mudflow deposit at Ranau, Sabah, East Malaysia	Bulletin of Geological Society of Malaysia, No. 3	139~146	"
V-12	Wong C.B.	Geology and pedology of the Quoin Hill olivine-basalt and associated volcanic areas, Sabah, East Malaysia	Unpublished Report (Thesis for B Sc.)	1~87	"
I-115	Leong K.M.	Regional geology: Eastern Sabah	Annual Report of GSM, 1971	70~71	1971
I-116	"	Regional geology: Igneous rocks	"	72~74	"
I-117	Lee D.T.C.	The geology and mineral resources of the Semporna area	"	145~147	"
I-118	Leong K.M.	Introduction to the geology of the Ranau-Paranchangan area, Sabah	"	148~154 (148~151)	"
I-121	"	Regional geology: Eastern Sabah	Annual Report of GSM, 1972	72~74	1972
I-122	"	Regional geology: Igneous rocks	"	75~77	"
I-123	"	Progress report: Ranau-Paranchangan area (Report 12)	"	239~241	"
I-126	"	Regional geology: Eastern Sabah and Igneous rocks	Annual Report of GSM, 1973	77~81	1973
I-127	Johnston P.J., Walls J.C.	Geology of the Telupid area, Sabah	"	213~220 (213~218)	"
I-128	Leong K.M.	Progress report: Ranau-Paranchangan area (Report 12)	"	220	"
IX-1	Ben-Avraham Z., Uyeda S.	The evolution of the China Basin and Mesozoic paleogeography of Borneo	Earth and planetary science letters 18	365~376	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
I-130	Leong K.M.	Regional geology: Eastern Sabah	Annual Report of GSM, 1974	87~ 88	1974
I-131	"	Regional geology: Igneous rocks	"	89~ 91	"
I-132	Lim P.S.	Progress report: The Gunung Wullersdorf area, Semporna	"	228~232 (228~ 230)	"
I-133	Walls P.J., Johnston J.C.	Progress report: Telupid area, Sabah	"	232~236 (232~ 235)	"
II-9	Leong K.M.	The geology and mineral resources of the Upper Segama Valley and Darvel Bay area, Sabah	Memoir of GSM (Memoir 4 rivised)	1~354 (1~ 272)	"
IX-2	Tokuyama A., Yoshida S.	Kinabalu fault, a large strikeslip fault in Sabah	In Kobayashi T. and Torizawa R. eds; "Geology and paleontology of southeast Asia"; Univ. Tokyo Press, Vol. 14.	175~188	"
I-135	Leong K.M.	Regional geology: Eastern Sabah	Annual Report of GSM, 1975	92~ 94	1975
I-136	"	Regional geology: Igneous rocks	"	94~ 96	"
I-137	Lim P.S.	Progress report: Gunung Wullersdorf area	"	231~236 (231~ 234)	"
I-139	Leong K.M.	Miocene chaotic deposits in eastern Sabah: Characteristics, origin and petroleum prospects (Abstract only)	"	238	"
IX-3	Kosaka H., Wakita K.	Geology amd mineralization of the Mamut Mine, Sabah, Malaysia	Mining Geology, 25. (in Japanese, abstract in English)	303~320 (303~ 309)	"
I-141	Leong K.M.	Regional geology: Eastern Sabah	Annual Report of GSM, 1976	92~ 94	1976
I-142	"	Regional geology: Igneous rocks	"	94~ 96	"
I-144	Lim P.S.	Preliminary notes on the Balung formation, Wullersdorf area, Sabah	Annual Report of GSM, 1976	213~220	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
I-146	Lee D.T.C.	Regional geology: Eastern Sabah	Annual Report of GSM, 1977	82~ 84	1977
I-147	Leong K.M.	Regional geology: Igneous rocks	"	84~ 86	"
I-148	Lim P.S.	Progress report: The geology of the Wullersdorf area, eastern Sabah	"	191~193	"
III-21	Newton- Smith J.	Geology and mineralization at the Mamut copper prospect, Sabah	Geological Papers of GSM, Vol. 2, 1977	55~ 65 (55~ 59)	"
III-22	Myers L.C.	A weathering profile developed on ultrabasic rocks at Telupid, Sabah	"	66~ 71	"
IV-4	Leong K.M.	New ages from radiolarian cherts of the Chert-Spilitite Formation, Sabah	Bulletin of Geological Society of Malaysia, No.8	109~111	"
I-150	Lee D.T.C.	Regional geology: Eastern Sabah	Annual Report of GSM, 1978	102~105	1978
I-151	Leong K.M.	Regional geology: Igneous rocks	"	105~108	"
I-153	Lim P.S.	Preliminary notes on the major element chemistry and chemical affinity of the Semporna volcanics	"	298~305	"
IX-4	Kosaka H., Wakita K.	Some geologic features of the Mamut porphyry copper deposit, Sabah, Malaysia	Economic Geology Vol. 73	618~627 (618~ 623)	"
I-155	Lee D.T.C.	Regional geology: Sabah	Annual Report of GSM, 1979	119~129	1979
IX-5	Haile N.S.	Rotation of the Borneo micro-plate completed by Miocene; paleomagnetic evidence	Warta Geologi, 5	19~ 22	"
IX-6	Hamilton W.	Tectonics of the Indonesian region	USGS Professional Paper 1078	1~348	"
V-16	Goh K.T.K.	Petrology of the ophiolitic rocks of Sungai Kawag area, Sabah	Unpublished Report (Thesis for B Sc.)	1~ 67	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
V-17	Lai H.K.	Geology of the Upper Bole River, Segama Valley, Sabah	Unpublished Report (Thesis for B Sc.)	1~ 68	1979
V-18	Yan A.T.W.	Petrology and geochemistry of the ophiolite suite, Lower Bole area, Lahat Datu, eastern Sabah	"	1~ 59	"
V-19	Gasah L	Petrology and petrochemistry of the volcanic rocks of the eastern region of north Tawau area, Tawau, Sabah	"	1~ 30	"
V-20	Tan G.J.	The geology of lower Umas Umas and Merotai Besar valley, Tawau, Sabah	"	1~ 82	"
I-157	Lee D.T.C.	Regional geology: Sabah	Annual Report of GSM, 1980	121-131	1980
III-24	"	Application of Landsat images to regional geologic studies, with reference to the geology of central and west coast Sabah and adjacent areas	Geological Papers of GSM, Vol. 3, 1980	126-133	"
IV-5	Bol A.J., Hoorn B.V.	Structural styles in western Sabah offshore	Bulletin of Geological Society of Malaysia, No.12	1~ 16	"
IX-7	Uyeda S., Nishiwaki C.	Stress field, metallogenesis and mode of subduction	In "The continental crust and its mineral deposits", edited by D.W. Strangway, Geological Association of Canada Special Paper 20	323-339	"
I-161	Lee D.T.C.	Regional geology: Sabah	Annual Report of GSM, 1981	119-128	1981
I-163	Hoppe P., Liau D.K.H., Weber H.S.	Photogeological investigation of the Gunung Wullersdorf area	"	369-386	"
II-10	Lim P.S.	Wullersdorf area, Sabah, Malaysia	Report of GSM (Report 15)	1-106 (1~ 80)	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
IV-6	Holloway N.H.	The north Palawan block, Philippines: its relation to the Asian mainland and its role in the evolution of the South China Sea	Bulletin of Geological Society of Malaysia, No.14	19~ 58	1981
IX-8	Nishiwaki C.	Tectonic control of porphyry copper genesis in the southwestern Pacific island arc region	Mining Geology 31, (in Japanese, abstract in English)	131~146	"
I-166	Lee D.T.C.	Regional geology Sabah	Annual Report of GSM, 1982	106~114	1982
I-167	Lim P.S.	Geology of the Mankadau area, Merungin, Sabah	"	251~254 (251~ 253)	"
IX-9	Holloway N.H.	The north Palawan block, Philippines-Its relation to the Asian mainland and its role in the evolution of South China Sea	The American Association of Petroleum Geologist Bulletin, Vol 66, No. 9	1355~ 1383	"
V-21	Tungah Surat	Petrology and geochemistry of the ophiolitic rocks of the upper Mailo area, Telupid, Sabah	Unpublished Report (Thesis for B Sc.)	1~ 39	"
V-22	Osman R.M.	Geology of Telupid, Sabah, with emphasis on the ophiolite	"	1~ 59	"
VI-5	Hoppe P.	Report on photogeology of the Paranchangan-Sungai Paliu area	Unpublished Report (Joint Malaysian-German mineral exploration project)	1~ 10	"
VI-6	"	Reconnaissance photogeology of Trusmadi area	"	1~ 12	"
VI-7	"	Report on photogeology of Kinabalu and Bidu-Bidu Hills	"	1~ 13	"
I-171	Lee D.T.C.	Regional geology: Sabah	Annual Report of GSM, 1983	112~121	1983
I-174	Lim P.S.	History of earthquake activities in Sabah, 1897-1983	"	350~357	"



Number	Author(s)	Title of Report	Bulletin	Page	Year
I-176	Lee D.T.C.	Regional geology: Sabah	Annual Report of GSM, 1984	116~126	1984
I-177	Tungah S.	Brief geology of the Karamuak area, Sabah	"	330~333	"
I-180	Lee D.T.C.	Regional geology: Sabah	Annual Report of GSM, 1985	122~131	1985
I-183	Lim P.S.	Seismic activities in Sabah and their relationship to regional tectonics	"	465~480	"
IV-7	Levell B., Kasumajaya A.	Slumping at the late Miocene shelf-edge offshore West Sabah: a view of a turbidite basin margin	Bulletin of Geological Society of Malaysia, No. 18	1~ 29	"
IV-8	Wood B.G.M.	The mechanics of progressive deformation in crustal plates-A working model for Southeast Asia	"	55~ 99	"
I-185	Lee D.T.C.	Regional geology: Sabah	Annual Report of GSM, 1986	66~ 75	1986
I-190	Yan A.S.W.	Progress report: Geological mapping, Gunung Meliau area, Sheet 5/117/1, Sabah	"	580~590 (580~588)	"
IV-9	McManus J., Tate R.B.	Mud volcanoes and the origin of chaotic deposits in Sabah	Bulletin of Geological Society of Malaysia, No. 19	193~205	"
I-192		Regional geology: Sabah	Annual Report of GSM, 1987	51~ 59	1987
I-197	Lim P.S.	Geology and geothermal potential of the Tawau area, Sabah	"	402~413	"
IV-11	Levell B.K.	The nature and significance of regional unconformities in the hydrocarbon-bearing Neogene sequence offshore West Sabah	Bulletin of Geological Society of Malaysia, No. 21	55~ 90	"
I-199		Regional geology: Sabah	Annual Report of GSM, 1988	67~ 75	1988
II-11	Lee D.T.C	Gunung Pock area, Semporna Peninsula, Sabah, Malaysia	Report of GSM, (Report 9)	1~120 (1~ 65)	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
IX-10	Jolivet L., Huchon P., Rangin C.	Tectonic setting of Western Pacific marginal basins	Tectonophysics, 160,	23~ 47	1989
IX-11	Rangin C.	The Sulu Sea, a back-arc basin setting within a Neogene collision zone	Tectonophysics, 161	119~141	"
IX-12	Gower R.J.W.	Early Tertiary plate reconstructions for the South China Sea region: constraints from northwest Borneo	Journal of Southeast Asian Earth Sciences, Vol. 4, No. 1	29~ 35	1990

[Note] GSM: Geological Survey of Malaysia

Table 13 B. Mineral Resources, Mineral Occurrences, Mineral Deposits

Number	Author(s)	Title of Report	Bulletin	Page	Year
I-1	Fitch F.H.	The mineral resources of the Colony of North Borneo	Annual Report of GSM, 1949	57~ 69	1949
I-2	"	The mineral resources of North Borneo	Annual Report of GSM, 1950	49	1950
I-4	"	Progress report: Geological reconnaissance of the Segama River and Darvel Bay region	Annual Report of GSM, 1951	68~ 87 (84)	1951
I-5	"	Mineral resources of North Borneo	Annual Report of GSM, 1952	96~ 99	1952
I-10	"	Mineral resources of North Borneo	Annual Report of GSM, 1954	88~ 94	1954
I-13	"	Progress report: Geological Reconnaissance of the Labuk Valley	"	106~110 (105)	"
I-15	Collenette P.	Progress report: Geological reconnaissance of the Kinabalu area	"	110~125 (123)	"
I-16	Stephenes E.A.	Progress report: The manganese deposits at Taritipan, Marudu Bay, with an account of the regional geology	"	125~166	"
II-1	Fitch F.H.	The geology and mineral resources of part of the Segama Valley and Darvel Bay area, Colony of North Borneo	Memoir of GSM (Memoir 4)	1~142 (113~125)	1955
I-18	Roe F.W.	Mineral resources of North Borneo	Annual Report of GSM, 1956	130~133	1956
I-19	Fitch F.H.	Geology of the Sandakan area and parts of the Kinabatangan and Labuk valleys	"	134~167 (156~167)	"
I-20	Collenette P.	Geology and mineral of the Jesselton - Kinabalu area	"	166~177	"
I-21	Stephenes E.A.	Geology and mineral resources of the Kota Belud and Kudat area	"	177~182 (181~182)	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
I-24	Roe F.W.	Mineral resources of North Borneo	Annual Report of GSM, 1957	127~130	1957
I-25	Fitch F.H.	Geology of the Sandakan area and parts of the Kinabatangan and Labuk valleys; Memoir 9	"	130~151 (140~145)	"
I-27	Collenette P.	Chromite deposit at Paranchangan	"	164~168	"
I-29	Roe F.W.	Mineral resources of North Borneo	Annual Report of GSM, 1958	146~150	1958
I-30	Fitch F.H.	Geology of the Sandakan area and parts of the Kinabatangan and Labuk valleys, Memoir 9	"	150~153 (151)	"
I-31	Collenette P.	Pensiangan and upper Kinabatangan survey; Memoir 12	"	154~170 (170)	"
I-33	Kirk H.J.C.	Geology and mineral resources of the Semporna peninsula; Memoir 14	"	191~206 (200~206)	"
II-2	Fitch F.H.	The geology and mineral resources of the Sandakan area and parts of the Kinabatangan and Labuk valleys, North Borneo	Memoir of GSM (Memoir 9)	1~202 (115~124) (174~187)	"
I-36	Roe F.W.	Mineral resources of North Borneo	Annual Report of GSM, 1959	92~102	1959
I-39	Wilson R.A.M.	Banggi island and Sugut river area; Memoir 15	"	154~181 (172~181)	"
I-41	Collenette P.	Mineral resources of North Borneo	Annual Report of GSM, 1960	68~ 76	1960
I-45	Kirk H.J.C.	Semporna peninsula, North Borneo; Memoir 14	"	106~123 (111~114)	"
V-1	Walker P.B.	Secondary dispersion of copper and chromium from mineral deposits in North Borneo	Unpublished Report (Thesis for M Sc.)	1-253	"
I-46	Wilson R.A.M.	North Borneo Mineral Resources	Annual Report of GSM, 1961	59~ 70	1961

Number	Author(s)	Title of Report	Bulletin	Page	Year
III-5	Walker P.B., Tooms J. S.	Secondary dispersion of copper from the Karang lode, North Borneo	Proceedings of the British Borneo geological conference 1961	91~118	1961
V-2	Sevillano A.C.	Secondary dispersion of copper, molybdenum, tungsten and nickel in Mount Nungkok area, Sabah, Malaysia	Unpublished Report (Thesis for M Sc.)	1~125 (19~125)	"
I-52	Kirk H.J.C.	North Borneo mineral resources	Annual Report of GSM, 1962	141~152	1962
I-53	Wilson R.A.M.	Nickeliferous laterite in the Taguuk area, Labuk valley, North Borneo	"	152~155	"
I-54	Kirk H.J.C.	Cinnabar near Ranau, North Borneo	"	155~157	"
II-4	"	The geology and mineral resources of the Semporna Peninsula, North Borneo	Memoir of GSM (Memoir 14)	1~178 (163~168)	"
I-57	Collenette P.	Mineral resources of Sabah	Annual Report of GSM, 1963	30~ 40	1963
I-64	"	Mineral resources of Sabah	Annual Report of GSM, 1964	44~ 56	1964
I-69	Newton-Smith J.	Progress report: Bidu Bidu Hills, Sabah	"	114~121	"
I-72	Newton-Smith J.	Copper mineralization in River Mamut area, Kinabalu, Sabah	Annual Report of GSM, 1965	88~ 96	1965
I-75	"	Progress report: Bidu-Bidu Hills, Sabah	"	134~140	"
II-5	Collenette P.	The geology and mineral resources of the Pensiangan and Upper Kinabatangan area, Sabah	Memoir of GSM (Memoir 12)	1~150 (119~132)	"
I-81	"	Mineral resources of Sabah	Annual Report of GSM, 1966	23~ 32	1966
I-85	Wong N.P.Y.	Progress report: Mount Silam area	"	62~ 68 (66~ 67)	"
III-11	Kirk H.J.C.	Hydrothermal mineralization and igneous rocks in East Malaysia	Geological Papers of GSM, 1966	53~ 61	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
III-13	Kirk H.J.C.	The Mamut copper prospect, Kinabalu, Sabah	Geological Papers of GSM, 1966	68~ 80 (72~ 78)	1966
III-14	Wong N.P.Y.	Geology and copper mineralization of the Bambang valley, Kinabalu, Sabah	"	81~ 88	"
I-87	Wilford G.E.	Mineral resources of Sabah	Annual Report of GSM, 1967	22~ 32	1967
II-6	Newton-Smith J.	Bidu Bidu Hills area, Sabah	Report of GSM (Report 4)	1~109 (68~ 103)	"
I-94	Wong N.P.Y.	Mineral resources of Sabah	Annual Report of GSM, 1968	43~ 52	1968
II-7	Kirk H.J.C.	The igneous rocks of Sarawak and Sabah	Bulletin of GSM (Bulletin 5)	1~210 (94~ 107)	"
V-9	Newton-Smith J.	Geology and mineralization at the Mamut copper prospect, Sabah	Unpublished Report (Thesis for D.I.C.)	1~142	"
I-100	Wong N.P.Y., Lee D.T.C.	Mineral resources of Sabah	Annual Report of GSM, 1969	35~ 44	1969
I-107	Lee D.T.C.	Mineral resources of Sabah	Annual Report of GSM, 1970	33~ 42	1970
I-110	Leong K.M.	Progress report: Upper Segama and Darvel Bay area, Sabah (Memoir 4 revised)	"	170~180 (178~ 180)	"
I-111	Lee D.T.C.	Progress report: Semporna area, Sabah	"	180~183 (182~ 183)	"
I-113	"	Search for mercury, Kenipir Valley, southeast of Ranau	"	202~203	"
II-8	Jacobson G.	Gunong Kinabalu area, Sabah	Report of GSM (Report 8)	1~105 (99~ 101)	"
I-114	Lee D.T.C.	Mineral resources of Sabah	Annual Report of GSM, 1971	38~ 48	1971
I-118	Leong K.M.	Introduction to the geology of the Ranau-Paranchangan area, Sabah	"	148~154 (151~ 154)	"

Number	Author(s)	Title of Report	Bulletin	Page	Year
I-120	Lee D.T.C.	Mineral resources of Sabah	Annual Report of GSM, 1972	40~ 50	1972
I-125	Lee D.T.C.	Mineral resources of Sabah	Annual Report of GSM, 1973	47~ 55	1973
I-127	Johnston P.J., Walls J.C.	Geology of the Telupid area, Sabah	"	213~220 (218~ 219)	"
V-13	Lim P.S.	Geology and copper mineralization of the Mamut area, Sabah	Unpublished Report (Thesis for B Sc.)	1~116	"
I-129	Lee D.T.C.	Mineral resources of Sabah	Annual Report of GSM, 1974	56~ 65	1974
I-132	Lim P.S.	Progress report: The Gunung Wullersdorf area, Semporna	"	228~232 (231~ 232)	"
I-133	Walls, P.J., Johnston J.C.	Progress report: Telupid area, Sabah	"	232~236 (235~ 236)	"
II-9	Leong K.M.	The geology and mineral resources of the Upper Segama Valley and Darvel Bay area, Sabah	Memoir of GSM (Memoir 4 revised)	1~348 (273~ 316)	"
I-134	Lee D.T.C.	Mineral resources of Sabah	Annual Report of G S M, 1975	61~ 70	1975
I-137	Lim P.S.	Progress report: Gunung Wullersdorf area	"	231~236 (235~ 236)	"
IX-3	Kosaka H., Wakita K.	Geology and mineralization of the Mamut Mine, Sabah, Malaysia	Mining Geology, 25 (in Japanese, abstract in English)	303~320 (310~ 318)	"
I-140	Lee D.T.C.	Mineral resources of Sabah	Annual Report of GSM, 1976	62~ 70	1976
V-14	Nagano K.	On the mineralization and ore-forming fluids of porphyry copper deposits, with special reference to the Mamut Mine	Unpublished Report	1~135	"
V-15	Bull P.F.	The Gunung Nungkok copper prospect	Unpublished Report (Thesis for M Sc.)	1~137 (12~ 24)	"
I-145	Lee D.T.C.	Mineral resources of Sabah	Annual Report of GSM, 1977	55~ 63	1977