

PERSATUAN GEOLOGI MALAYSIA

WARTA GEOLOGI

NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MALAYSIA

Jil. 8, No. 6 (Vol. 8, No. 6)

Nov–Dis 1982

KANDUNGAN (CONTENTS)

CATATAN GEOLOGI (GEOLOGICAL NOTES)

- G.B. Ong & P.H. Stauffer: A large prehistoric landslide near Raub, Pahang, Peninsular Malaysia 253
 H.D. Tjia: Disharmonic folds at Tanjung Mat Amin, Trengganu 258

Perbincangan (Discussion)

- C.S. Hutchison: A chromium-nickel laterite in Bukit Punggor, Malacca, Peninsular Malaysia—A Discussion 260
 B.K. Tan: A chromium-nickel laterite in Bukit Punggor, Malacca, Peninsular Malaysia—A Reply 263

PERHUBUNGAN LAIN (OTHER COMMUNICATIONS)

- S.K. Yong: Peninsular Malaysia Place-names 264

PERTEMUAN PERSATUAN (MEETINGS OF THE SOCIETY)

- C.R. Jones: Geological and mineral exploration of the Kalahari, SW Africa 268
 ROCKCON Training Course and Symposium—Report & Abstracts 268
 Petroleum Geology Seminar '82—Report & Abstracts 287

BERITA PERSATUAN (NEWS OF THE SOCIETY)

- GEOSEA V—First Circular 299
 Forthcoming GSM Bulletins 302
 GSM 2-year Councillors 1983/84—election results 303
 Keahlian (Membership) 303
 Pertukaran Alamat (Change of Address) 303

BERITA-BERITA LAIN (OTHER NEWS)

- Universiti Sains Malaysia M.Sc. Theses 304
 Universiti Teknologi Malaysia B.Sc. Theses 1981/82 304
 Carigali and Carigali-BP strike oil in Malaysia 304
 Overseas Research Students ORS Awards 1983 307
 XVIII General Assembly of IUGG 308
 10th International Geochemical Exploration Symposium 310
 Coastal Evolution in the Holocene—International Symposium 310
 Techniques for Hydrologic Investigation 311
 Kursus-kursus Latihan (Training Courses) 314
 Kalendar (Calendar) 316



DIKELUARKAN DWIBULANAN
 ISSUED BIMONTHLY

PERSATUAN GEOLOGI MALAYSIA
(GEOLOGICAL SOCIETY OF MALAYSIA)

Majlis (Council) 1982/83

Pegawai-pegawai (Officers)

- Presiden
(President) : Khoo Teng Tiong, Jabatan Geologi,
Universiti Malaya, Kuala Lumpur
- Naib Presiden
(Vice-President) : Leong Khee Meng, Carigali-BP,
P.O. Box 757, Kuala Lumpur
- Setiausaha Kehormat
(Honorary Secretary) : Tan Boon Kong, Jabatan Geologi,
Universiti Kebangsaan Malaysia, Bangi
- Penolong Setiausaha Kehormat
(Honorary Assistant Secretary) : Mohd. Ali Hasan, Jabatan Geologi,
Universiti Malaya, Kuala Lumpur
- Bendahari
(Honorary Treasurer) : Chin Lik Suan, 13 Lorong SS1/11A
Kampong Jamil Rais, Petaling Jaya
- Pengarang
(Editor) : Teh Guan Hoe, Jabatan Geologi,
Universiti Malaya, Kuala Lumpur
- Presiden Yang Dahulu
(Immediate Past President) : Mohd. Ayob, Petronas
P.O. Box 2444, Kuala Lumpur
- Ahli-ahli Majlis, 2-tahun
(Councillors, 2-year) : Abdul Aziz Hussin, Jabatan Kejuruteraan
Petroleum, Universiti Teknologi
Malaysia, Jalan Gurney, Kuala Lumpur
Khoo Kay Khean, Pejabat Penyiasatan
Kajibumi, Kuala Kangsar, Perak
Michael Leong, Petronas, P.O. Box
2444, Kuala Lumpur
Yeoh Gaik Chooi, Esso Production,
P.O. Box 857, Kuala Lumpur
- Ahli-ahli Majlis, 1-tahun
(Councillors, 1-year) : Abdul Malek Abdul Rani, Esso Produc-
tion, P.O. Box 857, Kuala Lumpur
Ahmad Said, Petronas, P.O. Box 2444,
Kuala Lumpur
Choo Mun Keong, Malaysia Mining Corp.,
P.O. Box 936, Kuala Lumpur
Gan Ah Sai, Jabatan Penyiasatan Kaji-
humi, Bang. Ukor, Jalan Gurney, Kuala
Lumpur
- Juruodit Kehormat
(Hon. Auditor) : Peter Chew

First published 7 Feb. 1983

Printed by Art Printing Works Sdn. Bhd., 29 Jalan Riong, Kuala Lumpur

CATATAN GEOLOGI

(GEOLOGICAL NOTES)

A LARGE PREHISTORIC LANDSLIDE NEAR RAUB, PAHANG, PENINSULAR MALAYSIA

ONG GUAN BEE, Robertson Research (Singapore) Pte. Ltd., and
PETER H. STAUFFER, Dept. of Geology, University of Malaya, Kuala Lumpur

Abstract

An area of about 2 km² in the lowlands just east of the Foothills Range shows hummocky topography, the low hills being composed of loose and unbedded bouldery debris. The local bedrock, exposed in places between the hills, is vertical shales and limestones of the (Carboniferous) Raub Group, but the clasts in the 10 - 20 m thick debris blanket resemble lithologies in the (Devonian?) Bilut beds, a redbed unit forming hills 300 m higher just to the west. This debris blanket is interpreted to represent a partly dissected landslide, most probably a very rapid debris flow, of probable Pleistocene age. The landslide has diverted the local drainage, including the Bilut River, which flows in a large bend around its margin.

Introduction

During the course of a geological mapping project near Raub, Pahang (Ong, 1974), one area was found which was characterized by hummocky topography and largely underlain by rubbly debris derived from a formation other than the local bedrock. This area was then interpreted as the partly dissected remains of a large landslide. It is the purpose of the present note to put this occurrence on record, an aim considered worthwhile because such landslides have only rarely been described or recorded in Peninsular Malaysia.

The area of inferred landslide debris covers approximately 2 km and is located about 5 km south of the town of Raub, Pahang (Fig. 1). It occupies low rolling country at elevations of 125 - 200 m (400 - 650 ft.) just east of the Foothills Range, with a front line of peaks at around 425 m (1400 ft.), and lies close to the Bentong-Raub road where it emerges from the gorge of the Bilut River (see Fig. 2).

Bedrock Geology

The general geology of the Raub area has been reviewed in Haile, *et al.*, (1977). Flanking the east side of the Main Range granitic batholith and forming the hills of the Foothills Range is a sequence of generally east-dipping and presumably eastward-younging unfossiliferous metasedimentary and sedimentary rock units. They are (from west to east) the "Schist Series", the Guntong beds (a unit of chert, argillite and sandstone), and the Bilut beds (a unit of conglomeratic to fine-grained redbeds). These units occur widely to the north and south, but the names used here are those applied by Ong (1974) in the Raub area.

Underlying the lower ground to the east of the Foothills Range are

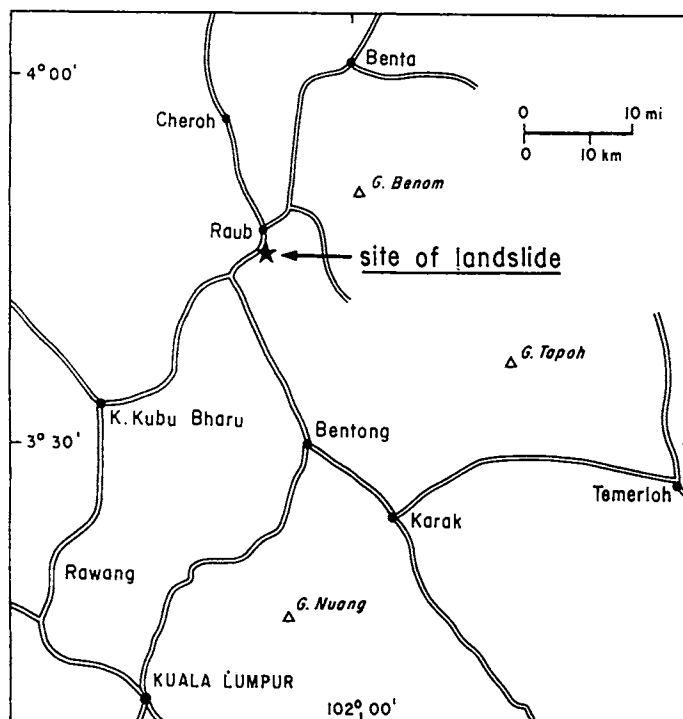


Fig. 1. Index map of part of western Pahang and eastern Selangor, Peninsular Malaysia, showing location of landslide described in text.

rocks of the Raub Group, consisting mainly of shales, tuffs and limestones locally bearing Carboniferous fossils. Although the contact between the Raub Group sediments and the presumably underlying (Devonian?) Bilut redbeds has been interpreted to be a conformably depositional surface (Ong, 1974), recent examination of new road cuttings in the area of the contact on the Bentong-Raub road show intense deformation and shearing and raise the possibility that this contact is a tectonic one.

Inferred Landslide Debris

Material inferred to be landslide debris covers most of an irregular area of about 2 km² within the Bilut (oil palm) Estate. From field mapping, the relief and drainage pattern in this area are strikingly different from the surrounding areas. The relief is low-lying, with scattered small hills whose slopes are rather gentle and smooth. The hills are found to be composed of loose material, while at lower elevations between the hills some exposures of vertically dipping beds of limestone and shale of the Raub Group occur (see Fig. 2). The loose material unconformably overlies the limestone and shale and is interpreted as representing landslide debris.

This debris consists of pebble to boulder size clasts in a sparse finer-grained matrix. It shows no clear bedding and is unconsolidated. The larger clasts consist of rounded white sandstone, quartzite, chert and quartz. The smaller clasts are of iron-stained sandstone. These clast types are unlike anything in the immediately underlying Raub

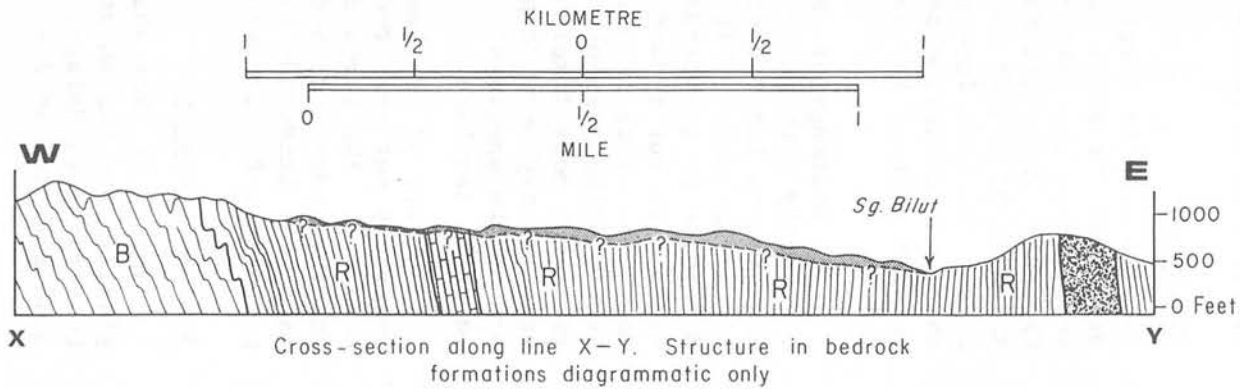
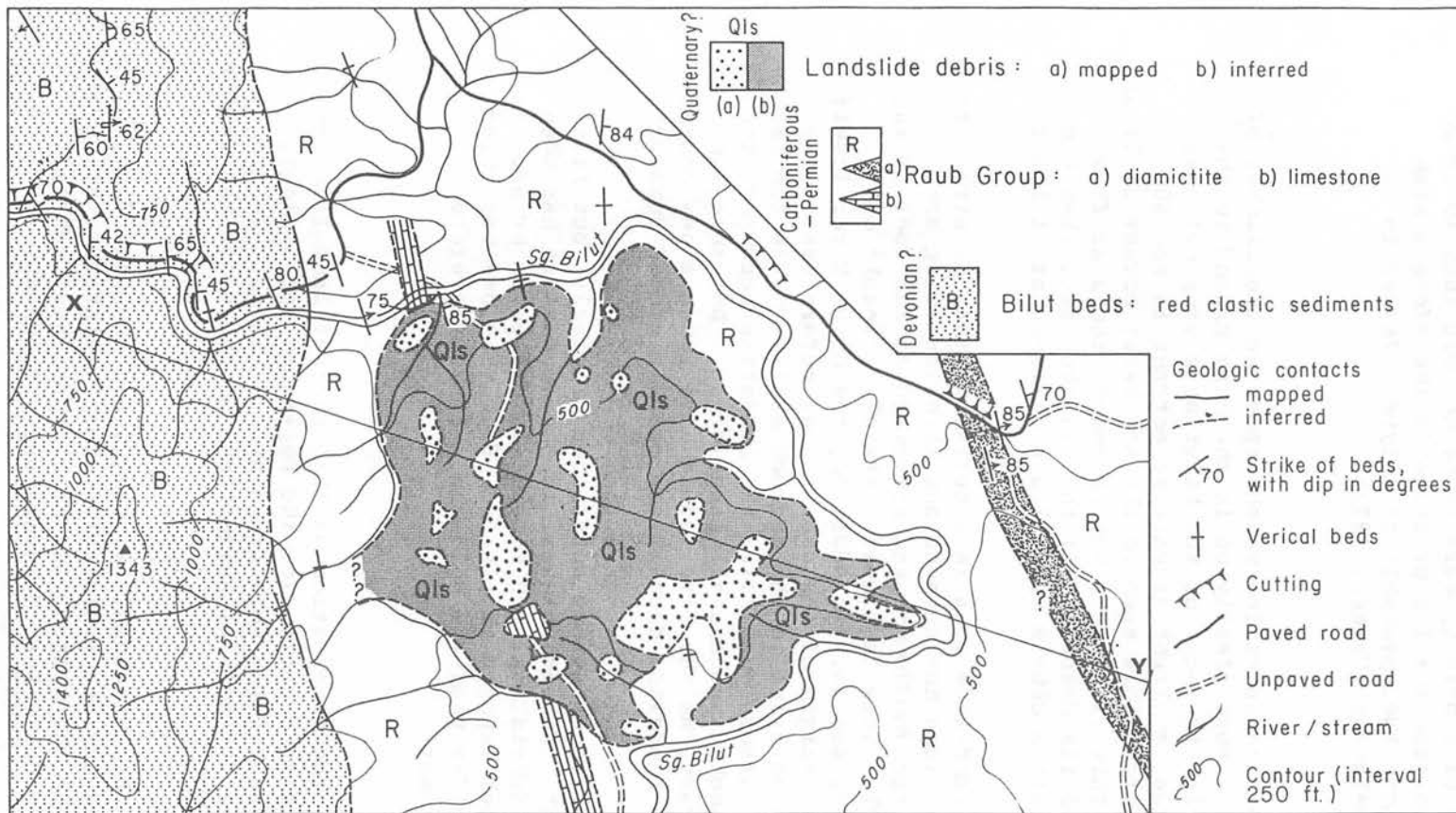


Fig. 2. Geological map and cross section of area of large landslide near Raub, Pahang. After Ong (1974).

Group, but they are very similar to the large clasts, and to broken fragments of the finer-grained beds in the Bilut beds cropping out in the higher hills to the west.

The extremely poor sorting of this debris material, the absence of bedding, and the limited amount of sand matrix indicate that the deposit is not the result of steam action. Despite its nearly 2 km east-west extent, the blanket of debris appears to be no more than 10 or 20 m thick. The best explanation for its presence is therefore a high-velocity catastrophic landslide, probably of a type referred to as debris flow or debris avalanche (Varnes, 1978).

Discussion

The site of origin of the landslide which deposited the blanket of debris in the Bilut Estate must clearly be in the high ground to the west, where the coarse clastic rocks of the Bilut beds crop out (see Fig. 2). There is, indeed, a slight arcuate re-entrant in the 400 - 425 m (1300 - 1400 ft.) high ridge seen in the southwest corner of Figure 2, and the east face of this ridge here may represent the scar from which the landslide began its descent. If this is the case, then the forward edge of the landslide debris travelled a distance of at least 2.5 km.

The drainage of the landslide area is peculiar in that no stream from the nearby higher strike ridge now cuts across this low-lying area. The streams instead diverge northward and southward at the foot of the higher hills (see Fig. 2). This is almost certainly a result of diversion by the landslide debris. In addition, the Bilut River itself makes a detour around the margin of the debris area before continuing southward along a course parallel to the bedrock strike. This too is likely to be a result of diversion. After the landslide occurred, the river was most likely blocked and a small lake formed. But this lake was probably very temporary, as the river would have found a new course around the margin of the landslide deposit and quickly eroded downward to drain the lake.

The age of the landslide cannot be determined precisely, but it is certainly not very recent. No remnant scar in the vegetation has been observed. The apron of debris has been moderately dissected by erosion, and the underlying bedrock exposed in places. From this one may infer that this landslide is older than the Holocene. It is therefore probably a Pleistocene event.

Acknowledgements

The study from which the observation of this ancient landslide originally came was an academic exercise for the Department of Geology, University of Malaya. The figures were drawn by Y.H. Ching. We are also grateful to J.K. Raj for helpful suggestions on the draft manuscript.

References

- Haile, N.S., Stauffer, P.H., Krishnan, D., Lim, T.P., and Ong, G.B., 1977. Palaeozoic redbeds and radiolarian chert: reinterpretation of their relationships in the Bentong and Raub areas, West Pahang, Peninsular Malaysia. Geol. Soc. Malaysia Bull. 8, 45-60.
- Ong, G.B., 1974. Geology of an area southwest of Raub, Pahang. Unpubl.

B.Sc. (Hons.) thesis, Department of Geology, University of Malaya, 94 p.

Varnes, D.J., 1978. Slope movement types and processes. In Schuster, R.C. and Krizek, R.J. (eds.), Landslides: analysis and control. Transportation research board, National Academy of Sciences, Washington, D.C., Special Report, 176, 11-33.

Manuscript received 7 May 1982

VC Agency, Sole Agent for.....

ibico

USE IBICO TO MIND YOUR BUSINESS FOR A PERFECT BIND

THE NEW P/B 24



**IBICO MACHINES ARE SWISS MADE
SIMPLE TO OPERATE, ROBUST
AND SATISFY ALL BINDING NEEDS.**

VC Agency, Lot 309, 2nd Floor, Ampang Park, Kuala Lumpur.
Tel: 482012 & 481928.

DISHARMONIC FOLDS AT TANJUNG MAT AMIN, TRENGGANU

H.D. TJIA, Department of Geology, Universiti Kebangsaan Malaysia, Bangi

Abstract

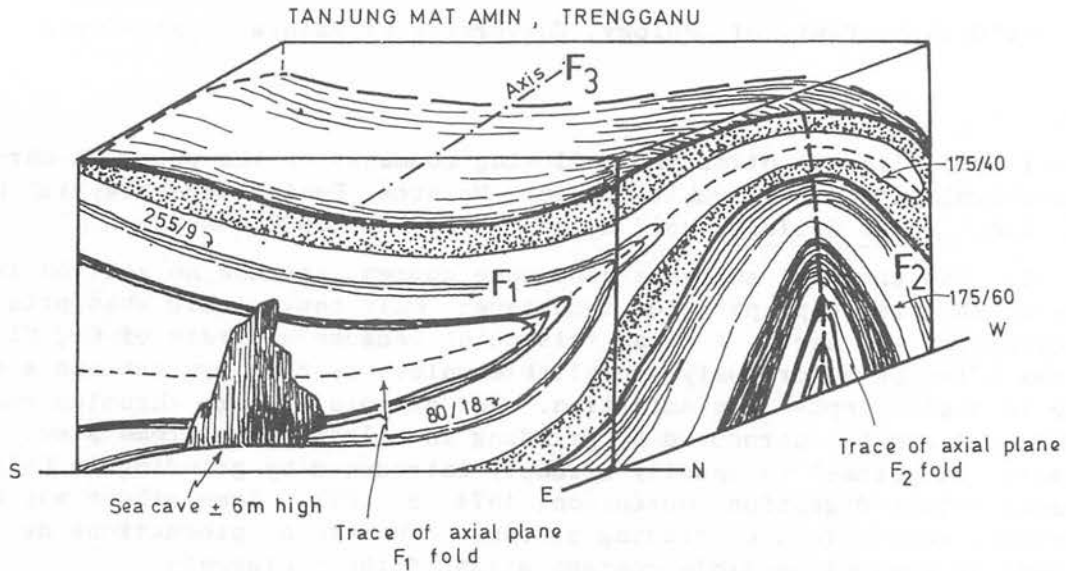
A series of Upper Palaeozoic, interfoliated meta-argillite and meta-arenite were folded into a large F_1 recumbent fold striking between NE and N, that became refolded into F_2 , upright but slightly asymmetrical folds with approximately N-S trends. Either the plunge of F_2 folds or regional compression developed broad warps upon the existing structures; the warp axes strike east-west. The recumbent fold has been interpreted to indicate tectonic transport westward, like similar structures studied at other localities on the east coast. It is further suggested that this type of deformation that took place over such a broad front is consistent with tectonic (partly involving soft sediments) deformation on the landward side of subduction trenches. The Upper Palaeozoic trench was located to the west of the present east coast. The Upper Palaeozoic volcanics of Pulau Tioman were very probably related to the above mentioned subduction.

At Tanjung Mat Amin near Kemaman, Trengganu, are exposed a well-foliated series of slate-phyllite-schist and meta-arenite intercalations. In the black coloured pelitic rocks occur carbonaceous plant fossils. According to Mr. T. Suntharalingam, these fossils have been studied by the Geological Survey of Malaysia. On existing regional maps, the rocks of Tanjung Mat Amin are of Late Palaeozoic age.

The block diagram of Figure 1 is a slightly schematical representation of structures that are exposed in the high sea cliffs of the cape. F_1 is a large recumbent fold; its axis strikes between northeast and north. I have not yet been able to determine if the fold is an anticline or a syncline. F_2 is a somewhat asymmetrical antiform; its west-facing limb is slightly steeper. Its axial plane dips steeply to the east, while its fold trend is a few degrees west of north. This fold has a wavelength in the order of 40 to 50 meters. The F_3 fold strikes approximately 80° and consists of a broad warp of low amplitude. Many faults and fault zones up to a meter in width have been found transecting the foliation and also running parallel to it. These faults complicate the detailed picture but do not influence the shape of the large structures. Although F_1 may be subparallel to F_2 , yet their field relationship is clearly disharmonic, as shown in the east-west section. F_3 may have formed in a "passive" manner, that is, the warp may merely indicate the area where F_2 folds are plunging. However, at Tanjung Sulung, smaller warps with identical axial strikes have also been mapped. This may mean that F_3 represents deformation at a regional scale rather than "passive" local folding.

The structural history is interpreted as follows. F_1 folds developed with strikes in NE to N direction; they became recumbent probably by tectonic transport (thrusting, overthrusting) towards west. The following deformation phase folded the F_1 structures into slightly asymmetrical anticlines (F_2) and synclines about approximately north-south axes. As a result of rising and plunging of F_2 fold axes, F_3 warps were developed with approximately east-west strikes. Alternatively, F_3 may represent the result of late regional compression in north-south direction.

Fig. 1: Cliff exposure of disharmonic folds at Tanjung Mat Amin as seen from Tanjung Sulung, approximately a kilometer more to the north. Except for the hinge of the F_1 fold at the west end of the diagram, all structures can be seen in the field.



Could F_1 be of nontectonic origin? Recumbent structures are known from similar rocks along the east coast, at least from as far north as Kuala Trengganu to as far south as Mersing, a distance of more than 300 km. It is difficult to conceive a sedimentary environment where slumping and sliding of solely gravitational nature could occur over such a broad front. Soft-sediment deformation, but hardly solely nontectonic, of such extent and uniform direction of transport may be envisaged to occur on the landward side of trenches marking active subduction zones. Therefore, the Late Palaeozoic subduction seems to have taken place from west towards east, while contemporary volcanism occurred in Pulau Tioman. The subduction axis was probably located to the west of the present east coast of Peninsular Malaysia.

Manuscript received 25 July 1982

P E R B I N C A N G A N
(D I S C U S S I O N)

A CHROMIUM-NICKEL LATERITE IN BUKIT PUNGGOR, MALACCA,
PENINSULAR MALAYSIA - A DISCUSSION

C.S. HUTCHISON, Dept. of Geology, University of Malaya, Kuala Lumpur

Sir,

I would like to offer the following comments on the paper "A chromium-nickel laterite in Bukit Punggor, Malacca, Peninsular Malaysia" by B.K. Tan. Warta Geologi, vol. 8, no. 2, Mar-Apr 1982, 42-46.

1) The chemical analyses need some comment because no mention is made of the sample preparation techniques, only that atomic absorption spectrometry was used. I raise this point because analysis of Cr, Ni and Co can often be notoriously unreliable unless certain precautions are made to avoid sample contamination. For example, severe chromium contamination may be introduced by grinding in Colmonoy or chrome steel vessels, and nickel is usually strongly introduced by grinding in Colmonoy vessels before digestion (Hutchison, 1974, p. 127). Some alloys may also introduce cobalt in the grinding process. Therefore, precautions need to be made to prevent possible contamination of these elements.

2) The title of the paper is misleading, for a maximum Cr content of 0.38% and maximum Ni content of 0.09% do not make this a chromium-nickel laterite. B.K. Tan refers solely to Park and MacDiarmid (1964) for information on nickel laterite. There are excellent and more authoritative papers by, for example, Trescases (1973), Reynolds, *et al.*, (1973) and Golightly (1979), which provide better background information on nickel laterite. Nickel is not known to be enriched 10 to 30-fold, as expressed, but commonly is enriched from 0.44% in the fresh peridotite by a 7-fold enrichment to typical in situ laterite ore values of 2.7% NiO. This leads me to compare B.K. Tan's analysis of the Telok Mas serpentinite (Cr 0.40%) with his laterite. It is noted that the laterite is not enriched in nickel but strongly depleted (maximum laterite content 0.09%) with values as low as 0.01% nickel (assuming that serpentinite is the parent rock). If the laterite is derived from an ultrabasic parent, then it must represent the upper levels of a weathered profile, but the low chromium contents cast doubt on this possibility.

There are two types of in situ laterite horizons. One is high in SiO₂ and MgO and low in Fe₂O₃ contents. It occurs low in the weathering profile, is green in colour and garnierite is visible. The second is low in MgO and SiO₂ and high in Fe₂O₃. It occurs high in the weathering profile, is red or reddish brown and no garnierite is visible. B.K. Tan mentions a green colour in some of the laterite.

Even when nickel laterite has been eroded, transported and sedimented, as in central Greece at Agios Ioannis, there is also a vertical chemical zonation (Mossoulos, 1964). More than 10 meters thickness of stratified laterite contains uniform Cr₂O₃ contents of 2 to 2.5%. The NiO content varies from 0.5 to 6.0%, and is richest at the bottom, showing that leaching after sedimentation is also important in producing ore grades low in the profile.

Cr_2O_3 is always strongly enriched in the upper parts of in situ profiles (Trescases, 1973, Golightly, 1979) and in the transported laterites, chromium values are high throughout (Mossoulos, 1964). Where NiO values are low, typically Cr_2O_3 exceeds 4%. B.K. Tan's highest Cr value is only 0.38% and his values dip to as low as 0.01%. Such low values may have been introduced by grinding before analysis, but even assuming that they are real, such low values, in conjunction with the low Ni values, preclude this from being named a nickel laterite, and even make it unlikely that the parent rock is ultrabasic, as is proposed.

The reported iron analyses leave us in further doubt. Near surface goethite-rich laterites normally cluster at Fe 40 to 47%, whereas the underlying horizons may range to as low as 8 to 18% Fe (Reynolds *et al.*, 1973). Only one reported analysis reaches 43.2% Fe, but values dip to as low as 4.0%, a value which is not at all characteristic of laterite. The New Caledonia nickel laterite has been referred to by Dr. B.K. Tan. Throughout its profiles, Fe_2O_3 normally exceeds 70%, dipping to low values only near the fresh peridotite, where the horizons are nickel rich.

Goethite is the major mineral in the upper parts of a laterite profile formed over ultrabasic rocks, and the reported 4 to 10% Fe contents cannot be of goethite-rich material. The low Cr and Ni values of the Malacca laterite cannot be attributed to an elongated period of leaching, for this is the very process that is responsible for laterite formation and therefore elongated leaching cannot account for the very low Cr values. The underlying source rock may itself be low in Cr and may be basic rather than ultrabasic.

3) With such disappointing material as reported by B.K. Tan, the recommendation to drill the laterite can have nothing than purely academic interest. Nickel laterites are not of any economic values unless they cap extensive plateau topography (in the case of autochthonous laterites), or form extensive sedimentary basin deposits (in the case of allochthonous laterites). The only potentially mineable deposit in Malaysia is at the Tavai Plateau of Sabah, where laterite extends over an area of 15 km². Prospecting by Borneo Mining Ltd in 1962 indicated over 200 million tons of nickeliferous laterite, containing 0.4 to 0.55% Ni and 40 to 49% Fe (Wilford, 1967).

4) The area shown on B.K. Tan's map is interesting, nevertheless, for its variety of rock types. In addition to the serpentinite occurrence in the borehole at Telok Mas, metabasites have been mapped and reported by me from Bukit Larang (Hutchison, 1973, p. 299). "The Bukit Larang amphibolite is a crudely foliated amphibolite composed essentially of bytownite feldspar, An_{74} , and both actinolite and hornblende. The brown pleochroic hornblende becomes opaque and clouded with magnetite dust as it is replaced by bright green fibrous actinolite. Accessory apatite is common". B.K. Tan reports that Dr. T.T. Khoo collected a specimen from Bukit Larang and found it to be gabbroic, in agreement with my published observations.

This area of Malacca, therefore, has similarities with other northwards extrapolations of the Bentong-Raub Line, in which ultrabasic rocks occur in association with metabasites (e.g. Richardson, 1939). The Telok Mas - Bukit Larang areas of Malacca may be taken as the most southerly known extrapolation of the Bentong-Raub Line, and therefore worthy of further study, as recommended by B.K. Tan.

22 June, 1983

References

- Golightly, J.P., 1979. Nickeliferous laterites: a general description. In: Evans, D.J.I., Shoemaker, R.S. and Veltman, H. (eds.) International Laterite Symposium Soc. Mining Eng. Amer. Instit. Min. Metall. Petrol. Engineers, New York, 3-23.
- Hutchison, C.S., 1973. Metamorphism. In: Gobbett, D.J. and Hutchison, C.S. (eds.) Geology of the Malay Peninsula. Wiley-Interscience, New York, 253-303.
- Hutchison, C.S., 1974. Laboratory Handbook of petrographic techniques. Wiley-Interscience, New York. 527 p.
- Mossoulos, L., 1964. Les gisements lateritique de fer chromonickelifere de Greece. Woodtli, R. (ed.). Methods for prospection for chromite. Organization for Economic Co-operation and Development, Paris, 61-77.
- Park, C.F. and MacDiarmid, R.A., 1964. Ore deposits. W.H. Freeman, San Francisco, 475 p.
- Reynolds, C.D., Havryluk, I., Bastaman, S., and Atmowidjojo, S., 1973. The exploration of the nickel laterite deposits in Irian Barat, Indonesia. Geol. Soc. Malaysia Bull. 6, 309-323.
- Richardson, J.A., 1939. The geology and mineral resources of the neighbourhood of Raub, Pahang, Federated Malay States. Geol. Surv. Dept. Federation of Malaya, Mem. 3, 166 p.
- Trescases, J.T., 1973. Weathering and geochemical behaviour of the elements of ultrabasic rocks in New Caledonia. In: Fisher, N.H. (ed.). Metallogenic provinces and mineral deposits in the south-west Pacific. Bur. Mineral Resources Geol. and Geophys. Bull., 141, 149-161, Canberra.
- Wilford, G.E., 1967. Iron and nickel prospecting at Tavai Plateau 1962-1964, Sabah. Geol. Surv. Malaysia Bull. 9, 80-87.

** This letter has been edited according to the suggestions and recommendations of the Editorial Advisory Board*



QUALITY CONTROL LABORATORY

ANALYTICAL & CONSULTING CHEMISTS

FULLY EQUIPPED TO SERVE:
AGRICULTURE, MINING, INDUSTRY AND COMMERCE

- AUTHORIZED LABORATORY FOR SMR
- MINERAL AND ORE ANALYSIS
- METAL AND ALLOYS
- PALM OIL/EDIBLE OILS
- ANIMAL FEED STUFFS/FOODSTUFFS
- WATER/EFFLUENTS
- SOIL FOR CIVIL ENGINEERING
- SOIL/LEAF
- INDUSTRIAL RAW MATERIAL ETC.

For More Information Call: —

04-301 281

1281, JALAN BHARU, CHAI LENG PARK, PRAI,
PENINSULAR MALAYSIA.

A DIVISION OF
RAHMAN HYDRAULIC TIN BERHAD

A CHROMIUM NICKEL LATERITE IN BUKIT PUNGGOR, MALACCA, PENINSULAR MALAYSIA - A REPLY

B.K. TAN, Dept. of Geology, University of Malaya, Kuala Lumpur

Sir,

The comments of Hutchison in no way alter the ultramafic patentage of the Bukit Punggor laterite and the first reported occurrence in Peninsular Malaysia of a thick lateritic soil derived from ultramafic rocks is geologically of some significance to Malaysian Geology. The preliminary paper makes no claim that this laterite is a proven ore body though the title chosen for the paper may be viewed in a different perspective by certain people. The question of nomenclature is involved in this choice of title. There is no strict definition of a chromium nickel laterite similar to the case of a lack of a universally agreed definition of what constitutes an ore body. The metal content is only one of the important factors, the others being the market price, the technology available, the tonnage, locality and other factors. The comments of Hutchison support my conclusion that the subject of my paper is worthy of further studies.

For the Bukit Punggor studies the specimens being mainly lateritised soil are comparatively soft and no grinding is necessary. Since my preliminary paper, I have carried out further analyses and the presence of Cr, Ni and Co has not only been definitely confirmed but the values for the individual metals can be appreciably higher than those earlier reported. However, these results will be reported later in a separate paper.

Hutchison's reference to other works on this subject appears irrelevant since only surficial or near surface samples can be collected in Bukit Punggor whereas in the well studied examples, the complete soil profile has been studied. It is also well known that weathering characteristics vary widely over different regions due mainly to climatic conditions and the nature of the bedrock. The possibility of the Malacca laterite being transported rather than being weathered *in situ* also adds to the difficulties of direct correlation.

Hutchison's reference to the Bukit Larang amphibolite is interesting. I am aware of his reference to this amphibolite but I did not mention it in my paper for the simple reason that in spite of an exhaustive search of the Bukit Larang area, no amphibolite was found. What was found and reported are a few small boulders of gabbroic rocks. From the nature of the terrain, it seems likely that if amphibolites were found here they would be in the form of boulders and not outcrops.

Even if the results from the soil profile confirm that the laterite is not economically viable of nickel, rock core samples could be useful for the extrapolation of the Bentong-Raub Line.

10 Jan 1983

* *This letter has been edited according to the suggestions and recommendations of the Editorial Advisory Board*

P E R H U B U N G U N L A I N
(O T H E R C O M M U N I C A T I O N S)

PENINSULAR MALAYSIA PLACE-NAMES

YONG, S.K., Geology Department, University of Malaya, Kuala Lumpur

The second year undergraduates of the Geology Dept., University of Malaya went to the east coast of Peninsular Malaysia, south of Kuantan, on a nine-day geology fieldtrip in August 1982 in the company of Prof. Charles Hutchison, Mr. Lee Chai Peng and visiting Fulbright Professor, Prof. Bruce Nelson and Mrs. Nelson.

Stops were made at a number of places, others we just passed through, read about or heard about. The names of the places relate to the history, language, culture, social, geography and geology of the peculiar locality. Heading towards the town of Pedas (Fig. 1) on the way to Segamat from Kuala Lumpur a topic of conversation arose on the probable origin of the name Pedas. It means in Malay hot, producing a burning sensation like when eating chillies. Of particular interest to geologist is a name like Sg. Besi, Kuala Lumpur where tin is found instead of iron as the name suggests. Perhaps it relates to the iron foundaries found there. There again the name Bukit Timah, Singapore can be misleading. Teluk Anson, Perak is recently renamed Teluk Intan. However there is no wish to see the name of Scrivenor Club of the Geology Department changed to Geology Club because of historical reasons.

Before reaching Segamat we passed through Gemas. The original name of the town was Kg. Ayer Terap but the whole area nearby was known as Gua Mas for there were large caves where Chinese prospectors dug and panned for gold. 'Gua' was pronounced as 'geh' by the Khek Chinese and Gua Mas became Geh Mas and with the English influence finally became Gemas.

The first stop of the fieldtrip was Segamat. According to Durai Raja Singam in his book "Place-Names in Peninsular Malaysia", 1980, it was during the Portuguese invasion of Malacca in the sixteenth century that a certain nobleman fled from Malacca with some followers. He fell ill on the way and arriving at a certain place he halted, rested and bathed in a nearby stream. After a few days he felt much better segara amat badan ku and decided to make his home there. This place is Segamat and the stream concerned is Sg. Segamat.

We made our first overnight stop at Kota Tinggi, which means high fort. An ancient settlement existed here with pottery and beads excavated dating back to the beginning of the Christian era. There were proto-historic sites going back to the Han times (200 BC - 200 AD) and possibly even earlier. Kota Tinggi has been identified with 'Palanda' in Ptolemy's days. Most of the beads and rough gemstones excavated were early Indian but there were some beads identified as coming from the Roman Empire during the first two centuries of the Christian era.

From Kota Tinggi we journeyed to the southern tip of the Asia mainland, Teluk Ramunia, in southeast Johore. Ramunia, *Bouea burmanica* is the name of a small edible fruit. The southernmost point of Asia, however is not Teluk Ramunia but Teluk Piai in southwest Johore. Piai is a common swamp plant.

Next we stopped at Mersing, our first east coast town. It is said that a Sikh, Amer Singh, an employee of a former Sultan of Pahang took refuge here for an offence he had committed. Mersing was derived from Amer Singh so the story went. From Mersing beach at the rest house Pulau Tioman can be seen. The name Tioman the largest of a chain of volcanic islets lying off the coast of Pahang is derived from Tiongman or Tiong Man meaning 'my tiong' referring to a boy chasing his bird, a tiong. It is said about one thousand years ago, a female dragon was on her way to be married to a male dragon in the north. Near where the island is today, she dropped her earrings and shawl (selendang). Just as she stooped to pick them up, the cock on her back crowed to show that it was daylight. Unfortunately her feet became entangled in the corals below, and when night came, she found that she could not move. The dragon, the story goes, turned into an island, Pulau Tioman.

We continued our east coast trip from Mersing towards Kuala Rompin en route to Kuantan. About 80 years ago there was a casuarina tree, pokok rhu, at the mouth of the river, Sg. Rompin. It was tall and leafy and from afar it looked like a person with very small hips, ramping. The river was therefore called Sg. Ramping which became Sg. Rompin. Kuantan as a merchant seaport may have already flourished in the first millenium, as mentioned in Chinese and Ptolemaio sources. Apparently the name Kuantan is only about a century old and previously it was known as Teruntang or Teruntum, a small tree growing on muddy ground. A party of Malays from a district named Kuantan in Sumatra arrived in Pahang about the year 1854. They settled at a site of the present Sg. Lembing town further upriver from the already existing Kampung Teruntum colonised by settlers from Trengganu. The Trengganu settlers called the new kampung upriver Kampung Orang Kuantan which was shortened to Kuantan. Today a shopping Complex Teruntum stands in the heart of Kuantan Town. There is also a Taman Teruntum, a park.

Sg. Lembing is the only existing underground tin mine in Malaysia. It is situated on the river Sg. Kenan and there is no river called Sg. Lembing. Lembing in Malay means spear and prehistoric spear implements had been found here. It seems very possible that the name is a Chinese name and may originally have been something like 'Lam Beng's Sungei' or 'Sungei Lam Beng'. Many places around this locality are still known by the names of old Chinese miners who worked here previous to 1883, that is before the Europeans began mining in the area.

From Kuantan we went passed through Beserah and beyond to Batu Hitam with its dark basaltic rocks. In the early days a devout Haji was invited to come and live at Kg. Teruntum. However he did not stay permanently at Teruntum but instead decided to settle at a place near Batu Hitam. As the place was overrun by wild animals and was unhealthy he was persuaded not to start a kampung there but he answered that he entrusted himself to God's keeping, *kepada Allah sehayya berserah*. Hence the kampung came to be known as Beserah.

From Kuantan we journeyed inland towards Gambang where we made a special stop to see the Malayanite tektites but they were no longer available from the tin mines there as they are now closed down. Gambang refers to a Javanese gamelan musical xylophone instrument.

We passed through Kg. New Zealand, Maran, Temerloh and Jengka Pass and finally arrived at Mentakab. Kampung New Zealand is a new kampung named in honour of New Zealand for their donation and provision of experts to develop a rubber plantation there. Maran may have been after an

aborigine. Temerloh at the confluence of Sg. Semantan and Sg. Pahang is also called Kuala Semantan. Temerloh means to fall asleep unintentionally. Several years ago there was a big durian plantation on the Temerloh island owned by a Malay chief who employed an aborigine to collect the fruits in the morning. Normally the collection was good but one day only a few durians were collected. The aborigine when asked for an explanation admitted that while he was asleep thieves had stolen them. His actual reply was, "Termerloh, Dato!" From Temerloh we journeyed along the Jerantut road with no intention of falling asleep in search of a road exposure that no longer existed. Jerantut is a corruption of the words Jeram Pa' Tut. An old resident Pa'Tut once lived near a jeram, or rapid. According to another resident in Mentakab, the town then a village was suppressed by a ruthless chief long ago. Tekab means to suppress. Jengka or jongka is an aboriginal word for a wooden trestle while jangka in Malay means long-term.

We returned to Kuala Lumpur from Mentakab via Bentong. The Chinese under Dr. Loke Yew built up the town first known as Kg. Buloh Betong. The Chinese called it Muntong and eventually it became Bentong. This journey of place-names is not complete without Kuala Lumpur. It means a muddy confluence of two rivers or taking a clue from a Frenchman arriving to see the pollution of the city: why, Kuala L'impure.

Article received 28 September, 1982.

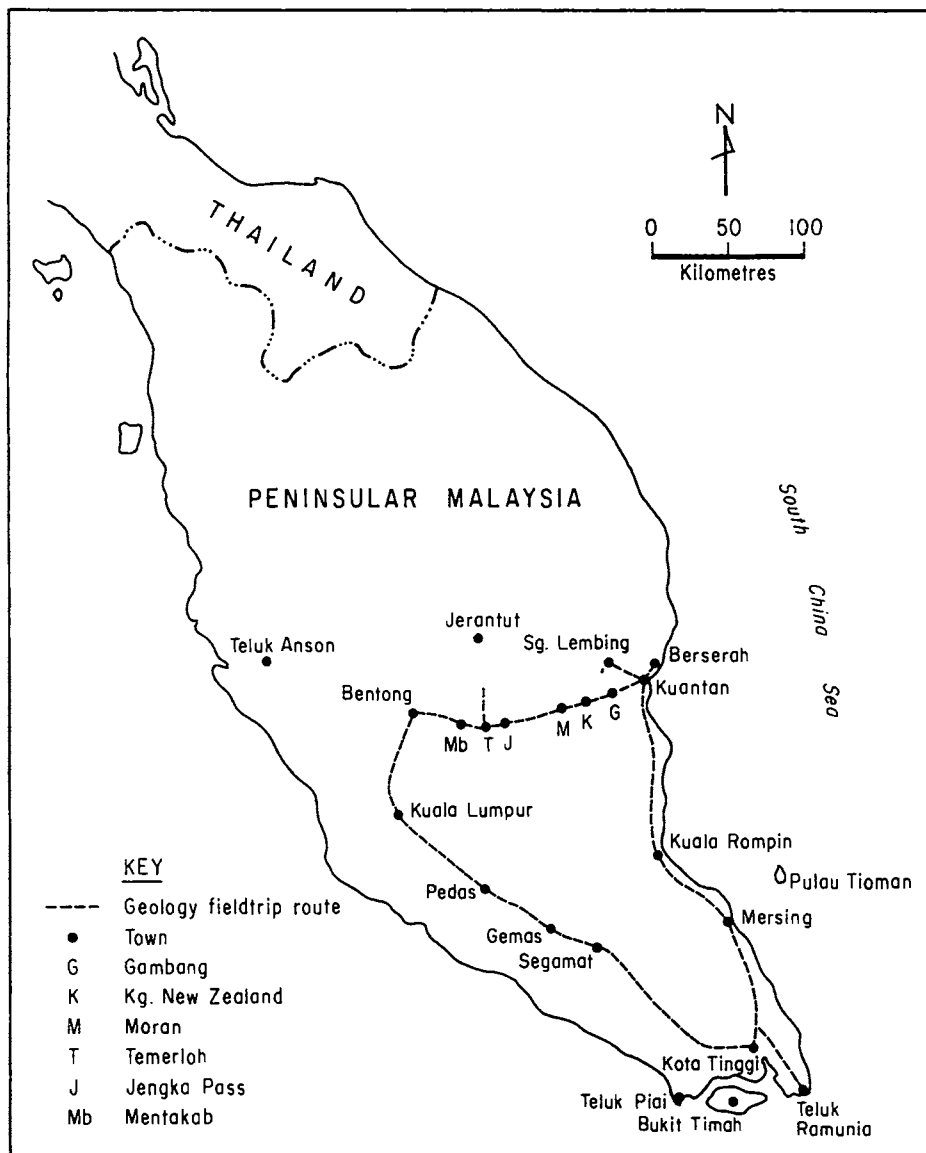


Fig. 1. Location map.

PERSATUAN GEOLOGI MALAYSIA

Geological Society of Malaysia



ADVERTISING SPACE ORDER FORM

I/We would like to take up advertising space in the following issues of WARTA GEOLOGI.

Please tick as appropriate:

WARTA GEOLOGI, Vol. 9, No. 1 (Jan-Feb 1983)

WARTA GEOLOGI, Vol. 9, No. 2 (Mar-Apr 1983)

WARTA GEOLOGI, Vol. 9, No. 3 (May-Jun 1983)

WARTA GEOLOGI, Vol. 9, No. 4 (Jul-Aug 1983)

WARTA GEOLOGI, Vol. 9, No. 5 (Sep-Oct 1983)

WARTA GEOLOGI, Vol. 9, No. 6 (Nov-Dec 1983)

Other issues (specify year and month)

.....

.....

Charges for black and white:

Full inside page M\$300 per issue or M\$1,600 for 6 issues

Half inside page M\$200 per issue or M\$1,000 for 6 issues

Charges for colour:

Full inside page M\$600 per issue or M\$3,500 for 6 issues

Half inside page M\$500 per issue or M\$3,000 for 6 issues

Name of Company

Designation

Enclosed cheque/money order/bank draft No. for M\$

.....
(Signature)

Please send this completed order form together with remittance to:

The Editor
Geological Society of Malaysia
c/o Dept. of Geology
University of Malaya
Kuala Lumpur 22-11, Malaysia

P E R T E M U A N P E R S A T U A N
(M E E T I N G S O F T H E S O C I E T Y)

TECHNICAL TALK

C.R. JONES: Geological and mineral exploration of the Kalahari, SW Africa

Dr. C.R. Jones, presently Regional Geologist Asia and the Middle East, Overseas Division, Institute of Geological Sciences, London, is no stranger to Malaysia for he is well-known for his classic memoirs of the Grik and Langkawi/Perlis areas and his studies on the Lower Palaeozoic of Peninsular Malaysia are significant contributions towards the understanding of Malaysian geology.

About 30 members were present at the Dept. of Geology, University of Malaya, on Friday, 19 November 1982 to take advantage of one of the rare opportunities to meet and listen to Dr. Jones.

In his talk Dr. Jones gave details of the Survey's exploration and mapping of Botswana with emphasis on the largely unexplored Kalahari Desert. The geology was explained with a series of colour slides and satellite photographs. The oldest rocks in the country are Archean metamorphics forming the basement and this is overlain by the Karroo rocks which include the Dwyka tillites, Ecca clastics and Beaufort sandstone. Younger sediments are generally flat lying. Other interesting geology include the discovery of a possible failed third arm of a rift and the geomorphology of 'ancient' dune fields.

The main economic deposits exploited at present are diamonds from kimberlite pipes, coal from the Ecca and salt, potash, soda ash from inland lakes. Revenue from mining contributes significantly to the economy of Botswana which is one of the relatively more prosperous African country (population $\frac{3}{4}$ million). Notwithstanding, mineral exploration of the relatively unexplored Kalahari which covers about 80% of Botswana is being encouraged. To attract mining companies to invest in mineral exploration of the Kalahari, the Survey has undertaken geological and geophysical surveys of the region. Airborne geomagnetic and gravity surveys have been completed and many potentially interesting areas have been identified. In addition funds from various countries such as Canada, Germany, and Japan have been obtained for drilling and other projects to provide more details of the mineral potential of the Kalahari. To date, however, there has yet to be a 'rush' to take up concessions for exploration by mining companies as the Kalahari is rather inhospitable and an expensive area to explore. However, considering the trend of mineral belts in neighbouring Zimbabwe, Namibia and South Africa, Dr. Jones is of the opinion that the Botswana Kalahari is potentially mineral-rich.

T.T. Khoo

ROCKCON TRAINING COURSE AND SYMPOSIUM - REPORT AND ABSTRACTS

The *ROCKCON Training Course* was held on 26 Nov - 6 Dec 1982 at the Dept. of Geology, Univ. of Malaya. It was attended by a total of 28



C. R. JONES



participants comprising of geologists and civil engineers from Malaysia, with one each from Indonesia and Thailand and two from the Philippines. Lecturers for the Course consist mainly of local geologists and civil engineers and also include three instructors from overseas. A wide spectrum of topics on rock as construction materials was covered in the lectures (see details of training course program), including some film shows, site visits and laboratory tests. One of the key features of the training course was the very lively discussions that followed every lecture, with contributions or comments coming from the participants as well. The relatively small number of the class also enabled a close exchange of ideas and experiences among the participants.

The *ROCKCON Symposium* was held on 30 Nov. - 1 Dec. 1982 at the Federal Hotel, Kuala Lumpur, in conjunction with the training course. 15 papers were presented in the Symposium, dealing with the same theme of rock as construction materials (see Symposium program for details of papers and abstracts). The Symposium was attended by about 80 people, consisting again of geologists, mining and civil engineers. There was again lively discussions following each paper presentation.

In conclusion, the ROCKCON Training Course and Symposium have, at least brought together engineers and geologists to promote a better understanding and rapport between the two groups of professionals. The Society would, undoubtedly, continue its efforts in promoting engineering geology/geotechnical engineering by organising similar training courses/symposia/seminars in the future.

Finally, I would like to thank the sponsors, Association of Geoscientists for International Development (AGID), Australian Development Assistance Bureau (ADAB) and the University of Malaya, all parties involved and members of the organising committee for making all this possible and in particular to Dr. T.T. Khoo, Dr. E.B. Yeap and Anna Lee for the tremendous efforts they have put in in seeing through every detail of the organizational work.

Acknowledgement

The following organizations and private firms which have contributed one way or another to the Training Course and Symposium are cordially acknowledged:

1. Geological Survey Malaysia
2. Geology Department, Universiti Kebangsaan Malaysia, Bangi
3. Faculty of Engineering, University of Malaya
4. Geology Department, University of Malaya
5. Jabatan Kerja Raya, Malaysia
6. Juta Industries Sdn. Bhd., Petaling Jaya
7. Juta Quarry Sdn. Bhd., Sungei Way
8. Tenaga Kimia Sdn. Bhd., Petaling Jaya
9. Associated Tractors Sdn. Bhd., Petaling Jaya
10. Batu Arang Bricks and Tiles Bhd., Kuala Lumpur
11. Hume Industries (M) Sdn. Bhd., Petaling Jaya
12. Tahir Wong Sdn. Bhd., Sungei Way
13. Associated Pan Malaysia Cement Sdn. Bhd., Kuala Lumpur
14. Nutritional Products Sdn. Bhd., (Nestle), Kuala Lumpur
15. Mara Institute of Technology, Shah Alam

Quotable Quotes

1. *The truth is in the stripping* Y.K. Shu, while lecturing on the rippability of rocks at the ROCKCON Training Course.
2. *A short course is like a miniskirt. It must not be too long as to be boring; yet it must be long enough as to cover all important parts.* T.T. Khoo, in his closing remarks for the ROCKCON Training Course.
3. *We must update the out-dated* T.T. Khoo, opening speech for ROCKCON Symposium.
4. *What is a tunnel? A tunnel is a long hole where at one end is a geologist and at the other end is a lawyer.* Prof. Leopold Muller (Father of Rock Mechanics) at the 4th IAEG Congress Special Lecture in New Delhi.

Tan Boon Kong

TRAINING COURSE ON ROCK AS CONSTRUCTION MATERIALS: PROGRAMME

Friday, 26 Nov. 1982

- | | |
|------------|--|
| 9.00 a.m. | Final registration of participants at the Geology Department, University of Malaya, Kuala Lumpur |
| 10.00 a.m. | Address by the President of the Geological Society of Malaysia |
| 10.15 a.m. | Address by the AGID representative |
| 10.30 a.m. | Address by Chairman, Organising Committee of the Rockcon Training Course |
| 10.45 a.m. | Tea break |
| 11.00 a.m. | Lecture 1
Classification of construction materials
Clutterbuck |
| 12.30 p.m. | Lunch break |
| 2.00 p.m. | Lecture 2
Engineering use and requirements of construction materials
Clutterbuck |

- 3.30 p.m. Tea break
- 3.45 p.m. Lecture 3
Materials for pavement: crushed rock aggregates
Clutterbuck
- Saturday, 27 Nov. 1982
- 8.30 a.m. Lecture 4/5
Material testing - physical and mechanical tests
Yudbir
- 10.30 a.m. Tea break
- 11.00 a.m. Lecture 6
Sample selection
Yudbir
- 12.30 p.m. Lecture 7
Interpretation of tests
Yudbir
- 1.30 p.m. Lunch break
- 2.30 p.m. Lecture 8
Materials for pavements: deficiencies and their treatments
Clutterbuck
- 4.00 p.m. Tea break
- Sunday, 28 Nov. 1982
- 8.30 a.m. Lecture 9
Material testing: chemical and durability
Clutterbuck
- 10.00 Tea break
- 10.15 a.m. Lecture 10
Principles of crushing and crushing equipment
M.T. Koh
- 11.45 a.m. Lecture 11
Processing of aggregates/Quarry Plant
A.M. Tan/T. Choy
- 1.00 p.m. Lunch break
- 2.00 p.m. Lecture 12
Economic aspect of aggregate processing
A.M. Tan/T. Choy
- 3.30 p.m. Tea break
- 3.45 p.m. Lecture 13
Aggregates and application in construction industries
A.M. Tan
- Monday, 29 Nov. 1983
- 8.30 a.m. Lecture 14
Location and selection of material sources
Clutterbuck
- 10.00 a.m. Tea break

- 10.15 a.m. Lecture 15
Quarry investigation - its approach and evaluation
Y.K. Shu
- 11.45 a.m. Lecture 16
Exploitation and utilization of construction materials -
land matters
Y.F. Wong
- 1.00 p.m. Lunch
- 2.00 p.m. Lecture 17
Excavation. From soil excavation to ripping
Stig. Olofsson
- 3.30 p.m. Tea break
- 3.45 p.m. Lecture 18
Excavation by blasting
Stig Olofsson

Tuesday, 30 Nov. 1982
SYMPOSIUM AND EXHIBITION

Wednesday, 1 Dec. 1982
SYMPOSIUM AND EXHIBITION

Thursday, 2 Dec. 1982
SYMPOSIUM AND TRAINING COURSE FIELD VISITS
Visit to (1) Juta Industries Quarry, Sungei Way
(2) A.P.M.C. Works at Rawang
(3) Hume Industries -Pre-stressed concrete plant
(4) Tenaga Kimia Explosive Plant (Batu Arang)
(5) Batu Arang Bricks Factory

Friday, 3 Dec. 1982

- 8.30 a.m. Lecture 19
Explosives and correct use of explosives
Stig Olofsson
- 10.00 a.m. Tea break
- 10.15 a.m. Lecture 20
Blasting practices for excavation and quarrying
Stig. Olofsson
- 11.45 a.m. Lecture 21
Asphalt premix manufacturing and asphalt premix plant
Rep. of ATSB
- 1.00 p.m. Lunch
- 2.00 p.m. Lecture 22
Sampling and asphalt premix tests
- 3.30 p.m. Tea break
- 3.45 p.m. Lecture 23
Statistical quality control of tests

Saturday, 4 Dec. 1982

Morning Demonstration
Soil and road aggregate tests
M.S. Subrahmanyam
Civil Eng. Dept., University of Malaya

Afternoon Concrete aggregate and strength tests
M.S. Subrahmanyam
Civil Eng. Dept., University of Malaya

Sunday, 5 Dec. 1982

Morning Demonstration
Blasting techniques in quarry operation at Juta Quarry,
Sungei Way. Drilling carried out by Ingersool Rand
Stig Olofsson

Seismic methods
John K. Raj/Samsudin Hj. Taib

Afternoon Demonstration
Site visit to the Federal Highway (renovation in progress)
C.I. Lim

Monday, 6 Dec. 1982

8.30 a.m. Demonstration/Film show
University of Malaya

10.00 a.m. Tea break

10.15 a.m. Lecture 24
Concrete
C.M.M. Aboo Bucker

10.45 a.m. Lecture 25
Concrete application
C.M.M. Aboo Bucker

1.00 p.m. Lunch break

2.15 p.m. Lecture 26
Types of cement and manufacture of cement
Kidav

4.00 p.m. Closing of training course
(i) Address by Organising Chairman
(ii) Closing by the President of the Geological Society
of Malaysia

SYMPOSIUM ON ROCK AS CONSTRUCTION MATERIALS: PROGRAMME & ABSTRACTS OF PAPERS

Date: 30th November 1982 and 1st December 1982

Venue: Banquet Hall, Federal Hotel, Kuala Lumpur

Tuesday, 30th November 1982

8.30 a.m. Late registration

9.00 a.m. Opening Ceremony
i) Address by Chairman, Organising Committee, ROCKCON 1
ii) Address and opening of Symposium by the President,
Geological Society of Malaysia

9.30 a.m. Geologic aspects of material requirements in road construction specification: P.J. Clutterbuck

10.10 a.m. Geotechnical problems associated with construction of major structures over subsurface marble bedrock: Tan Bock Kang

- 10.50 a.m. Tea break
- 11.20 a.m. Engineering properties of weathered granite profiles -
A preliminary study: Ibrahim Komoo
- 12.00 noon Weathering and rock strength: John Kumaraj
- 12.40 p.m. Lunch break
- 2.00 p.m. Dimension stone industries of Peninsular Malaysia: E.B. Yeap
- 2.40 p.m. Extraction of sand and gravel in Peninsular Malaysia: P.C. Aw
- 3.20 p.m. Tea break
- 3.50 p.m. Construction materials for the Sembrong & Bekok Dams, Johore:
Au Yong Mum Heng & Tan Boon Kong

Wednesday, 1st December 1982

- 9.00 a.m. Closure of Batu Caves Quarries and alternative rock sources
for the Federal Territory: P.C. Aw
- 9.40 a.m. Material survey for the Kemasin - Semerak Project, Kelantan:
Tan Boon Kong
- 10.20 a.m. Tea break
- 10.50 a.m. Emulsion explosives in rock excavation: Stig Olofsson
- 11.30 a.m. Seismic refraction surveys in areas of tropical weathering
and rugged topography: An example from a damsite investi-
gation in Pahang, Malaysia: C.A. Foss & K. Preamakanathan
- 12.10 p.m. Lunch break
- 2.00 p.m. Weathering profiles over granite bedrock - morphological
zones, seismic velocities and excavability: John Kumaraj
- 2.40 p.m. Conservation and management of construction materials:
Mohd. Ali Hasan
- 3.20 p.m. Tea break
- 3.50 p.m. Exploitation of construction materials and their relation
with geological environments: Agus P.P. Brotodihardjo
- 4.30 p.m. Closing remarks - Rockcon Organising Chairman

Geological aspects of materials requirements in road construction specifications

P.J. CLUTTERBUCK, Main Roads Department, Queensland, Australia

Economic construction of major engineering projects relies on the optimum utilisation of locally occurring natural construction materials.

Specifications are normally used to stipulate the project requirements and may be based on materials and methods, end products or performance criteria. It is considered that a thorough knowledge of geology and laboratory testing procedures is essential in the development of the material requirements or specifications. The adoption of specifications from other countries, often in different climatic environments, or from different applications is considered inappropriate in some cases.

The influence of rock type and weathering state and the applicability of results of various laboratory tests on construction materials are reviewed. These influences are considered in the context of their implications on adopted tests, and limiting values imposed in specifications for construction materials.

It is concluded that rock type and weathering play a fundamental role in the behaviour of construction materials in laboratory tests and thus influences the applicability of laboratory tests in specifications for construction materials. Adequate assessment of proposed and existing material sources is proposed.

Geotechnical problems associated with construction of major structures over subsurface marble bedrock

TAN BOCK KANG, Jabatan Geologi, Universiti Malaya, Kuala Lumpur

Surface underlain by marble or limestone bedrock is characterised by morphological, hydrogeological and geotectonical features. Infra-structure development over such areas have frequently encountered problems caused by the Karst morphology of the bedrock. The irregular Karst topography of the limestone surface is noted for the difficulties presented in the foundation stage of the development. Karst areas are also subjected to ground subsidence caused by the collapse of the roof of underground cavities in the bedrock. Cavities develop easily in marble due to the solubility of CaCO_3 . The size and occurrence of such cavities are governed partly by the structures in the limestone, such as joints and faults and partly by the amount of water available for dissolving the limestone and its acidity. Very little work has been done on marble overlain by alluvial sediments in Malaysia although the occurrence of sinkholes and surface cave-in indicate the probability of cavities in the marble bedrock. The presence of such cavities may be detected by various geophysical methods such as microgravitimeter down-hole and electromagnetic devices.

Engineering properties of weathered granite profiles - a preliminary study

IBRAHIM KOMOO, Jabatan Geologi, Universiti Kebangsaan Malaysia, Bangi

Four profiles of weathered granite from Kuala Lumpur - Karak Highway and several borehole data from proposed Mengkuang Dam, Bukit Mertajam, were used for this preliminary study. The samples from various depths along weathered granite profiles were taken and their basic engineering properties investigated. The results show that some engineering parameters were insensitive toward the development of weathering profiles. However the others, for instance the Atterberg limits and grain size distribution are valuable parameters for the development of the weathering profiles.

Weathered granitic soil has been used extensively as "construction material" in this region. It has been used as core and shoulder materials for the earth-filled dam and as filled materials for other engineering projects. Therefore, the investigation of their properties in relation to the development of weathering profiles is significant. Further research in this field will hopefully provide a more detailed and practical engineering classification of weathered rocks.

Weathering and rock strength

JOHN KUNARAJ, Jabatan Geologi, Universiti Malaya, Kuala Lumpur

Weathering of granite (considered on the scale of the hand specimen) follows several stages, each of which is characterized by the extent of staining of rock material and the extent of alteration of feldspar grains. These stages of weathering can also be characterized by simple physical criteria including dry bulk density and total porosity. The uniaxial compressive strength of granitic rock material furthermore shows a distinct decrease with increasing weathering effects (as reflected by increasing stages of weathering).

The dimension stone industry of Peninsular Malaysia

YEAP EE BENG, Jabatan Geologi, Universiti Malaya, Kuala Lumpur

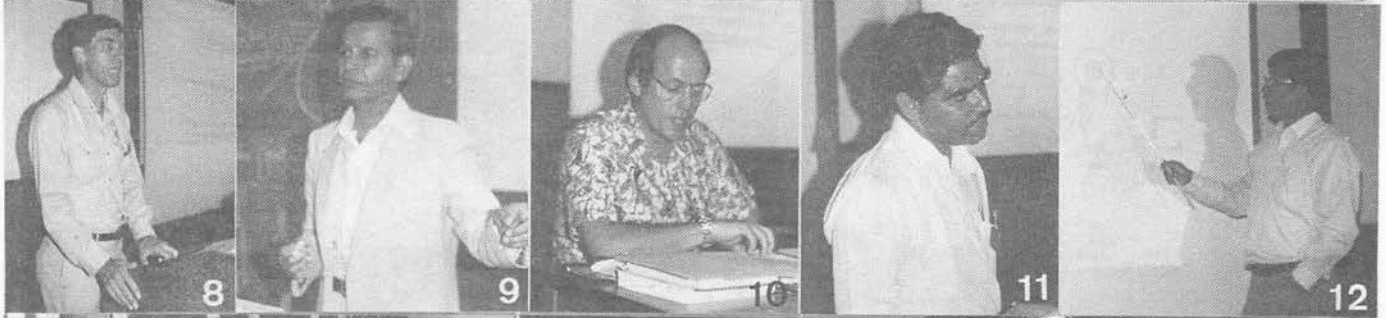
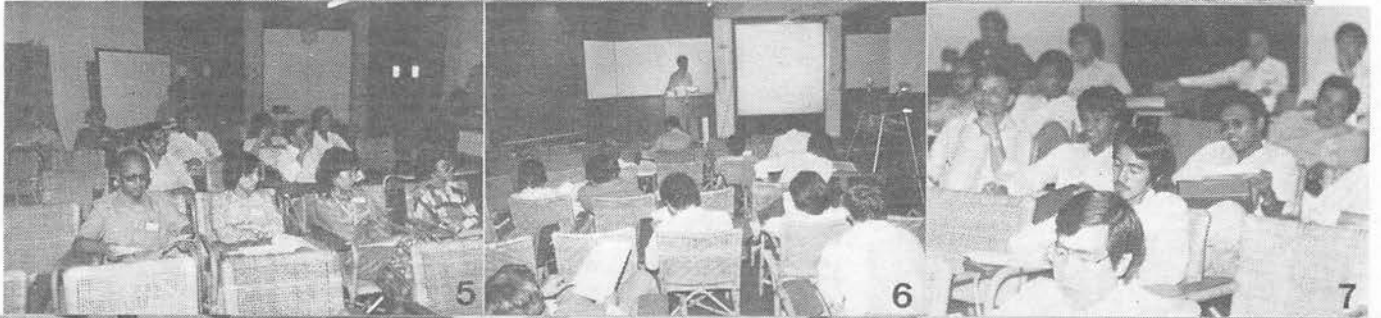
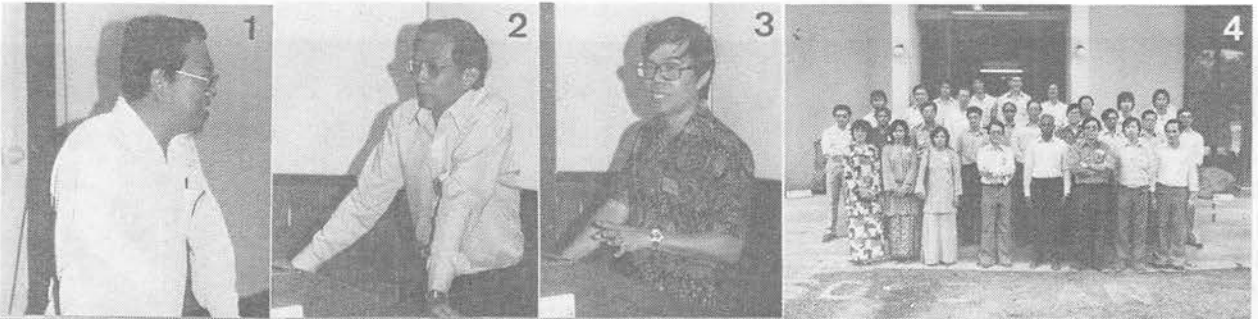
The relatively young dimension stone industry in Peninsular Malaysia is dominated by 4 large companies which produce cut, polished and trimmed-to-size both local and imported marble and other related stones. They produce in total about 46,000 square metres (500,000 sq. ft.) of 16 mm or 19 mm thick polished marble slabs per year largely used for floors, walls and exteriors of prestigious buildings.

Increasing numbers of smaller marble factories, largely concentrated in the Ipoh area, which traditionally produced broken marble, skirtings and marble skins are entering the more lucrative dimension stone market by producing 13 mm thick polished or unpolished marble slabs with dimensions up to 610 mm (2 ft.) by 305 mm (1 ft.).

Consumer preference (for imported marble), architect/decorator recommendation, lower price, poor recovery during processing, lack of variety and inability to produce large quantities of consistent quality weighed against the local marble slab production which within the last few years have captured only 35% of the dimension stone market.

Marble blocks have been successfully quarried from four areas (namely, Langkawi, Baling, Gunung Rapat and Keramat Pulau) for the production of dimension stones. Extraction of blocks is by drilling closely spaced (75 mm) holes followed by wedging. Two attempts to use helicoidal wire saw were unsuccessful although presently a newly formed company is extracting blocks by wire saw in an old block quarry face on Pulau Dayang Bunting, Langkawi.

Processing of the blocks to yield dimension stones involves 3 stages: sawing into slabs, trimming to size, levelling and polishing. Gang and sometimes circular blade saws are used for slab cutting. Gang saws fitted with 30 to 60 diamond impregnated blades are used. Cutting rate ranges from 15 cm to 25 cm per hour. Trimming to size is carried out by circular blade saws of diameters from 200 mm (8 inches) to 915 mm (36 inches) some of which can cut up to 8 slabs in a single pass. Levelling and polishing are carried out by diamond, carborundum and other abrasive compressed or impregnated polishing stones glued onto interchangeable polishing heads fitted to fully or semi-automatic polishers. The polishing consists of 4 or 5 steps using progressively finer grade impregnated abrasives. Finishing stones (last one or two steps) consist essentially of compressed oxalic acid impregnated with very fine graded polishing







ROCKCON - captions to photos

Training Course

- 1 GSM President, T.T. Khoo, addressing the participants
- 2 AGID Representative, B.K. Tan, with his address
- 3 Tan Boon Kong, Organising Chairman, with his speech
- 4 Group photo of some of the participants
- 5 - 7 The Training Course gets underway
- 8 P.J. Clutterbuck with one of his many lectures
- 9 Yudbir on material testing
- 10 Stig Olofsson on blasting practices
- 11 Aboo Bucker on concrete application
- 12 M.T. Koh on crushing equipment
- 13 - 16 Coffee time - time for discussions, exchange of ideas, etc.
- 17 Y.K. Shu on quarry investigation
- 18 Y.F. Wong elaborating on land matters
- 19 - 20 Participants listening and noting down important points
- 21-22 M.S. Subrahmanyam demonstrating the instruments at civil engineering dept., UM.

Symposium and Fieldtrip

- 23 Participants registering for the Symposium
- 24 GSM President declaring open the Symposium
- 25 P.J. Clutterbuck with his paper on material requirements
- 26 B.K. Tan on geotechnical problems over subsurface marble bedrock
- 27 - 28 The audience at the Symposium
- 29 A question from the floor
- 30 Session Chairman, Senathi Rajah lending an ear to the query
- 31 Ibrahim Komoo stressing a point
- 32 Tan Boon Kong locating the Bekok Dam on the screen
- 33 Session Chairman, H.C. Chu, starting off the second session
- 34 E.B. Yeap on dimension stone industries
- 35 Session Chairman, Y.K. Shu, inviting questions or comments for discussion
- 36 C.A. Foss on seismic refraction survey
- 37 P.C. Aw with his paper on the extraction of sand and gravel
- 38 S. Subramaniam with a question for J.K. Raj
- 39 S. Subramaniam taking over as Session Chairman
- 40 Yet another question from the floor
- 41 Mohd. Ali Hasan ably presenting his paper
- 42 Agus Brotodihardjo on exploitation of construction materials
- 43 - 46 Training course and symposium participants on the fieldtrip to Sungei Way Enterprises.

powder. Semi-automatic polishers appear to give a higher quality finish and one person can polish 5.5 to 7.5 sq. m. (60. to 80 sq. ft.) per 8 hour shift.

Imported marble blocks, largely from Italy and other European countries, are extracted by helicoidal or diamond wire saw methods and are more regular in shape (cubic, rectangular). Recovery from imported blocks is 15% to 25% higher than local blocks which generally show joints and cracks.

Most varieties of marble local or imported are unsuitable for exterior facing in the tropical humid and hot climate of Malaysia. There is an increasing trend in the use of imported granites and other igneous rocks, which are more expensive and constitute a few percent of the market, for exteriors.

There are abundant sources of suitable marble, granites and other rocks for the dimension stone industry in Malaysia. Consumers, architects and interior decorators should be exposed to the characteristics, the correct use and maintenance of the local dimension stones. For the good of the industry a more professional approach and better technological know-how (not necessarily totally foreign dependent) should be introduced so that the local dimension stone industry can face the challenges from imported stones, tiles and artificial, compressed and agglomerate marble.

Extraction of sand and gravel in Peninsular Malaysia

AW PECK CHIN, Geological Survey Malaysia, Ipoh, Perak

Extraction of sand and gravel is discussed in relation to the source area, physical and chemical characteristics, production statistics, price and uses. Despite the easy availability of sand/gravel in most places and the comparatively low price, sand/gravel is an under-utilized construction material in Malaysia.

Main source areas are the rivers and the tin mining areas. Extraction of sand/gravel from the rivers is done either by manually or mechanically scooping or pumping it from the river banks or beds. Environmentally, as well as materially, extracting sand/gravel from the rivers is recommended. Environmental impact is low. The resource is not only continually being replenished by water current, removal of sand/gravel also helps to prevent silting and flooding to some extent.

Generally the physical, chemical and mineralogical characteristics of river sand/gravel meet the specifications for most construction purposes. On the other hand, sand/gravel from mining areas and beaches, commonly contain fines and soluble salt respectively, which require washing before it can be used as concrete aggregate.

Production statistics for sand/gravel in 1981 was about 2.8 million tonnes compared to 18.7 million tonnes of crushed stones. Comparing the utilization of crushed stones to sand/gravel which is about 1:1 in the developed countries, the utilization of sand/gravel is very low in Malaysia.

Construction materials for the Sembrong and Bekok Dams, Johore

AU YONG MUN HENG, Kejuruteraan Maju Sekitar Sdn. Bhd., Kuala Lumpur & TAN BOON KONG, Jabatan Geologi, Universiti Kebangsaan Malaysia, Bangi

The Sembrong and Bekok Dams form part of a larger scheme, namely the Western Johore Agricultural Development Project. Initially undertaken by the Drainage and Irrigation Department mainly for flood mitigation, the two dams will now also be utilised for water supply purposes by the Waterworks Department. Sembrong Dam is currently under construction, while construction of the Bekok Dam would commence in the near future.

Detailed site investigations have been carried out for the two projects, including geologic and soil investigations for the dam foundations and related areas. This paper discusses only the investigations for construction materials for the two dams. The construction materials discussed include soil borrow materials for construction of the dams and embankments, sources of sand filters and possibly quarry sites for rock aggregates and rip-rap. Laboratory test results of the various materials are also presented.

Closure of the Batu Caves quarries and alternative rock sources for the Federal Territory

AW PECK CHIN, Geological Survey Malaysia, Ipoh, Perak

This paper examines the effect, if any, of the enforced closure of the Batu Caves quarries has on the supply and demand of construction materials in and around the Federal Territory. The three Batu Caves quarries which ceased rock blasting at the end of 1980 produced a yearly average of 512,500 tonnes of crushed stones between 1978 to 1980. In 1981 these three quarries produced 814,000 tonnes from their stockpiles. Most of the crushed limestone is used as concrete aggregate and road metal in the construction industry. Some of the limestone is used for making quick/hydrated lime, agriculture limestone, calcium carbonate powder, riprap and rock chips for terrazzo tiles.

The supply and demand of rock construction materials can be met by the production from other quarries operating in and around the Federal Territory. There are five other limestone quarries and seven granite quarries. Two other quarries, one limestone and one granite, ceased production since 1981. There are two quarries producing quartz powder for industrial uses. The new Public Works Department granite quarry in Sungai Long will be in operation in the near future.

The five limestone quarries produced a total of 1,553,000 tonnes of crushed stones in 1981. Two of them produced more than half a million tonnes each. Crushed granite from the seven quarries total 1,153,000 tonnes in 1981. Production of crushed limestone from the 5 quarries was nearly double that of the three quarries from Batu Caves. Total production of crushed stones (limestone and granite) from the other quarries was more than 3 times the production from the Batu Caves quarries.

For each unit weight/volume, the price of granite is invariably higher than that of limestone. Depending on the size of the crushed stones, the price of granite may be 5 to 60 percent higher than that of

limestone. The 1981 price list shows that 1 tonne of 10.0 mm (3/8 inch) size aggregate of granite and limestone was \$23/- and \$22/- respectively. For the corresponding 37.5 mm (1½ inch) and 150 - 230 mm (6-9 inch) size aggregate, the price was \$18/- and \$15/- for granite and \$11/- for both sizes of limestone.

Not only is the price of limestone lower than that of granite, for certain uses, however, there is no substitute for limestone. Generally, for concrete aggregate and road-metal, either granite or limestone can be used. Production of lime and terrazzo tiles requires limestone. Limestone is preferred to granite for the construction of riprap.

There should be no shortage in the supply of rock construction materials for the next few years. Any increase in demand can be met by the existing quarries. However, long term supply of limestone is dependent on the Federal Territory and Selangor State planners and authorities. If current areas of quarrying are zoned for resource exploitation, the supply of limestone can be assured for a decade or two to come. There is also an ample reserve of granite.

Material survey for the Kemasin-Semerak Project, Kelantan

TAN BOON KONG, Jabatan Geologi, Universiti Kebangsaan Malaysia, Bangi

The Kemasin-Semerak Project is undertaken by the Drainage and Irrigation Department for flood mitigation and irrigation purposes. The project involves, among other things, the construction of two earth dams, bunds and canals, and three breakwaters at the mouth of the rivers Pengkalau Datu, Kemasin and Semerak in Kelantan. This paper discusses the survey for possible sources of earthfill materials for the dams and bunds, and rock materials for the construction of the breakwaters. Though suitable geologic materials are available for construction purposes, non-geologic factors and economics might dictate the use of alternative materials, as would probably be the case for the breakwaters in the project.

Emulsion explosives in rock excavation

STIG OLOFSSON, Tenaga Kimia Sdn. Bhd., Petaling Jaya

Emulsion explosive, a new generation of water based explosives is composed of separate minute drops of ammonium nitrate solution and other oxidizers densely dispersed in a continuous phase of a mixture of oil and wax. This distinguishes the emulsion from other flowing and plastic explosives as it can be made to detonate without addition of explosive sensitizer. By using different percentages of microballoons and aluminium it is possible to obtain a wide range of emulsion explosives which can either be cap sensitive or booster sensitive. Emulsion explosive can be packed in papershells or plastic hoses and can be handled in bulk (pumpable).

In the USA, field tests proved that emulsion type explosives show advantages over conventional type of explosives in terms of work environment (no toxic fumes or by-products) and they are highly reliable and

risk of accidental detonation is very low. These advantages have been recognised by consumers in the USA such that there is a positive trend of switching from conventional explosives to the emulsion type. In Malaysia emulsion explosives will be marketed as Emulite R by Tenaga Kimia Sdn. Bhd., starting 1983.

Seismic refraction surveys in areas of tropical weathering and rugged topography: An example from a damsite investigation in Pahang, Malaysia

**C.A. FOSS, Dept. of Geology, University of Malaya, Kuala Lumpur &
K. PREAMAKANATHAN, Geomex Surveys, Angkasa Raya, Jalan Ampang, Kuala Lumpur**

The results and borehole correlations are described for a seismic refraction survey at a hydro-electric damsite in Pahang, Peninsular Malaysia. The area is composed of interbedded shales and well-cemented sandstones. In a temperate climate the major refractors would be lithologically controlled but in this tropical region the major refractors are at zones of change in degree of weathering which often cut across lithological boundaries. Along most of the survey lines two refractors were mapped using the Hawkins interpretation method, but in regions of irregular topography very sharp lateral changes in the velocity and depth of the surface zone caused uncertainty in positioning the deeper refractor.

Weathering profiles over granitic bedrock - morphological zones, seismic velocities and excavability characteristics

JOHN KUNARAJ, Jabatan Geologi, Universiti Malaya, Kuala Lumpur

Weathering profiles over granitic rock masses in Peninsular Malaysia are characterized by a vertical and lateral variation of the stages of weathering of granitic rock material that allows for the differentiation of three broad morphological zones within these profiles. These broad morphological zones, which can be equated with different stages of the weathering of a granitic rock mass, are characterized by different (P-Wave) seismic velocities that allow interpretation of the excavability characteristics of the material within the different zones.

Conservation and management of construction materials

MOHAMAD ALI HASAN, Jabatan Geologi, Universiti Malaya, Kuala Lumpur

The extraction of construction materials normally form the largest scale extraction industry in any country and rely largely on the open-pit method rather than mining. Perhaps, like others (rocks and minerals), these materials are non-renewable resources and definitely are finite in amount and thus depletion in the future is inevitable. For a geologist involved in the engineering geology assessment of a major construction project, for example, the most often encountered problem is perhaps in choosing the most suitable construction materials required. This presentation attempts to identify the sources of construction materials;

how they are used (especially in Peninsular Malaysia) and the problems related to their developments. Environmental problems which have resulted from their exploitations (and development) will also be evaluated, and finally efforts to conserve and manage these construction materials will be critically examined such that the utilisation of these 'non-renewable' resources will be made optimum.

Exploitation of construction materials and their relation with geological environments

AGUS P.P. BRODODIHARDJO, Engineering Geology Section, Institute of Hydraulic Engineering, Bandung, Indonesia

In the building industry era nowadays, physical building activities are greatly obvious. As one of the building tools, supplying of construction materials (especially for civil engineering works) is absolutely needed for starting, continuing and finishing the carrying out of the building.

As a matter of fact at the present time, there are some ways of how to supply construction materials which give bad influences on the geological and life environments. For example: The way of how to take sands, granules and pebbles which give some bad influences to the river environment, and the way of how to quarry rock materials which bring some bad influences to the geological and life environments in the surrounding area.

This brief paper contains discussion about the above matters viewed from the theoretical backgrounds in some cases or from the practical carrying out. There are also some suggestions in this paper about how the good ways are in the carrying out of the supply/exploitation materials, which do not give bad influences to the geological and life environments.

Geologic input, or the lack of it, in civil construction

TAN BOON KONG, Jabatan Geologi, Universiti Kebangsaan Malaysia, Bangi

Although the need for geologic input into civil engineering projects is common knowledge to all, for various reasons in many projects in Malaysia geologic input is either lacking or highly inadequate. An indicator of the extent of neglect of geologic input is the fact that many soil investigation reports in this country do not contain a section or even a brief write-up of the site geology.

This paper presents several case studies of civil engineering projects where geologic factors have been neglected, thus resulting in delay in the completion of the project and increase in project cost. The examples given include a bridge project, dams, building foundations, piling, construction material, etc.

ROCKCON - A letter of appreciation

Main Roads Department
Box 1412 GPO
Brisbane 4001
Australia

20 January 1983

Dr. T.T. Khoo
President
Geological Society of Malaysia
Department of Geology
University of Malaya
Kuala Lumpur 22-11
Malaysia

Dear Dr. Khoo

I would like to extend my sincere appreciation to the Geological Society of Malaysia for inviting me to participate in the recent ROCKCON Training Course and Symposium. I consider that the course was very successful and that the participants benefited considerably from both the course content and the exchange of experience with other geoscientists in similar fields.

Particular thanks are due to the organising committee with respect to Course content, format and delivery and I am sure that they will feel well satisfied with the good spirit which was generated between the participants during the Course. I would also like to thank yourself for your help, friendship and hospitality during my stay and Anna for her ready assistance in so many ways.

I have written to Dr. Tan to record my thanks to AGID and the University of Malaya and also to ADAB to thank them for their financial support.

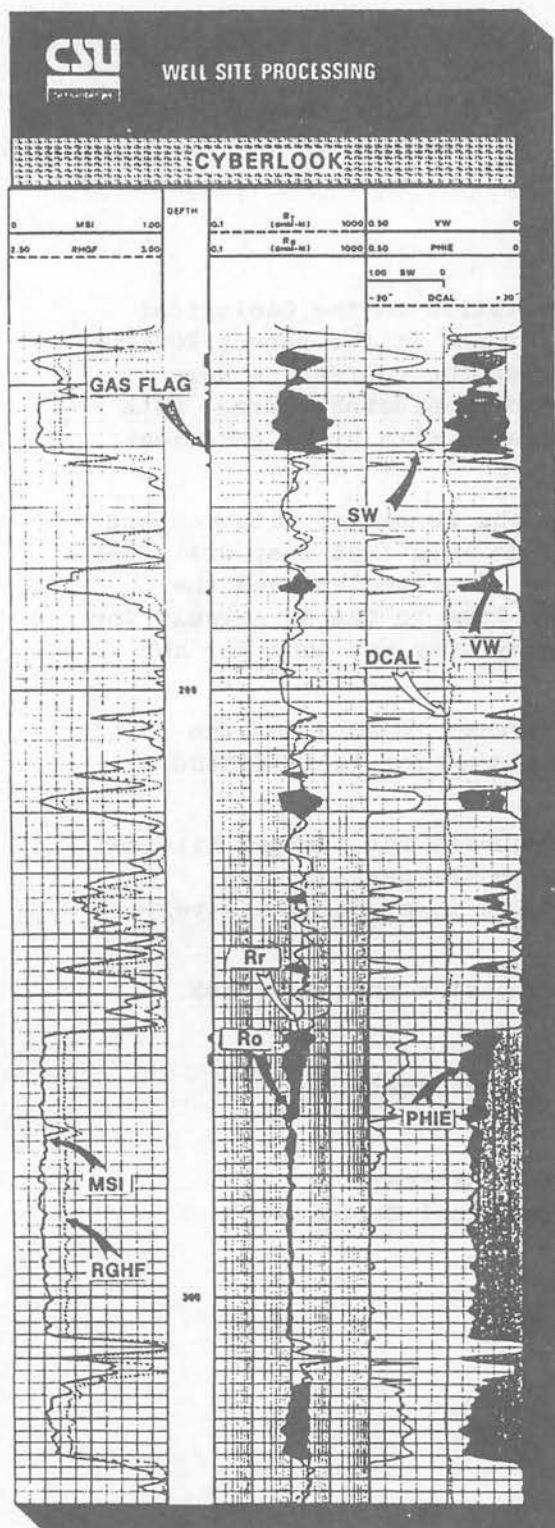
During the Course I received numerous requests for further literature and information and I will forward this to the participants shortly. This ongoing aspect of such courses is in my opinion a very valuable one.

Once again my sincere thanks and my very best wishes for 1983.

Yours sincerely

P.J. Clutterbuck
Principal Geologist

CYBERLOOK* brings Schlumberger computing power to the well site for decision makers



CYBERLOOK is a Dual-Water Computer model, easy to use, requiring a minimum of parameter selection and applicable to a wide range of formations. It is fast to run with outputs of grain size, porosity, fluid saturation and shale index, all answers you require from logs at the wellsite for making decisions on testing and completion of your well.

CYBERLOOK provides wellsite answers.

*Mark of Schlumberger.



PETROLEUM GEOLOGY SEMINAR '82 - PROGRAMME AND ABSTRACTS OF PAPERS

The GSM Petroleum Geology Seminar 1982 was held on 6th and 7th December 1982 at Hotel Merlin, Kuala Lumpur and attended by about 140 people.

The Seminar this year was declared open by Yang Amat Berhormat, Tun Hussein Onn, Adviser to PETRONAS. In his address, Tun Hussein Onn stressed the importance of oil, as it accounts for more than 90% of Malaysia's energy consumption and will remain the country's major source of energy for some time to come. Exploration results so far have indicated that Malaysia has remaining recoverable crude oil reserves estimated at 2.3 billion barrels. In addition, the country has natural gas reserves of about 40 trillion cu. ft., the equivalent in heat value of about three times its crude oil reserves.

According to Tun Onn, Malaysia is now producing oil at the rate of 300,000 barrels a day. About 170,000 barrels are consumed domestically each day while the remainder is exported for the purpose of earning foreign exchange. As the country has more natural gas than oil, Malaysia plans to develop its gas resources, both for revenue purposes and for local consumption.

Tun Onn then dealt on the activities of PETRONAS and its subsidiaries; Malaysia LNG Sendirian Berhad, PETRONAS Carigali and Carigali-BP.

He then reflected that Malaysia is blessed with a broad shallow continental shelf which occupies a significant portion of the Sunda Shelf. Six sedimentary basins, all offshore, have been identified as petroleum-bearing. It is estimated that about 414,000 sq. km (160,000 sq. miles) of Malaysia's continental shelf have hydrocarbon potential and about 80% of this area has not been tested by drilling.

Tun Onn noted that the potential for discovery of hydrocarbon resources in Malaysia is high and exploration success ratio in Malaysia is as good as 1 in 6, which is very favourable compared the world average of 1 in 10. Besides the exploration success ratio, other factors such as geological structure and the existence of offshore sedimentary basins, indicate that exploration efforts in Malaysia will be worthwhile.

In conclusion, Tun Onn commented on the objectives of the seminar to bring together local as well as foreign geoscientists to exchange information and share their knowledge and experiences in an attempt to discover new fields in order to enhance our petroleum reserves.

Earlier in his Welcoming Address, the Society President, Dr. T.T. Khoo traced the initiation and history of the popular Petroleum Geology Seminar. He then touched on the important role geosciences can offer towards national development, and how the Society has geared a major part of its activities towards promotion of better understanding in the fields of economic, engineering and petroleum geology by the provision of forums for discussion and training courses and through publications. He then called on petroleum companies and consultancies in this region to provide more vacation job opportunities for Geoscience students to help improve their knowledge and standards.

The 2-day seminar this year saw the presentation of 14 papers (see Programme). The seminar would not have achieved its present status if not for the various companies who hosted the lunches and cocktail party, and the generous support received from the following companies (up to 1st Dec 1982):

1. Western Geophysical Co.
2. Drexel Oilfield Services (M) Sdn. Bhd.
3. Bow Valley Exploration (SEA) Ltd.
4. Cities Service East Asia Inc.
5. Marathon Petroleum Exploration Ltd.
6. The Broken Hill Proprietary Co. Ltd. (BHP)
7. Teikoku Oil Co. Ltd.
8. British National Oil Corp (BNOC)
9. Racal-Decca Sdn. Bhd.
10. Geophysical Service Inc. (GSI)
11. Getty Oil Development Co. Ltd.
12. Amoco Production Co.
13. BP Malaysia Sdn. Bhd.
14. Carigali-BP Sdn. Bhd.
15. Exploration Logging International Inc.
16. Schlumberger Overseas SA
17. SHELL
18. Societe Nationale Elf Aquitaine (SNEA)
19. Esso Production Malaysia Inc. (EPMI)

G.H. Teh

Programme

Monday, 6th December 1982

- 8.00 a.m. Registration
- 8.40 a.m. Arrival of invited guests
- 8.50 a.m. Arrival of Y.A.B. Tun Hussein Onn, Adviser to PETRONAS
- OPENING SESSION
- 9.00 a.m. Welcoming address by Dr. T.T. Khoo, President of the Geological Society of Malaysia
- 9.10 a.m. Opening address by Y.A.B. Tun Hussein Onn, Adviser to PETRONAS
- 9.30 a.m. Coffee break
- 10.00 a.m. Exploration history of the Semangkok Field - Lye Yue Choong (Esso Production Malaysia Inc. Malaysia)
- 10.45 a.m. Semangkok Field delineation and evaluation - Mohd. Noor Ismail (Esso Production Malaysia Inc. Malaysia)
- 11.30 a.m. Rapid source rock evaluation by programmed pyroanalysis in petroleum exploration - Douglas Whyte (Exploration Logging International Inc., Singapore)
- 12.15 p.m. Lunch (Host: Exploration Logging International Inc., Singapore)
- 1.45 p.m. Seismic reflection survey in Bangladesh for hydrocarbon - Abdul Halim Quazi (Universiti Sains Malaysia, Penang, Malaysia)
- 2.30 p.m. Neogene Biostratigraphy of Western Taiwan, ROC - Tunyow Huang (Chinese Petroleum Corporation, ROC)
- 3.15 p.m. Coffee break
- 3.30 p.m. The dielectric properties of some Malaysian rocks saturated with fluids of microwave frequencies - Shaharin b. Ibrahim (Universiti Pertanian Malaysia, Malaysia)
- 4.15 p.m. Carbonates: A potential exploration target in the Malay Basin - Koh Tuck Wai (Petronas Carigali Sdn. Bhd., Malaysia)
- 7.00 p.m. Cocktail Party (Host: Schlumberger Overseas SA, Malaysia)

Tuesday, 7th December 1982

- 9.00 a.m. Pre-Tertiary Basement of Borneo: What and Where? - Charles S. Hutchison (Universiti Malaya, Kuala Lumpur, Malaysia)

- 9.45 a.m. New frontiers in seismic exploration - Svein Kjellesvik (Geophysical Company of Norway A.S. Norway)
- 10.30 a.m. Coffee break
- 10.45 a.m. Proposed calcareous nanofossil zonation scheme for the Miocene to Holocene of Southeast Asia - O. Varol (Robertson Research (S) Private Ltd., Singapore)
- 11.30 a.m. Interpretation of three dimensional seismic data, A review - Ted Selby (Geophysical Service Inc., Singapore)
- 12.15 p.m. Lunch (Host: Carigali-BP Sdn. Bhd., Malaysia)
- 1.45 p.m. The Tembungo Field, 1979-1982 - M.R. Dixon and S. Chakravathy (Esso Production Malaysia Inc., Malaysia)
- 2.30 p.m. The effects of petroleum exploitation and development on the physical environment - (The Malaysian Scene) - Mohamad Ali b. Haji Hasan (Universiti Malaya, Kuala Lumpur, Malaysia)
- 3.15 p.m. Coffee break
- 3.30 p.m. Diagenesis and depositional environment of the F6 Reef Complex, Central Luconia Province, Offshore Sarawak - Md. Nazri Ramli (Petronas, Malaysia)
- 4.15 p.m. Closing remarks.

Abstracts of Papers

Exploration history of the Semangkok Field

LYE YUE CHOONG, Esso Production Malaysia Inc., Kuala Lumpur

The search for oil in the Malay Basin started in 1968 and the Semangkok anticline was identified in 1972. Subsequent detailed interpretation led to the drilling of Semangkok I and the discovery of oil in Semangkok 2. Further drilling on Semangkok established that economic oil accumulation is restricted to the western fault block. The events that led to the Semangkok oil discovery provided the explorationists with many challenges and surprises.

Semangkok Field delineation and evaluation

MOHD. NOOR ISMAIL, Esso Production Malaysia Inc., Kuala Lumpur

The Semangkok field is in the down-faulted block on the west end of the Semangkok anticline. It is located about 137 km (85 miles) offshore northeast of Kuala Trengganu, Trengganu. The discovery well was drilled in 1980 and was followed by three delineation wells in 1981.

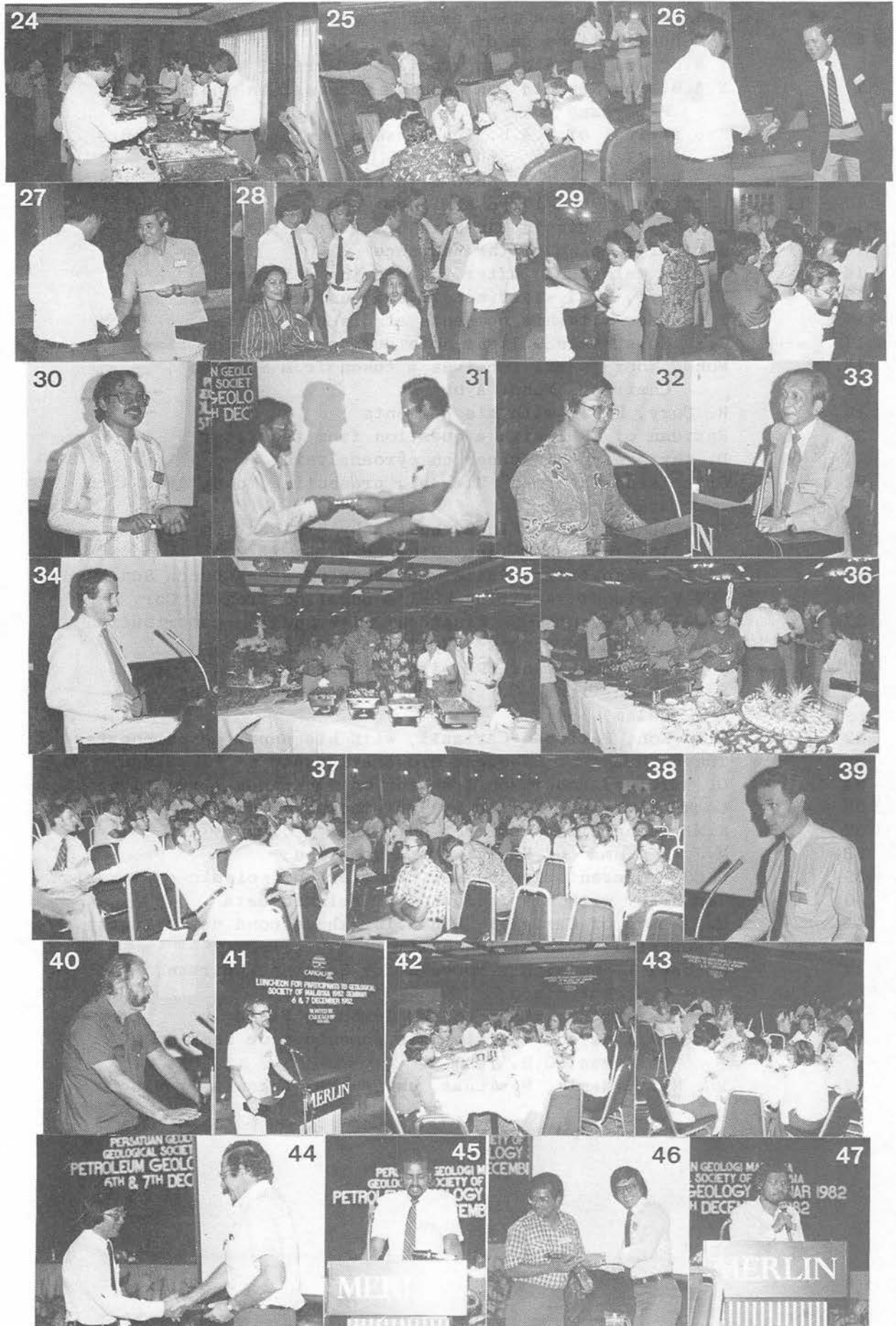
Pressure data aided the selection of delineation well locations by being used to predict fluid contacts. Hydrocarbon assessments also guided selection of well locations.

The Semangkok field is a north-south oriented anticline with a sealing fault along its east flank. The sandstone reservoirs in the field are of Late Miocene age and were deposited in a coastal plain environment.

PETROLEUM GEOLOGY SEMINAR '82



PETROLEUM GEOLOGY SEMINAR '82



Petroleum Geology Seminar 1982 - Captions to photos

- 1 - 4 It's registration time again
5 GSM publications on display
6 Y.A.B. Tun Hussein Onn greeted on arrival by Mohd. Ayob
7 Y.A.B. Tun Hussein Onn showing interest in the Seminar Programme
8 The arrival of Y.A.B. Tun Hussein Onn at the conference Hall
9 GSM President, T.T. Khoo with his welcoming speech
10 - 11 Sections of the large audience
12 Y.A.B. Tun Hussein Onn with his address
13 Another section of the audience
14 At the main table after the opening ceremony
15 Y.C. Lye, EPMI, starting off the Seminar with his paper
16 Y.H. Yeow with his comments at discussion time
17 K.F. Ho strikes a light note during discussion time
18 Mohd. Noor Ismail receives a token from Session Chairman, Mohd. Ayob
19 R. Cory, EPMI, with his comments
20 Redzuan of EPMI with a question from the floor
21 D. Whyte with his paper on pyroanalysis
22 Organising Chairman, Michael, presenting Mohd. Ayob with a momento
23 - 24 It's lunch time! Kindly hosted by Exploration Logging International Inc., Singapore
25 At the Hospitality Suite, courtesy of Racal-Decca Sdn. Bhd.
26 GSM President receiving EPMI's donation from R. Cory
27 K.F. Ho presents GSM President with Shell's contribution
28 - 29 Back at Racal-Decca's Hospitality suite
30 Shaharin Ibrahim of UPM with his presentation
31 Session Chairman, C.S. Hutchison, congratulating Q.A. Halim
32 T.W. Koh, Petronas-Carigali, with his paper on carbonates
33 Tunyow Huang on 'Neogene Biostratigraphy of W. Taiwan'
34 O. Varol of Robertson Research on nannofossil zonation
35 - 36 Cocktail time - hosted by Schlumberger Overseas S.A.
37 K.M. Leong with a comment on Borneo geology
38 M.J. Brolsma of Shell with a question
39 GECO representative on new frontiers of seismic exploration
40 Ted Selby with his review of 3D seismic data
41 M.J. Laws of Carigali-BP hosting the second day's lunch
42 - 43 Discussions even at lunch time!
44 Michael Leong with a momento for Session Chairman, C.S. Hutchison
45 S. Chakravathy, EPMI, on the Tembungo Field
46 Mohd. Ali Hasan receiving his momento from Session Chairman, G.H. Teh
47 Md. Nazri Ramli, Petronas, on Central Luconia Province

Rapid source rock evaluation by programmed pyroanalysis in petroleum exploration

DOUGLAS WHYTE, Exploration Logging International Inc., Singapore

New methods of assisting in the search for petroleum are constantly being developed. Pyroanalysis is a relatively recent development that will play an increasingly more important role in exploration. The technique is substantially faster than conventional methods of geochemical analysis and as such may be used as an aid in exploration programme decisions at the wellsite.

Pyroanalysis refers to the thermal degradation of organic matter in an inert atmosphere. Natural hydrocarbons in small quantities of rock cuttings or cores can be measured together with the products from the cracking of insoluble kerogens. The results can be used as an aid to determine the source rock potential, degree of maturation, the expected type of hydrocarbon generated from a mature rock, and identify petroleum accumulations.

When used in conjunction with total organic carbon determinations then kerogen typing, quality of the source rock and degree of maturation can be further substantiated.

Seismic reflection survey in Bangladesh for hydrocarbon

ABDUL HALIM QUAZI, Universiti Sains Malaysia, Penang

The Bengal delta forms one of the largest geosynclinal basins in the world. Bangladesh is covered for the greater part by alluvium laid down by three mighty rivers, the Ganges, Brahmaputra and Meghna, and their innumerable tributaries and distributaries.

The Holocene sediments are developed over the extensive plains and the Neogene sediments are found exposed in the folded flank of the Bengal Foredeep. They are traceable from the southeastern border of the Sylhet district, Comilla-Noakhali districts and cover all the territory of Chittagong and Chittagong Hill tracts.

The oldest exposed sediments here are the Tura sandstone of Palaeocene age and are situated in the Takerghat area of Sylhet. Mesozoic and Palaeozoic sediments and Pre-Cambrian basement rocks are not exposed anywhere in the country but are encountered in drill holes in the Gondwana basin and adjoining areas of North Bengal. Here geological survey has little possibility because the area is fully covered by alluvium with very little rock outcrops exposed. Extensive seismic reflection survey is required to locate hydrocarbon accumulation into structural or stratigraphic traps especially adjacent to the Eocene hinge zone.

The Bangladesh portion of Bengal basin can be divided structurally into three main units:

- i) Pre-Cambrian platform or the Buried Indian Shield*
- ii) The deeper basin*
- iii) Folded flank of the Chittagong trough.*

Here, the low velocity zone (LVZ) generally varies from 5 m to 60 m and velocity varies from 350 to 2000 m/sec. The average thickness is about 15 m. Vertically the LVZ can be divided into different layers,

each of them being characterised by a constant velocity. Lateral velocity variations were also observed within the LVZ (750 - 1200 m/sec.). The quality of reflection records mainly depends on the constitution of the LVZ. It also influences the behaviour of the first arrivals and the lining-ups of the consequent deeper reflections. The deepest reflection recorded comes from 4.9 sec. (depth 7.8 km).

Till today only 61 wells (8 offshore and 24 developed wells) have been drilled mainly on geophysical data, resulting in the discovery of one offshore and 11 onshore gas fields. Of the 12 gas fields only Chotak, Sylhet, Habigonj and Titas are producing gas and condensate at the rate of 180 million ft^3/d though the total recoverable gas is estimated at 12 trillion ft^3 .

An average of 1.6 million tons/yr. of petroleum products is used in Bangladesh, all of which is imported and is taking away nearly 2/3 of total foreign exchange earnings (US\$600 million).

Neogene biostratigraphy of Western Taiwan

TUNYOW HUANG, Chinese Petroleum Corporation

The Taiwan basin has a thick sequence of Tertiary shallow marine sediments. Micropalaeontological research play a predominant role in the basin study and the sub-surface correlation. The Neogene sequences are well developed in western Taiwan. These sequences are palaeontologically in these best known interval of the sedimentary column of the island.

The utility of both planktic and benthic foraminifera for correlation in marine sediments has been thoroughly established in Taiwan since the 1960s. The last few years have also witnessed the increased use of calcareous nanofossils.

The succession of planktic foraminifera, the datums, and the epoch boundaries in the Taiwan Neogene are discussed, with reference to a generalized range chart and the lithostratigraphic units. Biostratigraphic ranges of these species in the Neogene sequence of western Taiwan allow establishment of 18 foraminiferal datum planes useful for intraregional as well as international stratigraphic correlation. The benthic foraminiferal zonation and some prominent lineages are also discussed.

A preliminary study on the dielectric properties of a Malaysian "Rock" saturated with water and crude oil

S. IBRAHIM: A.H. SHAARI & K. KHALID, Universiti Pertanian Malaysia, Serdang

A preliminary study on the dielectric properties of a quartz crystal aggregates taken from Klang Gate's quartz ridge was conducted. The basic theory, the experimental set-up and the method of investigation were outlined. The dielectric properties of dry quartz crystal aggregates and two varieties of Malaysian crude oil were investigated. Saturating the quartz aggregate with crude oil or water has been found to increase the dielectric permittivity of the specimen. The effect of varying the frequency of the incident x -band microwave on the permittivity of the specimen was also investigated. Saturating the specimen

with crude oil seems to have an additive effect on the dielectric permittivity of the quartz crystal aggregates in the frequency range employed in this experiment.

Carbonates: A potential exploration target in the Malay Basin

KOH TUCK WAI, Petronas Carigali Sdn.Bhd., Kuala Lumpur

Sotong B-1, a discovery well drilled in 1973 in the Sotong Field (at the southern edge of the Malay Basin) penetrated 292 m (958 ft) of carbonates at the lowermost strata (2761 to 3053 m). The entire carbonate sequence is tight with no hydrocarbon shown. CONOCO, then the operator, considered the top of the carbonates as the top of a pre-Tertiary economic basement. In contrast, the author believes that the age is mid-Tertiary (Oligocene/Miocene) and that the top of the carbonate sequence coincides with a regional unconformity (probable Oligocene-Miocene age) which is clearly evident on seismic record. Three depositional facies can be recognised by means of detailed core-logging and petrographic studies: (1) a crystallized coral packstone facies, (2) a siliceous wackestone/packstone facies, and (3) a recrystallized coral boundstone facies. Source rock studies on the thin interbeds of shales showed the presence of low TOCs, inertinitic and vitrinitic kerogen and a maturity level corresponding to a mean of 0.82% vitrinite reflectance (peak oil generating phase). The hard, brittle and tight carbonates are expected to have extensive fracture porosity and excellent permeability. Dolomitization is rare within the sequence. Seismic data indicate that the carbonate complex may be of several square kilometres in areal extent and may be extensively faulted. As Miocene age carbonates generally have very good hydrocarbon potential in Southeast Asia, the appraisal of this type of carbonate prospect is highly recommended.

Pre-Tertiary Basement of Borneo: What and Where?

CHARLES S. HUTCHISON, Dept. of Geology, University of Malaya, Kuala Lumpur

In current stratigraphic-tectonic analyses of Borneo, only two basement terrains have been conceptualized: the West Borneo Basement of Sarawak and West Kalimantan, and the Crystalline Basement of Sabah.

The West Borneo Basement, together with its miogeoclinal Kuching Zone of shelf sediments and subduction, complex along the Lupar Line, is sufficiently well documented to form an anchor for tectonic modelling. The Late Cretaceous through Eocene Belaga Formation may be interpreted as an accretionary prism formed along the convergent margin of this basement and deformed by 50° post Middle Cretaceous counter clockwise rotation of the West Borneo Basement.

The tectonic evolution of the rest of Borneo is obscure. A major question is how far east to extend the west Borneo Basement. It is unwarranted to extend it farther east than the landward extension of the Pater Noster Fault, which forms the western margin of the Kutei Basin of Kalimantan, or beyond the Tinjar Fault zone.

The Crystalline Basement of Sabah is entirely of ophiolitic rocks, but unfortunately the basaltic layer of the ophiolite has by tradition

been included in the Cretaceous Chert Spilite Formation. They must be taken together. The ophiolite represents uplifted oceanic or marginal basin lithosphere. However, in the Segama Valley, potassium-rich granites have sporadically intruded and contact metamorphosed the ophiolitic rocks. Both the granites and the hornfelsed ophiolite have yielded Jurassic K:Ar radiometric dates. These granites could have had their origin only in underlying continental or mature island arc basement, about which nothing is known, because it does not outcrop. It is reasonable to assume that the ophiolitic "Crystalline Basement" is supported by sialic basement by analogy with New Caledonia and Cuba, for example. However it is important to clearly define that the Crystalline Basement of Sabah is of ophiolite, both metamorphic and unmetamorphic, but that it is cut by granites in a few places. These granites should not be included in the ophiolitic basement. Since the ophiolites form the basement for the Tertiary sedimentation, it seems preferable to redefine the "Crystalline Basement", together with the basaltic part of the "Chert Spilite Formation", as the Ophiolitic Basement, because the term Crystalline Basement conveys a false tectonic connotation. The rest of the Chert Spilite Formation represents sedimentary strata that overlie the ophiolite, most of which are pelagic, but some are clearly of very shallow water formation, and some even indicate that the ophiolite was uplifted and eroding, for example in the Labuk Valley where the "Chert Spilite Formation" contains serpentinite, conglomerates and sandstones. However there is so much melange in Sabah that the sequence of tectonic events may never be resolved.

Another basement terrain outcrops in the Mangkalimat Peninsula and adjoining Sungei Mahakam system, where apparent island arc terrain contains definite early Devonian limestones. This terrain forms the eastern and northern margin of the Kutei Basin. One might speculate that it extends into interior Kalimantan.

The Pater Noster Block is separated from the West Borneo Basement by the Barito Basin and the Meratus ophiolite. It appears to represent a stable basement terrain, about which little is known.

The Central Luconia-Balingian-Tatau terrain has evidence of shallow water deposition throughout much of the Tertiary, indicative of underlying sialic crustal basement. The collision of this terrain with the Belaga Formation accretionary wedge, as the West Borneo Basement rotated counter clockwise, may have resulted in the Bukit Mersing ophiolite uplift and the acid igneous volcano-plutonic province at Bukit Piring, southwest of Tatau.

The long persistence of shallow water carbonates (Eocene through Lower Miocene) from Mulu, Batu Gading to Tujoh-Siman area east of the Usun Apau Plateau, also suggests an underlying sialic basement. Extension eastwards, beneath the Kelabit Formation towards the Kalimantan Borderland, is necessary to explain the abundant occurrences of salt seepages in that region. Perhaps the underlying basement is a continental fragment rifted from the South China margin and the buried anhydrite deposits may record the early rifting episode. Unfortunately the Kelabit Highlands are remote and the geology poorly known, but the salt industry of the region is well documented. The Tinjar Fault and its tectonic complexities represents a transform fault margin between this terrain and the Balingian-Luconia terrain to the west.

Collision interplay between these basements terrains is more likely

to explain the Quaternary Plateau ignimbrites and basalts of the Hose Mountains, Linau Balui Plateau, Nieuwenhuis Mountains, and Usun Apau Plateau, which cannot satisfactorily be ascribed to subduction at the so called Northwest Borneo Trench.

The existence of these sialic basement terrains in central Borneo detracts from the usefulness of the Northwest Borneo Geosyncline concept, and the inclusion of the Sapulut, Trusmadi, Crocker and Temburong Formations of Sabah in the Rajang Group of Sarawak does not appear to be warranted.

New Frontiers in Seismic Exploration

SVEIN KJELLESVIK, GECO- Geophysical Company of Norway A.S.

One of the most important new advances in geophysical investigation is the successful application of 3-dimensional marine data acquisition and processing. This has taken place in relation to, and in parallel with, the development of areal energy sources, and represents a new frontier in marine seismic exploration.

For both economical and technical reasons, the present trend is towards more accurate and more detailed mapping of the complex structures beneath the sea-bed.

3D and the application of directive areal arrays are tools developed in order to meet these industry demands.

The paper will review all stages of a 3D survey by discussing:

- the planning stage with considerations of source and receiver geometry
- the processing of 3D data with case examples
- interpretation of 3D data.

Proposed calcareous nannofossil zonation scheme for the Miocene to Holocene of Southeast Asia

O. VAROL, Robertson Research (Singapore) Private Limited.

Calcareous nannofossils, as a result of their small size, wide geographical range and rapid evolution, are a most important tool in studies involving high resolution biostratigraphy in marine environments. Zonation schemes introduced by Martini (1971) and Okada and Bukry (1980) have been extensively used and applied worldwide by many workers. In Southeast Asia, however, both schemes are found to be of limited use individually. They must be combined and modified with an understanding of certain taxonomic difficulties and of the variation of ranges of species geographically.

The present study, therefore, proposes a zonation scheme modified from a combination of the above mentioned and which is found to apply more readily to the Southeast Asian situation.

Interpretation of three dimensional seismic data, a Review

TED SELBY, Geophysical Service Inc., Singapore

It is now about 10 years since the first experimental three dimensional surveys were conducted. Since these first surveys many changes have been made in techniques for collection, processing and interpretation. Many of the advances in interpretation methods have been dependent upon changes in collection and processing methods but as experience has been gained the interpretation steps have become more automated.

This paper will review some of the early methods, discuss advances made for both structural and stratigraphic interpretation and finally show examples obtained from a new interactive interpretation system which has recently been developed.

The Tembungo Field, 1979-1982

M.R. DIXON & S. CHAKRAVATHY, Esso Production Malaysia Inc.

The Tembungo field, located 75.6 km (47 miles) northwest of Kota Kinabalu, Sabah, in 84 m (277 feet) of water, was discovered in 1971 by Esso Exploration Inc. The major reservoirs are Upper Miocene turbidite sandstones. Four delineation wells defined the field and 18 conductor production platform was installed in 1974. Thirteen development wells, using 12 conductors, were drilled from 1974 to 1977. The results of these wells changed a simplistic structural picture to a complexly faulted structure that has multiple hydrocarbon systems. In 1977 production began to decline and reached a low point by late 1981.

Escalating oil prices in 1979 initiated another look at the Tembungo field. An additional seismic survey was shot, but there was no significant improvement in data quality compared to previous surveys. One exploration well was drilled on the basis of the new seismic data but it was unsuccessful in proving sufficient reserves from an additional platform. A development programme from the existing platform utilizing the six remaining conductors was successful in increasing production significantly.

The effects of petroleum exploitation and development on the physical environment - (The Malaysian scene)

MOHAMAD ALI B. HAJI HASAN, Dept. of Geology, University of Malaya

Over the last decade or so, development and exploitation of petroleum resources in the ASEAN countries have been very encouraging. The contribution and consequences of petroleum industries to the growth of these developing countries have been reckoned with and are far reaching. Management efforts have generally been carried out systematically. However, there are still some areas that need looking into, such as negative effects on the environment.

This short presentation therefore aims at identifying some of these effects, within the context of Peninsular Malaysia, how they have come into being and suggestions on how to overcome or minimise further detrimental influences.

**Diagenesis and depositional environment of the F6 reef complex,
Central Luconia Province, Offshore Sarawak**

MD. NAZRI RAMLI, Petronas, Kuala Lumpur

Detailed petrographic and palaeontologic investigations of carbonate cores and ditch-cuttings of six F6 wells found the F6 Reef Complex to have a very distinct internal architecture with well defined litho-stratigraphic zonation. Although the diagenetic overprint is very marked with virtually all porosities being secondary, the distribution of porous beds is mainly controlled by the primary depositional environment. Freshwater leaching and dolomitization mainly affected the protected and reefoid sediments while the argillaceous, open marine offreef and bank sediments became tight through compaction. These tight open marine intervals corresponding to the transgressive phases during carbonate growth can be traced across the entire F6 Reef Complex and form excellent stratigraphic markers for well correlation. The alternation of porous and tight intervals is clearly depicted by porosity log and gives a layered appearance on seismic impedance sections.

This detailed analysis of both the depositional pattern and the sequence of diagenesis allows the F6 carbonates to be subdivided into six stratigraphic zones, each with well defined rock types and porosity-permeability characteristics. The subsequent recognition of this zonation on well logs and seismic data permits a better lateral reservoir prediction and construction of a geological model for reserve calculation.

**B E R I T A P E R S A T U A N
(N E W S O F T H E S O C I E T Y)**

**GEOSEA V - FIFTH REGIONAL CONGRESS ON GEOLOGY, MINERAL
AND ENERGY RESOURCES OF SOUTHEAST ASIA**

Venue: Kuala Lumpur, Malaysia

Date: March/April 1984

Organized by: Geological Society of Malaysia

**In collaboration with: University of Malaya & National University of
Malaysia**

**With support and cooperation of: Ministry of Primary Industries Malaysia
Geological Survey of Malaysia
Petronas
States of Malaya Chamber of Mines
Southeast Asia Tin Research &
Development Centre
Institute of Mineral Engineering,
Malaysia
School of Physics, Science University
of Malaysia
Faculty of Mechanical Engineering,
University of Technology, Malaysia
Department of Soil Science, Agriculture
University of Malaya**



Other cooperating organizations:

Ikatan Ahli Geologi Indonesia
 Geological Society of Philippines
 Geological Society of Thailand
 Association of Geoscientists for International Development
 Department of Mineral Resources, Thailand.

The Geological Society of Malaysia cordially welcomes all recipients of this circular and all geoscientists interested in the geology of South-east Asia to participate in the Fifth Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia (GEOSEA V) to be held in Kuala Lumpur in March/April 1984. Further details will be sent in due course to all those who respond to this circular.

GEOSEA is held triennially in Southeast Asia and was held in Kuala Lumpur (1972), Jakarta (1975), Bangkok (1978), and Manila (1981). The aims of GEOSEA are to provide a forum for discussion of the geology, mineral and energy resources of the Southeast Asian region and to provide opportunities for beneficial exchange of ideas and information among geoscientists interested in the Southeast Asian region from within and outside the region. Rapid progress and advances have been made in the knowledge and understanding of the geology of the Southeast Asian region in recent years and it is hoped that GEOSEA V will promote further advances and accelerate the momentum.

Scope

Papers on aspects of the geology of the GEOSEA core region are invited. The core region (see figure) includes the following countries: Burma, Thailand, Malaysia, Singapore, Indonesia, Papua New Guinea, Brunei, Philippines, Vietnam, Laos, Kampuchea, Hong Kong and the southern parts of China.

Other areas bordering the core region are regarded as peripheral zones. Papers on the geology of the peripheral zones can only be acceptable for GEOSEA if they are of relevance to the geology of the core region or of special interest to the core region.

Papers

Original papers on the following topics are invited. * General Geology * Regional Geology * Sedimentology * Palaeontology/Stratigraphy * Mineralogy/Petrology * Tectonics/Structural Geology * Economic Geology * Marine Geology * Engineering Geology * Petroleum Geology/Energy Resources * Geochemistry/Applied Geochemistry * Geophysics /Applied Geophysics * Environmental Geology * Geohydrology * Quaternary Geology * Geomorphology * Geochronology and others.

Abstracts of papers intended for presentation at the Congress must be submitted to the Organizing Secretary as soon as possible, preferably before November 1983, for consideration of acceptance for presentation. Papers presented at the Congress will be considered for publication by the Society's Editorial Board in a special volume after the Congress. Papers are to be given in English.

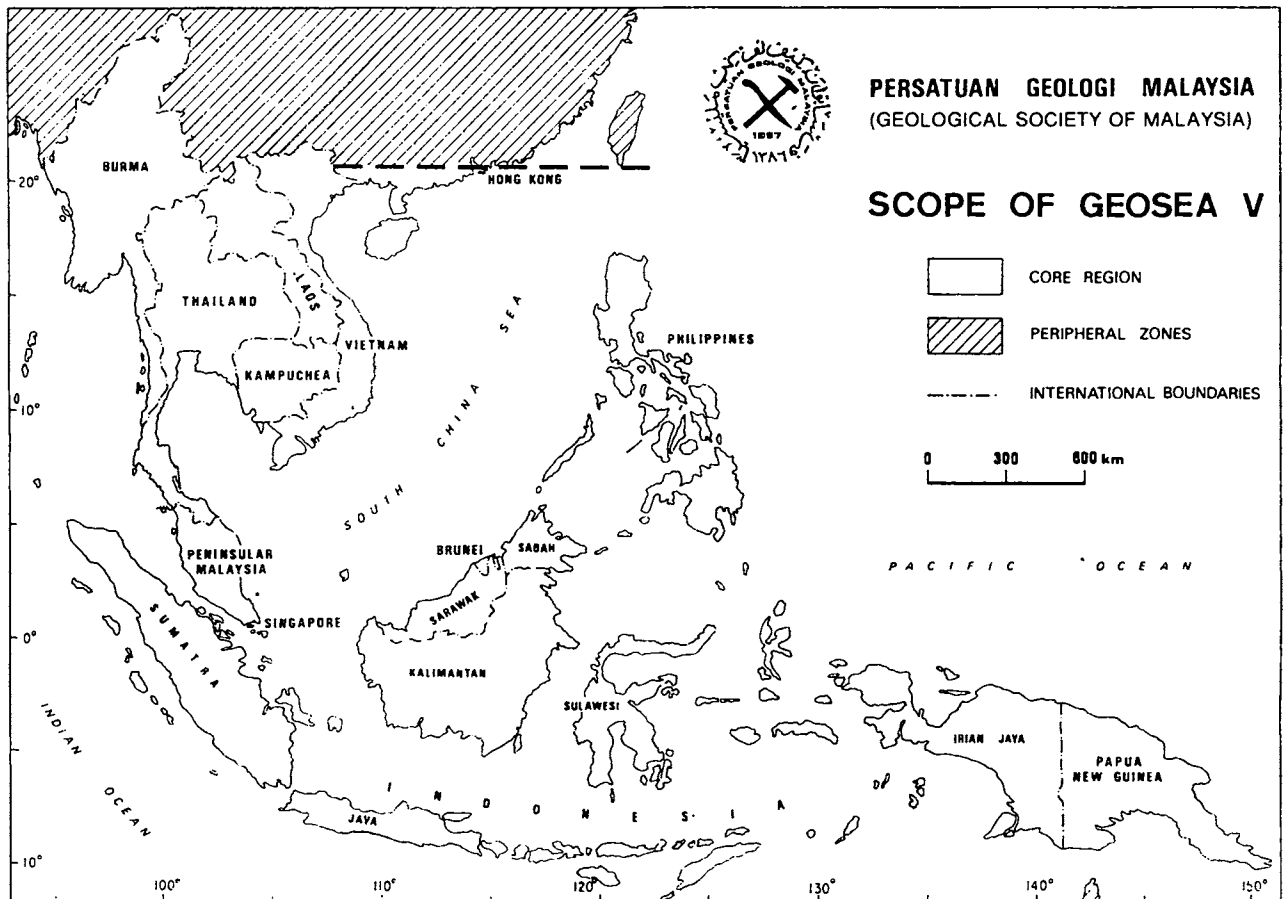
Other activities in conjunction with GEOSEA V

In conjunction with GEOSEA, post-Congress field trips and short training courses and continuing education courses will be held.

Field trips

The following field trips will be held subject to sufficient participants.

1. Northwest Peninsular Malaysia (Palaeozoic stratigraphy, structure)
2. Kinta Tinfield
3. Eastern Belt, Peninsular Malaysia
4. Kuala Lumpur Tinfield/Genting Highlands
5. Kuching-Bau area, Sarawak (Gold and stibnite mineralization)
6. Kota Kinabalu - Sandakan area, Sabah (Crocker Formation, Ophiolites)



Courses

The following short training/continuing education courses have been proposed. Efforts will be made to hold the courses if there are sufficient participants and suitable instructors can be found. Please indicate your interest and also suggestions for other suitable courses in the reply card.

- * Alluvial deposits evaluation
- * Banka drilling
- * Ore microscopy
- * Geochemical exploration in tropical terrain
- * Carbonate diagenesis
- * Granite
- * Sulphide mineralogy

- * Plate tectonics - concept and development
- * Industrial minerals
- * Tropical soil survey.

The Organizing Committee will strive to hold the courses at minimal costs. Lectures will be held in local universities. Hostel accommodation inclusive of meals for both course and conference participants can be arranged.

For further information write to:

The Organizing Secretary
 GEOSEA V
 Geological Society of Malaysia
 c/o Dept. of Geology
 University of Malaya
 Kuala Lumpur, Malaysia
 Tel. 03-577036.

FORTHCOMING GSM BULLETINS

To commemorate the 15th Anniversary of the Geological Society of Malaysia, the Society will be publishing Bulletin 15 and possibly Bulletin 16. Bulletin 15 will be out soon.

Among the articles appearing in these 2 Bulletins (subject to receipt of acceptable revised manuscripts) include:

1. H. Fontaine, R. Ingavat, & D. Vachard: Carboniferous corals from Northeast Thailand
2. C.A. Foss: On the feasibility of detecting potholes and limestone pinnacles in alluvial mining areas by gravity surveys
3. K.F.G. Hosking: A historical review of ways and means of searching for ore deposits in the southwest of England
4. T.T. Khoo: Metamorphic episodes of the western foothills of Gunung Ledang (Mt. Ophir)
5. P. Laznicka: Strata-related metallic deposits with their economic past, present and future
6. B.K. Lim & S.J. Jones: Some applications and problems of the seismic refraction technique in Civil Engineering Projects in Malaysia.
7. M.H. Loke, C.Y. Lee & G. van Klinken: Interpretation of regional gravity and magnetic data in Peninsular Malaysia
8. I. Metcalfe: Observations on the ornamentation and ultrastructure of some well preserved specimens of *Idiognathoides noduliferous inaequalis* Higgins (Pennsylvanian conodont)
9. I. Metcalfe, S.P. Sivam & P.H. Stauffer: Stratigraphy and sedimentology of Middle Triassic rocks exposed near Lanchang, Pahang, Peninsular Malaysia
10. J.K. Raj: Net directions and rates of present-day beach sediment transport by littoral drift along the East Coast of Peninsular Malaysia
11. J.K. Raj: Negative lineaments in the granitic bedrock areas of NW Peninsular Malaysia
12. P.J.C. Ryall: Some thoughts on the crustal structure of Peninsular Malaysia - results of a gravity traverse
13. Y.K. Shu: Osmiridium - a discovery in Cheroh, Pahang, Peninsular Malaysia

14. B.K. Tan: Structures in Peninsular Malaysia and their interpretations (Presidential Address)
15. N.K. Tan, Denis: The Lubok Antu Melange, Lupar Valley, West Sarawak: A Lower Tertiary subduction complex
16. S. Thompson: Oil source bed hydrocarbons analysis: some methods and interpretations
17. U. Khin Zaw: Rock geochemical exploration at Thabyebintaung Pb-Zn prospect, Bawsaing, southern Shan State, Burma

GSM 2-YEAR COUNCILLORS 1983/84 - ELECTION RESULTS

In the election for four 2-year Councillors to serve in the 1983/84 Council, the following candidates are successful.

1. Andrew Spykerman
2. Choo Mun Keong
3. Syed Sheik Almashoor
4. Yeap Ee Beng

KEAHLIAN (MEMBERSHIP)

The following have joined the Society:

Full Membership

Rohana Ahmad, Esso Production Malaysia, Inc., P.O. Box 857, Kuala Lumpur 01-02.

Student Membership

Abdul Jilani B. Ismail, Kampong Sungai Durian, Pokok Sena, Alor Setar, Kedah.

PERTUKARAN ALAMAT (CHANGE OF ADDRESS)

The following members have informed the Society of their new Addresses:

1. Cathy Connor, 808 Fritz Cove Road, Juneau, Alaska 99801, U.S.A.
2. R.B. Tate, c/o New House Farm, Hatton, Warrington, Cheshire, U.K.
3. Alexander Yan, Jabatan Kajibumi, Locked Bag, Kota Kinabalu, Sabah.
4. Chan Siew Hung, 48, Melissa Street, Donvale, Victoria, Australia 3111.
5. P.H. Quah, c/o G.P.O. Box 1911 R, 28th Floor, 35 Collins Street, Melbourne 3000, Australia.
6. A.B. Grant, P.T. Utah Indonesia, 6th Floor, S. Widjojo Centre, Jl. Jend. Sudirman Kav 57, Jakarta, Indonesia.
7. David K.H. Liau, Geological Survey Malaysia, Locked Bag, Jalan Penampang, Kota Kinabalu, Sabah, East Malaysia.
8. David T.C. Lee, Geological Survey Department, Locked Bag Service, Mile 2, Penampang Road, Kota Kinabalu, Sabah.
9. Lee Ah Kow, Makmal Penyiasatan Kajibumi, P.O. Box 1015, Ipoh, Perak.
10. W.W. Lynn, Rua Otavio Correia, 116/501, Urca, CEP 22291 - Rio de Janeiro, RJ, Brasil.
11. Lim Beng Kung, Geomex Surveys Sdn. Bhd., Lot A & B, 10th Floor, Angkasa Raya, Jalan Ampang, Kuala Lumpur, Malaysia.

BERITA - BERITA LAIN (OTHER NEWS)

UNIVERSITI SAINS MALAYSIA M.Sc. THESES

1. Lew Tan Sin, 1979. Near surface sediment structure and a search for tin, offshore Kedah.
2. Loke Meng Heng, 1982. Regional gravity survey across Peninsular Malaysia to study crustal structure.

C.Y. Lee

UNIVERSITI TEKNOLOGI MALAYSIA B.Sc. PETROLEUM ENGINEERING THESES 1981/82

1. Effectiveness of back flyshing to improve well productivities by Abdul Razak Lebai Ismail.
2. The effect of salt concentration on cement slurry properties by Alias Mohd Yusuf.
3. The effect of drill-string rotation on cutting transportation by Ismail Omar.
4. Electric model reservoir by Mohamad Khazim Shamsuddin.
5. Highly deviated hole cleaning by Mohd. Ariffin Daud.
6. Laboratory studies of corrosion in crude oil systems by Mohd. Shairazi Abd. Muhid.
7. Correlation between oil production and the reservoir pressure, production time and oil recovery by Rohayati Hj. Bakri.
8. Measurement of two-phase (oil & gas) in horizontal pipe using orifice plate by Suhaimi Awang.
9. Selection of water influx models for water drive reservoirs by Yew Lei Ming.

A. Aziz Hussin

CARIGALI STRIKES OIL

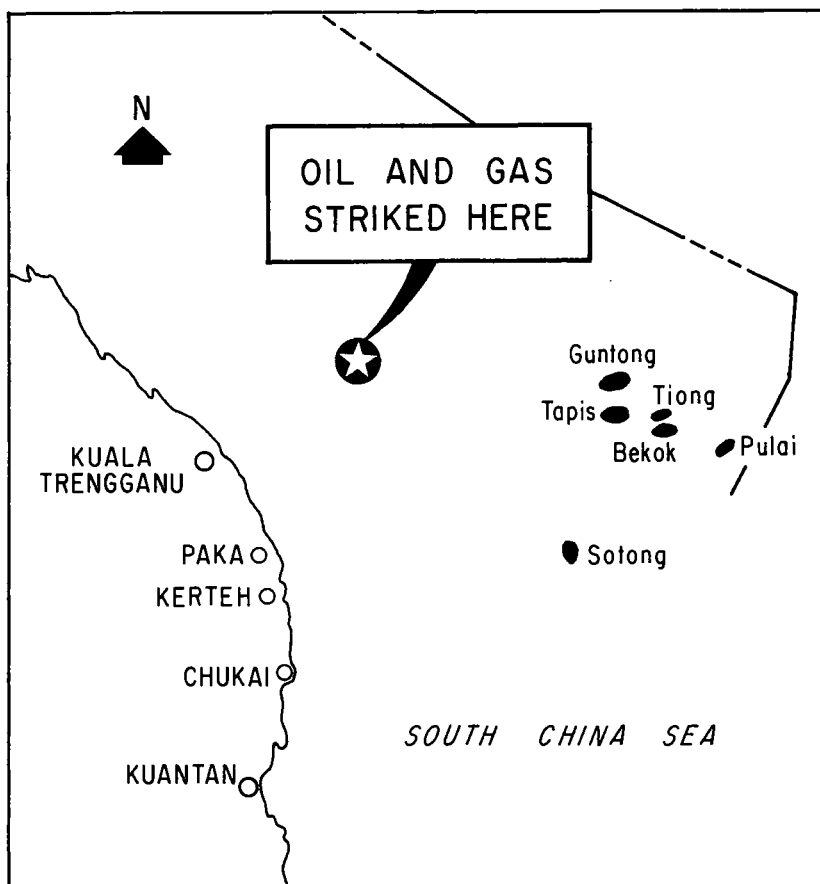
PETRONAS Carigali Sdn. Bhd. (Carigali) has struck oil and gas in their contract area offshore Trengganu.

The strike is historical in that this is the first time that a local company has been successful in discovering the hydrocarbon resource.

The oil and gas strike was from well 6G - 1.1. The well lies in Block PM 6 offshore Trengganu, about 125 km east of Kuala Trengganu.

Work on the drilling and testing of the well is being carried out by the drilling rig CORA since last May and was completed on 7 September.

CORA is carrying out the drilling in waters about 74 m deep and the oil and gas reservoir zone was encountered at 1,200 m below sea-level.



Production tests carried out in 5 areas yielded a total of 5,565 barrels of oil per day and 10 million cu. ft. free or non unified gas per day.

However, additional drilling is necessary to ascertain the potential of the strike.

Carigali, until now, has drilled 9 wells in its contract area in Peninsular Malaysia. The well is the second exploration well drilled in the particular block this year. Other wells drilled are evaluation wells in the Sotong and Duyong oilfields.

Carigali, a daughter company to PETRONAS, was formed on 11 May 1978. It is given the task of exploring and recovering oil in this country.

The setting up of Carigali gives the Malaysian people the opportunity to get directly involved in the upstream activities as well as the training and experience in the petroleum industry.

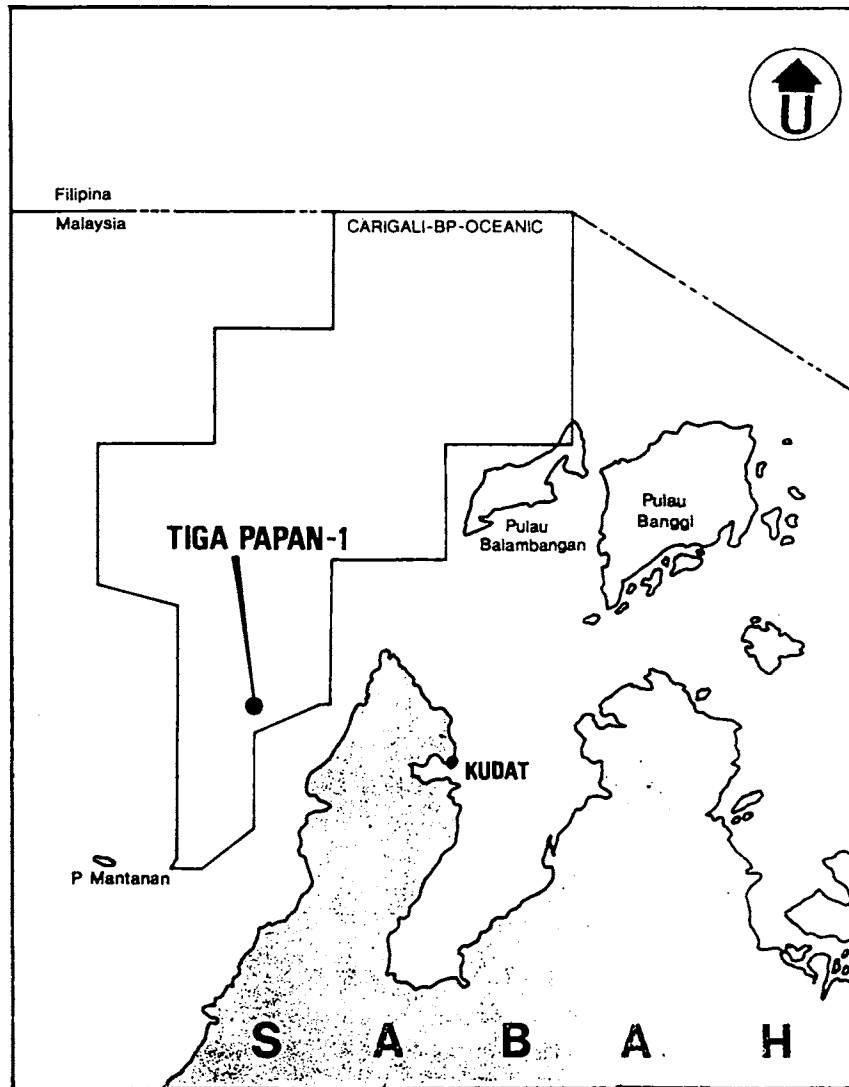
(Translated from Nada PETRONAS, Aug/Sept 1982)

CARIGALI-BP STRIKES OIL

Carigali-BP Sdn. Bhd., a joint venture company between PETRONAS Carigali and BP Group reported that their exploration well, Tiga Papan-1 produced oil at the rate of 1,741 and 2,048 barrels per day during recent tests.

The oil flow is from three levels drilled between 1,520 and 1,560 meters below sea level. The well also produces gas at 8.5 million cu. ft. per day from the shallowest level.

The well referred to lies in an area 47 meters deep about 15 km west of the Kudat Peninsula, Sabah and 120 km northeast of Kota Kinabalu. Further work is necessary to ascertain the potential of the strike.



Carigali-BP is the operator for a group which carries out the exploration work in an area of 3,760 sq. km. offshore Sabah under a production contract together with PETRONAS which was signed in May 1980.

Holdings of the company's share are PETRONAS Carigali 50%, BP Petroleum Development 42.5% and Oceanic Exploration 7.5%.

(Translated from Nada PETRONAS, Nov 1982)

OVERSEAS RESEARCH STUDENTS ORS AWARDS 1983

UNIVERSITIES AND COLLEGES IN THE UNITED KINGDOM

Some 600 new ORS Awards will be offered on a competitive basis in 1983 to overseas postgraduate students of outstanding merit and research potential.

Each Award will cover the difference between the tuition fee for a home postgraduate student and the "full-cost" fee chargeable to an overseas postgraduate student.

The Awards are tenable at any of the Academic Institutions listed below.

Awardholders will be overseas graduate students who, in Session 1983-84, are commencing full-time study, as registered research students, at one of the Academic Institutions for a higher degree, or are already undertaking such a course and do not have an ORS Award. They must be liable to pay tuition fees at the "full-cost" rate for overseas students.

The only criteria for the Awards are outstanding merit and research potential; other factors, such as means, nationality, proposed field and institution of study, will not be taken into account.

The Awards are made to individuals and not to Academic Institutions. They may be held in any field of study. Subject to the satisfactory progress of the Awardholder, they will be renewed for a second and third year, according to the normal or remaining length of the research course being undertaken.

The Scheme is administered by the Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom. The CVCP has appointed a special Committee, composed of representative senior members of academic staffs of the Academic Institutions, to be responsible for the selection of Awardholders and for the detailed management of the Scheme.

Further details and application forms may be obtained from the registrar or secretary of any of the Academic Institutions.

LIST OF ACADEMIC INSTITUTIONS

UNIVERSITIES

Aberdeen
Aston in Birmingham
Bath
Belfast
Birmingham
Bradford
Bristol
Brunel
Cambridge
City
Dundee
Durham
East Anglia
Edinburgh
Essex
Exeter
Glasgow
Heriot-Watt
Hull
Keele
Kent at Canterbury
Lancaster
Leeds
Leicester
Liverpool
Loughborough
Manchester
University of Manchester Institute of Science & Technology
Newcastle upon Tyne

Nottingham
Open
Oxford
Reading
St Andrew's
Salford
Sheffield
Southampton
Stirling
Strathclyde
Surrey
Sussex
Ulster
Warwick
York

Wales:—
Aberystwyth—University College of Wales
Bangor—University College of North Wales
Cardiff—University College
Swansea—University College
University of Wales Institute of Science & Technology
Welsh National School of Medicine
Lampeter—St David's University College

London:—

Bedford College
Birkbeck College
Chelsea College
Imperial College of Science & Technology
King's College London
London School of Economics & Political Science
Queen Elizabeth College
Queen Mary College
Royal Holloway College
Royal Veterinary College
School of Oriental & African Studies
School of Pharmacy
University College London
Westfield College
Wye College
Heythrop College

Courtauld Institute of Art
Institute of Advanced Legal Studies
Institute of Archaeology
Institute of Classical Studies
Institute of Commonwealth Studies
Institute of Education
Institute of Germanic Studies
Institute of Historical Research
Institute of Latin American Studies
British Institute in Paris
School of Slavonic & East European Studies
Institute of United States Studies
Warburg Institute

London:—

Charing Cross Hospital Medical School
King's College Hospital Medical School
London Hospital Medical College
Middlesex Hospital Medical School
Royal Dental Hospital School of Dental Surgery
Royal Free Hospital School of Medicine
St Bartholomew's Hospital Medical College
St George's Hospital Medical School
St Mary's Hospital Medical School
The United Medical Schools of Guy's and St Thomas's Hospitals
Westminster Medical School

British Postgraduate Medical Federation
London School of Hygiene & Tropical Medicine
Royal Postgraduate Medical School

OTHER INSTITUTIONS

Cranfield Institute of Technology
London Graduate School of Business Studies
Manchester Business School
Royal College of Art

The closing dates for applications are as follows:

By applicants to Registrar or Secretary: 3 May 1983
 By Registrar or Secretary to CVCP: 3 June 1983

Applications submitted to the CVCP after 3 June 1983 will not be considered.

Further information obtainable from:

The Secretary
 ORS Committee
 Committee of Vice-Chancellors & Principals
 29 Tavistock Square
 London WC1H 9EZ

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS (IUGG)
 XVIII GENERAL ASSEMBLY HAMBURG
 FEDERAL REPUBLIC OF GERMANY 15-27 AUGUST, 1983.

ASSEMBLY PROGRAMS

The meetings and symposia at the General Assembly will include:

IUGG

- Plenary and administrative meetings of the Union
- Union lectures
- Inter-disciplinary Symposia
- IUGG Scientific Committee meetings

IUGG ASSOCIATIONS

- Plenary and administrative meetings
- Association symposia
- Meetings of Association Sub-structural groups

INTER-UNION COMMISSIONS

The Inter-Union Commission on the Lithosphere (ICL) will hold scientific and administrative meetings.

INTER-DISCIPLINARY SYMPOSIA

The following inter-disciplinary symposia are at present planned. The Association responsible for each symposium is emphasized and other Associations and Commissions with an interest in the symposium are listed.

1. Structure and Processes in Subduction Zones
 IAVCEI, IASPEL, ICL.
2. Lithospheric Deformations, Geomagnetic and Geodetic Approaches
 IAG, IAGA, IASPEI, ICL.
3. Crustal Accretion in and around Iceland
 IAG, IAVCEI, ICL.

4. Geodetic Features of the Ocean Surface and their Implications
IAG, IAPSO.
5. Geophysics of the Polar Regions
Bureau, all Associations.
6. Management of Earth Sciences Data.
IAGA, ICL + all other Associations.
7. Hot Spots and Mantle Plumes
IAVCEI, IASPEI.
8. Assessment of Natural Hazards
IASPEI, IAVCEI, IAHS, IAPSO, Tsunami C.
9. Time-dependent Processes and Properties in Planetary Materials
IASPEI, IAVCEI, ICL.
10. Heat Flow and Geothermal Processes
IASPEI, IAVCEI, IAHS.
11. Structure and Composition of the Oceanic Crust
IAVCEI, IASPEI, IAPSO, ICL.
12. Plateau Uplift, Rifts and Volcanism
ICL, IAVCEI, IASPEI.
13. Scientific Discoveries from MAGSAT investigations
IAGA, IASPEI, IAPSO.
14. Interim Results from the Middle Atmosphere Program
IAGA, IAMAP, SCOSTEP.
15. Remote Sensing for Climate Studies
IAMAP, IAPSO, IUCRM.
16. Sea Ice Margins
IAHS, IAPSO, IAMAP.
17. Low Latitude Coupled Ocean/Atmosphere Circulation
IAPSO, IAMAP.
18. Ridge Crest Hydrothermal Activity and the Chemistry of Sea Water
IAPSO, IAVCEI, ICL.
19. The Ocean and the CO₂ Climate Response
IAMAP, IAPSO.
20. Ocean and Atmospheric Boundary Layers
IAPSO, IAMAP.
21. Coastal and near Shore Zone Processes
 - a) Physical Processes.
 - b) Chemical Processes.
 IAPSO, IAHS.

EXCURSIONS

Scientific excursions

The scientific excursions being prepared for delegates to the Assembly are divided into pre-Assembly excursions of 4-5 days duration, excursions of 1-2 days duration during the Assembly and Post-Assembly excursions which will be of 4-5 days duration.

ENQUIRIES

Enquiries regarding accommodation or attendance at the General Assembly should be addressed to

Local Organizing
Committee, IUGG 1983
Hamburg Messe
und Congress GmbH

Postfach 30 23 60
2000 Hamburg 36
Federal Republic of Germany
Tel. (0 40) 35 92 426
Telex 2 12 609

Enquiries regarding Inter-Disciplinary, Association, and Inter-Union Commission Symposia should be addressed to the Secretary General of the Association or Commission responsible for the symposium.

TENTH INTERNATIONAL GEOCHEMICAL EXPLORATION SYMPOSIUM THIRD SYMPOSIUM ON METHODS OF GEOCHEMICAL PROSPECTING

The symposium, organized by the Scandinavian Geological Surveys on behalf of the Association of Exploration Geochemists and the International Association of Geochemistry and Cosmochemistry, Working Group Geochemical prospecting, will be held in Finland from 28 August to 1 September, 1983. Eight pre- and post-symposium geological and geochemical excursions will be arranged in Scandinavia, Greenland and, possibly, the U.S.S.R.

Enquiries for further information should be addressed to

Dr. Alf Bjorklund,
General Chairman of the Organizing Committees,
Geological Survey of Finland,
SF-02150 Espoo 15,
Finland.

INTERNATIONAL SYMPOSIUM ON COASTAL EVOLUTION IN THE HOLOCENE

DATE: August 29 - September 3, 1983

SPONSOR: Japan Society for the Promotion of Science (JSPS)

INTERNATIONAL COOPERATION:

IGCP #61 The Sea Level Project
IGU Commission on the Coastal Environment
INQUA Commission on Shorelines, Indian and Pacific Oceans
Subcommission
INQUA Commission on Neotectonics

JAPANESE SUPPORTING BODIES:

- Japan Association for Quaternary Research
- The Association of Japanese Geographers
- Japanese Geomorphological Union
- Geological Society of Japan

LOCATION: Komazawa University, Setagaya, Tokyo, Japan.

MAIN TOPICS:

1. Method of research on the Holocene sea-level change.
2. Temporal sequence and spatial characteristics on the Holocene sea-level change and their causes.
3. Changes of coastal environment, induced by natural and human causes.

Contributions from Asian and Pacific areas will be expected.

REGISTRATION FEE: Japanese Yen (¥) 15,000 (or foreign currency at current exchange rates equivalent to ¥15,000).
Japanese Yen will be preferable to be sent. Registration fee should be sent to the following bank account by June 1, 1983.

Account No.: 292-1392372, FUJI BANK
 Holocene sea-level changes
 c/o Y. OTA
 Department of Geography
 Yokohama National University
 Hodogaya-Ku, Yokohama, 240 JAPAN

Personal check is not acceptable.
 Registration fee will be nonrefundable, if cancelled after
 June 1, 1983.

PAPERS: Papers are to be written and presented in English. Abstracts within four pages, including figures ready for printing, should be sent by July 1, 1983, to:

Prof. Y. OTA
 Secretary, Organizing Committee,
 Department of Geography,
 Yokohama National University,
 Tokiwadai,
 Hodogaya-Ku,
 Yokohama,
 240 JAPAN

Abstracts of papers will be available at the time of registration, August 29, 1983.

ACCOMMODATION: Rooms of Shibuya Tokyu Inn, convenient to Komazawa University, have been reserved. Room charge per person per night at the present rate is ¥6,100 for sharing twin room (including breakfast, service charge and tax). Extra charge for single room is ¥2,800 per night.

EXCURSION: Three days field trip will be held in the Niigata Plain and Sado Island. The excursion fee will be about ¥70,000 and should be paid at the time of registration, August 29, 1983. The cost covers all expenses during the round trip from Tokyo to Niigata in double accommodation basis.

TECHNIQUES OF HYDROLOGIC INVESTIGATIONS FOR INTERNATIONAL PARTICIPANTS

The U.S. Geological Survey (USGS), Water Resources Division, Office of International Hydrology, is pleased to announce the 1983 course "Techniques of Hydrologic Investigations for International Participants."

Date: June 20 through August 12, 1983.
Place: USGS National Training Center, Denver, Colorado.
Cost: 6,500 dollars per participant (includes meals Monday through Saturday and lodging throughout the course).
Language of Instruction: English (no interpreters will be provided).
Application Deadline: April 22, 1983.

Application must include the following attached documents:

1. Curriculum Vitae
2. Waiver of Claim for Reimbursement
3. Itinerary for additional visits/training
4. Medical Expense Form
5. Official Request for Training Form

Contact: Office of International Hydrology
Water Resources Division
U.S. Geological Survey
470 National Center
Reston, Virginia 22092

A. PURPOSE & OBJECTIVE

The purpose and objective of this course is to instruct the participating hydrologists in the techniques and methods used by the U.S. Geological Survey for collecting hydrologic data and interpreting that data to evaluate the water resources of an area or region. Data-collection techniques will include hands-on field methods of measuring and recording data and office procedures for processing and storing the data. Interpretive techniques will include graphical, analytical, and computer methods of analyzing data to determine hydrologic parameters and relationships. The interdisciplinary subject material will be presented in discipline groups - surface water, ground water, and water quality - but with an overall adherence to the concept that each discipline is only one aspect of the total hydrologic system. In this way, the participant will be able to learn the techniques and methods used in his own field of interest and how his field relates to and is affected by the total system. The participants will, thus, be prepared to effectively present all of the techniques and methods to their colleagues regardless of the particular discipline.

B. ORGANIZATION OF THE COURSE

The program of study has been structured to meet the needs of practicing hydrologists. Teaching methods will include lectures, discussions, workshops, films, written exercises, field trips, and actual practice with equipment. To ensure adequate instructor-student interaction, enrollment will be limited to approximately 25 participants.

All participants will be requested to give a 30-minute presentation on June 20 or 21 covering hydrology, hydrological problems, culture, and other areas of interest relating to their country. Students are encouraged to bring slides, pictures, etc., to facilitate this presentation.

C. PROFESSIONAL REQUIREMENTS

The participants should be practicing hydrologists with direct responsibilities in planning and performing hydrologic investigations and in training technicians and colleagues. The participants should have a minimum of a bachelor's degree in science or engineering (or equivalent work experience).

D. LANGUAGE REQUIREMENTS

All instruction will be in English. Applicants should provide English-language facility test scores or acceptable verification of English-language proficiency. Information on English-language facility testing can be obtained at the American Embassy or Consulate in each country.

E. COST

The 8-week course tuition fee of 6,500 dollars (U.S. currency) includes instruction, field trips, publications, calculator, lodging (single occupancy), three meals each day Monday through Saturday (Sunday meals will be purchased by the participant), room cleaning service, a television set in each suite of six rooms, and a public transportation bus pass. A graduation certificate will be awarded to each student successfully completing the course. Tuition fee is payable to the U.S. Geological Survey prior to attendance. Fee does not include international or U.S. travel.

Sponsors should provide attendees with at least 500 dollars to cover miscellaneous expenses such as Sunday meals, taxi fares, toilet articles, etc. Do not bring any form of currency that must be converted to U.S. dollars after arrival. Conversion may take 6 or more weeks and create a financial hardship for the student.

The USGS will present the course at the USGS National Training Center in Denver, Colorado. Students will be housed in the Twin Towers Residence Halls on the Colorado School of Mines Campus in Golden, Colorado, a northwestern suburb of Denver, at the foot of the Rocky Mountains. The Twin Towers Residence Halls are located only one-half kilometer from the main business district of Golden. Transportation will be provided daily from the Twin Towers Residence Hall to the USGS National Training Center and back to the Residence Hall in the afternoon. Closing date for application to attend the course is April 22, 1983. Early application is encouraged due to the limited number of spaces available. No scholarships or financial assistance can be provided by the U.S. Geological Survey.

Requests for information and applications should be submitted by a unit of the national government or by an international organization (not by personal request) to:

Office of International Hydrology
Water Resources Division
U.S. Geological Survey
470 National Center
Reston, Virginia 22092 USA

Telex inquiries may be address to government telex number 89-9153.

F. ADDITIONAL TRAINING AVAILABLE

Upon graduation (August 13), participants may wish to augment attendance at the course with on-the-job training or visits to other U.S. Government agencies and university research centers engaged in work related to their fields of interest.

All requests for visits, study tours, or on-the-job training must be received with the application for admission to the "Techniques of Hydrologic Investigations for International Participants" course.

TRAINING COURSES

February 1983 - November 1983

Geothermal Technology (Auckland, New Zealand): Post-graduate course on utilization of geothermal energy for power generation. For nationals of developing countries or N.Z. with B.Sc. or B. Eng. degrees. Leads to Diploma in Energy Technology (Geothermal). UNDP fellowships available. English. For information: Director, Geothermal Institute, University of Auckland, Private Bag, Auckland, New Zealand.

February 1983 - November 1983

Photointerpretation Applied to Geology and Geotechnics (Bogota, Colombia): Short course organized by the Interamerical Centre of Photo-interpretation (CIAF) in cooperation with ITC and Unesco. Spanish. For information: Academic Secretariat of the CIAF, Apartado Aereo 53754, Bogota, Colombia.

February 1983 - June 30 1983

Mineral Exploration (Leoben, Austria): Diploma course sponsored by Unesco. English. For information: University for Mining and Metallurgy, Postgraduate course on Mineral Exploration, Montanuniversitat, Leoben, A 8700, Austria.

February 15 1983 - December 15 1983

Geothermics (Pisa, Italy): Certificate course on geothermal energy sponsored by Unesco, UNDP and Italy. Spanish. For information: Istituto Internazionale per le Ricerche Geotermiche, 1, Via Buongusto, 56100 Pisa, Italy.

March 1983 - April 1983

Mineral Exploration (Paris, France): Short course sponsored by Unesco. French. For information: Prof. H. Pelissonnier, Ecole des Mines, 60 Bd Saint Michel, 75272 Paris, Cedex 06, France.

April 25 1983 - May 27 1983

Remote Sensing: Applications in geologic and hydrologic exploration and planning (Sioux Falls, South Dakota, U.S.A.). Workshop for foreign nationals. English. For information: Office of International Geology, Training Section, U.S. Geological Survey, 917 National Center, Reston, Virginia 22092, U.S.A.

May 1983 - June 1983

Small Scale Mining (Bangalore, India). An international short course with 10 days of lectures and seminars and 10 days of field trips. Sponsored by AGID and Bangalore University. English. Date changed from November - December 1982. For information: C. Naganna, Director School of Earth Science, Bangalore University, Jnana Bharati, Bangalore 560056, India.

May 30 1983 - July 1 1983; October 3 1983 - November 4 1983; May 28 1984 - June 29 1984; October 1 1984 - November 2 1984

Remote Sensing: Geological applications (Flagstaff, Arizona, U.S.A.). Advanced training program for foreign scientists. English. For information: Training Section, Office of International Geology, U.S. Geological Survey, National Center, M/S 917, Reston, Virginia 22092, U.S.A.

June 1983 - August 1983

Principles and Methods of Engineering Geology (Budapest, Hungary): Certificate course sponsored by Unesco. English. For information: Hungarian Geological Institute, Nepstadion ut 14, P.O. Box 106, H 1142 Budapest, Hungary.

July 1983 - August 1983

Summer course on Earth Sciences: Crystallography, Mineralogy, Metallogeny (Madrid, Spain): Short course sponsored by Unesco. Spanish. For information: Departamento de Geologia y Geoquimica, Facultad de Ciencias, Universidad Autonoma de Madrid, Canto Blanco, Madrid 34, Spain.

August 1983 - October 1983

Geochemical Prospecting Methods (Prague, Czechoslovakia): Certificate course organized by Geological Survey of Czechoslovakia and sponsored by Unesco, IAGC and Czechoslovakia. English. For information: GEOCHIM CSSR UNESCO, Geological Survey, Malostranske nam. 19, 118 21 Prague, Czechoslovakia.

September 1983 - October 1983

Geothermal Energy (Kyushu, Japan). Short course organized by Japan in cooperation with Unesco. English. For information: Unesco, 7 place de Fontenoy, 75700 Paris, France.

September 1983 - August 1984

Mining Exploration and Exploration Geophysics (Delft, The Netherlands). Diploma courses organized by the International Institute for Aerial Survey and Earth Sciences. Sponsored by Unesco. English. For information: ITC Student Affairs, P.O. Box 6, 7500 AA Enschede, The Netherlands.

September 12 1983 - October 14 1983

Remote Sensing: Application in vegetation assessment and land use planning (Sioux Falls, South Dakota, U.S.A.). Workshop for foreign nationals. English. For information: Training Section, Office of International Geology, U.S. Geological Survey, National Center, M/S 917, Reston, Virginia 22092, U.S.A.

October 1983 - September 1984

Fundamental and Applied Quaternary Geology (Brussels, Belgium). Organized by the Vrije Universiteit Brussel (IFAQ) and sponsored by Unesco. English. For information: Prof. Dr. R. Paepe, Director of IFAQ, Kwartairgeologie, Vrije Universiteit Brussel, Pleinlaan 2, B-1050, Brussels, Belgium.

October 1983 - November 1983

Seismology and Geophysics (Potsdam, G.D.R.). Training course organized by East German Academy of Sciences in collaboration with Unesco. English. For information: Prof. Dr. H. Kautzleben, Director, Central Earth's Physics Institute, Academy of Sciences of the German Democratic Republic, Telegraphenberg, DDR 1500 Potsdam, G.D.R.

February 6 1984 - March 2 1984

Remote Sensing: Digital image processing (Flagstaff, Arizona, U.S.A.). Advanced training program for foreign scientists. English. For information: Training Section, Office of International Geology, U.S. Geological Survey, National Center, M/S 917, Reston, Virginia 22092, U.S.A.

July 1984

Regional Geochemical Exploration in Tropics (Recife, Brazil). 3-week workshop. For information: Prof. Arao Horowitz, Coordenador do Programa de Mestrado em Quimica, Univ. Federal de Pernambuco, Cidade Universitaria, 50000 Recife, Brazil.

KALENDAR (CALENDAR)

A bracketed date (Mar-Apr 1982) denotes entry in that issue carried additional information.

1983

- Mar 6 - 10 : 3rd International Symposium on Hydrometallurgy, Atlanta, Georgia, USA. K. Osseo-Asare, Dept. of Materials, Science and Engineering, 202A, Steidle Building, The Pennsylvania State University, University Park, Pennsylvania 16802, USA). (Jul-Aug 1982).
- Mar 16 : Metamorphic Studies Research in Progress, (Meeting), London, U.K. (M. Brown, Honorary Secretary, Metamorphic Studies Group, Dept. of Geology & Physical Sciences, Oxford Polytechnic, Headington, Oxford OX3 0BP, UK).
- Apr 10 - 15 : Rock Mechanics (5th International Congress), Melbourne, Australia. (Australian Geomechanics Society Institution of Engineers, Australia, 11 National Circuit, Barton, ACT 2600, Australia).
- Apr 11 - 13 : Proterozoic '83 (1st International Conference), Lusaka, Zambia. Field trips. Sponsored by Geological Survey of Zambia and GSA. Languages: English and French. (The Secretariat, Proterozoic '83, P.O. Box 50135, Lusaka, Zambia).
- Apr 11 - 16 : Sedimentation on the Continental Shelf (Symposium, with special reference to the East China Sea), Hangzhou, People's Republic of China. (John D. Milliman, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, U.S.A.)
- Apr 11 - 15 : Benthos '83 (2nd International Symposium on Benthonic Foraminifera), Pau, France. Sponsored by French Academy of Sciences and French Paleontological Association. (M. Hamaoui, SNEA(P), Direction Exploration, Centre Micoulaou, B.P. 65, 64018 Pau, France).
- Apr 12 - 15 : Evolution of The Archaean Lithosphere (IGCP 92 Archaean Geochemistry Symposium), Glasgow, U.K. 8-day post-symposium field excursion to the Lewisian. (Professor B.F. Windley, Department of Geology, University of Leicester, Leics. LE1 7RH, U.K.)
- Apr - May : International Association of Sedimentologists, (4th European Meeting), Split, Yugoslavia. Pre- and post-Conference field trips. (V. Jelaska, Geoloski Zavod, Sachsova 2, 41000 Zagreb, Yugoslavia).
- Apr 16 : Metamorphism in Shear Zones (Geological Society Tectonic Studies Group Meeting), Cardiff, Wales. (Dr. W. Gibbons, Department of Geology, University College of Wales, Cardiff, U.K.)
- Apr 17 - 20 : AAPG and SEPM (Joint Annual Meeting), Dallas, U.S.A. (AAPG, Box 979, Tulsa, OK 74101, U.S.A.)
- May : Soil Mechanics and Foundation Engineering, (8th European Conference), Helsinki, Finland. (Secretary-General, VIII ECSMFE, c/o VTT/GEO, SF-02150 Espoo 15, Finland).

- May 2 - 6 : Methods and Instruments for the Investigation of Ground-water Systems, (International Symposium), Noordwijkerhout, The Netherlands. Co-sponsored by UNESCO, IHP, IAHS and IAH. Languages: English and French. (Secretary, Organizing Committee, Congress Bureau of the Corporate, Communication Dept. TNO, 148 Juliana van Stolberglaan, 2595 CL The Hague, The Netherlands).
- May 10 : Geology Applied to Civil Engineering Problems in the Developing Countries of SE Asia (Geological Society Joint Ordinary General Meeting and Engineering Group Meeting), London, U.K. (Mrs. J. Greenfield, Burlington House, Piccadilly, London W1V 0JU, U.K.)
- May 11 - 13 : Geological Association of Canada Mineralogical Association of Canada, Canadian Geophysical Union (Joint Annual Meeting), Victoria, British Columbia, Canada. (G. McArthur, Room 418, 617 Government Street, Victoria, BC V8V 1X4, Canada)
- May 17 - 18 : Marine Petroleum Source Rocks (Geological Society Joint Meeting, Petroleum Geochemistry and Marine Studies Group), London, U.K. (Dr. Jim Brooks, Exploration Division, BNOC, 150 St. Vincent Street, Glasgow G25 LJ, U.K.)
- May 18 - 20 : Soil and Rock Investigations by In-Situ Testing (International Symposium), Paris, France. Co-sponsored by IAEG and ISSMFE. Languages: English and French. (M. André Peter, B.R.G.M., Boite Postale 6009, 45060 Orleans Cedex, France)
- May 19 - 20 : Chemical and Physical Aspects of Subduction Related Magmatism (Geological Society Volcanic Studies Group Meeting), Leeds, U.K. (Dr. M.F. Thirlwall, Department of Earth Sciences, The University, Leeds 2, Yorkshire, U.K.)
- June : Engineering Geological Problems of River Valleys (Symposium), Poland, (Doc. Dr. Hab E., Falkowski Institute of Hydrogeology and Engineering Geology, Warsaw University, Al Zwirkkii Wigury 93, 02-089 Warsaw, Poland)
- June 12 - 17: 4th Geosat Workshop, Flagstaff, Arizona. Will cover LANDSAT 4, geobotany, and remote sensing of clays. (The Geosat Committee, 153 Kearny, Suite 309, San Francisco, CA 94108, U.S.A.)
- June 19 - 25: Soil Mechanics and Foundation Engineering (7th ISSMFE Conference), Vancouver, British Columbia, Canada. (Pan American Conference, 6060 Marine Drive, West Vancouver, BC, Canada V7W 2S3)
- July 4 - 7 : Petrology of Weathering and Soils (International Colloquium), Paris, France. Languages: English and French. (Prof. Daniel Nahon, Laboratoire de Petrologie de la Surface, Universite de Poitiers, 40 avenue Recteur Pineau, 86022 Poitiers Cedex, France)
- July 18 - 23: Paleoecology (1st International Congress), Lyon, France. Secrétaire, 1^{er} Congres int. de paleoecologie, Universite Claude Bernard, Department des Sciences de la Terre, 27-43 boulevard du 11 Novembre, 69622 Villeurbanne Cedex, France)
- July 19 - 21: Paleoceanography (1st International Conference), Zurich, Switzerland. The Conference will take the place of a 4th Planktonic Conference. (Ueli Briegel, Geological Institute, ETH-Zentrum, 8092 Zurich, Switzerland)

- Aug 7 - 12 : Fossil Corals (Symposium), Washington, D.C. (W.A. Oliver, Jr., U.S. Geological Survey, E-305 Natural History Building, Smithsonian Institution, Washington, D.C. 20560, USA).
- Aug 15 - 27 : IUGG (18th General Assembly), Hamburg, F.R.G. (Local Organizing Committee, IUGG 1983, Hamburg Messe und Congress GmbH, Congress Organization, Postfach 30 23 60, D-2000 Hamburg 36, F.R.G.).
- Aug 27 : Krakatau Eruption (Centennial Symposium), Jakarta, Indonesia. (D. Sastrapradja, Indonesia Institute of Sciences, Box 250, Jakarta, Indonesia).
- Aug 28 - Sept 2 : World Petroleum (11th Congress), London, U.K. (W.B. Waugh, Secretary-Treasurer, Canadian National Committee, World Petroleum Congress, c/o Shell Canada Limited, P.O. Box 400, Terminal A, Toronto, ON, Canada M5W 1E1).
- Aug 28 - Sept 3 : Groundwater in Water Resources Planning (Meeting), Koblenz, F.R.G. Sponsored by Unesco/IHP. (IHP/OHP Sekretariat, c/o Bundesanstalt für Gewässerkunde, Postfach 309, D-5400 Koblenz, F.R.G.).
- Aug 29 - Sept 1 : Methods of Geochemical Prospecting (10th IGES and 3rd SMGP), Espoo, Finland). Sponsored by AEG and IAGC. Pre- and post-symposium field trips to Scandinavia, Greenland and Soviet Karelia. (A. Bjorklund, 10th IGES - 3rd SMGP, Geological Survey of Finland, SF-02150 Espoo, Finland).
- Aug 29 - Sept 8 : International Association of Geochemistry and Cosmochemistry, (4th International Symposium of Water-Rock Interaction), Misasa, Japan. Technical sessions and post-Symposium field trips. Sponsored by Institute for Thermal Spring Research, Geochemical Society of Japan and Geothermal Research Society of Japan. (H. Sakai, Secretary-General, WRI-4, Institute for Thermal Spring Research, Okayama University, Misasa, Tottori-ken 682-02, Japan).
- Aug 31 - Sept 2 : Geoscience and Remote Sensing (International Symposium), San Francisco, California, U.S.A. (M. Buettner, M.S.L-156, Lawrence Livermore National Laboratory, P.O. Box 5504, Livermore, CA 94550, U.S.A.).
- Sept : International Symposium on Engineering Geology and Underground Construction, Lisbon, Portugal. (Sociedade Portuguesa de Geotecnia, c/o L.N.E.C., Av. Brasil, 101, 1799 Lisboa Codex, Portugal).
- Sept : Geomaterials: Rocks, Concretes, Soils, (Meeting), Evanston, Illinois, USA. (Secretary-General, IUTAM, Chalmers University of Technology, Fack, S-40220 Gothenburg 5, Sweden).
- Sept 5 - 9 : Blueschists and Related Eclogites (Penrose Conference. Bellingham and Seattle, Washington, U.S.A. (Edwin H. Brown, Department of Geology, Western Washington University, Bellingham, WA 98225, U.S.A.).
- Sept 12 - 17: Carboniferous Stratigraphy and Geology, (10th International Congress), Madrid, Spain. (Comite organizador del X Congreso Internacional de Estratigrafia y Geologia del Carbonifero, Instituto Geologico Minero de Espana, Rios Rosas, 23-Madrid - 3, Espana).

- Sept 16 - 17: Correlation of Caledonian Stratabound Sulfides (Symposium), Ottawa, Canada. Organized in collaboration with IGCP Project 60. Pre- and post-symposium field trips. (D.F. Sangster, Geological Survey of Canada, Room 699, 601 Booth Street, Ottawa, ON, Canada K1A 0E8).
- Sept 19 - 23: World Energy, (12th Conference), New Delhi, India. (E. Ruttley, World Energy Conference, 34 St. James Street, London SW1A 1HD, U.K.).
- Sept 19 - 24: Quaternary. (6th Meeting), Galicia, Spain. (Sr. Secretario del Grupo Espanol de Trabajo del Cuaternario, Instituto de Edafologia y Biologia Vegetal, Serrano, 115 duplicado, Madrid-6, Spain).
- Oct : International Council for the Exploration of the Sea (71st Statutory Meeting), Göteborg, Sweden. (General Secretary ICES, Palaegade 2-4, 1261 Copenhagen, Denmark).
- Dec : Groundwater 1983 (IAH Symposium), Sydney, Australia. (W. Williamson, Ibis House, 201/211 Miller St., P.O. Box 952, North Sydney, NSW 2060, Australia).

1984

- Mar/Apr : Geology, Mineral and Energy Resources of Southeast Asia (GEOSEA V), Kuala Lumpur, Malaysia. (T.T. Khoo, Geological Society of Malaysia, Dept. of Geology, University of Malaya, Kuala Lumpur 22-11, Malaysia).
- Mar 26 - 30 : Computer applications in the mineral industries (18th International Symposium), London, U.K. Organized by the Institution of Mining and Metallurgy. (The Conference Office, Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, U.K.).
- Aug 4 - 14 : 27th International Geological Congress, Moscow, USSR. (N.A. Bogdanov, General Secretary, Organizing Committee of the 27th IGC, Staromonetny per. 22, Moscow 109180, USSR).
- Aug 9 - 18 : Crystallography, (13th General Assembly and International Congress), Hamburg, F.R.G. (E.E. Snider, American Crystallographic Association, 335 East 45th Street, New York, NY 10017, USA).
- Aug 24 - 30 : 6th International Palynological Conference, Calgary, Canada. Sponsored by ICP, CAP, CSPG, the University of Calgary, and Arctic Institute of North America. Pre- and post-Conference excursions. (L. Kokoski, Conference Office, Faculty of Continuing Education, Education Tower Room 102, Calgary, Alberta, Canada T2N 1N4).
- Sept : Caledonide Orogen, (IGCP Project 27, Working Group Meeting), Edinburgh, Scotland. Pre-Meeting excursions in Ireland, Scotland, England and Wales. (A.L. Harris, The University of Liverpool, Jame Herdman Laboratories of Geology, Brownlow Street, P.O. Box 147, Liverpool L69 3BX, U.K.).
- Nov 5 - 8 : Geological Society of America, (Annual Meeting), Reno, USA. (S.S. Beggs, Geological Society of America, P.O. Box 9140, 3300 Penrose Place, Boulder, Colorado 80301, USA).
- Dec 2 - 6 : Society of Exploration Geophysicists, (54th Annual Meeting), Atlanta, Georgia, USA. (J. Hyden, SEG, Box 3098, Tulsa, Oklahoma 74101, USA).

1984

- Feb 9 - 14 : Recent Crustal Movements of the Pacific Region (International Symposium), Wellington, New Zealand. Sponsor, Royal Society of New Zealand. (Secretary, H.M. Bibby, Geophysics Division, DSIR, P.O. Box 1320, Wellington, New Zealand).
- Feb 22 - 25 : Applied Mineralogy in the Minerals Industry (2nd International Congress), Los Angeles, California, U.S.A. (The Organizing Committee Chairman, ICAM 84, P.O. Box 310, Danbury, CT 06810, U.S.A.).
- May 21 - 23 : Aggregates (International Symposium), Nice, France. Sponsored by IAEG. Languages: English and French. (M. Louis Primel, L.C.P.C., 58 boulevard Lefebvre, 75732 Paris Cedex 15, France).

1985

- June : Tunnelling (4th International Symposium), Brighton, U.K. (The Secretary, Institution Mining and Metallurgy, 44 Portland Place, London W1N 4BR, U.K.).

1986

- July 13 - 18: International Mineralogical Association (General Meeting), Stanford, California, U.S.A. (Prewitt, Department of Earth and Space Sciences, State University of New York, Stony Brook, NY 11794, U.S.A.).

PERSATUAN GEOLOGI MALAYSIA
(GEOLOGICAL SOCIETY OF MALAYSIA)

Tujuan Persatuan Geologi Malaysia adalah untuk memajukan sains bumi, terutama sekali di Malaysia dan negara-negara jiran. Barang siapa yang ingin menjadi ahli Persatuan adalah dipersilakan mendapatkan borang-borang daripada Setiausaha Kehormat.

The aim of the Geological Society of Malaysia is to promote the advancement of geological sciences particularly in Malaysia and the neighbouring countries. Anyone interested in becoming a member of the Society should obtain the necessary forms from the Hon. Secretary.

GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATIONS

INFORMATION FOR CONTRIBUTORS

General Information

The Society publishes the *Buletin Persatuan Geologi Malaysia* (Bulletin Geological Society of Malaysia) and the *Warta Geologi* (Newsletter of the Geological Society of Malaysia) which is issued bimonthly.

Papers of general interest or on the geology of the Southeast Asian region (South China, Burma, Thailand, Indochina, Malaysia, Singapore, Indonesia, Brunei and the Philippines) and also marine areas within the region are welcome for publication in the *Bulletin*. Short notes, progress reports and general items of information are best submitted to the *Warta Geologi*.

Papers should be as concise as possible. However, there is no fixed limit as to the length and number of illustrations. Therefore, papers of monograph length are also welcome. Normally, the whole paper should not exceed 30 printed pages and it is advisable that authors of papers longer than 30 printed pages should obtain the consent of the Editor before submission of the papers.

The final decision of any paper submitted for publication rests with the Editor who is aided by an Editorial Advisory Board. The Editor may send any paper submitted for review by one or more reviewers. Scripts of papers found to be unsuitable for publication may not be returned to the authors but reasons for the rejection will be given. The authors of papers found to be unsuitable for publication may appeal only to the Editor for re-consideration if they do not agree with the reasons for rejection. The Editor will consider the appeal together with the Editorial Advisory Board.

Unless with the consent of the Editor, papers which have been published before should not be submitted for consideration.

Twenty-five reprints of each paper are free-of-charge. Contributors should notify the Editor of extra reprints (which are of non-profit costs) required.

All papers should be submitted to the Editor, Geological Society of Malaysia, c/o Department of Geology, University of Malaya, Kuala Lumpur 22-11, MALAYSIA.

Script Requirements

Scripts must be written in Bahasa Malaysia (Malay) or English.

Two copies of the text and illustrations must be submitted. The scripts must be typewritten double-spaced on papers not exceeding 21 × 33 cm. One side of the page must only be typed on.

Figure captions must be typed on a separate sheet of paper. The captions must not be drafted on the figures.

Original maps and illustrations or as glossy prints should ideally be submitted with sufficiently bold and large lettering to permit reduction to 15 × 22 cm: fold-outs and large maps will be considered only under special circumstances.

Photographs should be of good quality, sharp and with contrast. For each photograph, submit two glossy prints, at least 8 × 12 cm and preferably larger. Use of metric system of measurements (ISU) is strongly urged wherever possible.

Reference cited in the text should be listed at the end of the paper and arranged in alphabetical order and typed double-spaced. The references should be quoted in the following manner:

Suntharalingam, T., 1968. Upper Palaeozoic stratigraphy of the area west of Kampar, Perak. *Geol. Soc. Malaysia Bull.*, 1, 1-15.

Hosking, K.F.G., 1973. Primary mineral deposits. In Gobbett, D.J. and Hutchison, C.S. (Eds), "*Geology of the Malay Peninsula (West Malaysia and Singapore)*". Wiley-Interscience, New York, 335-390.

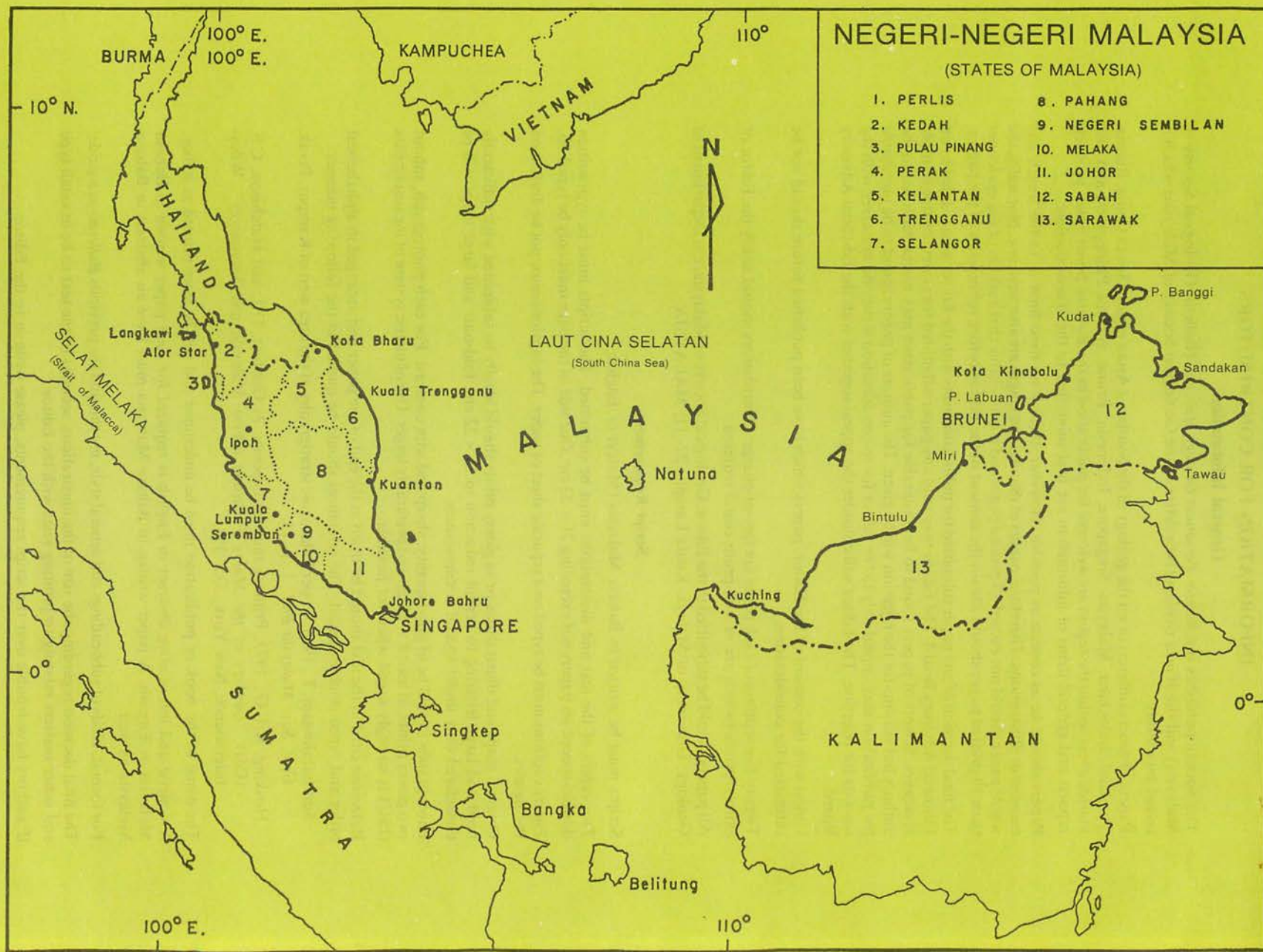
The name of the book or publication must be underlined and will be later printed in italics.

A concise and informative abstract in English is required for each paper written in Bahasa Malaysia or English. A paper written in Bahasa Malaysia must have an abstract in Bahasa Malaysia as well.

For format, kinds of subheadings and general style, use this and the previous *Bulletins* as a guide.

The final decision regarding the size of the illustrations, sections of the text to be in small type and other matters relating to printing rests with the Editor.

If authors have trouble over the script requirements, please write in to the Editor.



- ### NEGERI-NEGERI MALAYSIA
- (STATES OF MALAYSIA)
- | | |
|-----------------|--------------------|
| 1. PERLIS | 8. PAHANG |
| 2. KEDAH | 9. NEGERI SEMBILAN |
| 3. PULAU PINANG | 10. MELAKA |
| 4. PERAK | 11. JOHOR |
| 5. KELANTAN | 12. SABAH |
| 6. TRENGGANU | 13. SARAWAK |
| 7. SELANGOR | |

BURMA
100° E.
100° E.

KAMPUCHEA

110°

10° N.

VIETNAM



THAILAND

LAUT CINA SELATAN
(South China Sea)

SELAT MELAKA
(Strait of Malacca)

MALAYSIA

Natuna

BRUNEI

KALIMANTAN

SUMATRA

100° E.

110°

0°

Langkawi
Alor Star

Kota Bharu

Kuala Trengganu

Kuala Lumpur
Seremban

Johore Bahru
SINGAPORE

Singkep

Bangka

Belitung

P. Banggi
Kudat

Kota Kinabalu

P. Labuan

Miri

Bintulu

Kuching

Sandakan

Tawau

2

3

4

7

8

9

10

11

5

6

Kuantan

13

12