REPUBLIC OF INDONESIA

MINISTORY OF MINES AND ENERGY
DIRECTORATE GENERAL OF MINES
GEOLOGICAL SURVEY OF INDONESIA

REPORT ON GEOLOGICAL SURVEY OF CENTRAL KALIMANTAN

CONSOLIDATED REPORT

FEBRUARY. 1979

METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

REPUBLIC OF INDONESIA

MINISTORY OF MINES AND ENERGY
DIRECTORATE GENERAL OF MINES
GEOLOGICAL SURVEY OF INDONESIA

REPORT ON GEOLOGICAL SURVEY OF CENTRAL KALIMANTAN

CONSOLIDATED REPORT

FEBRUARY. 1979

METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

PREFACE

The Government of Japan, in response to the request extended by the Government of Republic of Indonesia, decided to conduct an integrated geological survey for mineral exploration and prospecting in the Central Kalimantan, Indonesia, and commissioned its implementation to the Japan International Cooperation Agency.

The Agency, taking into consideration of the importance of technical nature of survey works, in turn sought the Metal Mining Agency of Japan for its cooperation to accomplish the task within a period of four years.

The Government of Republic of Indonesia appointed the Geological Survey of Indonesia to execute the survey as counterparts to the Japanese team. The survey has been carried out jointly by experts of the both Governments.

The first phase of surveys is consisting of Landsat data analysis; the second and third phases, of aerial photography and airborne magnetic survey; and, the fourth phase, of photo-geological survey and geological survey.

This consolidated report submitted hereby summarizes the results obtained in a period of four years.

We wish to take this opportunity to express our gratitudes to all sides with execution of surveys.

February 1979

Prof. Dr. J.A. KATILI
Director General,
Ministry of Mines and Energy,
Republic of Indonesia.

Shinsaku HOGEN
President,
Japan International Cooperation Agency.

Masayuki NISHIIE
President,
Metal Mining Agency of Japan.

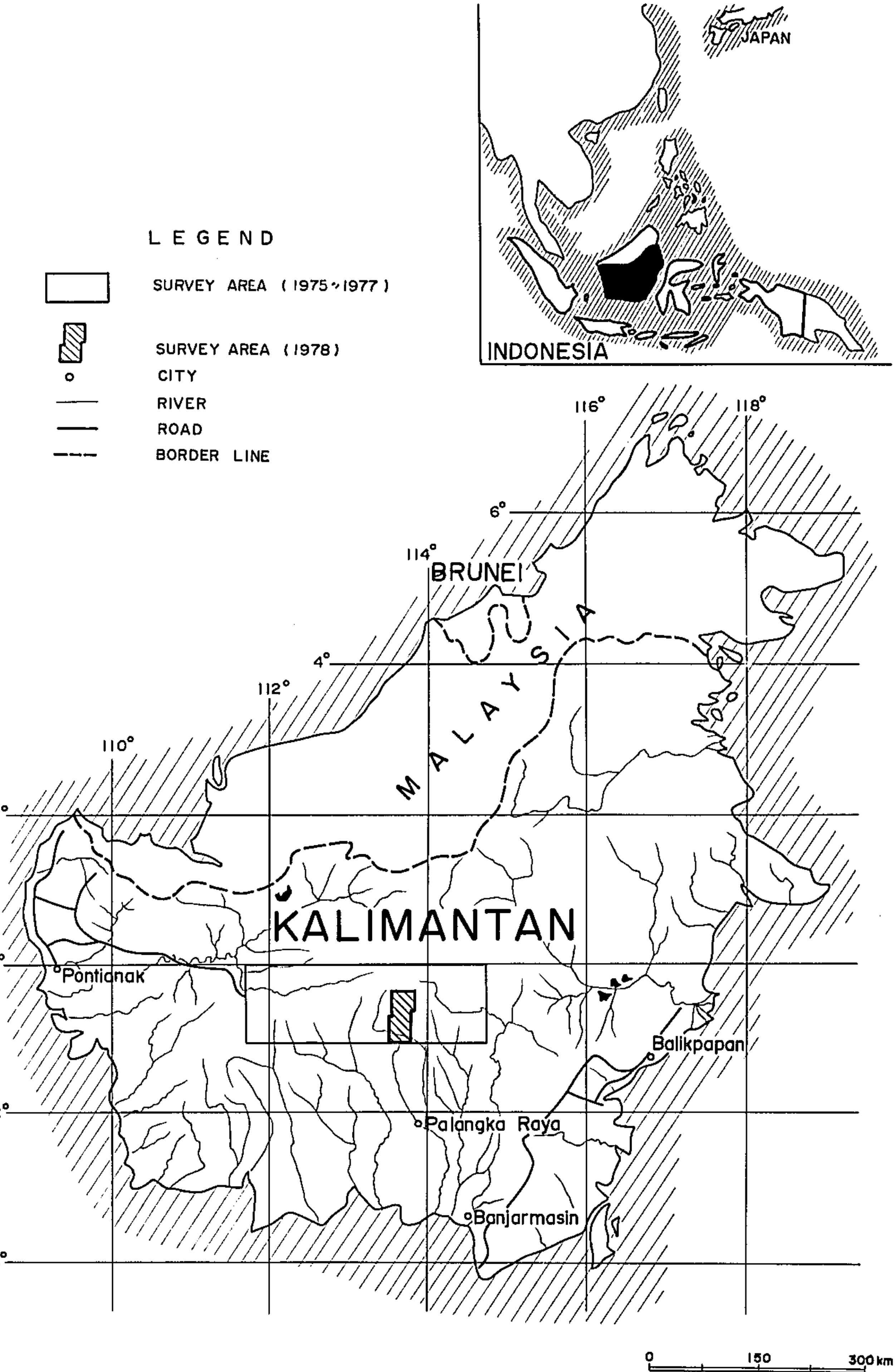


Fig. 1 Location map of survey area

Table of Contents

Figures

Tables

Attached Sheets

ABSTRACT

The integrated surveys have been conducted in the Central Kalimantan, Republic of Indonesia, aiming to make clear geology, stratigraphical sequences, igneous activities, geological structures and mineralizations, and to investigate possibilities of the development of natural resources, based on the study of relationship between geology and mineral deposits. For this purpose, the LANDSAT-data analysis in Phase I, aerial photography and airborne magnetic survey in Phase II and Phase III, and photo-geological survey in Phase IV No.1 have been conducted in the whole project area of about 36,300 Km^2, and resulted in extraction of a target area for the geological survey. During Phase IV No. 2, the geological surveys, together with the geochemical surveys, radiometric prospectings and placer gold prospectings, were carried out in an area of about 2,000 Km^2, located in central-southern parts of the whole project area.

During the LANDSAT-data analyses done in 1975, geology, geological structures and photo-lineaments were examined by pattern analyses, while tonal anomalies were also studied by spectoral analyses. The outline of geology and geological structures as well as the existence of mineral deposits were generally made clear.

During Phase II and Phase III, aerial photography was completed, covering 71 % and 22 % of the area, respectively, totaling 93 % of the area of 33,750 Km^2. 2,848 prints were obtained.

The airborne magnetic surveys conducted as portions of Phase II and Phase III covered 25 % and 70 % of the area, respectively, totaling 95 % of planned survey. As a results of these surveys, magnetic features divided the surveyed area into three parts. And, structures of granitic

rocks and sedimentary formations as well as magnetic tectonic lines, which are considered to be related to fault lines, were examined.

The photo-geological surveys done during Phase IV No. 1 were performed on total of 2,848 prints of the aerial photographs on a scale of about 1:40,000. Results were compiled in a photo-geological map and its profile, and more detailed knowledge regarding geology, geological structures and mineral deposits was obtained. A target area for the geological survey including the geochemical survey and radiometric prospecting was chosen.

As a result of the geological surveys conducted during Phase IV No. 2 in the area of about 2,000 Km^2, geology, stratigraphical sequences, igneous activities, geological structures and mineralizations in the mapped area were made much more clear. They are as follows;

(1) There are two stages of mineralization in the area; one is an earlier mineralization forming mineralized zones in metamorphic rocks of the basement and in tonalites of the late Permian and the close of Jurassic Periods. Another is a later mineralization related to plutonic or hypabyssal igneous activities and volcanisms during periods from the close of Cretaceous to Tertiary. They form the principal important mineralized zones or ore deposits in the surveyed area.

(2) As a result of the geochemical surveys and radiometric prospectings together with placer gold prospectings, which were performed along with the geological surveys, three anomalous areas were found; mineralized zones of porphyry copper-type ores, copper-bearing pyritic ore veins, and gold-lead-zinc ore veins.

(3) For the future, target areas for further investigations and more

detailed works in the surveyed area were suggested. Furthermore, continuation of the survey and expansion of the survey area were also recommended.

I. INTRODUCTION

CHAPTER I. INTRODUCTION

I-1 Purpose of Survey

The Collaboration surveys for development of natural resources have been conducted since 1975 in the Central Kalimantan, Republic of Indonesia, aiming to make clear geology, geological structures and igneous activities in the area of about 36,300 km^2, and to examine mineral occurrences and possibilities of their further development.

I-2 General Remarks of Survey

The surveys have been performed in cooperations between Indonesian and Japanese Governments, and are summarized as shown in Table 1.

Table 1 Operation program performed

Item \ Year of performance	1975 (Phase I)	1976 (Phase II)	1977 (Phase III)		1977-1978 (Phase IV)	
			No.1	No.2	No.1	No.2
1. LANDSAT-data analysis	100 %					
2. Aerial photography		71 %	22 % (Total 93 %)			
3. Airborne magnetic survey		25 %	29 %	41 % (Total 95 %)		
4. Photo-geological survey					93 %	
5. Geological survey						100%*

* Area of about 2,000 km^2

At Phase I, the LANDSAT-data analysis was carried out and resulted to interpretate geology, geological structures and photo-lineaments through pattern analyses as well as tonal anomalies through spectoral information analyses.

At Phase II and Phase III, the aerial photography and the air-borne magnetic survey were conducted. Although obstructions of weather condition have met for taking the aerial photographs, 71% in 1976 and 22% in 1977, totaling 93% of the whole target area were covered. While, the airborne magnetic surveys were completed 25% in 1976 and 70% in 1977, totaling 95% of planned schedule, although accidents of the aircraft happened.

At Phase IV, the photo-geological survey using the aerial photographs taken in 1976 and 1977 was performed in 1977, and the geological survey together with the geochemical survey and radio-metric prospecting was carried out in the areas of about 2,000 km^2 in 1978, which had been selected through previous works.

I-3 Personnel Engaged in Survey

(1) LANDSAT-data analysis in 1975

Planning and regulation

Tsuneaki	MIZUNO	(MMAJ)
Yuichi	KANITA	(JICA)
Teiichi	TODA	(MMAJ)

Survey team

	Indonesian team	Japanese team
Team leader :	Adjat SUDRADJAT (GSI)	Haruhiko HIRAYAMA (NED)
Members :	Turus SOEJITNO (GSI)	Tokichiro TANI (NED)
	Saeum HARDJOPRAWIRA (GSI)	Hiroyuki FUJIOKA (NED)
		Teruo TAKEYAMA (NED)

Note :
- GSI Geological Survey of Indonesia
- JICA Japan International Cooperation Agency
- MMAJ Metal Mining Agency of Japan
- NED Nikko Exploration and Development Co., Ltd.

(2) Aerial photography and Airborn magnetic survey in 1976

Planning and regulation

Nobutaka	MIYAZOE	(MMAJ)
Masaharu	KANEKO	(MMAJ)
Toshio	KAWAGUCHI	(MMAJ)
Yutaka	HATANO	(JICA)

Survey team

	Indonesian team	Japanese team
Team leader :	Adjat SUDRADJAT (GSI)	Haruhiko HIRAYAMA (NED)
Members :		
	Aerial photography	Aerial photography
	H.M.D. ROSIDI (GSI)	Junichi UMEZAWA (AAS)
	Turus SOEJITNO (GSI)	Koichi TANAKA (AAS)
	Onong KASWANDA (GSI)	Koki YAGI (AAS)
	Ungkap L BATU (GSI)	Nobumichi TAKEKAWA (AAS)
	Aircraft crew (EXSA, INDOAVIA)	

Indonesian team	Japanese team
Airborne magnetic survey	Airborne magnetic survey
Soetijoso DJOJOMIHARDJO (GSI)	Kenichi NOMURA (NED)
Sarjono (GSI)	Tamotsu FUJIKAWA (NED)
Nanan KOMARA (GSI)	Ikuo TAKAHASHI (NED)
Aircraft crew (PENAS)	

(3) Aerial photography and Airborne magnetic survey in 1977

Planning and regulation

Nobutaka MIYAZOE (MMAJ)

Keiichi TAKEDA (MMAJ)

Survey team

	Indonesian team	Japanese team
Team leader :	Ajat SUDRADJAT (GSI)	Haruhiko HIRAYAMA (NED)
Members :	Aerial photography	Aerial photography
	H.M.D. ROSIDI (GSI)	Junichi UMEZAWA (AAS)
	Turus SOEJITNO (GSI)	Koichi TANAKA (AAS)
	Onong KASWANDA (GSI)	Koki YAGI (AAS)
	Ungkap L. BATU (GSI)	Nobumichi TAKEKAWA (ASS)
	Aircraft Crew (P.T. EXSA International Co., Ltd. P.T. Indonesian Aviation Corp.)	
	Airborn magnetic survey	Airborne magnetic survey
	Soetijose DJOJOMIHARADJO (GSI)	Kenichi NOMURA (NED)
	Sarjono (GSI)	Tamotsu FUJIKAWA (NED)
	Nanan KOMARA (GSI)	Ikuo TAKAHASHI (NED)
	Aircraft Crew (Perusahaan Umum Survey Udara)	

(4) Photogeological Survey in 1977

Planning and regulation

Toshio KAWAGUCHI (MMAJ)

Survey team

	Indonesian team		Japanese team	
Team leader:				
	Adjat SUDRADJAT	(GSI)	Haruhiko HIRAYAMA	(NED)
Members :				
	H.M. DJURI ROSIDI	(GSI)	Tokichiro TANI	(NED)
	Turus SOEJITNO	(GSI)	Susumu TAKEDA	(NED)
	Oong KASWANDA	(GSI)		
	Tjandra SANTOSA	(GSI)		
	Ungkap L. BATU	(GSI)		
	Bargur S. HASAN	(GSI)		
	M. FIRDAUS	(GSI)		
	Deddy MULYADI	(GSI)		
	E. KERTAPATI	(GSI)		

Expert

Sakae ICHIHARA (JICA-GSI)

Mitsuharu YAKOH (JICA-GSI)

(5) Geological Survey in 1978

Planning and regulation

Kenji NAKAMURA (MMAJ)

Hiroaki OHKUBO (JICA)

Survey team

	Indonesian team		Japanese team	
Team leader :				
	Yaya SUNARYA	(GSI)	Nobuo HAKARI	(NED)

Indonesian team			Japanese team		
Members:			**Members:**		
Koswara	YUDAWINATA	(GSI)	Katsumi	HAYASHI	(NED)
Witoto		(GSI)	Akitsura	SHIBUYA	(NED)
Tatto	SUDHARTO	(GSI)	Masayoshi	MATSUGI	(NED)
Idik	SUMPENA	(GSI)	Susumu	TAKEDA	(NED)
Johny	R. TAMPUBOLON	(GSI)	Yuuji	NISHIKAWA	(NED)
Z. H.	DHANNY	(GSI)	Atsushi	GOMI	(NED)
Assistant for Doctor:			**Medical Doctor :**		
Muktamar		(GSI)	Shiro	TABUCHI	(NED)

Expert:

Sakae ICHIHARA (JICA-GSI)

I-4 Location and Access

The whole project area is located in the central parts of Kalimantan, Republic of Indonesia, and is ranged about 36,300 Km^2 being enclosed by following latitudes and longitudes; from 0°00' to 1°00' S and from 111°45'E to 114°45'E.

The area geologically surveyed in 1978 occupies central-southern parts of the whole project area being covered the area of about 2,000 Km^2 as shown in Fig. 1.

Access to the project area is as follows ; Daily flights exist between Jakarta and Banjarmasin, the capital city of the South Kalimantan, and take one and a half hours by jet plane. Regular and irregular flights exist between Banjarmasin and Palangka Raya, the capital city of the Central Kalimantan. Smaller planes for four to nine passengers are used, and take about 45 minuts.

Tb. Miri, where the Base Camp was established, is situated in southern end of the surveyed area at the confluence of River Kahayan and River Miri. Transportations between Plangka Raya and Tb. Miri are provided exclusively by engine boats on waterways. The journey takes five days or about 50 hours by big engine boat, so-called "slow boat", for seven to fifteen passengers with three to seven tons of cargo, due to the tremendous meanderings of the river developed within only 160 Km of direct distance between the two bases.
There is no land route except for limited timbering and farming areas along the river, and no open land for heli-port except play grounds of the school in Tb. Miri.

I-5 Topography

Most of the project area consist of relatively low lands including semi-plains and hilly regions at between 100 and 500 m above sea level. And, mountainous regions range from southwestern to central-northern parts of the project area forming the Schwaner and Muller mountain ridges at between 1,000 and 2,000 m high. Principal rivers are flowing started from these water-heads toward the Melawi low lands at northwest and the low lands of Schwaner mountain ridges at south and east.

I-6 Climate

Climate of the area is characterized by high temperature and high humidity with plentiful rainfalls, owing to locations of the project area situated directly on the equator and composed of rather low elevation of 100 to 1,000 m excluding high mountainous regions in the northern parts. Although there are no detailed meteorological data, indoors temperatures in the Miri Base Camp during survey periods ranged from 26°C to 28°C in the morning, 30°C to 32°C in the afternoon and 23°C to 25°C at night. There are no big seasonal variations of temperature. The average humidity reaches 75% to 85%.

Generally, dry seasons are from June to September, and rainy seasons continue from October to May. Rainfall during dry seasons averages from 200 mm to 300 mm, and that of rainy seasons reaches from 300 mm to 400 mm. In mountainous regions of the northern parts, there are more rainy days and rainfalls than in hilly regions and semi-plains of central to southern parts of the area.

Thus, the climate of the area belongs to that of a typical Tropical zones, and thick jungles of tropical plant have developed reflecting such weather conditions. However, because tree canopy greatly reduces the amount of light penetrating to the ground level, ground level vegetation is not very dense.

This area is one of the most dangerous regions for malaria and an infectious disease such as cholera, disentry, typhoids, and leprosy, as well as epidemic of influenza.

Ⅱ. LANDSAT DATA ANALYSIS

CHAPTER II. LANDSAT-DATA ANALYSIS

II-1 General Remarks

Pattern and spectral analyses of LANDSAT-data were carried out for the project area as Phase I, with the purpose of obtaining basic information for further prospecting.

From the pattern analysis, data pertaining to geology and geologic structures were obtained, and geology of the project area was classified into 16 geological units. These units were further correlated to the existing geological maps, and distributions of the various lithological units of the area were clarified. Geologic structures of the area are controlled by the uplifted belt extending from southwestern to northeastern parts of the area, and by the basins in both east and west of this belt. WNW-ESE folds are prominent in the western basin and NEN-SWS folds are developed in the eastern basin.

From the spectral analysis, mineral showings were extracted. Alluvial and diluvial deposits were found in localities shown as placer deposits in the map, and two types of anomalies were observed for areas indicated to contain vein-type ore deposits. Being porphyry copper-type ore deposits expected to be found in this project area, acidic plutonic bodies were extracted, and many occurrences of granitic body were confirmed.

II-2 Method of Analysis

LANDSAT images used for this analysis are the following 15 sceens, including 12 sceens in the project area and 3 sceens in outside area.

Western zone

Image number	Latitude / Longitude of the central point	
E-1356-02185	N00-05	E110-42
E-1355-02131	N00-04	E112-08
E-1355-02133	S01-23	E111-49

Eastern zone

E-1444-02054	N00-01	E113-42
E-1246-02082	S00-08	E113-35
E-1138-02080	S00-08	E113-39
E-1138-02082	S01-34	E113-19
E-1444-02061	S01-26	E113-22
E-1372-02074	S01-20	E113-17
E-1137-02022	S00-07	E115-05
E-1443-02003	S01-32	E114-47
E-1101-02023	S01-29	E114-47

Neighboring area

E-1051-02240	N01-24	E109-47
E-1051-02242	S00-03	E109-26

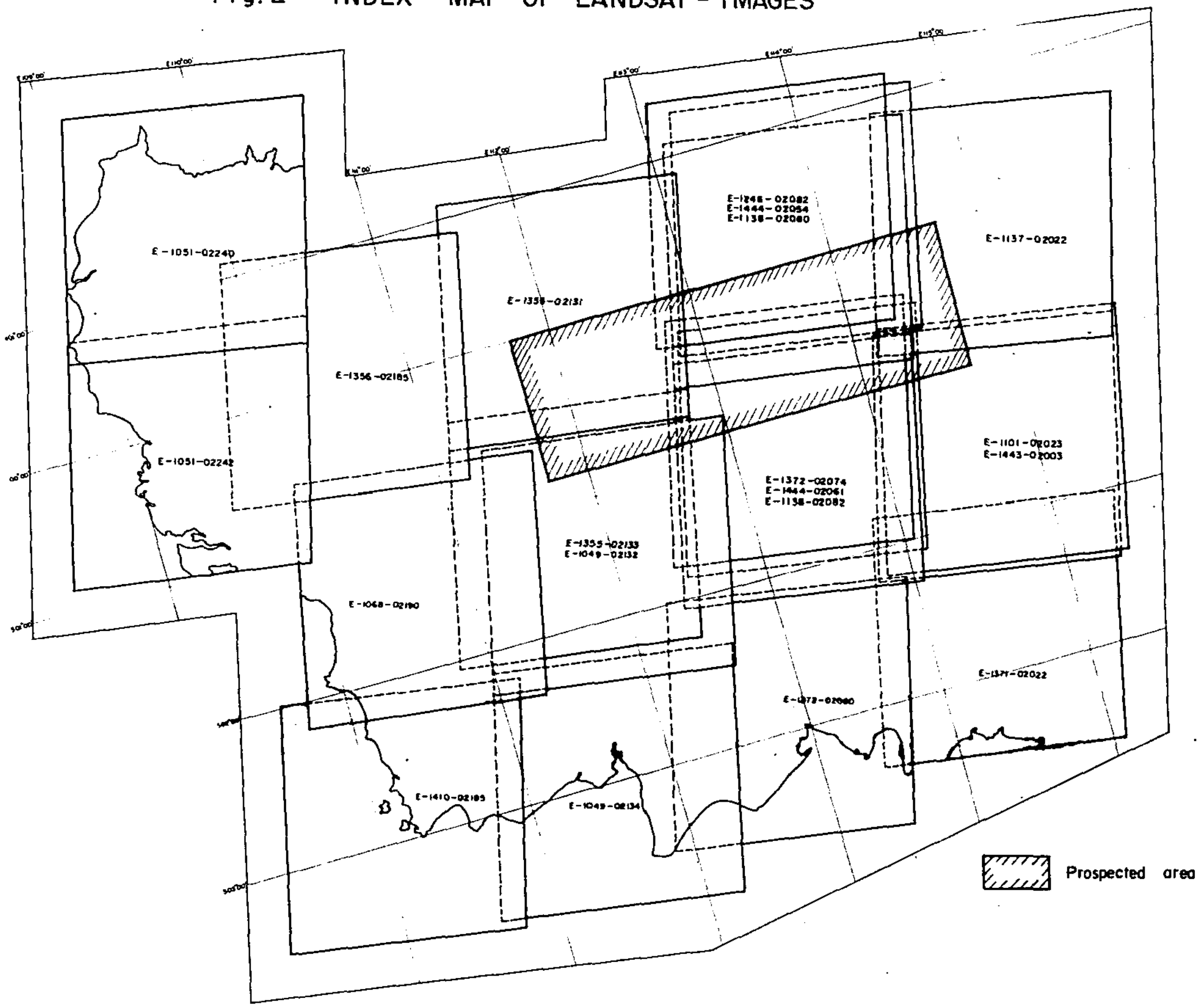
The vicinity of the Mamut mine

E-1173-02001	N05-43	E116-34

(1) Geographical analysis

Topography, density of forests, savanna, human population and transportation network (roads, waterways) were classified

Fig. 2 INDEX MAP OF LANDSAT - IMAGES



by additive color composites, edge enhanced images, three dimensional display images and other methods.

(2) Geological and structural interpretation

Geological patterns were read directly from five types of positive images; namely, black and white images and false color compositive images of each band. Geomorphological characteristics such as density, lengths, and patterns of drainage system; resistance to erosion, cross sections of valley, forms of ridge; density, direction, and lengths of fissure system, as well as tone and texture were considered in determining lithological distributions. Also geological structural analysis was carried out by referring to trends of bedding, schistosity, and patterns of linear system.

(3) Extraction of anomalies (mineralized and alteration zones)

These works were done by employing additive color methods, color enhancement and extraction, and print out method.

(a) Additive color analysis

The negative and positive films of each band were studied by using additive color viewer under various combinations of light of three primary colors. The combination by alteration haloes of the known mineralized zones (including those not in the project area) standing out most conspicuously were selected. Additive color images were then prepared by this combination, and similar anomalies were delineated.

(b) Color enhancement and extraction analysis

Combinations of light of three primary colors and negative and positive films of each band were produced by the multi-color data system. The color patterns which indicated the mineralized zones and the activation of vegetation in the vicinity were extracted and used in identifying mineralized zones.

(c) Print out method

For the zones which were delineated from the operations explained above, more detailed, accurate, and objective data were printed out by CCT (Computer Compatible Tape) and analysed.

(4) Interpretation

All images prepared by the above procedures were studied. Topographic, tonal, hazy and geobotanical anomalies were correlated, and their significance to geology and geological structures was analysed.

Also during the analysis and interpretation mentioned above, various geological literatures concerning vicinity of the project area were fully utilized, and the data obtained by the Geological Survey of Indonesia during reconnaissance survey were of great value.

(5) Map preparation

Results of analysis of the images were compiled into a geological interpretation map.

II-3 Analytical Results

The present study shows that geology of this area are consisting of 16 geological units as shown in Table 2, and these units were correlated with the available geological maps. Units M (mainly metamorphic rocks) and D (mainly metasediments) are correlated to Carboniferous - Triassic; N (mainly andesites) to Cretaceous; H (mainly alternation of shale and sandstone), ℓ (mainly limestone), T (mainly tuffs), and E (mainly pyroclastic rocks) to Eocene - Miocene; B (basalts), S (mainly coarse sandstone), F (mainly sandstone), and C (mainly fine sandstone) to Pliocene - Pleistocene; Q (river sediments) and L (laterite) to Alluvium; and A (andesite), I (intrusive rocks), and G (granites) to acidic to intermediate rocks of the maps.

Geological structures of eastern and western parts of the area differ greatly, and the boundary of two parts is the basement rocks of Units M,D,N, and G which are distributed from northeastern to southwestern parts of the project area. Lineations with NWN - SES, NEN - SWS and ENE - WSW trends are developed in areas where the basement rocks are distributed. In the west, Units T,H,F, and S overlie the basement unconformably, and geology is controlled by the WNW - ESE trending folds. While, in the east, Units E, H, and C overlie the basement unconformably, and are controlled by NEN - SWS trending folds.

The project area is geologically divided into the following three zones, namely southwest-northeast, northwest, and southeast zones.

II-3-1 Southwestern-northeastern area

This zone is consisting mainly of Units M and D (metamorphic rocks), N (andesitic rocks), and G (granitic rocks). This zone is situated in northern parts of the Sunda Land - Tewah High of "Tectonic map of central and southeast Kalimantan" (Fig. 3), and forms the uplifted zone at borders between the Melawi basin and the Mahakam basin at east.

Occurrences of Au, Cu, Pb, Mo, and other metallic veins have been reported in granitic rocks.

As a result of the analyses, especially the pattern analysis and the color enhancement and extraction method, granitic bodies are classified into relatively large bodies of different tone, texture, and resistivity to erosion. Also major fissure systems trending at NWN - SES direction and metallic veins are believed to be controlled by that trend. The analysis by print out method revealed two types of anomalies. One type is developed in the vicinities of granitic bodies, and is characterized by clearly developed linear structures of NWN - SES system. Thus, these zones are considered to be promising for occurrences of metallic vein from developments of fissure and its relation to igneous activities. The other type of anomaly is consisting of belts of relatively dark and light tones in single rock bodies. These belts occur in an echelon arrangement, and no vegetation difference is observed in these anomalous zones. This is believed to be caused by differences in water content, due to the siliciffication and argillization along the fissures.

Mineralizations are not observed in the project area, but one of the types of mineralization which can be expected from this area is porphyry copper. One of the basis for this inference is disseminations of chalcopyrite and pyrite in granitic rocks found by the GSI at south of the project area. Also one of the porphyry copper zones extending southward from the Philippines (Liddy, 1974) can be inferred to continue to western parts of the Kalimantan via Mamut deposit in the Malaysia side of northern parts of the island. With these facts in mind, acidic plutonic bodies which are believed to be related to the above mineralization have been extracted. Many granitic bodies were extracted as a result of the operations. However, as there is no mineralization of this type known in this area, they could not be correlated to which type of granite is related to mineralization.

II-3-2 Northwestern area

Major geological units of this zone are T (Tuffs), H (sandstone-shale alternation), F and S (sandstones), B (basalts), and A (andesite dykes) which have intruded into all of the above units. This zone is situated on southeastern margins of the Melawi basin.

Gold and diamond placer deposits have been reported from the project area. Distribution of alluvial and diluvial deposits was clarified by this analysis, however, it was not possible to obtain particular information regarding these deposits.

Other types of mineralization, which can be expected to occur in the project area from geological and structural considerations, are veins associated with andesite dyke, sedimentary uranium deposits, and epithermal syngenetic deposits.

Metallic veins associated with andesite dyke have been discovered by the GSI at south of the present area. Because of these informations, andesite dyke zones were analysed by print out method, and clarified their shapes and distributions. However, it was not possible to study these anomalies concerning mineralization because of a lack of data.

Sandstone-type uranium deposits occur in Tertiary or Quaternary Systems which unconformably overlie granitic basement and form basins (Hayashi, 1970, Katayama 1974). There are geologic environments suitable for the occurrence of this type of deposits in this zone.

Kuroko deposits have been reported to occur in marginal parts of the Tertiary basins with intense igneous activity by the Society of Mining Geologists of Japan (1974). And, there are geological conditions favorable for occurrences of these submarine exhalative deposits.

II-3-3 Southeastern area

The major geological units of this zone are E (pyroclastic rocks), H' (sandstone-shale alternation), and C and S (sandstones). This zone is situated on southwestern margins of the Mahakam basin.

Data of geology and ore deposits of this zone are very few. This zone is located at marginal parts of a sedimentary basin, and pyroclastic formations are predominant, also there are possibilities of occurrence of the Kuroko-type deposits as in case of northwest zone. Unfortunately, LANDSAT images of this zone are somewhat cloudy, and there are many parts where details could not be analysed.

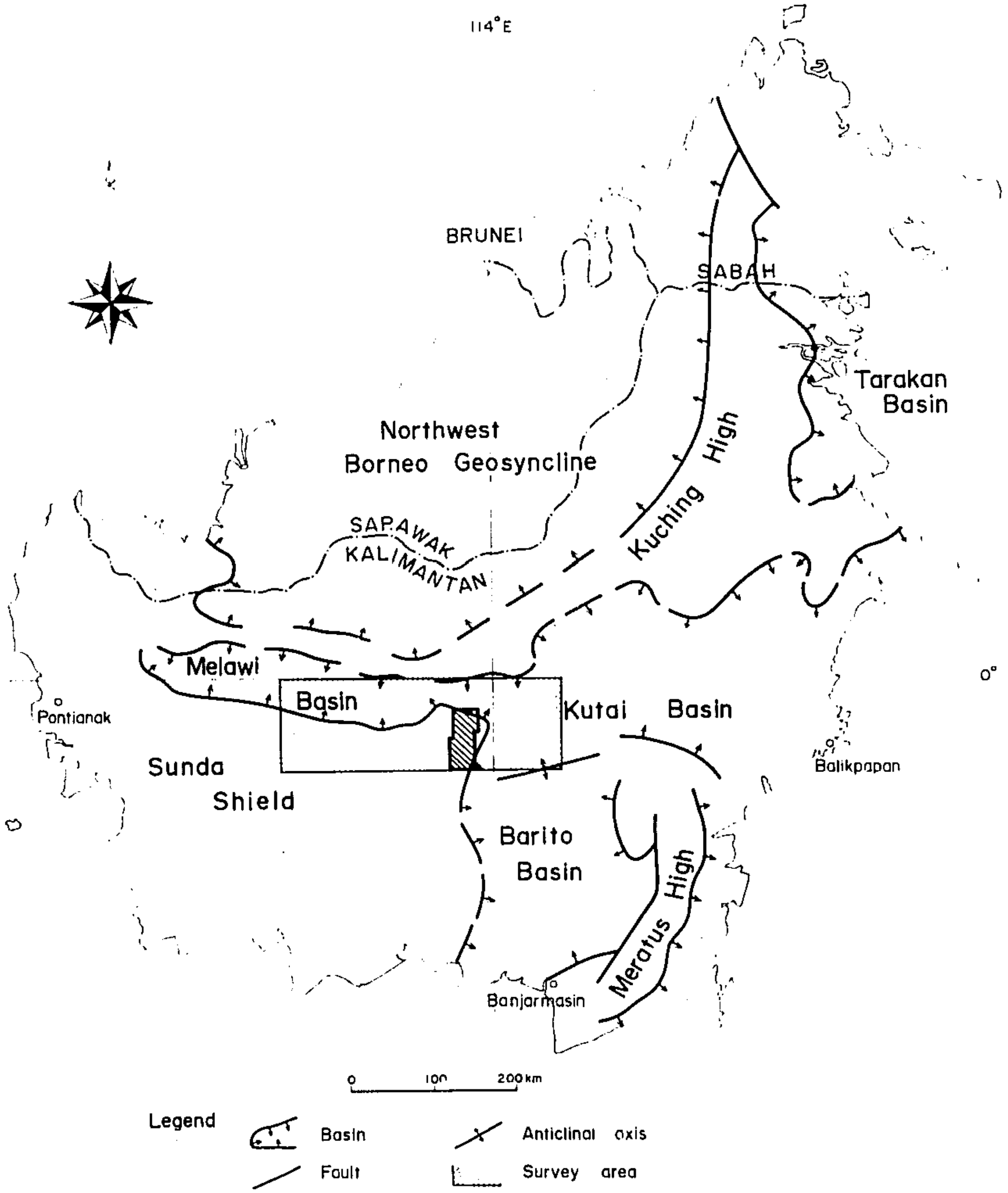


Fig 3 Tectonic map of Kalimantan

Table 2 CHARACTERISTICS CHART OF LANDSAT-IMAGE

UNIT	PHOTOGRAPHICAL C.		TOPOGRAPHICAL CHARACTERISTICS									COMMENT	PROBABLE LITHOLOGY
			DRAINAGE			RESISTIVITY, SECTION			LINEARMENT, BEDDING				
	TONE	TEXTURE	PATTERN	DENSITY	PARAMETER	ROCK	VALLEY	RIDGE	DIRECTION	INTENSITY	KINDS		
Q	light	hazy	meander	rare	permanent	very weak	flat		-	-	-	swamp, oxbow rich, poor vegetation.	Quaternary Sediments
L	gray	fine	meander	rare	permanent	very weak	flat		-	-	-	well vegetation	Laterites
B	gray	coarse	dendritic	medium	very short	strong	∨	⌒	mainly 1	medium	joint	ditto	Basalts (Lava + Tuff)
S	very dark	fine	-	-	-	strong	–√–	–√	rare	strong	bedding	dipping is nearly flat. F\S\B	Coarse Sandstones
F	dark	fine	-	-	-	medium	–√–	–√	rare	strong	bedding	dipping is very gentle H\F\S	Sandstones
C	dark	fine	dendritic	medium	short	medium	~	⌒	rare	weak	bedding	ditto H\C	Fine Sandstones
H(H')	light	coarse	-	-	-	medium	semi cuesta		rare	very strong	bedding	foldings are observed.	Alternation of Shales & Sandstones
ℓ	light	fine	-	-	-	very strong	-	⌒	rare	very strong	bedding	2 horizones T\ℓ //ℓ// H/E	Limestones
E	light	fine	-	-	-	medium	◡	⌒	rare	strong	bedding joint		Pyroclastics
T(T')	light ~ dark	hazy	-	-	-	weak ~ strong	flat partialy	(T')	medium	weak	joint	characteristics are variable	Tuffs
N	light	coarse	dendritic	medium	very short	medium	◡	⌒	mainly 1	medium	joint	resistivity is different in place by place	Andesites (Lava + Tuff)
D	gray	coarse	semi-dendritic	dense	short	medium	∨	⌒	many	medium	joint	overlain by S & C	Metasediments
M	gray ~ dark	fine	dendritic	medium	short ~ medium	strong	∪	∩	many	strong	joint	intruded by units G	Metamorphic rocks
A	very light	coarse	-	-	-	very strong	-	∩	rare	weak	joint	intruded in units S & G	Andesites intrusive
I	dark	coarse	-	-	-	strong	-	∧	rare	weak	joint	intruded in units H & G	Intrusive rocks
G(G')	gray	rugged	rectangular	medium	medium ~ long	strong	∨	∧	many	strong	joint	characteristics are variable	Granites

Table 3. LIST OF SPECTRAL DATA ANALYSIS

Analytical Methods			Object			
			Geomorphology	Geological Units	Geological Units	Ore Showings
Analogic Process	Photographic Process	False Color Composition	O	O	O	
		Additive Color Composition	O	O	O	
	Electronic Process	*Color Enhancement* & Extraction	O	O		O
		Density Measurement		O		O
		Edge Enhancement	O		O	
		Three Dementional Display	O		O	
Digital Process		Print Out Method		O	O	O

II-4 Conclusions

Geology of the project area is consisting of the following 16 units in ascending stratigraphic order. Carboniferous - Triassic metamorphic rocks, Cretaceous andesites, Eocene - Miocene tuffs and sedimentary rocks, Pliocene - Pleistocene sedimentary rocks and basalts, Recent sediments, and intrusive rocks such as Cretaceous granites and Pleistocene andesites.

Geological structures are controlled by the uplifted belt in the southwest - northeast zone, by the Melawi basin at west, and by the Mahakam basin at east. Folds of WNW - ESE system are developed in the Melawi basin and NEN - SWS folds in the Mahakam basin.

Three systems of lineation, NWN - SES, NEN - SWS, and ENE - WSW are developed in metamorphic rocks. While, only NWN - SES lineation is predominant in other units. The lineations of NWN - SES direction gradually change from N - S to NW - SE directions as formations become younger.

Placer and vein-type mineralizations are known in this area. Placer deposits cannot be extracted from the LANDSAT images by any method, but alluvial and diluvial deposits were found in localities where placer deposits are shown in the geological map. Veins themselves cannot be extracted, but anomalies of linear structure and tonal anomalies were observed in the vicinity of localities shown as vein occurrence in the geological map.

Mineral showings have not been found in the project area yet, however, there are possibilities of porphyry copper, sedimentary uranium, and Kuroko-type exhalative deposits in the area from geologic and structural considerations.

Analysis was made of the area with porphyry copper in mind. The deposits in other areas were referred to. It was not possible to extract mineral showings, but the distributions of granite were determined fairly accurately.

Ⅲ. AERIAL PHOTOGRAPHY

CHAPTER III. AERIAL PHOTOGRAPHY

III-1 General Remarks

Taking aerial photographs were carried out at Phase II and Phase III, and photographic coverage reached 71 % in 1976 and 22 % in 1977, totaling 93 % of the project area, or 33,750 Km^2.

III-2 Procedures of Taking Photographs

III-2-1 Flight plan

At Phase II, flight courses were basically chosen in north-south direction with some expections of east-west direction depending on weather conditions. At Phase III, eastern and northwestern parts of the project area were flown in north-south direction, and central and southwestern parts of the project area were flown in east-west direction, respectively.

Other flight plan specifications are as follows; 3,600 m of flight altitude, 1:40,000 of photo scale, and 240 Km/hour of flight speed.

III-2-2 Air base

Palangka Raya Airport at Phase II and Banjarmasin Airport at Phase III were employed as air bases, respectively.

III-2-3 Aircraft and equipment

(1) Aerial Camera

WILD RC-9 super wide angle camera with super Aviogon lens (F = 8.8 cm)

(2) Film

KODAK Double X Aerographic Film

(3) Aircraft

BEECHCRAFT H-18 S (Twin Engine)

Registration No. PK-BIF

Operated by P.T.Indonesian Aviation Corporation
(P.T. INDOAVIA)

III-3 Survey Results

The specifications for aerial photographs were as follows :

1. Photographic Scale : Approximately 1:40,000
2. Overlap : Forward Overlap : Not less than 60 per cent.
   Sidelap : 20 - 80 per cent.
3. Tilt and Tip of Film Angle : Within 5 degrees (and usually less than 3 degrees)
4. Cloud Coverage : Less than 10 per cent (less than 20 per cent in some parts of the mountainous areas).
5. Type and Size of Film : Panchromatic Black and White, 23 cm x 23 cm.
6. Type of Printing Paper : Semi-glossy, Double-weight, FUJI AM3

The number of aerial photographs taken this time is 2,848 prints in total.

Ⅳ. AIRBORNE MAGNETIC SURVEY

CHAPTER IV. AIRBORNE MAGNETIC SURVEY

IV-1. General Remarks

Airborne magnetic surveys were conducted as Phase II and Phase III, with a purpose to clarify geological structures, distributions of igneous rock, and possibility of ore deposits in the whole project area.

Based on obtained magnetic features, the surveyed area is divided into three parts : i.e. 1) low magnetic anomalies of long wavelength in northwestern parts of the surveyed area, 2) extremely high magnetic anomalies of short or medium wavelength in southwestern parts of the surveyed area, and 3) eastern parts of the surveyed area having a mixed characteristic feature of the above two parts.

It is concluded on the basis of magnetic measurements of rock samples that extremely high magnetic anomalies may be caused by andesite and diorite, on the other hand, weak magnetic anomalies may be distributed in relation to sandstone, mudstone, shale, etc.

The magnetic analyses with results of rock-magnetic measurements and available geological data come to the following conclusions of distributions of igneous rock and possibilities of ore deposits.

1) Granitic rocks forming the basement extend in the direction of WNW-ESE over southwestern parts of the surveyed area and ENE-WSW over central parts. It is presumed that structures reach northeastern and southeastern borderlines of the eastern part.

2) Sedimentary rocks, such as sandstone, mudstone, shale, etc. are distributed in the direction of E-W over the northwestern parts of the surveyed area. It is presumed that they form thick layers at eastern sections of the northwestern part.

3) Predominant distributions of andesitic rock are found in the eastern part.

4) Magnetic features are well consistent with the basement with WNW-ESE trending magnetic structural lines in western parts and NE-SW trending magnetic structural lines in eastern parts of the surveyed area.

5) The basement and the major magnetic structural lines turn their trends at southern sections of the central part, where magnetic features reflect complex geology including a number of fault lines.

6) Mineralized zones promising for ore deposits are found at southern sections of the central part by geological surveys. The mineralization is presumed to have a relation with Tertiary granites. Although exact distributions of Tertiary granite are not clarified from the present survey, it is probably true that, based on complex geology of southern sections of the central part as mentioned in 5), geological conditions of forming the mineralization related Tertiary granite is satisfied there.

IV-2 Method of Survey

The area surveyed in 1976 occupies northwestern and central parts of about 25 per cent of the whole project area with effective flight line extensions of 3,606 km. In 1977, surveys were successively carried out to cover the remaining parts with effective flight line extensions of 9,144.9 km. Totaling the surveys in 1976 and 1977, 95 per cent of the whole project area was covered with the flight lines of 12,750.9 km in length.

The 1976 survey flight was started from northwestern parts of the surveyed area, including the range contoured with a comparatively high accuracy in topographic maps of 1/250,000 scale.

The 1977 survey flight was started from eastern parts of the surveyed area. Navigations were maintained by use of a Doppler navigation system with 1/250,000 scale topographic maps (printed by the Army Map Service, sheet numbers 12/VI, 12/VII, 12/VIII, 13/VI, 13/VII, 13/VIII), photomosaics of LANDSAT imagery and SLAR (Side Looking Airborne Radar) imagery and a 1/40,000 scale photomosaic of aerial photographs.

Length of traverse lines flown in the north-south direction amounted to 111 km at a standard line spacing of 3 km. The tie lines were flown in the east-west direction.

Flight altitude of the survey was maintained at a constant height of 2,000 m above sea level, except mountainous zones of 1,800 m or higher in altitude.

Data processings and analytical programm of airborne magnetic survey are shown in flow chart of Fig. 4.

IV-3 Conclusions

Based on obtained magnetic features, the surveyed area is divided into three parts : northwestern parts (Area I), southwestern parts (Area II) and eastern parts (Area III).

Area I is characterized by very low magnetic anomalies of long wavelength in contrast to Area II occupied by a swarm of extremely high magnetic anomalies of short or medium wavelength. Area III has a mixed characteristic feature of the above two areas.

The present work contributes to clarifying the geological structure and the igneous rock distribution in the surveyed area, on the basis of the airborne magnetic survey. Granitic rocks forming the basement are extensively distributed over southwestern parts of the surveyed area at WNW-ESE trend, and extend from central parts to central-eastern parts at ENE-WSW trend. Further extensions may presumably cover northeastern and southeastern borderlines of the eastern part.

Sandstone, mudstone, shale, etc. are distributed at direction of E-W over northwestern parts of the surveyed area. They can form very thick layers at eastern sections of the northwestern part. Predominant distributions of andesitic rock are located at central sections of the eastern part.

The magnetic features well reflect geological structures running at WNW-ESE trend in the western parts, while, at ENE-WSW trend in the eastern parts of the surveyed area. The basement is considered to be well consistent with the general tendency of magnetic features.

Mineralized zones promising for ore deposits are found at south of the central part by geological surveys. The mineralizations are presumed to have a relation with Tertiary granites. Although distributions of Tertiary granite have not been disclosed by the present survey, it is pointed out that Tertiary granitic rocks concentrate around magnetized bodies at south of the central part. Judging from survey results that the basement turns its trend from WNW-ESE to ENE-WSW together with magnetic evidence of existing a number of fault lines, south of the central part is composed of complex geology. In such a district, geological conditions of forming Tertiary granite may be satisfied.

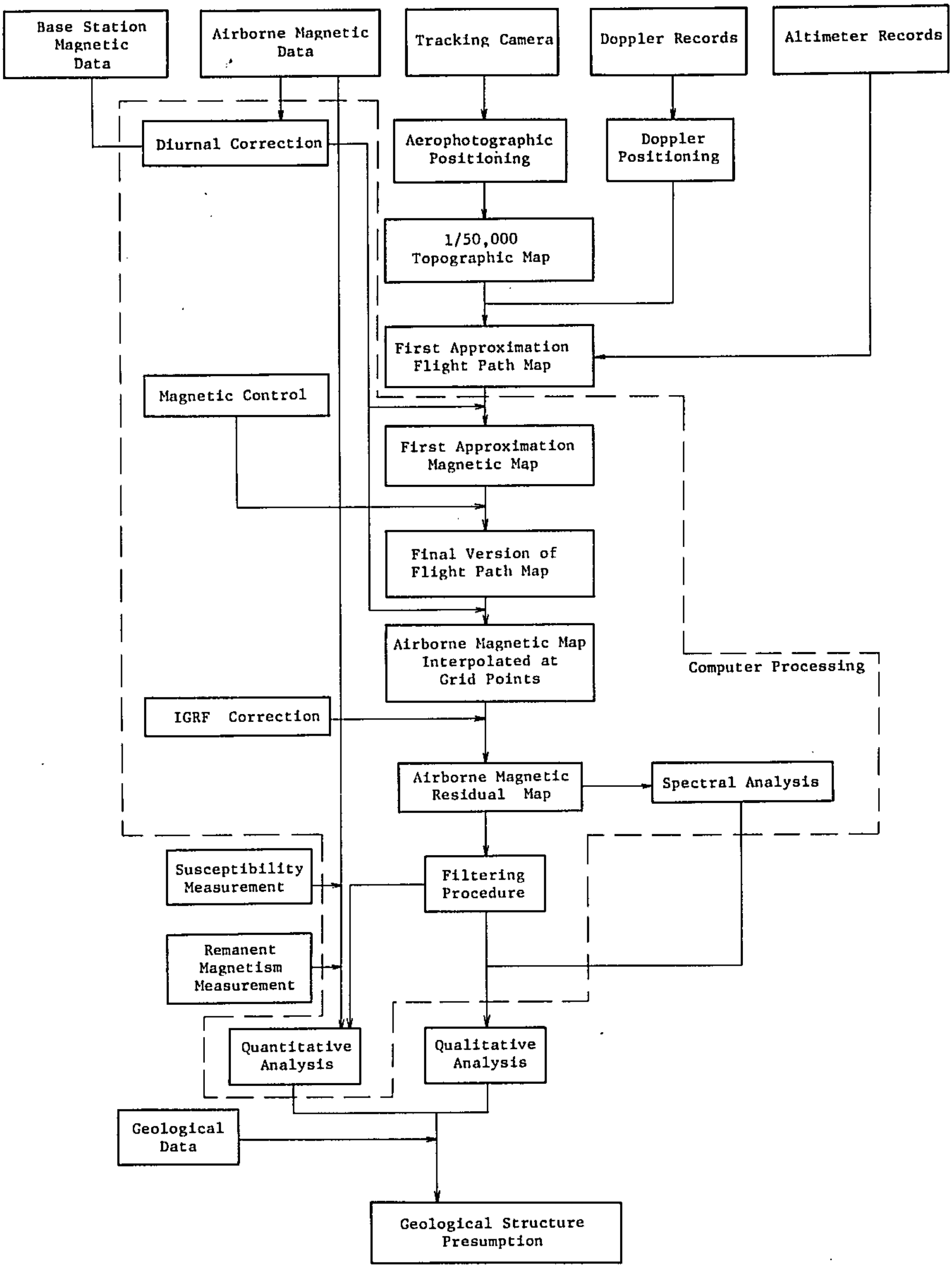


Fig. 4 Flow chart of data processing and analysis of airborn magnetic survey

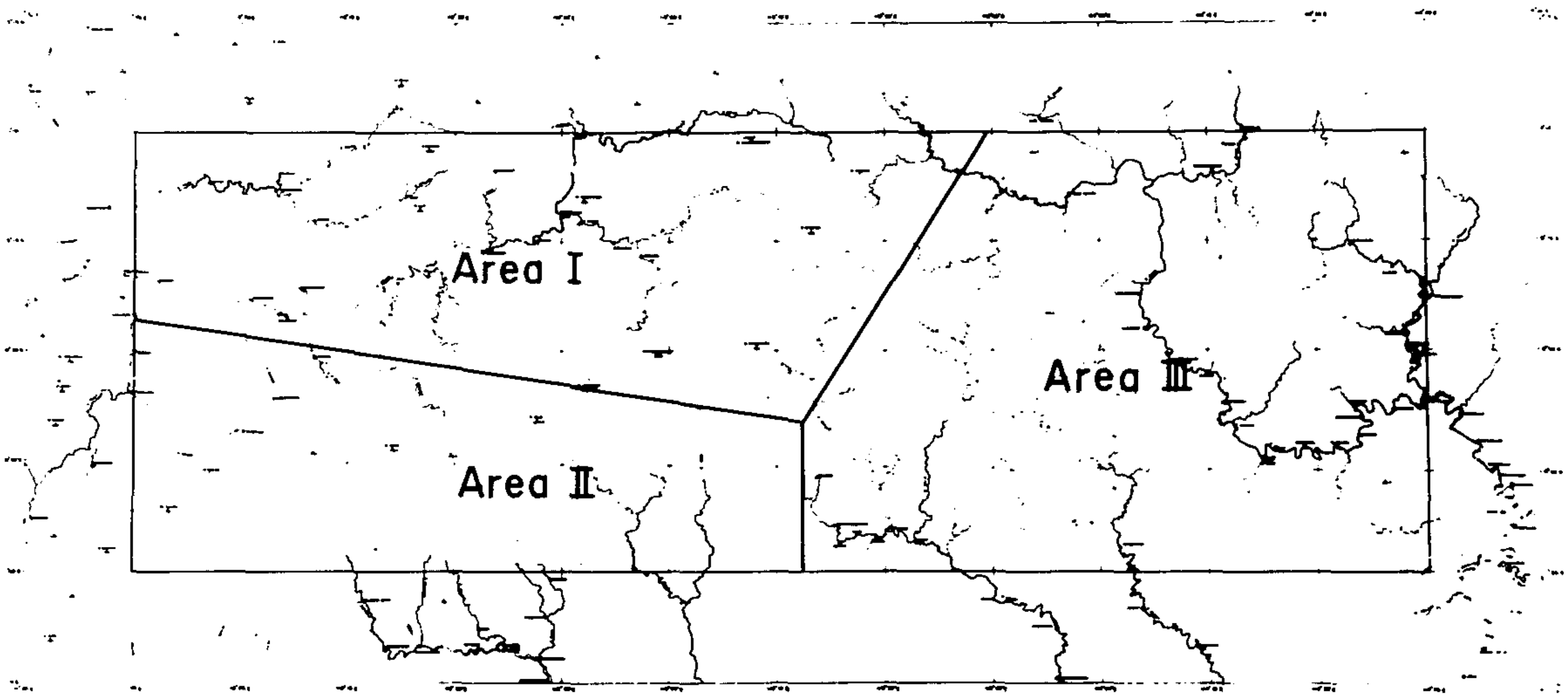


Fig. 5 Sectional map of airborne magnetic survey

V. PHOTO-GEOLOGICAL SURVEY,

CHAPTER V. PHOTO-GEOLOGICAL SURVEY

V-1 General Remarks

According to the present survey, geology in the project area is divided into 22 units. However, the area is generally divided into four parts in a geological sense :

The southwestern area located at northeastern margins of the Sunda Shield where the basement composed of Tertiary rocks is exposed.

The northwestern area corresponding to an eastern half of the Melawi basin of Paleogene in age.

The eastern area located at western margins of the Kutai basin of Tertiary in age.

The northern area where the terrigenous Plateau Sandstone of Tertiary in age occurs.

The basement rocks consist of Paleozoic metamorphic rocks which are mainly schists, and sediments, volcanics and granitic rocks of Paleozoic to Mesozoic in age. Sedimentary rocks constituting the Melawi basin are grouped and called as the Melawi formation. The formation can be divided further into two parts, the upper and the lower. The lower formation of the Melawi Proper is consisting mainly of sandstone, shale and interbedded layers of coal, and the upper formation is called as the Lebang Claystone. These appear to be deposited under the littoral and lagoonal environments.

Western margins of the Kutai basin at eastern parts of the area is consisting of the Paleogene Tertiary sedimentary rocks, which are mainly formed by deltaic sediments under neritic to shallow water environment. Furthermore, so-called Plateau Sandstone is distributed mainly at northern parts. This consists of inland quartz sandstone. Quartz diorites and andesites have intruded into these Tertiary formation as small stocks or dykes.

The geological structures given here coincide nearly with the former structural divisions. Sedimentary rocks in both Kutai and Melawi basins have generally low dips (less than 15°) and folding structures have commonly E-W axes. Faults are of WNW-ESE system at southwestern parts (northeastern parts of the Sunda Shield), and of NE-SW system at eastern parts (western margins of the Kutai basin).

Concerning mineral deposits, small scale gold and diamond placer mines are under operation in the surveyed area. There are known several mineral showings of copper, lead and zinc, and thin coal seams.

V-2 Method of Analysis

The numbers of aerial photographs used in the present works are 2,848 which cover 93% of the whole region. They consist of 1,987 photographs taken in 1976 and 861 photographs taken in 1977. A scale of the photographs is approximately 1:40,000.

(1) The following geological and geomorphological features are identified from the aerial photographs by using stereoscopes; drainage pattern, density, texture, resistance (relief energy and errosion), valley section, ridge pattern, lineament, tone, geological boundary, and strikes and dips of bedding and

schistosity.

(2) These are drawn directly on an overlay of each aerial photograph so that an interpretation chart is prepared. Thus, a classification of lithostratigraphic units and analyses of geological structures can be carried out.

(3) Because of enormous numbers of photographs, overlays of four to five courses are compiled together. The compilation diagram is, then, reduced to a scale of the available topographic map (1:250,000) so that major rivers coincide with those on the topographic map.

(4) A preliminary photo-geological map is prepared on water system maps of the whole area, on the basis of compilation diagrams.

(5) The semi-controlled mosaics are also drawn by using the aerial-photographs reduced to a scale of about 1:250,000, in order to understand the macrostructures of the area, and to clarify positional and structural relationships among the photographs. The complete photo-geological map is prepared with supplementary geological data reported by the GSI, in respect to obscure boundaries and geological structures in each unit on the preliminary photo-geological map.

V-3 Analytical Results

V-3-1 Geology

As a result of analyses, the area were divided into 22 units, as shown in Table 4.

Unit M : Metamorphic rocks of crystalline schist, quartzite and slate, and sedimentary rocks of sandstone, shale and limestone are included. Metamorphic rocks can be correlated to Carboniferous - Permian, and sedimentary rocks are to Traissic - Jurassic.

Unit I : It is impossible to jduge this unit from aerial photographs, and is made clear by surveys of the GSI. This unit is consisting of andesites, which is correlated to the Serian Volcanic Formation of upper Triassic classified by Khee, Meng Leon (1972).

Units S1 - 12 : These are consisting of sedimentary rocks, such as sandstone, shale, mudstone and limestone, which are correlated to Cretaceous to Tertiary. Unit S-3 among Units S1 - 12 is consisting of quartz sandstones, and corresponding to Plateau Sandstone which is developed within all horizones of the Tertiary System, and has a relation of interfingers with these Units.

Unit Q : This is river sediments of gravel and sand.

Units V - 1 - 3 : These are consisting of granitic rocks, and lavas of andesite and basalt, and are correlating to Tertiary.

Units I - 1 - 4 : These units include granitic rocks and gneisses which are assumed as activities from Paleozoic to Mesozoic.

V-3-2 Geological Structure

Geological structure of the surveyed area is divided into three tectonic provinces roughly as follows:

(1) The southwestern and central-northern upheaval zones, where basement rocks are distributed.

(2) The basin from the central-northern parts to northwestern parts of the surveyed area (eastern parts of the Melawi basin).

(3) The basin at eastern parts of the surveyed area (western margin of the Kutai basin).

The boundary between Melawi basin and Kutai basin is an upheaval zone, but no clear boundary line is drawn. Near the boundary, Tertiary basal conglomerate and sandstone are present.

On eastern side of the Melawi basin, although small scale and loose fold structures exist in the whole, structure is generally NW or N dipping loose monocline. On western side, a synclinal structure with E-W fold axis develops.

In the Kutai basin, towards the east, upper strata are distributed gradually. At eastern edge, a synclinal structure is formed at position corresponding to the western elongation of center of deposition in the Kutai basin by Samuel, Luki and Muchsin, S. (1975).

Dips of sedimentary rocks in both basins are low, in general, and are less than 15°. In particular, dip tends to become low from the Plateau Sandstone (Unit S-3) and upwards.

The photo-lineament from aerial photographs have differences in density and direction from place to place. At southwestern parts in which the basement rocks are exposed, generally the lineaments are predominant from N-S system to NE-SW system, following NW-SE system parpendicular to the former.

At area corresponding to the Melawi basin in northwestern parts, remarkable direction is recognized, and NWN-SES system is predominant.

At area corresponding to the Kutai basin in eastern parts, there develop ENE-WSW system and WNW-NW system. Generally, developments of photo-lineament are a little, especially no clear lineament is recognized in the area covered by Plateau Sandstone.

As is described above-mentioned, lineaments in this area are of predominant two systems such as NE-SW system or NW-SE system, and in the area except Melawi basin, these two systems are recognized.

In this area, two principal faults of NE-SW system are recognized at eastern parts. One of them is faced between Tewah village and Miri village along the Kahayan River, and northward. Fault becomes subdued within sandstone and conglomerate beds (Unit S-2). The basement rocks are bordered by Tertiary sandstone and conglomerate (Unit S-2) at this fault in western tributary of the Kapuas River. Other faults trend in the NE-SW direction through Rudijak Village along Kapuas River and Muara Lahung village along Barito River.

This fault is inferred from fault structure shown by airborne magnetic survey that had been carried out before this survey. It seems that Tertiary igneous rocks intrude along fault lines, but the detail is not clear owing to insufficiency

Table 4 List of Mineralized zone and chemical assays of ore

Group and age of mineralization	Name of mineralized zone	Location: Grid of map	Location: River	Mode of occurrence	Scale of mineralized zone: Plan (Km)	Scale of mineralized zone: Width (m)	Kind of Ore	Sample No.	Sampling Width (m)	Assay: Au (g/t)	Assay: Ag (g/t)	Assay: Cu (%)	Assay: Pb (%)	Assay: Zn (%)	Remarks
Stratiform	Piton Kecil	E-6	S.Piton besar	Stratiform	1.0^m × ?		Py, Chl, Qt								
and Skarn	Siruk Besar	I-5	S.Siruk besar	Stratiform	0.1 × 0.02	20 + α	Py, Cp	RH-17	Chips	<0.1	<1	0.006			
(Permian	Kitan	G-5	S.Kitan	Stratiform	0.05^m × ?		Pyr, Skarn								
Jurassic)	Pejangoi	G-10	S.Pejangoi	Dissemination	1 × 3		Py, Qt								
	Raea	H-11	S. Raea	Dissemination	0.3 × 1	0.20	Py, Clay	RB-44	0.20	<0.1	<1	0.011			
		G-11	S. Raea	and Vein	5^m×5^m+α	5.00	Py, Qt, Gos	RB-53	5.00	<0.1	<1	0.004			
Porphyry copper	Lintong	H-11	S.Lintong	Diss.and Vein	0.2 × 0.5	0.15	Py, Qt	RA-83	0.15	0.1	1	0.002			
type and	Sating	G-12	S. Miri	Dissemination	0.3 × 1		Py.								
Cp-Py vein	Kapangoi	G-12	S. Miri	Dissemination	0.3 × 0.3		Cp, Py	RA-84	Chips	0.1	<1	0.021			
	Ngahukup	H-12	S.Ngahukup	Dissemination	0.2+α × 2		Cp, Py								
(Cretaceous)	Pari	H-12	S. Pari	Dissemination	0.2 × 0.5		Py								
	Masukih	H-11	S.Masukih	Dissemination	1 × 2.5		Py								
	Onguk	H-11	S. Miri	Vein	1.5^m×5^m+α	1.50	Py	RA-82	1.50	<0.1	<1	0.002			
Cp-Py vein	Rangan Hiran	K-9	S. Pari	Vein	1 × 1		Py	RG-2	Chips	0.7	60	0.002			
						0.12	Cp, Qt	RD-11	0.12	<0.1	<1	0.001			
(Cretaceous)	Morandoi	J-7	S.Morandoi	Vein	1 × 4	3.00	Py	RC-83B	3.00	<0.1	<1	0.008			
	Anoi	J-8	S. Anoi	Vein		0.20	Cp, Bo, Py, Qt	RD-58	0.20	0.1	124	3.97			
	Piton	E-6	S.Piton besar	Lens		0.40 + α	Gl, Sp	RF-3	0.40	4.2	296	0.274	17.72	5.23	
			"	Lens		0.40 + α	Gl, Sp	RF-5	0.20	8.8	526	0.75	33.18	13.00	
			"	Vein	0.5 × ?		Au, Ag, Qt	RF-9	Chips	0.3	1				
			"	Vein		0.20	Au, Ag, Qt	RF-10	0.20	1.5	76				
Au-Qz Vein			"	Vein		0.20	Au, Ag, Qt	RF-11	0.20	1.1	5				
and	Sarau	E-6	S.Sarau	Vein	0.1^m × ?	0.10	Qt	RF-18	0.10	<0.1	<1				
Gl-Sp Vein	Middle Sonang	F-5	S.Bahio Kecil	Vein	0.2 × 0.2	0.25	Py, Qt	RF-26	0.25	<0.1	<1	0.246			
with	Kohongoi	F-5	S.Sepoi besar	Vein	0.3 × ?	0.10	Py, Qt	RF-51	0.10	<0.1	<1				
Alteration	Upper Sonang	E-7	S.Sonang	Dissemination	0.5 × 2		Cp, Py	RF-38	Chips	<0.1	1	0.068			
			S.Sudiron	and Vein		0.50	Py, Qt	RF-45	0.50	<0.1	2				
(Tertiary)	Horas	G-3	S.Hamputung	Vein	2^m × ?	2.00	Cp, Py, Clay	RH-29	Chips	<0.1	<1	4.00			Fault zone
	Pitu	F-2	S.Pitu	Dissemination			Py, Clay	RH-31	Chips	<0.1	<1				
		F-3	"	Dissemination	0.2 × 0.5		Py, Clay	RH-32	Chips	<0.1	<1				
		F-3	"	Dissemination			Py, Clay	RH-33	Chips	<0.1	<1				
	Lapan	H-4 I-4	S.Popoi uang	Alteration	0.7 × 1		Qt	RG-15	Pebbles	<0.1					Qt-pebble

(Note) Cp : Chalcopyrite Gl : Galena Py : Pyrite Pyr : Pyrrhotite

Bo : Bornite Sp : Sphalerite Qt : Quartz Gos : Gossan

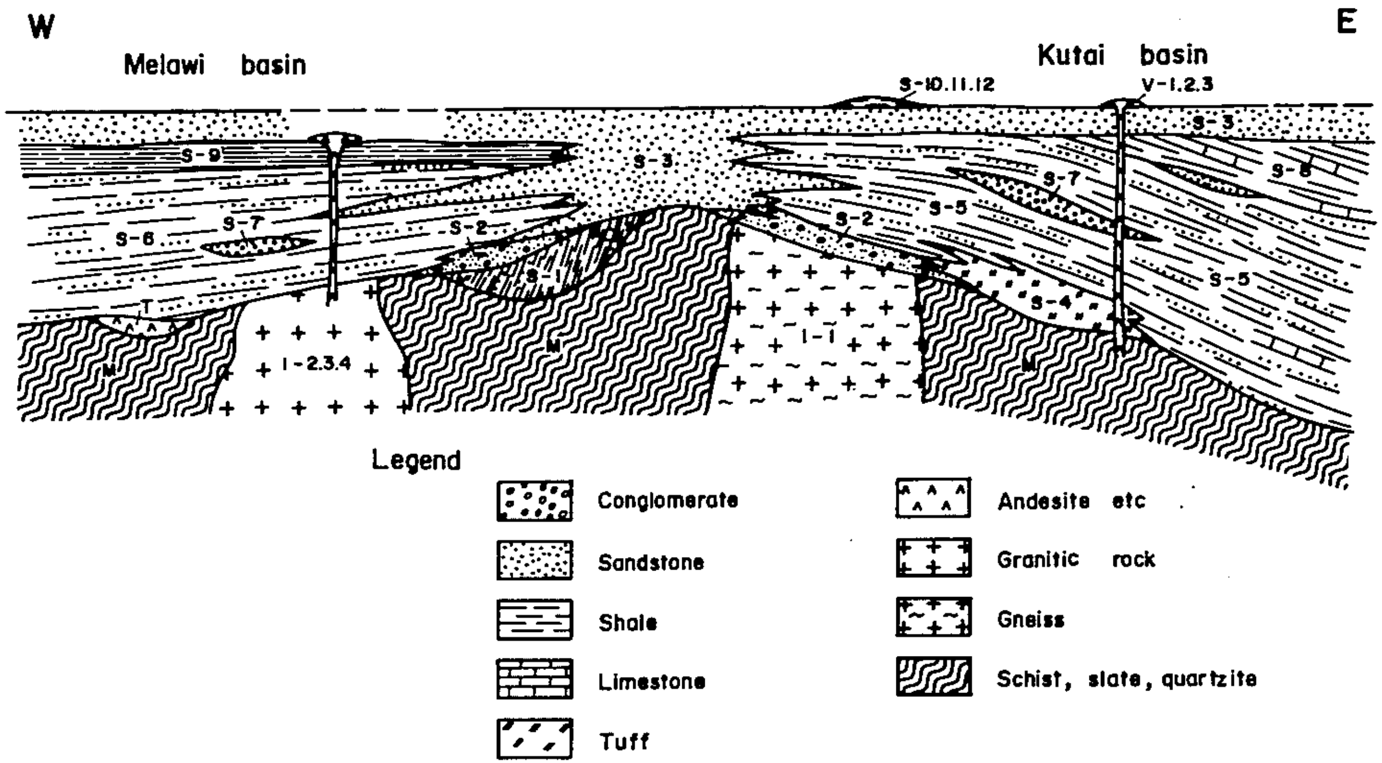


Fig. 6 Idealized cross section by photo geology

of geological data.

V-3-3 Mineral Deposit

Ore deposits in this region are divided into four types ;

1) Mineralized zones of either copper, lead, or zinc.

2) Gold deposits.

3) Diamond deposits.

4) Coal seams.

All descriptions in this chapter are based on data of geological reconnaissance undertaken independently by the GSI. No detailed investigation on ore deposits has been carried out beyond their survey.

(1) Mineralized zones of base metal

This type of mineralized zones are concentrated at central-southern area of the region. There exist 14 deposits especially within confined areas around the rivers of the Kahayan, Miri and Kanpuas. Most deposits have mode of occurrences of a vein or network-type. Ore minerals are consisting usually of pyrite, sphalerite, galena and rarely chalcopyrite.

(2) Gold deposits

There are eight gold deposits which are classified into two modes of occurrences; gold-bearing quartz veins and alluvial deposits at areas of the Barito River and of the Kapuas River.

(3) Diamond deposits

There exist two diamond mines at southeast of the surveyed area. Diamond is picked from surface soils overlying Tertiary sandstone and conglomerate. The deposits appear to be of Alluvial, but origin is rather speculative. The mining procedure is a panning of soils obtained through pits sank with a size of 1.5 meters in diameter and 6 meters deep.

(4) Coal seams

It is said that coal is presently mined on a small scale in neighborhood of the surveyed area. However, a few poor outcrops of coal layers are only observed within the area.

The mineral deposits are classified into four types as described above. Gold and diamond are currently mined, however, future outlooks for development are poor because of small scale of deposits. It is also poor in respect to coal except its mining on a small scale judging from thickness of seams.

Mineralizations of base metals, copper, lead and zinc, are concentrated at central-south of the surveyed area. They are definitely in some relation with distributions of Tertiary granite intrusions, which are characteristic geological episode in the central-south. Field surveys also suggest that there is a relationship between mineralizations and the intrusions of granite, since rock alterations accompanying pyrite-disseminations tend to become stronger toward margins of the granite.

V-4 Conclusions

Promising mineralizations are of a vein or dissemination-types. Both types seem to be intimately related to Tertiary granite. Future prospecting of ore deposits should be undertaken for porphyry copper or large scale vein-type deposits.

The Mamut mine, at the Sabah State, along northeastern extensions of the surveyed area, is porphyry copper ore deposits with a close relation to the Kanabalu granite, Tertiary in age. Distributions of the mineralized zones of copper, lead and zinc, as well as Tertiary granite are concentrated at central-southern parts of the surveyed area.

Survey of the next year should be confined at central-southern area having such deposits. The proposed investigations are geological survey including the investigations of ore deposits at promising area. It may be more effective, if geochemical prospectings are carried out at the same time.

Furthermore, prospectings of radioactive minerals have been carried out by the CEA-BATAN at western side of the area. Because of distributions of granitic rock and conglomerate, a radioactive reconnaissance should be also undertaken.

VI. GEOLOGICAL SURVEY,

CHAPTER VI. GEOLOGICAL SURVEY

VI-1 General Remarks

VI-1-1 Purpose of survey

The target area for geological survey, central-southern parts of the whole project area, was selected as a promising area having ore deposits or mineralized zones, as revealed by the result of previous works - LANDSAT-data analysis, aerial photography, airborne magnetic survey and photo-geological survey, including available geological data obtained by their own geological surveys of the Geological Survey of Indonesia. The purpose of this year's survey is to make clear the geology, stratigraphical sequences, igneous activities, geological structures, and ore deposits and/or mineralizations in the target area, through various surveys such as photo-geological interpretation, geological and geochemical surveys, together with radiometric prospecting.

VI-1-2 Method and amount of survey

(1) Photo-geological interpretation

A photo-geological interpretation of geological structure of the target area was carried out by analyses of stereographic observation of aerial photographs, and was assisted in geological survey.

(2) Geological survey

Geological surveys were conducted along rivers and creeks by using drainage maps of 1:40,000 scale, which had been made from aerial photographs taken in 1976 and 1977. Results of the survey, together with results of the photo-geological interpretation, were compiled in drainage maps of 1:100,000 scale. The area geologically studied is 2,035 Km^2.

In addition, sketches of ore deposits and/or mineralized zones were made by 1:1,000 or more detailed scale.

(3) Geochemical survey

Keeping place with geological surveys, sampling of stream sediments from each rivers and creeks was carried out by using 80 mesh sieve. Total number of samples reached 1,231 samples, and number of 1,030 samples were sent for chemical analysis of Cu, Pb, Zn and Mo elements in assay laboratories of both Indonesia and Japan.

(4) Radiometric prospecting

In addition to geological and geochemical surveys, reconnaissance surveys were carried out for an existence of radioactive minerals in the target area. Eight scintillation counters of Model TCS-121C have been employed in radiometric prospectings, and total number of measurements reached 1,175 points.

(5) Placer gold prospecting

Gold mineralizations are known in southern parts of the surveyed area, and nugget gold is collected during dry seasons. In order to study gold ore deposits and placer gold deposits, sampling of nugget gold in stream sediments was conducted by panning in the areas centering mainly around Tertiary volcanic formation. 127 samples of panning were obtained.

(6) Other samples

For laboratory analyses, neccessary samples were taken during field surveys. They were supplied for examinations as follows; 60 rock samples and 16 ore samples for examinations under microscope, 3 samples of plutonic rocks for determinations of their absolute datings, 15 rock and ore samples for X-Ray analysis of clay minerals, 28 samples of ore or 68 elements of chemical analysis for mainly Au, Ag and Cu, and 6 samples for judgement of fossils.

VI-2 Geology, Stratigraphical Sequences and Igneous Activities

Geology, stratigraphical sequences and igneous activities in the surveyed area are generally classified as follows;

(1) Metanorphic rocks of basement and plutonic activities of tonalite.

Metanorphic rocks, distributed in areas from central-eastern parts to southwestern parts of the area, consisting of Pendarangas-Riang Gneiss, Meraya-Popoi-Punyoi Crystalline schist, Habaon Phyllite and Pejangoi Hornfels. It is considered that these rocks had been deposited from the Carboniferous to the Permian Periods, and were changed to various metamorphic rocks by regional metamorphisms occurring from

Fig. 7 Geological Column

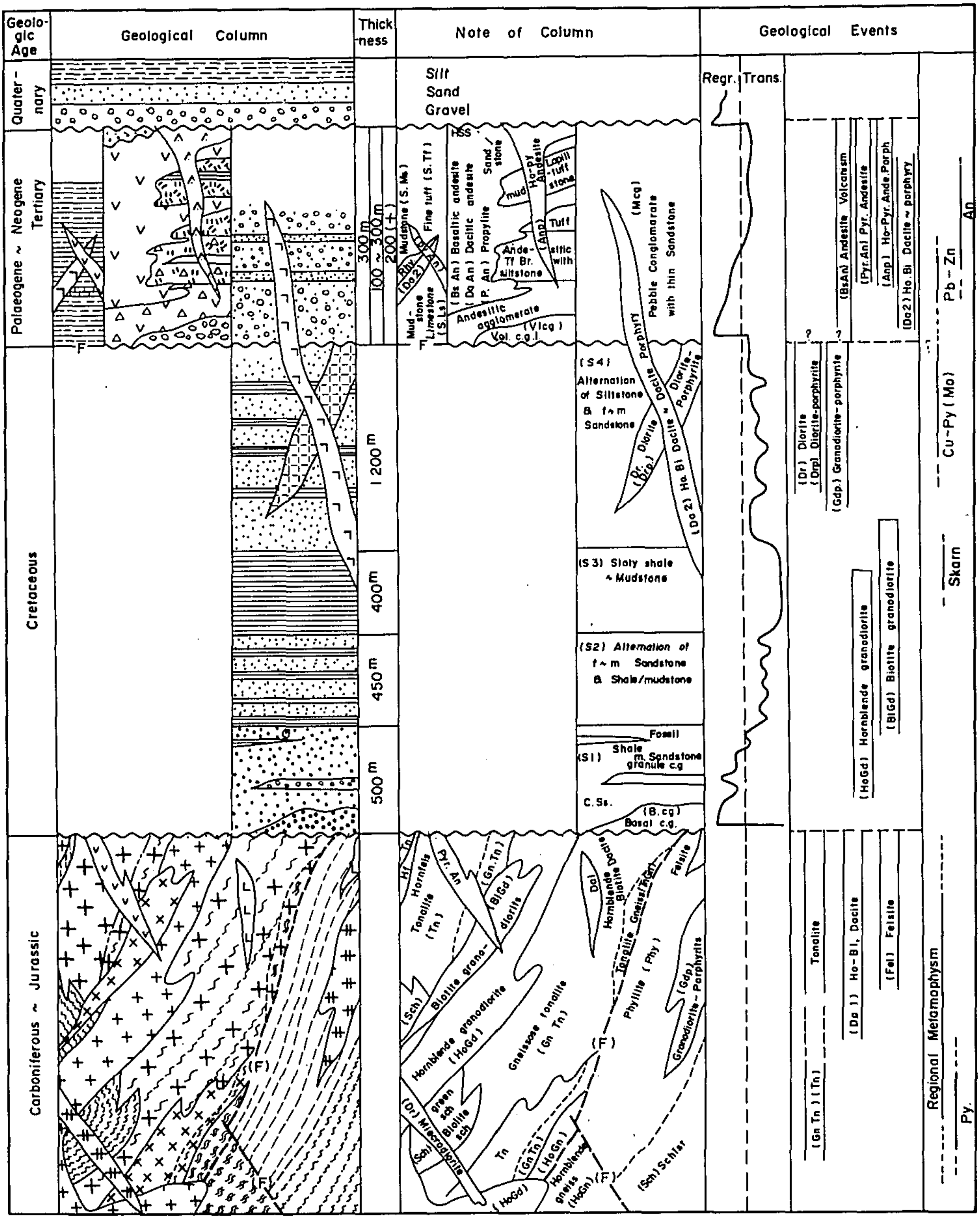
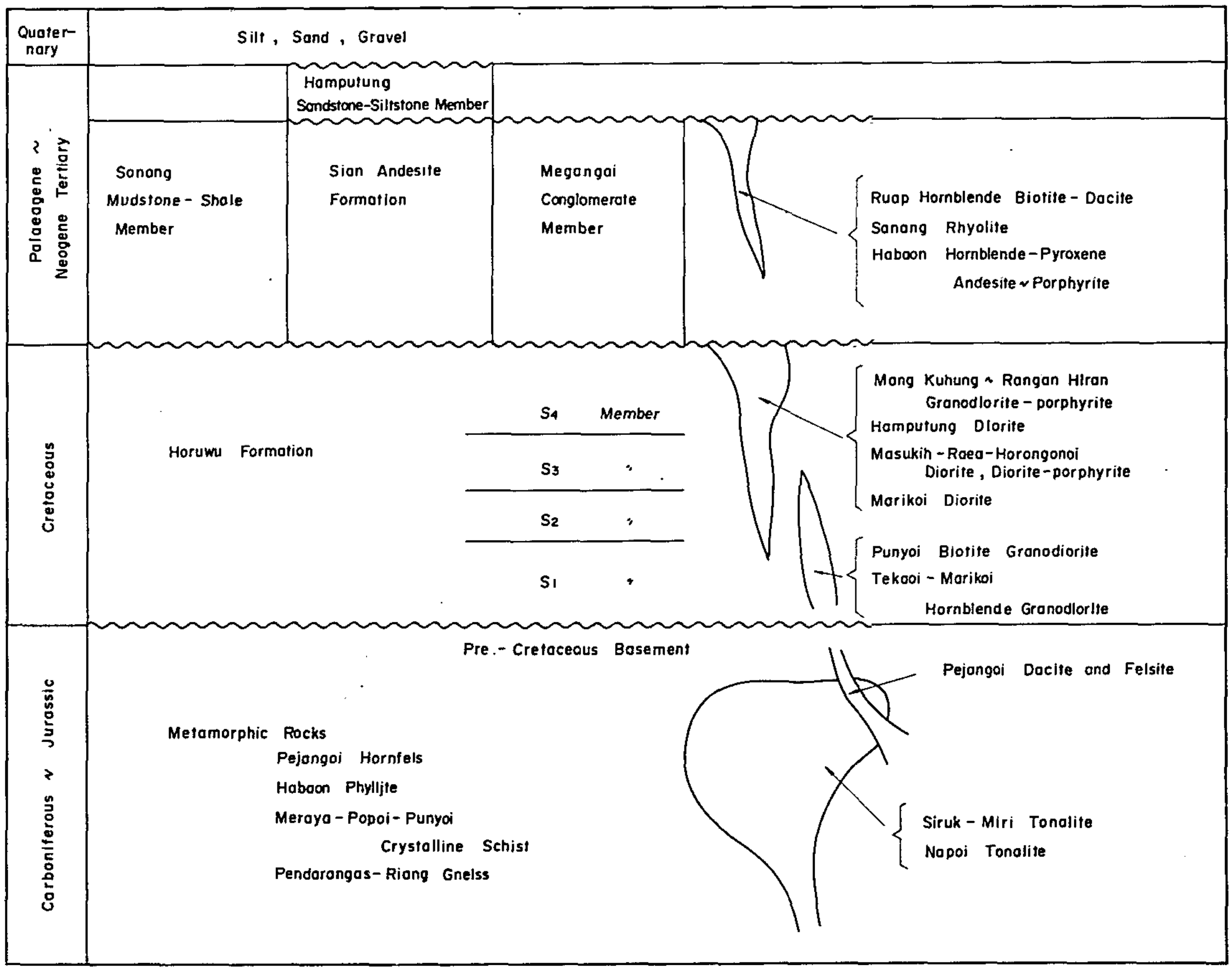


Fig. 8 Stratigraphical Sequences



the close of Permian to the close of Jurassic, and by thermal metamorphisms related to intrusions of tonalite.

Tonalites are divided into Napoi Tonalite and Siruk-Miri Tonalites, occupying wide areas of central parts of the area. These tonalites have been intruded under conditions of compressive stress during the period from late Permian to late Jarassic, which correspond to periods of regional metamorphism. They show, more or less, gneissose structures in parts of their bodies located near metamorphic rocks, and gradually change to massive tonalites in and near central parts of the intrusive mass.

(2) Sedimentary rocks of Cretaceous System and plutonic or hypabyssal activities of late Cretaceous Period

Sedimentary rocks of the Cretaceous System are composed of the Horuwu Formation located in northern parts of the area, which has formed sedimentary basins unconformably overlying basement rocks and tonalites. The formation can be divided into four Members. Although fossils of gastropoda and bivalves have been found in relatively lower portions of the Formation, it is difficult to determine their exact species and geological ages, because of poor preservation.

Raea Diorite, Masukih Diorite, Horongonoi Diorite and Kahungoi Diorite-porphyrite have intruded into the Horuwu Formation, forming phacolithic intrusive bodies as well as a swarm of dikes like sheets. At central parts of the area, Tekaoi Granodiorite, Marikoi Granodiorite and Punyoi Granodiorite have intruded into gneissose tonalites, and formed portions of batholithic intrusive mass called "Tonalite-Granodiorite Complex". On the other hand, dikes of granodiorite-porphyrite, called Mang Kuhung Granodiorite-porphysite and Rangan Hiran Granodiorite-porphyrite, have intruded into Habaon Phyllite, parallel to structures of the "Rangan Hiran-Siruk-Tajungan" Tectonic Line.

(3) Volcanic formation, and sedimentary rocks of Tertiary System.

The Sian Andesite Formation, consisting mainly of lavas of basaltic andesite together with its pyroclastics, is distributed in central-southern parts of the area. These volcanisms are assumed to have acted during periods from the late Oligocene to the early Miocene Epochs. Moreover, dikes or volcanic necks of augite-hornblende andesite and hornblende-biotite dacite are recognized intruding into older formations.

Sedimentary rocks of the Tertiary Period, the Merangai Conglomerate Member, the Sonang Mudstone-Shale Member and the Hamputung Sandstone-Siltstone Alternation Member are distributed at northeastern edge, at central-western margine and at southwestern part, respectively. Because they developed locally and independently, it is difficult to define stratigraphical sequences within the Tertiary System.

(4) Quaternary System

Sediments of the Quaternary System are found on a small scale, along river banks in semi-plains of southern parts of the area.

VI-3 Geological Structure

Geological structures of the surveyed area are mostly characterized by folds developed in metamorphic rocks which have been caused by compressive stress in WNW-ESE direction, and by the "Rangan Hiran-Siruk-Tajungan" Tectonic Line, which have been formed as series of structural breaks at the latest stage of metamorphism.

Namely, the formers are represented by wavy structures of a gently elongated reverse letter "S" appearing in crystalline schists near western margin of Siruk Tonalite, as well as by tremendous folds developed in Habaon Phyllite. Tonalites, which intruded under conditions and in places of regional metamorphism and folding, have gneissose structure which is parallel to structures of metamorphic rocks. Structural breaks at the latest stage have resulted in formation of the "Rangan Hiran-Siruk-Tajungan" Tectonic Line, which pushed up plutonic bodies of mainly tonalite over metamorphic rocks of mostly Habaon Phyllite. It is considered that these structural breaks were accompanied by movements of a kind of twist or rotation, which resulted in structural changes of gneissose tonalite, and by lateral movements, by which tonalite blocks were relatively moved toward southwest to phyllite blocks.

Regarding a formation period of the Tectonic Line, it is assumed to range from the close of the Permian to that of Jurassic Periods, which correspond to periods of regional metamorphism, and the latest stage of tonalite intrusions.

Besides the Tectonic Line, faults of NE-SW and NW-SE systems are of the first class, and have strongly controlled geological structures in the area. In comparison, faults of E-W and N-S systems are less important, and have only a limited control over geological structures.

VI-4 Mineral Deposit

Mineralizations in the surveyed area can be divided into two stages, namely; earlier mineralizations related to igneous activities of from the late Paleozoic to middle Mesozoic Eras, and later mineralizations, related to plutonic or hypabyssal activities and volcanic activities from the late Cretaceous to Tertiary Periods. The later are principal and the most important mineralizations, among which copper-bearing pyritic ores as well as gold ores have been explored and mined. Followings represent the main mineralized zones and ore deposits in the surveyed area.

(1) Porphyry copper-type mineralized zones associated with pyrite-quartz veins located in and around Raea Diorite in northern parts of the area,

(2) Vein-type copper-bearing pyritic ore deposits developed in and near dikes of granodiorite-porphyrite intruded into Habaon Phyllite in central-eastern parts of the area, and,

(3) Vein-type gold ore deposits and lead-zinc ore deposits related to Tertiary volcanisms in central-southern parts of the area.

These mineralized zones or ore deposits are strongly controled by geological structures, such as the structures of intrusive rocks and faults, and some of them have a kind of zonal arrangements.

Based on these structural controls together with characteristics of mineralization, centers and neighbors of the three areas mentioned above can be indicated as targets for further investigations and detailed surveys. This is also proven by results of geochemical surveys, radiometric prospectings and placer gold prospectings.

VI-5 Geochemical Survey, Radiometric Prospecting and Placer Gold Prospecting

As a result of geochemical surveys and radiometric prospectings covered the whole surveyed area as well as placer gold prospectings conducted in southern half of the area, following results were obtained.

Because methods and objectives of the survey or prospecting were different, that is search for base metals, radioactive minerals and gold ores, the anomalous areas obtained by three methods did not generally overlaped each other. All of them do not seem to be very promising. However, interesting anomalous areas are as follows;

(1) Through the geochemical surveys, three anomalous areas were obtained; Raea anomalous area indicating porphyry copper-type mineralized zones and associated pyrite-quartz veins, in northern parts, Rangan Hiran anomalous area suggesting a swarm of copper-being pyrite veins in central-eastern parts which continues outside of the surveyed area, and Lapan anomalous area suggesting possible ore deposits of base metal at deeper sections of the Sian Andesite Formation.

Table 5 List of Mineralized zone and chemical assays of ore

Group and age of mineralization	Name of mineralized zone	Location: Grid of map	Location: River	Mode of occurrence	Scale of mineralized zone: Plan (Km)	Scale of mineralized zone: Width (m)	Kind of Ore	Sample No.	Sampling Width (m)	Assay: Au (g/t)	Assay: Ag (g/t)	Assay: Cu (%)	Assay: Pb (%)	Assay: Zn (%)	Remarks
Stratiform	Piton Kecil	E-6	S.Piton besar	Stratiform	$1.0^m \times ?$		Py, Chl, Qt								
and Skarn	Siruk Besar	I-5	S.Siruk besar	Stratiform	0.1 × 0.02	20 + α	Py, Cp	RH-17	Chips	<0.1	≤1	0.006			
(Permian	Kitan	G-5	S.Kitan	Stratiform	$0.05^m \times ?$		Pyr, Skarn								
Jurassic)	Pejangoi	G-10	S.Pejangoi	Dissemination	1 × 3		Py, Qt								
	Raea	H-11	S. Raea	Dissemination	0.3 × 1	0.20	Py, Clay	RB-44	0.20	<0.1	<1	0.011			
		G-11	S. Raea	and Vein	$5^m \times 5^m + \alpha$	5.00	Py, Qt, Gos	RB-53	5.00	<0.1	<1	0.004			
Porphyry copper	Lintong	H-11	S.Lintong	Diss. and Vein	0.2 × 0.5	0.15	Py, Qt	RA-83	0.15	0.1	1	0.002			
type and	Sating	G-12	S. Miri	Dissemination	0.3 × 1		Py.								
Cp-Py vein	Kapangoi	G-12	S. Miri	Dissemination	0.3 × 0.3		Cp, Py	RA-84	Chips	0.1	<1	0.021			
	Ngahukup	H-12	S.Ngahukup	Dissemination	0.2+α × 2		Cp, Py								
(Cretaceous)	Pari	H-12	S. Pari	Dissemination	0.2 × 0.5		Py								
	Masukih	H-11	S.Masukih	Dissemination	1 × 2.5		Py								
	Onguk	H-11	S. Miri	Vein	$1.5^m \times 5^m + \alpha$	1.50	Py	RA-82	1.50	<0.1	<1	0.002			
Cp-Py vein	Rangan Hiran	K-9	S. Pari	Vein	1 × 1		Py	RG-2	Chips	0.7	60	0.002			
						0.12	Cp, Qt	RD-11	0.12	<0.1	<1	0.001			
(Cretaceous)	Morandoi	J-7	S.Morandoi	Vein	1 × 4	3.00	Py	RC-83B	3.00	<0.1	<1	0.008			
	Anoi	J-8	S. Anoi	Vein		0.20	Cp, Bo, Py, Qt	RD-58	0.20	0.1	124	3.97			
	Piton	E-6	S.Piton besar	Lens		0.40 + α	Gl, Sp	RF-3	0.40	4.2	296	0.274	17.72	5.23	
			"	Lens		0.40 + α	Gl, Sp	RF-5	0.20	8.8	526	0.75	33.18	13.00	
			"	Vein	0.5 × ?		Au, Ag, Qt	RF-9	Chips	0.3	1				
			"	Vein		0.20	Au, Ag, Qt	RF-10	0.20	1.5	76				
Au-Qz Vein			"	Vein		0.20	Au, Ag, Qt	RF-11	0.20	1.1	5				
and	Sarau	E-6	S.Sarau	Vein	$0.1^m \times ?$	0.10	Qt	RF-18	0.10	<0.1	<1				
Gl-Sp Vein	Middle Sonang	F-5	S.Bahio Kecil	Vein	0.2 × 0.2	0.25	Py, Qt	RF-26	0.25	<0.1	<1	0.246			
with	Kohongoi	F-5	S.Sepoi besar	Vein	0.3 × ?	0.10	Py, Qt	RF-51	0.10	<0.1	<1				
Alteration	Upper Sonang	E-7	S.Sonang	Dissemination	0.5 × 2		Cp, Py	RF-38	Chips	<0.1	1	0.068			
			S.Sudiron	and Vein		0.50	Py, Qt	RF-45	0.50	<0.1	2				
(Tertiary)	Horas	G-3	S.Hamputung	Vein	$2^m \times ?$	2.00	Cp, Py, Clay	RH-29	Chips	<0.1	<1	4.00			Fault zone
	Pitu	F-2	S.Pitu	Dissemination			Py, Clay	RH-31	Chips	<0.1	<1				
		F-3	"	Dissemination	0.2 × 0.5		Py, Clay	RH-32	Chips	<0.1	<1				
		F-3	"	Dissemination			Py, Clay	RH-33	Chips	<0.1	<1				
	Lapan	H-4 I-4	S.Popoi uang	Alteration	0.7 × 1		Qt	RG-15	Pebbles	<0.1					Qt-pebble

(Note) Cp : Chalcopyrite Gl : Galena Py : Pyrite Pyr : Pyrrhotite
Bo : Bornite Sp : Sphalerite Qt : Quartz Gos : Gossan

(2) Through radiometric prospectings, only one, Rangan Hiran anomalous area was found. However, it has very interesting anomalies having sizable zones with the highest values and still continuing toward northeast.

(3) By placer gold prospectings, concentrations of nugget gold in stream sediments were confirmed in areas centering around the Piton mineralized zone, where a swarm of gold-bearing quartz veins and a lead-zinc vein occur.

VI-6 Conclusions

Geological surveys were carried out in the Central Kalimantan as the last phase of a four year project started in 1975, for central-southern areas of 2,035 Km^2 of the whole project area, which was selected on the basis of previous works as a target area having ore deposits and mineralized zones.

As a result of these surveys and examinations, the stratigraphical sequences, igneous activities, geological structures, and ore deposits and mineralized zones in the surveyed area were made clear. In addition, target areas for further detailed investigations were suggested. It is hoped, that it will be possible to expand the survey area toward west of the mapped area.

Further work suggested;

(1) A more detailed geological survey with more detailed geochemical survey of stream sediments and/or soils and with more detailed radiometric survey of the following target areas; porphyry copper-type mineralized zones in northern parts, copper-bearing pyritic ore deposits and its anomalous areas of radioactivity

in central-eastern part which have a continuation further to northeast, and mineralized zones of gold-lead-zinc ores at central-southern parts of the area.

(2) Geological surveys together with geochemical surveys, radiometric prospectings and placer gold prospectings in adjoinning areas at west of the surveyed area, which have the same geology and where mineralized zones and/or ore deposits exist in the upper streams of River Kahayan.

VII. CONCLUSIONS

CHAPTER VII. CONCLUSIONS

A four year programme of the systematic and integrated surveys has been carried out from 1975 to 1978, in wide areas covering about 36,300 Km^2 in the Central Kalimantan, Republic of Indonesia.

As a result of the surveys, geology, stratigraphical sequences, igneous activities, geological structures, mineralizations and ore deposits were made clear. The consolidated surveys, including the LANDSAT-data analysis and the photo-geological analysis as well as the airborne magnetic survey are very useful to obtain knowledge regarding geology and mineralization in the wide areas with poor access, and to extract a target area for further geological surveys and other explorative works.

As a result of the geological surveys conducted during Phase IV, No.2, together with the geochemical surveys, radiometric prospectings and placer gold prospecting, more details regarding geology and mineral deposits in the mapped area were obtained. The target areas for further detailed works where there are possibilities of new discovery or development of natural resources were suggested. In addition, continuations of the survey and expansions of the survey area were also recommended.

REFERENCES

1. Ministry of Mines Indonesia, GSI, JICA and MMAJ (1977); Report on Geological Survey of Central Kalimantan. Phase I and II, LANDSAT-Data Analysis, Aerial photography and Airborne Magnetic Survey.

2. Ministry of Mines Indonesia, GSI, JICA and MMAJ (1978); Report on Geological Survey of Central Kalimantan. Phase II-1, 2 and Phase III-1, 2, Aerial Photography and Airborne Magnetic Survey.

3. Ministry of Mines Indonesia, GSI, JICA and MMAJ (1978); Report on Geological Survey of Central Kalimantan. Phase IV-1, Photo-Geological Survey.

4. Ministry of Mines and Energy, Directorate General of Mines, Indonesia, GSI, JICA and MMAJ (1979);
Report on Geological Survey of Central Kalimantan. Phase IV-2, Geological Survey.

PL. I

METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY — GEOLOGICAL SURVEY OF INDONESIA

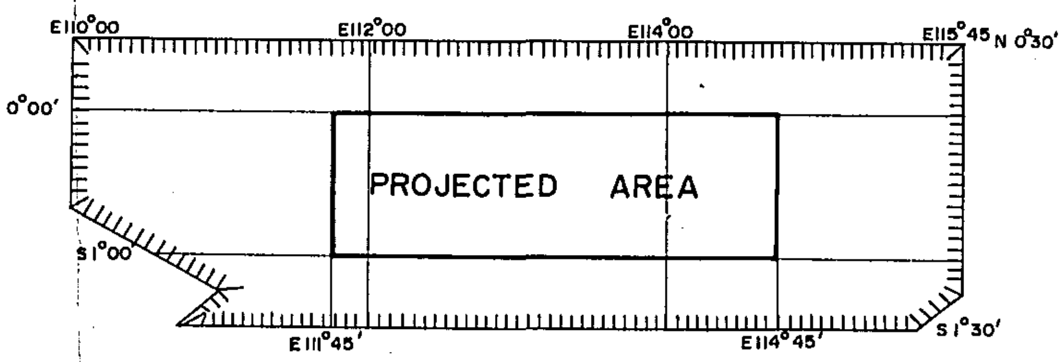
GEOLOGICAL SURVEY OF CENTRAL KALIMANTAN, INDONESIA

PHASE I

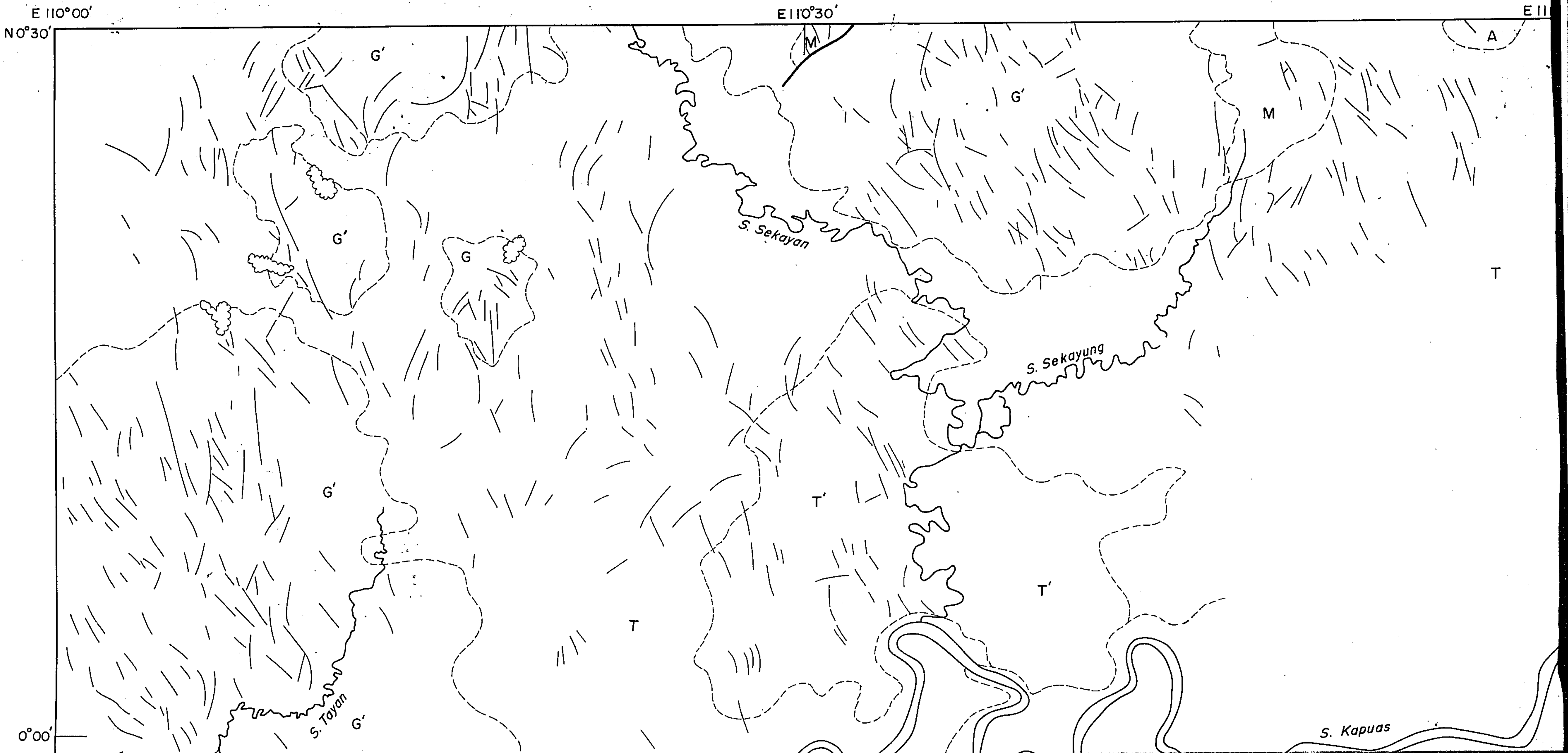
GEOLOGICAL INTERPRETATION MAP OF LANDSAT — IMAGE

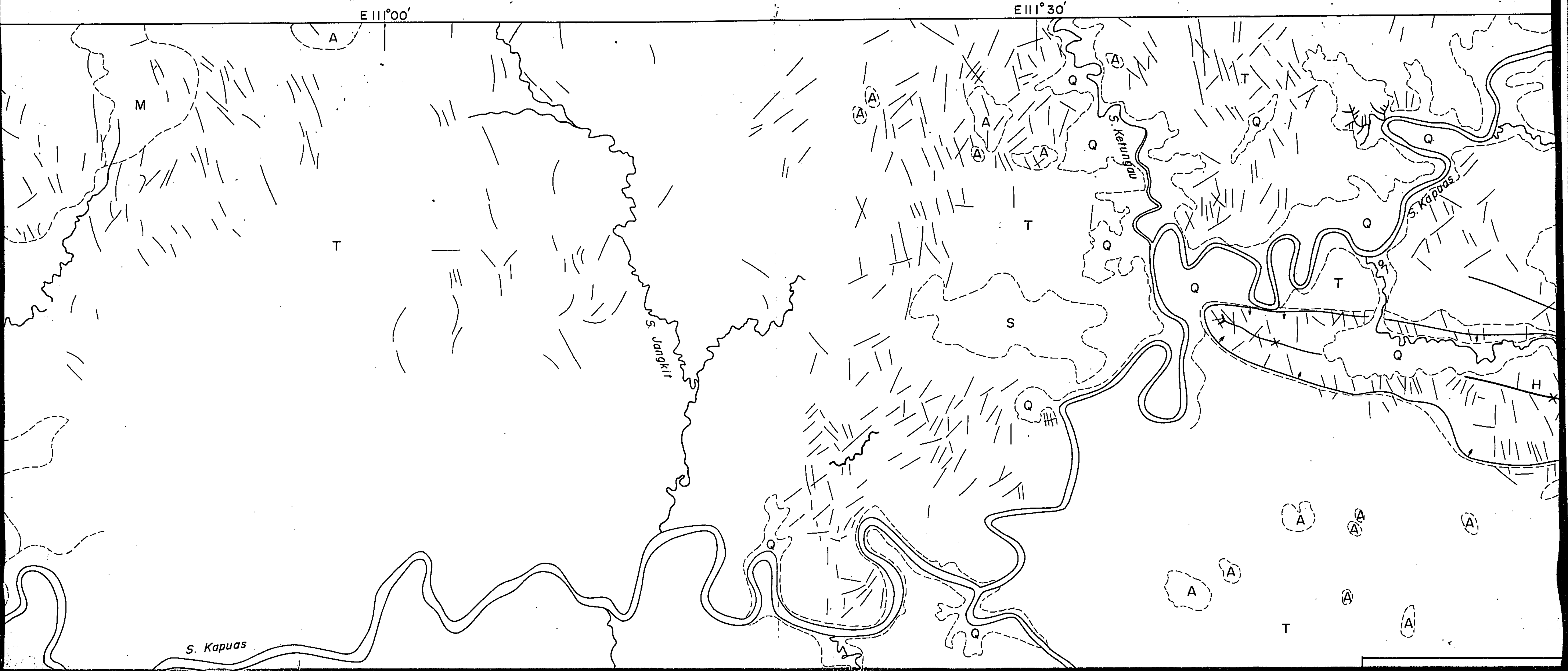
Scale approx. 1: 250,000

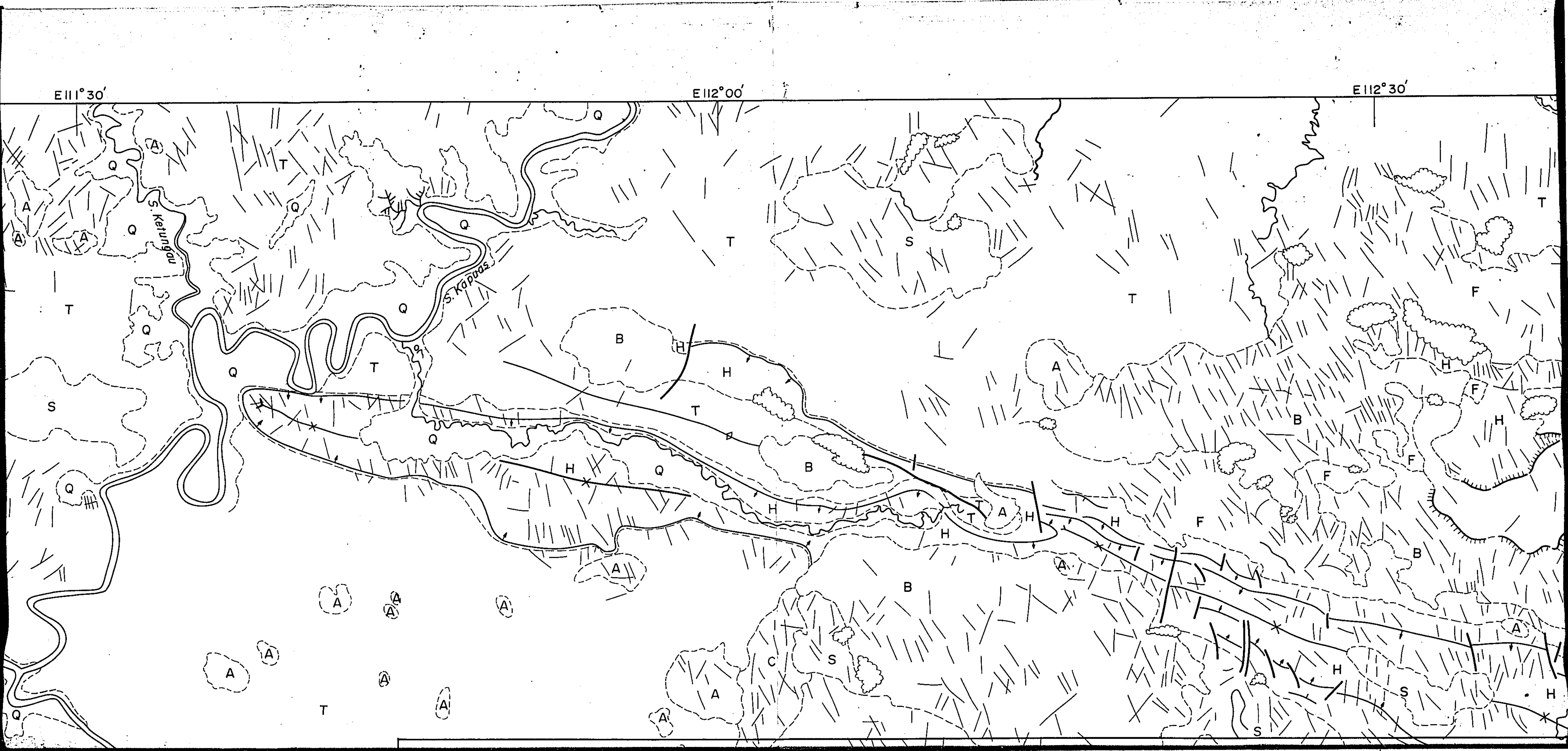
0 5 10 15 20 Km

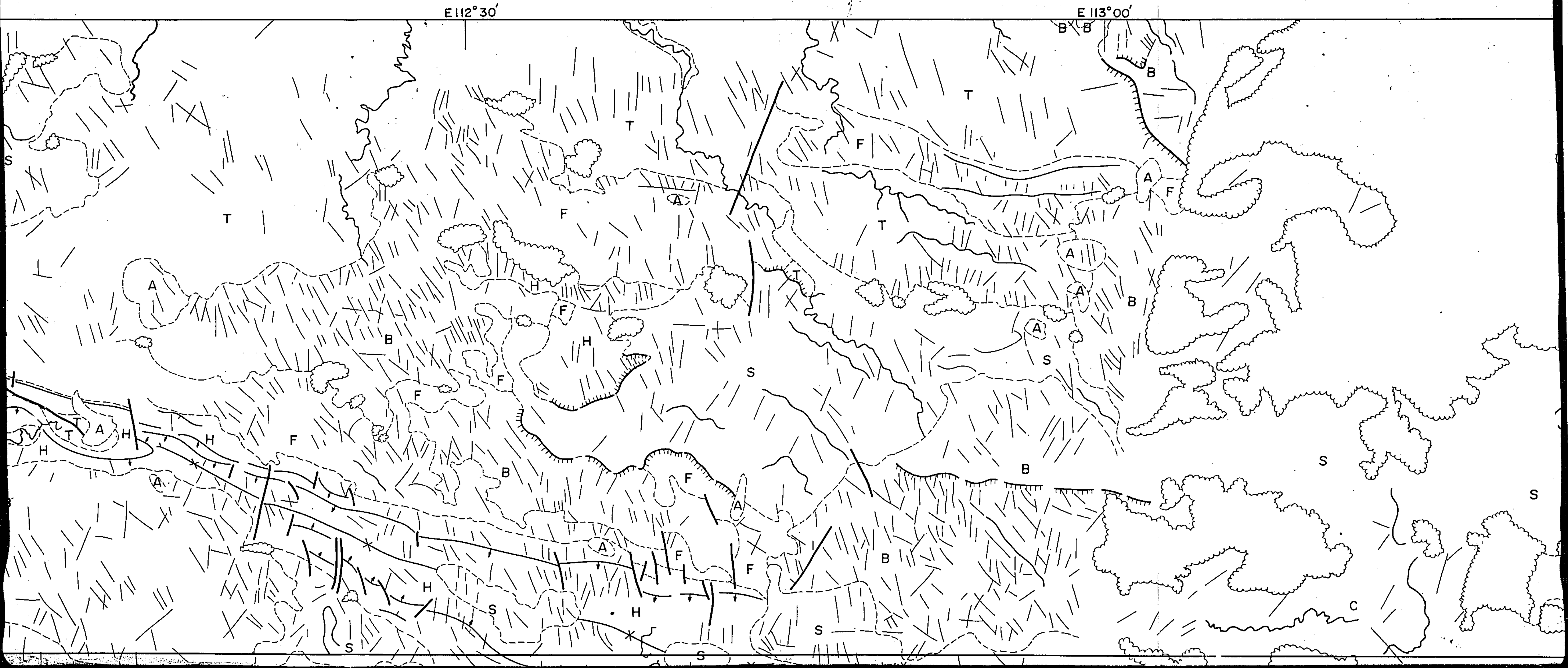


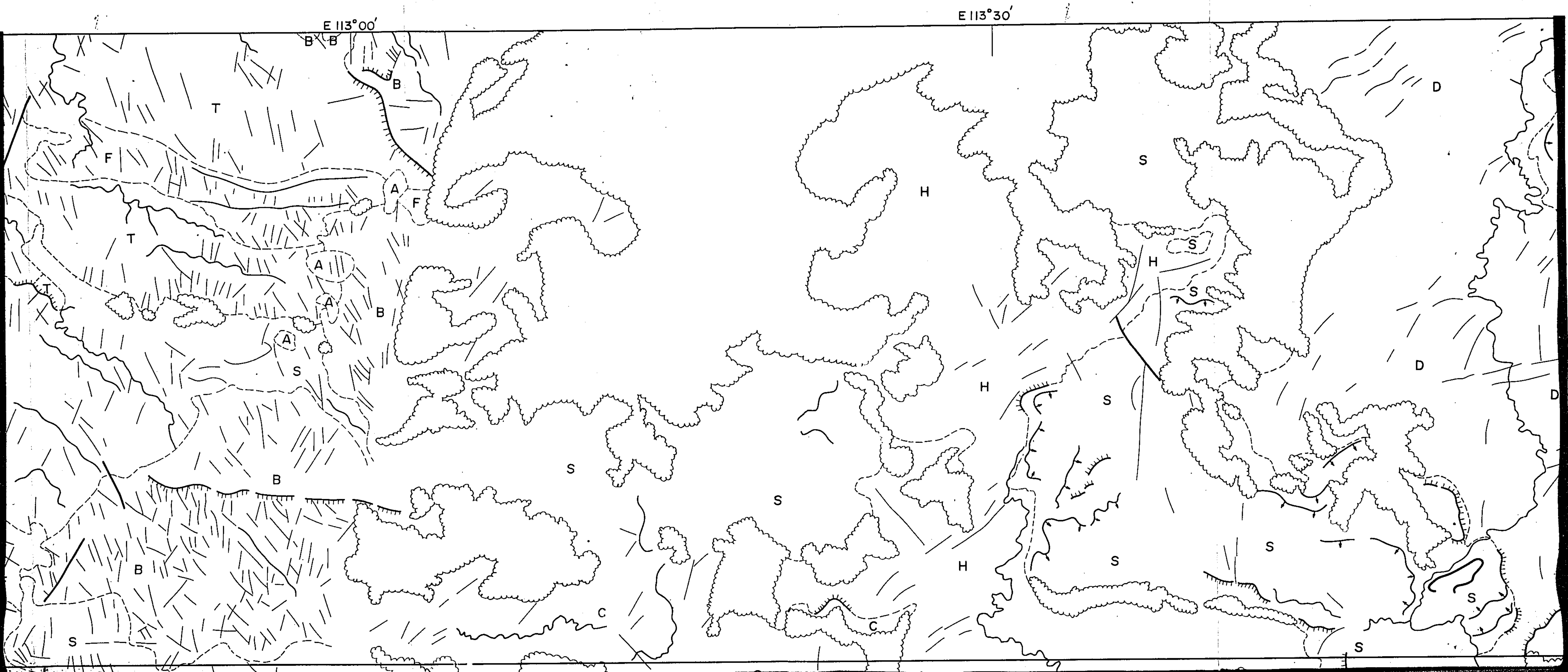
February · 1976


E 110°00'
E110°30'
E11
N0°30'
0°00'
G'
M
G'
M
A
G'
G
S. Sekayan
T
S. Sekayung
T'
G'
T'
T
S. Tayan
G'
S. Kapuas

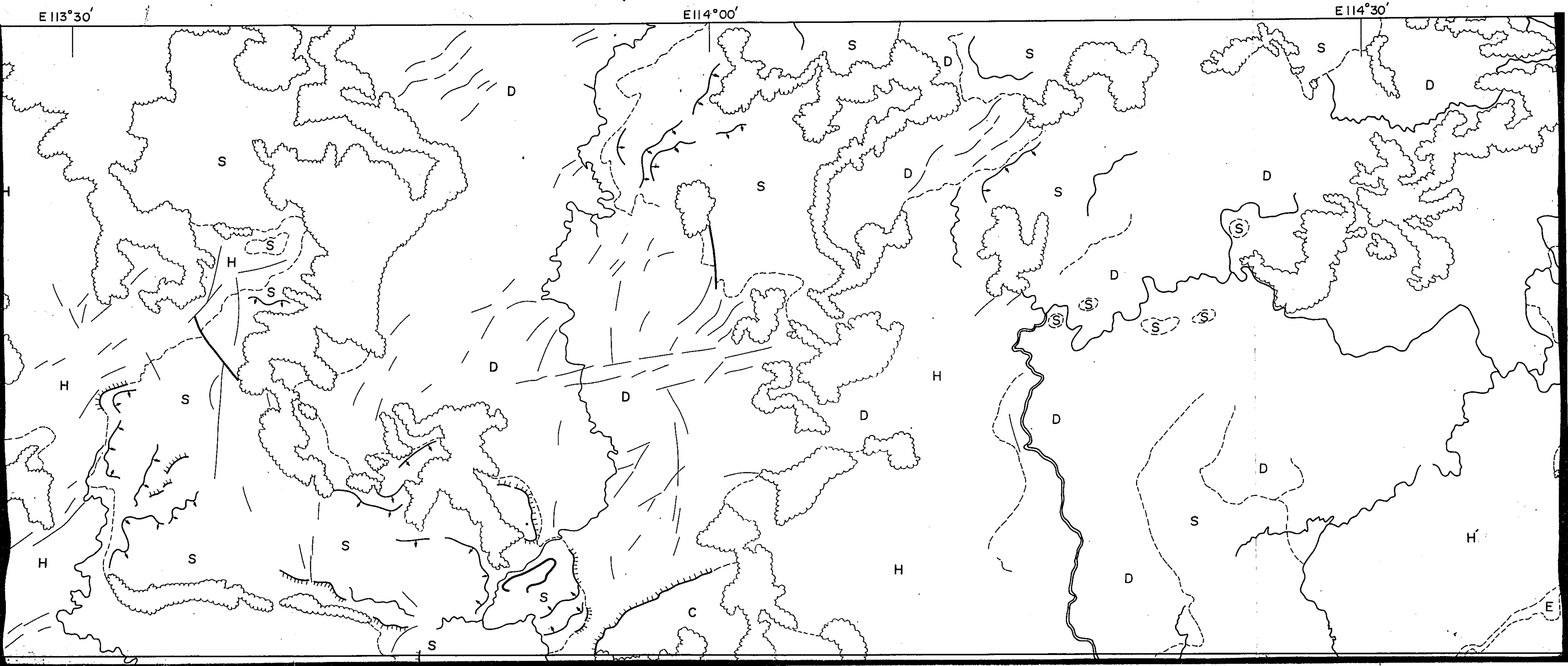

E111°00'
E111°30'
A
M
T
Q
S
H
S. Jangkit
S. Ketungau
S. Kapuas
S. Kapuas

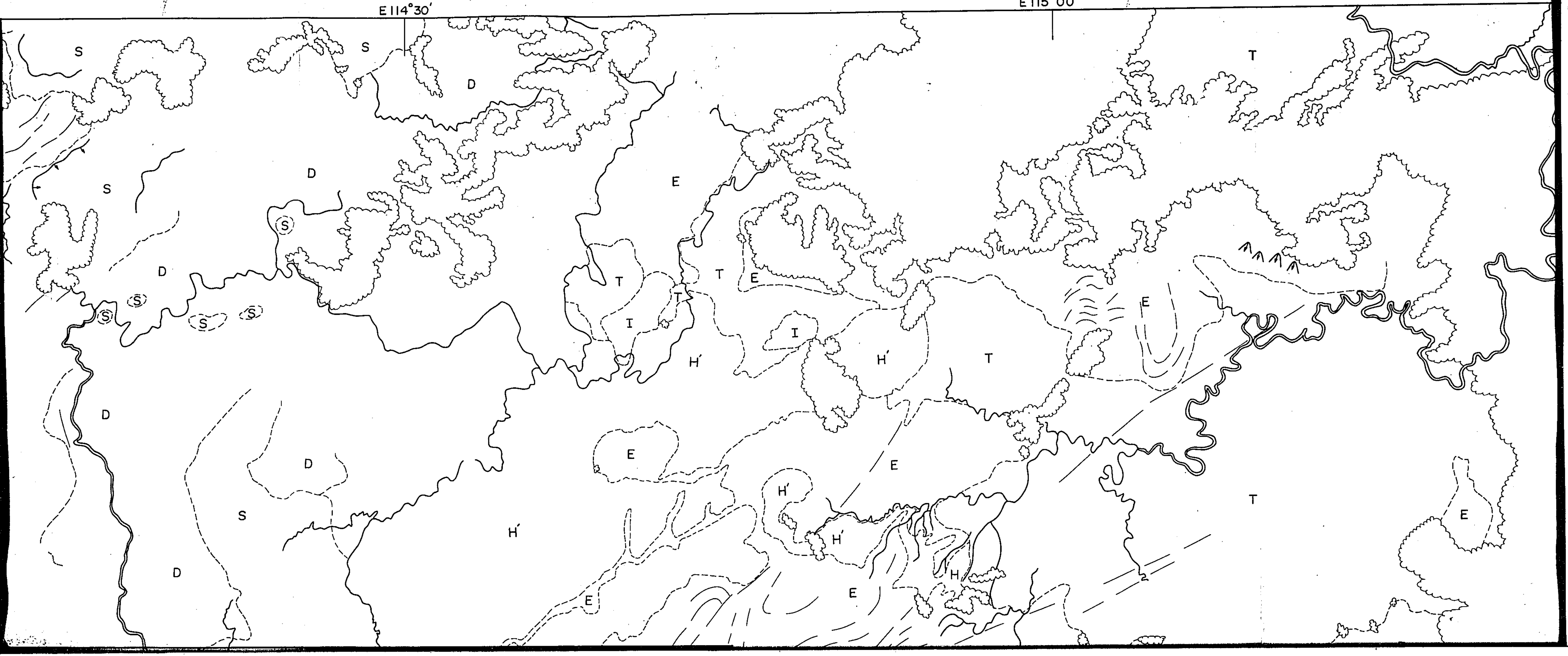

E111°30'
E112°00'
E112°30'
S. Ketungau
S. Kapuas


E112°30′
E113°00′
B
B
B
T
T
F
A
T
A
F
A
A
H
F
B
H
S
A
S
F
F
S
T
T
A
H
H
F
B
B
A
F
A
F
A
F
F
B
S
H
S
S
S
S
C
S

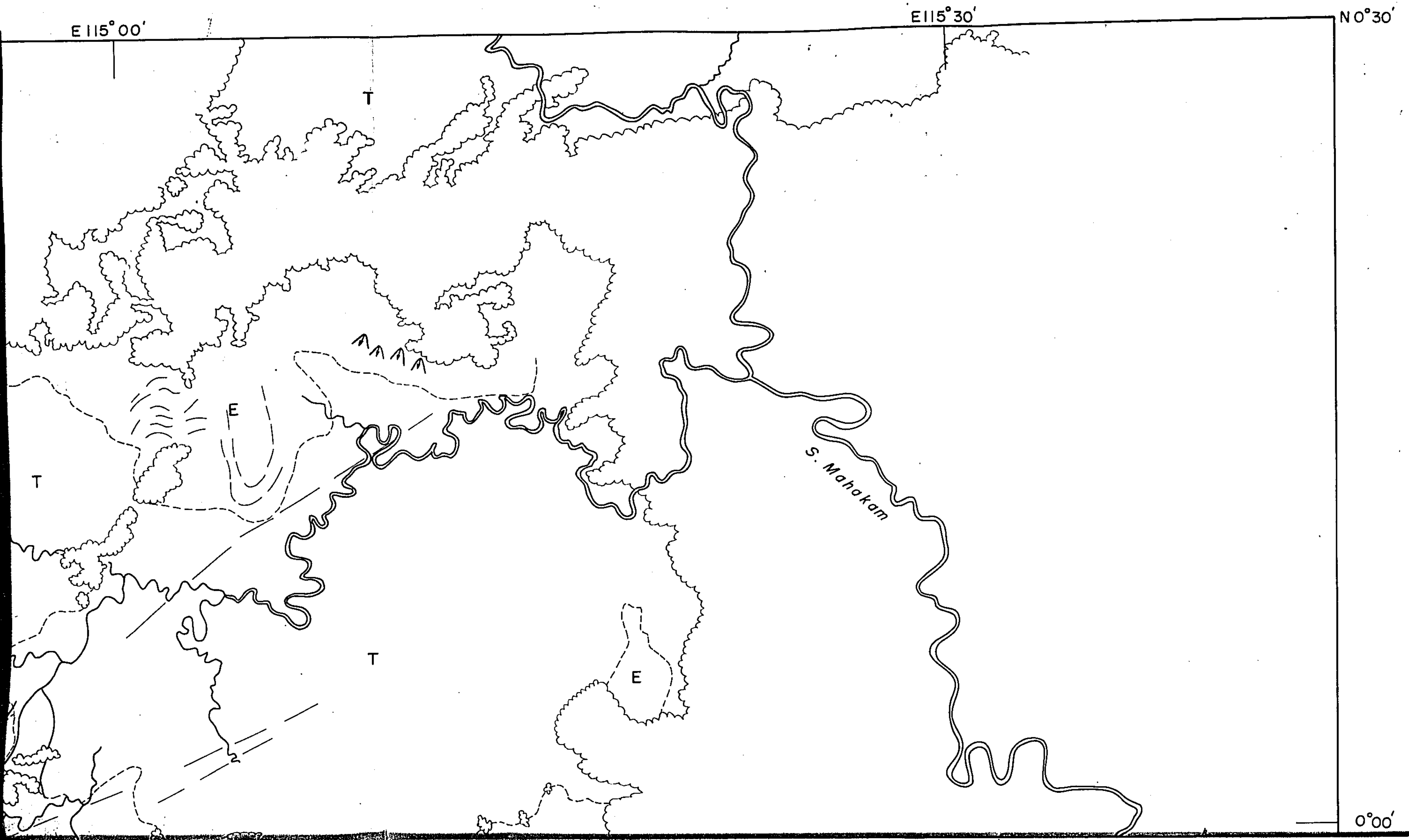


E 113°00'
E 113°30'
B
B
B
T
F
A
F
T
A
T
A
B
A
S
B
S
B
C
S
H
H
H
C
H
S
S
S
S
S
S
S
D
D
D
S
S


E113°30′
E114°00′
E114°30′



E 114°30′
E 115°00′
S
D
E
T
I
H′
H



METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL
COOPERATION AGENCY

— GEOLOGIC
OF

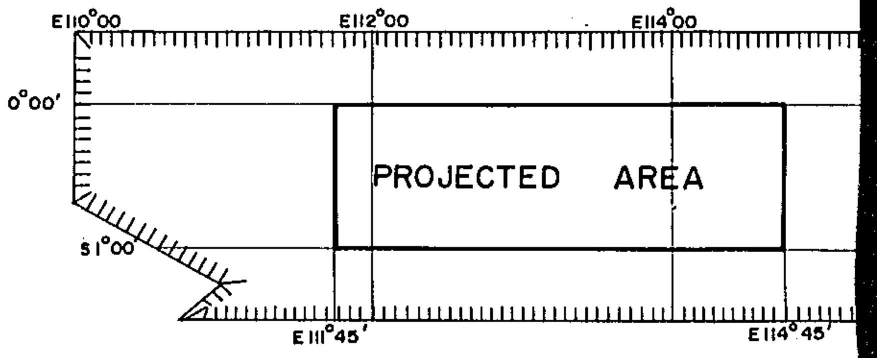
GEOLOGICAL SURVEY
OF
CENTRAL KALIMANTAN, INDONESIA

PHASE I

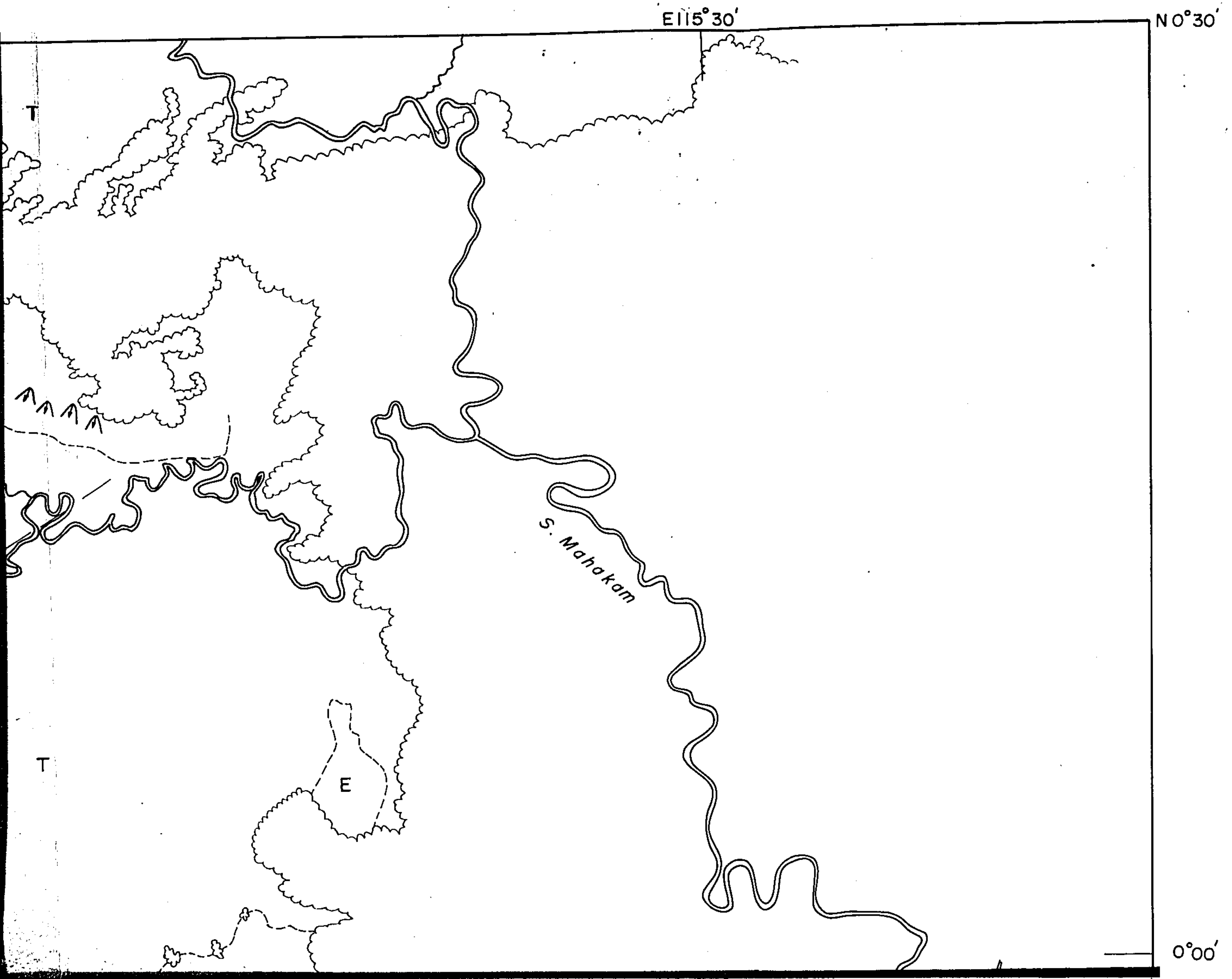
GEOLOGICAL INTERPRETATION
OF
LANDSAT — IMAGE

Scale approx. 1: 250,000

0 5 10 15 20 Km



February · 1976



PL. I

METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
— GEOLOGICAL SURVEY OF INDONESIA

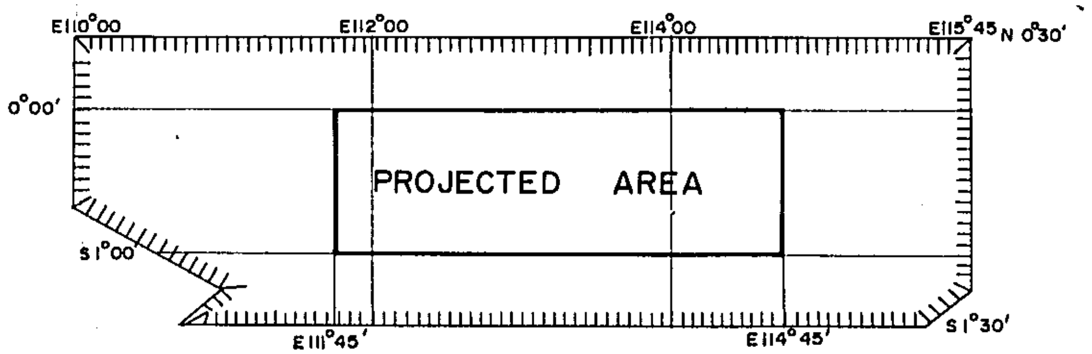
GEOLOGICAL SURVEY OF CENTRAL KALIMANTAN, INDONESIA

PHASE I

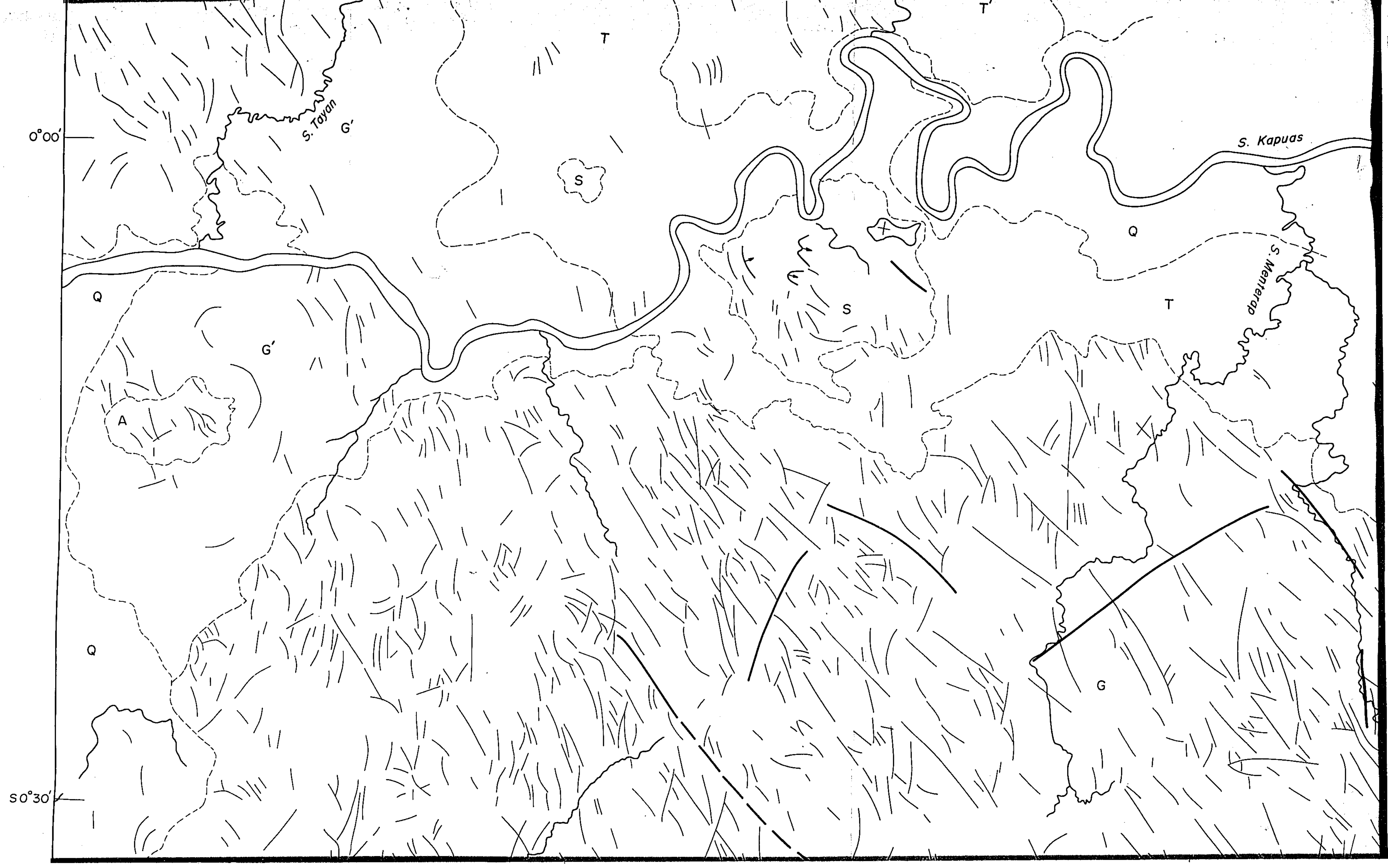
GEOLOGICAL INTERPRETATION MAP OF LANDSAT — IMAGE

Scale approx. 1: 250,000

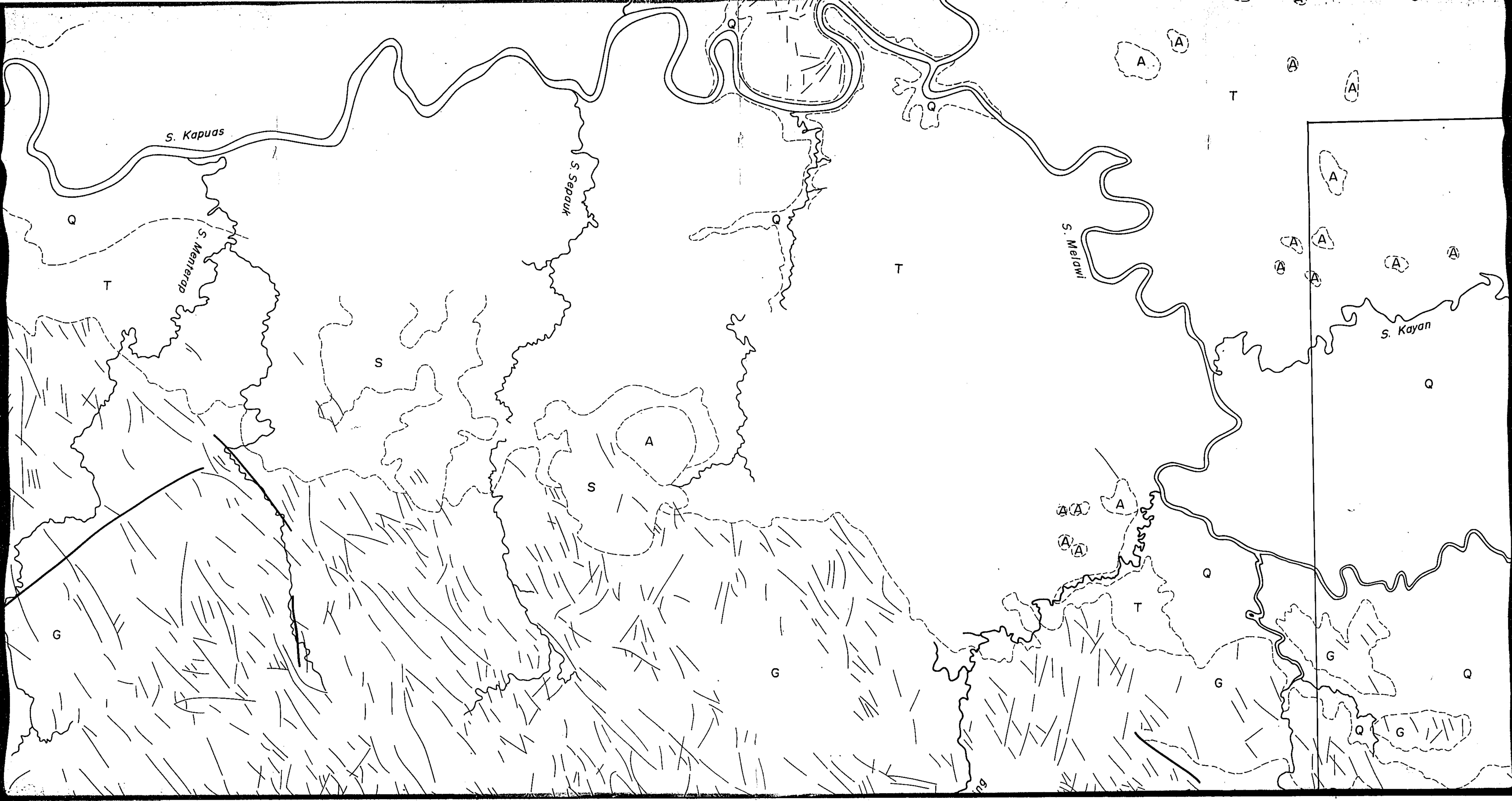
0 5 10 15 20 Km



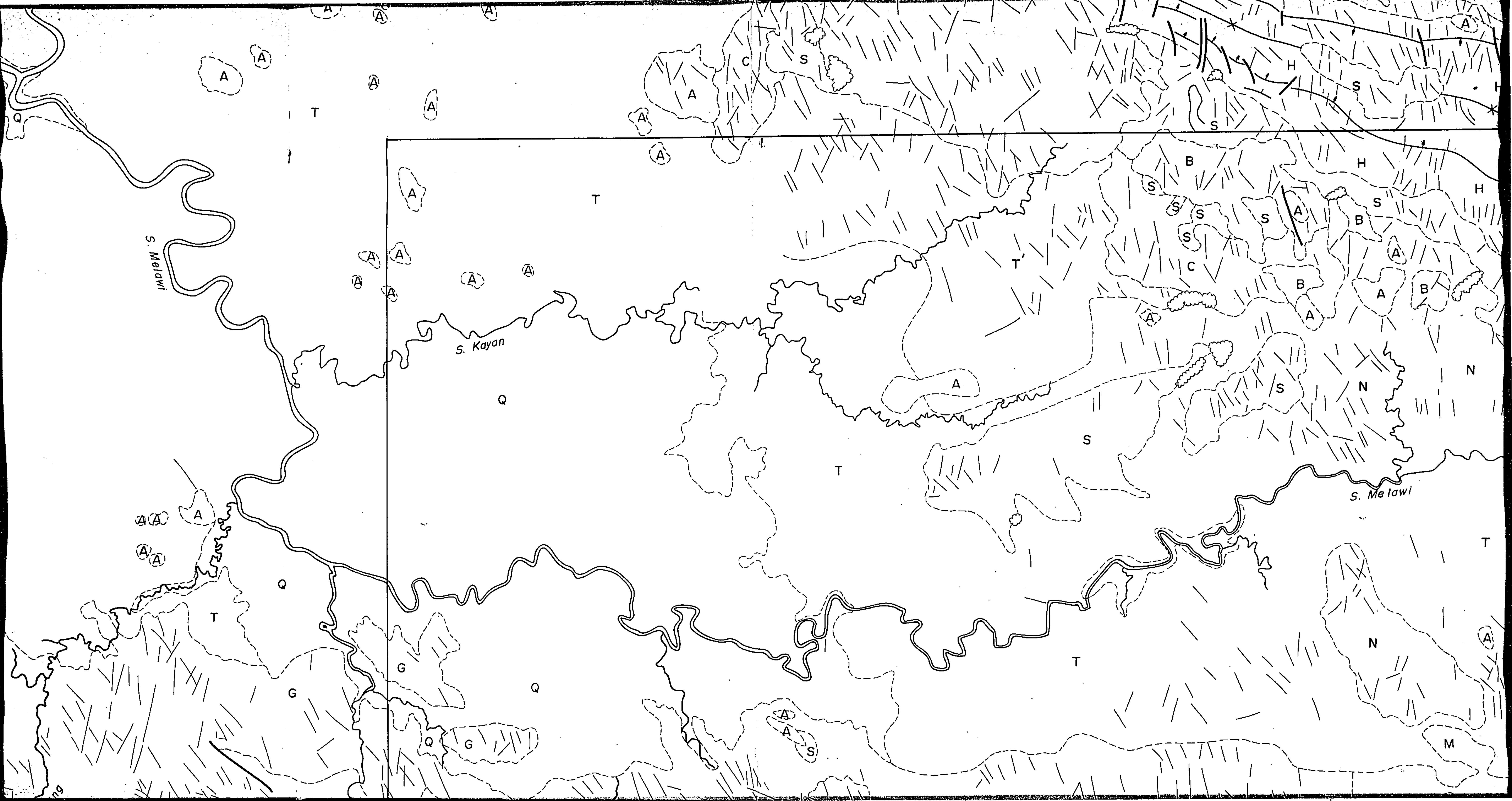
February · 1976

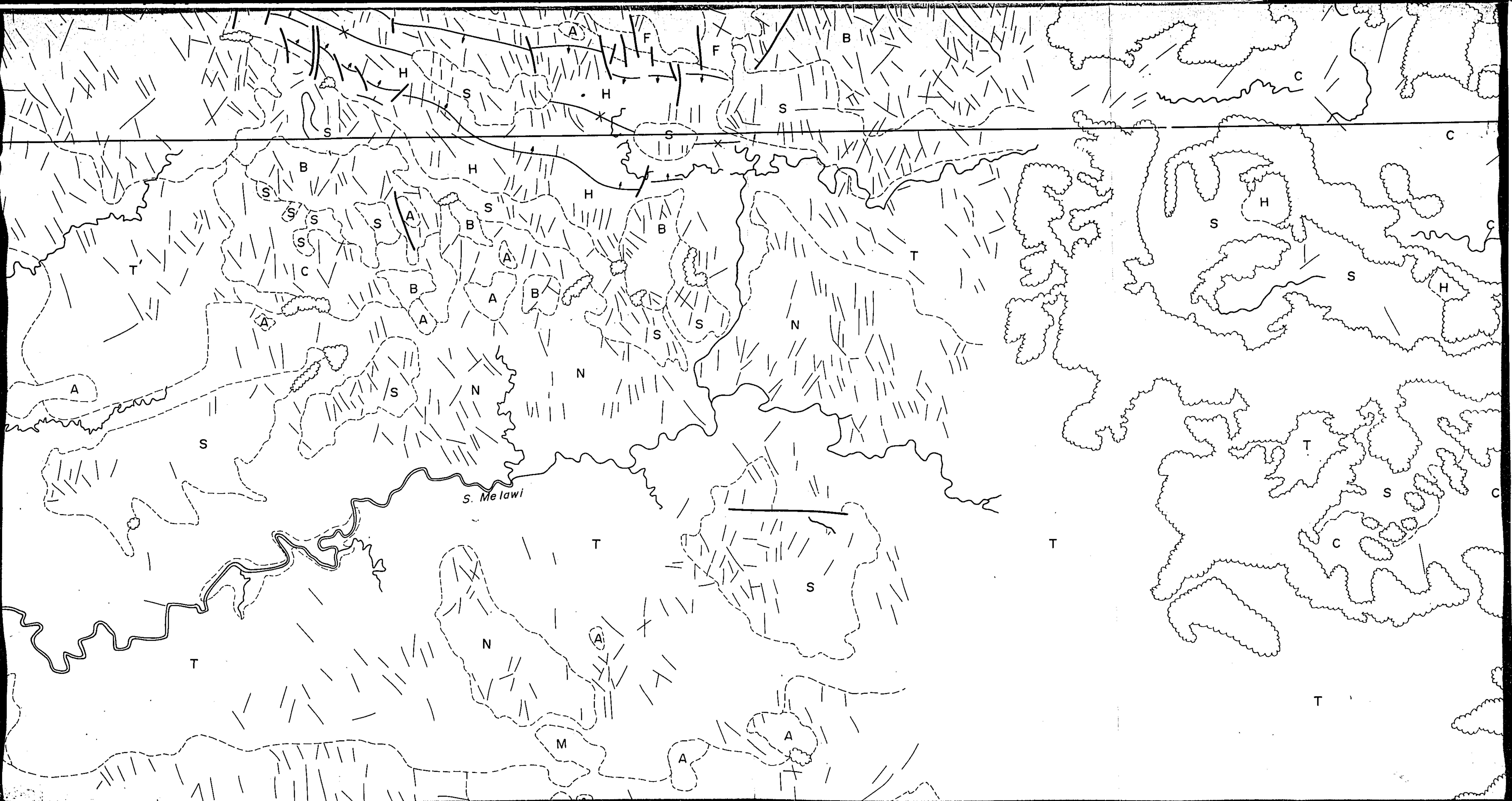


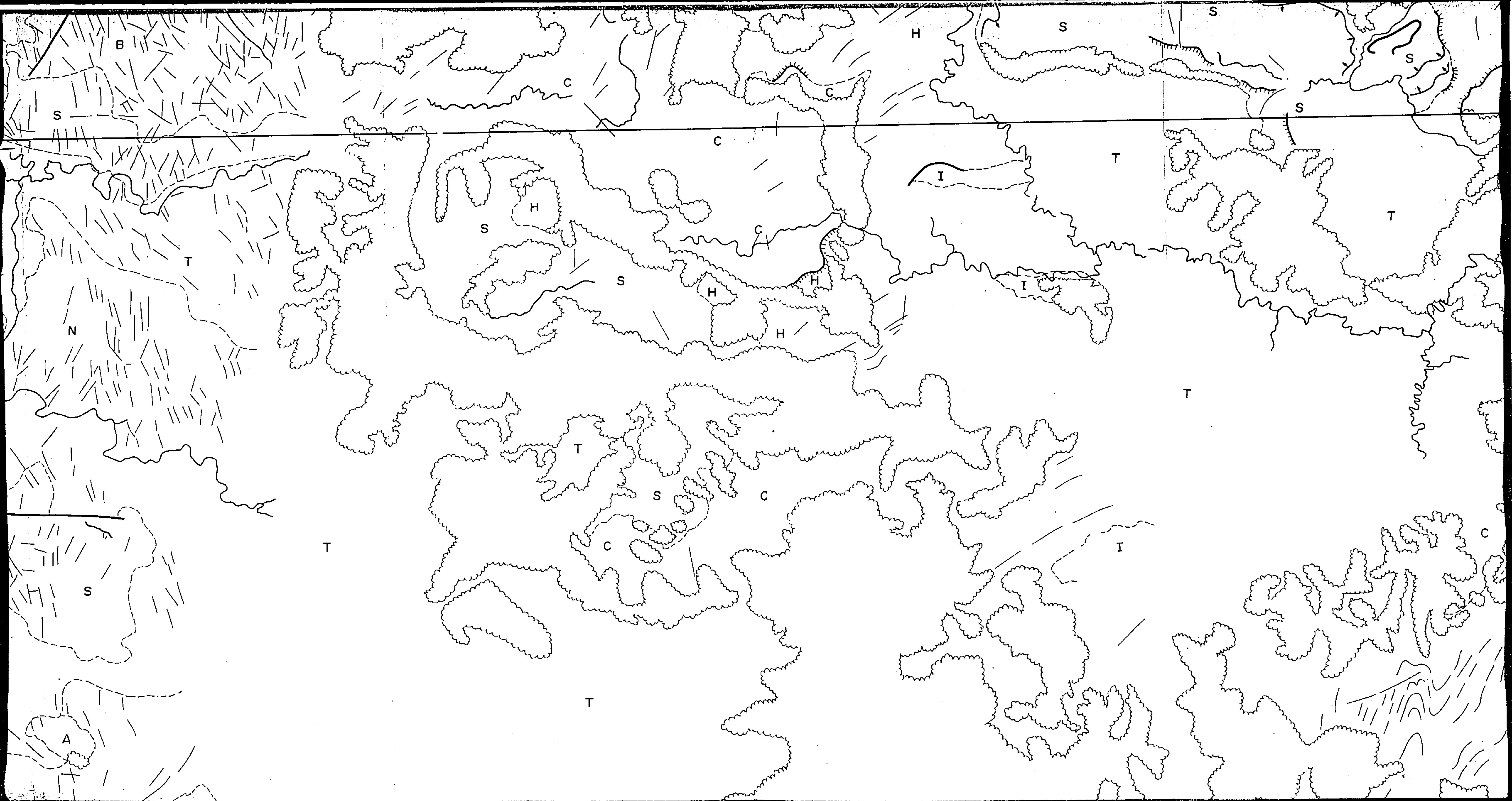
0°00'
S0°30'
S. Tayan
S. Kapuas
S. Menterap
G'
T
T'
S
Q
A
G



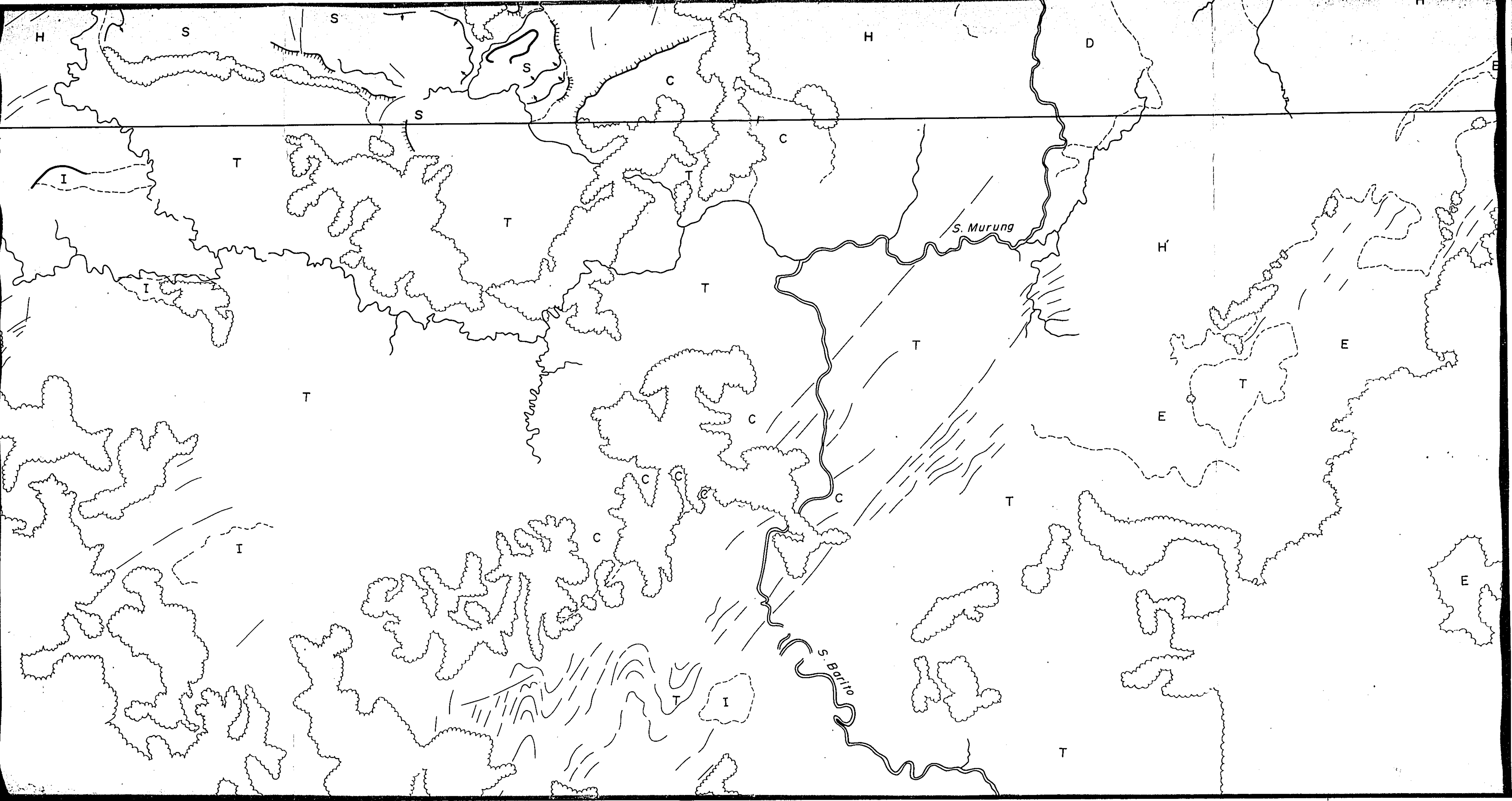
S. Kapuas
S. Sepauk
S. Menterap
S. Melawi
S. Kayan
Q
T
S
A
G


S. Melawi
S. Kayan
S. Melawi


S. Melawi

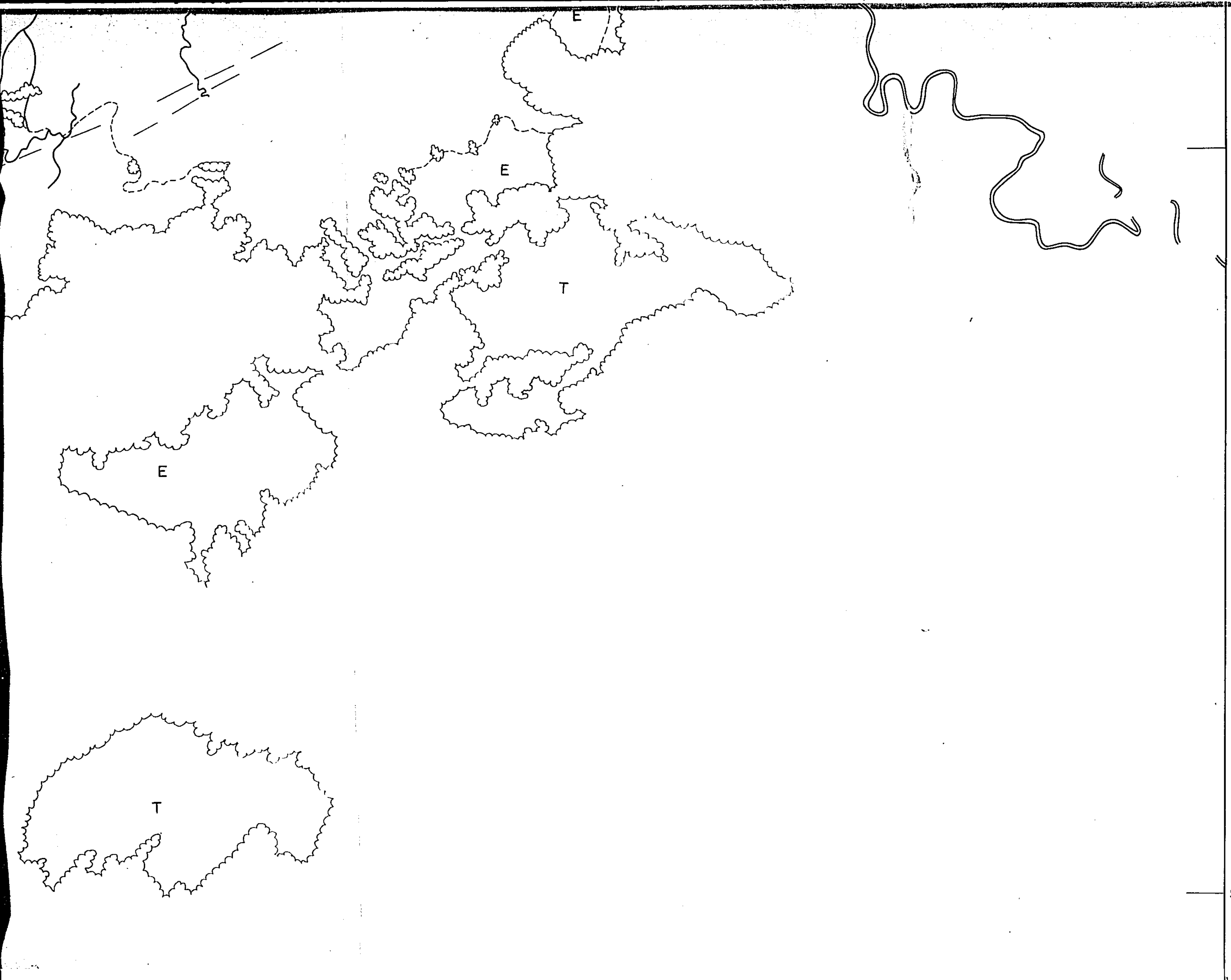


B
S
C
H
S
S
S
C
S
C
T
I
T
H
S
S
H
H
H
C
T
I
N
H
T
T
S
C
T
C
I
C
S
T
A


H
S
S
S
S
H
D
C
C
T
I
T
T
T
S. Murung
H
I
T
T
T
E
T
E
C
C
C
C
C
I
E
S. Barito
T
I
T

H′
H′
D
E
E
H
S. Murung
H′
E
T
E
E
E
T
T
E
T
E
Ma. Tupuh
Biha
T

February · 1976



0°00′

S 0°30′

LEGEND

Q : Quaternary Sediments

L : Laterites

B : Basalt

S : Coarse Sandstones

F : Sandstones

C : Fine Sandstones

H : Alternation of Shales & Sandstones

l : Limestones

E : Pyroclastic rocks with clastic sediments

T : Tuffs & Clastic sediments

N : Andesites

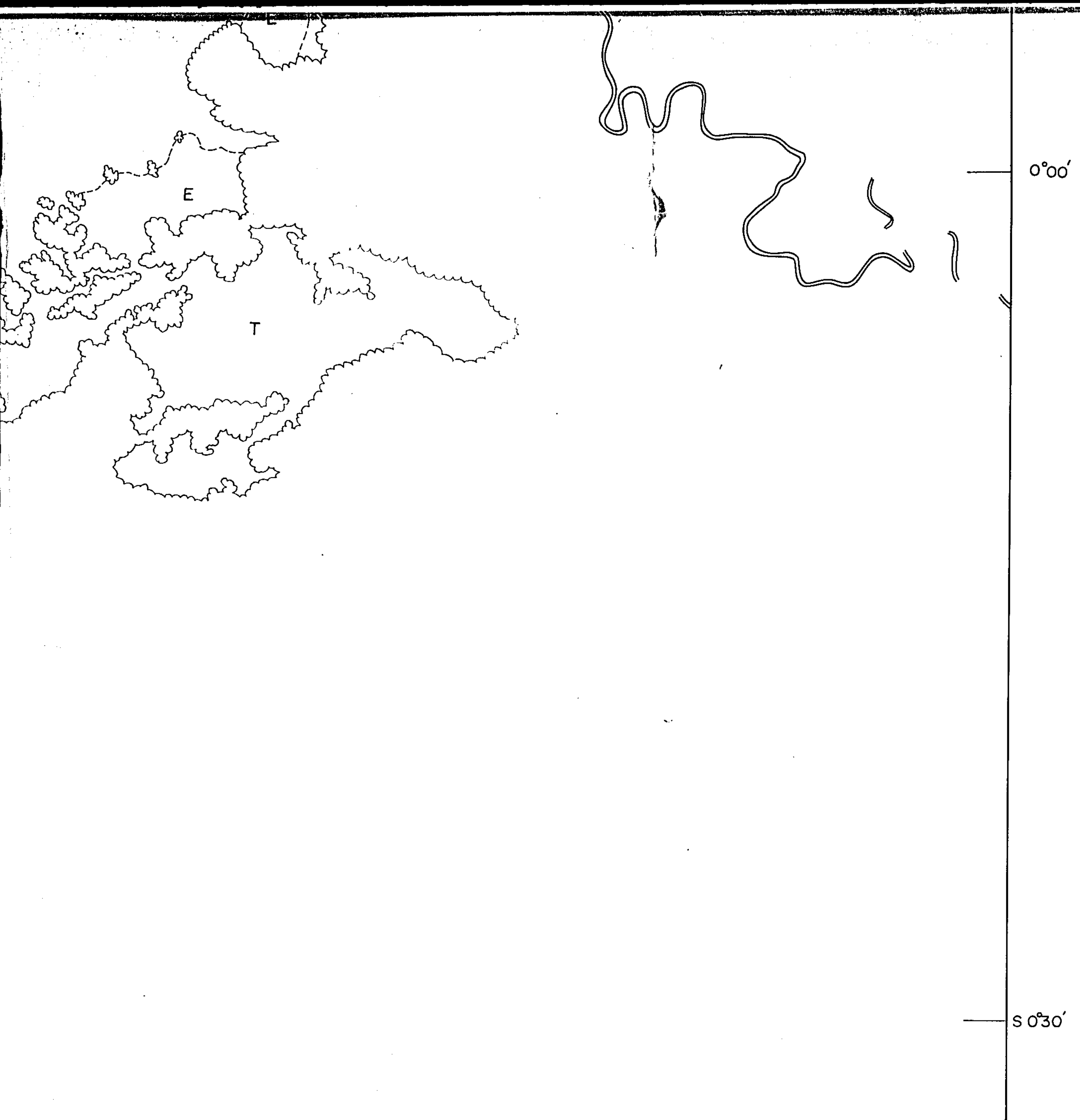
D : Metasediments

M : Metamorphic rocks

A : Andesites Intrusives

I : Intrusive rocks

G : Granites



February · 1976

LEGEND

Q : Quaternary Sediments

L : Laterites

B : Basalt

S : Coarse Sandstones

F : Sandstones

C : Fine Sandstones

H : Alternation of Shales & Sandstones

l : Limestones

E : Pyroclastic rocks with clastic sediments

T : Tuffs & Clastic sediments

N : Andesites

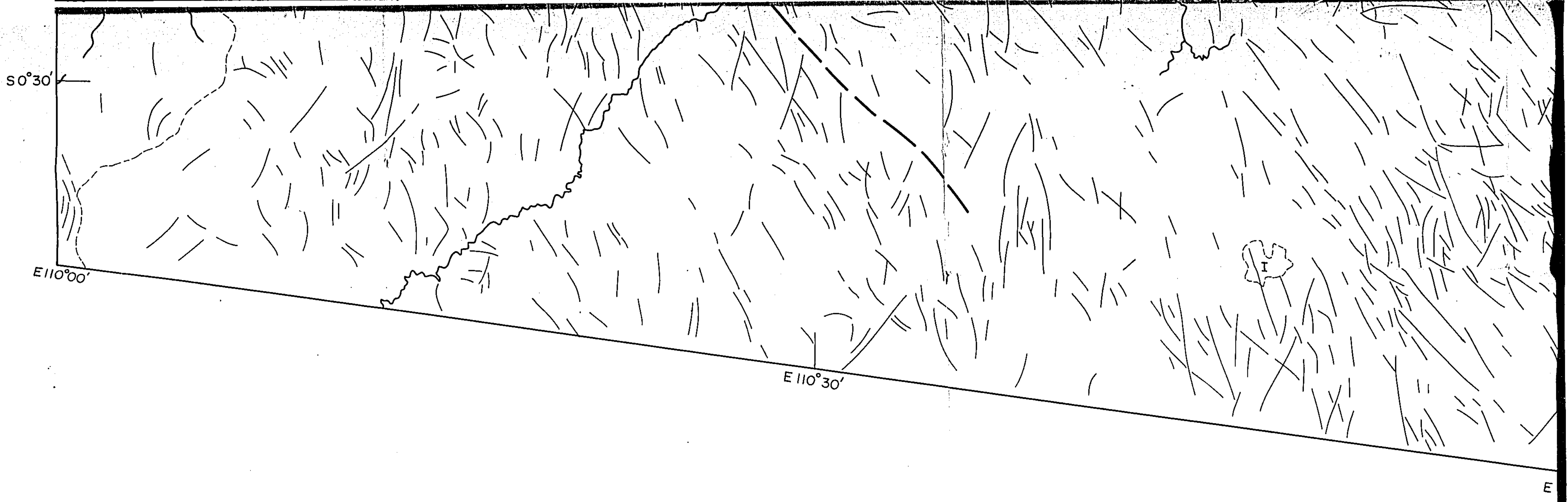
D : Metasediments

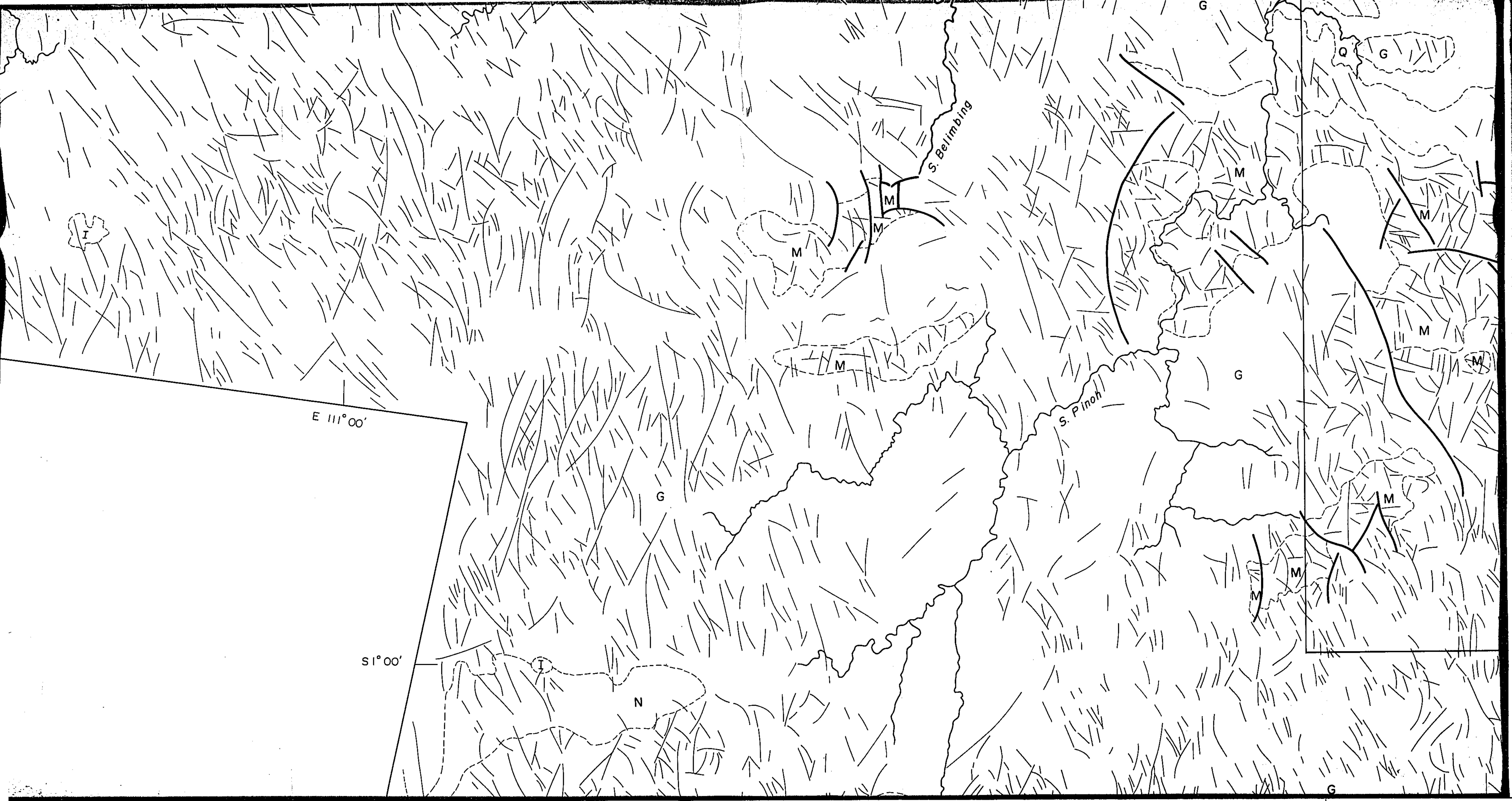
M : Metamorphic rocks

A : Andesites Intrusives

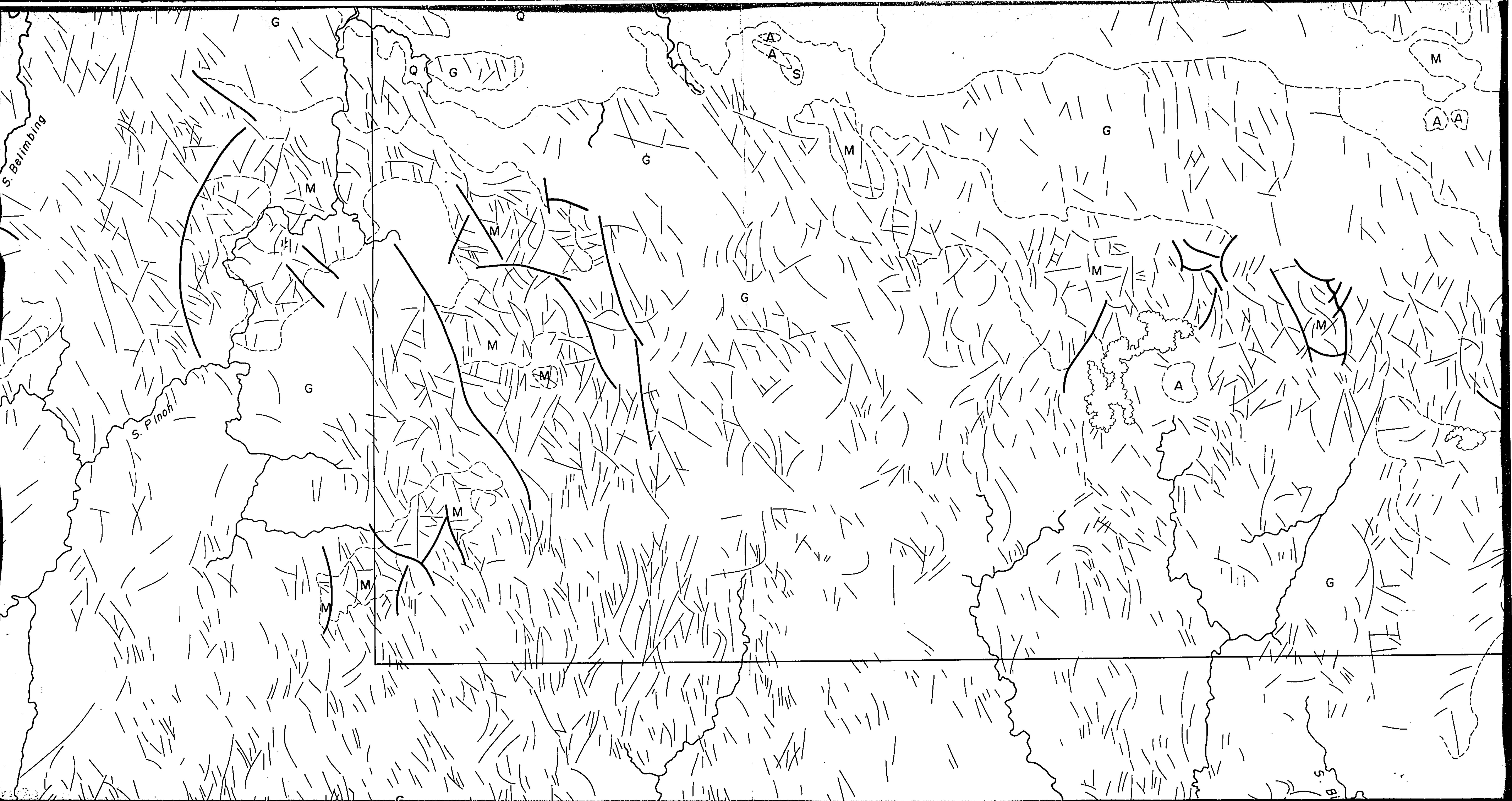
I : Intrusive rocks

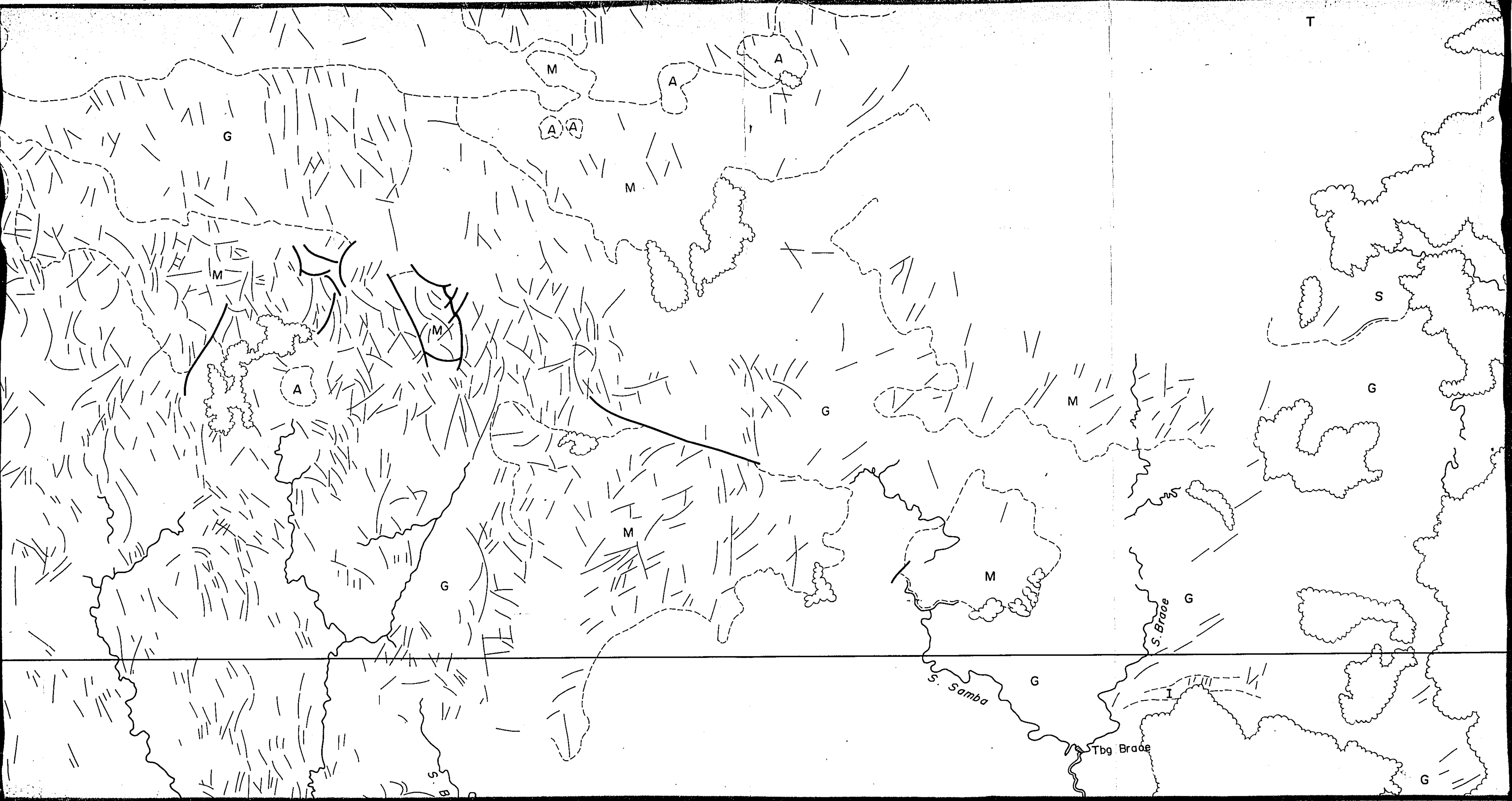
G : Granites


S0°30'
E110°00'
E110°30'
I
E

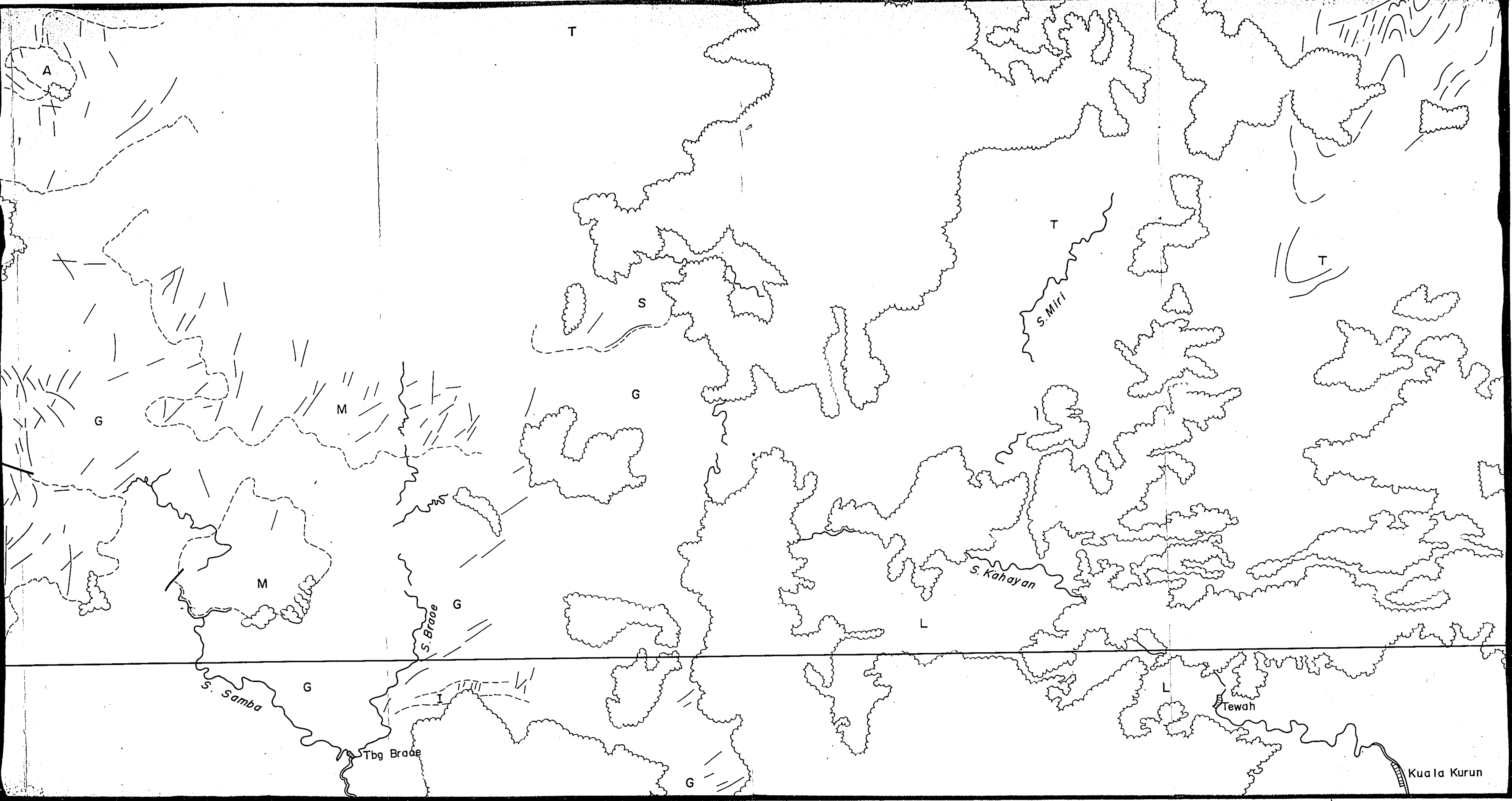


G
Q
G
S. Belimbing
M
M
M
M
I
M
M
G
S. Pinoh
M
M
G
E 111°00'
G
M
M
M
S1°00'
I
N
G

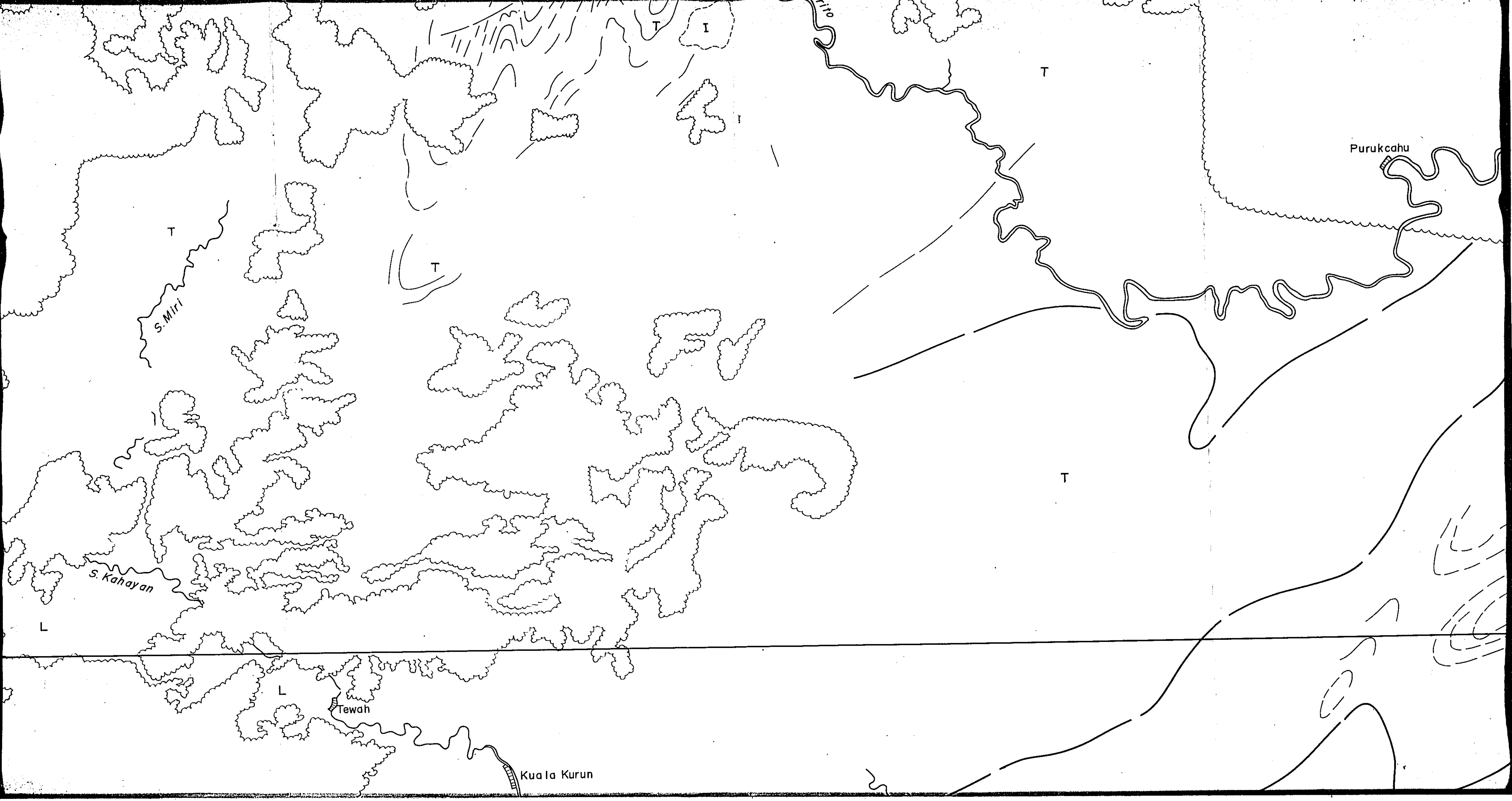

S. Belimbing
S. Pinoh
G
Q
M
A
S

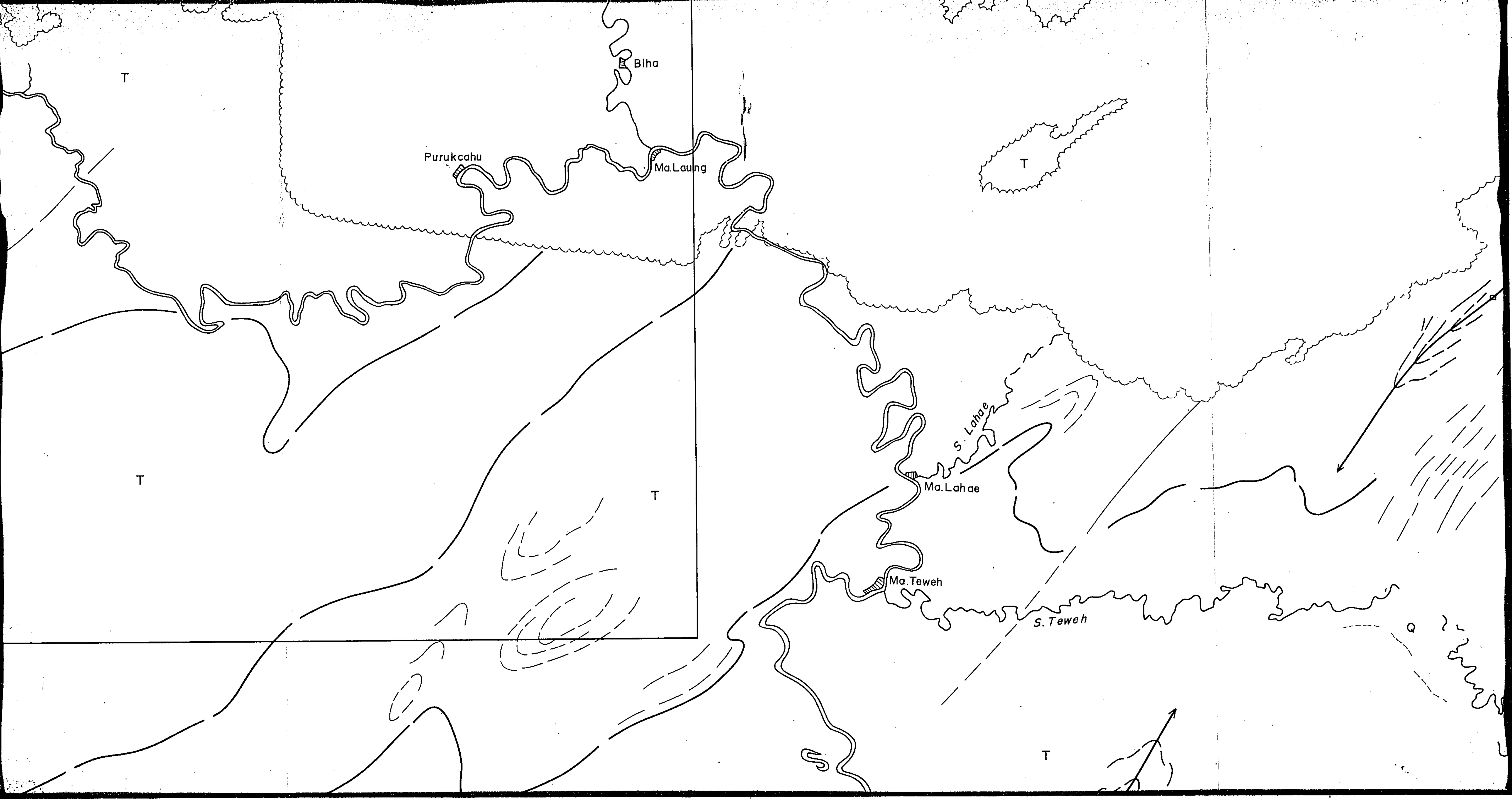


T
M
A
A
A
A
G
M
M
M
A
S
G
M
G
M
M
G
G
M
G
S. Braoe
S. Samba
G
I
Tbg Braoe
G

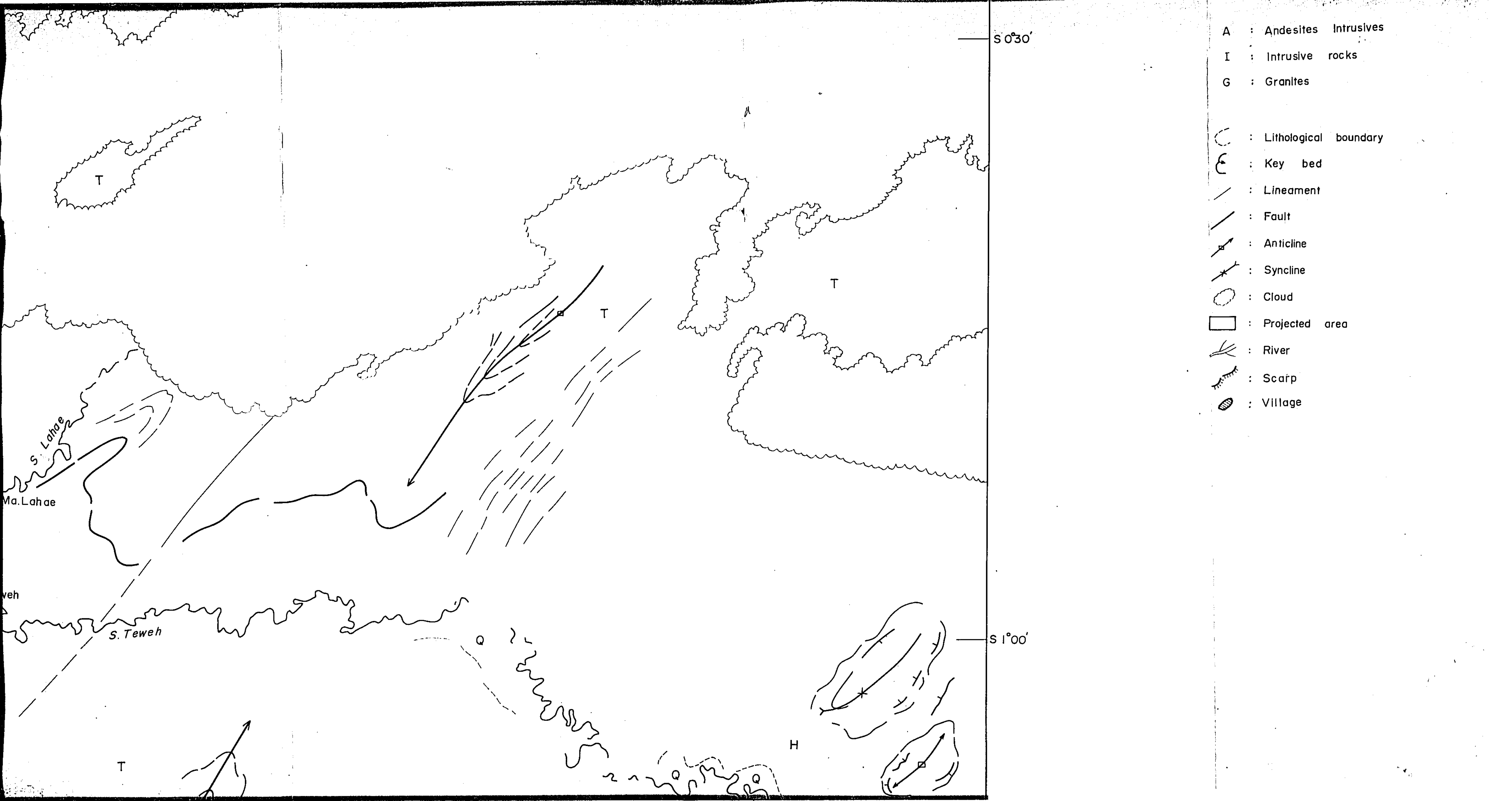


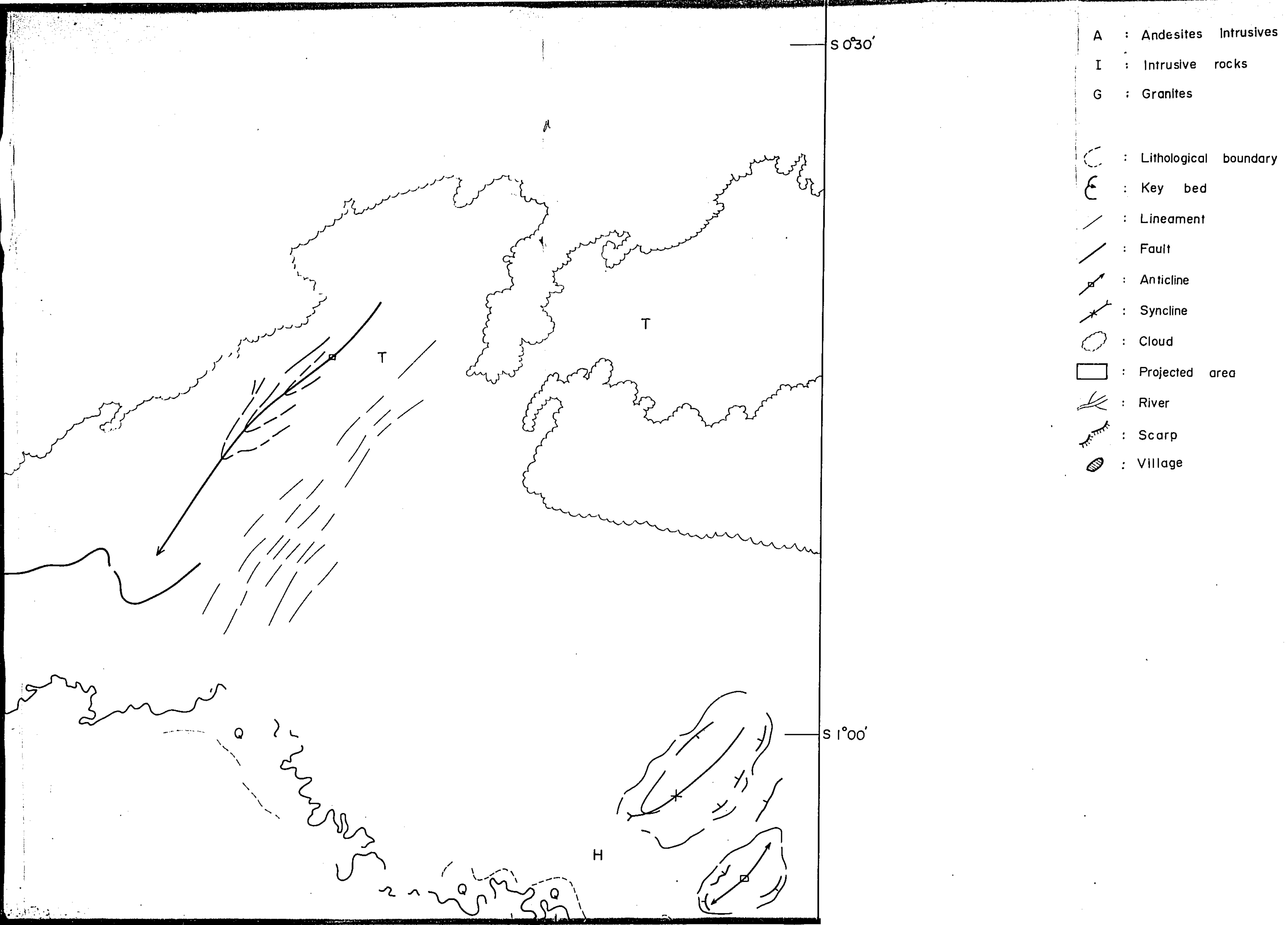
T
A
T
T
S
G
M
G
M
G
S. Miri
S. Kahayan
S. Braoe
L
S. Samba
G
I
L
Tewah
Tbg Braoe
G
Kuala Kurun

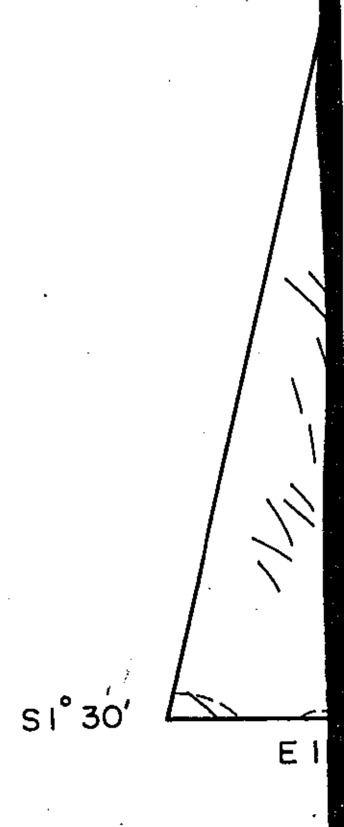

T
I
T
Purukcahu
T
S. Miri
T
T
S. Kahayan
L
L
Tewah
Kuala Kurun

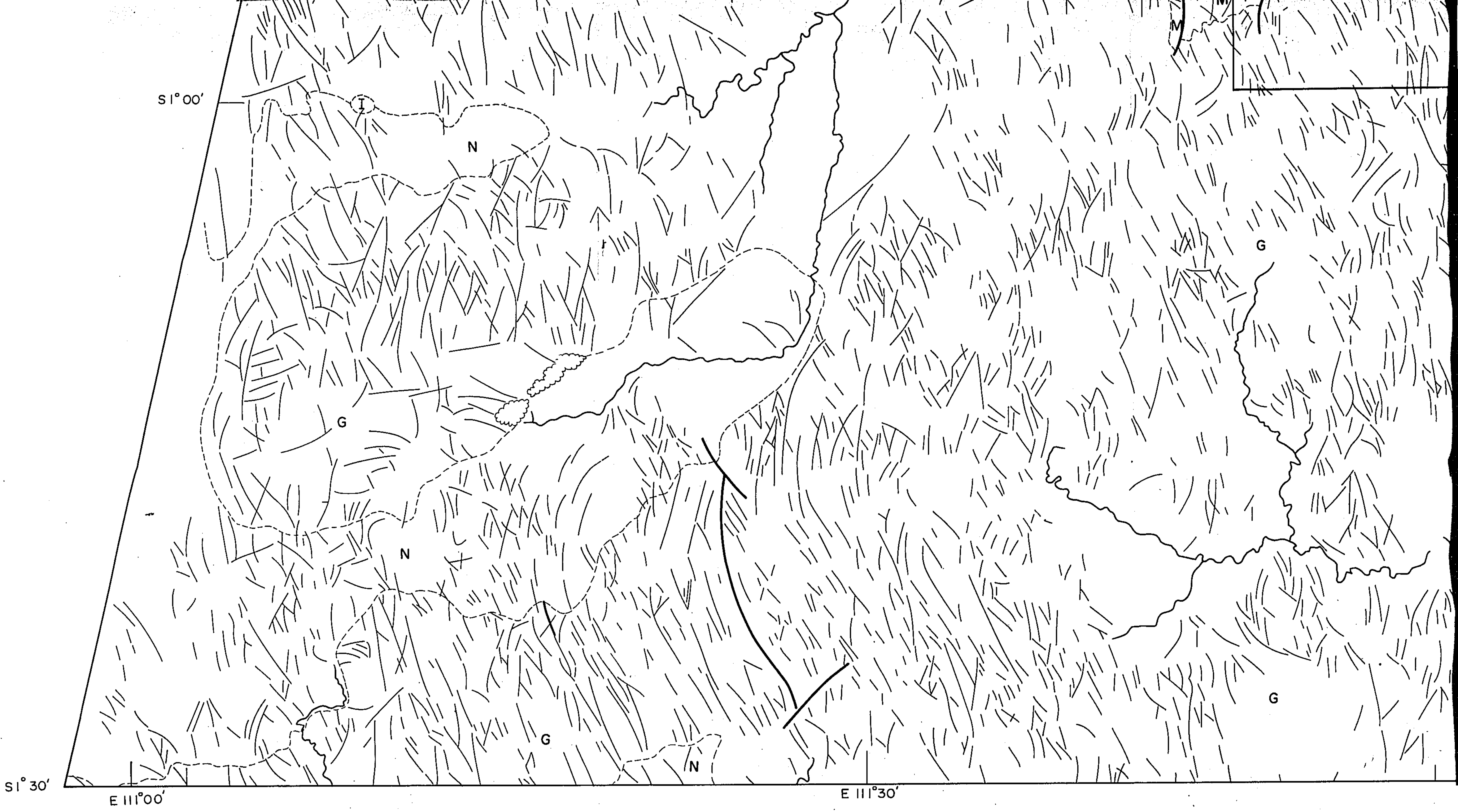


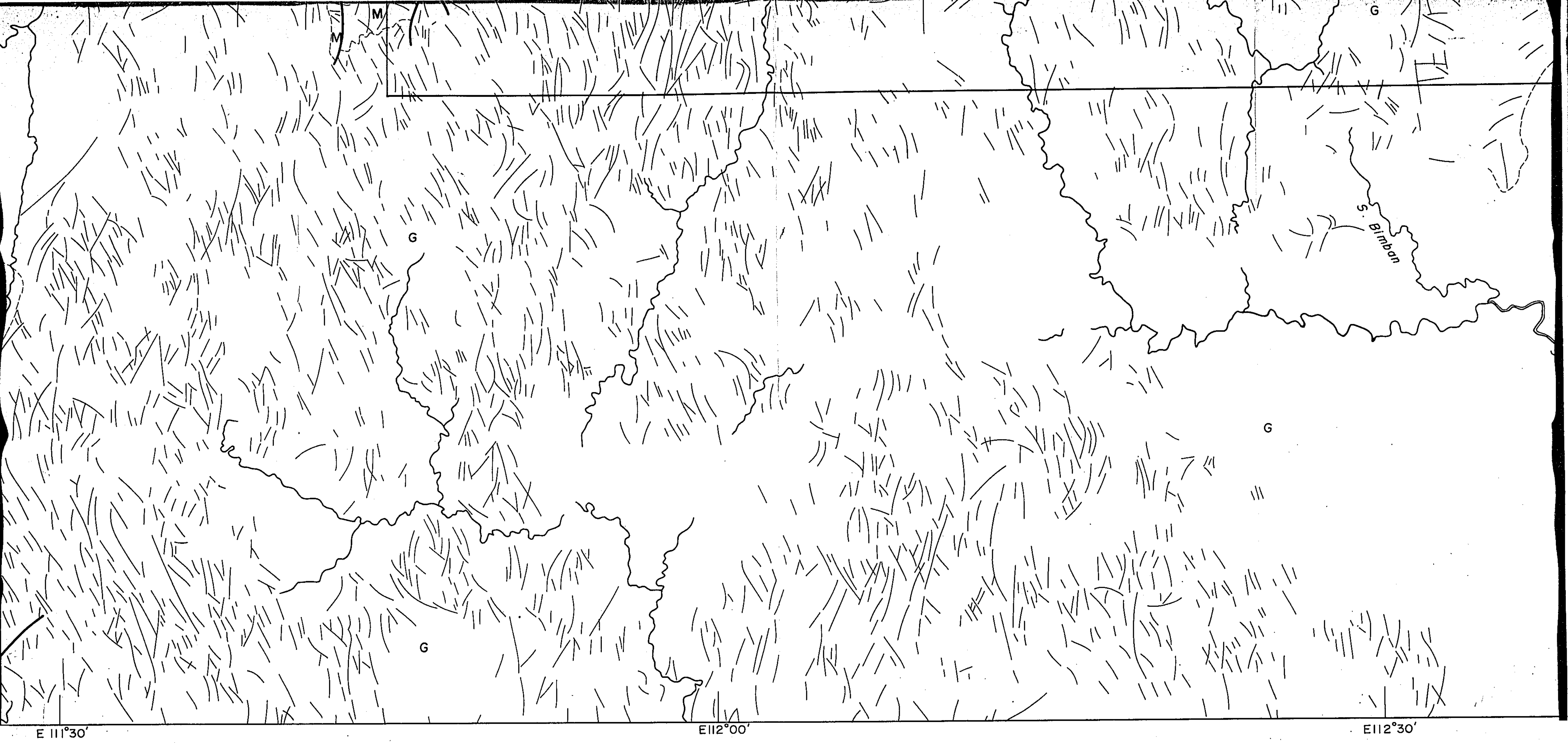
Biha
T
Purukcahu
Ma.Laung
T
S. Lahae
Ma.Lahae
T
T
Ma.Teweh
S.Teweh
Q
T

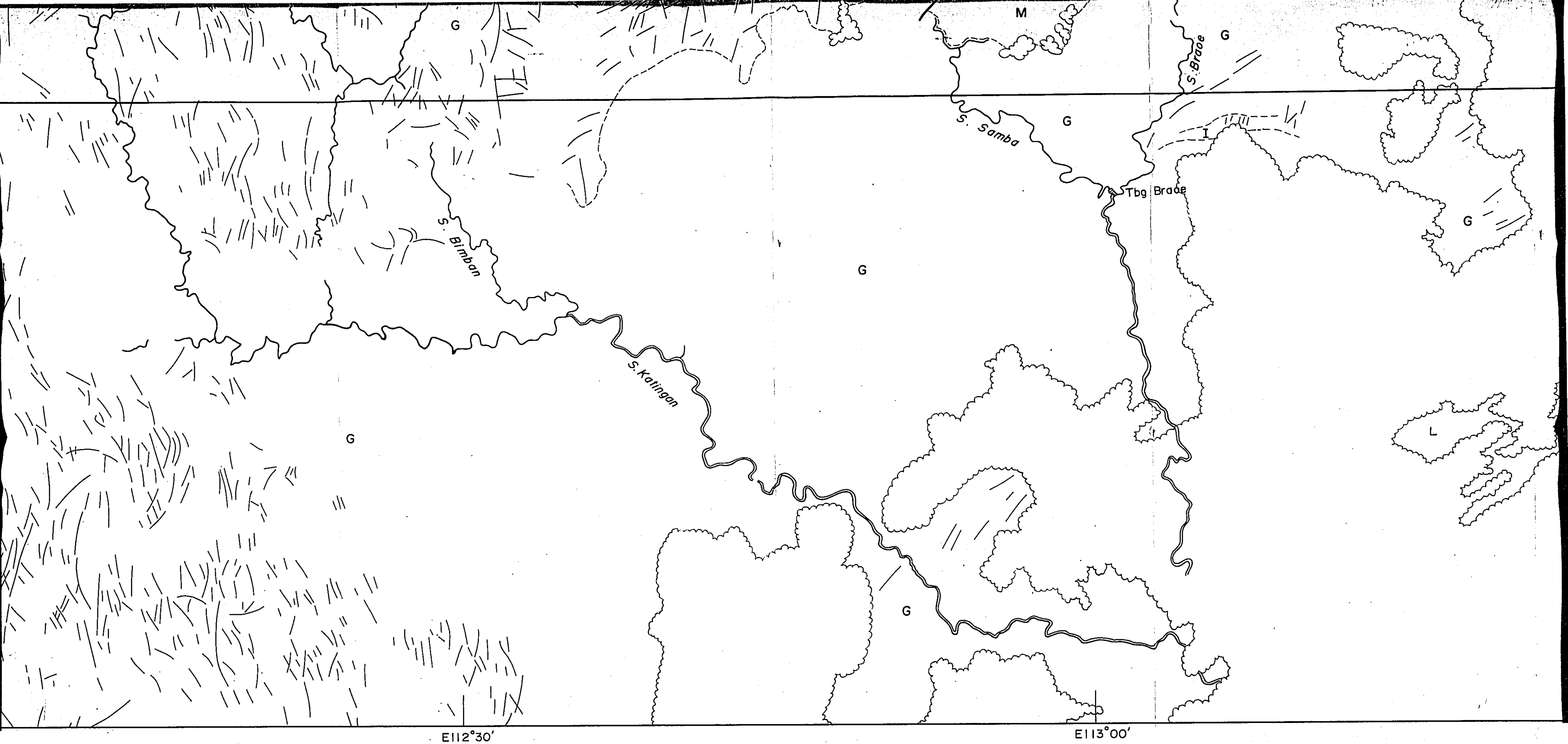

S 0°30'
S 1°00'
T
T
T
T
T
Q
Q
Q
H
S. Lahae
Ma. Lahae
S. Teweh
weh
A : Andesites Intrusives
I : Intrusive rocks
G : Granites
: Lithological boundary
: Key bed
: Lineament
: Fault
: Anticline
: Syncline
: Cloud
: Projected area
: River
: Scarp
: Village

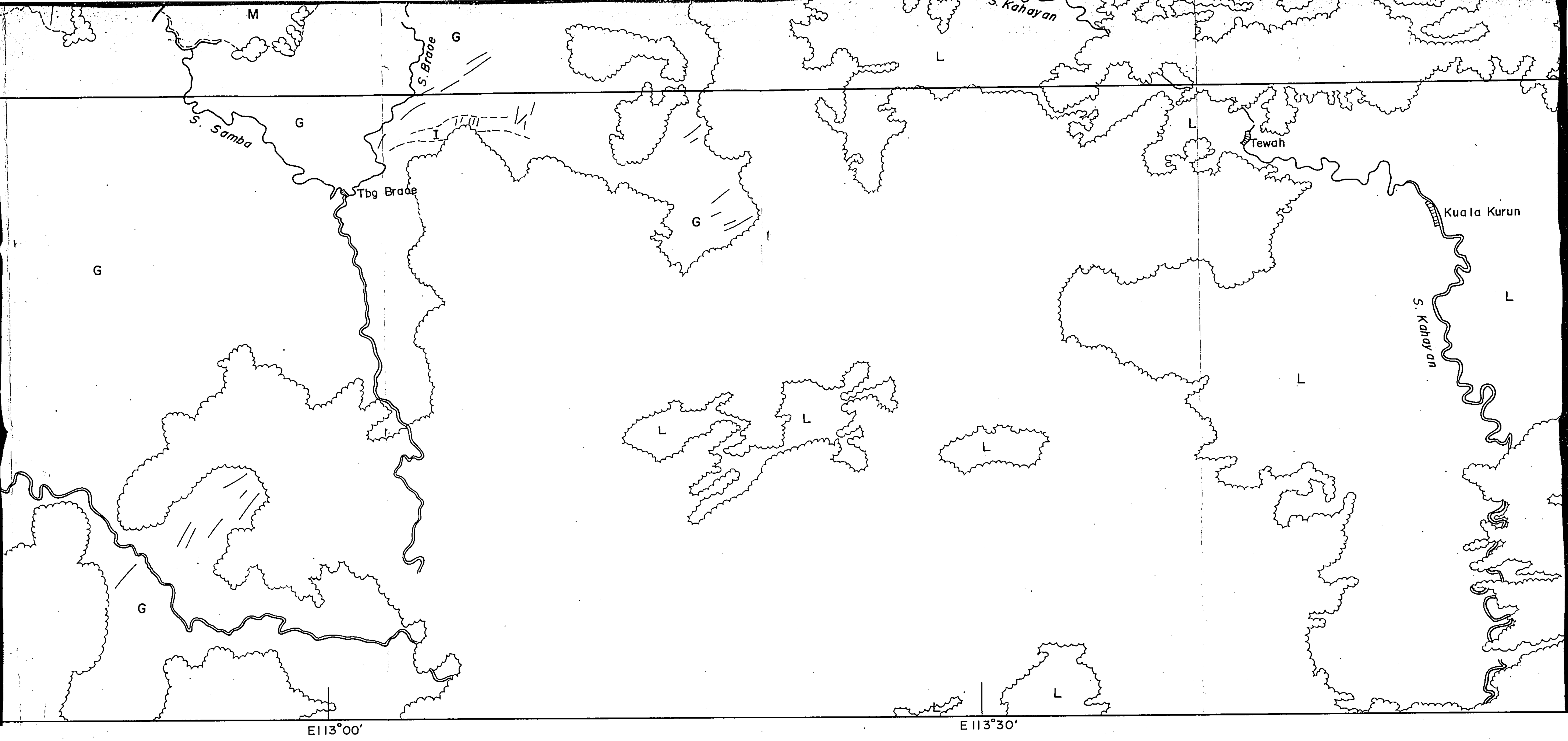

S 0°30'
S 1°00'
T
T
T
Q
Q
Q
H
A : Andesites Intrusives
I : Intrusive rocks
G : Granites
: Lithological boundary
: Key bed
: Lineament
: Fault
: Anticline
: Syncline
: Cloud
: Projected area
: River
: Scarp
: Village


S1° 30′
E1

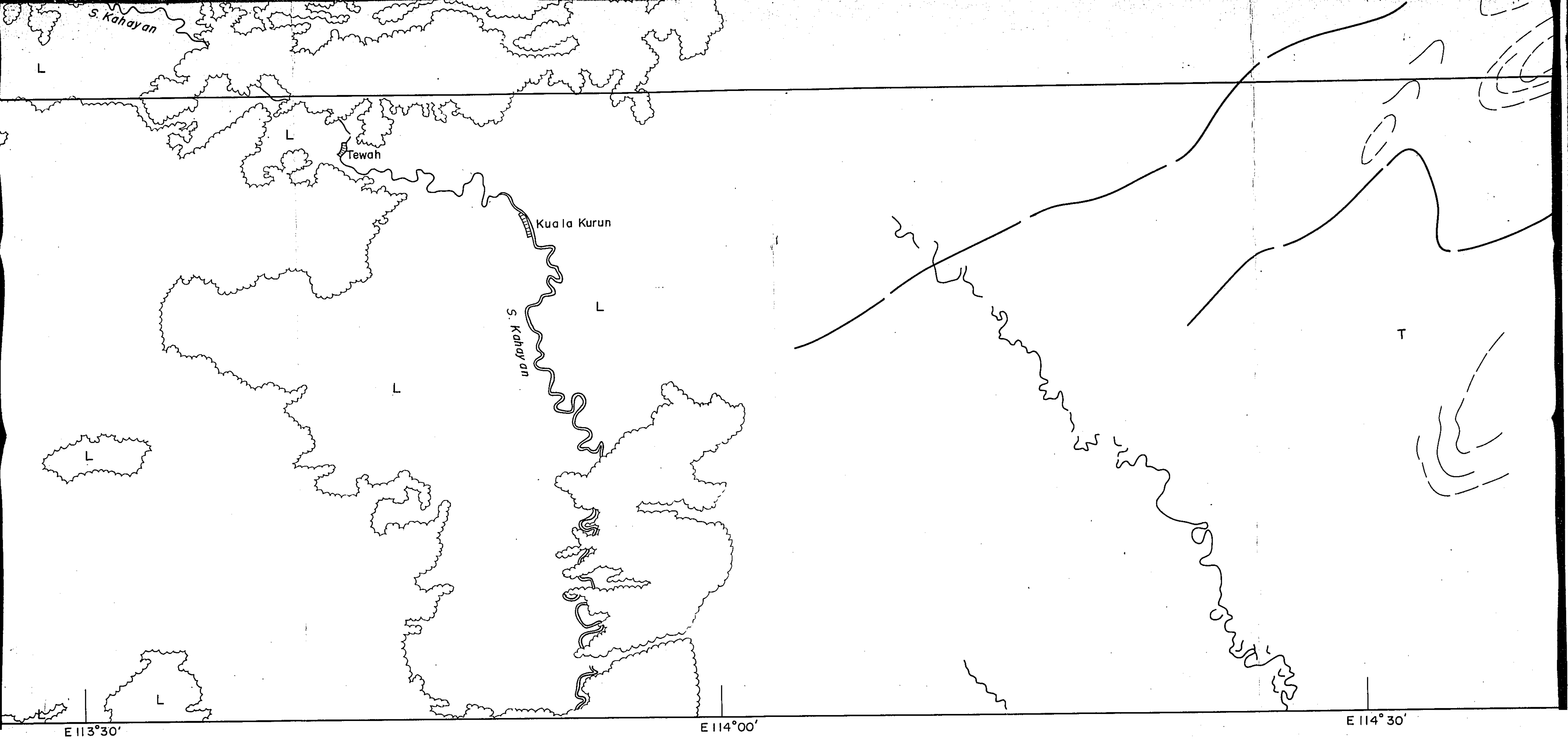

S1° 00'
S1° 30'
E 111°00'
E 111°30'
N
G
N
G
N
G
N
G
I
M


M
M
G
G
G
G
S. Bimban
E 111°30′
E112°00′
E112°30′

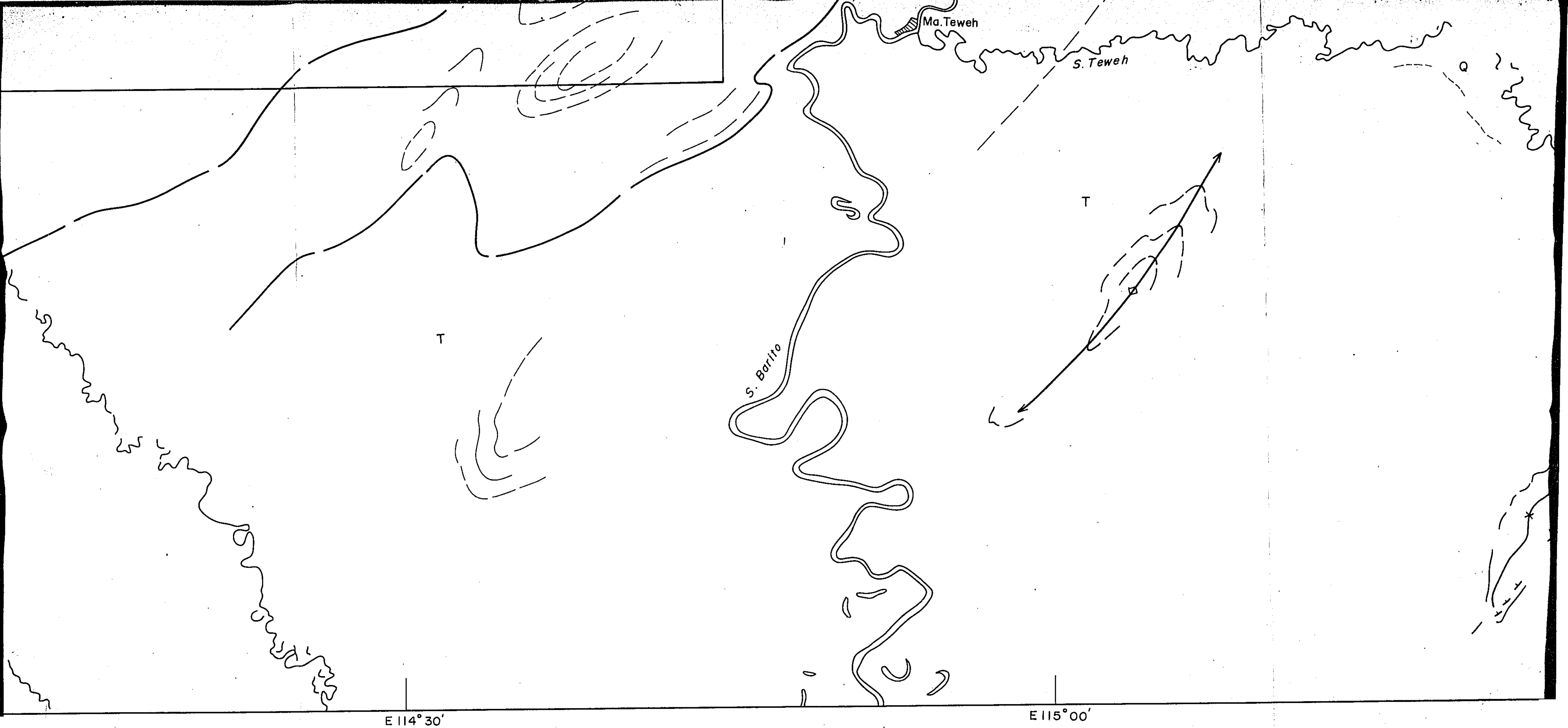

M
G
S. Braoe
S. Samba
Tbg Braoe
I
S. Bimban
S. Katingan
L
E112°30′
E113°00′



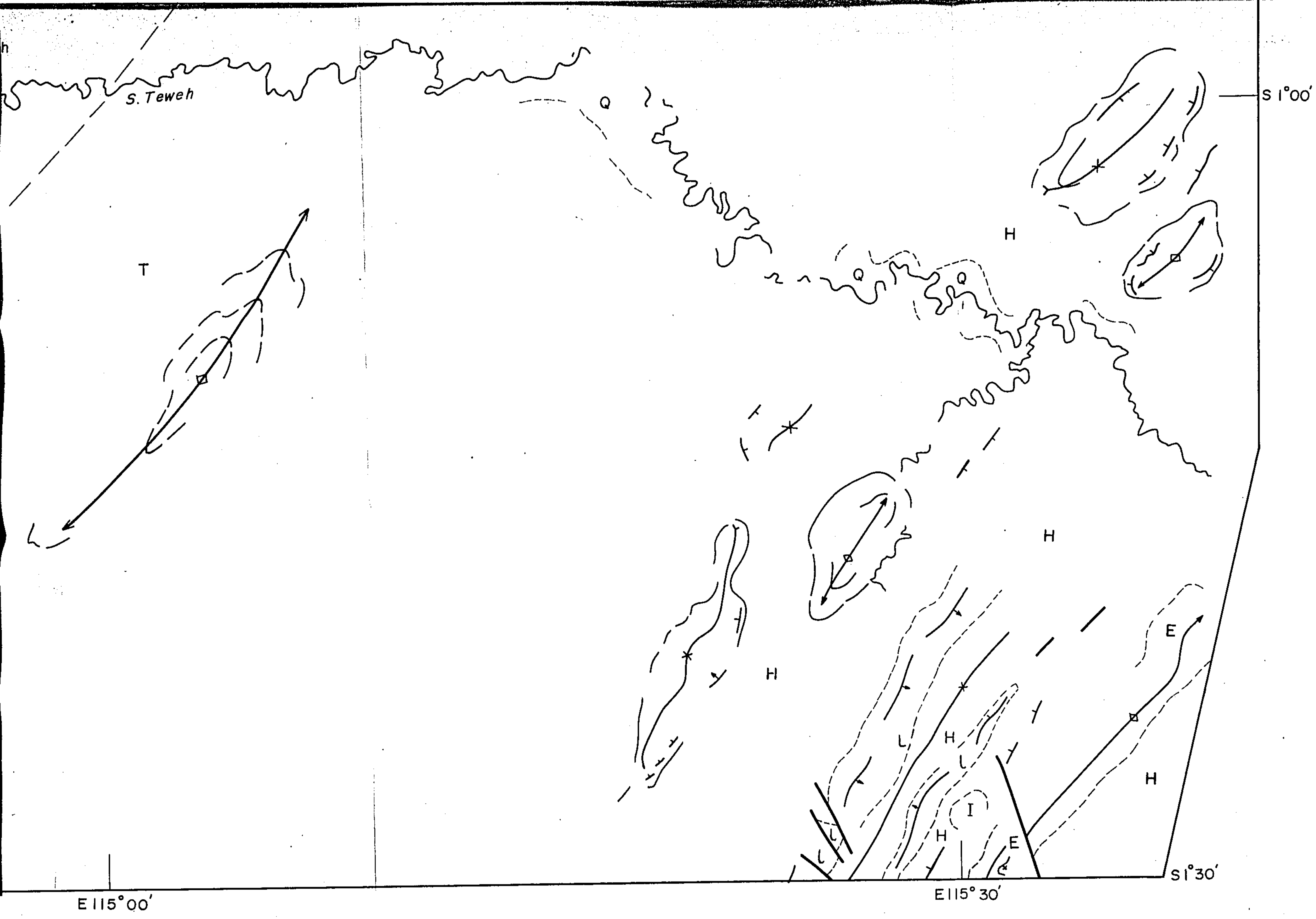
M
G
S. Braoe
S. Kahayan
L
S. Samba
G
I
L
Tewah
Tbg Braoe
Kuala Kurun
G
G
L
S. Kahayan
L
L
L
L
G
L
E113°00'
E113°30'



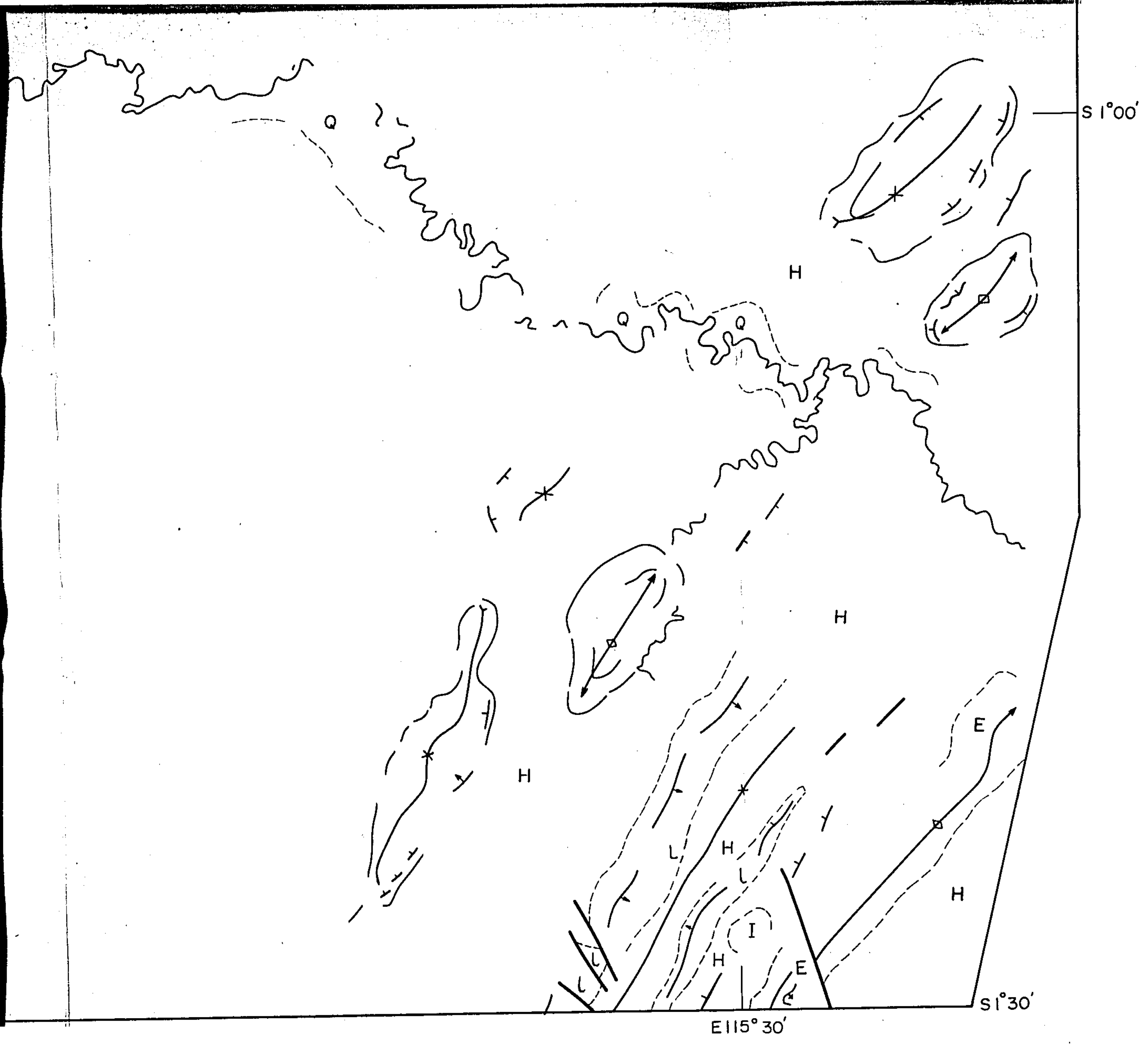
S. Kahayan
L
L
Tewah
Kuala Kurun
L
S. Kahayan
L
L
T
L
E 113°30'
E 114°00'
E 114°30'



Ma.Teweh
S. Teweh
Q
T
T
S. Barito
E 114°30′
E 115°00′



S. Teweh
Q
T
H
Q
Q
H
H
E
H
L
H
I
H
E
H
L
L
S 1°00′
S 1°30′
E 115°00′
E 115°30′



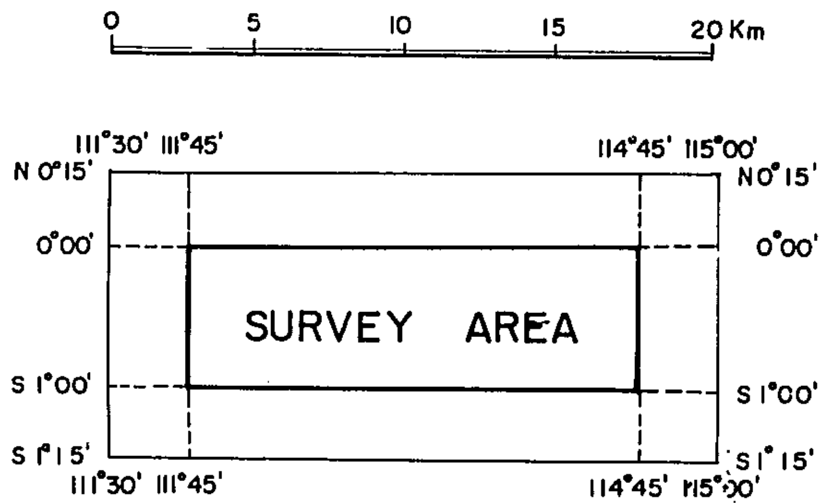
S 1°00′
Q
Q
Q
H
H
H
E
L
H
L
I
L
H
E
H
S1°30′
E115° 30′

METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY — GEOLOGICAL SURVEY OF INDONESIA

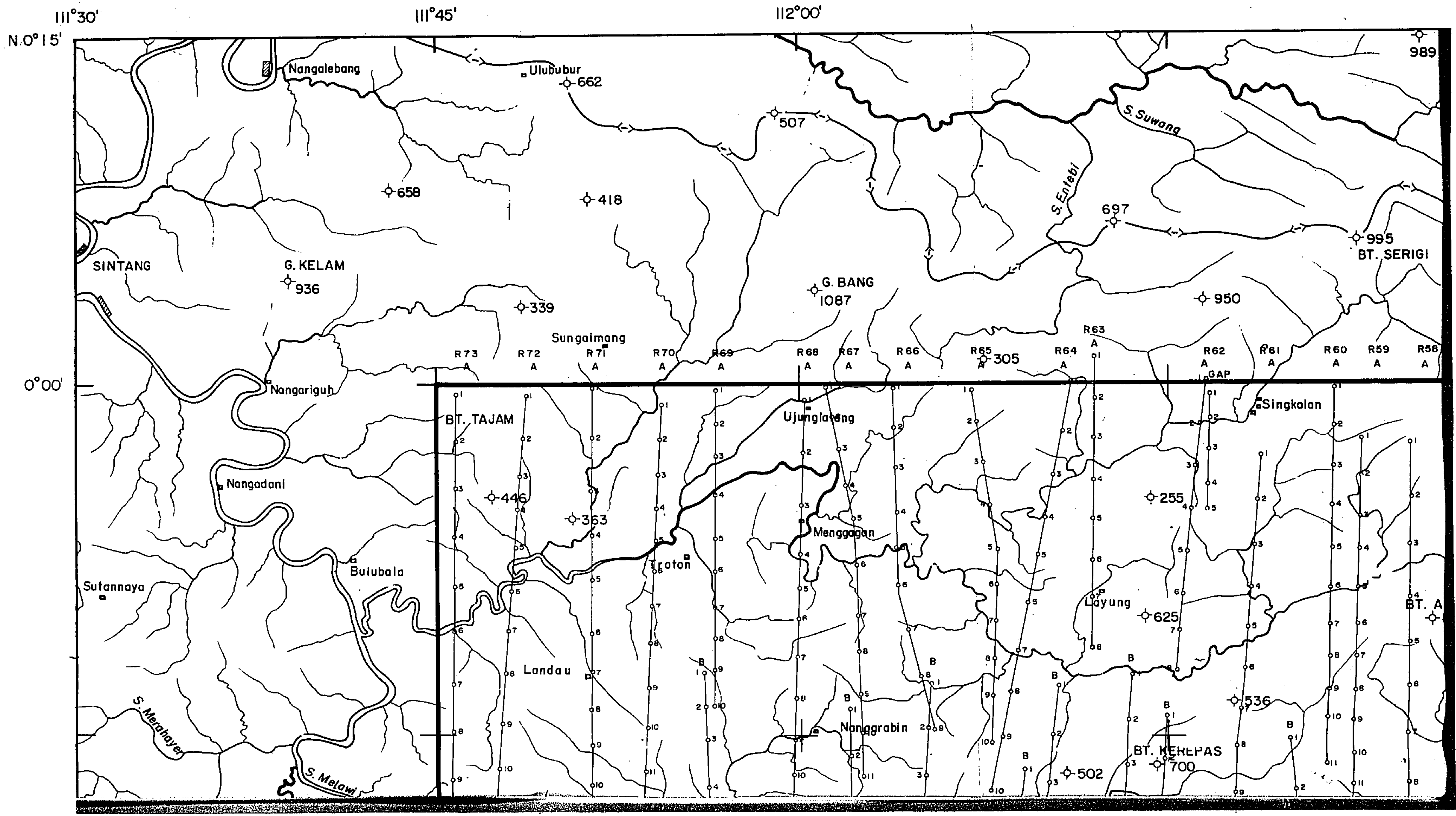
AERIAL PHOTOGRAPHY OF CENTRAL KALIMANTAN, INDONESIA

FLIGHT INDEX
AIRIAL PHOTOGRAPHY

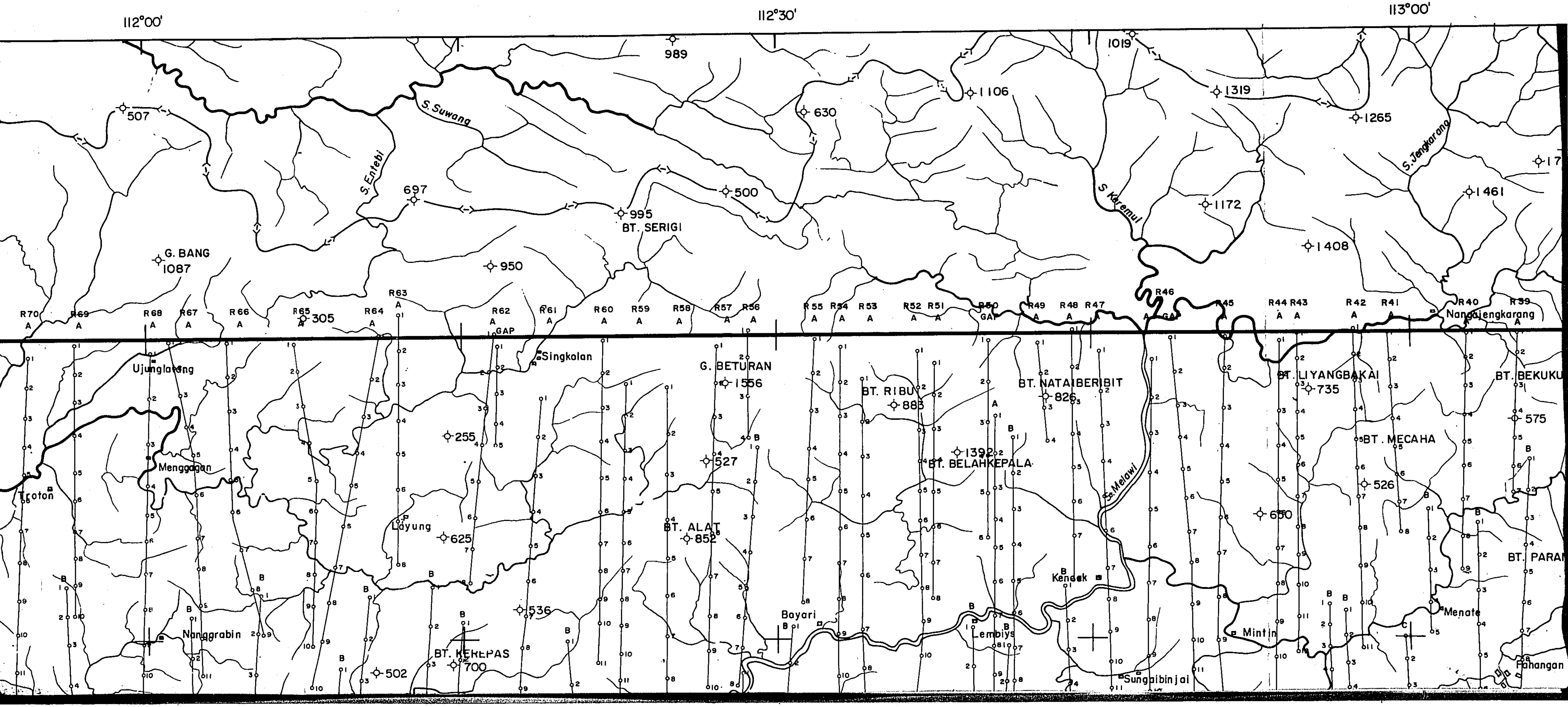
Scale approx. 1 : 250, 000

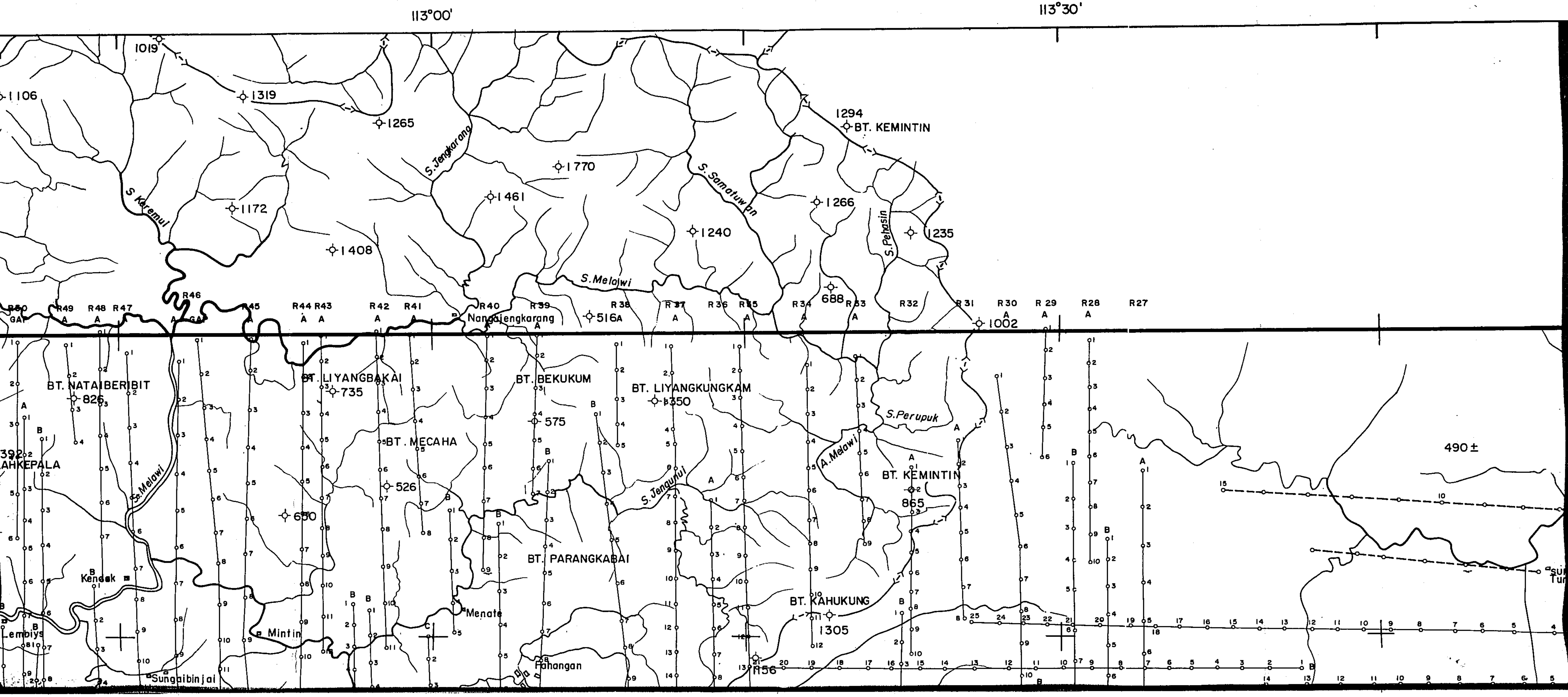


July · 1977

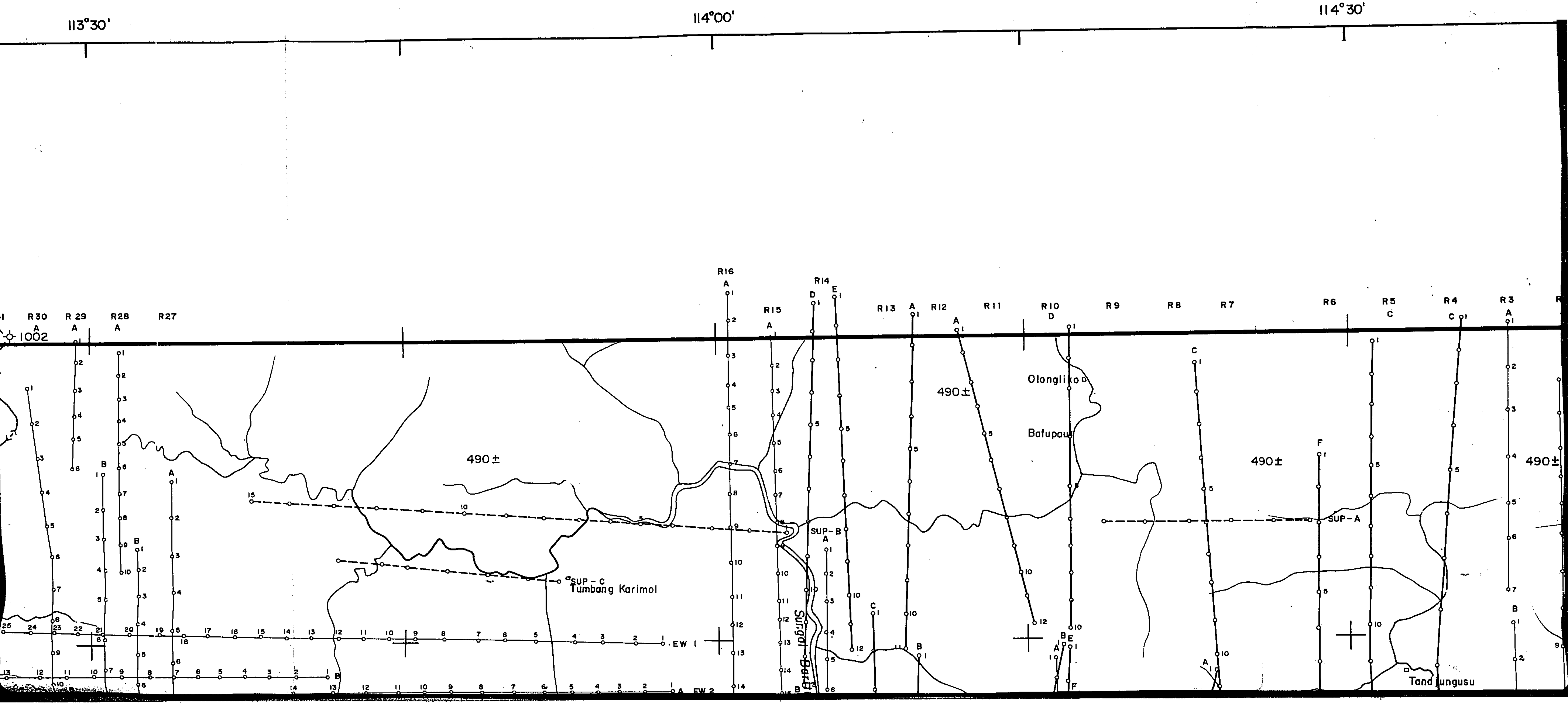


111°30'
111°45'
112°00'
N.0°15'
0°00'
Nangalebang
Ulububur
662
507
989
S. Suwang
S. Entebi
658
418
697
995
BT. SERIGI
SINTANG
G. KELAM
936
339
G. BANG
1087
950
Sungaimang
R73
R72
R71
R70
R69
R68
R67
R66
R65
305
R64
R63
R62
GAP
R61
R60
R59
R58
Nangariguh
BT. TAJAM
Ujunglatung
Singkolan
Nangadani
446
363
Menggagan
255
Troton
Bulubala
Sutannaya
Layung
625
BT. A
Landau
536
Nanggrabin
BT. KEREPAS
700
502
S. Merahayen
S. Melawi

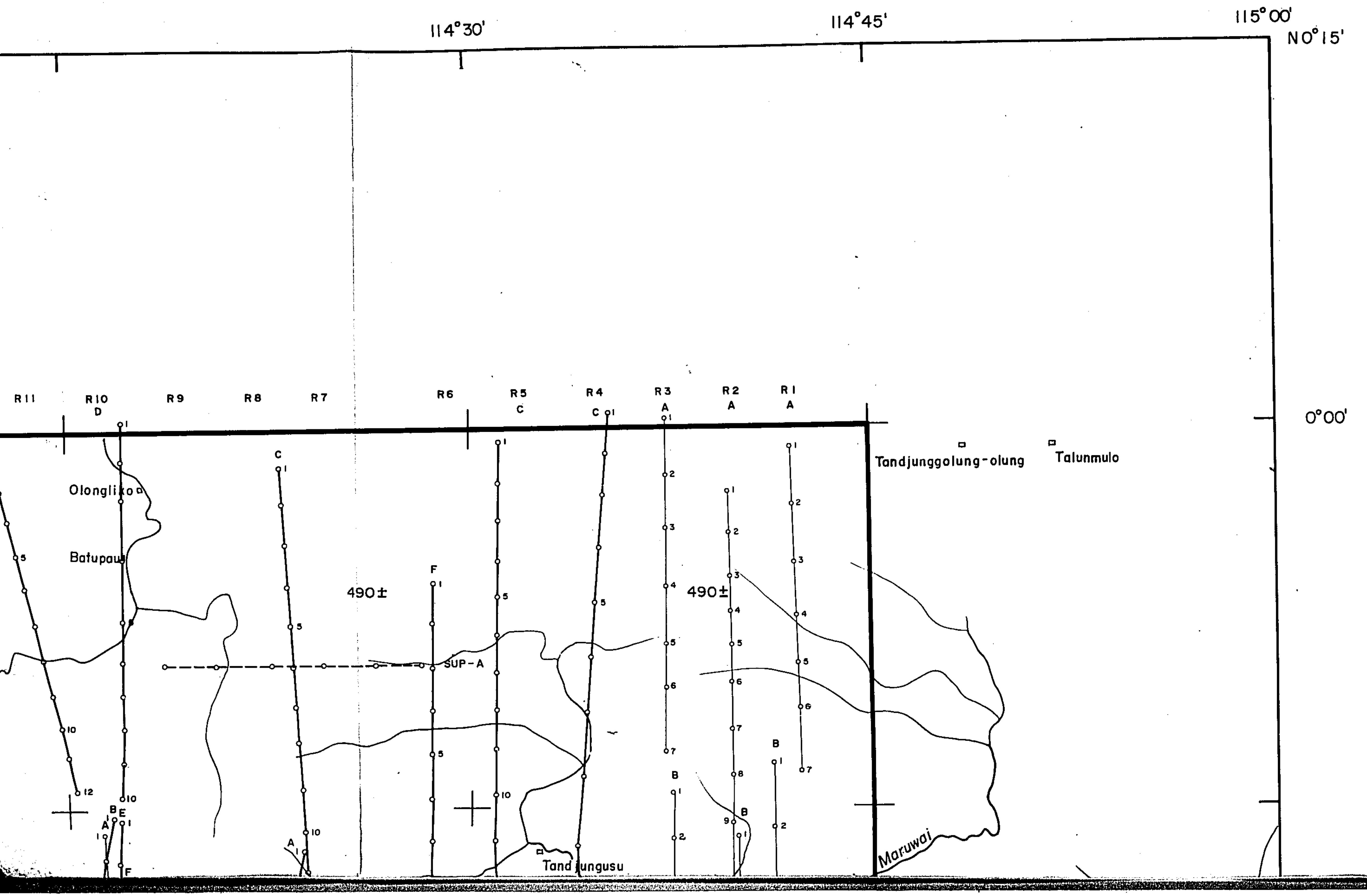

112°00'
112°30'
113°00'
989
1019
1106
1319
1265
507
630
S. Suwang
S. Entebi
697
995
BT. SERIGI
500
S. Karemul
S. Jengkarang
1172
1461
1408
G. BANG
1087
950
305
R70
R69
R68
R67
R66
R65
R64
R63
R62
R61
R60
R59
R58
R57
R56
R55
R54
R53
R52
R51
R50
R49
R48
R47
R46
R45
R44
R43
R42
R41
R40
R39
GAP
Nangajengkarang
Singkolan
Ujunglatang
G. BETURAN
1556
BT. RIBU
883
BT. NATAIBERIBIT
826
BT. LIYANGBAKAI
735
BT. BEKUKU
575
255
Menggagan
Troton
527
1392
BT. BELAHKEPALA
BT. MECAHA
526
S. Melawi
650
Layung
625
BT. ALAT
852
BT. PARAI
Kendek
Menate
536
Bayari
Lembiys
Mintin
Nanggrabin
BT. KEREPAS
700
502
Sungaibinjai
Pahangan



113°00'
113°30'
1019
1106
1319
1265
S. Jengkarang
1294
BT. KEMINTIN
1770
S. Karemul
1461
1172
S. Samatuwan
1266
1240
S. Pehasin
1235
1408
S. Melawi
688
R50
R49
R48
R47
R46
R45
R44
R43
R42
R41
R40
R39
R38
R37
R36
R35
R34
R33
R32
R31
R30
R29
R28
R27
Nangajengkarang
516
1002
BT. NATAIBERIBIT
826
BT. LIYANGBAKAI
735
BT. BEKUKUM
BT. LIYANGKUNGKAM
350
575
S. Perupuk
BT. MECAHA
392
AHKEPALA
490±
S. Melawi
526
650
S. Jengunui
A. Melawi
BT. KEMINTIN
865
BT. PARANGKABAI
Kendak
BT. KAHUKUNG
Menate
1305
Lembiys
Mintin
Pahangan
1156
Sungaibinjai



113°30'
114°00'
114°30'
R30
R 29
R28
R27
R16
R15
R14
R13
R12
R11
R10
R9
R8
R7
R6
R5
R4
R3
1002
490±
490±
490±
490±
Olongliko
Batupau
SUP-A
SUP-B
SUP-C
Tumbang Karimol
Sungai Barito
Tandjungusu
EW 1
EW 2



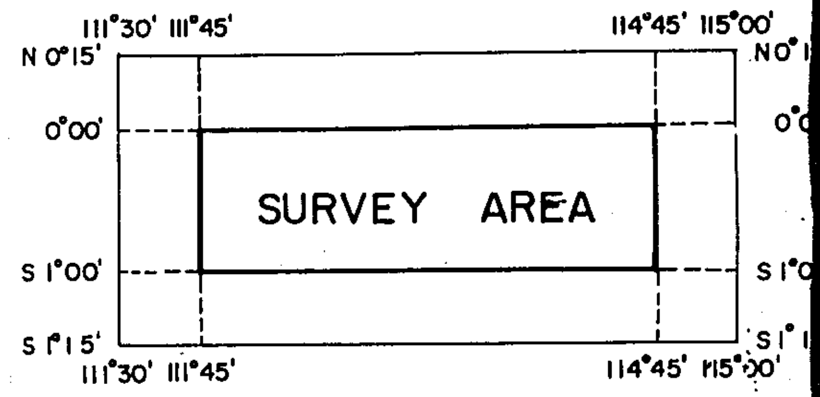
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY — GEOLOGI OF I

AERIAL PHOTOGRAPHY OF CENTRAL KALIMANTAN, INDONESIA

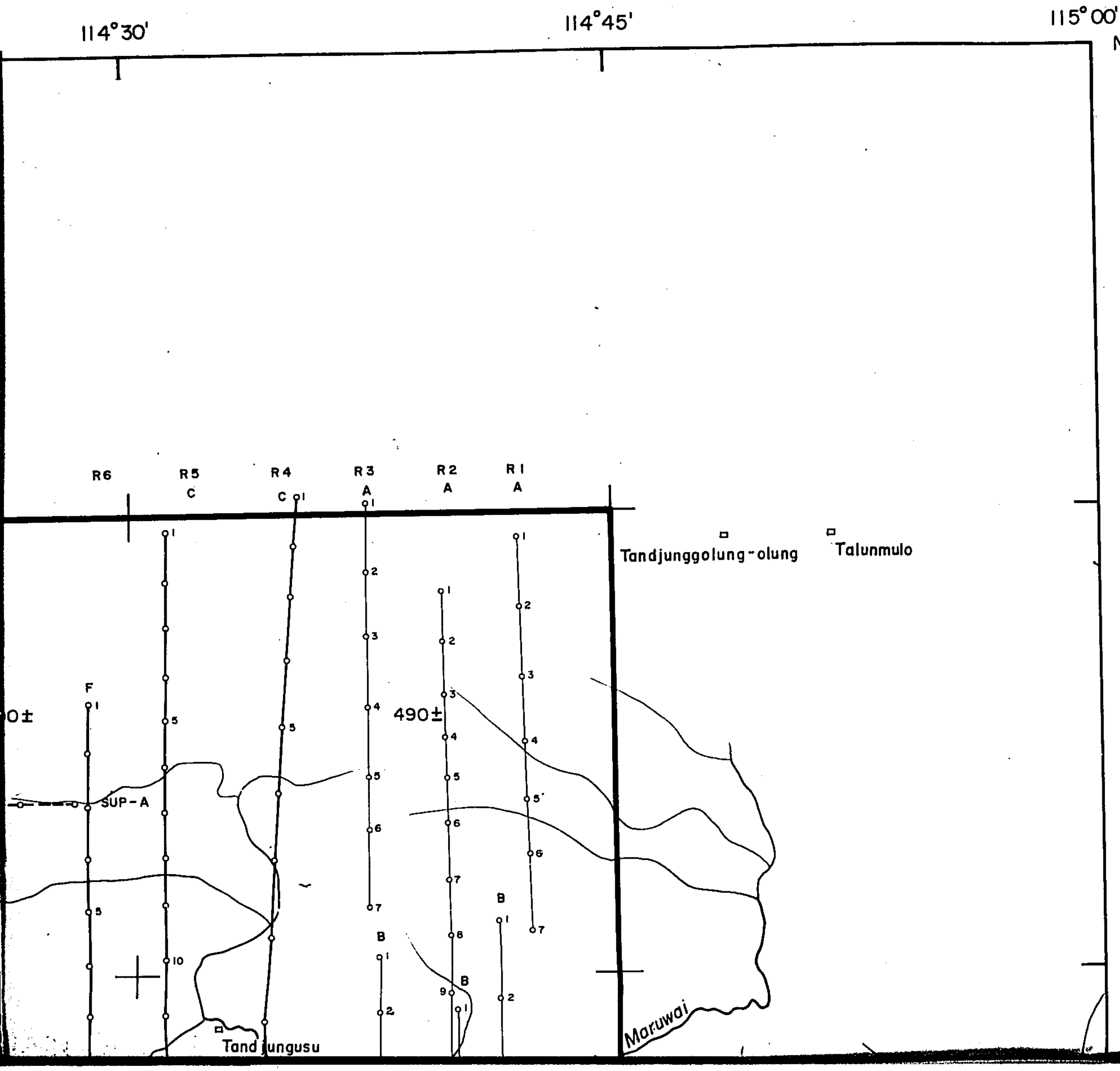
FLIGHT INDEX
AIRIAL PHOTOGRAPHY

Scale approx. 1 : 250,000

0 5 10 15 20 Km



July · 1977



PL. 2

METAL MINING AGENCY OF JAPAN — GEOLOGICAL SURVEY OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY

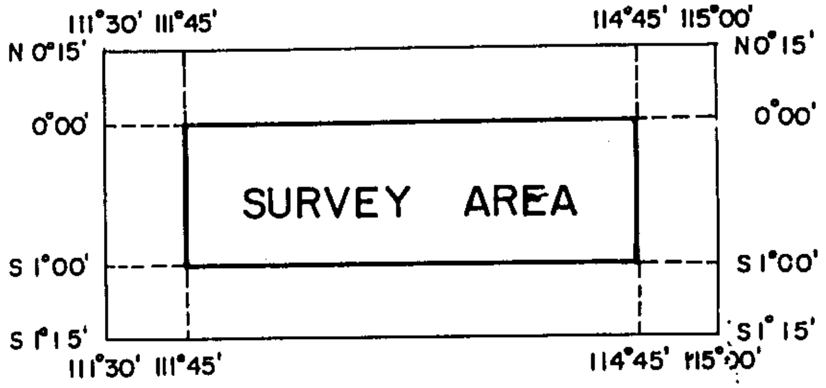
AERIAL PHOTOGRAPHY OF CENTRAL KALIMANTAN, INDONESIA

FLIGHT INDEX

AIRIAL PHOTOGRAPHY

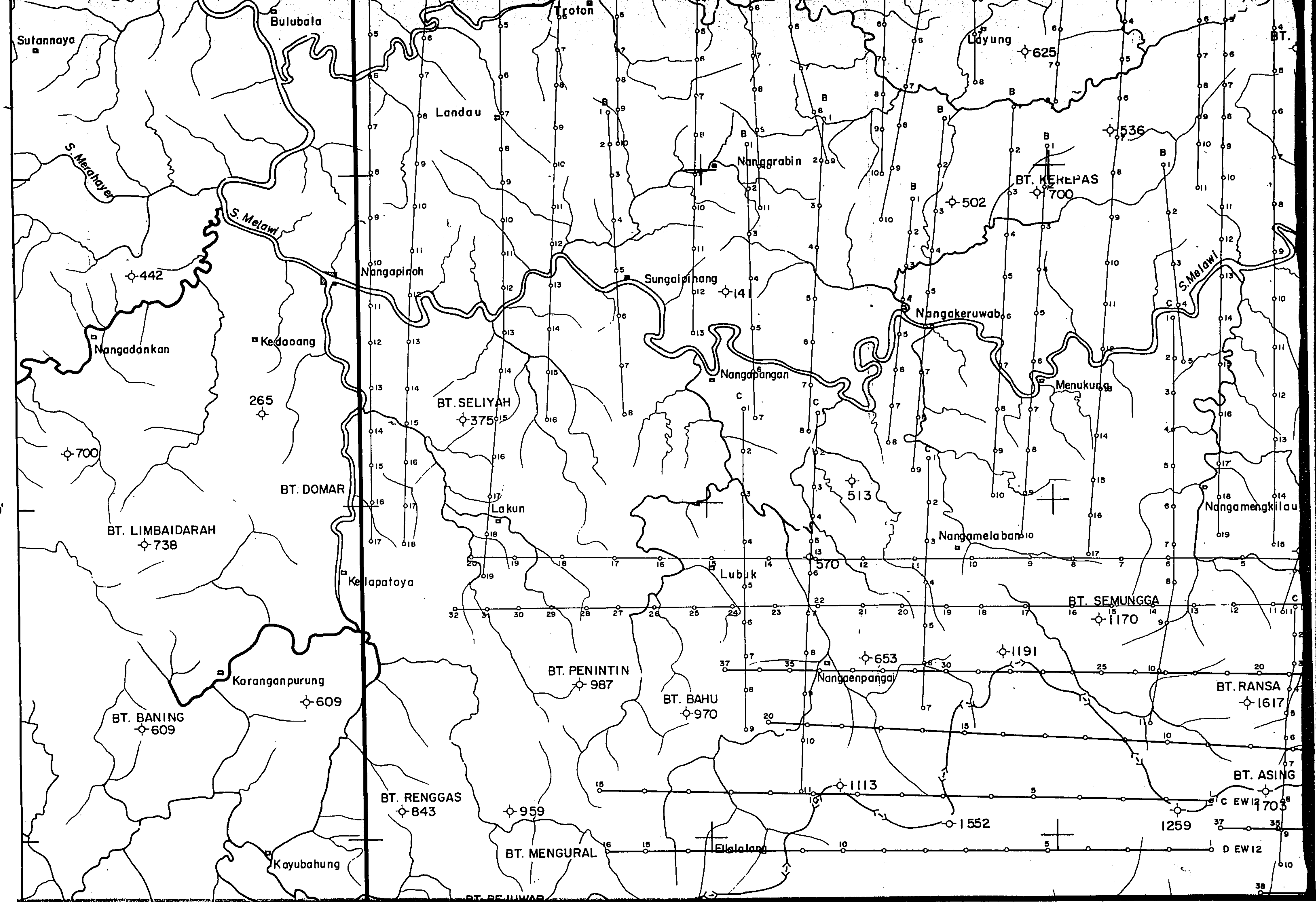
Scale approx. 1 : 250,000

0 5 10 15 20 Km

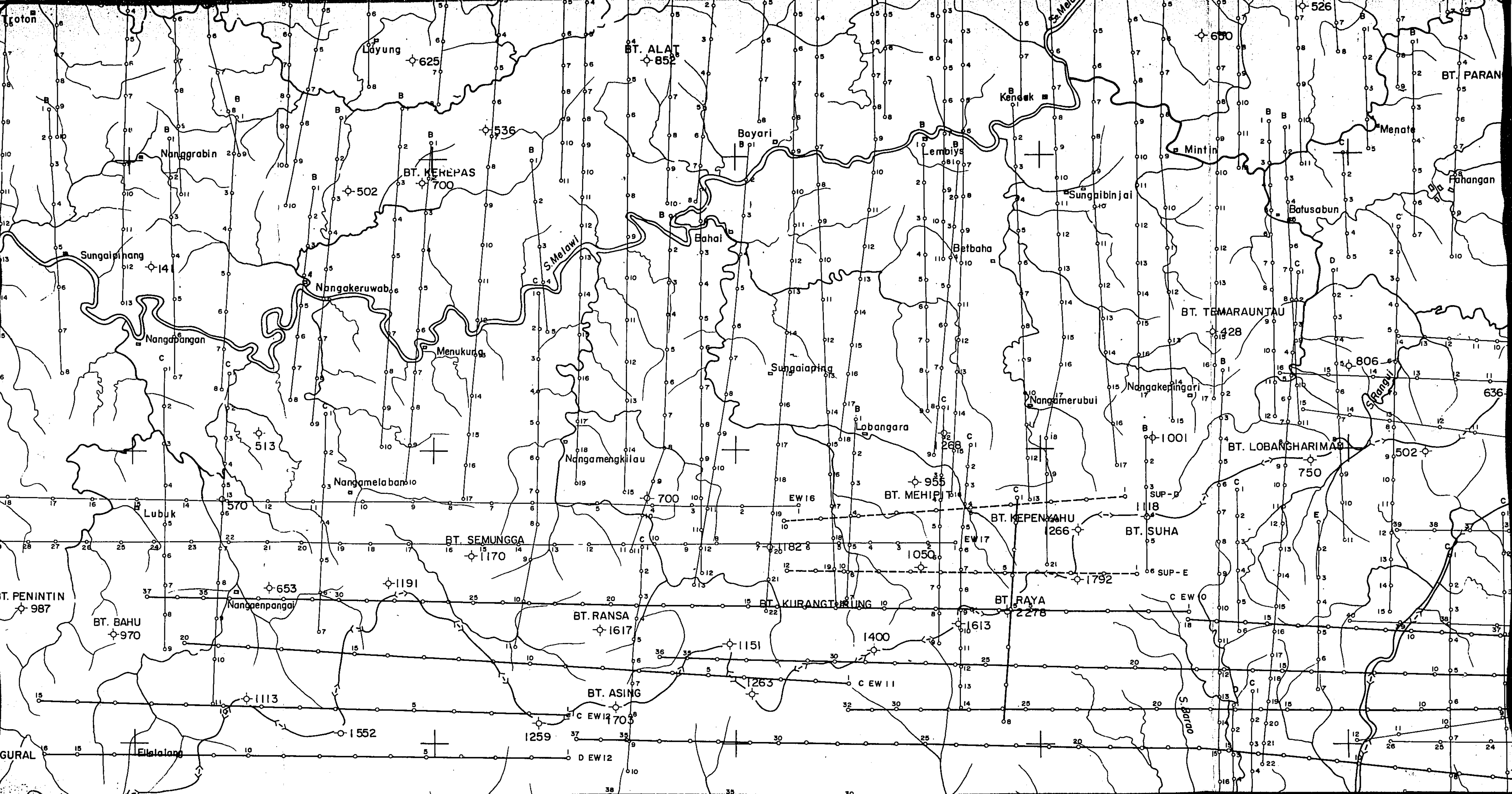


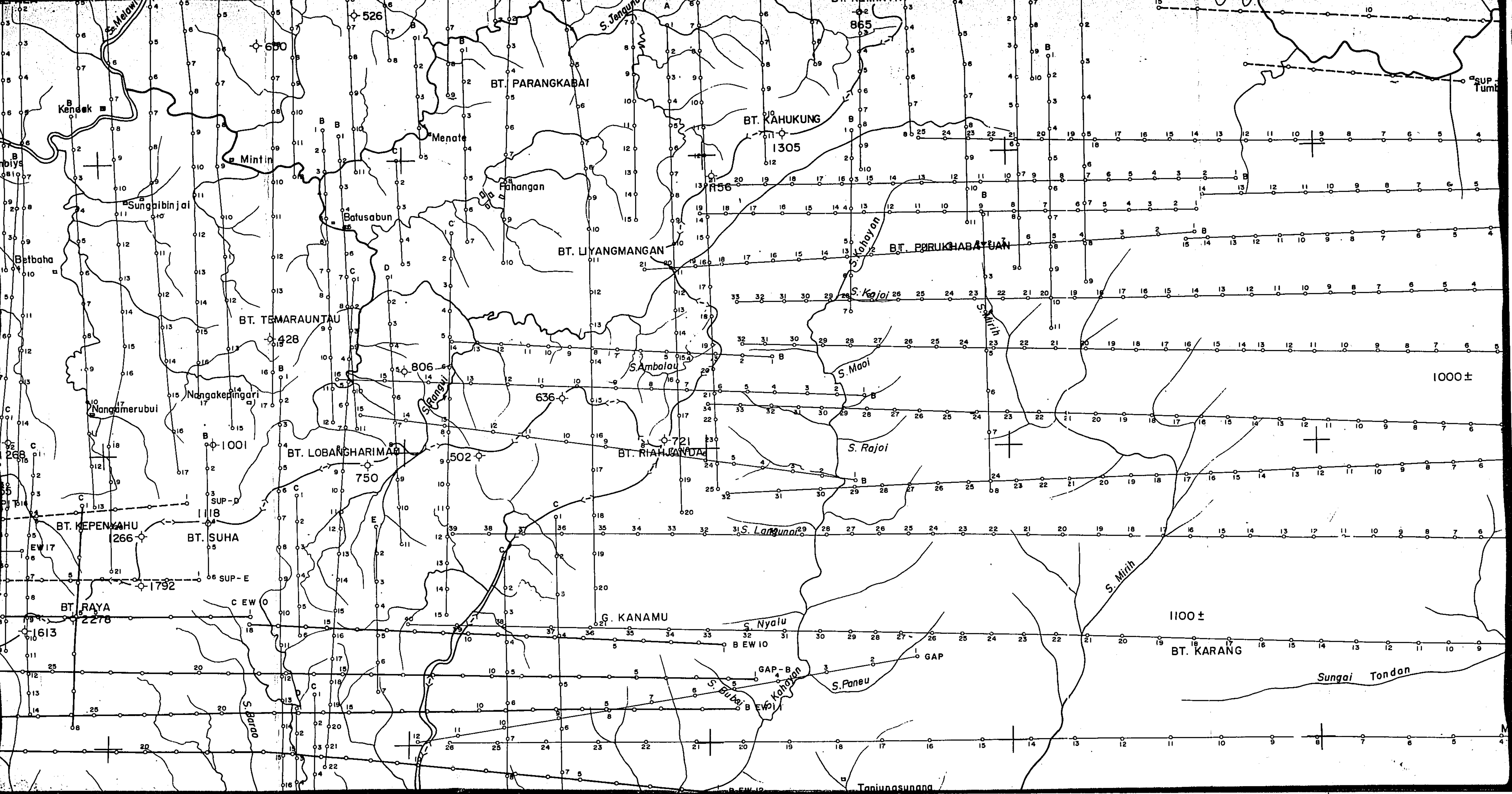
July · 1977

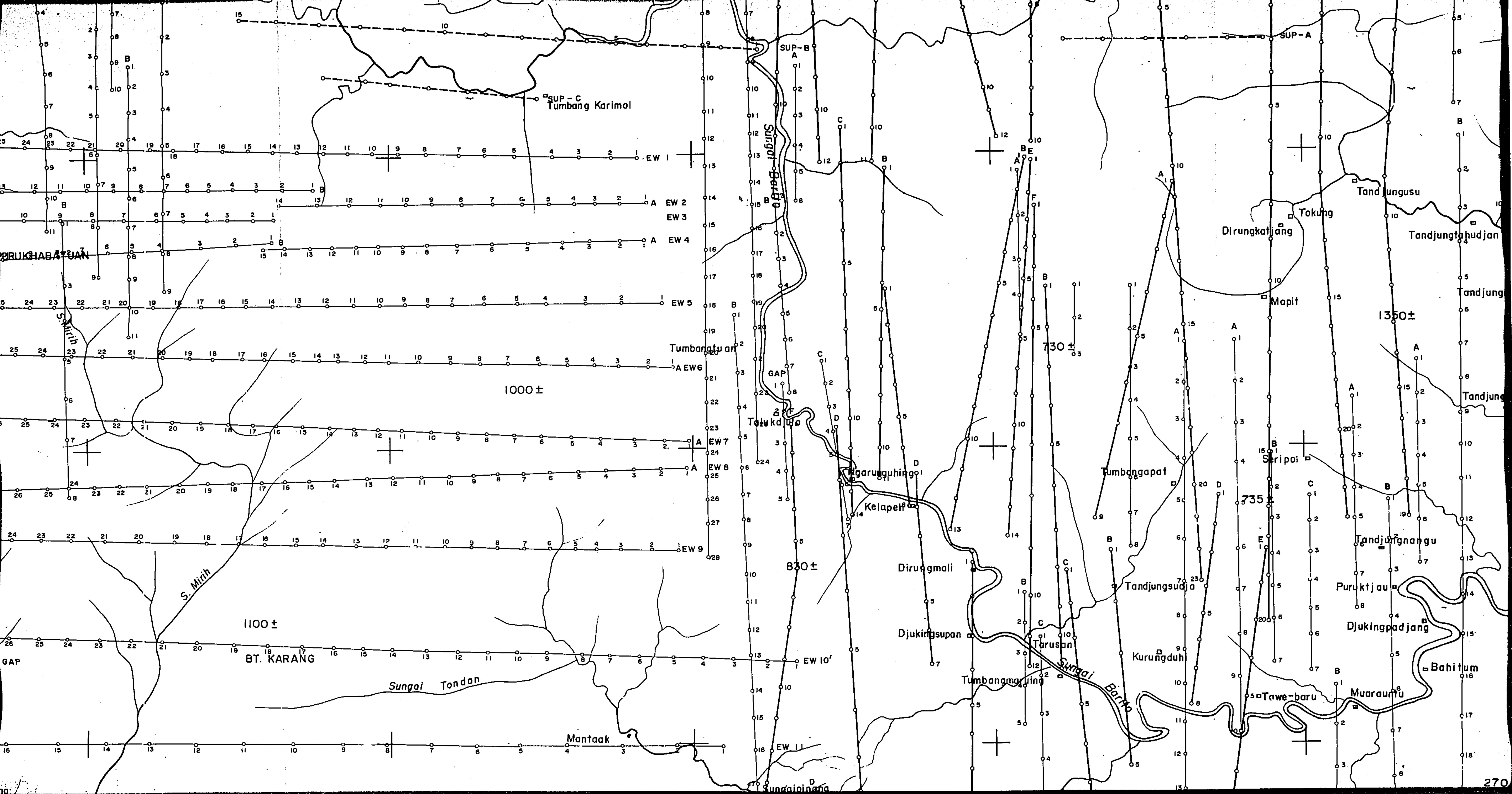
S 0°30'

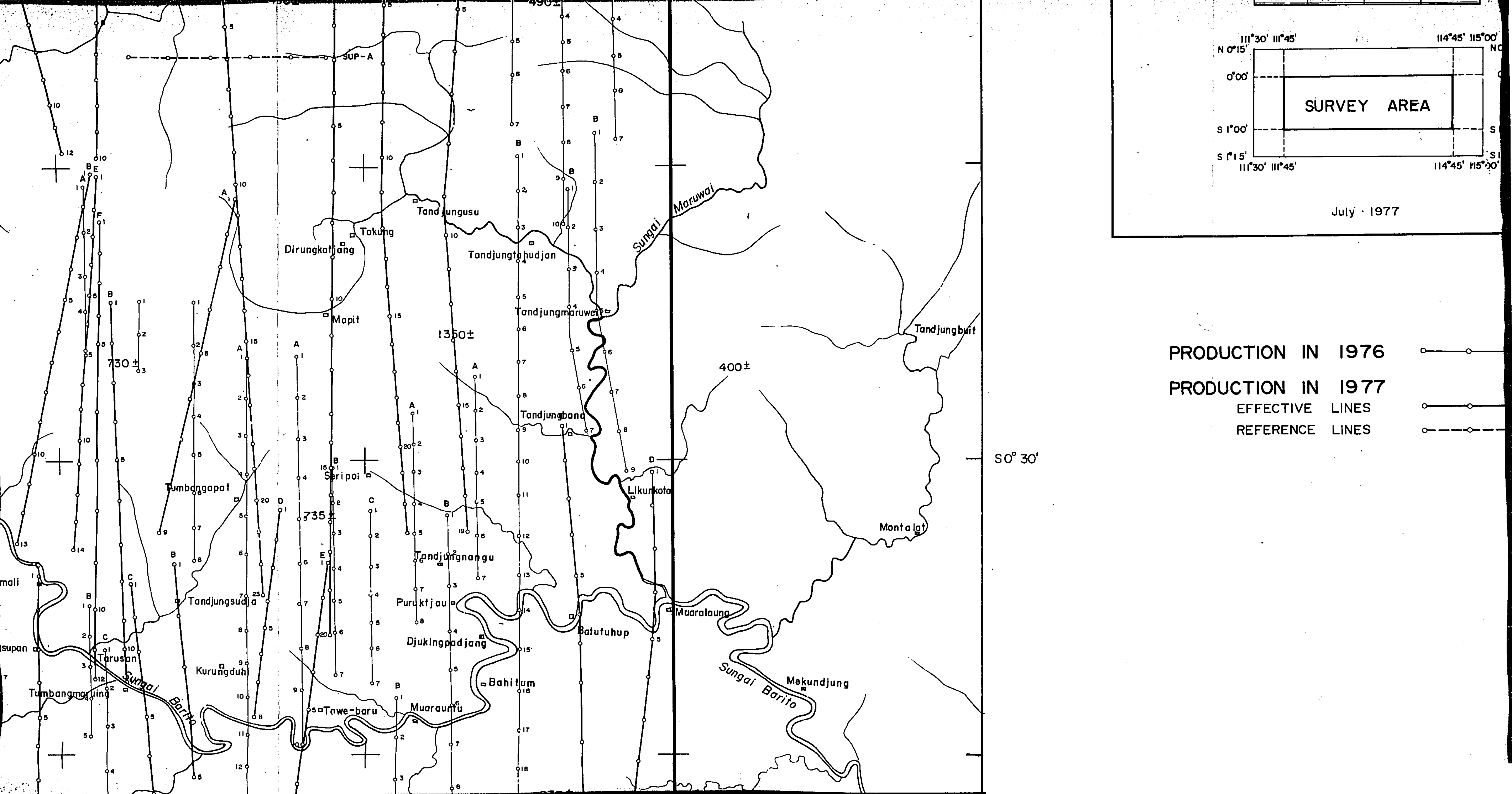


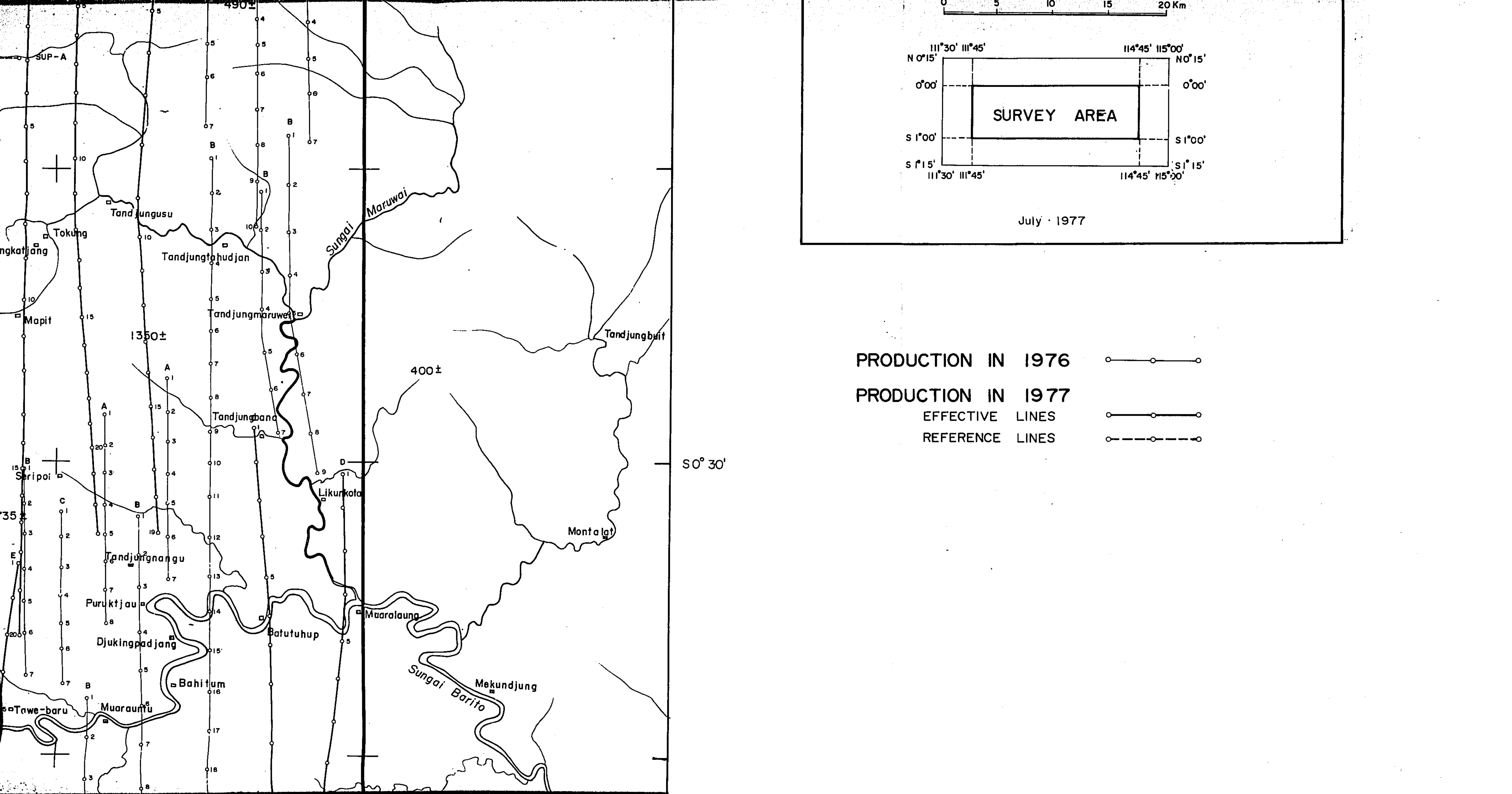
Bulubala
Sutannaya
Troton
Layung
625
536
S. Merahayen
Landau
Nanggrabin
BT. KEREPAS
700
502
S. Melawi
442
Nangapinoh
Sungaipinang
141
Nangakeruwab
Nangadankan
Kedaoang
Nangapangan
Menukung
265
BT. SELIYAH
375
700
513
BT. DOMAR
Lakun
Nangamengkilau
BT. LIMBAIDARAH
738
Nangamelaban
570
Lubuk
Kelapatoya
BT. SEMUNGGA
1170
1191
653
BT. PENINTIN
987
Nangaenpangai
BT. RANSA
1617
Karanganpurung
609
BT. BAHU
970
BT. BANING
609
BT. ASING
1113
1703
C EW12
BT. RENGGAS
843
959
1552
1259
BT. MENGURAL
Ellalalang
D EW12
Kayubahung


Troton
Layung
625
BT. ALAT
852
526
650
BT. PARAN
Kendak
Menate
Mintin
Bayari
Lembiys
Nanggrabin
BT. KEREPAS
700
502
536
Sungaibinjai
Pahangan
Batusabun
Bahai
S. Melawi
Sungaipinang
141
Nangakeruwab
Betbaha
Nangapangan
Menukung
BT. TEMARAUNTAU
428
806
S. Rangui
636
Sungaiaping
Nangakepingari
Nangamerubui
Lobangara
1268
513
Nangamengkilau
1001
BT. LOBANGHARIMAU
502
750
Nangamelaban
955
BT. MEHIPIT
EW 16
BT. KEPENYAHU
1118
SUP-D
Lubuk
570
700
BT. SUHA
1266
BT. SEMUNGGA
1170
1182
1050
EW 17
SUP-E
1792
653
1191
T. PENINTIN
987
Nangaenpangai
BT. KURANGTURUNG
BT. RAYA
2278
C EW 10
BT. BAHU
970
BT. RANSA
1617
1613
1400
1151
C EW 11
1263
BT. ASING
1703
1113
C EW 12
1552
1259
S. Barao
D EW 12
GURAL
Elilalang

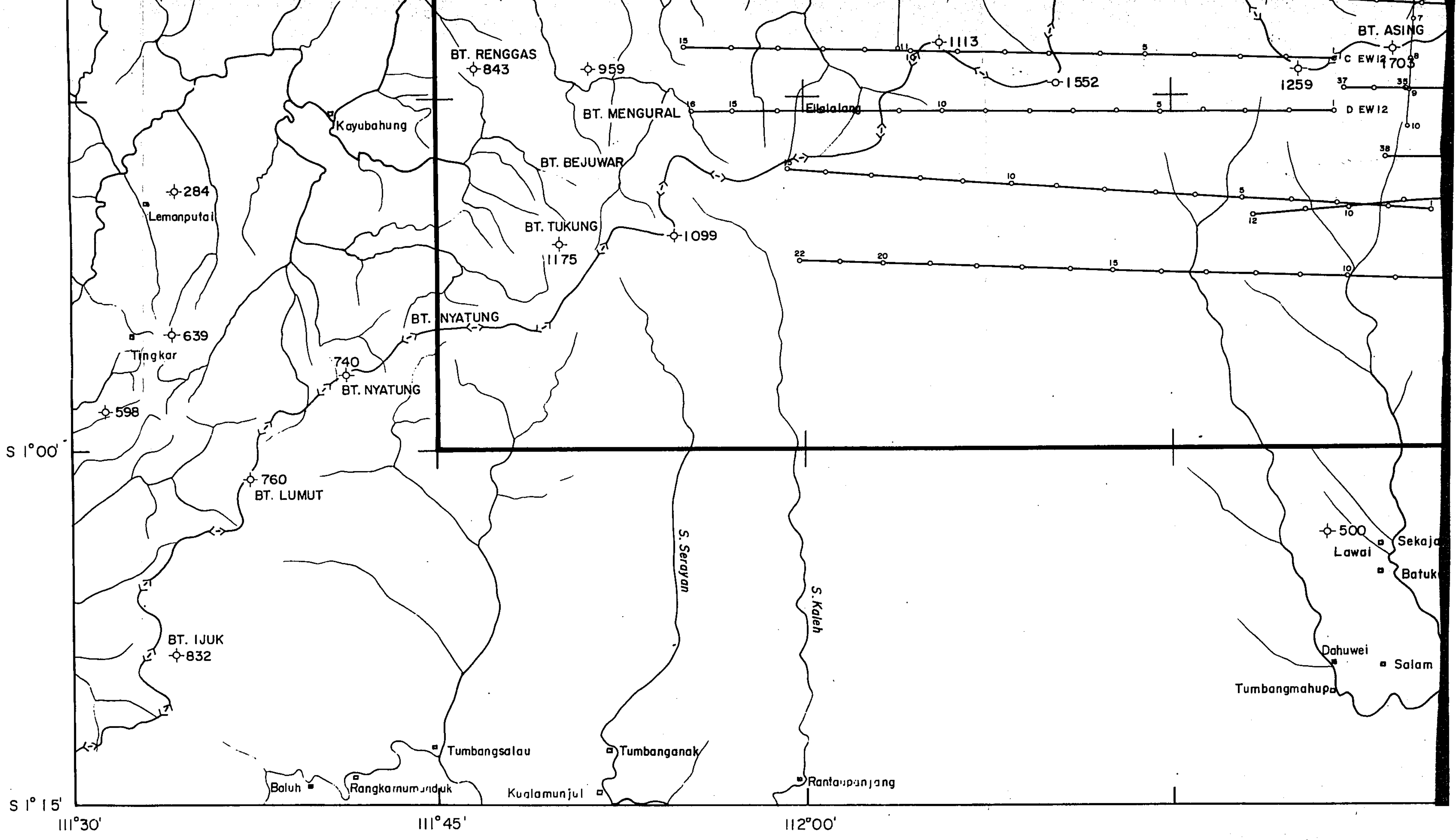

S. Melawi
526
650
865
Kendak
Mintin
Menate
BT. PARANGKABAI
BT. KAHUKUNG
1305
1156
Pahangan
Sungaibinjai
Batusabun
Betbaha
BT. LIYANGMANGAN
S. Kahayan
S. Kajoi
S. Mirih
BT. TEMARAUNTAU
428
Nangakepingari
Nangamerubui
806
636
S. Ambalau
S. Maoi
S. Rangui
1000 ±
1001
750
502
721
S. Rajoi
SUP-D
1118
BT. SUHA
1266
EW 17
SUP-E
1792
BT. RAYA
2278
1613
C EW 10
G. KANAMU
S. Nyalu
B EW 10
1100 ±
BT. KARANG
GAP
GAP-B
S. Paneu
Sungai Tondan
S. Barao


SUP - C
Tumbang Karimol
SUP-B
SUP-A
EW 1
EW 2
EW 3
EW 4
EW 5
EW6
EW 7
EW 8
EW 9
EW 10'
EW 11
Sungai Barito
Tumbangtuan
GAP
1000 ±
1100 ±
830 ±
730 ±
735 ±
1350 ±
S. Mirih
BT. KARANG
Sungai Tondan
Mantaak
Ngarunguhing
Kelapeli
Dirungmali
Djukingsupan
Tarusan
Sungai Barito
Kurungduh
Tawe-baru
Muarauntu
Bahitum
Djukingpadjang
Puruktjau
Tandjungnangu
Seripoi
Tumbangapat
Tandjungsudja
Mapit
Dirungkatjang
Tokung
Tandjungusu
Tandjung

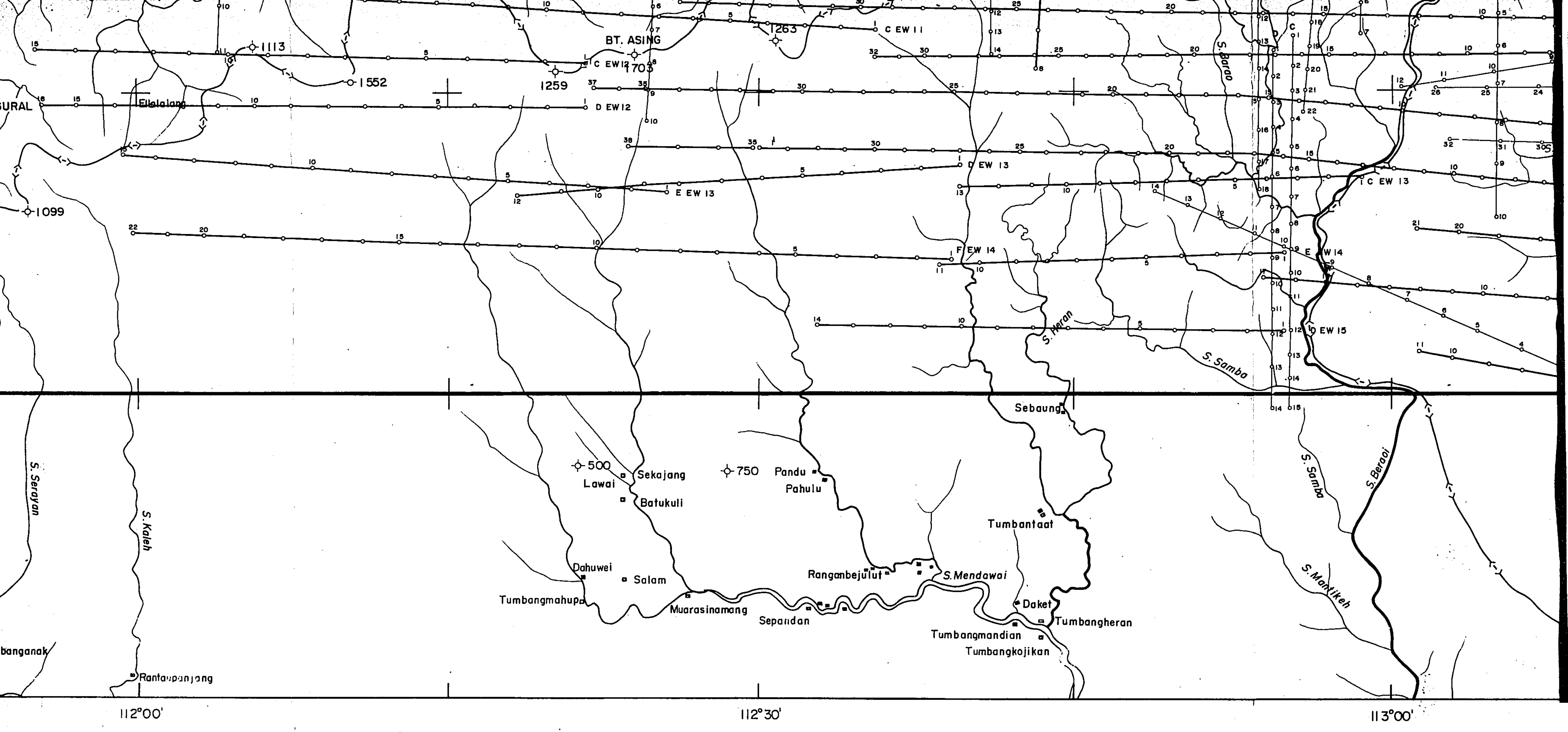

SUP-A
Tandjungusu
Tokung
Dirungkatjang
Tandjungtahudjan
Sungai Maruwai
Mapit
1350±
730±
Tandjungmaruwei
Tandjungbuit
400±
Tandjungbang
Seripoi
Tumbangapat
735±
Likunkota
Montalat
Tandjungnangu
Tandjungsudja
Puruktjau
Muaralaung
Batutuhup
Djukingpadjang
Tarusan
Kurungduhi
Bahitum
Sungai Barito
Mekundjung
Tumbangmaruing
Tawe-baru
Muarauntu
S0° 30'
SURVEY AREA
N 0°15'
0°00'
S 1°00'
S 1°15'
111°30' 111°45'
114°45' 115°00'
July · 1977
PRODUCTION IN 1976
PRODUCTION IN 1977
EFFECTIVE LINES
REFERENCE LINES



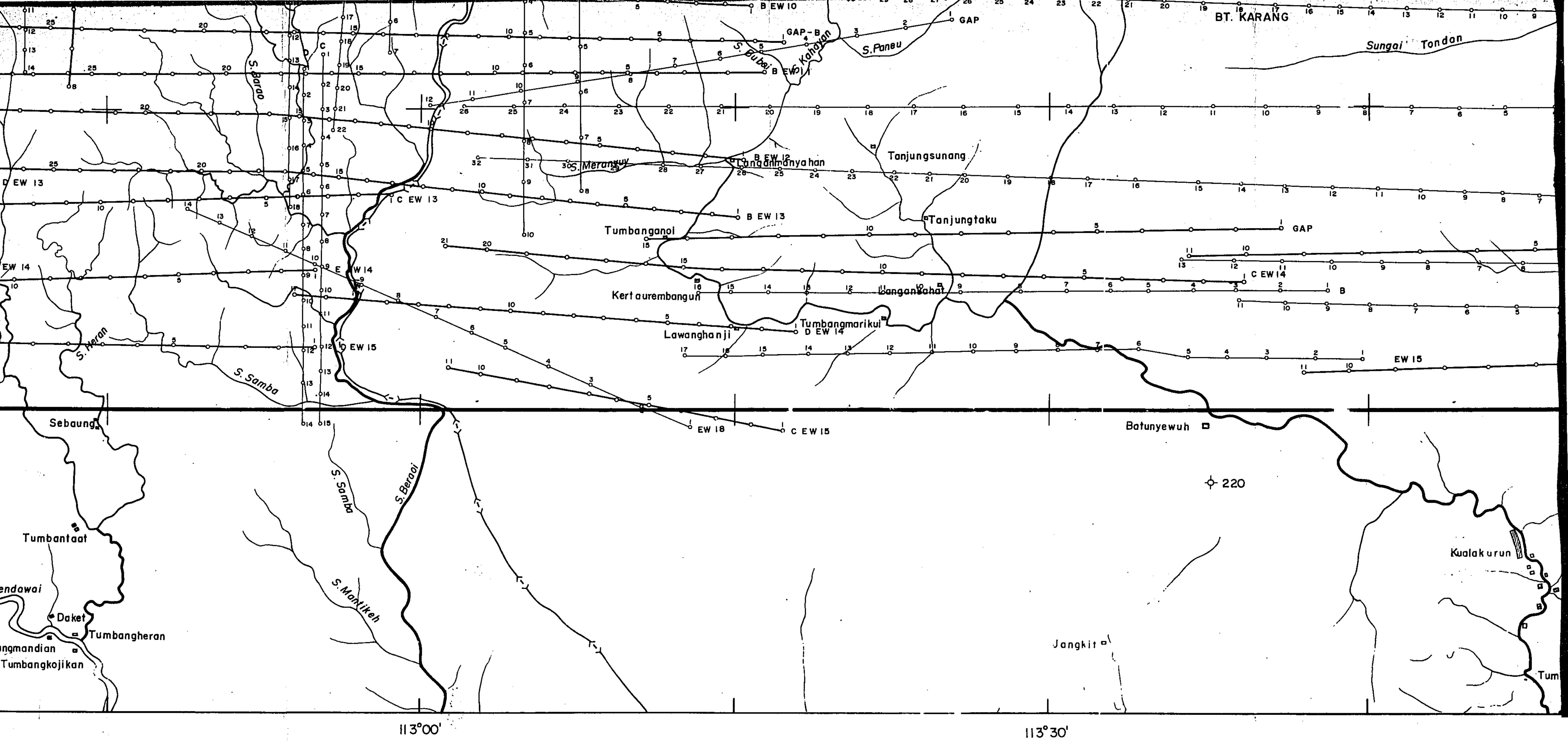
490±
SUP-A
Tandjungusu
Tokung
ngkatjang
Tandjungtahudjan
Sungai Maruwai
Tandjungmaruwei
Mapit
1350±
400±
Tandjungbuit
Tandjungbang
Seripoi
735±
Likunkota
Montalat
Tandjungnangu
Puruktjau
Muaralaung
Batutuhup
Djukingpadjang
Bahitum
Sungai Barito
Mekundjung
Tawe-baru
Muarauntu
S0° 30'
0 5 10 15 20 Km
SURVEY AREA
N 0°15'
0°00'
S 1°00'
S 1°15'
111°30' 111°45'
114°45' 115°00'
July · 1977
PRODUCTION IN 1976
PRODUCTION IN 1977
EFFECTIVE LINES
REFERENCE LINES

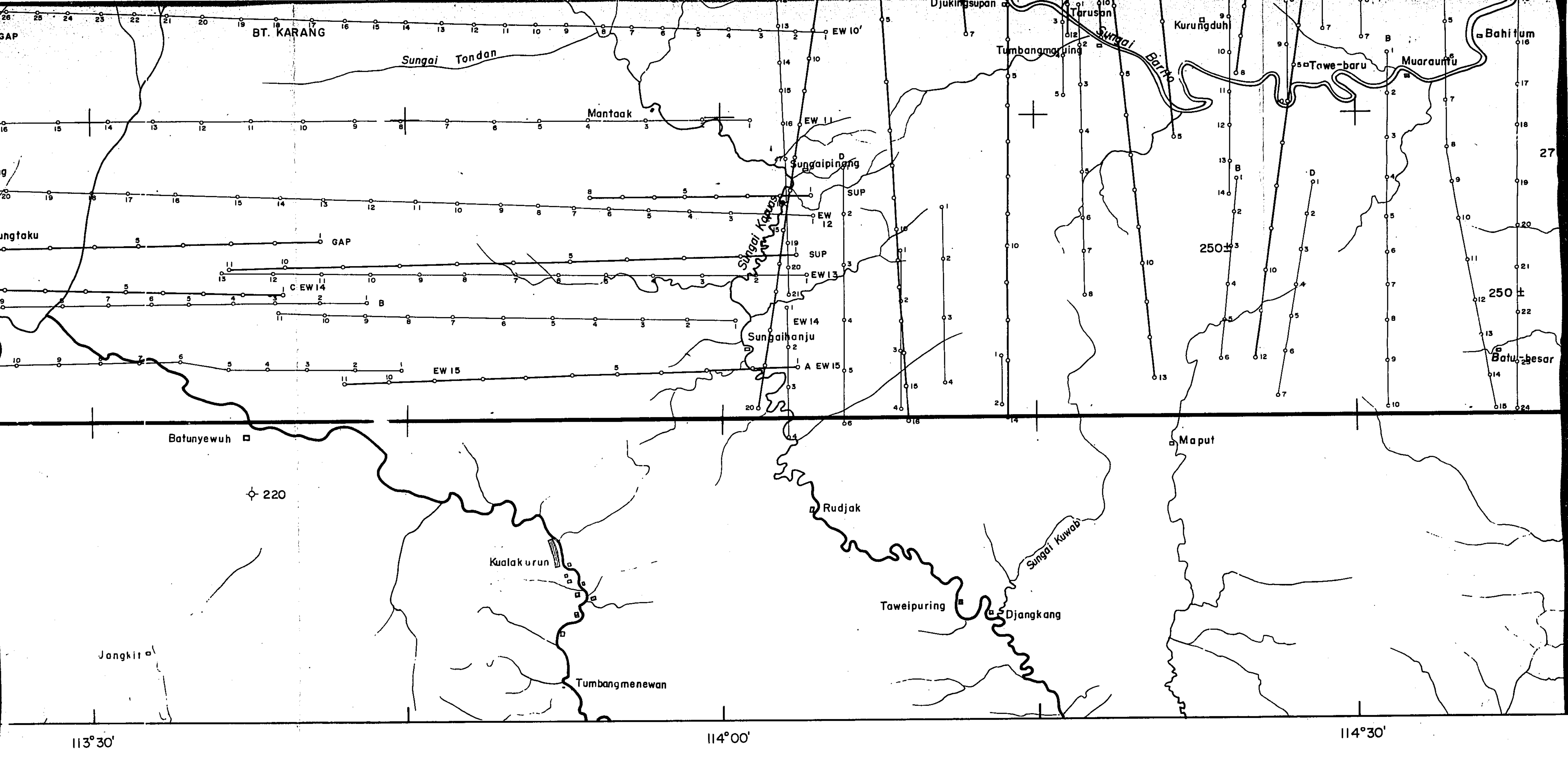


BT. RENGGAS
843
959
1113
1552
BT. ASING
C EW12
1703
1259
BT. MENGURAL
Eilalalang
D EW12
Kayubahung
BT. BEJUWAR
284
Lemanputai
BT. TUKUNG
1175
1099
BT. NYATUNG
639
Tingkar
740
BT. NYATUNG
598
S 1°00'
760
BT. LUMUT
S. Serayan
S. Kaleh
500
Lawai
Sekaja
Batuk
BT. IJUK
832
Dahuwei
Salam
Tumbangmahup
Tumbangsalau
Tumbanganak
Baluh
Rangkarnumundak
Kualamunjul
Rantaupanjang
S 1°15'
111°30'
111°45'
112°00'

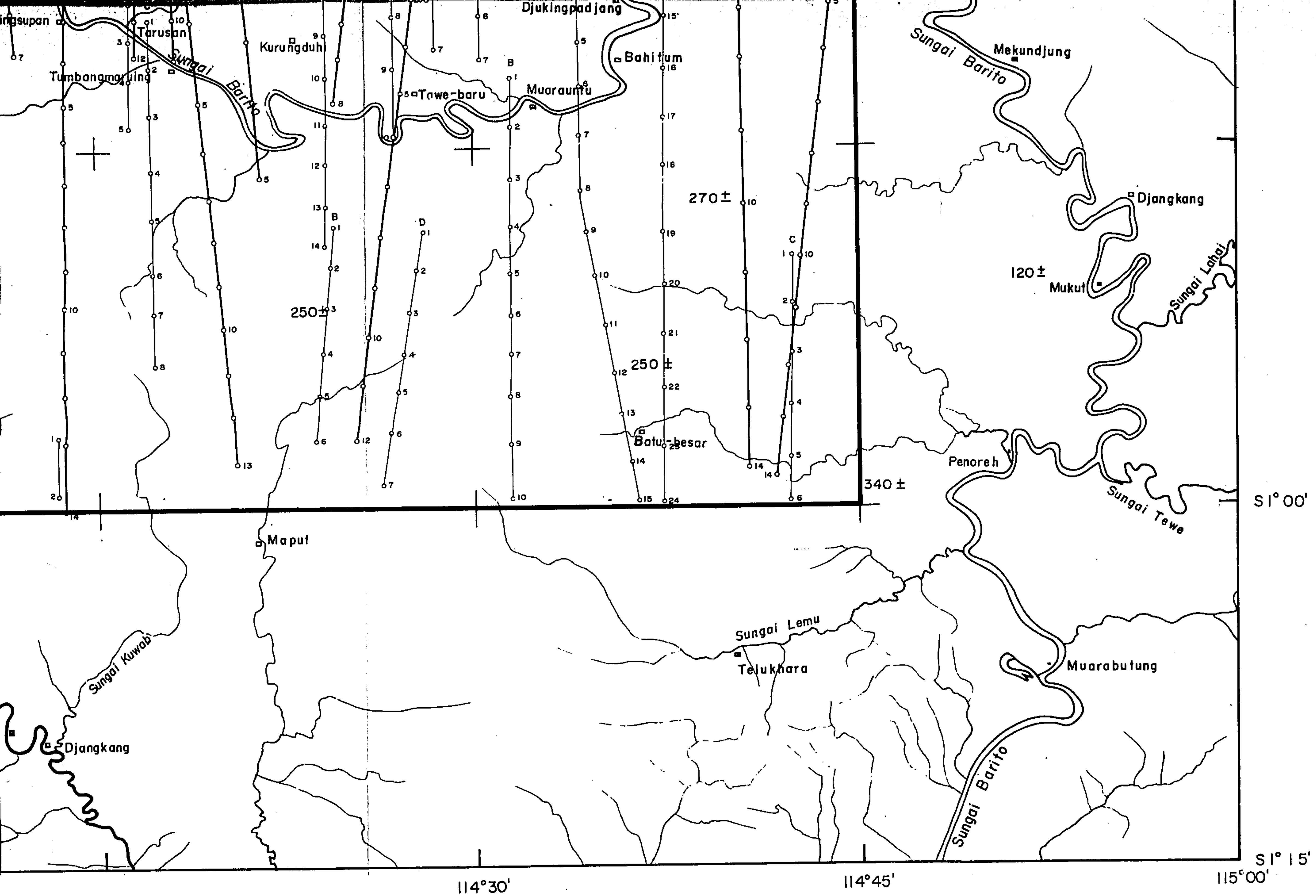


BT. ASING
1113
1552
1259
1703
1263
1099
SURAL
Ellalalang
C EW 11
C EW 12
D EW 12
D EW 13
E EW 13
C EW 13
F EW 14
E W 14
D EW 15
S. Barao
S. Heran
S. Samba
S. Serayan
S. Kaleh
S. Beraoi
S. Mantikeh
S. Mendawai
Sebaung
500
750
Sekajang
Lawai
Batukuli
Pandu
Pahulu
Tumbantaat
Dahuwei
Salam
Tumbangmahup
Muarasinamang
Ranganbejulut
Sepandan
Daket
Tumbangheran
Tumbangmandian
Tumbangkojikan
banganak
Rantaupanjang
112°00'
112°30'
113°00'

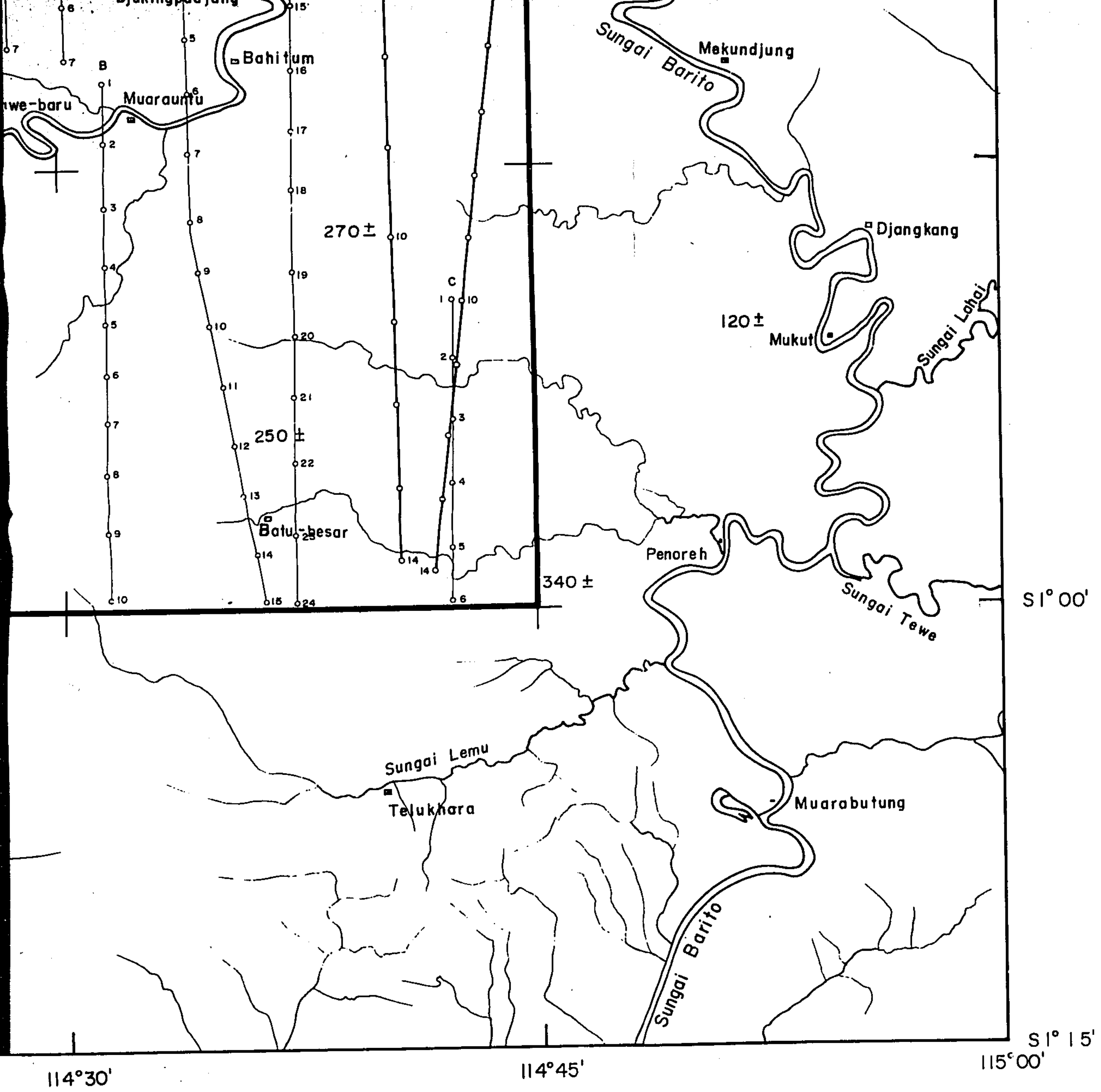

BT. KARANG
Sungai Tondan
S. Paneu
S. Kahayan
S. Bubai
S. Barao
S. Meranguy
GAP
GAP-B
B EW 10
B EW 11
B EW 12
B EW 13
C EW 13
D EW 13
EW 14
E W 14
C EW 14
D EW 14
D EW 15
EW 15
C EW 15
EW 18
Tanjungsunang
Tanjungtaku
Tumbanganoi
Kertaurembangun
Lawanghanji
Tumbangmarikui
S. Heran
S. Samba
S. Beraoi
S. Mantikeh
Sebaung
Tumbantaat
Daket
Tumbangheran
Tumbangkojikan
Batunyewuh
220
Kualakurun
Jangkit
113°00'
113°30'



BT. KARANG
GAP
EW 10'
Sungai Tondan
Mantaak
EW 11
Sungaipinang
SUP
EW 12
ungtaku
GAP
SUP
EW 13
C EW 14
B
EW 14
Sungaihanju
A EW 15
EW 15
Sungai Kapuas
Djukingsupan
Tarusan
Kurungduhi
Tumbangmaruing
Sungai Barito
Bahitum
Tawe-baru
Muaraumu
250 ±
250 ±
27
Batu-besar
Batunyewuh
220
Maput
Rudjak
Sungai Kuwab
Kualakurun
Taweipuring
Djangkang
Jangkit
Tumbangmenewan
113°30'
114°00'
114°30'



Djukingpadjang
Tarusan
Kurungduh
Tumbangmaruing
Sungai Barito
Bahitum
Tawe-baru
Muarauntu
Mekundjung
Djangkang
Sungai Lahai
Mukut
120 ±
270 ±
250 ±
250 ±
340 ±
Batu-besar
Penoreh
Sungai Tewe
Maput
Sungai Lemu
Telukhara
Muarabutung
Sungai Kuwab
Djangkang
Sungai Barito
S1° 00'
S1° 15'
114°30'
114°45'
115°00'


Bahitum
Muarauntu
Mekundjung
Sungai Barito
Djangkang
270 ±
250 ±
120 ±
Mukut
Sungai Lahai
Batu-besar
Penoreh
340 ±
Sungai Tewe
S 1° 00'
Sungai Lemu
Telukhara
Muarabutung
Sungai Barito
S 1° 15'
114°30'
114°45'
115°00'

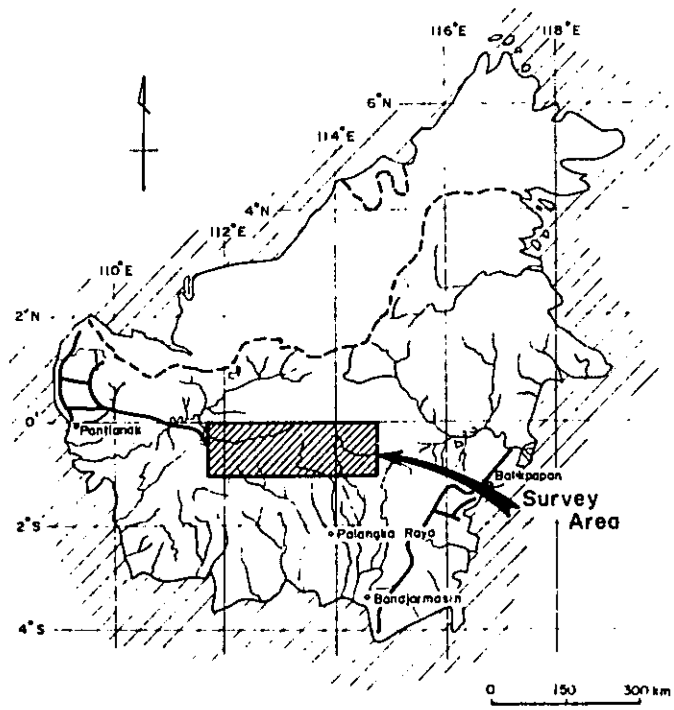
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY — GEOLOGICAL SURVEY OF INDONESIA

AIRBORNE MAGNETIC SURVEY OF CENTRAL KALIMANTAN, INDONESIA

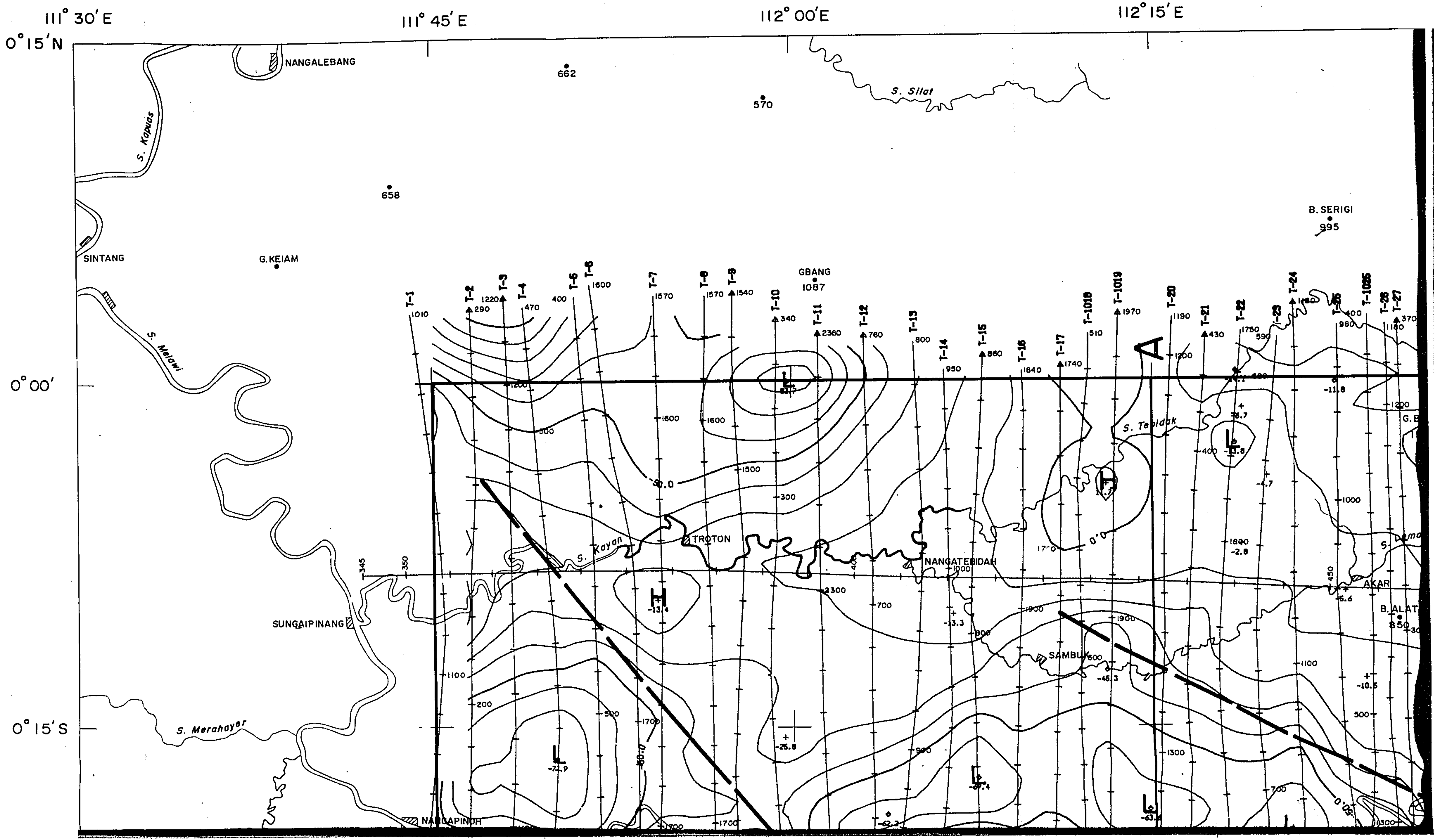
INTERPRETATION MAP AIRBORNE MAGNETIC SURVEY

Scale 1: 250,000

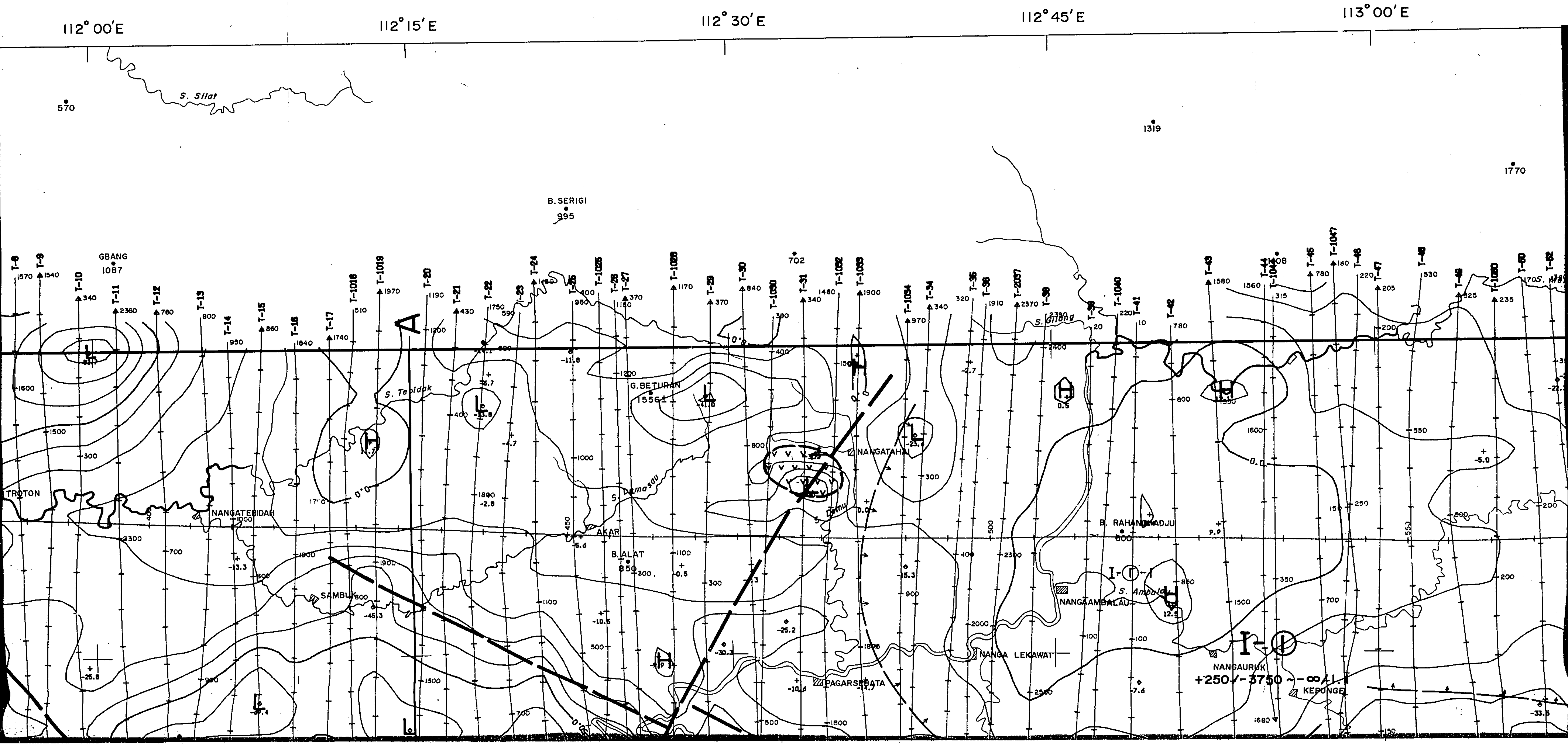
0 5 10 15 20km

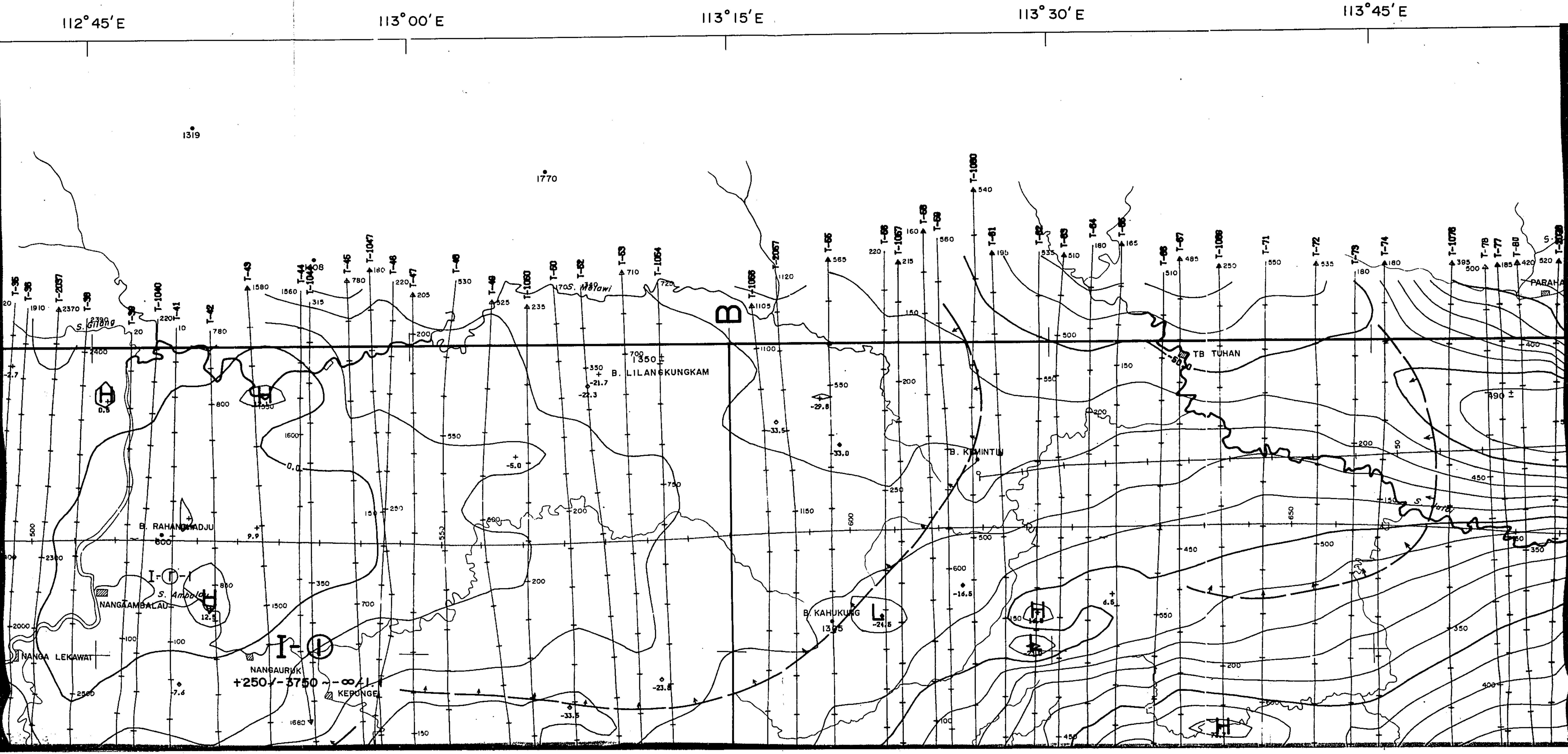


February · 1978

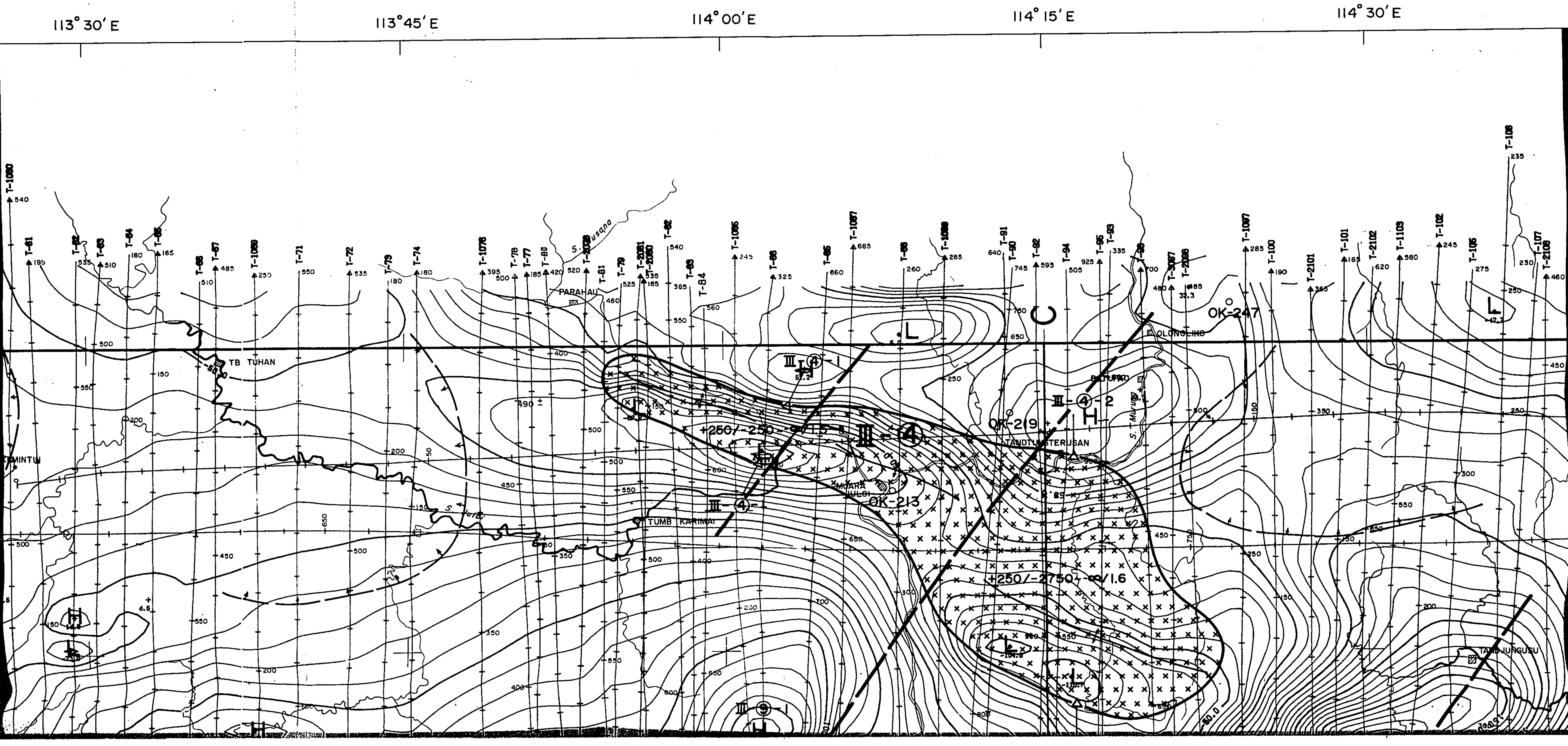


111° 30′ E
111° 45′ E
112° 00′E
112° 15′ E
0° 15′N
0° 00′
0° 15′S
NANGALEBANG
S. Kapuas
S. Silat
SINTANG
G. KEIAM
S. Melawi
GBANG
1087
B. SERIGI
995
S. Tebidak
S. Kayan
TROTON
NANGATEBIDAH
SUNGAIPINANG
SAMBUK
AKAR
B. ALAT
S. Merahayer
NANGAPINOH
A
T-1
T-2
T-3
T-4
T-5
T-6
T-7
T-8
T-9
T-10
T-11
T-12
T-13
T-14
T-15
T-16
T-17
T-1018
T-1019
T-20
T-21
T-22
T-24
T-1025
T-27

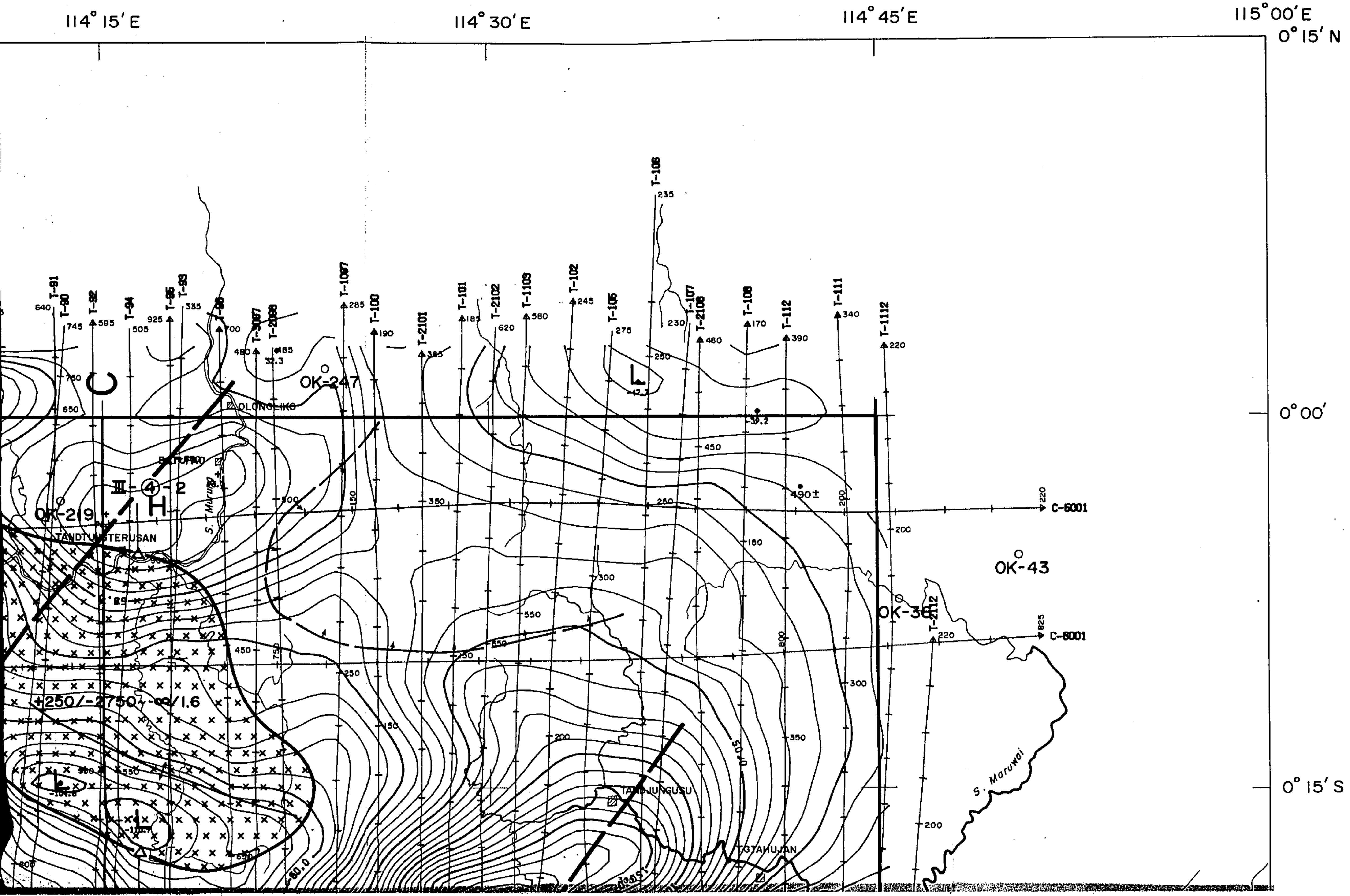

112° 00'E
112° 15'E
112° 30'E
112° 45'E
113° 00'E
S. Silat
B. SERIGI
995
GBANG
1087
G. BETURAN
S. Tebidak
S. Demasau
S. Gilang
TROTON
NANGATEBIDAH
AKAR
B. ALAT
850
SAMBUK
NANGATAHAI
NANGAAMBALAU
S. Ambalau
NANGA LEKAWAI
PAGARSEBATA
NANGAURUK
+250/-3750 ~ -∞/1.



112°45'E
113°00'E
113°15'E
113°30'E
113°45'E
S. Gilang
S. Melawi
B
B. LILANGKUNGKAM
TB TUHAN
NANGA AMBALAU
S. Ambalau
NANGA LEKAWAI
NANGAURUK
B. KAHUKUNG
I-I
+250/-3750



113° 30′ E
113°45′ E
114° 00′ E
114° 15′ E
114° 30′ E
TB TUHAN
PARAHAU
TUMB KARIMAI
OK-213
OK-219
OK-247
OLONGLIKO
+250/-250-∞/1.5
+250/-2750-∞/1.6



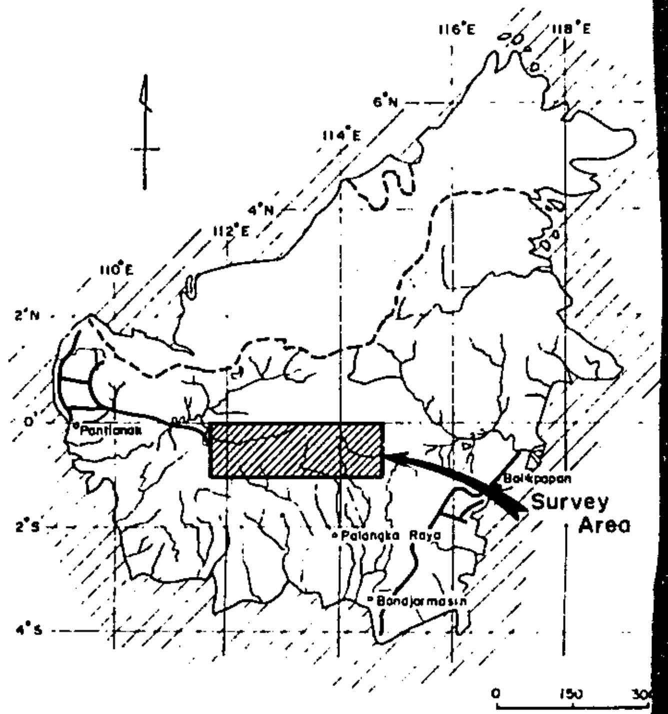
METAL MINING AGENCY OF JAPAN — GEOL
JAPAN INTERNATIONAL COOPERATION AGENCY — OF

AIRBORNE MAGNETIC SURV
OF
CENTRAL KALIMANTAN, INDONES

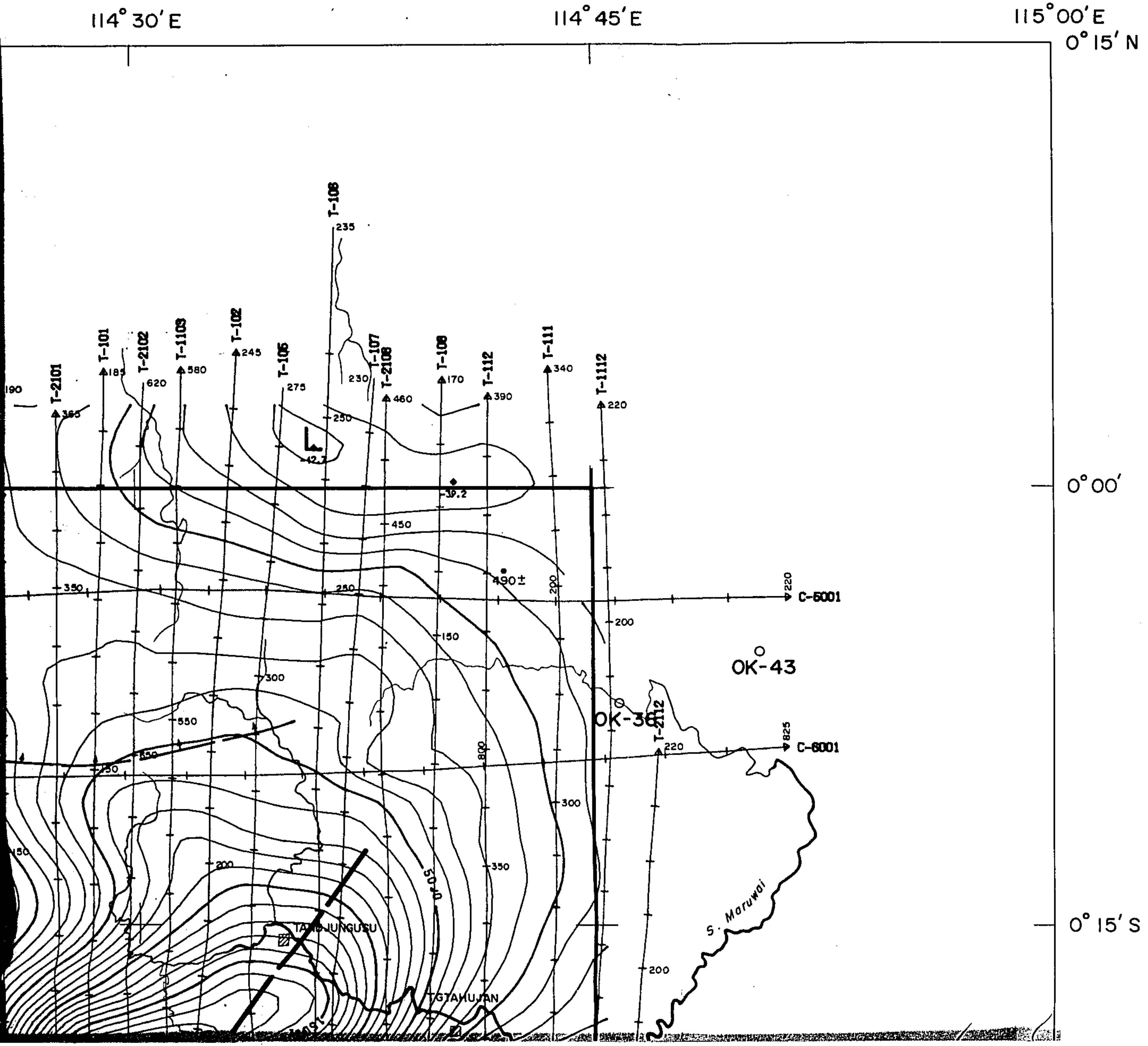
INTERPRETATION MAP
AIRBORNE MAGNETIC SURV

Scale 1: 250,000

0 5 10 15 20



February · 1978



PL. 3

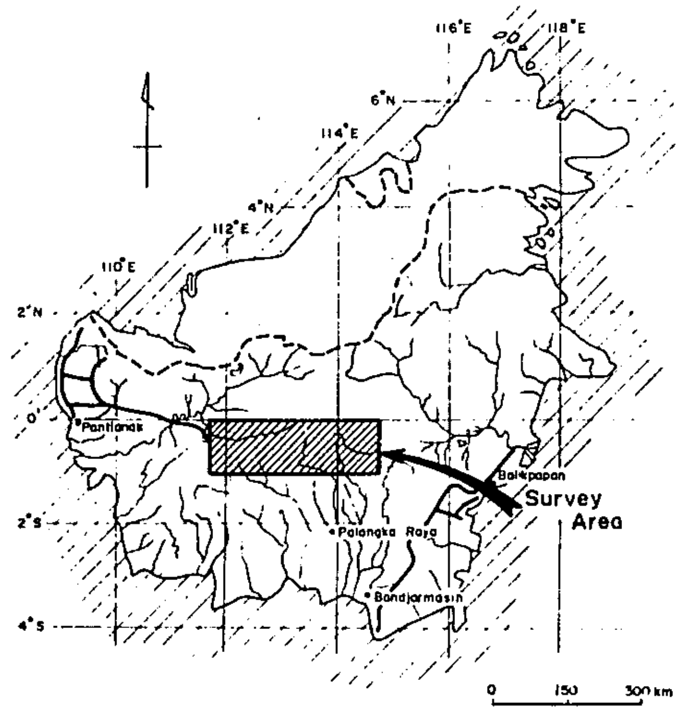
METAL MINING AGENCY OF JAPAN — GEOLOGICAL SURVEY
JAPAN INTERNATIONAL OF INDONESIA
COOPERATION AGENCY

AIRBORNE MAGNETIC SURVEY OF CENTRAL KALIMANTAN, INDONESIA

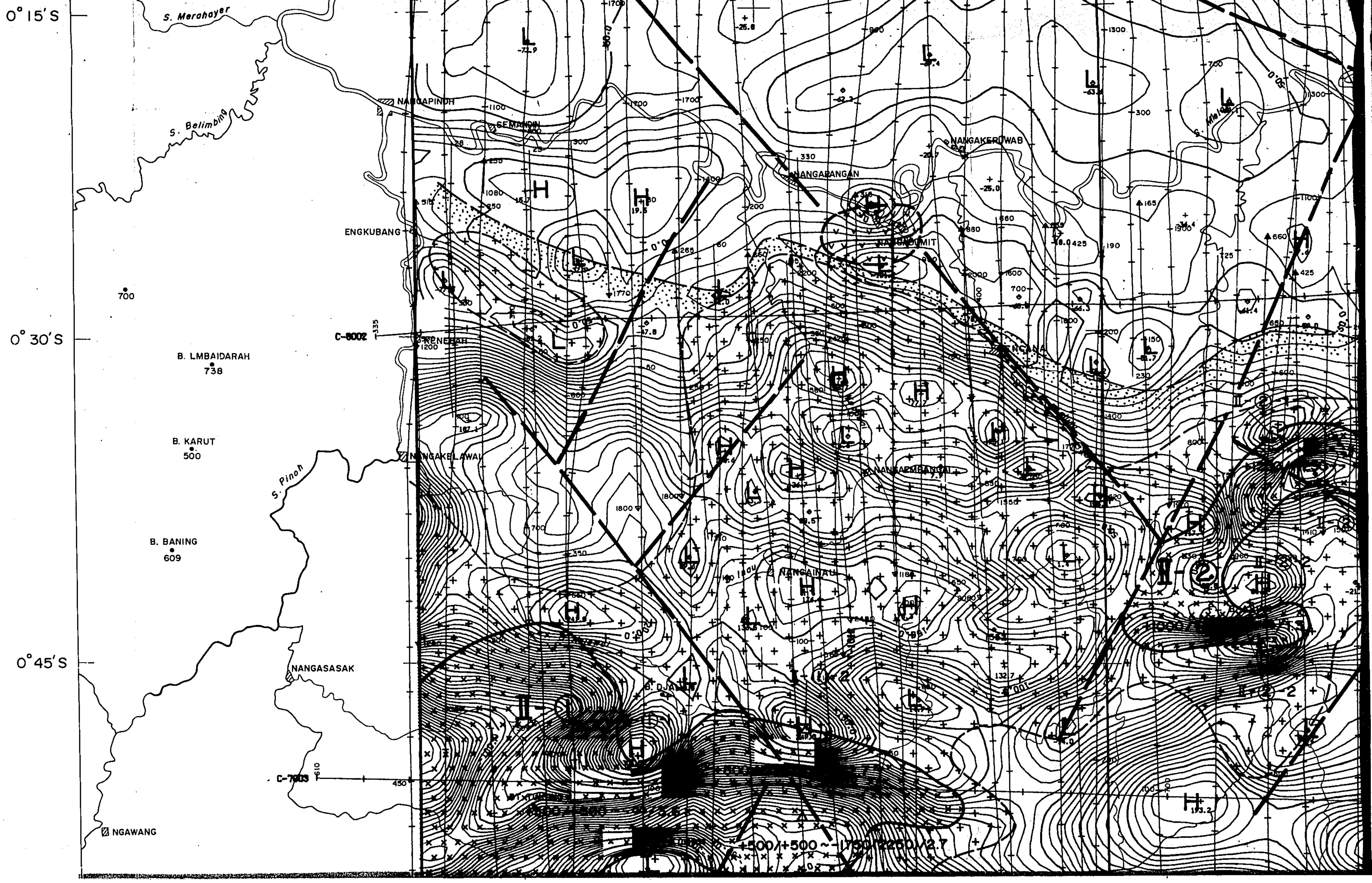
INTERPRETATION MAP AIRBORNE MAGNETIC SURVEY

Scale 1: 250,000

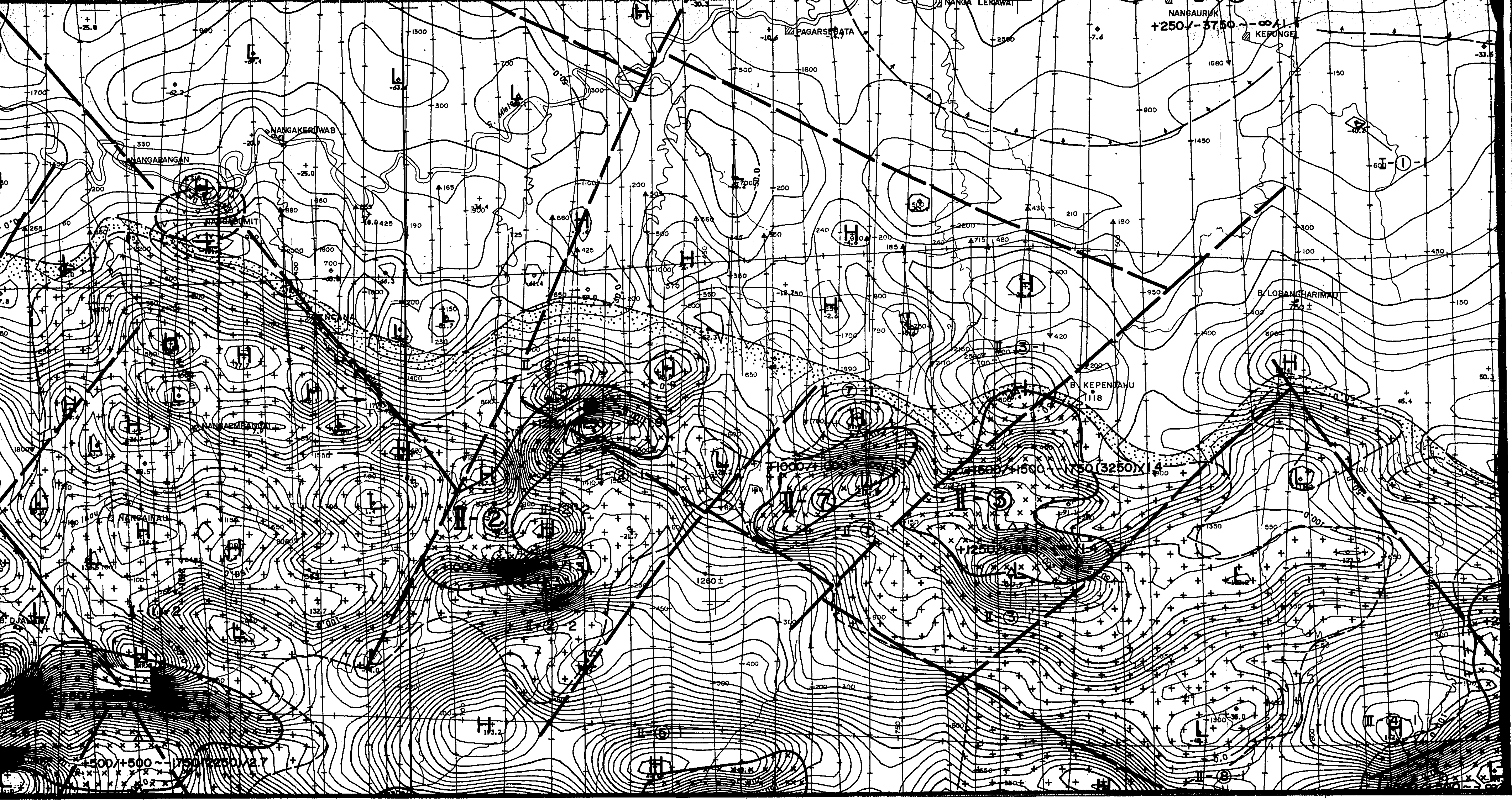
0 5 10 15 20km

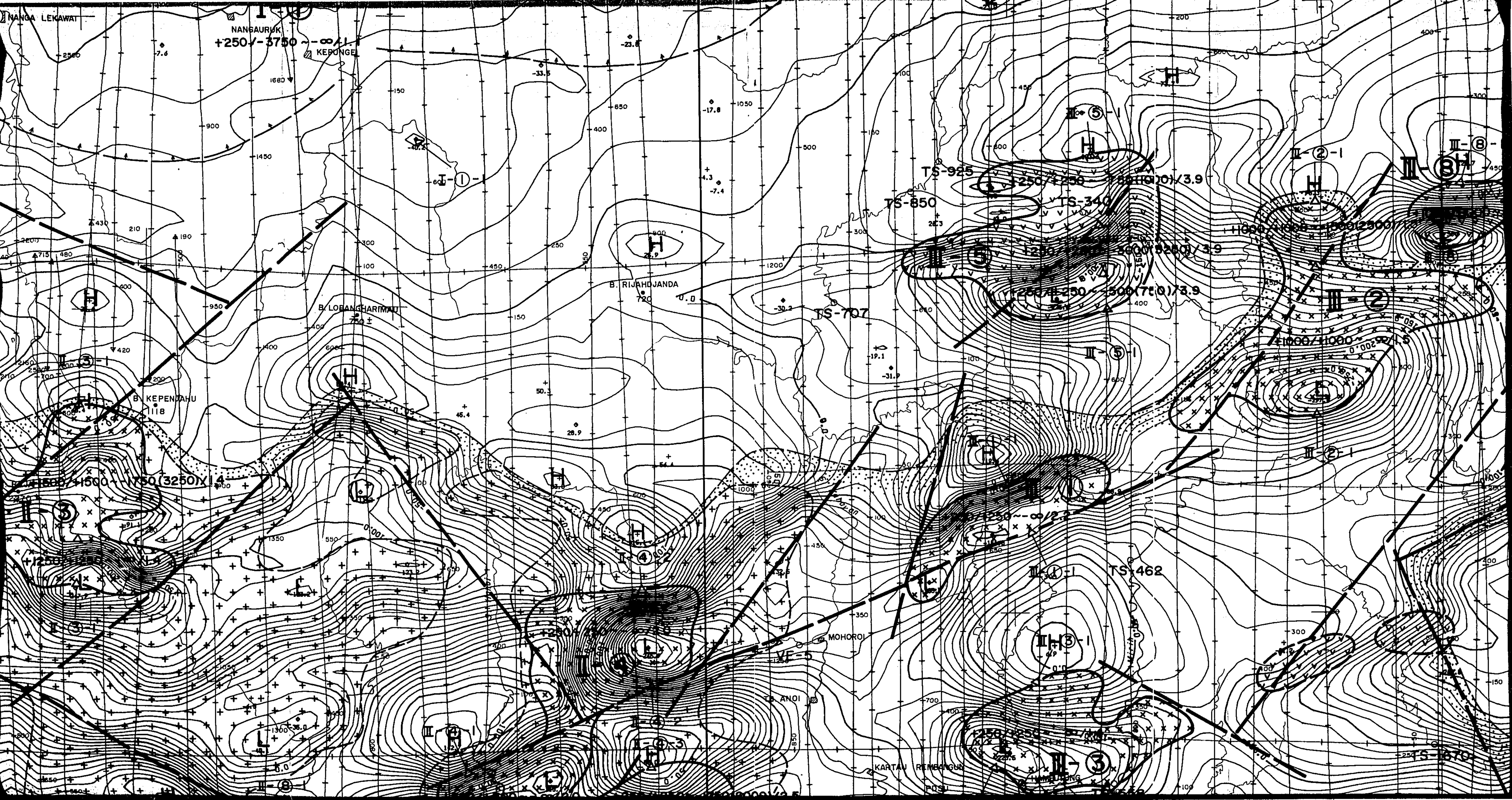


February · 1978

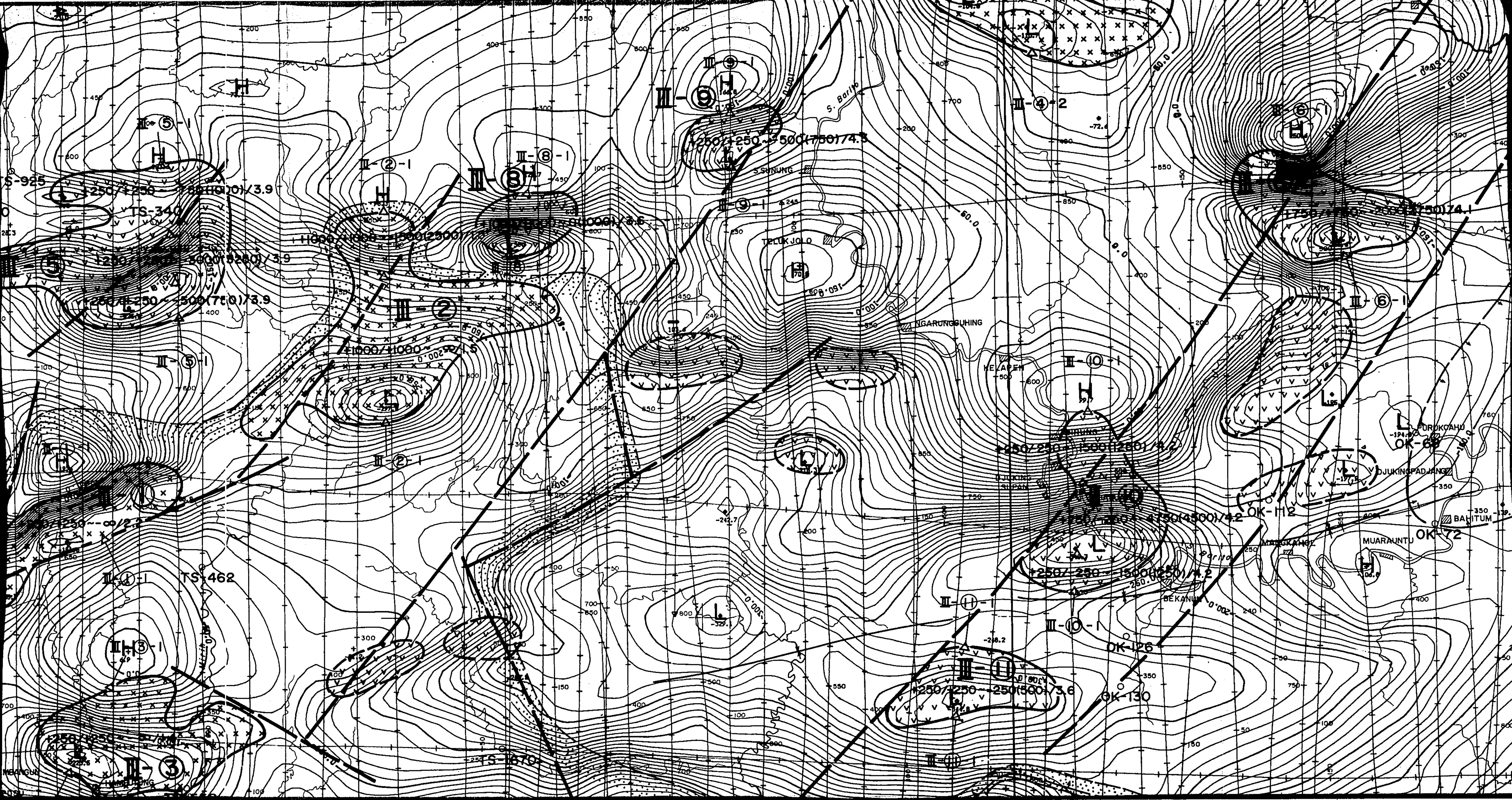


0°15'S
0°30'S
0°45'S
S. Merahayer
S. Belimbing
S. Pinoh
NANGAPINOH
SEMANDIN
ENGKUBANG
NANGARANGAN
NANGAKERUWAB
KENEBAH
C-8002
NANGAKELAWAI
NANGAEMBANAU
NANGAINAU
NANGASASAK
NGAWANG
C-7903
B. LMBAIDARAH
738
B. KARUT
500
B. BANING
609
700
+500/+500 ~ -1750/2250/2.7

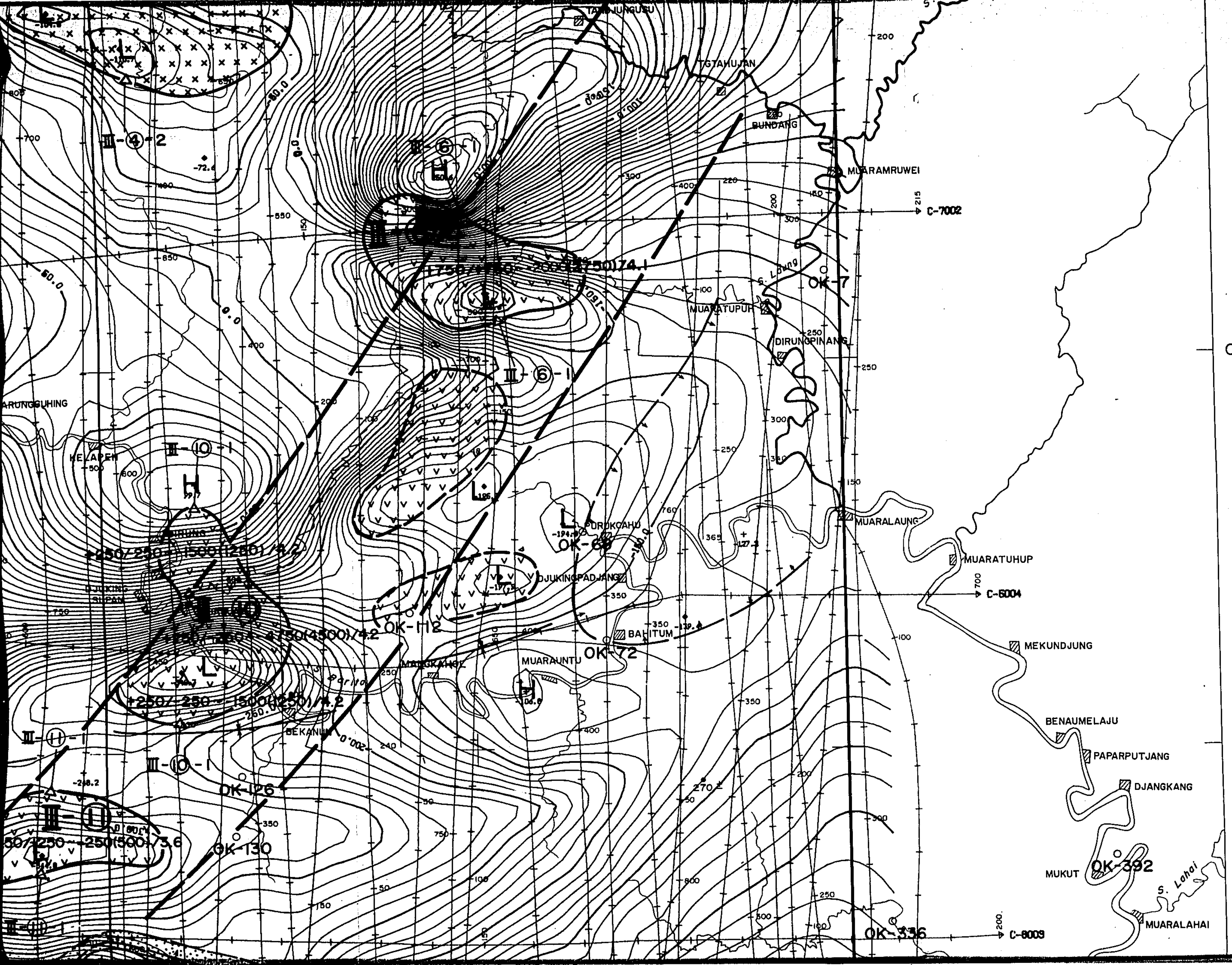

NANGA LEKAWAI
NANGAURUK
PAGARSEBATA
KEPUNGEI
NANGAKERUWAB
NANGARANGAN
NANGABUMIT
NANGAINAU
B. LOBANGHARIMAU
B. KEPENDAHU
+250/-3750~-∞/1.1
+500/+500~-1750/2250/2.7



NANGA LEKAWAI
NANGAURUK
KERUNGEI
B. RIJAHDJANDA
B. LOBANGHARIMAU
B. KEPENDAHU
TS-925
TS-850
TS-340
TS-707
TS-462
MOHOROI
VF-5
TB. ANOI
KARTAU REMBANGUN


TS-925
TS-340
TS-462
S-1670
III-⑤
III-⑧
III-⑨
III-②
III-①
III-③
III-⑩
III-⑪
III-④-2
III-⑥-1
III-⑩-1
III-⑪-1
+250/+250~+500(750)/4.3
+250/+250~+500(1000)/3.9
+250/+250~+500(750)/3.9
+1000/+1000~+1500
+250/-250~+1500(1250)/4.2
+250/+250~+250(500)/3.6
S. Barito
SUNUNG
TELUKJOLO
NGARUNGGUHING
HELAPEN
PURUKCAHU
DJUKINGPADJANG
BAHITUM
MUARAUNTU
BEKANUN
OK-65
OK-112
OK-72
OK-126
OK-130

February 1978



CONTOUR INTERVAL ~ 50 g

~ 10 g

FLIGHT ALTITUDE 2,000m

TRAVERSE LINE SPACING 3,000 m

TIE LINE SPACING 40,000 m

LEGEND

o OK-7 Location and number of roc

III - ⑤ Number of magnetic anon

III-⑤-1 ▽ ◁ III-⑤-1 Location and number of m

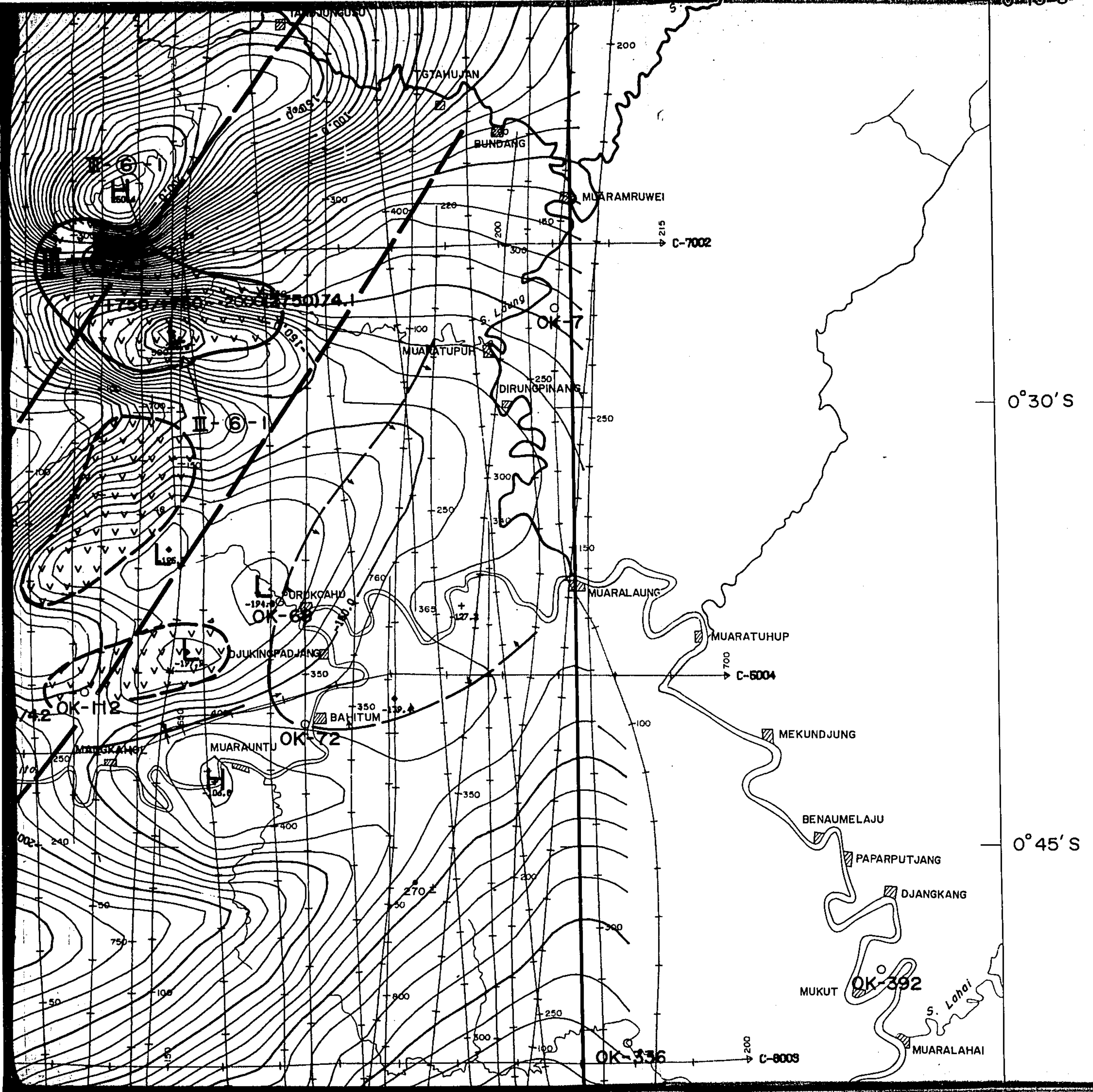
+250/+250~-1500(1750)/1.3 Results of qualitative analys
Elevation of topography i
Depth to top of magneti
Depth to bottom of mag
(Thickness)/Apparent su
in 10^{-3} cgsemu/cc

Boundary of magnetic r

Dioritic rock

Granitic rock

February · 1978



CONTOUR INTERVAL — 50 gammas

— 10 gammas

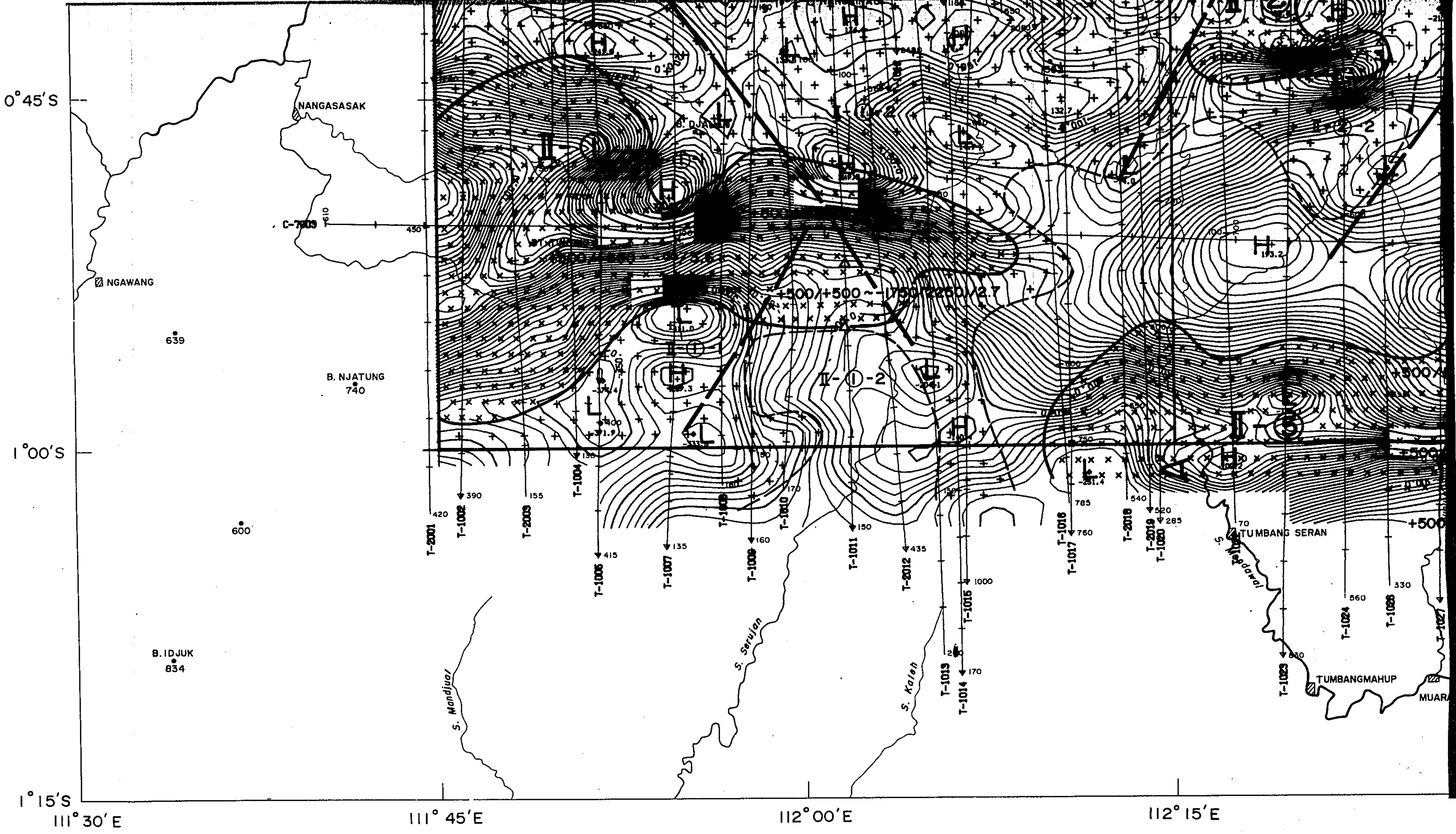
FLIGHT ALTITUDE 2,000^{m} A.S.L.

TRAVERSE LINE SPACING 3,000 meters

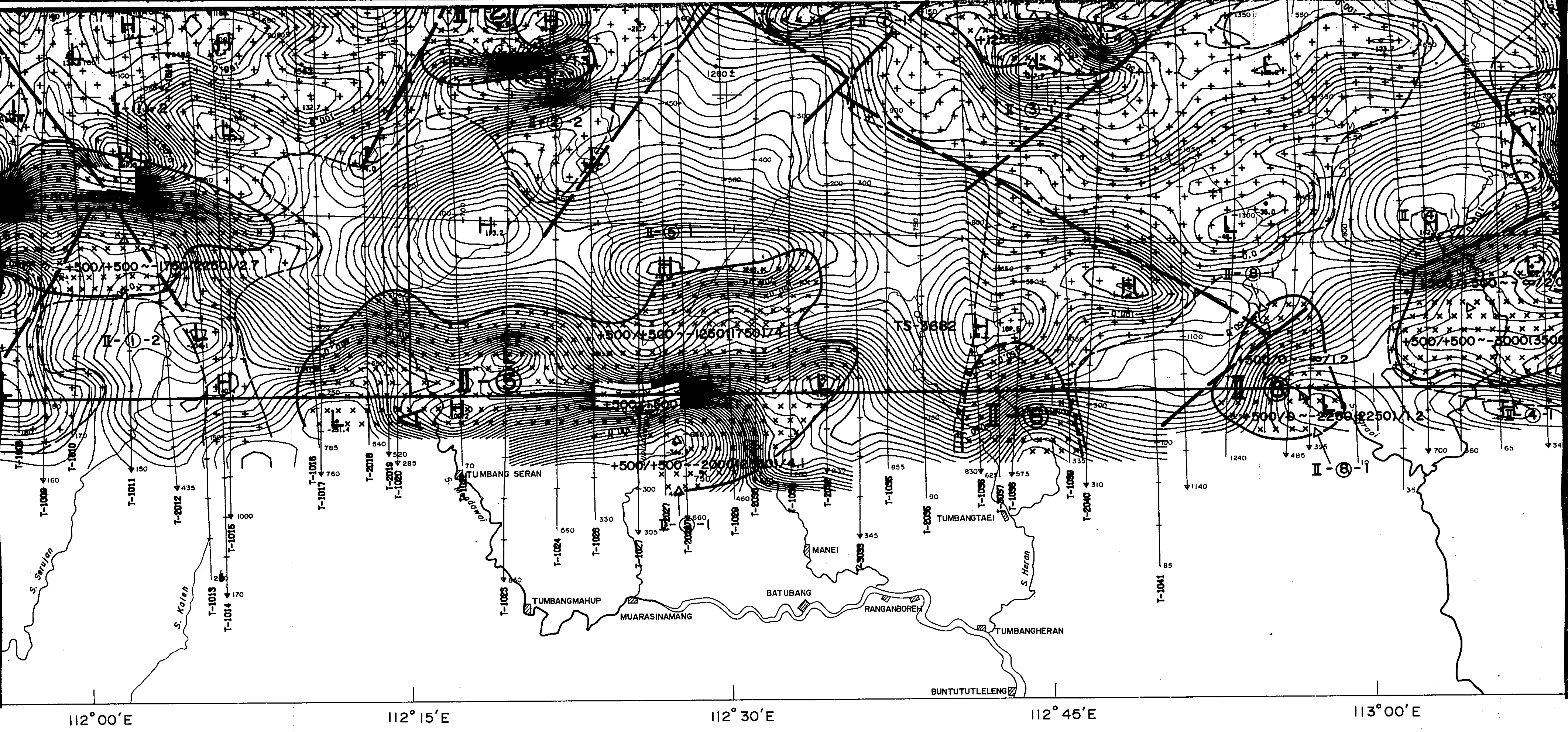
TIE LINE SPACING 40,000 meters

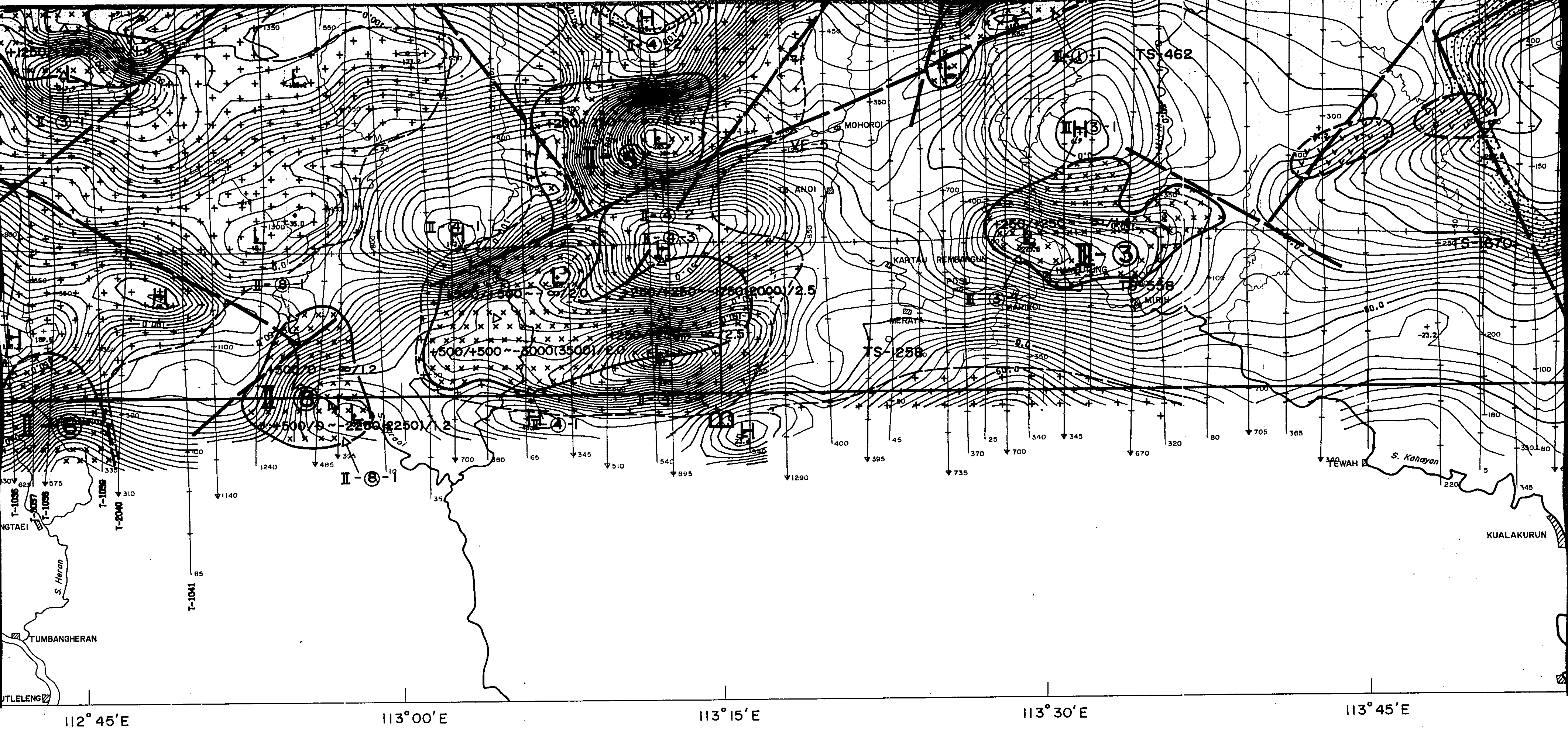
LEGEND

o OK-7	Location and number of rock sample
III - ⑤	Number of magnetic anomaly
III-⑤-1 ▷ ◁ III-⑤-1	Location and number of magnetic profile
+250/+250~-1500(1750)/1.3	Results of qualitative analysis Elevation of topography in m ASL/ Depth to top of magnetic rock ~ Depth to bottom of magnetic rock (Thickness)/ Apparent susceptibility in 10^{-3} cgsemu/cc
	Boundary of magnetic rock
	Dioritic rock
	Granitic rock

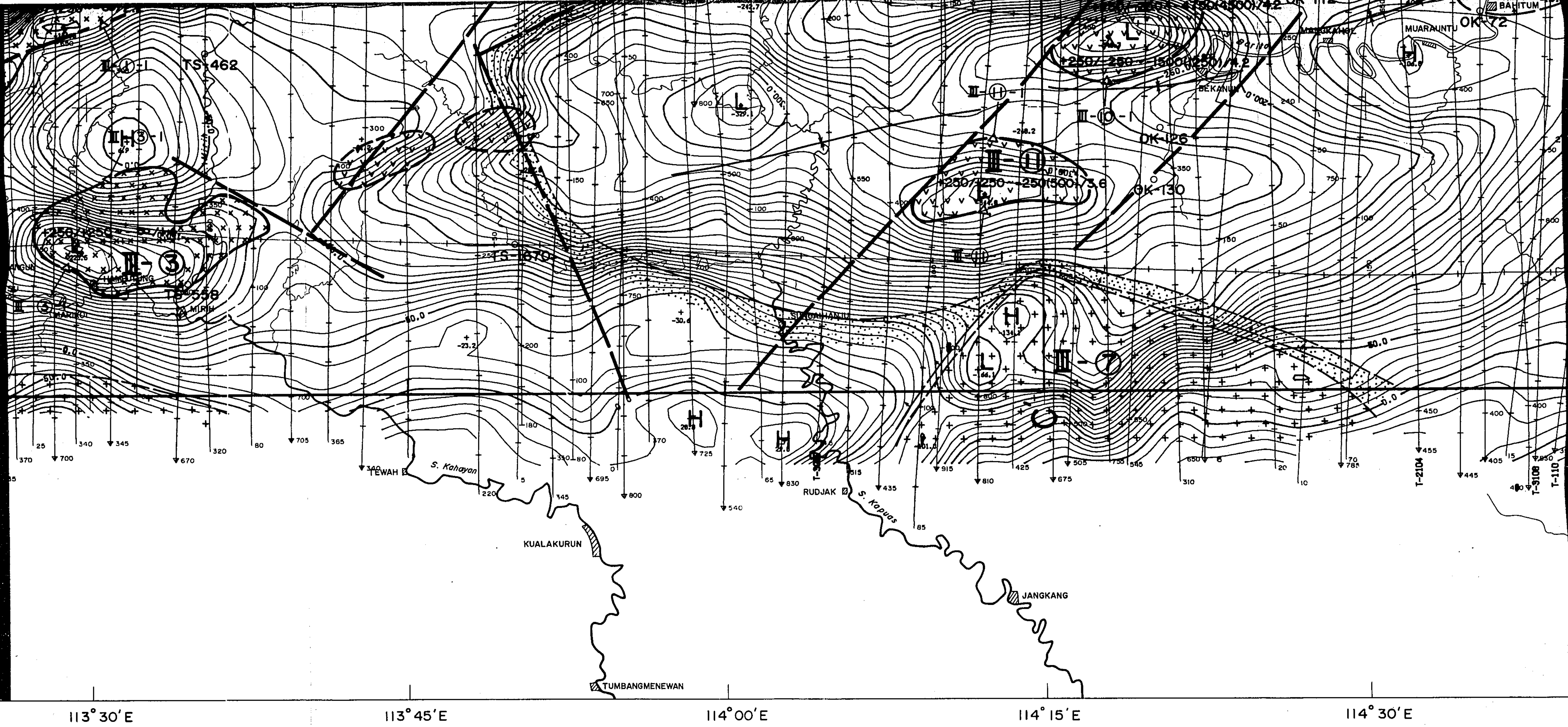


0°45'S
1°00'S
1°15'S
111°30'E
111°45'E
112°00'E
112°15'E
NANGASASAK
NGAWANG
C-7303
639
B. NJATUNG
740
600
B. IDJUK
834
S. Mandjual
S. Serujan
S. Kaleh
TUMBANG SERAN
TUMBANGMAHUP
+500/+500~-1750/2250/2.7
II-①-2
T-2001
T-1002
T-2003
T-1004
T-1005
T-1007
T-1008
T-1010
T-1011
T-2012
T-1013
T-1014
T-1015
T-1017
T-1023
T-1024

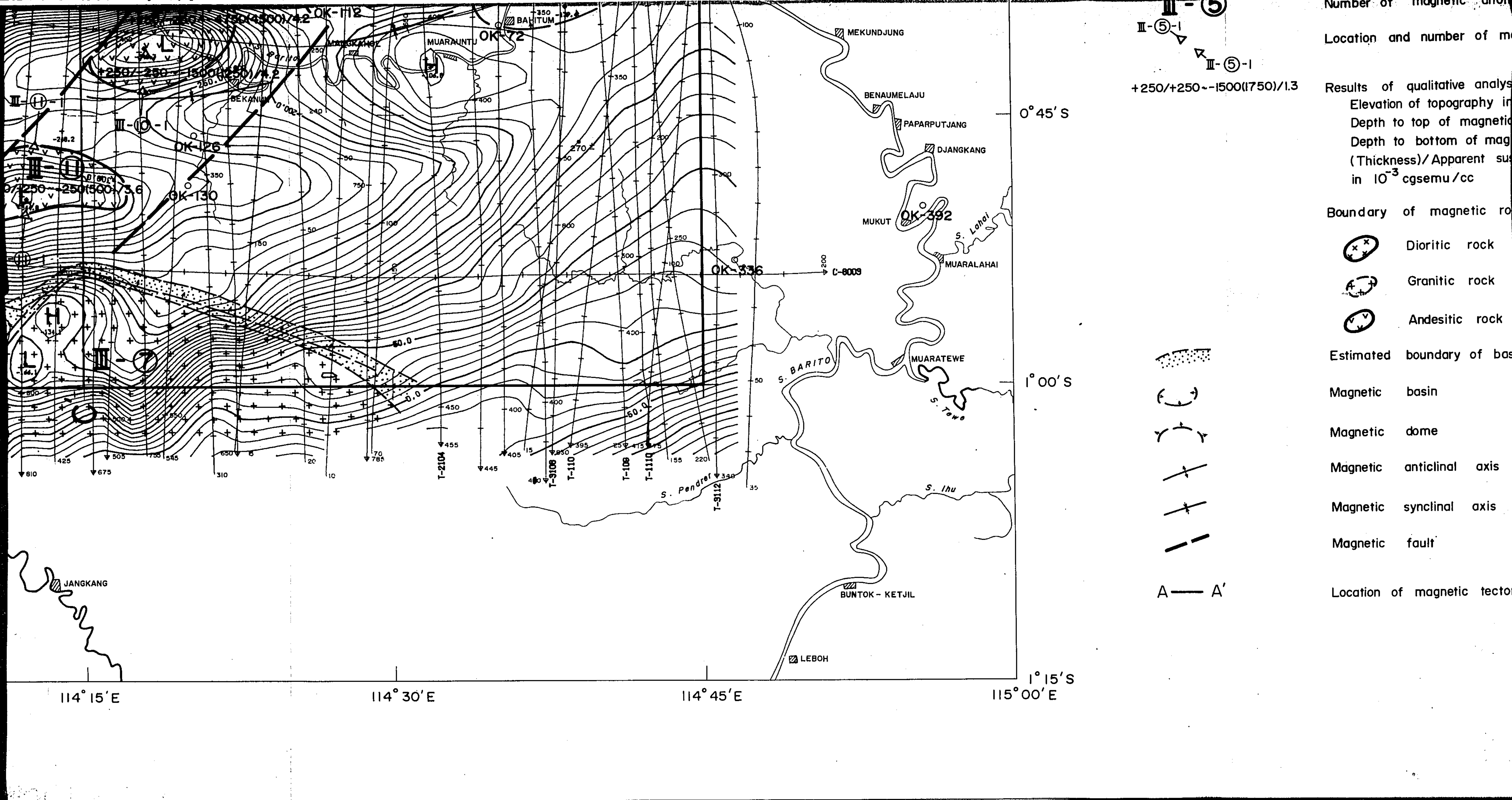

TUMBANG SERAN
TUMBANGMAHUP
MUARASINAMANG
BATUBANG
MANEI
RANGANBOREH
TUMBANGTAEI
TUMBANGHERAN
BUNTUTUTLELENG
S. Serujan
S. Kaleh
S. Heran
TS-3682
+500/+500~-1250(1750)/4
+500/+500~-2000(2500)/4.1
+500/+500~-1750/2250/2.7
112°00'E
112°15'E
112°30'E
112°45'E
113°00'E



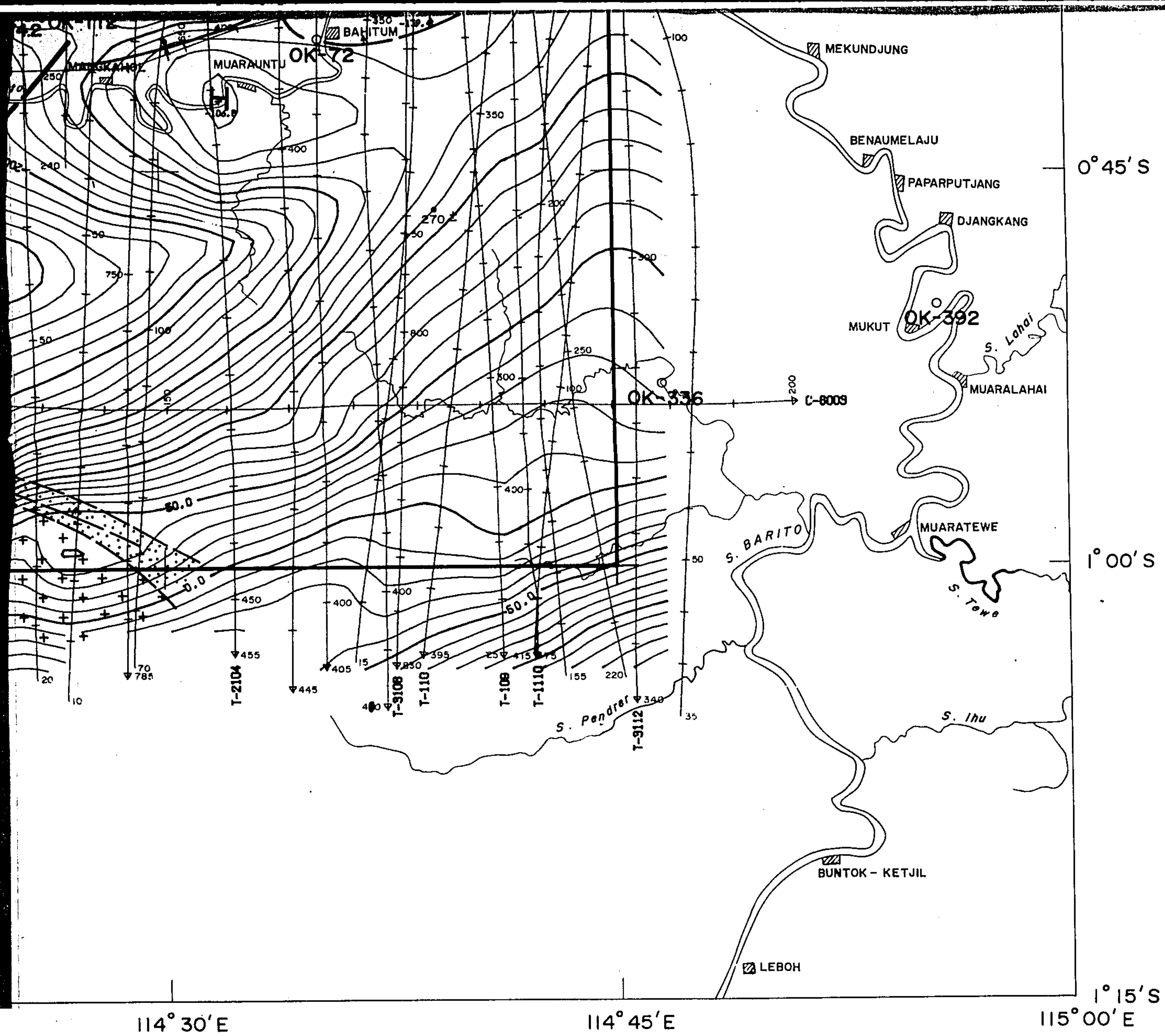
TS-462
MOHOROI
XF-5
TB ANOI
KARTAU
REMBANGUN
POSU
MERAYA
HAMPUTUNG
MIRIH
TS-558
TS-1258
TS-1670
TEWAH
S. Kahayan
KUALAKURUN
S. Heran
TUMBANGHERAN
T-1041
T-2040
112°45′E
113°00′E
113°15′E
113°30′E
113°45′E



TS-462
TS-1670
TS-558
OK-72
OK-126
OK-130
MUARAUNTU
BAHITUM
BEKANUN
MIRIH
TEWAH
S. Kahayan
KUALAKURUN
TUMBANGMENEWAN
RUDJAK
S. Kapuas
JANGKANG
T-2104
T-3108
113°30'E
113°45'E
114°00'E
114°15'E
114°30'E



Number of magnetic anom
Location and number of m
III-⑤-1
III-⑤-1
+250/+250--1500(1750)/1.3
Results of qualitative analys
Elevation of topography i
Depth to top of magneti
Depth to bottom of mag
(Thickness)/Apparent su
in 10^{-3} cgsemu/cc
Boundary of magnetic ro
Dioritic rock
Granitic rock
Andesitic rock
Estimated boundary of ba
Magnetic basin
Magnetic dome
Magnetic anticlinal axis
Magnetic synclinal axis
Magnetic fault
A —— A'
Location of magnetic tecto
OK-112
OK-72
OK-126
OK-130
OK-336
OK-392
C-8009
III-11
III-7
III-11-1
III-10-1
+250/+250--1500(2250)/4.2
BAHITUM
MUARAUNTU
BEKANUN
MEKUNDJUNG
BENAUMELAJU
PAPARPUTJANG
DJANGKANG
MUKUT
MUARALAHAI
MUARATEWE
BUNTOK - KETJIL
LEBOH
JANGKANG
S. BARITO
S. Lahai
S. Tewe
S. Ihu
S. Pendrer
T-2104
T-3108
T-110
T-108
T-1110
T-3112
0°45'S
1°00'S
1°15'S
114°15'E
114°30'E
114°45'E
115°00'E



II-⑤-1 Location and number of magnetic profile

+250/+250~-1500(1750)/1.3 Results of qualitative analysis
Elevation of topography in m ASL / Depth to top of magnetic rock ~ Depth to bottom of magnetic rock (Thickness) / Apparent susceptibility in 10^{-3} cgsemu/cc

Boundary of magnetic rock

Dioritic rock

Granitic rock

Andesitic rock

Estimated boundary of basement

Magnetic basin

Magnetic dome

Magnetic anticlinal axis

Magnetic synclinal axis

Magnetic fault

A —— A′ Location of magnetic tectonic profile

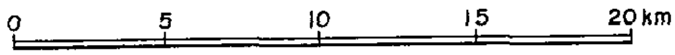
PL. 4

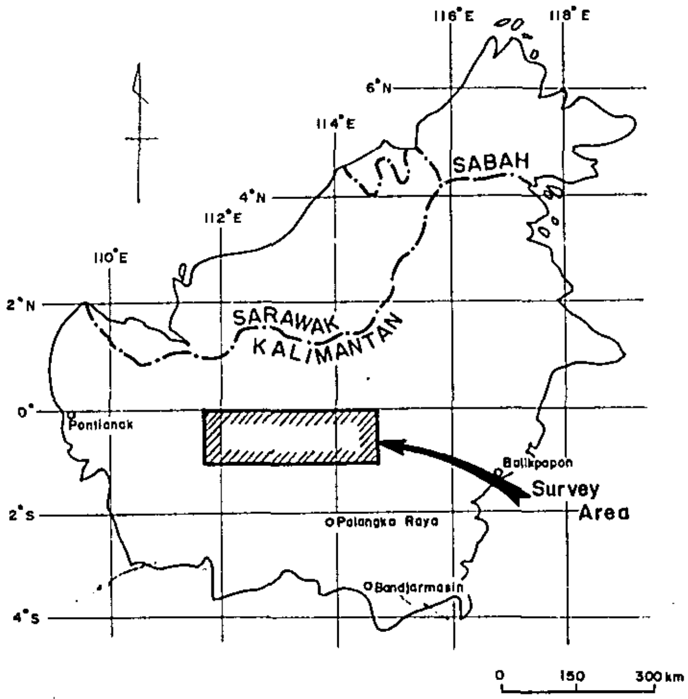
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY — GEOLOGICAL SURVEY OF INDONESIA

PHOTO - GEOLOGICAL SURVEY
OF
CENTRAL KALIMANTAN INDONESIA

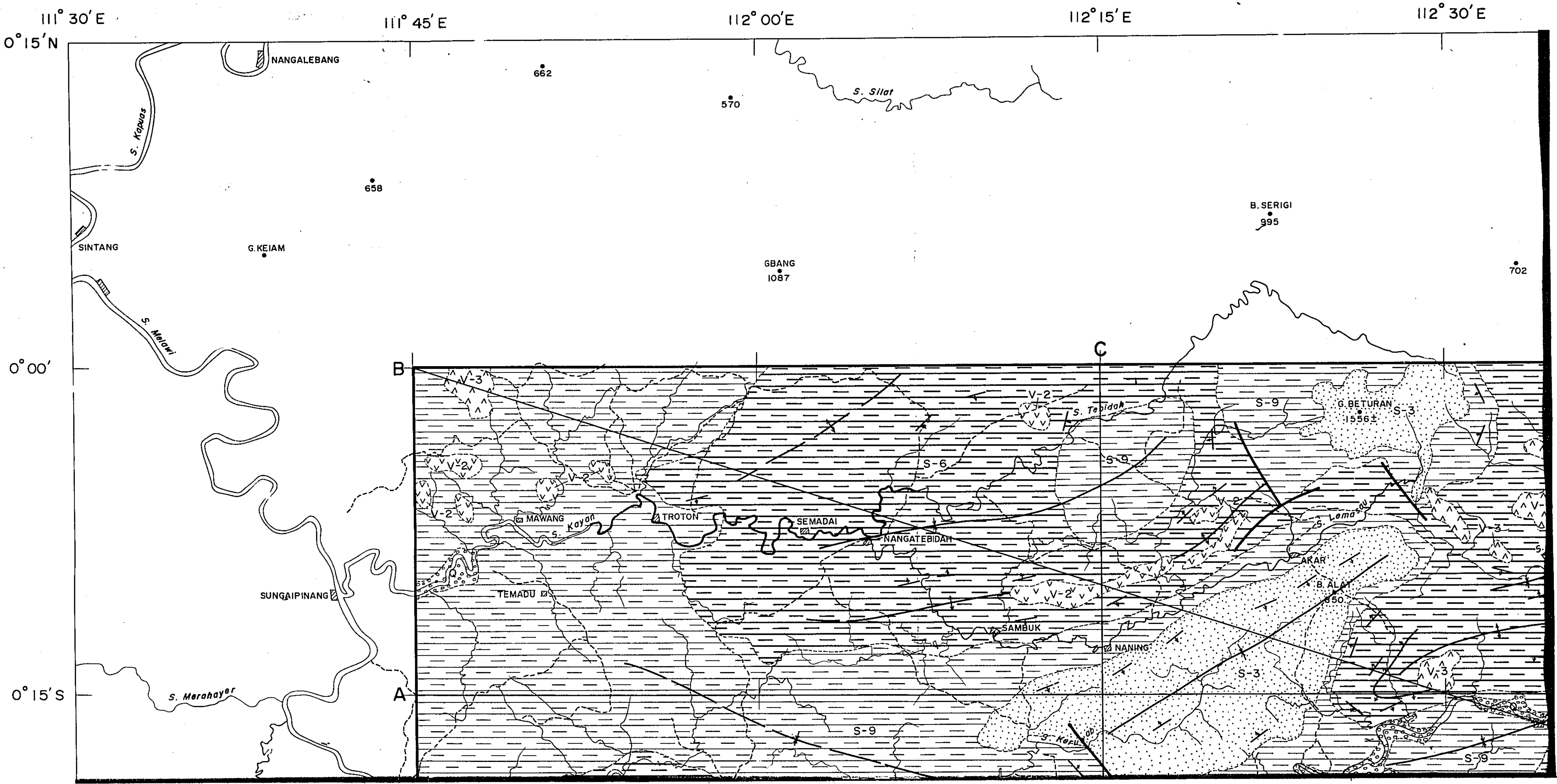
PHOTO - GEOLOGICAL MAP

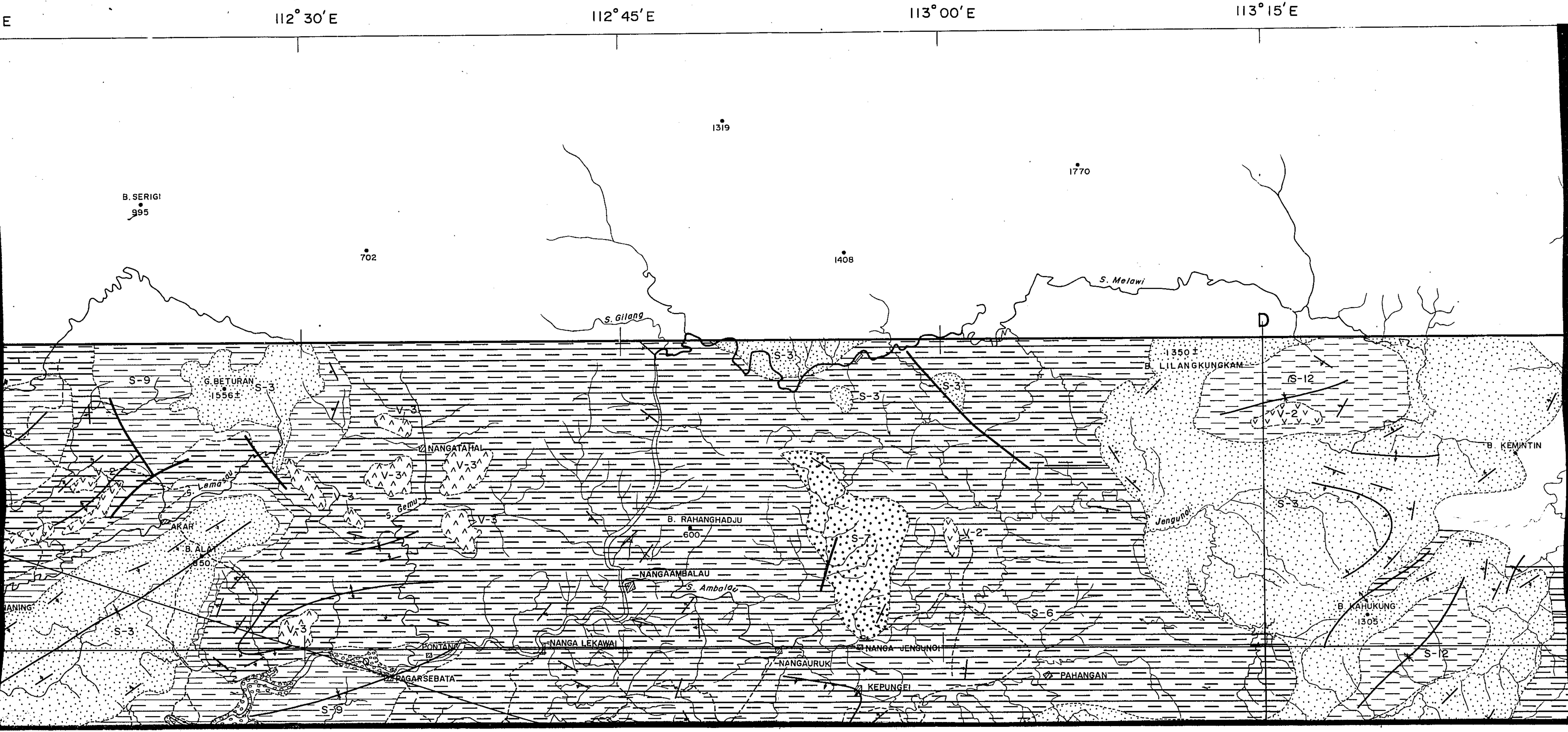
Scale 1: 250,000



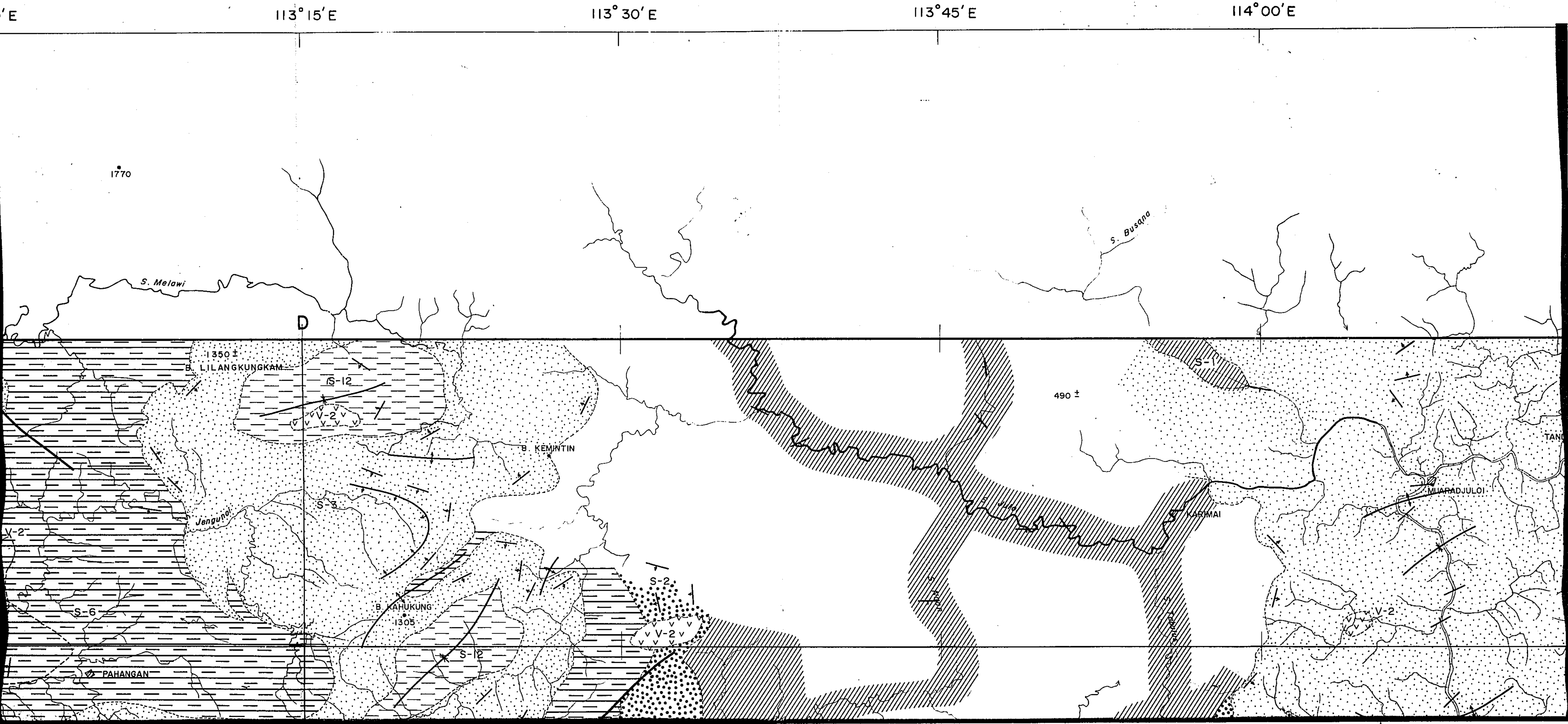


January · 1978

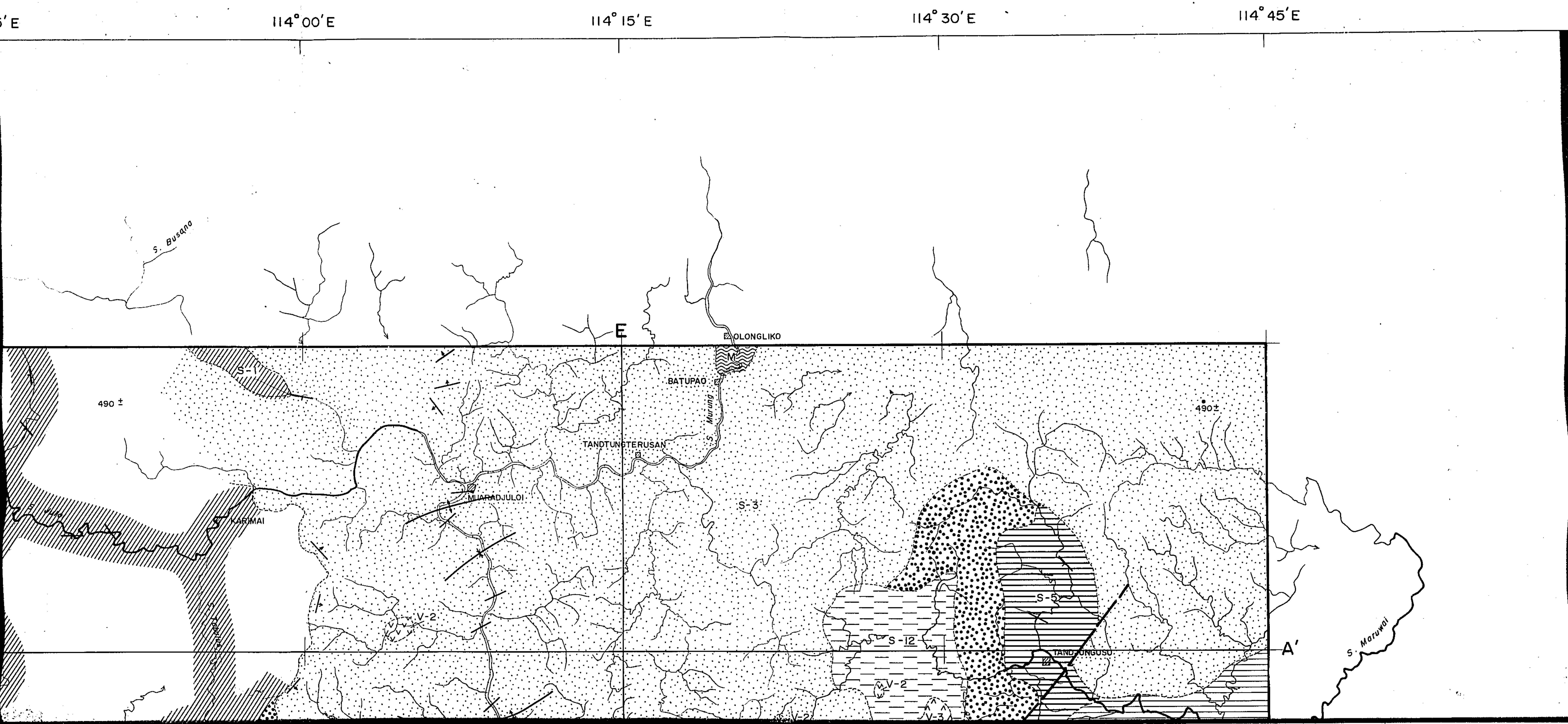

111° 30′ E
111° 45′ E
112° 00′ E
112° 15′ E
112° 30′ E
0° 15′ N
0° 00′
0° 15′ S
NANGALEBANG
662
570
S. Silat
S. Kapuas
658
B. SERIGI
995
SINTANG
G. KEIAM
GBANG
1087
702
S. Melawi
C
B
A
V-3
V-2
S. Tebidah
S-9
G. BETURAN
1556±
S-3
S-6
MAWANG
S. Kayan
TROTON
SEMADAI
NANGATEBIDAH
S. Lemasau
AKAR
B. ALAT
950
SUNGAIPINANG
TEMADU
SAMBUK
NANING
S. Merahayer
S. Kerujab



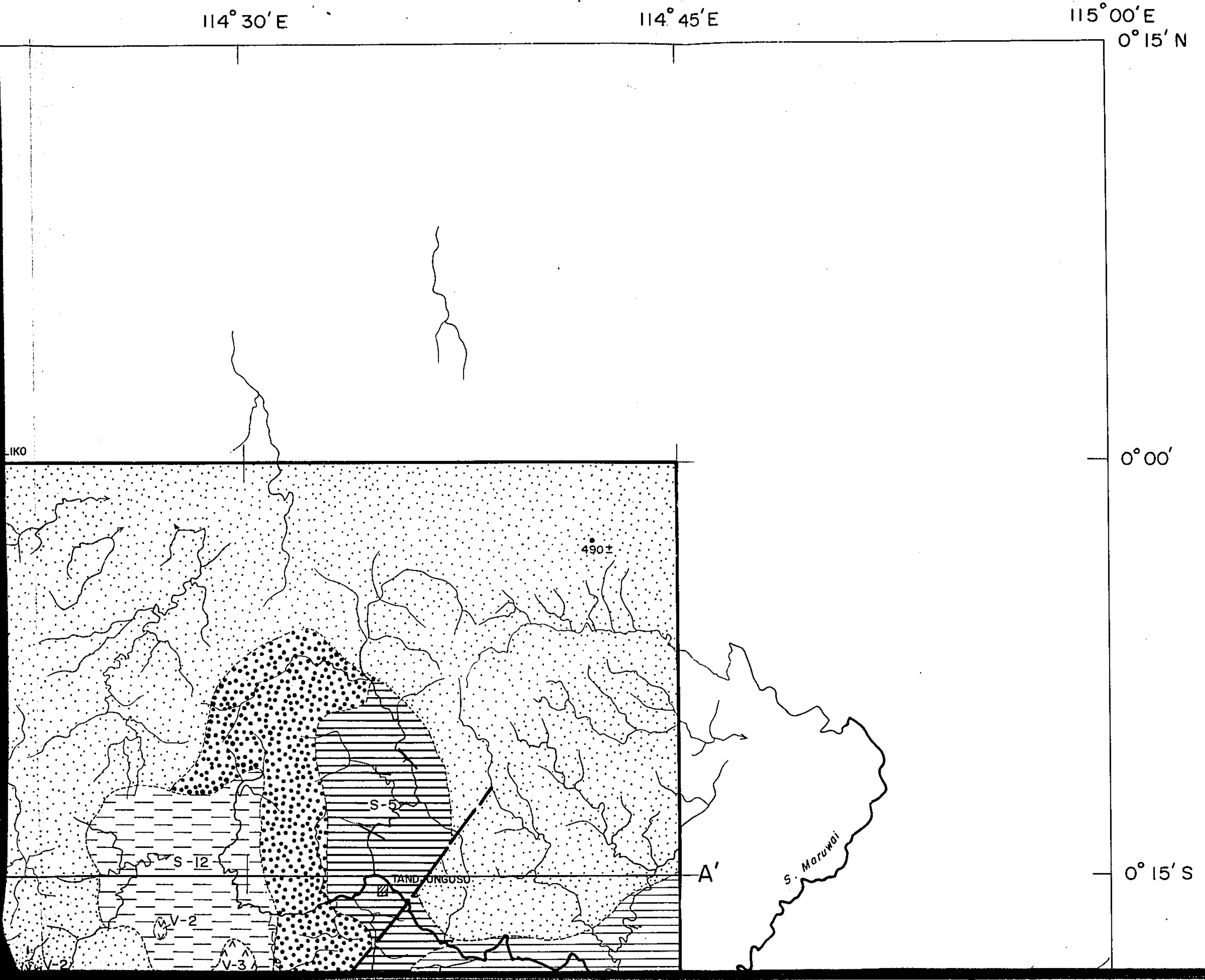
112° 30′E
112° 45′E
113° 00′E
113° 15′E
1319
1770
B. SERIGI
995
702
1408
S. Melawi
S. Gilang
D
S-9
G. BETURAN
1556±
S-3
V-3
NANGATAHAL
V-2
S. Lemasau
S. Gemu
AKAR
B. ALAI
650
B. RAHANGHADJU
600
NANGAAMBALAU
S. Ambalau
S-7
S-6
1350±
B. LILANGKUNGKAM
S-12
B. KEMINTIN
Jengunoi
B. KAHUKUNG
1305
NANGA LEKAWAI
PONTANG
PAGARSEBATA
NANGAURUK
NANGA JENGUNOI
KEPUNGEI
PAHANGAN



113°15'E
113°30'E
113°45'E
114°00'E
1770
S. Melawi
S. Busana
D
1350 ±
B. LILANGKUNGKAM
S-12
V-2
B. KEMINTIN
S-3
Jengunoi
S-6
V-2
B. KAHUKUNG
1305
S-12
PAHANGAN
S-2
V-2
S-1
490 ±
MUARADJULOI
KARIMAI
V-2



114°00'E
114°15'E
114°30'E
114°45'E
S. Busang
E
OLONGLIKO
M
BATUPAO
S. Murung
TANDTUNGTERUSAN
MUARADJULOI
KARIMAI
S-1
S-3
S-5
S-12
V-2
V-3
490 ±
490±
S. Joloi
S. Tabuan
TANDJUNGUSU
A'
S. Maruwai



PL.4

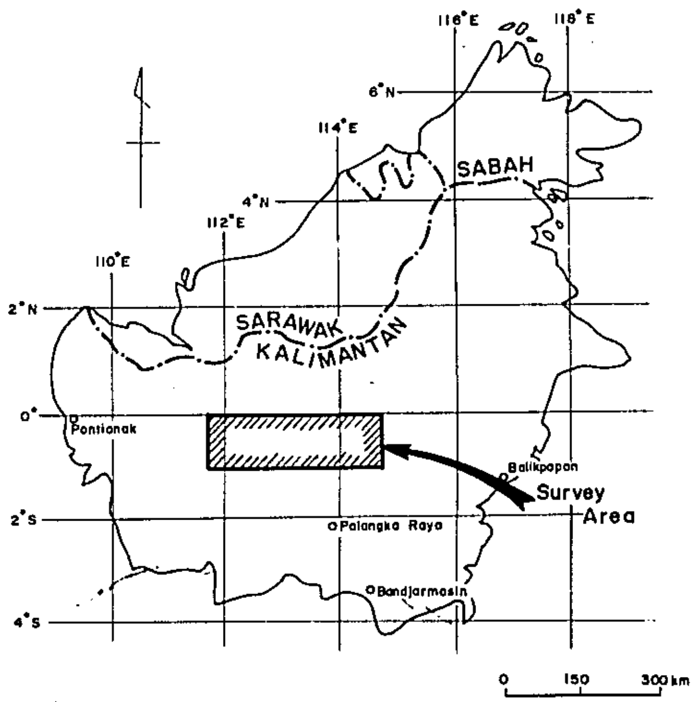
METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
— GEOLOGICAL SURVEY OF INDONESIA

PHOTO - GEOLOGICAL SURVEY OF CENTRAL KALIMANTAN INDONESIA

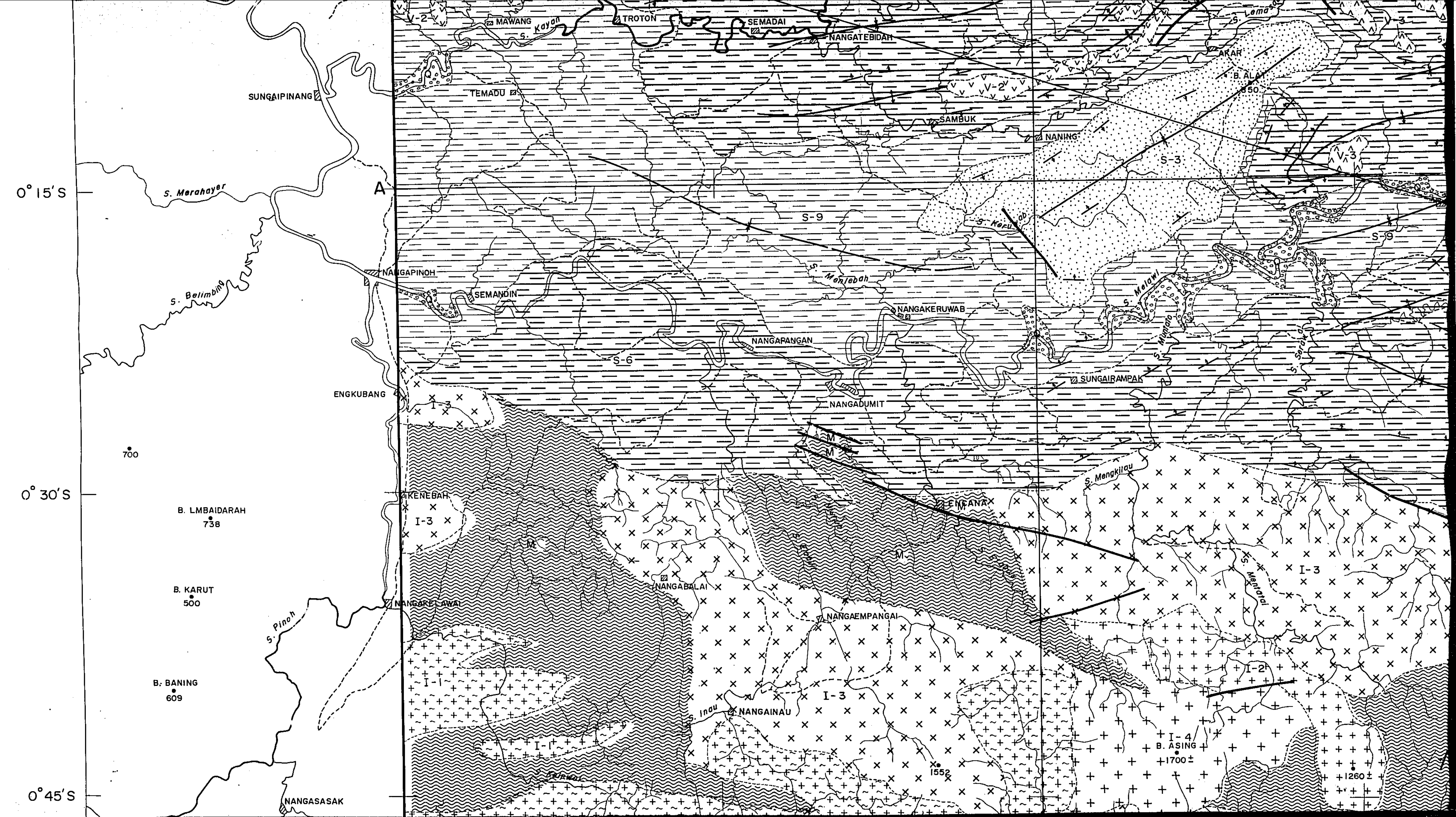
PHOTO - GEOLOGICAL MAP

Scale 1 : 250,000

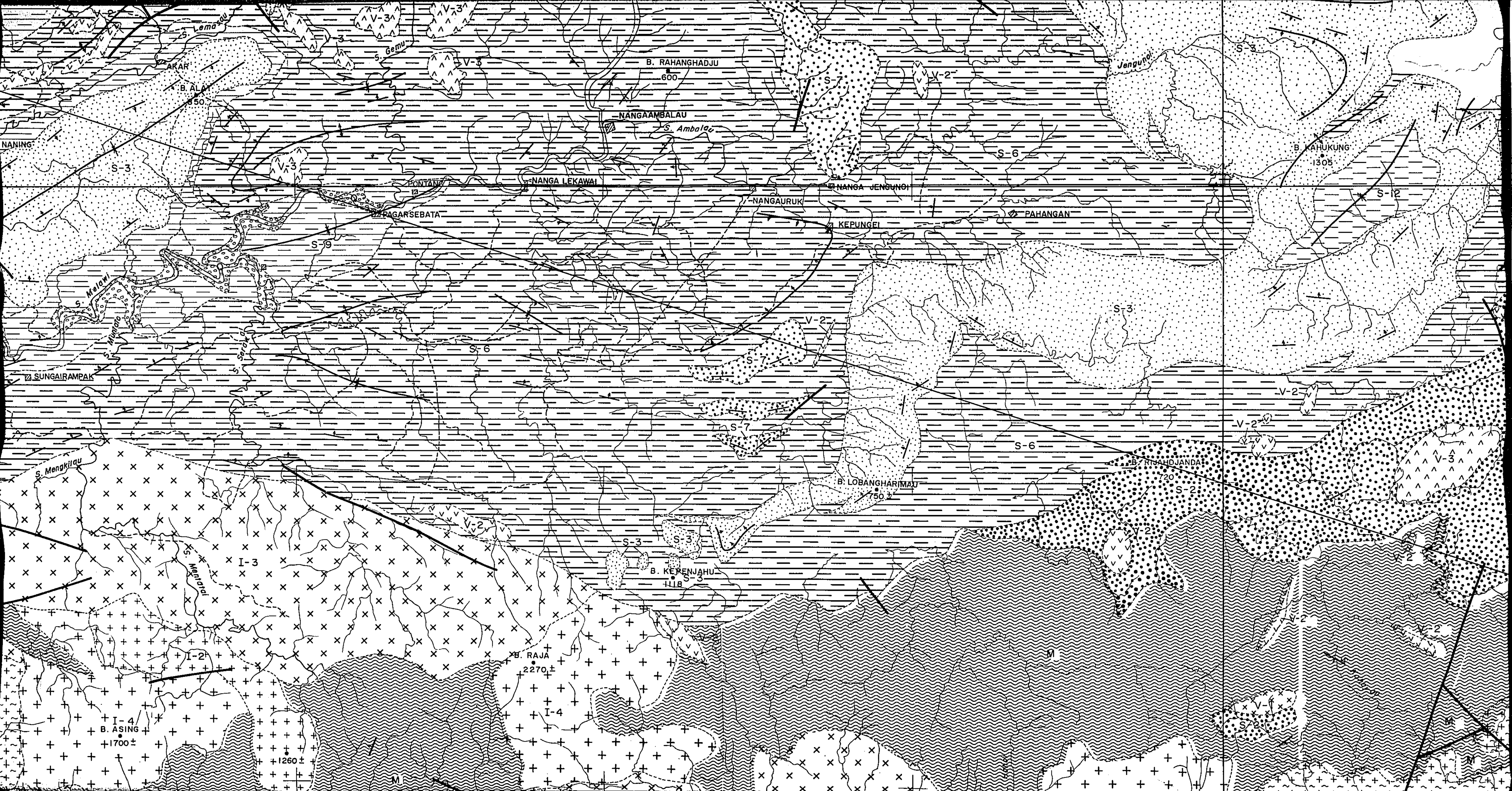
0 5 10 15 20 km



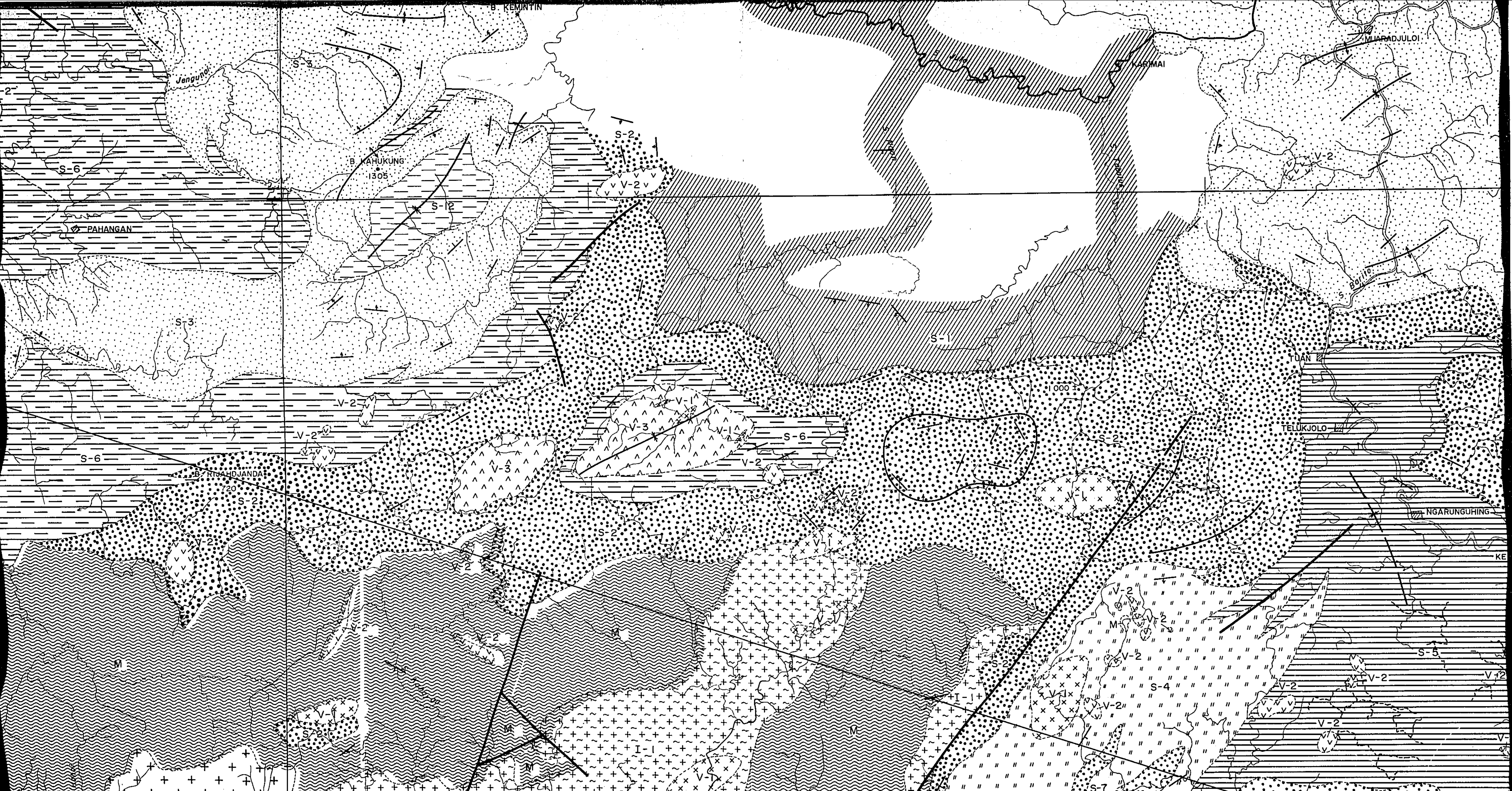
January · 1978

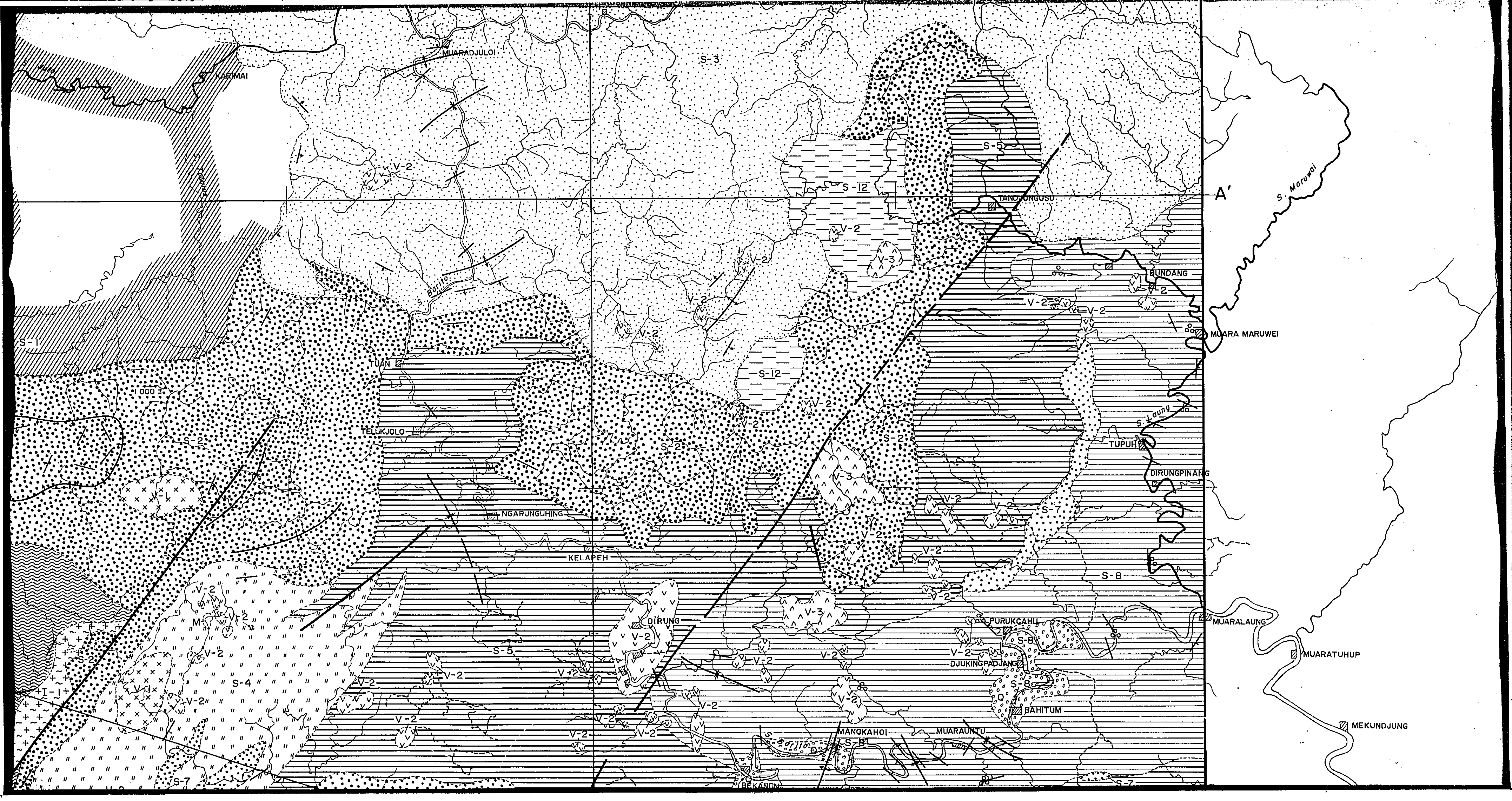


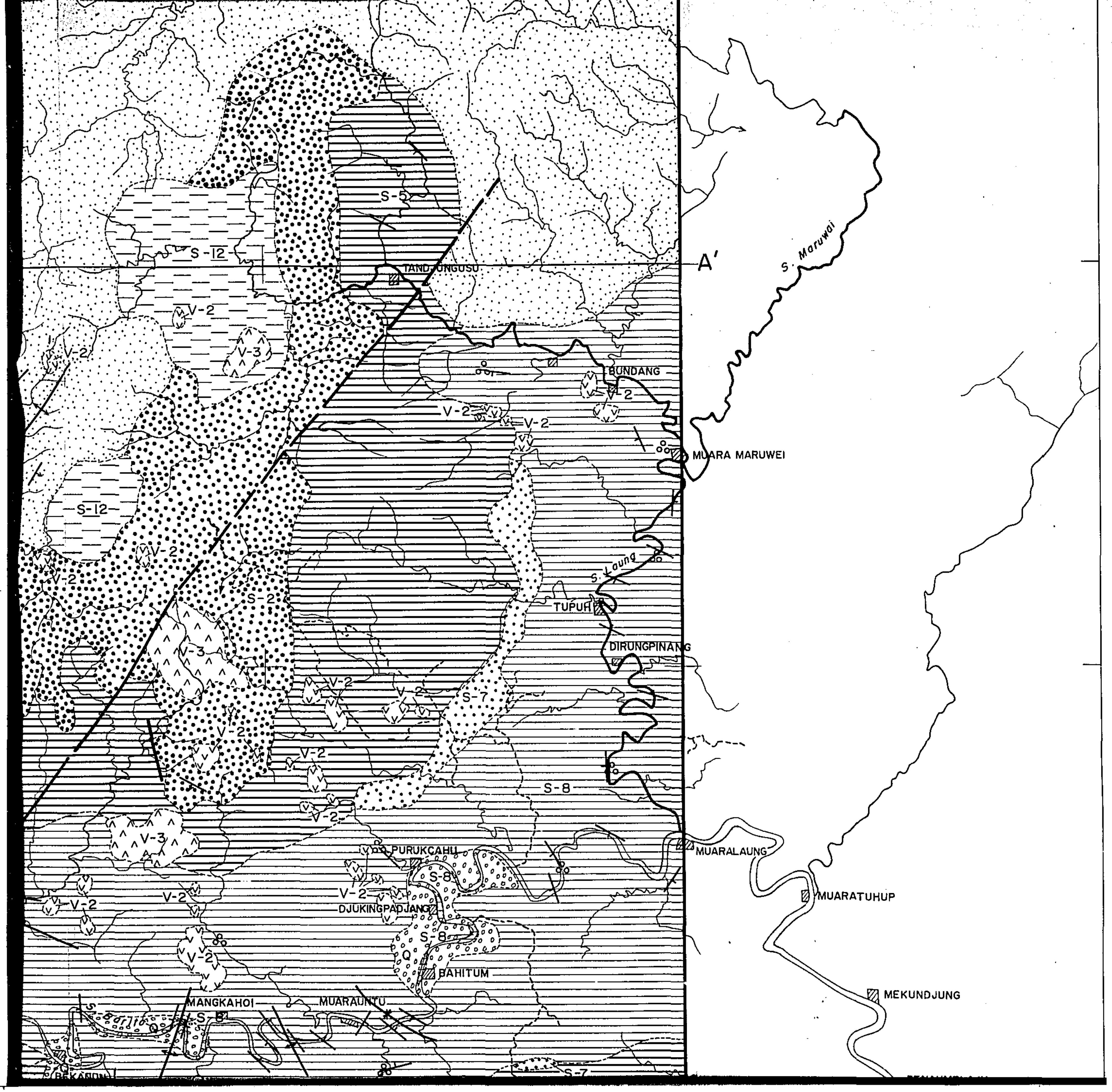
MAWANG
S. Kayan
TROTON
SEMADAI
NANGATEBIDAH
S. Lemasa
AKAR
B. ALAI
850
V-2
V-3
SUNGAIPINANG
TEMADU
SAMBUK
NANING
S-3
0°15'S
A
S. Merahayer
S-9
S. Keruwab
NANGAPINOH
SEMANDIN
S. Belimbing
S. Menlebah
S. Melawi
NANGAKERUWAB
NANGAPANGAN
S. Mungalo
S. Serak
S-6
SUNGAIRAMPAK
ENGKUBANG
I-3
NANGADUMIT
M
700
S. Mengkilau
0°30'S
KENEBAH
ENCANA
B. LMBAIDARAH
738
I-3
M
NANGABALAI
S. Mentatai
B. KARUT
500
NANGAKELAWAI
NANGAEMPANGAI
S. Pinoh
I-2
B. BANING
609
I-1
I-3
S. Inau
NANGAINAU
I-1
I-4
B. ASING
1700±
1552
1260±
0°45'S
NANGASASAK

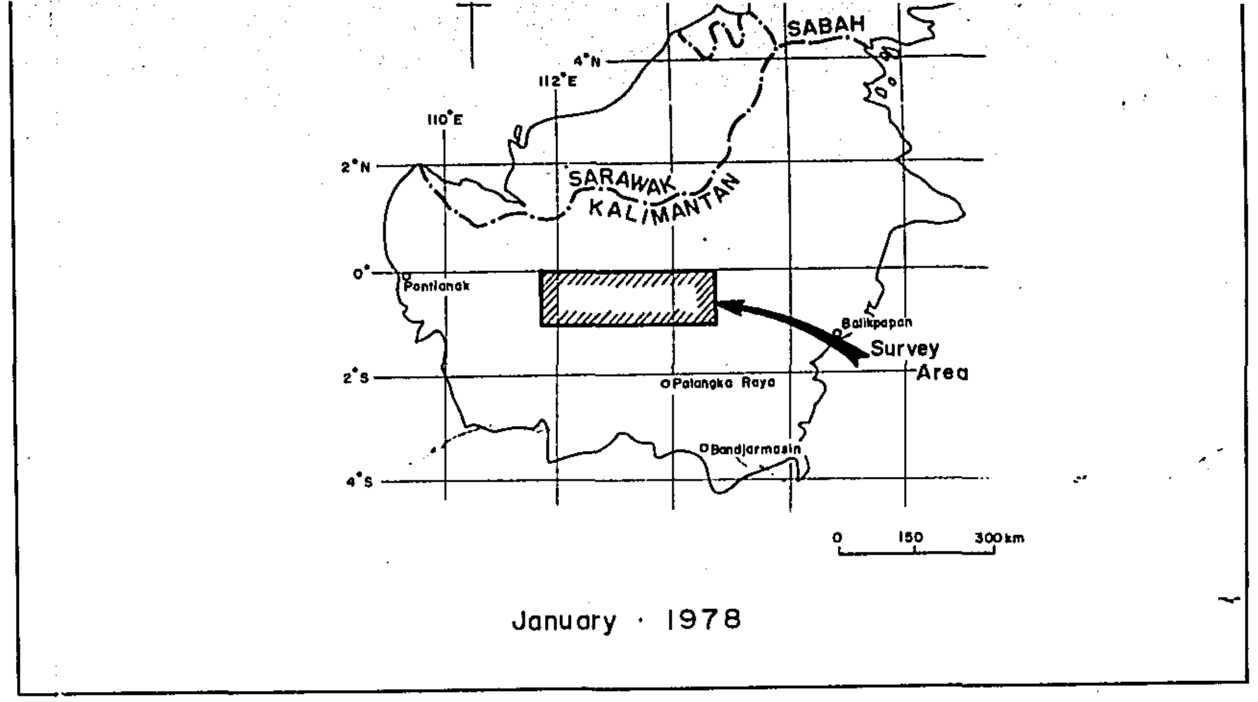


S. Lemasau
AKAR
B. ALAT
850
NANING
S-3
V-3
S. Gemu
B. RAHANGHADJU
600
NANGAAMBALAU
S. Ambalau
S-7
V-2
Jengunoi
B. KAHUKUNG
1305
S-6
S-12
PONTANG
NANGA LEKAWAI
PAGARSEBATA
NANGAURUK
NANGA JENGUNOI
KEPUNGEI
PAHANGAN
S-9
S. Melawi
SUNGAIRAMPAK
S. Mengkilau
S. Mentatai
I-3
S-3
B. KERENJAHU
1118
B. LOBANGHARIMAU
750
B. RIJAHDJANDA
720
S-2
V-3
I-2
B. RAJA
2270±
M
I-4
B. ASING
1700±
1260±


B. KEMINTIN
Jengunoi
S-3
S-6
S-2
B. KAHUKUNG
1305
S-12
PAHANGAN
V-2
KARIMAI
MUARADJULOI
S. Barito
S-1
TUAN
TELUKJOLO
NGARUNGUHING
1000
V-1
V-3
B. RIJAHDJANDA
720
M
I-1
S-4
S-5
S-7
KE

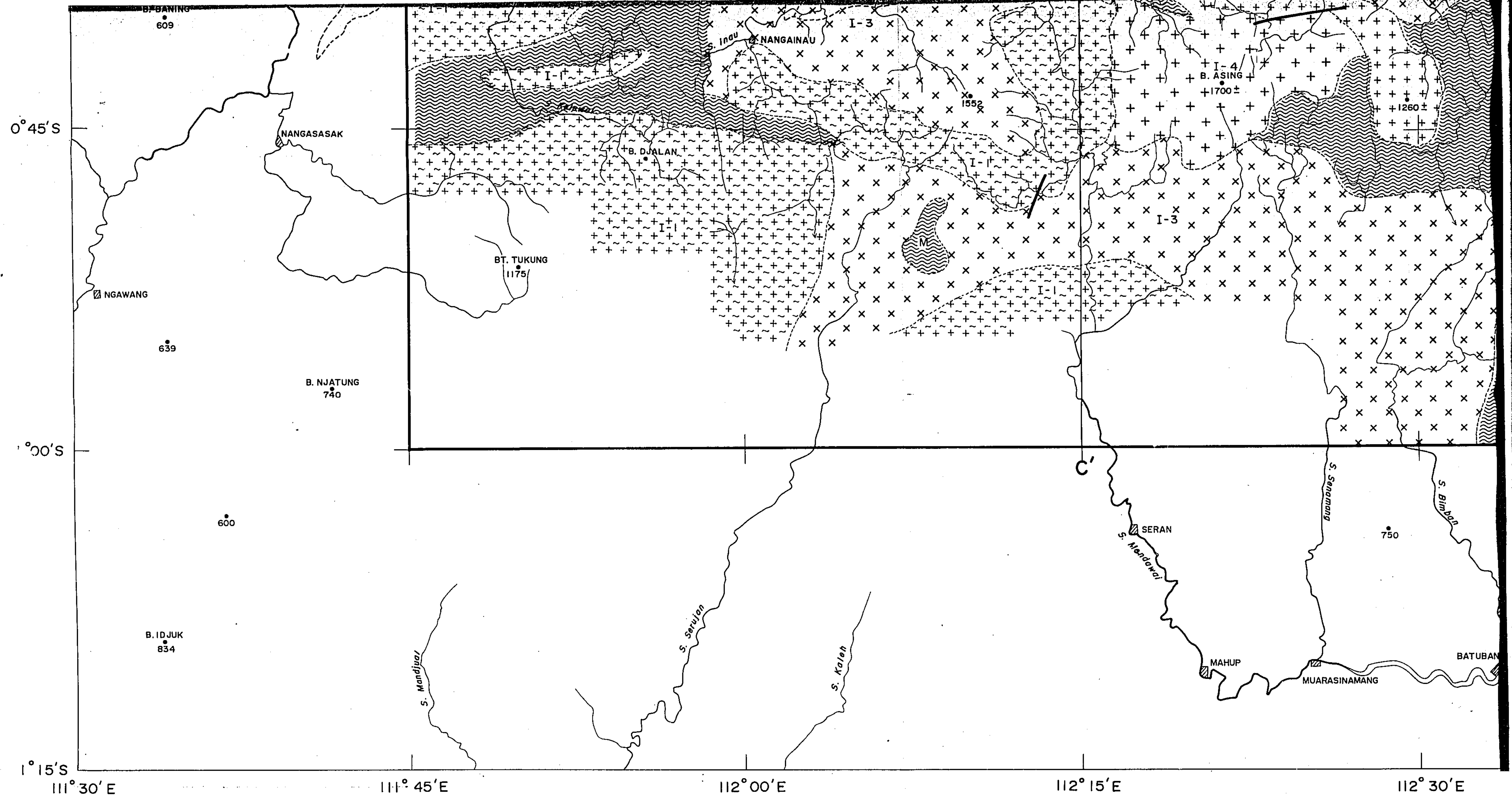

MUARADJULOI
KARIMAI
S-3
V-2
S-12
S-5
TANDJUNGUSU
A′
S. Maruwai
BUNDANG
MUARA MARUWEI
S-1
TUAN
1000 ±
S-2
TELUKJOLO
S. Barito
V-3
S. Laung
TUPUH
DIRUNGPINANG
NGARUNGUHING
KELAPEH
S-7
S-8
DIRUNG
PURUKCAHU
DJUKINGPADJANG
BAHITUM
MUARALAUNG
MUARATUHUP
MEKUNDJUNG
S-4
M
MANGKAHOI
MUARAUNTU
BEKANON



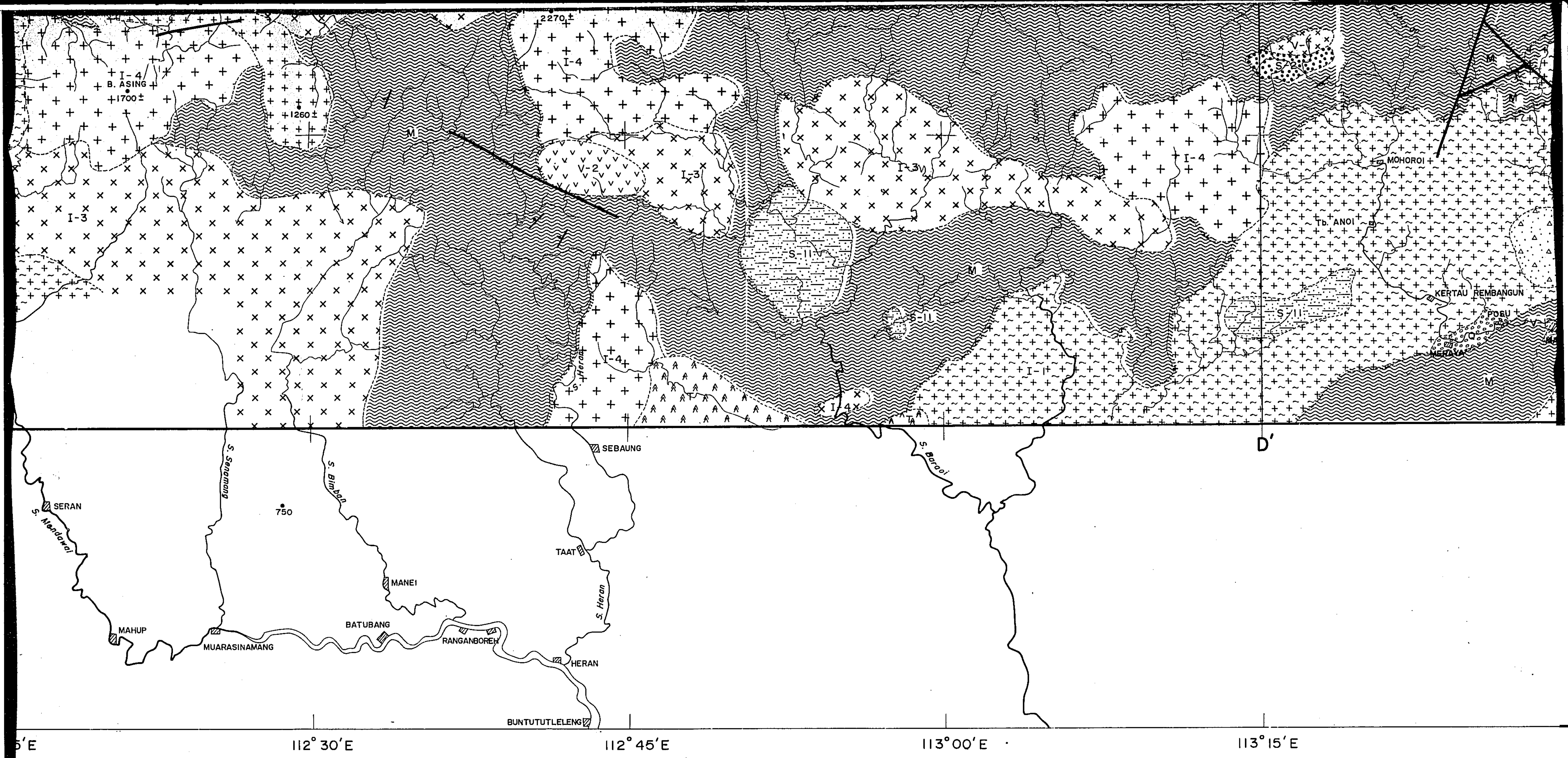


Legend

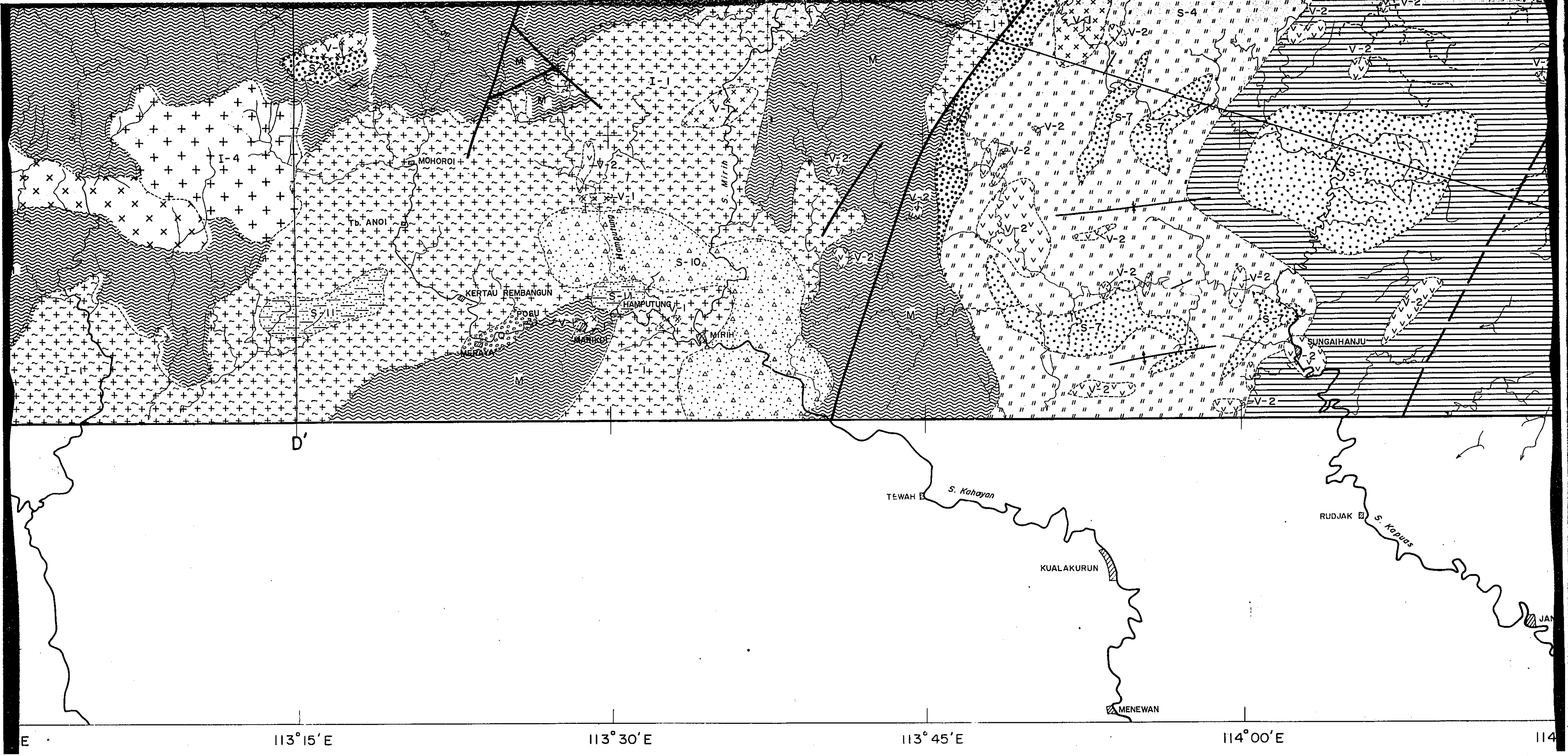
Q	Sand, gravel	
S-12	Silt	
S-11	Sandstone	
S-10	Andesite agglomerate	
S-9	Shale, sandstone, marl	
S-8	Shale, sandstone, limestone	
S-7	Sandstone	
S-6	Shale, sandstone, marl, lignite	
S-5	Shale, sandstone, limestone	
S-4	Pyroclastic rock	
S-3	Sandstone	
S-2	Sandstone, conglomerate	
S-1	Shale, sandstone, limestone	
T	Andesite	



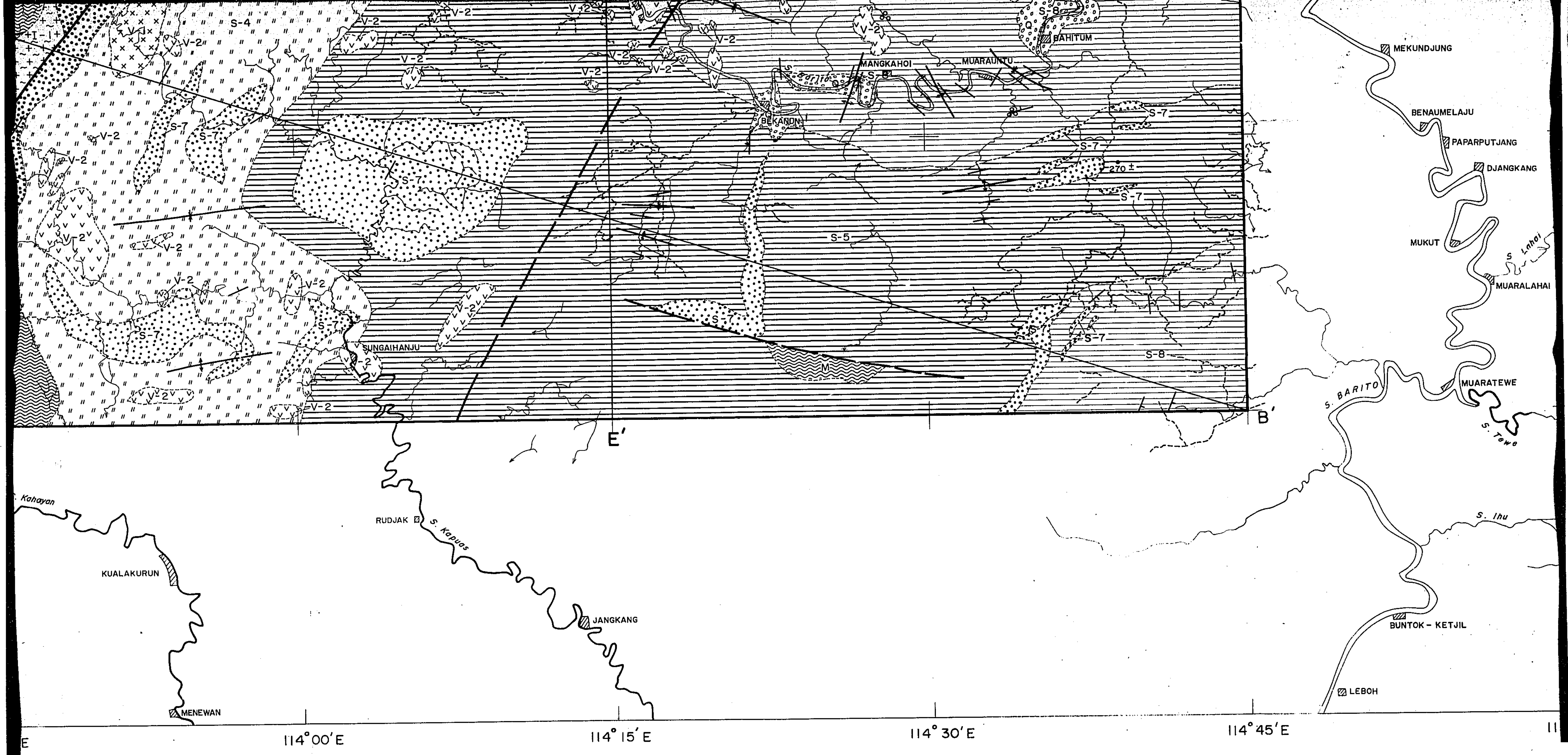
B. BANING
609
NANGAINAU
I-3
I-1
I-4
B. ASING
1700±
1260±
1552
0°45'S
NANGASASAK
B. DJALAN
I-1
M
I-3
BT. TUKUNG
1175
NGAWANG
639
B. NJATUNG
740
1°00'S
C'
SERAN
S. Mandawai
S. Senamang
S. Bimban
750
600
B. IDJUK
834
S. Mandjul
S. Serujan
S. Koleh
MAHUP
MUARASINAMANG
BATUBAN
1°15'S
111°30'E
111°45'E
112°00'E
112°15'E
112°30'E



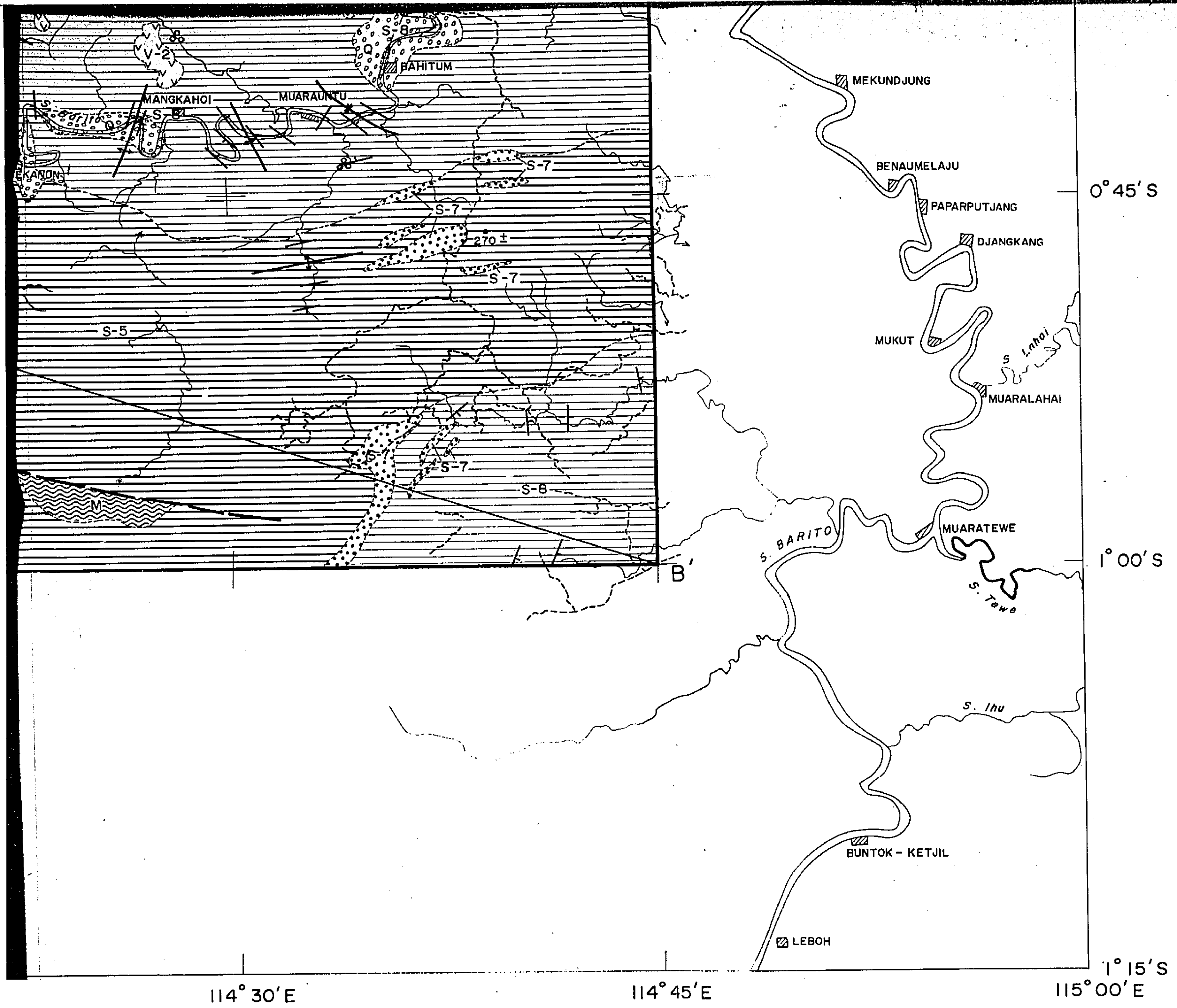
I-4
B. ASING
1700±
1260±
2270±
I-3
M
V-2
S-11
I-1
MOHOROI
Tb. ANOI
KERTAU REMBANGUN
POSU
MERAYA
D'
SEBAUNG
S. Senamong
S. Bimban
S. Heran
S. Barooi
S. Mandawai
SERAN
750
TAAT
MANEI
BATUBANG
MAHUP
MUARASINAMANG
RANGANBOREH
HERAN
BUNTUTUTLELENG
112°30'E
112°45'E
113°00'E
113°15'E

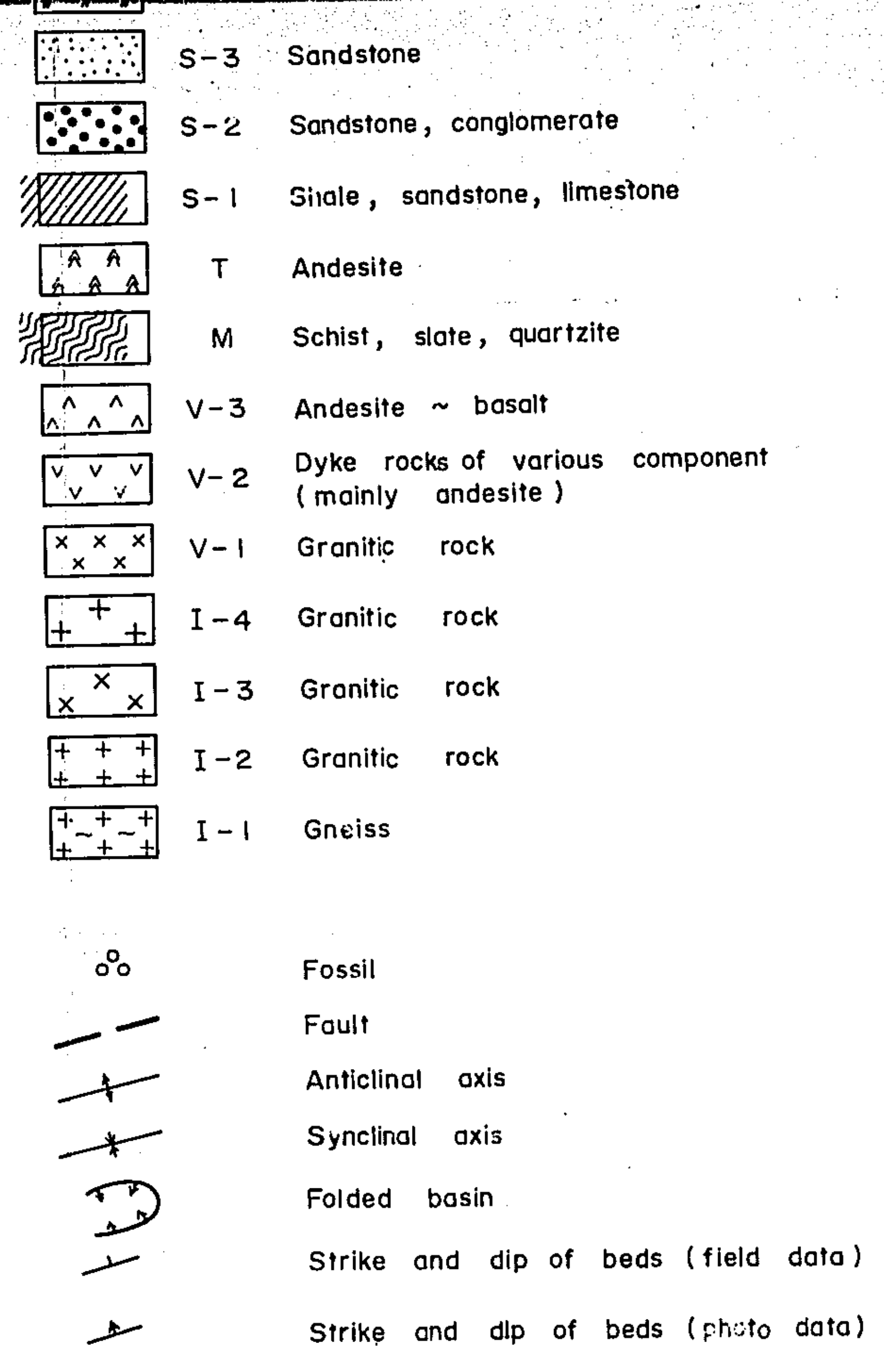


MOHOROI
Tb. ANOI
KERTAU REMBANGUN
POSU
MERAYA
MARIKOI
HAMPUTUNG
MIRIH
S. Mirih
S. Hamputung
SUNGAIHANJU
TEWAH
S. Kahayan
KUALAKURUN
MENEWAN
RUDJAK
S. Kapuas
D'
I-1
I-4
V-1
V-2
S-4
S-7
S-10
S-11
M
Q
113°15'E
113°30'E
113°45'E
114°00'E



S-4
V-2
S-7
S-5
S-8
M
BAHITUM
MANGKAHOI
MUARAUNTU
S. Barito
BEKANON
270 ±
SUNGAIHANJU
E′
B′
MEKUNDJUNG
BENAUMELAJU
PAPARPUTJANG
DJANGKANG
MUKUT
S. Lahai
MUARALAHAI
MUARATEWE
S. BARITO
S. Tewe
S. Ihu
BUNTOK - KETJIL
LEBOH
S. Kahayan
KUALAKURUN
MENEWAN
RUDJAK
S. Kapuas
JANGKANG
114°00′E
114°15′E
114°30′E
114°45′E


S-8
V-2
BAHITUM
MEKUNDJUNG
MANGKAHOI
S-8
MUARAUNTU
S. Barito
EKANON
S-7
BENAUMELAJU
PAPARPUTJANG
0°45'S
S-7
270 ±
DJANGKANG
S-7
S-5
MUKUT
S. Lahai
MUARALAHAI
S-7
S-7
S-8
M
MUARATEWE
S. BARITO
B'
1°00'S
S. Tewe
S. Ihu
BUNTOK - KETJIL
LEBOH
1°15'S
114°30'E
114°45'E
115°00'E


S-3 Sandstone
S-2 Sandstone, conglomerate
S-1 Shale, sandstone, limestone
T Andesite
M Schist, slate, quartzite
V-3 Andesite ~ basalt
V-2 Dyke rocks of various component (mainly andesite)
V-1 Granitic rock
I-4 Granitic rock
I-3 Granitic rock
I-2 Granitic rock
I-1 Gneiss
Fossil
Fault
Anticlinal axis
Synclinal axis
Folded basin
Strike and dip of beds (field data)
Strike and dip of beds (photo data)