COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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Astrolabe Area Aeromagnetic Survey,

Territory of Papua & New Guinea 1967

by

Compagnie Generale de Geophysique

TEXT

BUREAU OF MINERAL RESOURCES

AIRBORNE MAGNETOMETER SURVEY ASTROLABE AREA

(Territory of PAPUA and NEW GUINEA)

By

COMPAGNIE GENERALE DE GEOPHYSIQUE

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INTRODUCTION

Coincidental with the execution of approximately 20,000 line miles of recorded magnetometor profiles in PAPUA for the Australian BUREAU OF MINERAL RESOURCES, which programme is the subject of its own report, the COMPAGNIE GENERALE DE GEOPHYSIQUE carried out for the same client a smaller survey, known as the ASTROLABE AREA programme.

(i) LOCATION OF THE SURVEYED AREA

The surveyed area is located near PORT MORESBY between the sea and an irregular eastern boundary dictated largely by terrain consideration. The northern and southern boundaries are 9°15' and 10° South latitude respectively.

(ii) TECHNICAL SPECIFICATIONS

Flight Grid

The flight grid was composed of 53 east-west flight lines spaced one mile apart and 29 north-south traverse lines spaced two miles apart.

Mileage

The total mileage flown was 1,570 line miles.

Flight Altitude

The survey height was nominally 1,000 feet above terrain. Since however, the terrain was locally very rugged this constant clearance over the ground was not easy to maintain, and for this reason, departure from the nominal height may, in certain instances, be far from negligible.

The altitude was controlled by an APN-1, supplemented by the barometric altimeter.

(iii) Equipment

The equipment used was the same as on the larger programme: B17 aircraft, CSF Cesium vapor magnetometer, ROCHAR frequency meter, etc. with the exception of the TORAN equipment which was not used.

(iv) Personnel

Likewise, with the exception of the TORAN technicians, the personnel complement was the same as for the B.M.R. PAPUA survey.

CHAPTER I

GEOLOGICAL BACKGROUND & OCCURRENCES OF MINERAL DEPOSITS

1. GEOLOGICAL BACKGROUND

The geological formations which outcrop in the survey area, or in the vicinity, are the following :

Owen Stanley Metamorphics

These regionally metamorphosed sediments (mainly phyllites) occur along the eastern boundary of the survey. In many places, however, they might be overlain by volcanics (Astrolabe Range) or Tertiary deposits.

Lower Tertiary Deposits

The PORT MORESBY series which outcrops from Port Moresby to the KEMP WELCH River consists of siliceous beds and calcareous lenses. In the LALOKI area, the ERIAMA series (slightly older than the Port Moresby series) is mainly calcareous. These two series are thought to be Eocene in age.

Upper Tertiary and Recent Alluvium

Very little is known about the Upper Tertiary marine sediments which outcrop from Kemp Welch River to ABAU. In the swampy lowlands of the south coast, outcrops are concealed beneath recent alluvium.

Basaltic Flows (Pliocene)

Late Tertiary basaltic agglomerates form a thick cover on the ASTROLABE plateau. Similar flows may be found to the south.

Sadowa Gabbro

Several outcrops of gabbro occur a few miles west of the Astrolabe escarpment. The gabbro is considered to be part of a discordant basic igneous batholith extending over an area of at least 200 square miles from the Goldie River to the Kemp Welch River. This batholith is variable in composition. It intrudes the Lower Tertiary sediments and is believed to be of Oligocene age (Yates and de Ferranti, 1965).

2. OCCURRENCES OF MINERAL DEPOSITS

The "Astrolabe Mineral Field" is the usual name for several ore bodies which were worked sporadically in the past, from 1906 to 1942: LALOKI, MORESBY KING, DUBUNA, ELVINA and MT. DIAMOND are the most important. The mineralization is made of pyrite, marcasite, chalcopyrite and sphalerite. The source of the mineralization is thought to be the gabbro intruding the sediments. All ore bodies are located less than one half mile from the gabbro sediment contact.

The main production from these mines was copper (80,000 tons) and gold.

3. PREVIOUS GEOPHYSICAL WORK

Some geophysical work was carried out in the Astrolabe Field in 1949 and

1950. The magnetic, potential ratio and equipotential methods were used. The magnetic method was reported as successful. Both the ore bodies and gabbro intrusives, however, were found to be weakly magnetic, and their magnetic effects difficult to separate. (Tate, 1951).

CHAPTER II

MAGNETIC MARKERS

The possible magnetic markers in the area are the following :

The Owen Stanley Metamorphics

The metamorphics themselves could be only weakly magnetic since their composition ranges from phyllites to sericite schists. However, possible areas of intrusion inside the metamorphics might form stronger magnetic markers.

The Gabbro Intrusives

The gabbros of the Astrolabe Field have been found to be weakly magnetic, but the susceptibility of gabbros is variable and some of them have a high magnetic susceptibility.

The Ore Bodies

As a general rule pyritic lodes do not yield strong magnetic anomalies. The intensity of an anomaly related to such a pyritic lode may be expected to be under a few tenths of a gamma. For this reason, detecting the ore bodies directly from the aeromagnetic measurements ranges from the difficult to the almost impossible.

The Volcanic Flows

The Astrolabe plateau and other possible volcanic flows were expected to be strong magnetic markers. Several profiles were extended a few miles over the plateau. The basalt agglomerate was found to be a comparatively weak magnetic marker, probably due to the intense weathering of the whole agglomerate and its moderate thickness (400 to 800 feet).

CHAPTER III

DESCRIPTION OF INTERPRETATION OF RESIDUAL FIELD CONTOUR MAPS

1. REDUCTION OF THE MAGNETIC DATA

The residual values plotted on the Field Contour Maps are obtained according to the following process :

- The total field values of the digital records are listed.
- The regional gradient is removed from the field values. The components of this regional gradient are as follows:

  + 6.2 gammas per kilometre from north to south
  + 0.84 gamma per kilometre from east to west

- The residual values are adjusted by comparison of the field values at the intersections between lines and tie-lines.
- The final field contours are then drawn by joining the points of equal value and interpolating between these points. This contouring was made manually. For many other surveys the contouring is made automatically with a special machine but the contours are then a little more angular.

2. DESCRIPTION AND INTERPRETATION (See plates "Interpretation" and "Total Field" - 1/100,000)

In view of a closer and easier description, the survey area will be subdivided

into three areas :

- Northern area (North of 9°30')
- Central area (from 9°30' to 9°40')
- Southern area (from 9°40' to 10°)

2.1 Northern Area (North of Latitude 9°30')

The major trend of the magnetic contours is approximately northwest - southeast. This trend is not absolutely constant but is always comprised between N30°W and N60°W.

From northeast to southwest the following zones may be seen.

Zone AA'

A "basic belt", orientated northwest - southeast, extending from the northern escarpment of the Astrolabe Plateau to the BROWN River swamps.

This area is characterized by strong positive anomalies, orientated N50°W. The residual field intensity is higher than 3,100 gammas.

Reference to magnetic markers: these strong anomalies cannot be related either to the Owen Stanley metamorphics or to Lower Tertiary sedimentary deposits, nor to basaltic agglomerates similar to the Astrolabe agglomerate. Two possible origins of the anomalies are :

- A basic belt (either gabbros or ultrabasic rocks)

- Volcanic flows overlain by Eocene deposits and/or recent alluvium.

The first hypothesis (basic belt) is the most likely due to the homogeneous aspect of this magnetic area.

Area B

The depth estimates computed from several narrow anomalies in this area make it possible to conclude that many magnetic bodies are outcropping. The most interesting ones have been mapped and tentatively referred to as gabbros.

Area C

This area is located between the old RIGO Road and the eastern boundary of the survey, thus including the Astrolabe Mineral Field.

The magnetic trends are N60°- N70°W, instead of N30° - N50° for the major part of the survey.

The main anomalies are the following :

Laloki River Anomaly: Along the Laloki River, an important positive anomaly takes place. Its intensity reaches 300 gammas near ROUNA Falls and decreases to the west. Several outcrops of gabbro are known south of Laloki River and the old mines worked in the area are regarded as in relationship to the gabbro mass. (The mining zones are HECTOR, MORESBY KING, LALOKI, FEDERAL FLAG Area).

The magnetic anomaly may be regarded as produced by the gabbro mass.

Sadowa Hill Anomaly: To the south, an anomaly of nearly 400 gammas takes place over SADOWA Hill (see profile T310).

In the geological map this area is mapped as Eocene sediments and gabbro. Considering the amplitude of the magnetic anomaly and the geological background it may be assumed that the origin of this anomaly is in the gabbro. The depth computation indicates that the magnetic body is outcropping. Consequently this area should be closely investigated by geological and geophysical survey.

Remark

Calculations made on this anomaly (profile 310 S) indicate a width of the magnetic body of about 100 metres and a magnetic susceptibility in the order of 0.012 CGS electromagnetic unit.

From the calculations other small anomalies south of the previous one correspond to near-surface magnetic bodies which are almost certainly parts of the underlying gabbro.

No significant anomalies were noted over DUBUNA, ELVINA and MT. DIAMOND. (The three mines which were worked in this area). However, these mines are located in the alignment of the Sadowa magnetic body which could be responsible for the mineralization of the whole area.

It must also be pointed out that this airborne survey was not a very detailed one (1 x 2 miles) and several magnetic bodies may possibly have been left out. Hence recognition and mapping of the gabbro cannot be very accurate.

In the interpretation map, probable areas of near-surface gabbro have been mapped. Many other such areas may have been left unnoticed.

ERIAMA FAULT ZONE

West of the previous zone the anomalies take a different trend - almost north-south. This area was called the Eriama fault zone in accordance with the geological map. This faulted zone coincides with a depressed area coincident with a river tributary of the Laloki River.

This area is a major zone of interest since several gabbro outcrops are located along the fault.

AREA DD'

This area has a low level of magnetic intensity (average of the residual field: 2,800 gammas). The magnetic trends range from N20°W to N60°W.

The magnetic marker is generally deeper than for the previous areas. Two probable gabbro bodies have been mapped near the faults which separate areas B-C from DD'.

AREA E

The magnetic style is very quiet and practically no significant anomaly can be noted. This area appears to be without interest for mining research.

2.2 CENTRAL AREA (From latitude 9°30' to 9°40'S)

AREA F

Area F covers all of the survey located between latitudes 9°30' and 9°40'. Two distinct magnetic trends may be considered :

- One is almost east-west
- The other is northwest-southeast.

The magnetic marker is generally deep (500' to 1,000'), which is unfavourable for mining research. An exception is the small area located in the southeast corner, where the magnetic marker outcrops.

2.3 SOUTHERN AREA (From latitude 9°40' to 10°S)

The succession of magnetic zones from northeast to southwest is as follows:

AREA G-G'

This area is notable for its high level of magnetic intensity. The residual field intensity is higher than 3,100 gammas and may be as great as 3,400 gammas.

The analogy with area AA' is obvious. Both areas have the same alignment and similar level of magnetic intensity. The conclusions therefore are the same as for AA':

Area GG' is composed of:

- Either a basic belt - (gabbros or ultramafic rocks)
- Or volcanic flows (Lower Eocene or Cretaceous volcanics)

The first hypothesis is by far the most likely and reliable. The basic belt is generally overlain by a thin sedimentary cover (approximately 300 - 500 feet), but in some places basic plugs may be outcropping.

AREA H-H'

This is a transitional zone intermediate between the previous basic zone and the remainder of the survey. Magnetic intensity is still comparatively high (the residual field is generally over 3,000 gammas). Several basic bodies have been mapped and are probably portions of the gabbro batholith. Some of them are outcropping (see depth estimates equal to zero upon the interpretation map).

AREA J

J is an area of medium-level magnetic intensity (average residual field: 2,800 - 2,900 gammas). The anomalies are generally elongated with trends ranging from N30°W to N60°W. Because of the moderate intensity of the anomalies, no near-surface basic rocks are likely to take place in this area.

AREA K

This belt is characterized by a very low level of magnetic intensity. The residual field intensity is generally under 2,700 gammas and sometimes falls down to 2,500 (minimum: 2,200 gammas). Another specific feature is the poor organization of the magnetic trends. The anomalies have various shapes and trends and few correlations have a great extension.

Despite the general low level of magnetic intensity, many anomalies are very intense (negative anomalies). For this reason, this area could be related tentatively to volcanic flows with strong remanent magnetization and overlain by Eocene deposits.

AREA L

In contrast to the previous one, this area has very consistent magnetic trends and well defined elongated anomalies. The main magnetic trend is N50°W. Several strong anomalies (200 - 500 gammas) may be seen along the southwest boundary of this area.

The interpretation of the most southerly of these strong anomalies (profile T324) gives the following results:

- Width of the magnetic body: approximately 500 metres.
- Magnetic susceptibility: K = 0.015 CGS e-m-u.

This magnetic susceptibility is of the same order as that for the Sadowa magnetic body (see Area C). This permits the assumption that the

magnetic body is composed of basic rocks. The same conclusion applies to the other magnetic bodies mapped in the area (dotted zones). They all have approximately the same susceptibility (from 0.010 to 0.015 CGS); a width of some hundreds of metres, and a length between 1 and 5 kilometres.

This area is therefore a very interesting one for the detection of gabbro and possible associated mineralization.

AREA M-M'

This area presents some analogy with areas G and H, and is characterized by a high level of magnetization. It probably extends well beyond the area investigated.

A narrow belt with low magnetic intensity extends between M and M'. Along the contact between this belt and area M' the magnetic gradient may be as great as 600 gammas. This area of strong magnetic gradient should be investigated since it is a possible faulted zone along which basic rocks may have come up.

AREA N

This area is characterized by a broad positive anomaly bearing N55°W. Calculations of depth are made difficult by the many interferences on the records, but the magnetic body is certainly deep. In the southwest corner a strong magnetic gradient may be seen.

All of this area appears to be devoid of practical interest for mining purposes.

CONCLUSIONS AND RECOMMENDATIONS

The primary object of the survey was the mapping of "gabbro intrusives and basaltic flows". It is therefore necessary to examine the extent to which this objective has been fulfilled.

Gabbro Intrusives:

Two basic belts (AA' - GG') and several zone including probable basic intrusions (areas B, C. H, L and M) have been defined and mapped. The recognition of these intrusives as gabbro (or other basic rocks) relies mainly on the similarity of all these magnetic bodies to the one observed south of Laloki River where many gabbro outcrops are known.

Basaltic Flows:

The Astrolabe plateau is almost entirely outside the boundaries of the survey which makes it difficult to appreciate the magnetic effect of the volcanic flows. A few extremities of profiles flown over the plateau indicate that the level of magnetic intensity is not considerably modified by the presence of the volcanic agglomerate. This can be explained by the severe weathering of the plateau and by the fact that the matrix of the agglomerate is not magnetic itself.

For these reasons the mapping of volcanic flows similar to the Astrolabe agglomerate is not possible. Area K, however, has been tentatively ascribed to volcanics with strong remanent magnetization. The presence of volcanic flows

is not a useful indication in the search for mineral deposits but the mapping of gabbro intrusives may be a useful guide since the ore bodies are supposed to be connected with them.

Consequently a programme of geological and geophysical investigations could be undertaken in the following areas:

Areas B and C.

In these areas most gabbro intrusives are already known. However, the magnetic body referred to as the "Sadowa magnetic body" in this report should be closely investigated, since it is probably of major importance for the distribution of the mineralization.

Area L

Six magnetic bodies have been mapped here. The interesting area is 25 kilometres long and approximately 2 kilometres in width. In addition to the geological investigations, southwest - northeast profiles of ground magnetic measurements could be made across the magnetic bodies to outline their shape where they are not outcropping. The most northerly magnetic bodies in this area are in the vicinity of RIGO and no major difficulty of access should be met.

In a second stage of surveying, attention could be paid to other areas which present more difficult access but interesting prospects: the two basic belts AA' and GG' as well as area MM'.

Area AA'

Area AA' is a mountainous area where the basic rocks may be generally covered by Eocene deposits. Some apophyses and dykes derived from the main mass are probably outcropping.

Area GG'

Area GG' is similar and probably the prolongation of AA'. It could be investigated by beginning with area G', then proceeding westwards to check the small apophysis drawn on the interpretation map, and then the lenticular magnetic body intersected by profile T326. The intensity of this anomaly is 400 gammas and the magnetic body is most likely outcropping.

Area M - M'

The main magnetic bodies in this area could be checked, as well as the strong magnetic gradient area between M and M'.

Respectfully submitted,

Interpreted by :
J. LERIDON

J-M. CUNIN
Australian Branch Manager

BRISBANE, August 5th.1968.

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Report 105 (1967)

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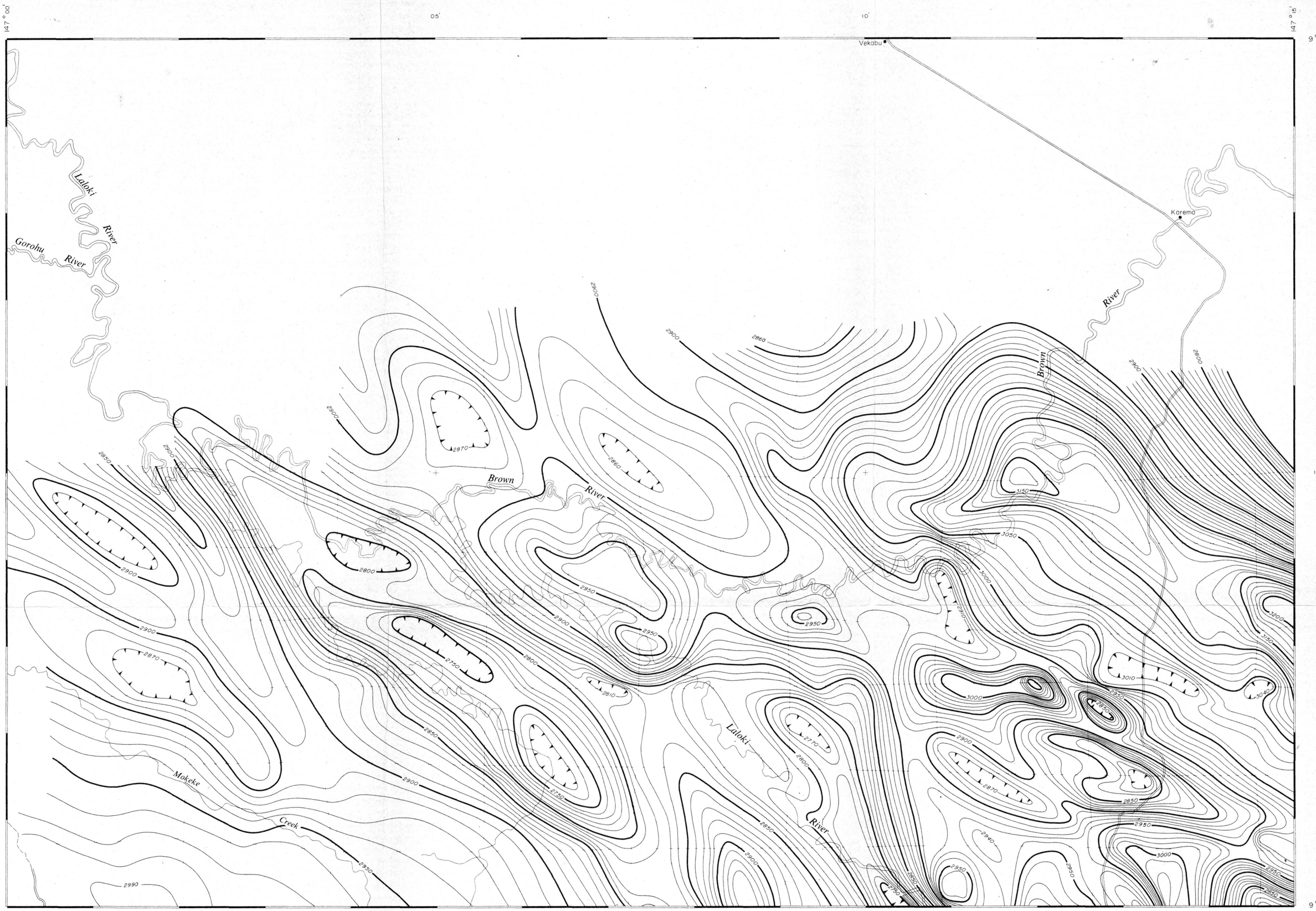
Plates

NEW GUINEA 1:50,000

LALOKI RIVER

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS PLATE 1



COMPAGNIE GENERALE DE GEOPHYSIQUE

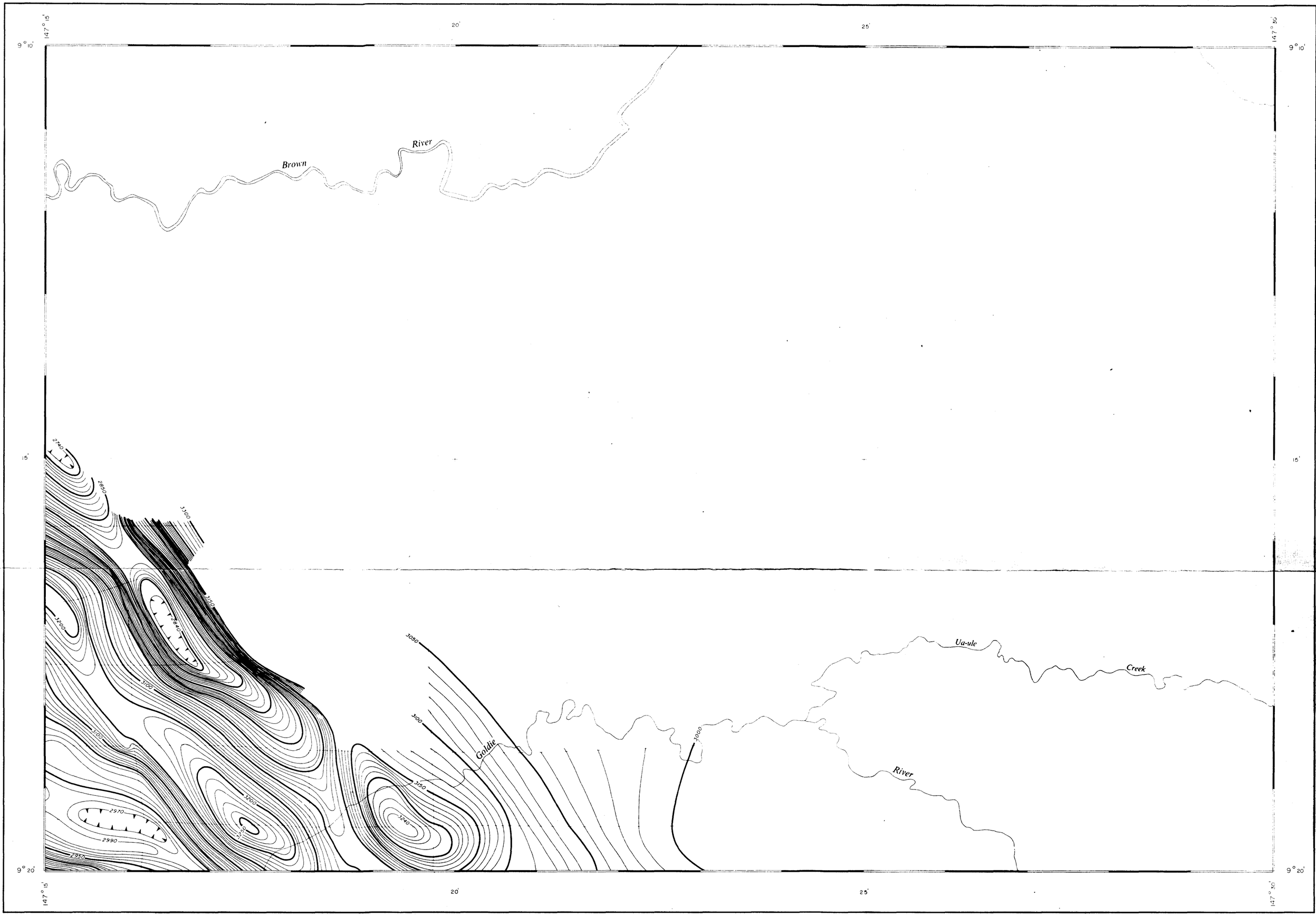
TOTAL MAGNETIC INTENSITY

CONTOUR INTERVAL 10 GAMMAS

NEW GUINEA 1:50,000

GOLDIE RIVER

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS PLATE 2 LITHO



COMPAGNIE GENERALE DE GEOPHYSIQUE

TOTAL MAGNETIC INTENSITY

CONTOUR INTERVAL 10 GAMMAS

NEW GUINEA 1:50,000

PORT MORESBY

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS PLATE 3 LITHO

147° 00' 05' 10' 147° 15'

9° 20'

25'

9° 30'

Mokeke Creek

Laloki River

Boera

Porebada

Tatana

TATANA ISLAND

HAIDANA ISLAND

NAPA NAPA

GEMO ISLAND (HANUDAMVA ISLAND)

LOLORUA ISLAND

CORAL SEA

PORT MORESBY

MOUNT LAWES

JACKSON AERODROME

HUBERT MURRAY HIGHWAY

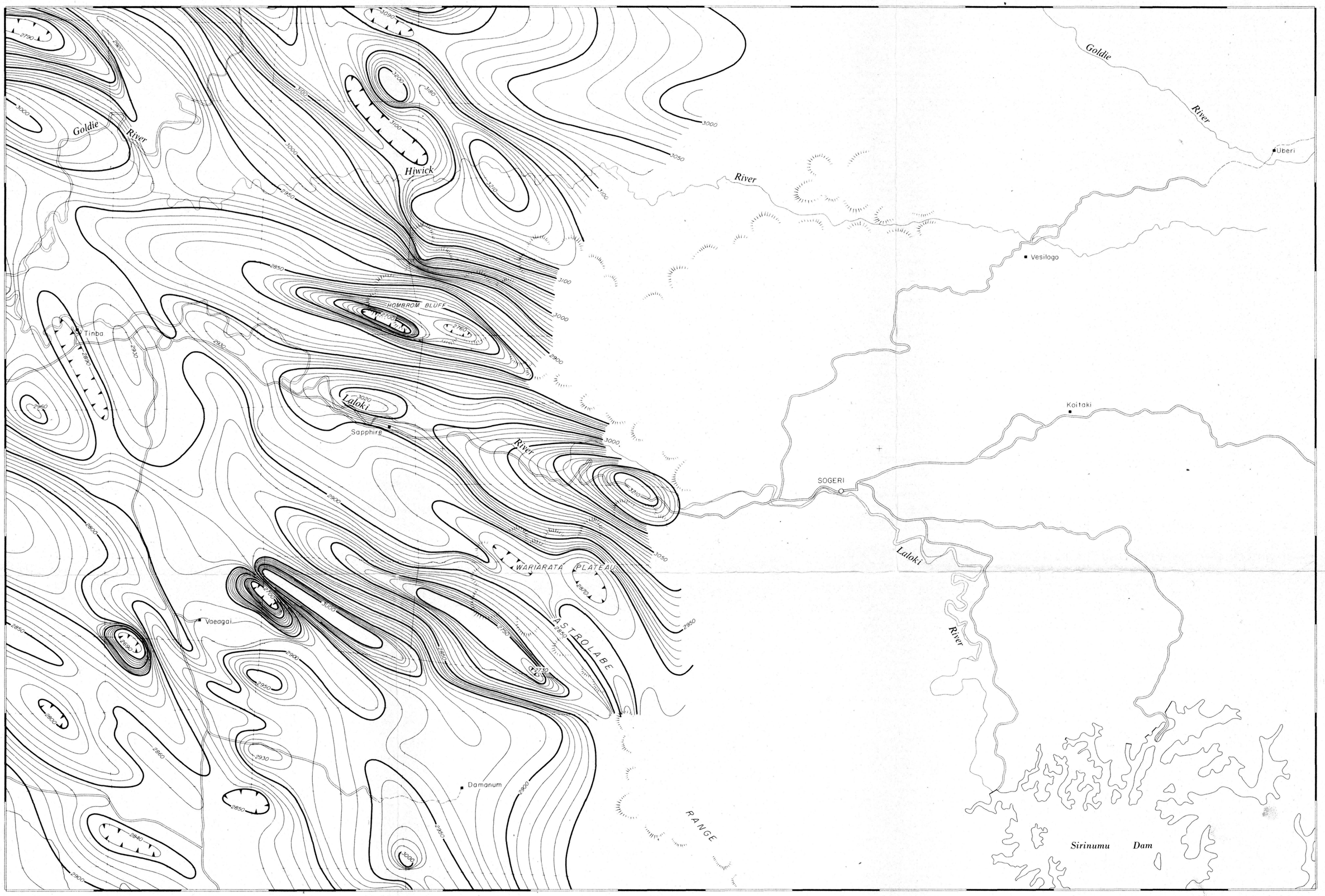
2990 2980 3000 3010 3020 2960 2950 2940 2930 2900 2850 2800 2750 2790 2810 2710 2640

COMPAGNIE GENERALE DE GEOPHYSIQUE

TOTAL MAGNETIC INTENSITY

CONTOUR INTERVAL 10 GAMMAS

SOGERI



COMPAGNIE GENERALE DE GEOPHYSIQUE

TOTAL MAGNETIC INTENSITY

CONTOUR INTERVAL 10 GAMMAS

NEW GUINEA 1:50,000

TUPUSELEIA

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS PLATE 5 LITHO

147° 15' 20' 25' 147° 30'

9° 30'

9° 40'

35'

MOTUPORE ISLAND

MANUNUNA ISLAND

LOLOATA ISLAND

Tupuseleia

Rabuka

Barakau

Dagoda

Daburaik

ASTROLABE RANGE

Sirinumu Dam

Merudau Creek

Eoti Creek

Vailala River

C O R A L S E A

2860 2940 2900 2950 3000 2850 2870 2880 3090 3050

TOTAL MAGNETIC INTENSITY

CONTOUR INTERVAL 10 GAMMAS

COMPAGNIE GENERALE DE GEOPHYSIQUE

147° 15' 20' 25' 147° 30'

9° 40'

9° 45'

9° 50'

Uruma Creek

Sabuia

Gaile Mission

Manugoro

Tavai

Tavai Creek

2950 2900 2850 2800 2940 2870 2910

C O R A L

S E A

147° 15' 20' 25' 147° 30'

9° 50'

COMPAGNIE GENERALE DE GEOPHYSIQUE

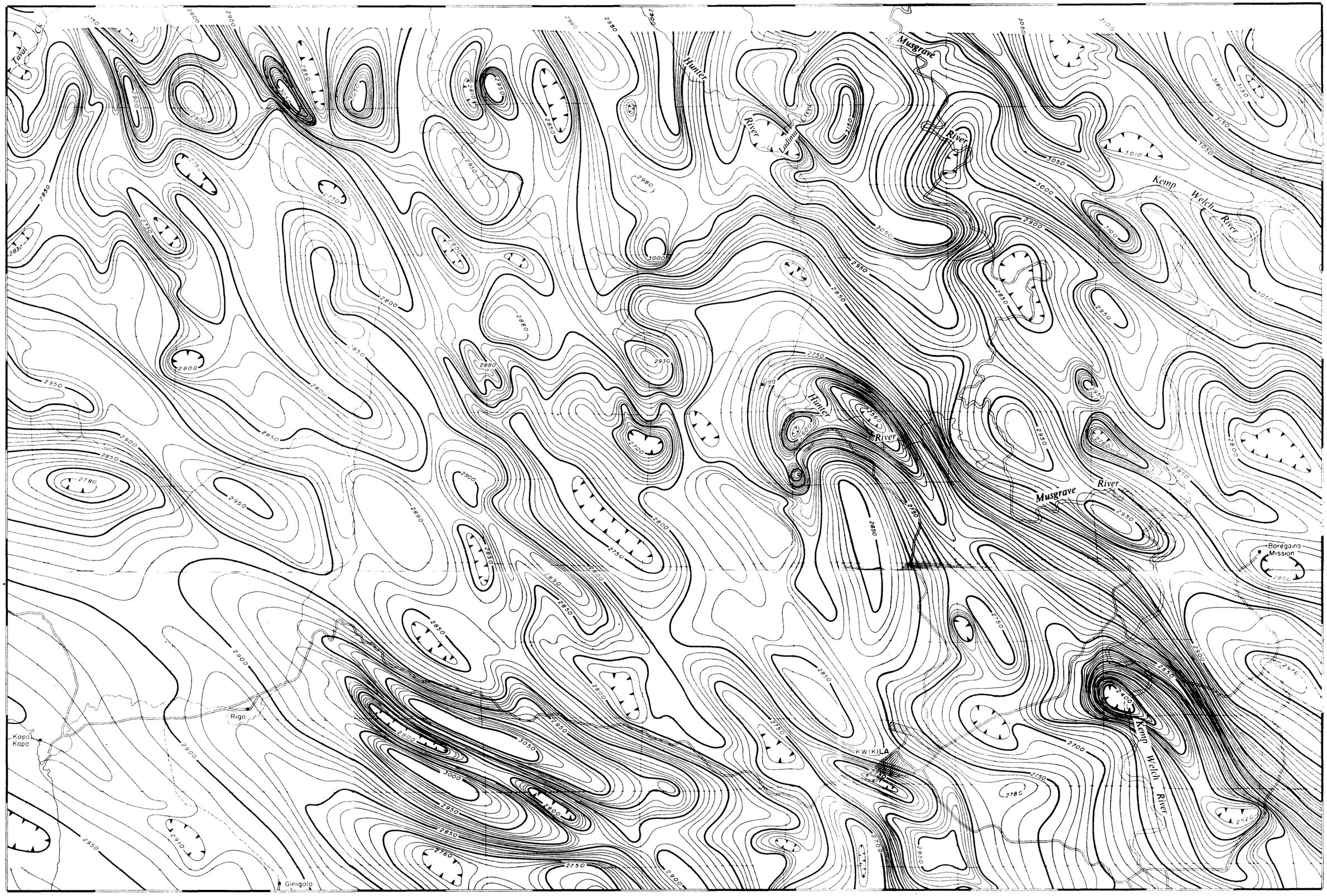
TOTAL MAGNETIC INTENSITY

CONTOUR INTERVAL 10 GAMMAS

NEW GUINEA 1:50,000

GEA

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS PLATE 7 LITHO



COMPAGNIE GENERALE DE GEOPHYSIQUE

TOTAL MAGNETIC INTENSITY

CONTOUR INTERVAL 10 GAMMAS

UROGOLO

147° 45'
50'
55'
148° 00'
9° 40'
45'
9° 50'

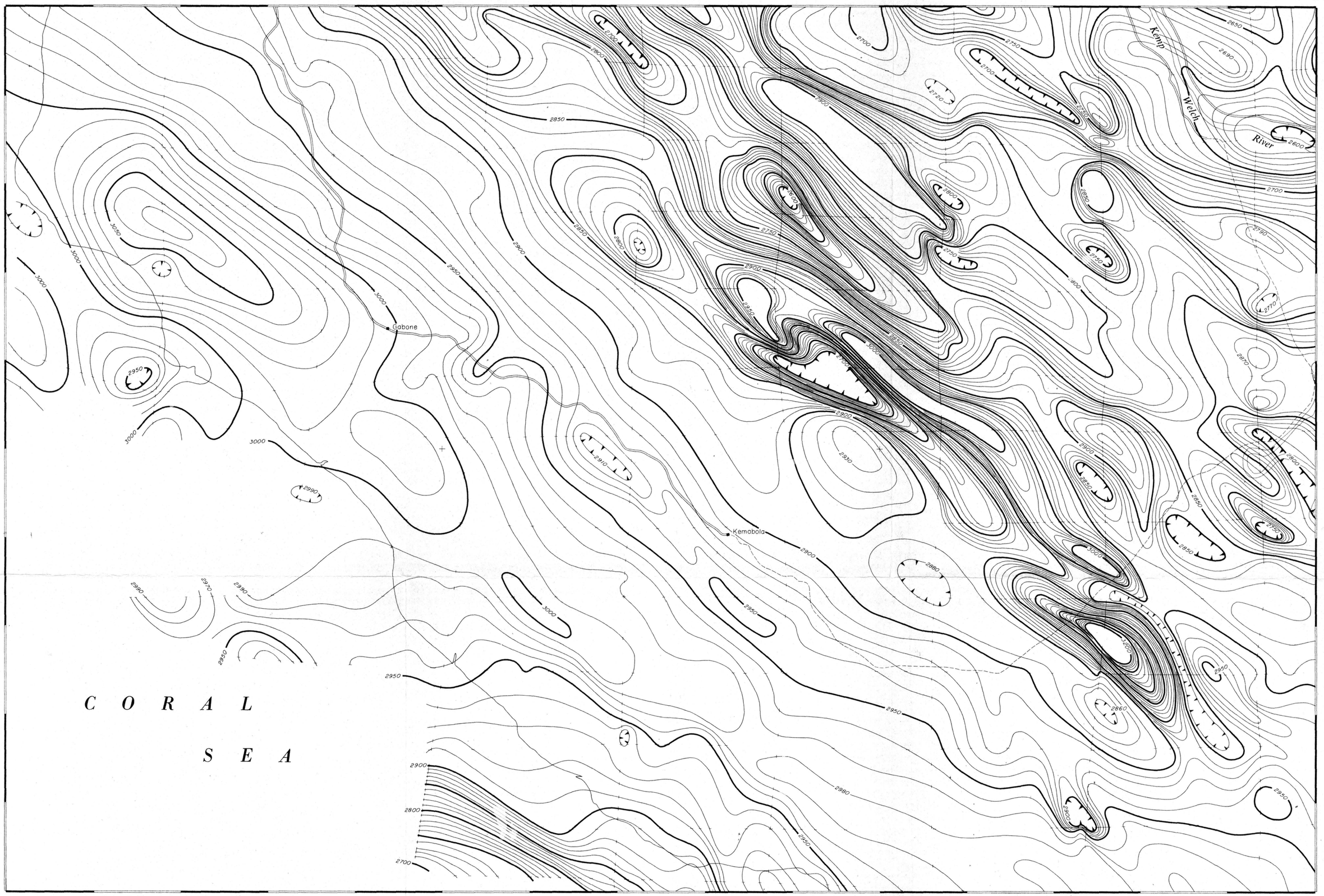
Urogolo
Kwairobu
Ormond River

COMPAGNIE GENERALE DE GEOPHYSIQUE

TOTAL MAGNETIC INTENSITY

CONTOUR INTERVAL 10 GAMMAS

ROUND POINT



TOTAL MAGNETIC INTENSITY

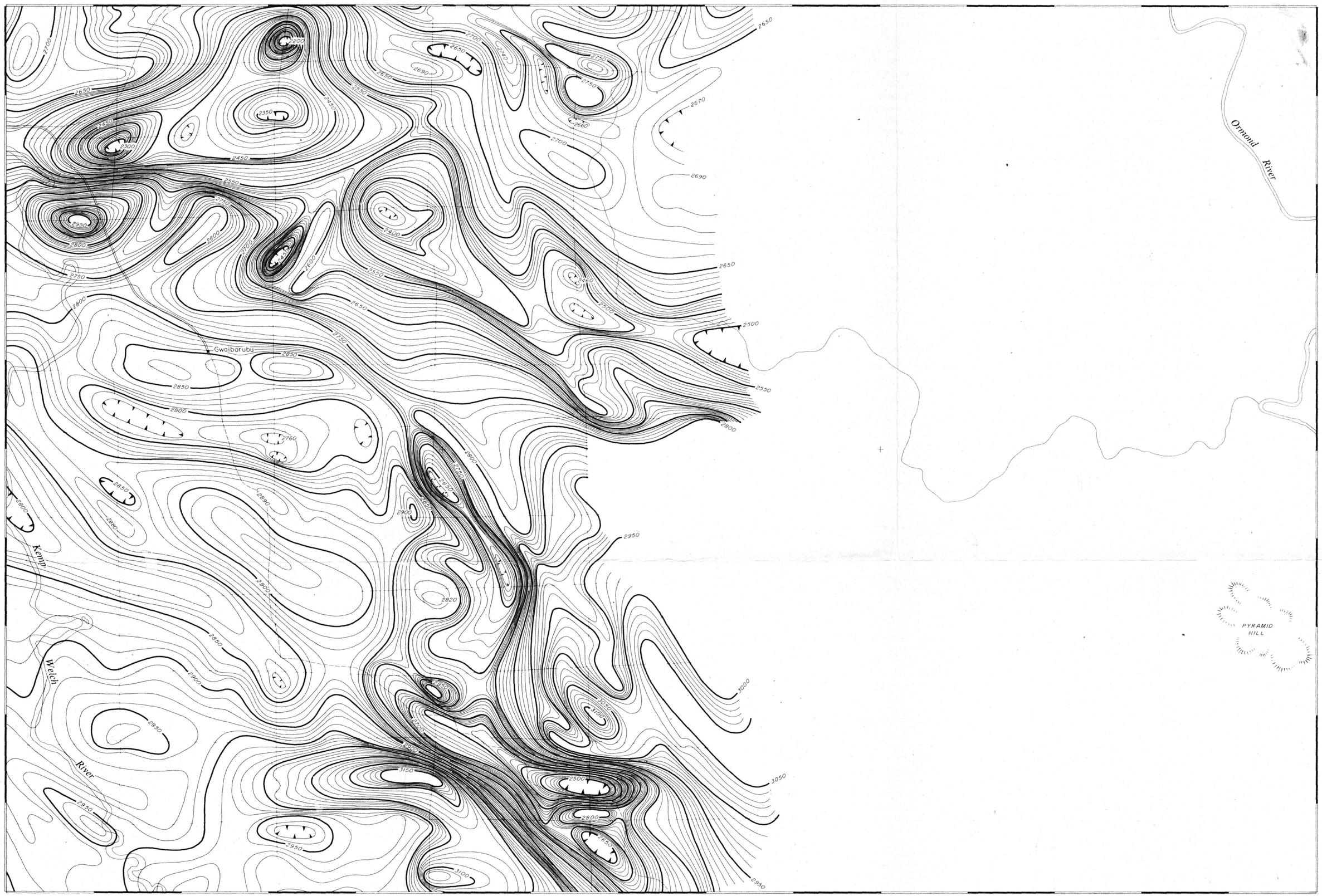
CONTOUR INTERVAL 10 GAMMAS

COMPAGNIE GENERALE DE GEOPHYSIQUE

NEW GUINEA 1:50,000

KEMP WELCH RIVER

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS PLATE 10



TOTAL MAGNETIC INTENSITY

CONTOUR INTERVAL 10 GAMMAS

COMPAGNIE GENERALE DE GEOPHYSIQUE

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS PLATE II

AIRBORNE MAGNETOMETER SURVEY
ASTROLABE AREA
TOTAL MAGNETIC INTENSITY

SCALE : 1/100,000

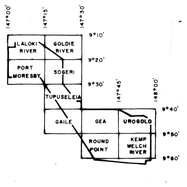
CONTOUR INTERVAL : 10 GAMMA

LEGEND

MAGNETIC CONTOURS

MAGNETIC LOW

LOCALITY MAP



COMPAGNE GENERALE DE GEOPHYSIQUE

CORAL SEA

HOOD LAGOON

HENRY RANGE

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS. PLATE 12.

AIRBORNE MAGNETOMETER SURVEY

ASTROLABE AREA

(PAPUA AND NEW-GUINEA)

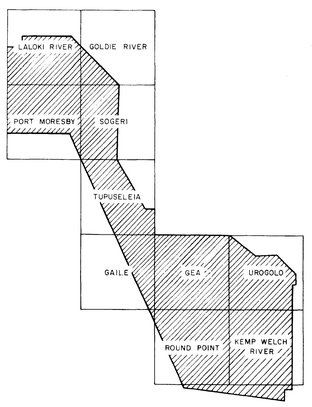
INTERPRETATION MAP

SCALE 1/100 000

LEGEND

- Mine location — MORESBY KING
- Zone symbol — A
- Magnetic marker depth estimate (in feet below ground level) — -400'
- Change in level of magnetic intensity
- Magnetic trend (positive)
- Magnetic trend (negative)
- Fault
- Fault (with transcurrent movement)
- Fault (mo.emen. unknown)
- Boundaries of Survey
- Probable basic intrusion (Gabbro etc)

COMPAGNIE GENERALE DE GEOPHYSIQUE
50 rue Fabert. PARIS 7 eme



147°15' 147°30' 147°45'

9°20' 9°30' 9°40' 9°50' 10°00'

147°00'

ASTROLABE PLATEAU

LALOKI FAULT

ERAMA - FAULT ZONE

MORESBY KING

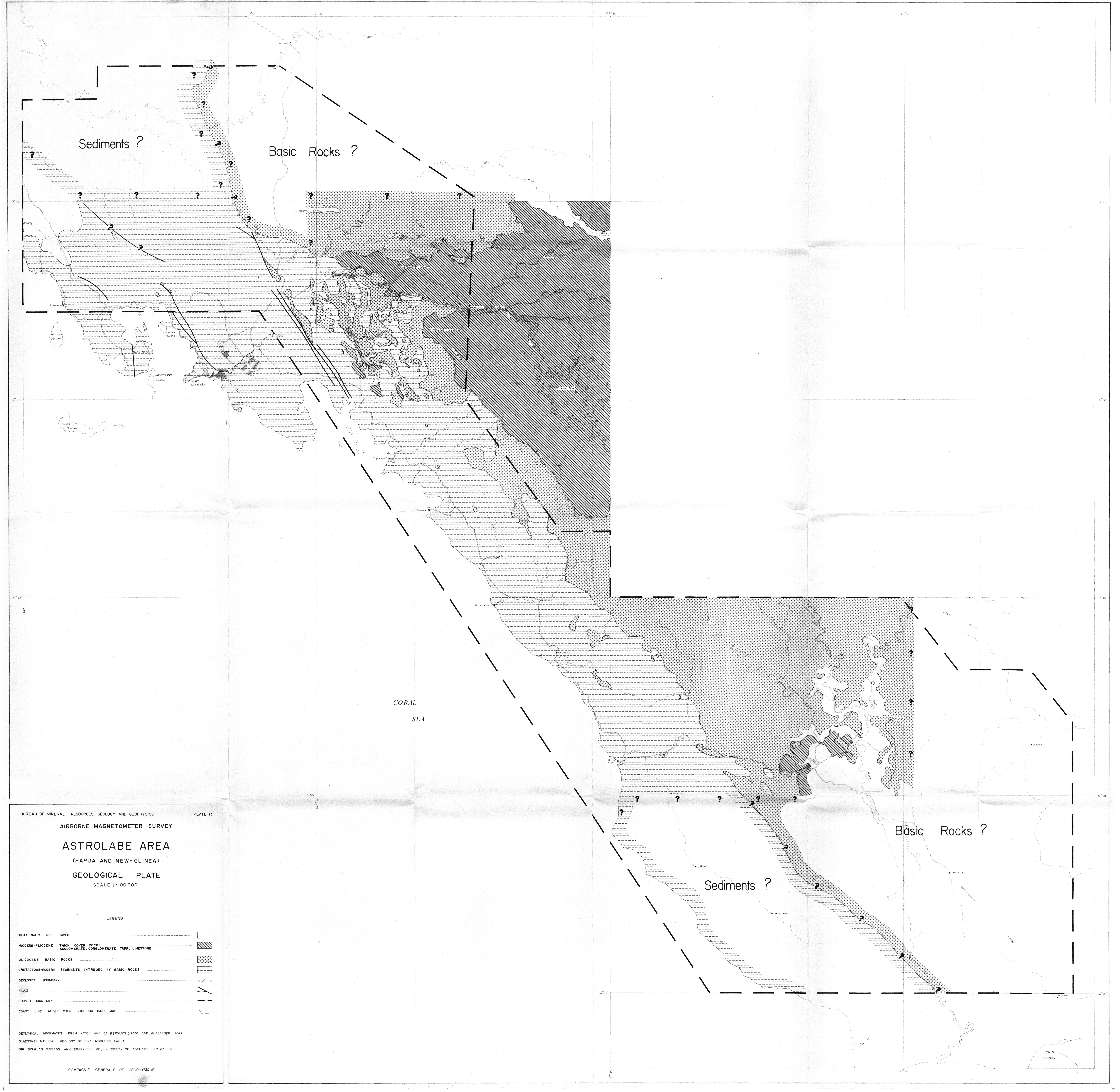
LALOKI

SADOWA

DUBUNA

ELVINA

MT DIAMOND



BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS — PLATE 13

AIRBORNE MAGNETOMETER SURVEY

ASTROLABE AREA

(PAPUA AND NEW-GUINEA)

GEOLOGICAL PLATE

SCALE 1/100 000

LEGEND

QUATERNARY SOIL COVER

MIOCENE-PLIOCENE THICK COVER ROCKS
AGGLOMERATE, CONGLOMERATE, TUFF, LIMESTONE

OLIGOCENE BASIC ROCKS

CRETACEOUS-EOCENE SEDIMENTS INTRUDED BY BASIC ROCKS

GEOLOGICAL BOUNDARY

FAULT

SURVEY BOUNDARY

COAST LINE AFTER C.G.G 1/100 000 BASE MAP

GEOLOGICAL INFORMATION FROM YATES AND DE FERVANTI (1965) AND GLAESSNER (1952)

GLAESSNER MF 1952 GEOLOGY OF PORT-MORESBY, PAPUA

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