第Ⅲ部　結論及び提言

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第１章　既存資料の解析結果に基づく結論

既存資料を調べた限りでは，サバ州で最もベースメタルの鉱床賦存の可能性のあるのは，1982年ボーリングにより発見されて以来試錐探鉱が行われ，現在フィーズビリティ・スタデーを実施中のサバ州中央部のBidu Bidu Hills 地域のWest-Sualog のキプロスタイプ含銅塊状硫化物鉱床と同タイプの鉱床と考えられる。West-Sualog 鉱床は白亜紀－始新世の "Chert-Spilite Formation"に属するオフィオライト質岩石に伴われており，鉱体の下盤は玄武岩，上盤は頁岩である。Chert-Spilite Formation はサバ州に比較的広く分布しているので，Chert-Spilite Formation に属するオフィオライト質岩石に伴ったWest-Sualog タイプの塊状硫化物鉱床の賦存の可能性は未だあると思う。

次に可能性のあるのは，斑岩銅鉱床タイプの鉱床と考える。Mamut 鉱床周辺のKinabalu地域では，斑岩銅鉱床の探鉱がかなり行われたが，その他の地域ではあまり行われていない。Kinabalu 地域に次いで斑岩銅鉱床タイプの鉱床賦存の可能性のあるのはSemporna半島のPock山及びMantri山-Wullersdorf山の両地域と考える。これら両地域では斑岩銅鉱床そのものの露頭はないが，亜鉛－鉛－銅－石英よりなる細脈～微細脈が珪化された鮮新世の石英安山岩及び安山中にみられる。Pock山地域では微閃緑岩が石英安山岩中に貫入している。石英安山岩及び安山岩には珪化作用の他，緑泥石化，緑簾石化，炭酸塩化，絹雲母化，黄鉄鉱化，カオリン化などの熱水変質作用がみられる。

緑泥石，緑簾石，炭酸塩鉱物の鉱物組み合わせは緑泥石，緑簾石，炭酸塩鉱物，氷長石，曹長石よりなり，斑岩銅鉱床に伴う熱水変質帯のうちの最も外側に発達しているPropylitic帯，石英，カオリン，緑泥石の鉱物組み合わせはPropylitic帯の内側に発達するArgillic帯，石英，絹雲母，黄鉄鉱の組み合わせはPropylitic帯及びArgillic帯の内側に発達するPhyllic 帯を示唆している可能性がある。

鉛－亜鉛－銅－石英よりなる細脈～微細脈は黄銅鉱，方鉛鉱，閃亜鉛鉱，金，銀よりなり，斑岩銅鉱床の周辺部の最も外側に発達する鉱脈帯あるいはその内側の細脈帯に相当する可能性がある。

以上から，斑岩銅鉱床は関連する貫入岩とともに潜頭している可能性があり，亜鉛・鉛・銅の鉱化作用及び熱水変質作用は潜頭せる斑岩銅鉱床の上部或いは周辺の徴候を示唆しているのではないかと考えられる。

第２章　今後の調査に対する提言

本地域において多数の探鉱が実施され，多くの有望地が抽出されているものの，手法・精度が様々であり，統一的に評価することが困難である。従って，先ず第１に全地域を総合的に評価す

るために，同一規準による地化学探鉱の実施を提言する。その際，解析を効果的に行うため，地化学探鉱を実施した地域の地質調査を同時に行うことが望ましい。

次段階として，抽出された有望地での詳細な探鉱の実施が望まれる。現地点では，オフィオライトを伴うChert-Spilite Formation の分布している地域及び Semporna 半島の Pock 山周辺・Mantri-Wullersdorf山地域が有望と推察される。

FIGURE 9

PETA TABURAN GALIAN SABAH
(MINERAL DISTRIBUTION MAP OF SABAH)
MALAYSIA

1st. EDITION

SCALE 1:500,000

10 5 0 10 20 30 Miles

10 5 0 10 20 30 40 Kilometres

SEDIMENTARY AND SEDIMENTARY-VOLCANIC ROCKS

- Alluvium, peat, coral, sand, silt, mud, clay and gravel (Pleistocene - Recent)
- Sandstone, limestone, shale, marl, mudstone, conglomerate, coal beds (Miocene - Pleistocene)
- Tuffaceous sandstone and mudstone, conglomerate, volcanic breccia, agglomerate, tuff (Miocene - Pliocene)
- Sandstone, shale, mudstone, stump breccia, chert, tuff, some limestone and coal beds (Oligocene - Miocene)
- Sandstone, shale, phyllite, argillite, some limestone and volcanic rocks (Palaeocene - Oligocene)
- Sandstone, shale, limestone, chert, tuff, spilite, basalt, volcanic breccia, agglomerate (Cretaceous - Early Tertiary)

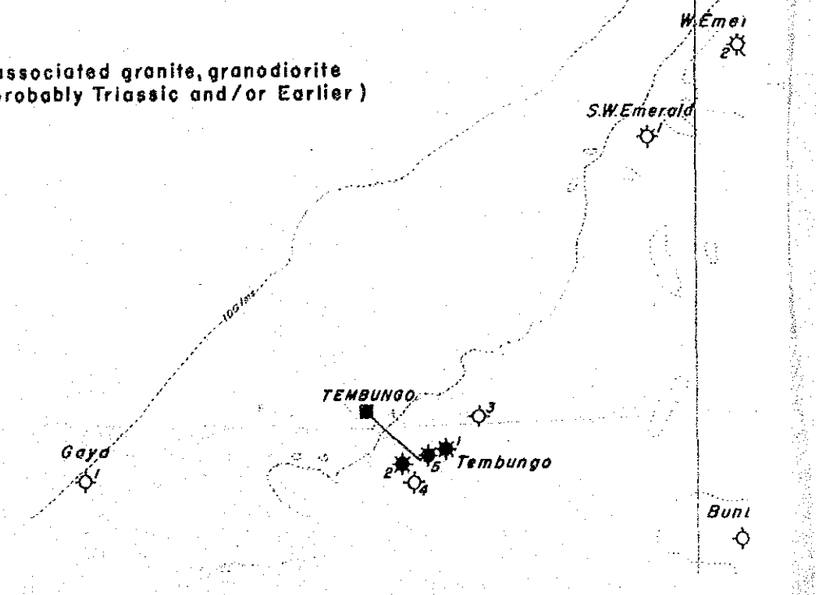
IGNEOUS AND METAMORPHIC ROCKS

- Olivine basalt and dacite lava, pyroclastic rocks, andesite, tuff and silicified volcanic rocks (Pliocene - Quaternary)
- Adamellite, granodiorite, tonalite, tonalite porphyry and other hypabyssal rocks (Upper Miocene - Pliocene)
- Gabbro, dolerite (Cretaceous - Early Tertiary)
- Serpentinite, peridotite, dunite, pyroxenite (Cretaceous - Early Tertiary)
- Gneiss, schist, amphibolite and associated granite, granodiorite and tonalite (Pre - Cretaceous, probably Triassic and/or Earlier)

TOPOGRAPHICAL SYMBOLS

- Road (major)
- Other roads
- Railway
- Main town
- Other settlement
- Major airfield
- Airstrip
- Summit of mountain or hill with height in feet
- Marine contour with depth in fathoms
- International boundary
- State boundary

Bukit	Bt	hill
Gunung	G	mountain
Kampung	Kpg	village
Kuala	K	river mouth
Pulau	P	island
Sungai	S	river
Tanjung	Tg	cape, headland



MINERAL GROUPS

Based on the properties, uses, and significance of the minerals

- Major Metals
- Other Metals (used mainly in alloys)
- Precious Metals and Gemstones
- Industrial (non-metallic) Minerals and Rocks
- Fuels
- Clays and Constructional Stone
- Other Minerals

Note: Construction materials such as coral, gravel and sand collected near shore, beaches and from rivers are not shown. Several of the clay deposits produce bricks. Many of the constructional stone deposits are producing crush rock; only some deposits estimated to contain more than 100,000 cu.yds. of stone are shown on the map

SIZE OF DEPOSITS

Two symbol sizes are used; e.g.

- ◯ Large deposit, or significant prospect
- ○ Occurrence

LETTER STYLE

- Cr *in situ* occurrence
- *Cr* alluvial, float or block

FRAME SYMBOL

Where two or more different minerals occur at a locality, the symbols denoting the minerals are enclosed by a block frame

- Minerals occur in the same deposit or in closely related deposits or same rock sample
- Minerals occur in unrelated deposit but at the same locality

ALPHABETICAL LIST OF MINERALS

MINERAL NAME AND LETTER		SIZE OF DEPOSITS		MINERAL NAME AND LETTER		SIZE OF DEPOSITS	
Aluminium Aluminous laterite	Al AlFe		▲	Magnesite	Mg		●
Antimony	Sb		✚	Magnetite see *black sand minerals*			
Asbestos; chrysotile	Ac		●	Manganese Manganiferous limonite (or laterite)	Mn MnFe	✖	✖
Bauxite - see *aluminium*				Mercury	Hg		●
Bentonite, bentontic clay, fuller's earth	Bn		●	Mica	M		▮
Black sand minerals: ilmenite and magnetite; for chromite sand, see *chromium*	Bim		◆	Molybdenum	Mo		●
Chromium	Cr	●	●	Monazite	Mon		▼
Clay: brick and pottery	Cl		●	Natural gas - see *oil, gas and other symbols*			
Coal (p: peat)	C	⬟	⬟	Nickel Nickeliferous laterite	Ni NiFe	●	●
Copper	Cu	■	■	Petroleum - see *oil, gas and other symbols*			
Dolomite, magnesium limestone	Do		▮	Phosphate rock, guano, cave earth	P	▬	▬
Gemstones: agate	Ge		□	Pyrite Pyrrhotite (significant occurrence only)	Pyr Pyrr		✸
Gold	Au	⬭	○	Salt - see *oil, gas and other symbols*			
Guano and cave earth - see *phosphate rock*				Silica - quartz pebble, silica sand, quartz	Si	■	■
Gypsum	Gy		▲	Silver	Ag	▽	▽
Ilmenite - see *black sand minerals*				Stone, constructional	St		●
Iron, iron-rich laterite	Fe	◆	◆	Talc	Tl		●
Lead	Pb		●	Tungsten	Ts		▼
Limestone, coral limestone	Ls	L	L	Zinc	Zn		●

OIL, GAS AND OTHER SYMBOLS

- Well with no hydrocarbon shows or data lacking
- Well with gas shows
- Well with oil shows
- Well with oil and gas shows
- Well with significant gas shows
- Well with significant oil shows
- Well with significant oil and gas shows
- Oil production platform
- Isolated oil-producing well
- Hydrocarbon smell
- Oil seepage, impregnation
- Gas seepage
- Oil and gas seepages
- Mud volcano, mostly with gas seepage
- Mud volcano with saline water

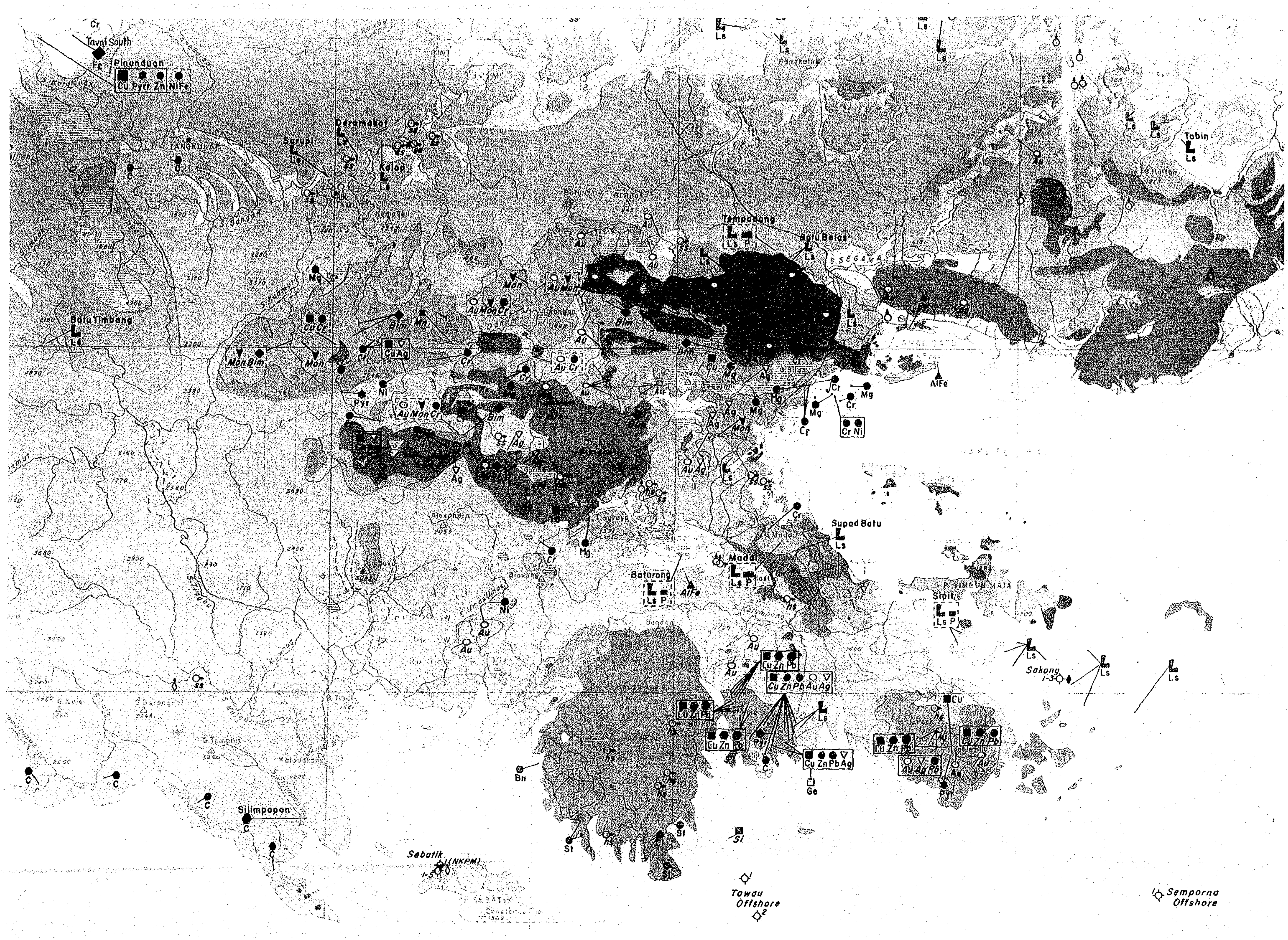
SUMMARY OF MINERAL PRODUCTION IN SABAH

Manganese ore was mined at Taritipan from 1903 to 1908 with total production at less than 6,000 tons.

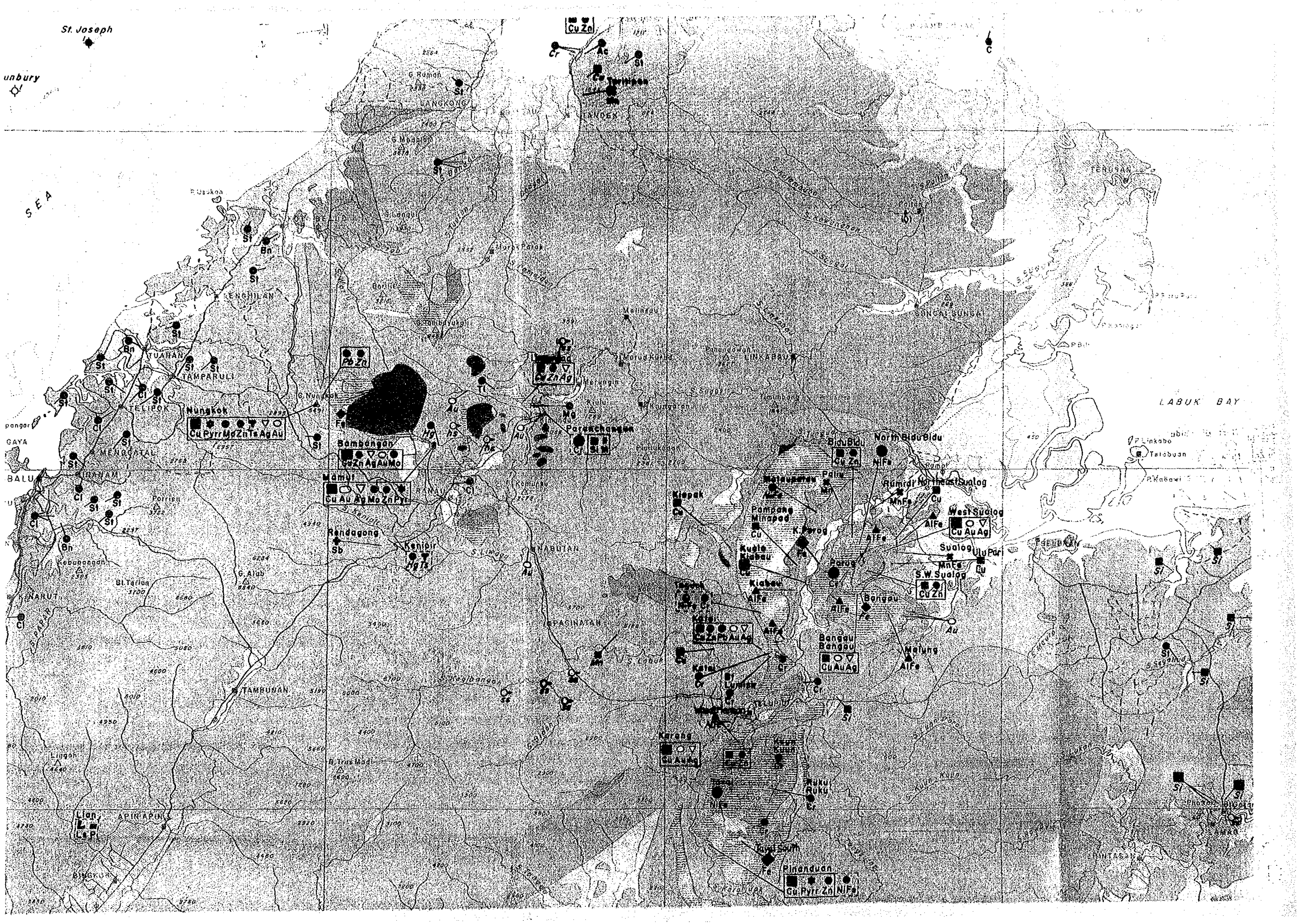
Gold has been prospected for the last 90 years in the Upper Segama River and Darvel Bay region. No large payable alluvial deposits were found; only small amounts were obtained from Sungai Segama, Bole and Sabahan.

Coal has been mined at Silimpopon and on Labuan Island. At Silimpopon, a colliery operated from 1905 to 1932 and produced about 1½ million tons of coal. A survey from 1950 to 1952 showed that 14 million tons of high rank sub-bituminous coal may remain. At Labuan, coal was produced for more than 60 years from 1847 until 1912, but total production was only half a million ton. An investigation in 1948 showed that 9 million tons of sub-bituminous non-coking coal may still exist.

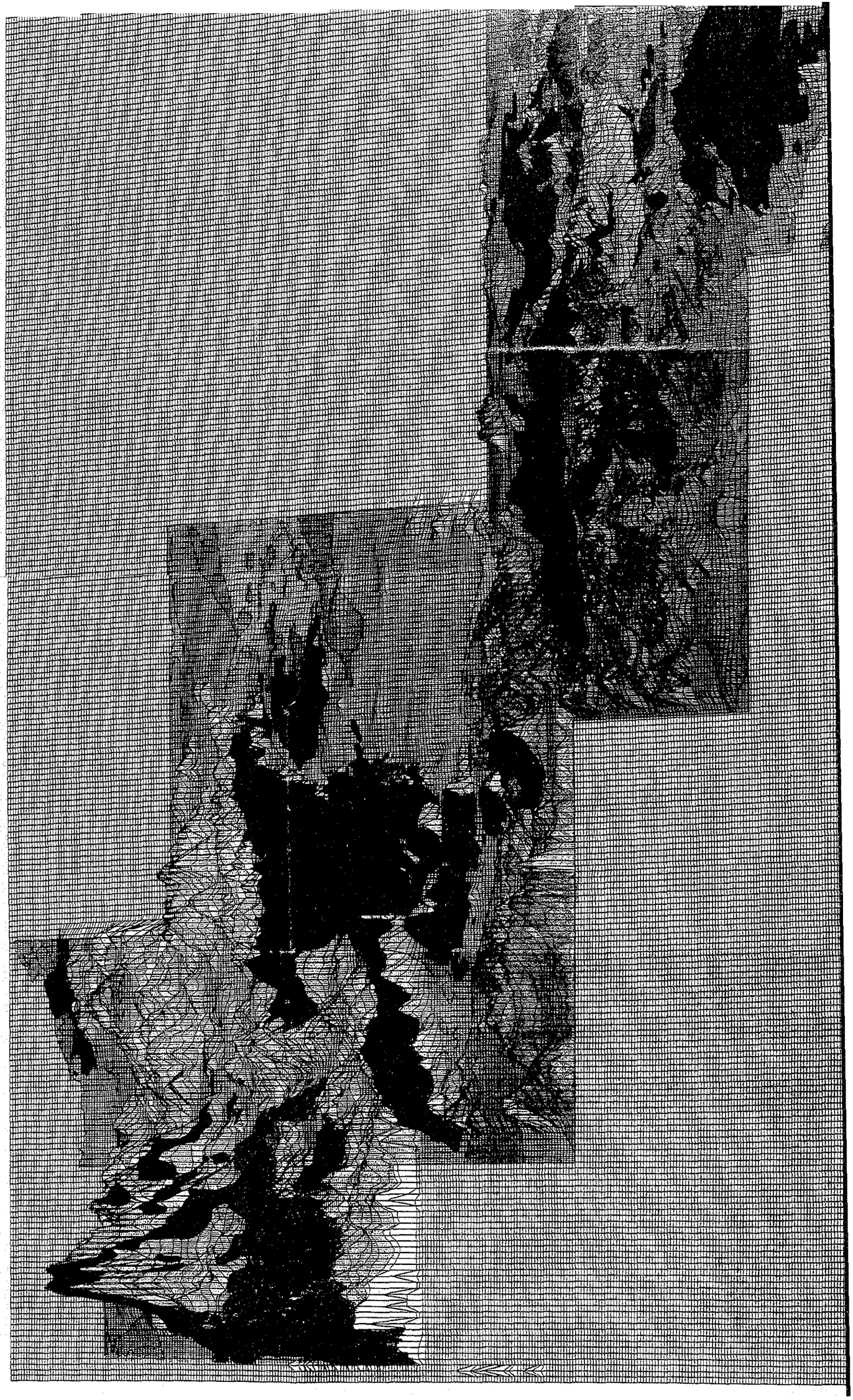
From the closure of the coal mines until late

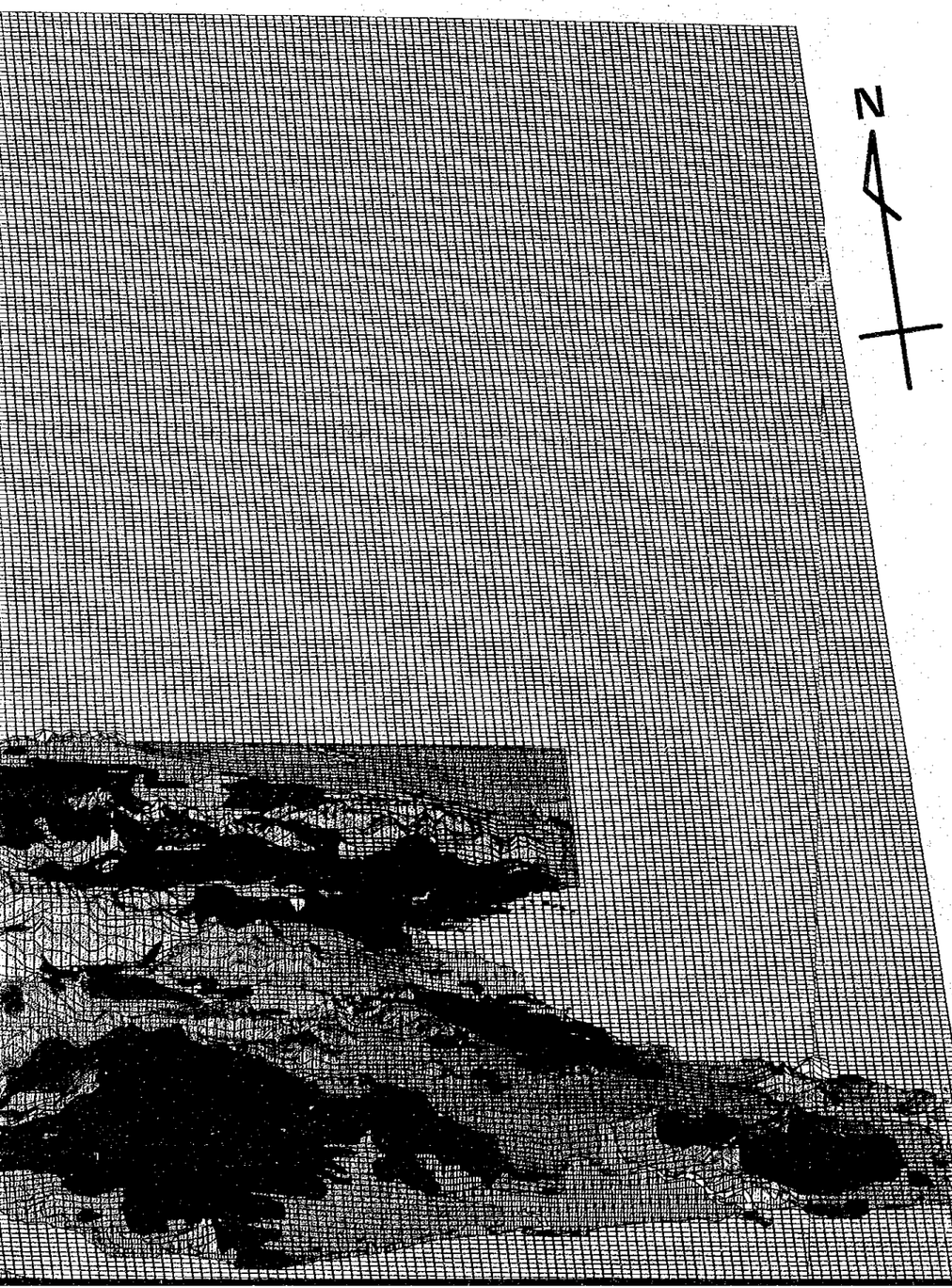


Tavat South
Fe
Pinanduan
Cu Pyr Zn NiFe
Deramakot
Sarupi
Kalap
Batu Timbang
Tempadong
Batu Belas
Tabin
Mon Bim
Cu Cr
Cu Ag
Au Mon Cr
Au Cr
Cr Ni
AlFe
Supad Batu
Madai
Baturong
Slpit
Sakong
Cu Zn Pb
Cu Zn Pb Au Ag
Cu Zn Pb Ag
Au Ag Pb
Bn
Ge
Silimpopon
Sebatik
Tawau Offshore
Semporna Offshore



St. Joseph
unbury
SEA
LABUK BAY
LANGKONG
TANDEK
Taritipan
Cu Zn
Cr
Ac
St
Cu
TUARAN
TAMPARULI
TELIPOK
MENGGATAL
INANAM
BALU
GAYA
KINARUT
S. PAPAR
KENGHILAN
Nungkok
Cu Pyrr Mo Zn Ts Ag Au
Pb Zn
Fe
Bambangan
Cu Zn Ag Au Mo
Mamut
Cu Au Ag Mo Zn Pyr
RANAU
Hg
Au
hs
Ti
Cl
Mg
Cu Zn Ag
Parenchangan
Cl
Si Ni
Rendagong
Sb
Kenipir
Hg Ts
S. Liwagu
NABUTAN
PAGINATAN
TAMBUNAN
G. Alab
Porrien
Kebubongan
Lingan
APIN APIN
Lian
L
Ls P
BINGKOR
LINKABAU
Melinsau
SONGAI SUNGAI
TERUSAN
Paitan
Bidu Bidu
Cu Zn
North Bidu Bidu
Ni Fe
Kiepak
Cu
K. Parog
Fe
Parog
Cr
Kiabau
Al Fe
Bangau
Fe
Bangau Bangau
Cu Au Ag
Malung
Al Fe
Rumidi
Mn Fe
Northeast Sualog
Cu
West Sualog
Cu Au Ag
Sualog
Mn Fe
Ulu Pari
Cu
S.W. Sualog
Cu Zn
Au
Si
Karang
Cu Au Ag
Ruku Ruku
Cr
Ni Fe
Pinanduan
Cu Pyrr Zn
Ni Fe
Fe
P. Linkabo
Taisbuan
P. Kabawi
PINTASAN





N

SEDIMENTARY AND SEDIMENTARY-VOLCANIC ROCKS

- RECENT
- PLEISTOCENE
- MIDDLE MIOCENE - PLIOCENE
  (Ganduman, Bongaya, Sandakan, Umas Umas, Sebahat, Belait)
- MIDDLE MIOCENE
  (Tungku, Tabanak conglomerate, Libong Tuffite)
- EARLY MIOCENE - MIDDLE MIOCENE
  (Tanjong, Meligan, South Banggi, Kapilit)
- OLIGOCENE - MIDDLE MIOCENE
  (Garinono, Ayer, Kuamut, Kalabakan, Wariu, Kalumpang)
- OLIGOCENE
  (Kudat, Labang, Temburong)
- EOCENE - OLIGOCENE
  (Kulapis)
- PALAEOCENE - EOCENE
  (Trusmadi)
- LATE CRETACEOUS - LATE EOCENE
  (Sapulut)
- CRETACEOUS - EOCENE
  (Chert-Spilite)
- EARLY CRETACEOUS
  (Madai-Baturong Limestone)

IGNEOUS AND METAMORPHIC ROCKS

- BASALT AND DACITE
  (PLEISTOCENE - HOLOCENE)
- DACITIC AND ANDESITIC PYROCLASTIC ROCKS & LAVA, DIORITE, MICROGRANODIORITE, MICROGRANITE, TONALITE (PLIOCENE)

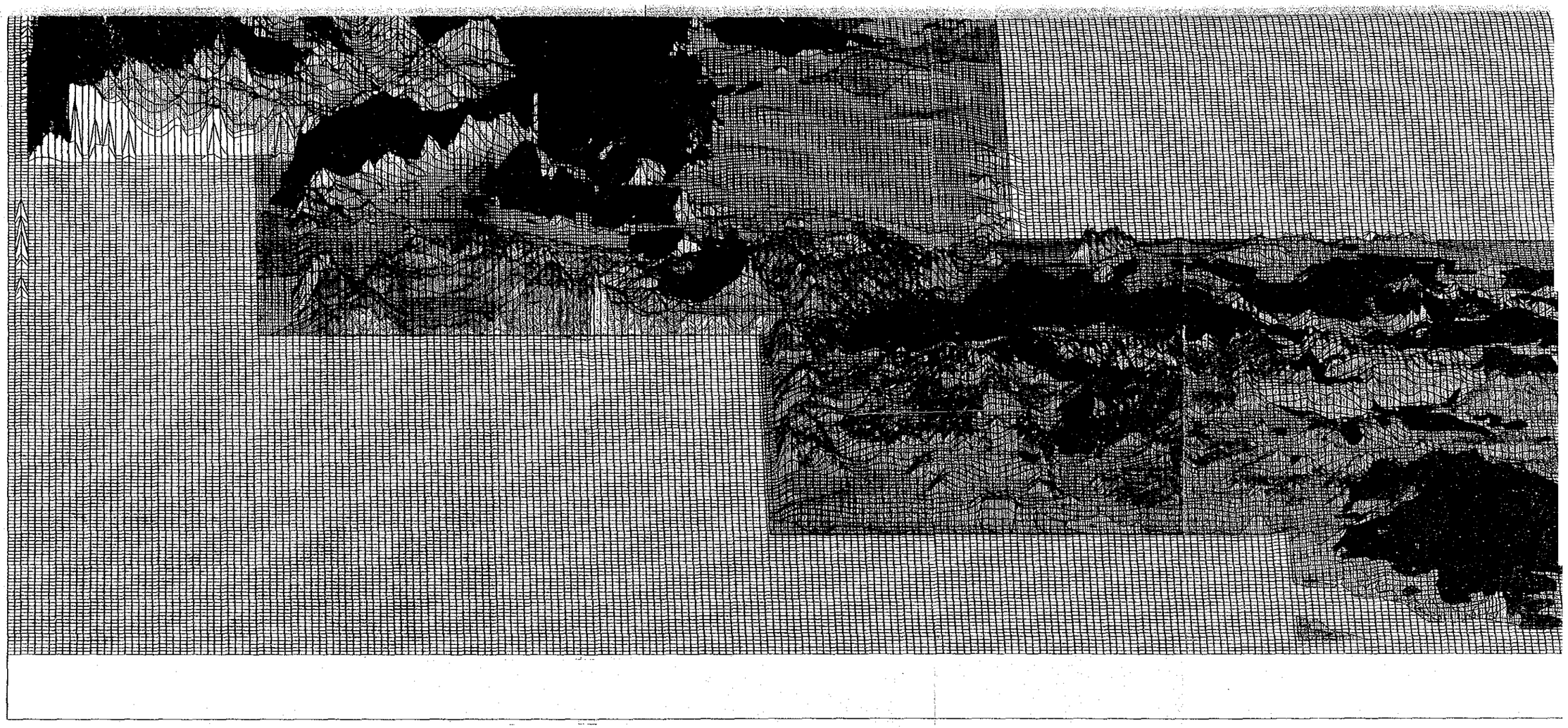
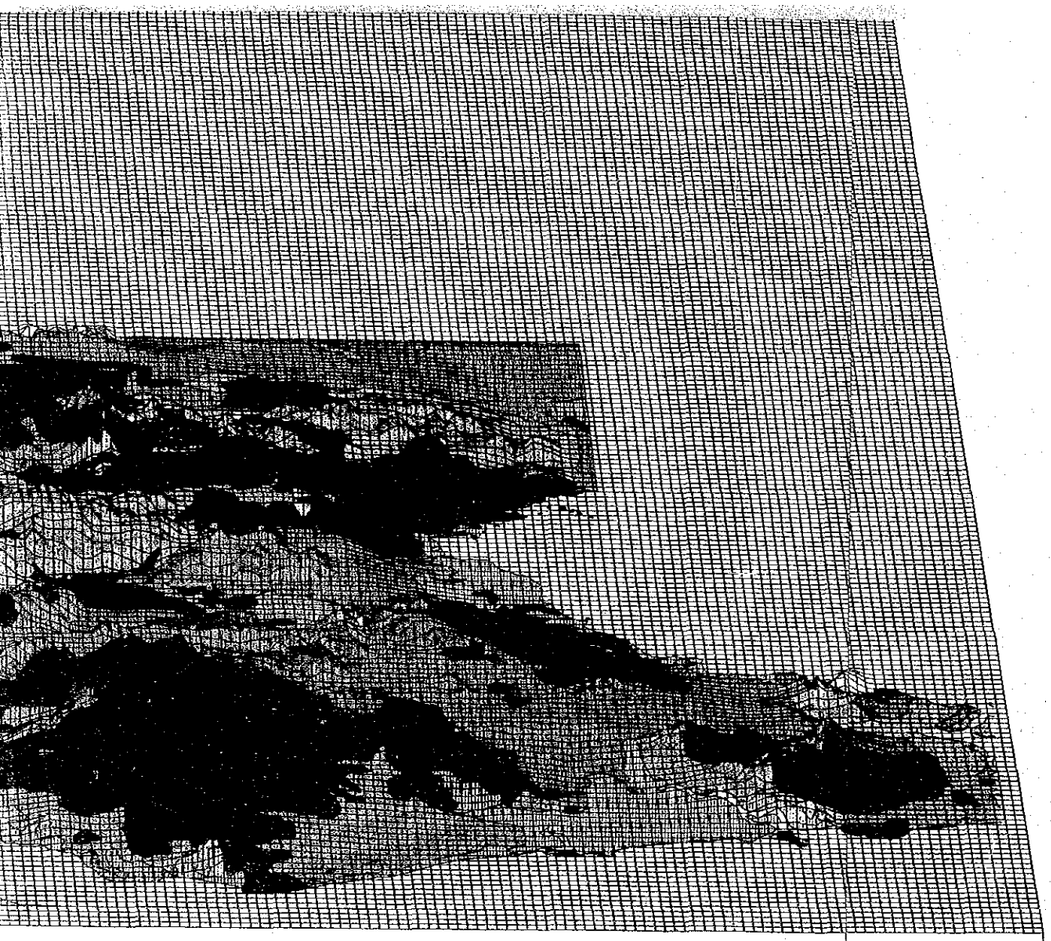


図１１－１　マレーシア　サバ州　地質鳥瞰図

（地質、Ａｎｎｅｘ　２）



垂直縮尺　1:1,000,000
水平縮尺　1: 430,000

俯　　角　30度
方 位 角　南
高さ倍率　15×

OLIGOCENE
(Kudat, Labang, Temburong)

EOCENE - OLIGOCENE
(Kulapis)

PALAEOCENE - EOCENE
(Trusmadi)

LATE CRETACEOUS - LATE EOCENE
(Sapulut)

CRETACEOUS - EOCENE
(Chert-Spilite)

EARLY CRETACEOUS
(Madai-Baturong Limestone)

IGNEOUS AND METAMORPHIC ROCKS

BASALT AND DACITE
(PLEISTOCENE - HOLOCENE)

DACITIC AND ANDESITIC PYROCLASTIC ROCKS & LAVA, DIORITE, MICROGRANODIORITE, MICROGRANITE, TONALITE (PLIOCENE)

ADAMELLITE, GRANODIORITE
(LATE MIOCENE - PLIOCENE)

GABBRO, DOLERITE, SERPENTINITE, PERIDOTITE, DUNITE, PYROXENITE
(CRETACEOUS - EARLY TERTIARY)

CRYSTALLINE BASEMENT

GNEISS, SCHIST, AMPHIBOLITE AND ASSOCIATED GRANITE, TONALITE
(TRIASSIC AND/OR EARLIER)