

PERSATUAN GEOLOGI MALAYSIA

WARTA GEOLOGI

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KANDUNGAN (Contents)

CATATAN GEOLOGI (Geological Notes)

- | | |
|--|-----|
| Ibrahim Abdullah, Juhari Mat Akhir, Abd. Rasid Jaapar & Nor Azian Hamzah: The Tertiary Basin in Felda Nenering, Pengkalan Hulu (Keroh), Perak. | 181 |
| Basir Jasin, Sanudin Hj. Tahir & F.F. Tating: Late Eocene Planktonic foraminifera from the Crocker Formation, Pun Batu, Sabah | 187 |

PERTEMUAN PERSATUAN (Meetings of the Society)

- | | |
|--|-----|
| Advances in Petroleum Geochemistry in Malaysia and Southeast Asia | 192 |
| Jonathan Redfern: Glacial facies – their sedimentology, distribution and hydrocarbon potential | 194 |

BERITA-BERITA PERSATUAN (News of the Society)

- | | |
|---|-----|
| Obituary – Kenneth Frederick George Hosking | 195 |
| Keahlian (Membership) | 198 |
| Pertukaran Alamat (Change of Address) | 198 |
| Pertambahan Baru Perpustakaan (New Library Additions) | 199 |

BERITA-BERITA LAIN (Other News)

- | | |
|--|-----|
| National Seminar on Applications of Physics in Industry | 200 |
| Management of Groundwater Supply for Urban Areas | 213 |
| Kursus-kursus Latihan dan Bengkel-bengkel (Training Courses and Workshops) | 215 |
| Kalendar (Calendar) | 216 |



GEOLOGICAL SOCIETY
OF MALAYSIA

DIKELUARKAN DWIBULANAN
ISSUED BIMONTHLY

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About the Society

The Society was founded in 1967 with the aim of promoting the advancement of earth sciences particularly in Malaysia and the Southeast Asian region.

The society has a membership of about 600 earth scientists interested in Malaysia and other Southeast Asian regions. The membership is worldwide in distribution.

**The Tertiary Basin in Felda Nenering,
Pengkalan Hulu (Keroh), Perak.
Lembangan Tersier di Felda Nenering,
Pengkalan Hulu (Keroh), Perak**

IBRAHIM ABDULLAH, JUHARI MAT AKHIR,
ABD. RASID JAAPAR & NOR AZIAN HAMZAH
Jabatan Geologi, Universiti Kebangsaan Malaysia.

Abstract: A well exposed rock sequence believed to be of Tertiary age is outcropping in Felda Nenering area, Pengkalan Hulu, Perak. This sequence, which consists of mudstones, sandstones and minor conglomerates, is unconformably overlying the rocks of Silurian Baling Group. At the basal parts of the sequence, most of the sandstone bodies with thickness 1 - 2 metres are channel shaped while others are more tabular. Field evidences show the rock sequence here has undergone normal faulting with throw in the order of tenth of metres.

Abstrak: Satu jujukan batuan yang dipercayai berusia Tersier ditemui tersingkap dengan baik di kawasan Felda Nenering, Pengkalan Hulu, Perak. Jujukan ini yang terdiri daripada batu lumpur, batu pasir dan minor konglomerat terletak secara tak selaras di atas batuan Kumpulan Baling yang berusia Silur. Di bahagian bawah jujukan ini, jasad batu pasir yang berketebalan antara 1 - 2 metre kebanyakannya berbentuk palung manakala yang lainnya lebih berbentuk sekata (tabular). Bukti lapangan menunjukkan batuan ini telah mengalami penyesaran normal dengan lemparannya puluhan meter.

INTRODUCTION

The documented Tertiary sedimentary deposits in Peninsular Malaysia are described from Bukit Arang (Perlis), Lawin, Enggur and Tanjung Rambutan (Perak), Batu Arang (Selangor), Kepong, Kluang and Layang-Layang (Johor) (Gobbett & Hutchison, 1973). In our recent field visit to the Pengkalan Hulu area, we found a rock sequence unconformably overlying the rocks of Silurian Baling Group.

The rock sequence is exposed and observed at km 6 to 9.5, along a new road from Kampong ayer Panas to Padang Lalang (Fig. 1), and is believed to be of Tertiary age based on its lithology, degree of consolidation and structures. This is only a preliminary report about the occurrence of the Tertiary deposits in the area. Further studies on sedimentology, structural geology and palaeontology (palynology) of the sequence are in progress and the result of these detail studies will be reported later.

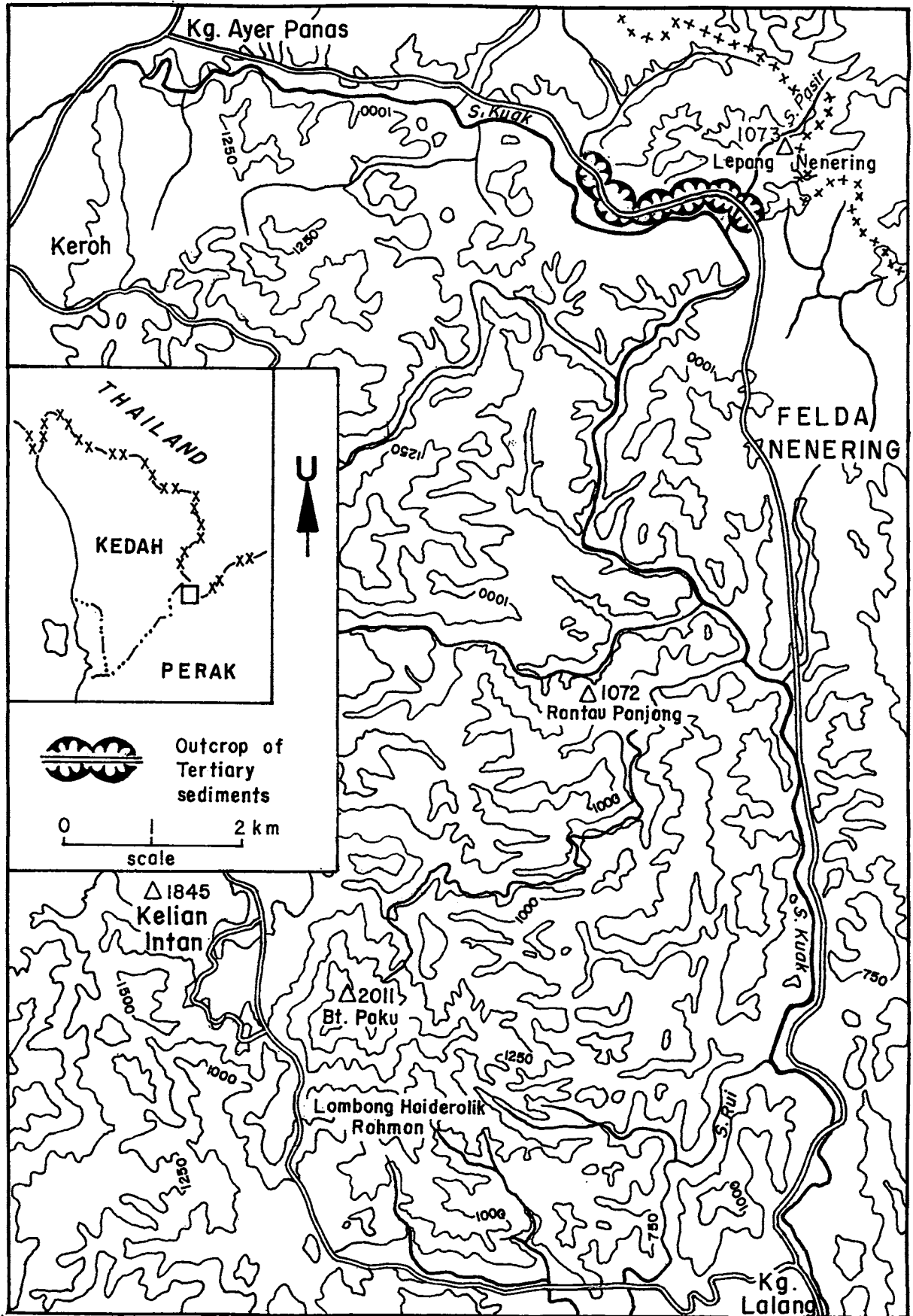


Figure 1: Map of Kg. Ayer Panas-Kg. Lalang area showing the locality of the Tertiary sediments.

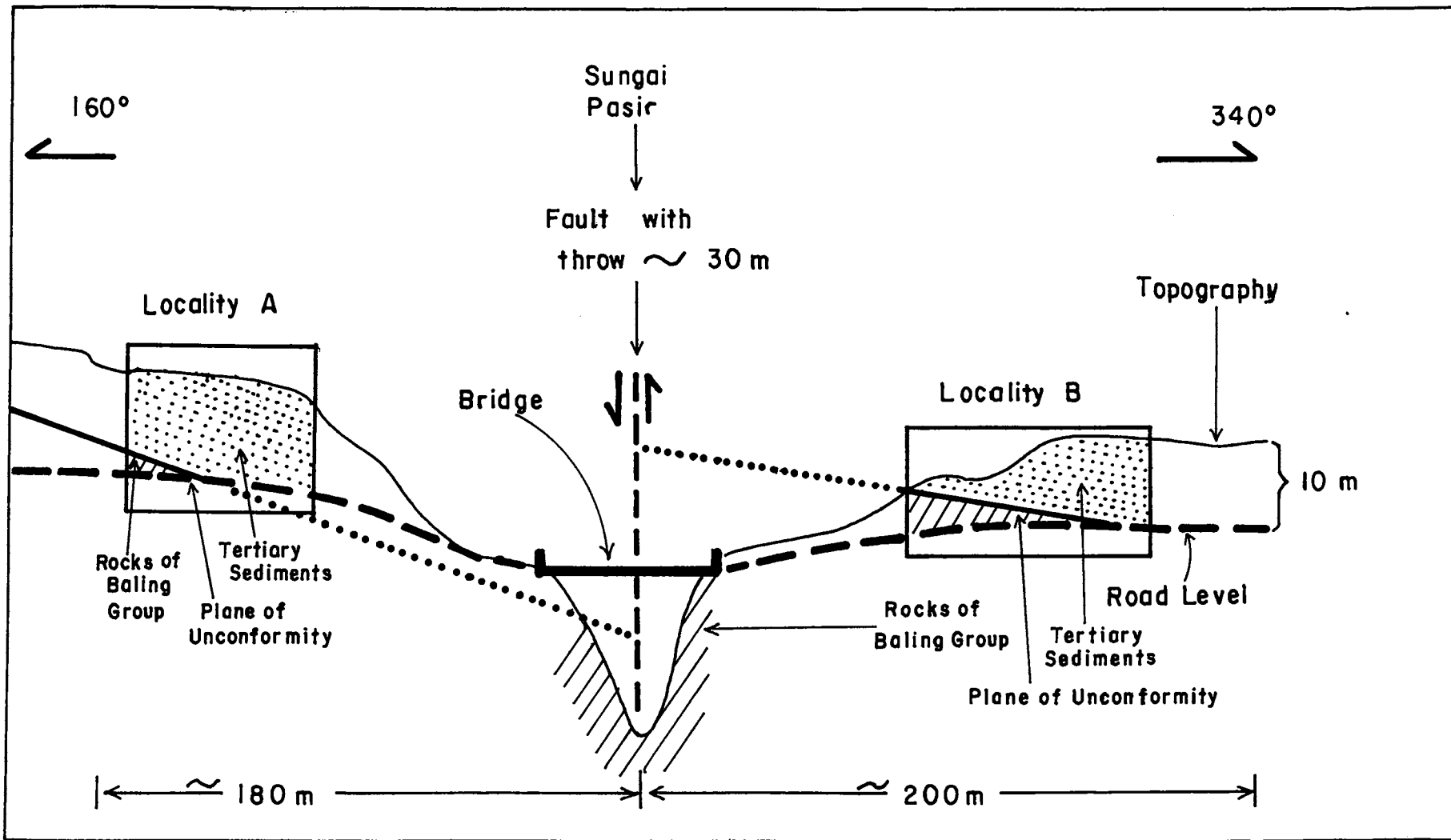


Figure 2: A schematic diagram to illustrate the relationship between the unconformity plane at Locality A and Locality B which is displaced by a normal fault with throw 30 metres.

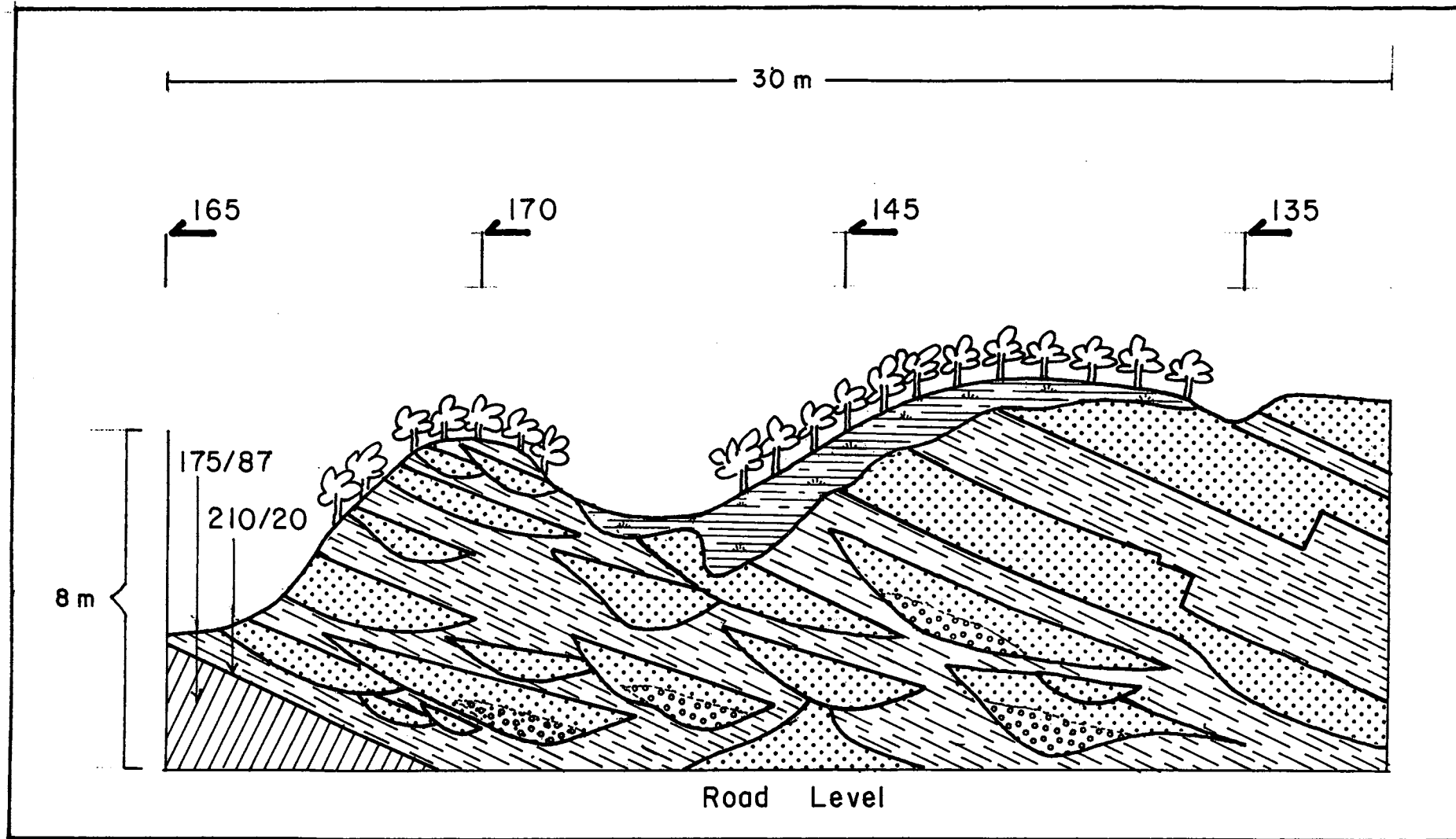


Figure 3: A field sketch of the outcrop at Locality B showing the plane of unconformity and general rock type and structures of the Tertiary sediments:

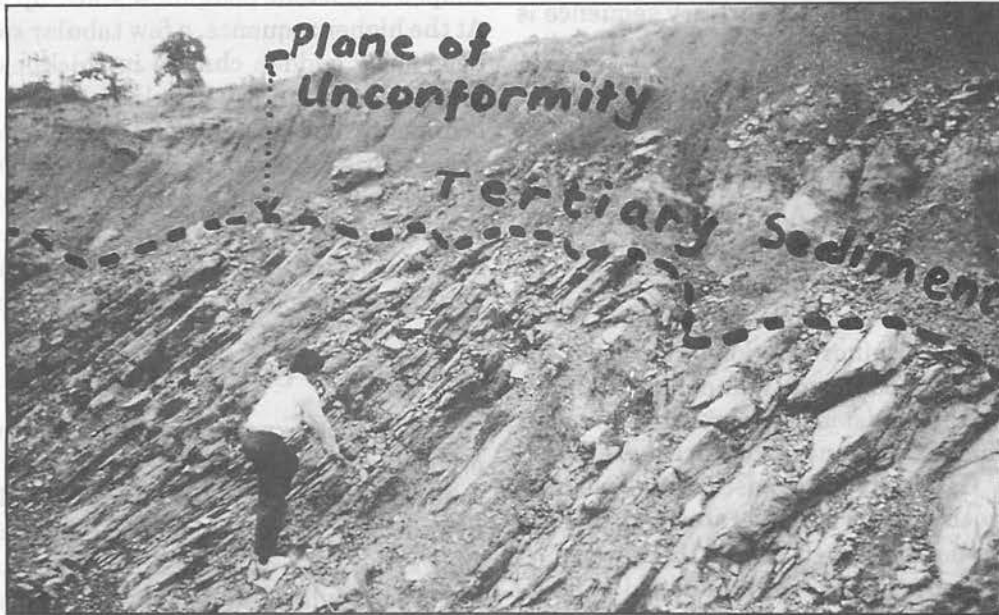


Figure 4: The plane of unconformity separating the rocks of Baling Group (below) and the Tertiary sediments (above).

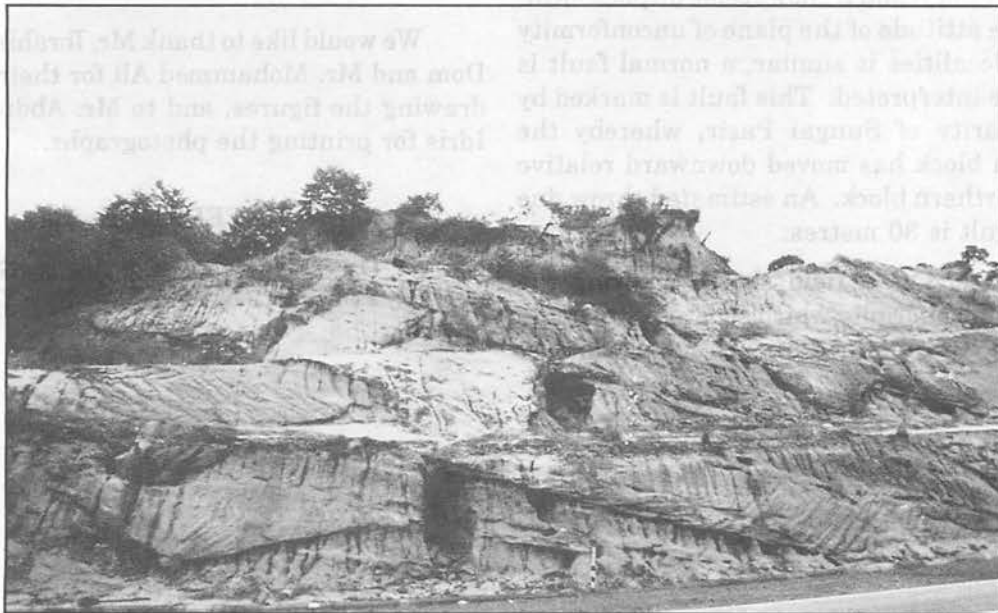


Figure 5: Channel-shaped (at the lower sequence) and the more tabular (at the upper sequence) sandstone bodies (lighter colour) in between the mudstone beds (darker colour) at Locality B.

FIELD OBSERVATIONS

The plane of unconformity which separates the Baling Group and the Tertiary sequence is observed at two localities (Fig. 2). At Locality A, the unconformity can be observed more clearly than at Locality B (Fig. 4). At both localities, the beds of the Baling Group, which consist of quartzites, are vertical and strike in almost north-south direction. At Locality B as shown in Figure 3, the attitude of the unconformity plane is $210^{\circ}/20^{\circ}$. The rock sequence above the plane of unconformity consists of mudstones, sandstones and minor conglomerates. On the plane of the unconformity and also at lower sequences, the mudstones are brownish in colour while at higher sequences they are more bluish in colour. Generally the sandstones are medium grained with minor conglomerate bands. These sandstone bodies, especially at the lower part of the sequence, are channel shaped (Fig. 5) while others are more tabular.

DISCUSSION

The relationship between the unconformity plane observed at both localities is shown in Figure 2. The projected unconformity plane from localities A and B shows some displacement. Since the attitude of the plane of unconformity at both localities is similar, a normal fault is therefore interpreted. This fault is marked by the linearity of Sungai Pasir, whereby the southern block has moved downward relative to the northern block. An estimated throw due to the fault is 30 metres.

Figure 3 is a field sketch showing the plane of unconformity which separates the rocks of the steeply dipping Baling Group in contrast

to the gently dipping Tertiary sediments. Near the base of the sequence, most of the channel-shaped sandstone beds show stack-up features. At the higher sequence, a few tabular sandstone beds show sudden change in thickness which may be caused by bank collapse during sedimentation. In general, the whole sequence observed is believed to have been deposited in fluvial environment. Further interpretation regarding the depositional environment will be discussed later after detail sedimentological and palaeontological studies are completed.

CONCLUSION

The rock exposure in the Nenering Basin probably represents the best exposure of Tertiary sediments found so far in Peninsular Malaysia. In addition, the rock sequence at this area also shows the best exposure of an unconformity plane for Malaysian geology in general and a Tertiary basin in particular. Field observations and the interpreted fault may indicate that the Tertiary sediment, at least for this area, has suffered some degree of normal faulting after its deposition.

ACKNOWLEDGEMENTS

We would like to thank Mr. Ibrahim Mohd. Dom and Mr. Mohammed Ali for their help in drawing the figures, and to Mr. Abdul Ghani Idris for printing the photographs.

REFERENCE

- GOBBETT, D.J. & HUTCHISON, C.S., 1973. *Geology of Malay Peninsula*. Wiley & Sons, New York, 143-153.

* * * * *

Manuscript received 15.7.91

Late Eocene planktonic foraminifera from the Crocker Formation, Pun Batu, Sabah

BASIR JASIN¹, SANUDIN HJ. TAHIR² & TATING, F.F.²

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²Jabatan Sains Bumi dan Sumber Alam,
Universiti Kebangsaan Malaysia, Sabah.

INTRODUCTION

The Crocker Formation in the area is composed of repeated sequences of interbedded sandstone and mudstone. These sequences were deposited in deep-water marine environment by many episodes of turbidity currents. The thickness of the sandstones and mudstone varies. Some sandstone beds have thickness ranging from 1 m to 20 m. The thickness of mudstone beds ranges from half a meter to more than 12 m. Very few agglutinated foraminifera were reported from this formation. Recently one of the authors (TFF) has collected some red mudstone samples from an exposure north of Pun Batu (Fig. 1). This sample contains very rich planktonic foraminifera. The presence of planktonic foraminifera in the sample gives some information about the age of the formation.

MATERIAL AND METHOD

The red mudstone sample was boiled in a weak solution of sodium bicarbonate to aid deflocculation. After about three hours of boiling the sample was washed through a 200 mesh sieve then filtered through a filter paper. The sample was then dried and sieve through fractions of

30, 60, and 100 mesh. Each fraction was examined under binocular microscope.

RESULT AND DISCUSSION

A large number of planktonic foraminifera were retrieved from the red mudstone sample. They are fairly well preserved. Eleven species and subspecies of planktonic foraminifera were identified. The most common species are *Turborotalia ceroazulensis* s.l., *Hantkenina alabamensis* Cushman, *Globigerina eocaena* Guembel, and *Cribohantkenina inflata* (Howe). The rare species include *Globigerina officinalis* Subbotina, *Globigerina linaperta* Finlay, *Globorotaloides suteri* Bolli and *Chiloguembelina cubensis* (Palmer) (Plates 1 and 2). Four subspecies of *Turborotalia ceroazulensis* were identified. They are *Turborotalia ceroazulensis ceroazulensis* (Cole), *T. ceroazulensis cocoansis* (Cushman), *T. ceroazulensis pomeroli* Toumarkine and Bolli and *T. ceroazulensis cunialensis* Toumarkine and Bolli (Plate 1). The occurrence of *Turborotalia ceroazulensis* s.l. and *Cribohantkenina inflata* suggests that this assemblage represents the *Turborotalia ceroazulensis* s.l. Zone in the late Late Eocene (Bolli, 1972).

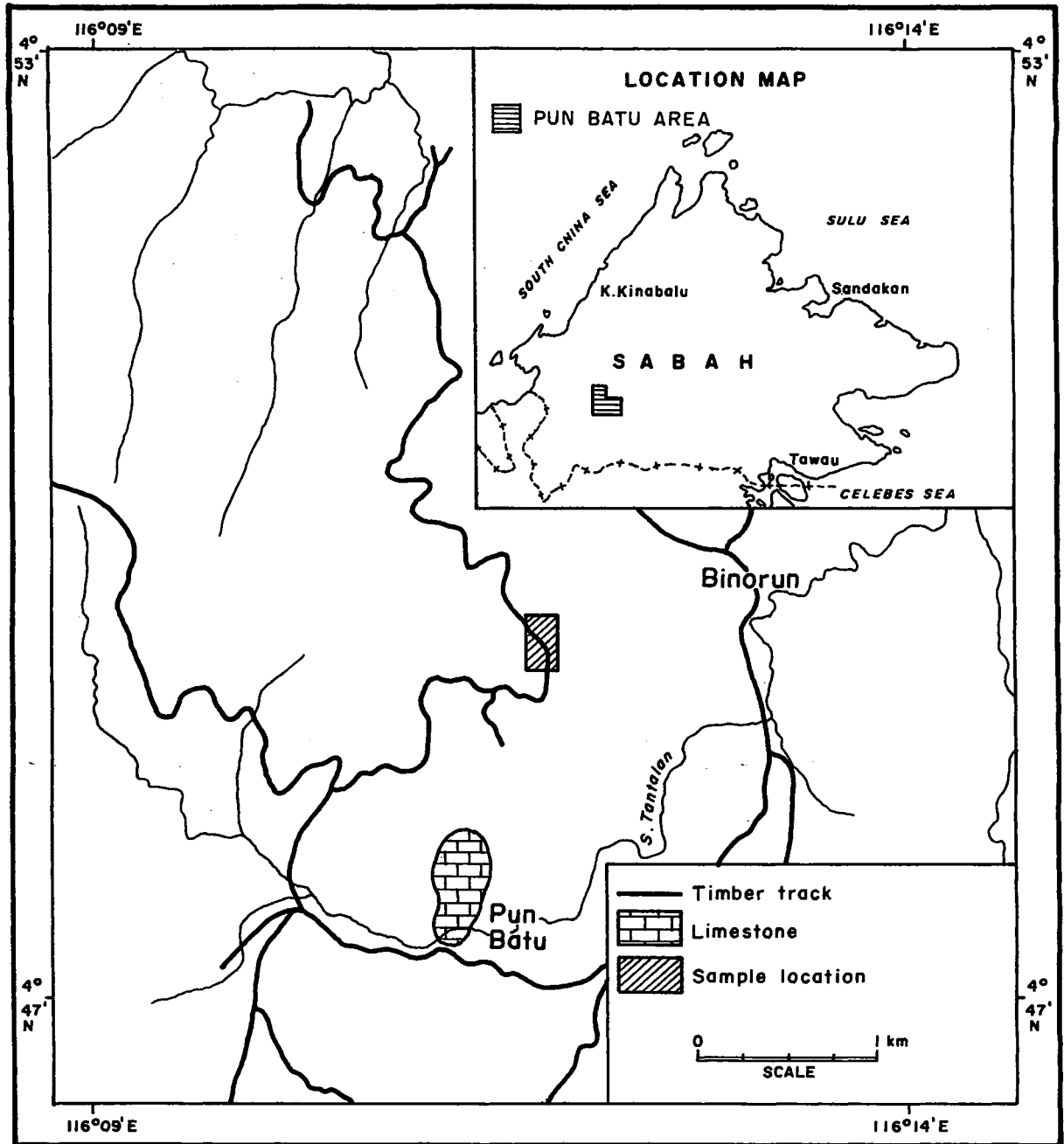
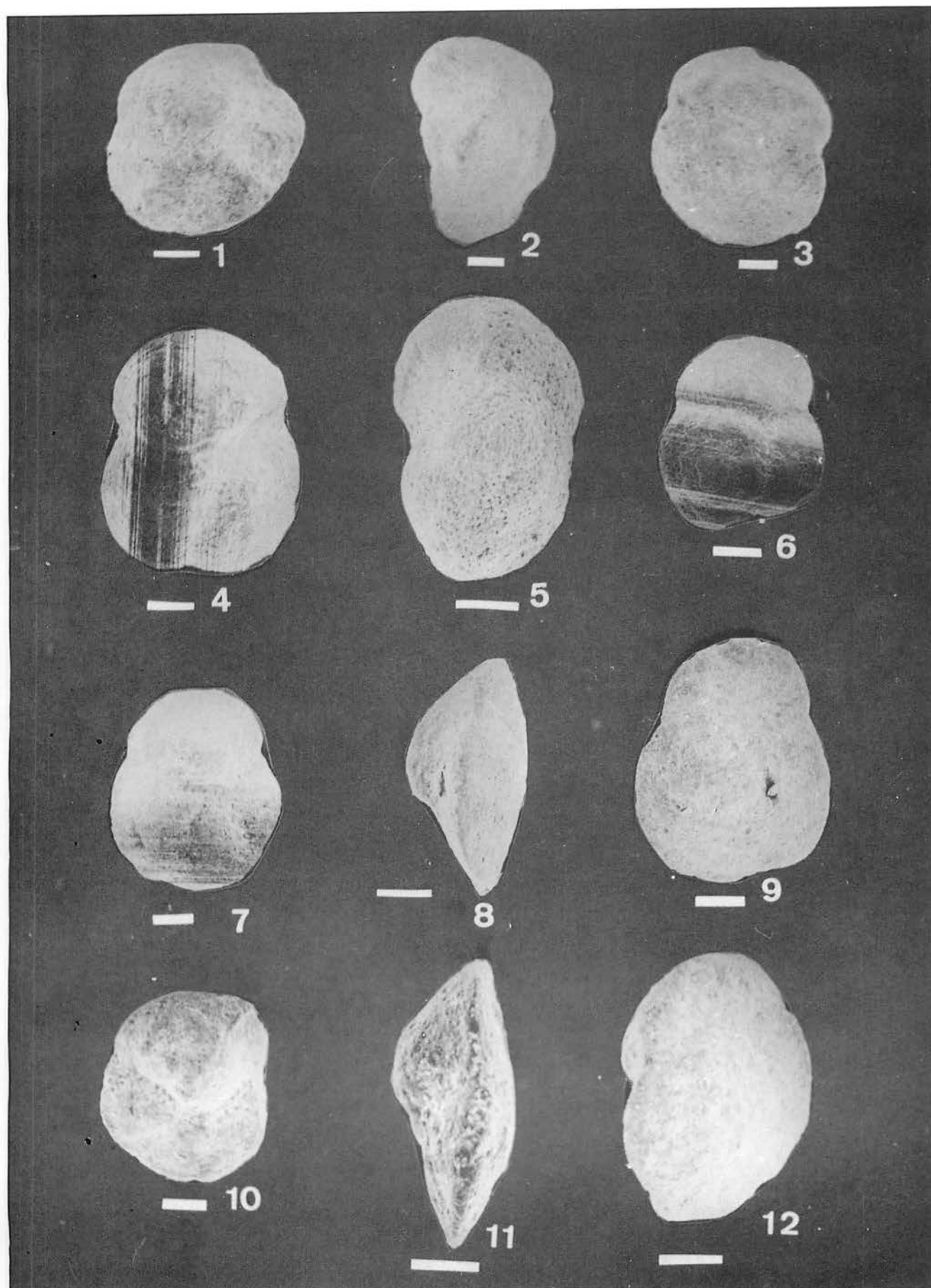
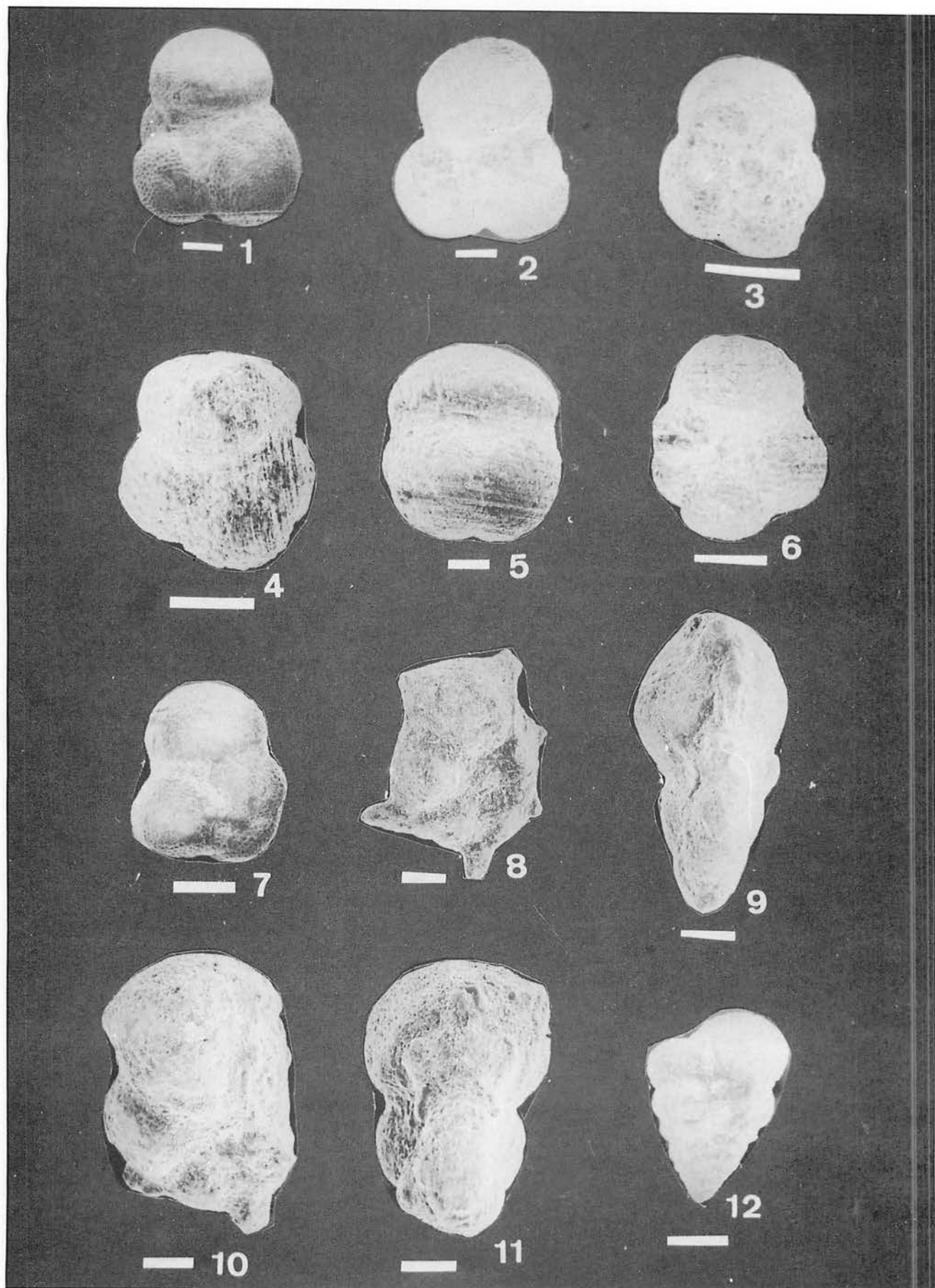


Figure 1: Map of sample location.

Plate 1: (scale bar = 0.1mm)

- Figures 1–3: *Turborotalia cerroazulensis cerroazulensis*.
 1. umbilical view, 2. side view, 3. spiral view.
- Figures 4–6: *Turborotalia cerroazulensis pomeroli*
 4. umbilical view, 5. side view, 6. spiral view.
- Figures 7–9: *Turborotalia cerroazulensis cocoaensis*
 7. umbilical view, 8. side view, 9. spiral view.
- Figures 10–12: *Turborotalia cerroazulensis cunialentis*
 10. umbilical view, 11. side view, 12. spiral view.





CONCLUSION

The major parts of the Crocker Formation was deposited by turbidity currents in deep marine fans and basin. The planktonic foraminifera were deposited during the calm interval without turbidity currents. The assemblage of planktonic foraminifera indicates that the age of the mudstone bed is late Late Eocene.

ACKNOWLEDGEMENTS

We would like to thank the Petronas Research Institute especially Prof. Madya Dr. Ibrahim Komoo for his permission to use the SEM, We thank En. Bahari Md. Nasib for the SEM photographs.

REFERENCES

- Bolli, H.M., 1972. The Genus *Globigerinatheka* Bronnimann. *Journal Foraminiferal Research* 2 (3), 109-136.

* * * * *

Manuscript received 23.8.91

Plate 2: (scale bar = 0.1mm)

- Figures 1-2: *Globigerina eocaena*
1. umbilical view, 2. spiral view.
Figures 3-4: *Globigerina officinalis*
3. spiral view, 4. umbilical view.
Figure 5: *Globigerina linaperta*
umbilical view.
Figures 6-7: *Globorotaloides suteri*
6. umbilical view, 7. spiral view.
Figures 8-9: *Hantkenina alabamensis*
8. spiral view, 9. side view
Figures 10-11: *Cribrohantkenina inflata*
10. spiral view, 11. side view.
Figure 12: *Chiloguembelina cubensis*.

PERTEMUAN PERSATUAN
Meetings of the Society

**Advances in Petroleum Geochemistry
in Malaysia and Southeast Asia**

The Workshop was held at the Ming court Hotel (Room 3 & 4), Kuala Lumpur, on the 27th July 1991.

Programme

- 8.30 Registration and Coffee
- 9.30 Opening Address
 Ahmad Said, President GSM
- Session Chairman:** Neville S. Haile, Petroleum Research Institute
- 9.45 Introductory Remarks
 Nik Ramli
- 10.15 Terrestrial Oil Families – Diagnostic Geochemical Characteristics.
 S.S. Wooding, Core Laboratories
- 11.00 Application of Palynogeochemistry for Hydrocarbon Source Rock Evaluation
 in N.W. Borneo
 Wong Chung Lee, Sarawak Shell Berhad
- 11.45 Recent Advances in 1D Basin Modelling from Subsidence Studies to
 Petroleum Expulsion
 P.Y. Chenet, BEICIP/IFP
- 12.30 Discussion
- 13.00 **Lunch**
- 14.00 Geochemistry of the Tembungo Field Area
 Abd. Jalil Muhamad, Petroleum Research Institute
- 14.45 Detailed Geochemical Evaluation of Selected Coals and Carbonaceous
 Shales of Miocene Age from the Batu Arang Quarry – Implications for Oil
 Generation from Coals in Malaysian Hydrocarbon Producing Basins.
 P. Abolins, S.S. Wooding, Core Laboratories & W.H. Abdullah, University
 of Malaya
- 15.30 Discussion and Chairman's Closing Remarks.
 Tea and Savouries

Advances in Petroleum Geochemistry in Malaysia and Southeast Asia



Captions to figures

- 1-2. Sections of the participants.
3. P.Y. Chenet on recent advances in Basin Modelling.
4. A question from Barney Mahendran.
5. Session Chairman, N.S. Haile.
6. C.L. Wong on palynogeochemistry.
7. A comment from Herman Soedonio.

Ceramah Teknik (Technical Talk)

Dr. Jonathan Redfern: Glacial facies – Their sedimentology, distribution and hydrocarbon potential (Fina Far East Pte. Ltd., Singapore)

Abstrak (Abstract)

A review of the sedimentology of the Permo-Carboniferous Grant Group of the Canning Basin and analogous Gondwanan glacial sequences.

Glacial sediments provide unusual, complex and yet in some areas prolific hydrocarbon reservoirs. Understanding the environment of deposition and controls on facies distribution plays a major part in predicting the reservoir potential of these sequences.

A detailed study has been undertaken in the Canning Basin, Western Australia, where over 5 km of core has been cut through the Permo-Carboniferous Grant Group by Western Mining Corporation. These cores provide an excellent and unique data set through this enigmatic glaciogenic facies suite.

The Grant Group sediments indicate that the ice sheet covered the Canning Basin during the Permo-Carboniferous and record the gradual deglaciation of the basin. The basal Hoya Formation contains all the glaciogenic sediments, and provides evidence for periodic ice advance and retreat. The overlying mudrock dominated Calytrix Formation is interpreted to reflect the rise in sea level subsequent to the main deglaciation phase, and the regressive package of sediments that form the upper Cliathus Formation result from isostatic uplift and basin fill under post glacial conditions.

The talk will review the hydrocarbon prospectivity of the Grant Group in the relatively unexplored Canning Basin, and compare it with analogous glacial sequences from Oman, which contain in excess of 3 billion barrels of oil in place.

Jonathan Redfern obtained a degree in geology from the University of London in 1983, and a Ph.D. in 1989 on the sedimentology of the Grant Group, studying at Bristol University (UK) and Adelaide University (S.A.). He currently works for Fina Far East Pte. Ltd. in Singapore.

Jonathan Redfern



BERITA-BERITA PERSATUAN
News of the Society

OBITUARY

Kenneth Frederick George Hosking
30 October 1915 – 30 June 1991

Kenneth Hosking, (Ken to his many friends), who died at the age of 75 earlier this year after a long illness, was one of the most eminent members of the Geological Society of Malaysia. He was the foremost expert on Cornish mineralization, and a world authority on tin and tungsten deposits.

Kenneth Hosking was born in Camborne. He studied at Exeter where his first degree (then a London University external) was a B.Sc in Botany in 1938. He obtained a further B.Sc., in Geology, from London University by private study in 1940. This combination was to bear fruit later, in his research into indicator plants, which characterize certain types of metallic mineralization, and in geochemical prospecting based on analyzing the ashed remains of accumulator plants. After serving as an officer in the Royal Artillery in the British army in World War II, he joined the staff of Camborne School of Mines in 1948 and soon became the department's head. He was one of the pioneers of geochemical exploration, designing a variety of chemical techniques for identifying mineral species in the laboratory and in the field. Many of his ideas were taken up and developed by others at Imperial College. Mainly by private study, he gained his M.Sc in Geology in 1951, and his Ph.D. in 1954, both from London University, and a D.Sc in geology there in 1966. In 1968 he left the School to become the first Professor of Applied Geology at the University of Malaya. He devoted his considerable energy, knowledge, and the benefit of his long experience, including his previous research on Malaysian tin mines, to building up this new degree course. At the peak of the tin mining industry in Malaysia, Ken was known to the staff of all the larger mines, and of the Mines Department, because many of their mining geologists and engineers had been his former students at Camborne, and the others knew him by reputation. His visits to mines in the course of his research were always welcomed, because his advice was uniquely valued and respected. He played a prominent role in setting up the Southeast Asian Tin Research Centre (SEATRAD) in Ipoh, and compiled the UNDP proposal based on which the Centre was established. The decline, due to economic factors, of the tin industry in Malaysia, and its virtual extinction in Cornwall, must have saddened him, but he had many other geological interests. We mention his work, some decades ahead of the wide interest now shown in the subject, on statistical correlation between the geochemistry of soil and water and the incidence of certain diseases due to excess or lack of specific elements or compounds.

He played a prominent role in the affairs of the Geological Society of Malaysia, serving as President, and on his retirement in 1977 he was elected an honorary member. He continued to contribute to the Society publications after leaving Malaysia.

Upon retiring from the University of Malaya in 1977, he and Natasha settle in Sitges, Spain. However, Ken found insufficient interest in the local geology scene, and

missed living close to a mining community. He always enjoyed the company of miners and their conversation in the local hostelry over several glasses of beer. So, in 1979, he returned to Cornwall, where he resumed an active life in consultancy and research, being made an honorary research fellow of the Camborne School of Mines in 1980. Recently the School awarded their premier tribute, the Fellowship, to Kenneth Hosking, in tribute to his immense contribution to Cornwall and its mining industry, and to geology in general. He was a former president and gold medal holder of the Royal Geological Society of Cornwall.

A sportsman, he played cricket for Troon and Cornwall, and cricket, soccer, fencing, and hockey at Exeter.

He had a keen appreciation for art, and was a painter in oils of high ability. His favorite subjects were connected with the tin mining industry. We remember the walls of his home adorned with paintings of picturesque ruins of Cornish mine buildings, and panners at work in Malaysian alluvial mines. Ken was a prolific writer, with a very personal and direct style, and those who knew him as a teacher and colleague will picture him from reading through his voluminous writings. He will be remembered for his masterful analyses of the world's tinfields, especially those of his beloved Cornwall and Malaysia. Ken's legacy not only includes more than 200 papers over a career spanning 42 years, but his numerous students, spanning several generations, many of whom now occupy senior positions in Universities, Geological Surveys and industry. His knowledge of minerals was encyclopedic, and he could identify most strange specimens brought to him by a careful examination with a hand lens (many times, indeed, by a casual glance!). During his time in Malaysia he earned the respect and affection of his colleagues, for his immense scholarship, quiet humour, warm-heartedness, integrity, and enthusiasm. Invariably courteous, and usually calm, he could wax wrath (usually on behalf of someone else) at injustice or bureaucratic obtuseness. From so many memories of Ken, we recall his genial

figure, smoking a fragrant pipe (he had a large collection), and treating his audience (whether in the common room, a miners bar, or in the field) to a fascinating discourse on minerals, mining, geology, or life in general, from his inexhaustible fund of experience.

He is survived by his wife Natasha, two sons, and three grandchildren.



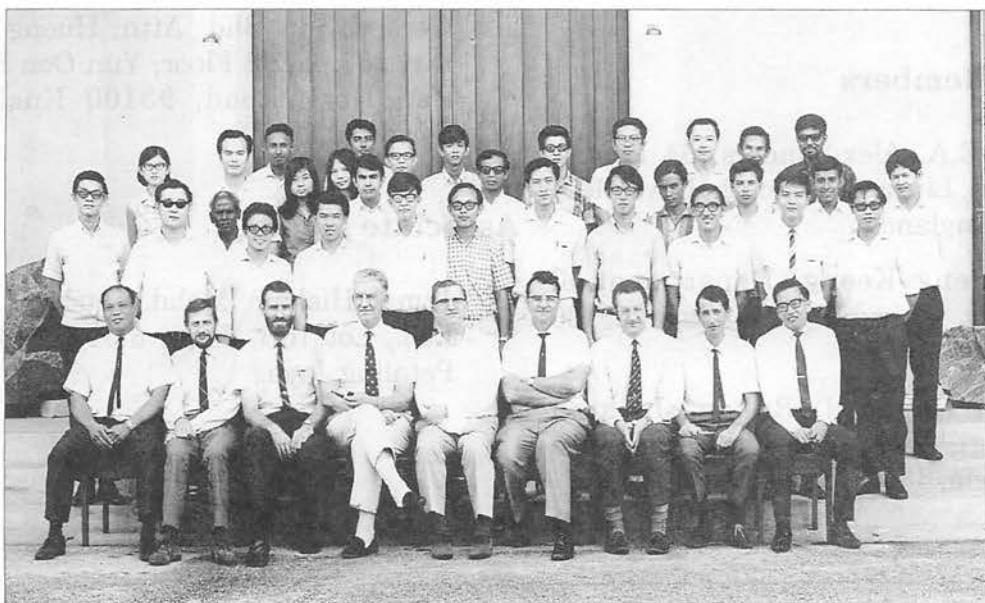
N.S. Haile

C.S.Hutchison

K.F.G. Hosking



The Hoskings' New Year's Party 1970.



Jan/Feb 1970 – With the External Examiner, Staff and Final Year Students Geology Department, University of Malaya.

Keahlian (Membership)

The following applications for membership were approved:

Full Members

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Lim Eng Hwa, c/o OPIC, 10 & 11 Floor, Wisma Nusantara, Jalan Punchak, Off Jalan P. Ramlee, 50250 Kuala Lumpur. 2. Raymond D. Shaw, Petroconsultants, 7th Floor, 63, Robinson Road, Singapore 0106. 3. Andrew J.H. Davys, Fugro-McClelland, 51, Jalan SS15/4, 47500 Subang Jaya. 4. Robert J. Hall, MIM Holdings, 410 Ann St., Brisbane, Australia. 5. Mohazam Mohd. Jobal, SEREM (M) Sdn. Bhd., 1988, Jalan Padang Gold, Pengkalan Chepa, 16100 Kota Bharu, Kelantan. | <ol style="list-style-type: none"> 4. Lim Chun Hui, Jabatan Geologi, Universiti Kebangsaan Malaysia, 43600 Bangi. 5. Mohd. Faizul Hamdan, Jabatan Geologi, Universiti Kebangsaan Malaysia, 43600 Bangi. 6. Nasharuddin Zaini, Jabatan Geologi, Universiti Malaya, 59100 Kuala Lumpur. 7. Zakiah Hj. Zainol, 56 Jalan Enggang, Taman Keramat, 54200 Kuala Lumpur. |
|--|--|

Student Members

1. Mark E.A. Alex-Sanders, 54 Beatrix Avenue, Lipson, Plymouth, Devon PL4 8QB, England.
2. Law Seng Keong, Department of Geology, University of Malaya, 59100 Kuala Lumpur.
3. Simun Rugag J. Rukag, Jabatan Geologi, Universiti Kebangsaan Malaysia, 43600 Bangi.

Institutional Member

1. Geospec Sdn. Bhd., Attn: Huong Tung Ing, 137, 1 & 2 Floor, Yun Oon Bldg., Ban Hock Road, 93100 Kuching, Sarawak.

Associate Member

1. Ikmal Hisham Mohd. Hashim, Core Lab., Lot 10B, Jalan 51A/223, 46100 Petaling Jaya.

Pertukaran Alamat (Change of Address)

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

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Max Holtby, #8-9344-122 Street, Surrey, B.C. V3V 4L6, Canada. | <ol style="list-style-type: none"> 2. Kuwait Foreign Petroleum Exploration Co. k.s.c., P.O. Box 6087 Dubai - U.A.E. Attn: Dr. John Small. |
|--|--|

3. Mohammad Yamin Ali, Petroleum Research Institute, PETRONAS, Lot 1026 PKNS Industrial Area, Mukim Hulu Klang, 54200 Kuala Lumpur.
4. Yong Fook Shin, Mamut Copper Mining Sdn. Bhd., P.O. Box 11474, 88816 Kota Kinabalu, Sabah.
5. Roger T. Eubank, #04-04/09 ThongTeck Building, Singapore 0922.
6. John Ringis, 18, Pasir Panjang Hill, Singapore 0511.

Perambahan Baru Perpustakaan (New Library Additions)

The Society has received the following publications:

1. U.S. Geological Survey Bulletin: 1990: 1754-E, 1744. 1991: 1945, 1954.
2. U.S. Geological Survey Professional Paper: 1990: 1403-E, 1515.
3. AAPG Explorer, July & August 1991.
4. Annales Academiae Scientiarum Fennicae, no. 153, 1991.
5. Sopac News, vol. 8, no. 1, 1991.
6. Marine geology around Taiwan.
7. Special Publication of the Central Geological Survey, no. 4, 1990.
8. Igneous rocks of Taiwan.
9. The Pyongyang Times, no. 27, 1991.
10. Bulletin of the Geological Survey of Japan, vol. 42, nos. 1-4, 1991.
11. China offshore oil & gas (geology), vol. 5, no. 2, 1991.
12. Commonwealth Science Newsletter, Jan-Feb & May-June, 1991.
13. Memoires pour servis a l'Explication des Cartes Geologiques et Minieres de la Belgique, Mem. no. 31, 1991.
14. The Science Reports of the Tohoku University, vol. 61, no. 1 & 2, 1991.
15. Bulletin of the National Science Museum, vol. 17, no. 1, 1991.
16. Chronique de la Recherche Miniere, no. 503, 1991.
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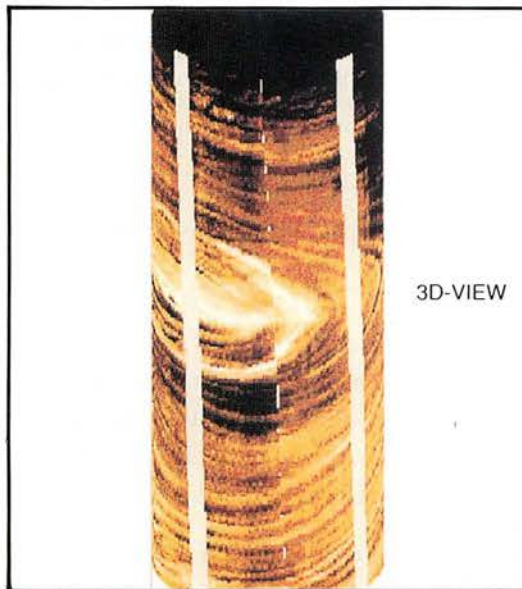
Fullbore Micro Imager*

Formation imaging using microelectrical arrays has benefited the oil industry since its introduction in the mid-80s. The FMI*, Fullbore Formation MicroImager tool, is the latest-generation electrical imaging device. It belongs to the family of imaging services provided by the MAXIS 500* system with its digital telemetry capability.

The FMI log, in conductive muds, provides electrical images almost insensitive to borehole conditions and offers quantitative information, in particular for analysis of fractures.

The FMI tool combines high-resolution measurements with almost fullbore coverage in standard diameter boreholes, thus assuring that virtually no features are missed along the borehole wall. Fully processed images and dip data are provided in real time on the MAXIS 500 imaging system.

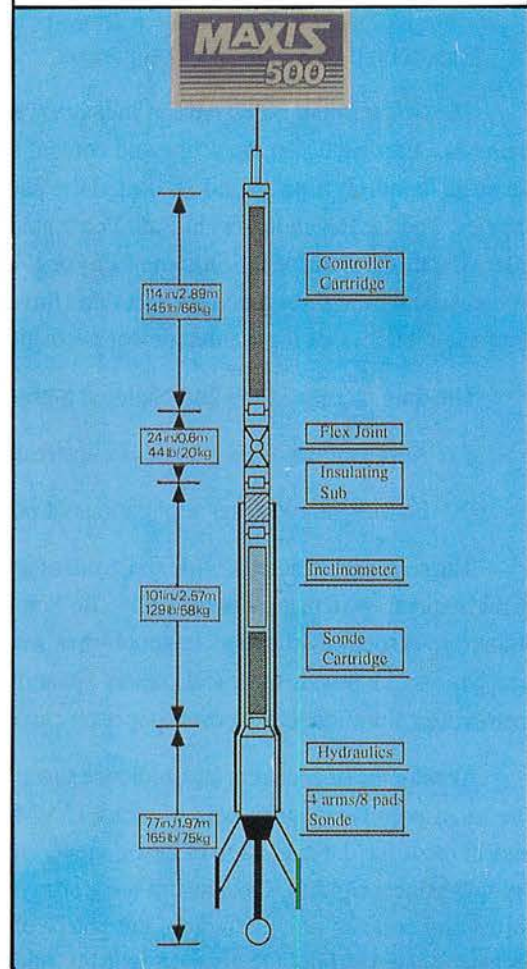
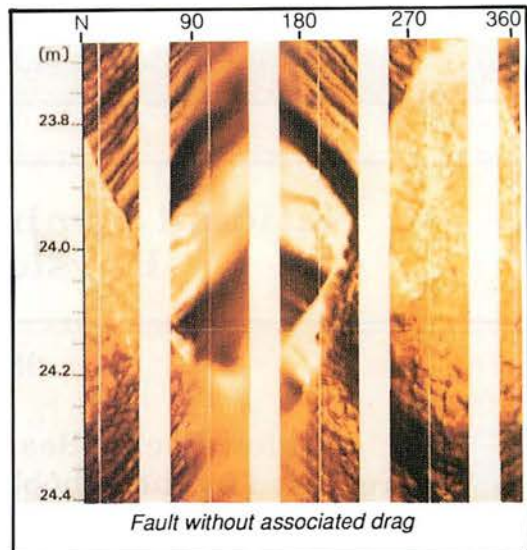
The tool's multiple logging modes allow wellsite customization of results to satisfy client needs without compromising efficiency.



3D-VIEW

"Bullseye" structure

Schlumberger



BERITA-BERITA LAIN
Other News

**National Seminar on Applications of
Physics in Industry**

25 – 26 June 1991

**Bayview Pacific Beach Resort, Batu Ferringhi, Penang
Organised by the School of Physics, Universiti Sains Malaysia**

Report on the Geophysics Component:

The first seminar on Physics in Industry was organised in 1990 in Skudai, Johor by the Universiti Teknologi Malaysia. Expanding on the scope and content of this previous seminar, the School of Physics, Universiti Sains Malaysia, between June 25 and 26 hosted the 2nd National Seminar on Applications of Physics in Industry at the Bayview Pacific Beach Resort in Batu Ferringhi, Penang. The theme chosen by the organising committee was to reflect the thrust areas of the School of Physics. Inevitably this was synchronous with the image of Penang as the Silicon Island of Malaysia and the fact that Universiti Sains Malaysia is the only university in Malaysia to grant a degree in Geophysics for the manpower needs of the country.

The dual themes of the 2nd National Seminar were:

- (i) Applications of geophysics in upstream exploration in the petroleum industry, and
- (ii) Instrumentation and applications of physics in the semiconductor industry.

The seminar attracted a wide spectrum of interested scientists and professionals from industry. Total number of participants was in excess of 170. The Seminar was endorsed and supported by the Geological Society of Malaysia. A total of 15 papers in geophysics were received. These were divided into 3 categories, viz., 3 invited lead papers, 11 theme technical papers spanning acquisition, processing, interpretation and special studies in upstream exploration and 1 poster paper on curriculum development. The abstracts of these papers follow.

Comments of speakers and audience towards the organisation and standard of the seminar were favourable. The most popular enquiry was of when U.S.M. will host another again. The seminar provided an academic environment for the exchange of news, views and ideas, and where industry and academia could meet outside of formal business rigidity. Geophysics was portrayed as an integral component in upstream exploration. It has its own norms and code of practice within the petroleum industry and the geological sciences. Perhaps the pre-dinner cocktail, hosted by GECO Seismic Sdn. Bhd., and the dinner that followed, hosted by the Penang State Government, on the evening of 25th June, helped to make the Seminar memorable and the cause of nice comments from the participants.

Leong Lap Sau

**NATIONAL SEMINAR
ON APPLICATIONS OF
PHYSICS IN INDUSTRY**
25-26 June 1991, Universiti Sains Malaysia, Penang

— ABSTRACTS OF PAPERS —

**THE ROLE OF GEOPHYSICS IN THE DEVELOPMENT OF
MALAYSIA'S PETROLEUM INDUSTRY**

AHMAD SAID

PETRONAS

Menara Dayabumi, Kompleks Dayabumi

Jalan Sultan Hishamuddin

P.O. Box 12444

50778 Kuala Lumpur

Geophysics has played a major role in the development of Malaysia's petroleum industry, contributing to the discovery and development of the 32 oilfields and 4 gasfields which are currently producing 630,000 stb/day. A total of 32 PSCs, involving 40 multinational companies are presently in various phases of exploration, development and production.

The seismic method is the most extensively used method and since 1977 a total of 465,840 km of seismic data has been acquired comprising 51% 2D marine seismic, 48% 3D marine seismic and 1% 2D land seismic data. The 3D marine seismic method, first conducted in 1984, has become increasingly prominent in the exploration and development phases and in 1991 constitutes 87% of the total seismic programme for the year. Navigation and positioning systems have been developed to fulfil the crucial requirements of highest integrity, accuracy and repeatability for the surveys both onshore and offshore.

High-speed digital computers have revolutionized the geophysical (in particular seismic) data processing and interpretation. In the highly competitive data processing market, sophisticated state-of-the-art software have been developed for cost-efficiency, reliability and speed. The use of interactive interpretation workstations have greatly enhanced the quality of interpretation. Integration and interpretation of geophysical, geological and reservoir engineering data utilising computer workstation has now become a reality.

Airborne gravity, magnetic and radar surveys are the tools to provide fast and economic reconnaissance to delineate prospective areas for more detailed exploration. With the use of aircraft (fixed wing and helicopter), remote and inaccessible areas can be explored cost-effectively.

Borehole geophysics is one of the major tools in the estimation of rock properties and saturations in the reservoir. Borehole geophysics provides direct information about the substrata and enables a geophysicist to correlate and interpret the data obtained from geophysical surveys with the borehole information.

GEOPHYSICS: PRI CHALLENGES IN THE 1990s

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54200 Hulu Klang, Selangor

Hydrocarbons are non-renewable commodities. Based on present rate of world consumption, the currently known world reserves will not last very long. Man will eventually need to rely on other fuel sources for energy. There are still substantial coal reserves which are exploitable, but man's concern for environment may not allow the coal reserves to be exploited fully and extensively. The consideration for nuclear energy as an alternative energy source to-day becomes less certain. This is proven by the Chernobyl disaster. Hydro, solar, wind and wave are non-depletable energy sources. These are abundant, but generally they have not been harnessed extensively. What is the potential of water as an eventual energy source? Can the energy locked in water be harnessed? For short term measures, man would probably:

- (a) exploit the use of the remaining hydrocarbons more intelligently and prolong their availability for more useful products,
- (b) optimize hydrocarbon recovery through proper reservoir management, and
- (c) continue aggressive exploration for additional reserves, employing new technologies and new thinking concepts. As one wise man said "oil is found in the minds of men".

Hydrocarbon reserves in Malaysia will face the same future. Unless new reserves are found, Malaysia will one day join the "hydrocarbon importing league". PETRONAS therefore has a big task at hand: to ensure that not only will the country's hydrocarbon production meet demand but also exceed demand, and, that our future generations will continue to enjoy the benefits generated by it. To make these a reality, PRI developed focused research strategies, and these include the applications of geophysical tools to enhance:

- (a) the understanding of subsurface geology and
- (b) the prediction of occurrences of porous media at depths and the nature of fluids contained within the media.

OVERVIEW OF CURRENT SEISMIC TECHNIQUES IN THE OIL INDUSTRY

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In the last 10 years, great improvements have been made in the technologies of data acquisition and data processing and in the tools that are available to the seismic interpreter.

In (marine) data acquisition, these improvements have been largely a matter of scale: more receiver channels, finer time-sampling, dual or even triple streamers and sources and two-boat operations for 3D surveys. These new techniques are designed to reduce costs of especially 3D acquisition, but have little geophysical impact in the sense of improving data quality. However, complex acquisition requires very good quality control technology, especially on navigation data, and it is in this area that R & D has had the major impact.

In data processing and interpretation, a growing use is made of open systems; i.e. computer-systems with a non-proprietary operating system. Advanced RISC based systems now rival mainframes in performance at a

fraction of the cost. Due to the open nature of both hardware and software, such computers offer great scope for expansion from third party (competitive) vendors.

Geophysical processing techniques have become more sophisticated as computer-technology allows more intensive operations. The focus today is on the correct positioning of reflectors (in depth and 3 dimensions) from impulse-response data that are measurements in time.

Interpretation systems are now based on standard hardware that does not differ very much from the data-processing system, and need no longer rely on expensive proprietary image-processors. Over the last 5 years the interpreter has become used to these systems, both for 2D and 3D surveys.

In this paper, examples will be given on these technology changes, and some predictions will be made on future trends.

SEISMIC DATA ACQUISITION INSTRUMENTATION ADVANCES

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Since the start of digital recording of seismic data in the 1960's, instrumentation has had to keep abreast of the innovation in techniques of multi-fold recording, 3D data acquisition, high resolution data acquisition, complex sweeps, multiple sources and other new modes of operation. This paper examines recent advances in seismic data acquisition instrumentation and the corresponding effect on seismic data collection, crew operations and geophysical data quality.

With oil prices stabilizing at lower levels during the late 1980's, there has been increased emphasis placed on cost effective exploration and improved recovery from existing fields. Today's improvements in seismic instrumentation are providing geophysicists with better tools to meet these objectives.

Data acquisition systems have progressed from the 48 channel DFS V's of the mid 70's to the 480+ channel telemetry systems of today. Fortunately system reliability, user-friendly control, flexibility, automation, and built-in diagnostics have also progressed to allow 500 to 1000 channel systems to be practical and productive.

Field quality control has progressed from a simple visual analysis of camera records to sophisticated field processing available on the crew with workstation based seismic processing packages. In addition, online quality assurance systems are beginning to appear which provide survey preplanning, automated logging of the actual operation in the field and machine readable observer's logs. Survey data and field statics can be integrated with the data acquisition information to create a comprehensive data base containing all of the information necessary to QC the data acquisition and automate processing inputs for reduced processing cycle time.

Advances in seismic instrumentation provide better crew productivity in difficult environments, efficient high channel 3D operations, improved broad-band data and significantly improved quality assurance and control in the field. Further advancements in the next few years will provide major improvements in instantaneous dynamic range for better high frequency data and less dependence on spatial arrays for noise reduction. Quality control will continue to advance toward the goal of complete assurance of data quality before the crew leaves the field. This will include all aspects of data quality : signal-to-noise ratio, bandwidth, timing, statics and positioning.

MULTIPLES IN HARD WATER-BOTTOM AREAS

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Singapore 2057

In areas where the seafloor is comprised of hard sediments, multiple reflections can obscure the primary seismic energy. The water layer acts as a wave guide and source generated noise or unwanted signal is observed on the data. The backscattered energy from irregularities on the seafloor can be described in terms of acoustic normal modes and the more near vertical multiple reverberation energy can be described by analogy to the modes of vibration in a closed organ pipe. The paper demonstrates this analogy using recently recorded seismic data and discusses the potential to attenuate this energy utilizing arrays of seismic sources and acquisition parameter selection.

IN-SITU EQUIPMENT TESTING, DATA ACQUISITION, AND FIELD PROCESSING OF VERTICAL SEISMIC PROFILES

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Wellsite processing of VSP data is necessary to allow quick on-site decision making as to future drilling plans. Prior to processing, the acquisition equipment must allow for adequate quality control during recording. With new state-of-the-art hardware, in-situ testability will allow both qualitative and quantitative information on tool electronics performance, coupling quality, and geophone response changes during the survey whenever required. Processing can then be performed (either in realtime, depending on hardware availability or immediately after the survey) which will provide a multiple-free broad band seismic trace at the wellbore.

A CLASS OF DETECTION FILTERS FOR NOISE SUPPRESSION IN SEISMIC DECONVOLUTION

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Seismic deconvolution problem is associated with the extraction of the sequence of earth reflectivity series for different rock layers. Most of the time, the seismic traces recorded by geophones are corrupted by additive noise due to various sources such as wind, oceanic wave, and inherent noise in recording instrument. In this paper, a class of filters known as the high-resolution detection filters is introduced for seismic deconvolution and additive noise suppression. The filters, which are formulated in the frequency domain, are a function of the wavelet and noise spectra. Two cases are investigated. In the first case, the desired signal, which is the wavelet, and the noise are assumed to be correlated while in the other case, they are assumed to be uncorrelated. The performance of the filters is assessed based on their ability to simultaneously reconstruct the earth reflectivity series and suppress the additive noise that corrupted the input data. The results indicate that the filters perform extremely well for signal-to-noise ratio (SNR) above 10 dB. As the noise contamination becomes severe, the ability of the filters to discriminate the reflectivity series against the noise deteriorates.

DMO AND MIGRATION: IMAGING TOOLS IN GEOPHYSICS

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The primary goal of a seismic survey is to provide a clear and accurate image of the subsurface structure of the earth. Obstacles to achieving this objective such as reverberations of the seismic source, noise in the recorded data, and lack of detailed knowledge of the physical characteristics of the subsurface often prove difficult if not impossible to overcome. However, the class of problems in seismic imaging related to focusing the seismic reflections has enjoyed dramatic success in recent years. Dip moveout (DMO) and migration are numerical processes based on the wave equation that attempt to focus the seismic images in much the same way as a camera lens focuses light. This paper will introduce the concepts of DMO and migration and demonstrate the power of these techniques through field data examples.

AVO AND POISSON'S RATIO: AN APPLICATION TO SEISMIC DATA PROCESSING

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The theory of elasticity governs the scattering of the energy of an incident wave at an interface; the energy repartition of the different scattered waves has been first studied by *Zoepf*. His well known equations governs the repartition of seismic amplitude of the reflected and transmitted waves. A simplification of these equations has been achieved by *Shuey*. His reflection coefficient equation is a simple equation, using the incidence, the normal incidence reflection coefficient, and the Poisson's Ratio. The Poisson's Ratio Variation, is directly linked with the fluid saturation conditions, upper and below the interface, which represents an important information to the geophysicists. The **Amplitude Versus Offset (AVO)** is a process by which, the assumption that the seismic amplitude is proportional to the reflection coefficient, is used to deduct two seismic rock properties i.e. the Poisson's Ratio Variation, and normal incidence reflection coefficient.

INVERSE PROBLEM THEORY: AN APPLICATION TO STRATIGRAPHIC INVERSION

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Seismic prospecting investigates the subsurface by measuring the response of the Earth to seismic waves. The aim of which is to determine the stratigraphic distribution and physical properties of the rocks; which is a typical inverse problem. Inverse problems occur in most branches of physics. The data set **D**, obtained from more or less reliable observation has to be processed in order to determine the "best" physical model in a model **M**. A forward theory, using known equations of physics, enables us to compute for every element of **M**, an element of **D**. A probability distribution is defined on **M** to express "a priori" information about the model parameters, whereas on **D** a second distribution will express our reliability to the observed data. Solving the inverse problem consists of determining the model which maximizes a probability function encompassing all of this information. For seismic data, theoretically the forward problem may be computed by solving the elastic wave equation, but it is a very computer intensive process. Modern processing methods can include various inversion techniques utilising iterative computations to shape an acoustic impedance section, fitting both seismic and well log data.

A QUANTITATIVE STUDY OF THE SEISMIC TIME-AMPLITUDE REFLECTION CHARACTERISTICS IN AN OIL FIELD

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The seismic time-amplitude reflection characteristics of selected sandstone horizons in a recently developed oil field are examined for effects of thicknesses, continuity and bed quality. This study uses an integrated approach of well data calibration, forward seismic modelling and 3D seismic data set for interpretation.

In this area, wireline logs indicate velocity to be a poor lithologic descriptor. The acoustic impedance at sand-shale interfaces could be accounted for by changes in the density instead. Gassman's equation confirms the minor effect of velocity perturbation with gas. Forward amplitude modelling both 1D and 2D for coal and sandstone encased in shale in the selected stratigraphic horizons permit values of tuning thicknesses to be ascertained for each lithologic unit. This learning phase quantizes subsequent reflection parameters and aids 3D seismic interpretation.

Preliminary results suggest an east-west trending sandstone reservoir with thicker and better developed sandstone horizons towards the flanks of the anticlinal structure.

ACQUISITION AND PROCESSING OF THE SHALLOW MARINE SEISMIC SURVEY OVER THE SARACEN BANK, OFFSHORE SABAH

EILEEN M.C. LAU & KUEK CHIAW OI

Sarawak Shell Berhad/Sabah Shell Petroleum Co. Ltd.
98100 Lutong, Miri, Sarawak

After the Production Sharing Contract for the offshore Block SB1 between Sabah Shell Petroleum Company, Pecten Malaysia, Petronas Carigali and PETRONAS was signed in July 1987, comprehensive seismic programmes of 2D seismic data and 3D data have been carried out over the area. Due to very shallow water depths, the Saracen Bank area, an offshore shallow water area which includes reefs, remained uncovered by these conventional marine seismic surveys. This paper describes the survey preparation, seismic programme, acquisition technique, onboard Q.C. processing system, seismic production and results of a unique marine seismic survey over this shallow reef area. The results of extensive processing tests are also described.

HOW IS GEOPHYSICS APPLIED TO ASSESSING HAZARDS IN OFFSHORE DRILLING?

ROD EVANS

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This paper presents the range of geophysical tools used in site surveys. Each geophysical tool is briefly discussed followed by examples of the data generated.

Site surveys are an essential prerequisite to the safe installation of temporary structures such as jack-up and semi-submersible rigs, to the installation of permanent structures such as production platforms, and to offshore drilling. Assessment of a range of geological variables and potential hazards is required. For example, an appraisal of seabed obstructions and sediments is important in planning the anchoring pattern for a semi-submersible rig or predicting the leg penetration of a jack-up rig. Perhaps the greatest hazard to offshore drilling is shallow gas. The site survey aims to identify such occurrences, and geological features such as faults which can act as migration pathways for shallow gas.

The appropriate geophysical tool at seabed and deeper sub-seabed are discussed. For example, a sleeve gun cluster seismic source generates a broader bandwidth, and a higher primary/bubble ratio when compared to water guns and conventional air guns, resulting in superior data quality. The "Delph-1" is illustrated, which is a digital recording and real time processing system especially designed for very high resolution single channel systems; the system renders obsolete the conventional graphic recorders and range of electronic peripherals still used in analogue seismic reflection data acquisition today.

Examples illustrate next the increasing use of computer assisted gridding and contouring in the interpretation and reporting phase of site survey work.

INTEGRATION OF 3D AND SITE SURVEY SEISMIC DATA IN ANALYSIS OF NEAR-SURFACE HAZARDS TO PLATFORM LOCATION AT DULANG FIELD

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The Dulang oilfield, operated by Carigali in partnership with EPMI, began development drilling from two platforms, A and B, in late 1990 after installation of the platforms earlier in the year. Installing these platforms involved driving piles up to 120m into the seabed, to provide support for the structures in about 75m of water. To do this it is essential to have a good understanding of the near subsurface to ensure the structural integrity of the platforms as well as identify potential hazards.

At Dulang Field we found that integrating the 3D seismic survey, shot for exploration and field development purposes, with the site survey data, acquired specifically to address the seabed and near subsurface, provided a quicker and more comprehensive interpretation than the more conventional approach of interpreting the site survey alone. The 3D seismic survey comprises about 1100km of digitally recorded and processed multichannel data with a 75m line spacing and a bandwidth of approximately 10 to 110 Hz in the shallow section.

The site survey comprises four data sets with a 100 m line spacing:

- (a) High resolution digital seismic data. These are similar to the data shot for exploration/development but the shooting parameters are somewhat different, aiming for high resolution in the uppermost 500-1000 m. The source is high resolution air/ watergun arrays or sleeve exploders giving frequencies of about 10 to 250 Hz.
- (b) Boomer Data. These employ an implosive source and have peak frequencies of 2-7 kHz which provides very high resolution but limited penetration, only about 60m into the seabed at Dulang.
- (c) Sidescan sonar data. These are very high frequency data, again analogue, generated by transducers which emit 105 kHz pulses. Sidescan sonar has no penetration, imaging the seafloor obliquely, in detail, about 100 m either side of the ship's track.
- (d) Echo Sounder data. Whilst water depth information is visible on both Boomer and sidescan sonar data, echo sounder data provide detailed information using a high frequency transducer source.

At Dulang we used all these data sets in analysing the platform locations but when moving the planned position of the A platform in 1990, we integrated the 1984 3D seismic data set.

The main hazard to platform location at Dulang is a Pleistocene channel about 500m wide which cuts from near the seabed to about 80m below the seabed. Soil borings show the channel-fill to comprise dominantly stiff clays but with significant organic material and some coarse clastics at its base. Generation of timeslices on the 3D workstation enabled mapping of this channel and its associated point bar. Mapping by hand from the high resolution digital data would have been much more time consuming and despite somewhat limited resolution, the 3D data give the best overall visualisation of the laterally-accreted point bar and abandoned channel. With the site survey Boomer data, additional resolution becomes an important factor. Rising gas plumes sourced from biogenic degradation of organic matter are evident in the sediments at the channel margins. In concert with the sidescan sonar data these can be seen to cause up to 5m seafloor depressions, and, where they have reached the seabed evacuation of water and gas has cause proliferation and coalescence of seafloor pockmarks above the channel margins.

Two potential platform locations were identified on the basis of this interpretation, an optimum location (for drilling considerations) at the channel centre and an alternative outside the channel. Subsequent soil borings and engineering tests showed both locations to be acceptable and the A platform was successfully installed at the optimum location without encountering any hazards.

We would like to acknowledge Mike Sullivan, consultant to Racal Surveys, who interpreted the site survey data.

AN APPRAISAL OF GEOPHYSICS CURRICULUM AT THE UNIVERSITY OF MALAYA AND ITS ROLE IN THE PETROLEUM INDUSTRY

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The paper attempts to assess and critically examine the geophysics courses that have been taught for the past three decades at the University of Malaya. The basis of the assessment is through various informations derived from personal observations, discussions among academic and non academic staff, past graduates of the department and also the theses projects that have been produced so far. Have the courses been relevant and adequate for the petroleum industry? What are the strength and weaknesses of our geophysics curriculum? How can we improve the present curriculum to meet the variety of industrial needs. Do we need a separate geophysics department in the University of Malaya? How can research, training and career development of geophysics be expanded?

The emphases of the paper include:-

- (a) To outline the present geophysics curriculum and its development through time.
- (b) To evaluate the strength and weaknesses of the present geophysics courses.
- (c) To examine the relevance and adequateness of the curriculum for the petroleum industry.
- (d) To suggest ways and means to improve the present curriculum to meet the varied industrial needs (including geophysics industry).
- (e) To suggest various avenues for collaborative research, training and career development of geophysicists.

Hopefully from the above deliberations, a much more industry related or involvement geophysics courses/ curriculum will be put into practice in the near future.

MANAGEMENT OF GROUNDWATER SUPPLY FOR URBAN AREAS

Advanced International Training Programme in Göteborg, Sweden
May 17-June 24, 1993

Organised by BITS - Swedish Agency for International Technical and Economic Co-Operation

OBJECTIVES

The purpose of this training programme is to strengthen the competence and capacity in developing countries in utilizing existing ground water resources in an efficient and environmentally sustainable way. Another purpose is to provide the participants with applicable insights into the management of groundwater supply systems for urban areas, particularly in a long-term perspective.

The objectives of the training programme are to:

- improve the participants abilities in administration and organization and thereby increase the efficiency of the water sector
- provide the participants with an increased ability to assess groundwater resources and manage supply systems as well as stressing the importance of incorporating groundwater resources as a vital part of national development plans. Emphasis will also be placed on environmental issues and the sustainability of groundwater resources
- improve the capacity of participants to efficiently deal with external inputs (e.g. consultants and contractors) in the groundwater sector and to put necessary demands on the project results. The participants will also be given the opportunity to present and discuss case studies with Swedish consultants and persons with experience of foreign aid

Other objectives of the programme are to provide the participants with an in-depth knowledge of:

- modern groundwater exploration techniques, aquifer assessment, drilling and well design
- groundwater protection and quality
- maintenance and operation of groundwater supply systems
- principles of legislation and financing

The programme will provide a forum for discussion and exchange of experience between groundwater engineers, geologists, hydrogeologists, and managers from different developing countries and Sweden. The presentations will concentrate on urban groundwater supplies, i.e. groundwater abstraction on a large scale.

All participants are requested to prepare case studies concerning groundwater supply before commencement of the course. The case studies may concern any of the themes indicated under *training programme* and will be presented by the participants as seminars. A summary of the case study should be submitted with the application form to guide the lecturers in adapting the course to the local conditions of the participants.

PARTICIPANTS

The programme is designed for participants holding positions as managers in the area of urban water supply or groundwater exploration within a national or local authority. The participants, as senior technical officers, managers or engineers, are expected to hold an academic degree at least equivalent to a B.Sc. (Eng.) in relevant subjects, have 5 to 20 years of professional experience, and to be fluent in English. The programme also welcomes lecturers at universities or other educational institutions connected to groundwater and/or water supply.

Women are encouraged to participate in the programme.

Only participants officially nominated by the appropriate national authority or ministry will be considered for admission to the programme.

Participants are selected on individual merits and will on completion of the entire training programme be awarded a certificate of participation. The participants are expected to contribute to the training programme e.g. in the discussion related to the conditions in their own countries.

The number of participants is limited to 25 in order to ensure a close working relationship between participants and lecturers.

===== LANGUAGE =====

The training programme will be organized and conducted in English. Consequently high proficiency in English language is required. Candidates whose native language is not English will be required to submit, with the application form, an official language certificate indicating their proficiency in English.

===== VISAS =====

If required, participants, should obtain an entry visa for Sweden and Denmark. It should be valid for a period of two months and specify multiple entries.

After the termination of the programme, participants may wish to visit some other countries on their way back home. Participants should ensure that visas are obtained for such countries before leaving for Sweden.

===== ACCOMMODATION =====

Each participant will be accommodated in a single room with bath/shower during the course period. All participants will be accommodated at the same hotel.

Participants may not be accompanied by family members, due to the character of the programme.

All participants are covered by group insurance while in Sweden and an organized study tours during the course. This includes medical care in the event of acute illness or accident, together with group life and third-party liability insurance. The cost of the insurance is included in the participation fee.

===== APPLICATION PROCEDURE =====

Application should be made on the special form attached to this pamphlet. The application form can also be obtained from the nearest Swedish Embassy. The Embassy can also be consulted concerning the language test. Each participant should give a telefax or telex number, on the application form which can be used by the course administration. In addition, there should be a passport photograph attached to the application form.

The completed application form should be sent *via* local official channels to the Swedish Embassy. The complete application should be

approved by the National Ministry responsible for official nomination of candidates.

Closing date for applications is **February 12, 1993**. Applications cannot be accepted after this date.

===== COST OF PARTICIPATION =====

The cost of participation is divided into two parts, one covering participation in the training programme, the other covering the cost of accommodation. The participation fee covers tuition, visits and other local transport within the programme, course literature and documents, general group insurance and certain social activities. The accommodation fee covers accommodation and meals.

The participation fee, cost for accommodation and meals will be paid by the programme for participants coming from lower income countries.

For participants from other countries the fees are

Participation fee	42.900 SEK
Accommodation fee	38.900 SEK

5.90 SEK are equivalent to 1 USD (November 1992)

Payment must be made in Swedish kronor (SEK) or in a convertible currency such as USD, Pounds Sterling (GBP), etc. to the equivalent rate at the time of payment.

International travel costs to and from Sweden and costs for personal expenses are not included. Each participant should arrange for his or her own transport from the home country to Landvetter Airport, Göteborg, Sweden as well as for funds covering all personal expenses in Sweden.

===== DATE AND PLACE =====

The course will take place from **May 17 - June 24, 1993**. The main part of the course will be held at Chalmers University of Technology in Göteborg, Sweden.

===== SECRETARIAT =====

The address for all communication is:

Chalmers Industriteknik
Attn: Christina Nilsson*)
Chalmers Teknikpark
S-41288 Gothenburg, Sweden
Telephone: +46 31772 40 00
*) direct call +46 31772 43 32
Telefax: +46 3182 74 21
Telex: 20863 SSPAGBGS

Kursus-kursus latihan & bengkel-bengkel (Training Courses & Workshops)

1992

November 18-22

GEOLOGY AND GEOPHYSICS FOR THE RESERVOIR ENGINEER (Rueil-Malmaison). Language: French (English, if number of participants allows).

December 2-13

WELL LOG ANALYSIS (Rueil-Malmaison). Language: French (English, if number of participants allows).

MINING MANAGEMENT (Kensington, New South Wales, Australia). Master's and graduate diploma degrees in Mining Management, as well as individual short courses. (Courses may be presented at other locations by arrangement.) For Information: Dr. Mike Katz, Associate Director, International Key Center for Mines, University of New South Wales, P.O. Box 1, Kensington NSW 2033, Australia.

PROFESSIONAL DEVELOPMENT SEMINARS IN MINERAL ENGINEERING AND MINERAL ECONOMICS. Conducted by the Department of Mining and Metallurgical Engineering, McGill University. Language: English. For Information: Lorna McFadden, Department of Mining and Metallurgical Engineering, McGill University, 3480 University Street, Montreal, Quebec H3A 2A7, Canada.

SHORT COURSES IN PETROLEUM GEOLOGY AND RELATED DISCIPLINES. Conducted by IHRDC. Language: English. For Information: IHRDC Instructional Programs, 535 Boylston Street, Boston, MA 02116, USA.

SWEDISH INTERNATIONAL UNIVERSITY CONSORTIUM (Stockholm, Sweden).

Master's degree programs lasting three semesters, including a Master's thesis project. Courses in applied Geophysics and Geochemistry at Lulea. Language: English. For Information: Dr. Bjorn Ohlander, Economic Geology, Lulea University of Technology, S-951 Lulea, Sweden.

TWAS ITALIAN AWARDS SCHEME. A series of grants for developing-country geoscientists of proven ability to work and study for periods up to 10 months at the following Italian universities: Florence, Milan, Padua, Pisa, Rome, Trieste, Turin, and CNR Pisa. For Information: Executive Secretary, Third World Academy of Sciences, International Centre for Theoretical Physics, P.O. Box 586, Strada Costiera 11, I-34100 Trieste, Italy.

WEDC (Water, Engineering and Development Centre). Concerned with urbanization and urban infrastructure. Courses offered range in duration from 6 weeks to 12 months, deal with a wide variety of water, engineering, developmental, environmental, and management topics, and lead to certificates, diplomas, or MSc degrees. For Information: Professor John Pickford, WEDC, Loughborough University of Technology, Leicestershire LE11 3TU, UK. Phone: 0(44) 509 222390; telex: 34319 UNITECG; fax: 0(44) 509 610231.

THE ROBERTSON GROUP plc, Llandudno, Gwynedd, UK, attention: Dr. C.J. Burgess, Manager, Petroleum Training Centre. Phone: 44(0) 492 581811; fax: 44(0) 492 583416; telex: 61216 ROBRES G.

U.S. GEOLOGICAL SURVEY, Office of International Geology, Training Section, 917 National Center, Reston, Virginia 22092. USA.

KALENDAR (CALENDAR)

1992

October 17-22

HYDROLOGY AND HYDROGEOLOGY, mtg., Portland, Ore. (American Institute of Hydrology, 3416 University Ave. S.E., Minneapolis, 55414-3328. Phone: 612/279-1030)

October 18-23

LATE PRECAMBRIAN TECTONICS AND THE DAWN OF THE PHANEROZOIC, GSA Penrose Conference, Death Valley, Calif. (Ian W.D. Dalziel, Institute for Geophysics, University of Texas, Austin, 78759-8345. Phone: 512/471-6156. Fax: 512/471-8844)

October 19-21

BIO-LEACHING MINERALS AND MINERAL-LAND RECLAMATION, mtg. and workshop, Sacramento, Calif. (Yung Sam Kim, Nevada Institute of Technology, Box 8894, Campus Station, Reno, Nev. 89507. Phone: 702/673-4466)

October 25-30

IN-SITU MINERALS RECOVERY, mtg., Santa Barbara, Calif. (Engineering Foundation, 345 E. 47th St., New York, 10117. Phone: 212/705-7835. Fax: 212/705-7441)

October 26-28

EXTRACTIVE METALLURGY OF GOLD AND BASE METALS, int'l. mtg., Kalgoorlie, Western Australia. (V.N. Misra, Kalgoorlie Metallurgical Laboratory, Box 881, Kalgoorlie, 6430, Australia. Phone: (090) 220 120. Fax: (090) 912 762) Papers invited.

October 26-29

GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Cincinnati, Ohio, USA. (Jean Kinney, GSA Headquarters, P.O. Box 9140, Boulder, Colo. 80301, USA. Phone: (303) 447-2020).

November 8-13

WATER RESOURCES AND ENVIRONMENTAL ENGINEERING, mtg., Santa Barbara, Calif. (C.V. Freiman, Engineering Foundation, 345 E. 47th St., New York, 10017. Phone: 212/705-7835. Fax: 212/705-7441)

November 29-December 2

TECTONIC FRAMEWORK AND ENERGY RESOURCES, mtg., Kuala Lumpur, Malaysia. (Secretariat, c/o Dept. of Geology, University of Malaya, 59100 Kuala Lumpur, Malaysia)

November 30-December 3

OFFSHORE SOUTHEAST ASIA, mtg., Singapore. (Society of Petroleum Engineers, Box 833836, Richardson, Texas 75083-3836. Phone: 214/669-3377. Fax: 214/669-0135)

December 28-31

GEODYNAMICS OF THE ARABIAN LITHOSPHERE, int'l. mtg., Baghdad. (Sahil Alsinawi, Dept. of Geology, College of Science, University of Baghdad, Jadiryah, Iraq)

1993

April 17-20

EXPLORATION AND DISCOVERY, mtg., Denver, by Society of Economic Geologists, Society of Exploration Geophysicists, and others. (J. Alan Coope, SEG Conference '93, Box 571, Golden, Colo. 80402. Phone: 303/837-5819. Fax: 303/837-5851)

April 25-28

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, ann. mtg., New Orleans. (AAPG, Box 979, Tulsa, Okla. 74101-0979. Phone: 918/584-2555. Fax: 918/584-0469)

May 16-20

ENVIRONMENTAL HYDROLOGY AND HYDROGEOLOGY, mtg., Washington, D.C. (Secretariat, American Institute of Hydrology, Second USA/USSR Conference, 3416 University Ave. S.E., Minneapolis, 55414-3328. Phone: 612/379-1030. Fax: 612/379-0169)

May 17-19

GEOLOGICAL ASSOCIATION OF CANADA/ MINERALOGICAL ASSOCIATION OF CANADA (Joint Annual Meeting), Edmonton, Alberta, Canada. (J.W. Kramers, Alberta Geological Survey, P.O. box 8330, Station F, Edmonton, Alberta T6H 5X2, Canada. Phone: (403) 438-7644; telefax: (403) 438-3644)

May 25–June 15

BASIN TECTONIC AND HYDROCARBON ACCUMULATION, mtg., Nanjing, People's Republic of China, by Nanjing University, USGS, Society of Petroleum Geology of China, and others. (David G. Howell, MS902, USGS, 345 Middlefield Road, Menlo Park, Calif. 94025. Phone: 415/329-5430. Fax: 415/354-3224)

June 1–5

GEOTECHNICAL ENGINEERING, int'l. mtg., St. Louis. (Norma R. Fleming, 119 ME Annex, University of Missouri, Rolla, 65401-0249. Phone: 314/341-6061; 800/752-5057. Fax: 314/341-4992)

June 7–11

EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS (55th Annual Meeting and Exhibition), Forum, Stavanger, Norway. (Evert van der Gaag, Business Manager, European Association of Exploration Geophysicists, Utrechtseweg 62, NL-3704 HE Zeist, The Netherlands. Phone: (03404) 56997)

June 20–27

ZEOLITES, int'l. mtg., Boise, Idaho, by International Committee on Natural Zeolites. (F.A. Mumpton, Dept. of Earth Sciences, State University of New York, Brockport, 14420. Phone: 716/395-2635; 716/637-2324. Fax: 716/395-2416)

June 21–25

ROCK ENGINEERING, mtg. and workshop, Lisbon, Portugal, by International Society for Rock Mechanics. (Luis Ribeiro e Sousa, Portuguese Society for Geotechnique, Laboratorio Nacional de Engenharia Civil, Av. do Brasil, 101, 1799 Lisboa Codex Portugal. Phone: 848 21 31. Fax: 89 76 60)

July

ENVIRONMENTAL CONTEXT OF HUMAN EVOLUTION (International Scientific Congress and Exhibition), The Netherlands and Indonesia. (Dr. Hans Beijer, Geological Survey of The Netherlands, P.O. Box 157, NL-2000 AD Haarlem, The Netherlands. Telefax: 31 23 351614)

July 18–23

CLAY CONFERENCE (10th International Conference in conjunction with Commission VII of the International Soil Science Society), Adelaide, South Australia. (Dr. Tony Eggleton, Geology Department, ANU, GPO Box 4, Canberra, ACT 2601, Australia)

August 23–29

GEOMORPHOLOGY (3rd International Conference), Hamilton, Ontario, Canada. (3rd International Conference on Geomorphology, McMaster University, Hamilton, Ontario L8S 4K1, Canada. Phone: (416) 525-9140, ext. 4535; telefax: (416) 546-0463; telex: 061-8347)

August 23–29

COASTAL SEDIMENTOLOGY, mtg., Hamilton, Ontario. (William F. Tanner, Dept. of Geology B-160, Florida State University, Tallahassee, 32306. Phone: 904/644-3208)

September 25–October 1

INTERNATIONAL ASSOCIATION OF VOLCANOLOGY AND CHEMISTRY OF THE EARTH'S INTERIOR, mtg., Canberra, Australia. (IAVCEI ACTS, GPO Box 2200, Canberra ACT 2601, Australia. Phone: 61/6/257-3299. Fax: 61/6/257-3256)

1994

June 6–10

EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS (56th Annual Meeting and Exhibition), Austria Center, Vienna, Austria. (Evert Van der Gaag, Business Manager, European Association of Exploration Geophysicists, Utrechtseweg 62, NL-3704 HE Zeist, the Netherlands. Phone: (03404) 56997; telefax (03404) 62640; telex: 33480)

1995

May 29–June 2

EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS (57th Annual Meeting and Exhibition), Glasgow, UK. (Evert van der Gaag, European Association of Exploration Geophysicists, Utrechtseweg 62, NL-3704 HE Zeist, The Netherlands. Phone: (03404) 56997; telefax: (03404) 62640; telex: 33480)

GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATIONS

Back Issues Available

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- Bulletin 7** (1974). 138 p. A collection of papers on geology. Edited by B.K. Tan. Price: M\$12.00.
- Bulletin 8** (1977). 158 p. A collection of papers on geology. Edited by T.T. Khoo. Price: M\$12.00.
- Bulletin 9** (1977). 277 p. The relations between granitoids and associated ore deposits of the Circum-Pacific region. A collection of papers presented at the IGCP Circum-Pacific Plutonism Project Fifth Meeting. 12-13 November 1975, Kuala Lumpur, Edited by J.A. Roddick & T.T. Khoo. Price: M\$25.00. **Out of stock.**
- Bulletin 10** (1978). 95 p. A collection of papers on the geology of Southeast Asia. Edited by C.H. Yeap. Price: M\$10.00.
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- Bulletin 14** (1981). 151 p. A collection of papers on geology of Southeast Asia. Edited by G.H. Teh. Price: M\$30.00.
- Bulletin 15** (1982). 151 p. A collection of papers on geology. Edited by G.H. Teh. Price: M\$30.00.
- Bulletin 16** (1983). 239 p. A collection of papers on geology. Edited by G.H. Teh. Price: M\$30.00.
- Bulletin 17** (1984). 371 p. A collection of papers on geology. Edited by G.H. Teh. Price: M\$35.00.
- Bulletin 18** (1985). 209 p. Special Issue on Petroleum Geology. Edited by G.H. Teh & S. Paramanathan. Price: M\$30.00.
- Bulletin 19 & 20** (1986). GEOSEA V Proceedings Vols. I & II, Fifth Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia, Kuala Lumpur, 9-13 April 1984. Edited by G.H. Teh & S. Paramanathan. Price for both Bulletins 19 & 20: Members – M\$50.00, Non-Members – M\$125.00.
- Bulletin 21** (1987). 271 p. Special Issue on Petroleum Geology Vol. II. Edited by G.H. Teh. Price: M\$40.00.
- Bulletin 22** (1988). 272 p. Special Issue on Petroleum Geology Vol. III. Edited by G.H. Teh. Price: M\$40.00.
- Bulletin 23** (1989). 215 p. A collection of papers on the geology of Malaysia, Thailand and Burma. Edited by G.H. Teh. Price: M\$35.00.
- Bulletin 24** (1989). 199 p. A collection of papers presented at GSM Annual Geological Conference 1987 and 1988. Edited by G.H. Teh. Price: M\$35.00.
- Bulletin 25** (1989). 161 p. Special Issue on Petroleum Geology Vol. IV. Edited by G.H. Teh. Price: M\$40.00.

Bulletin 26 (1990). 223 p. A collection of papers presented at GSM Annual Geological Conference 1989 and others. Edited by G.H. Teh. Price: M\$40.00.

Bulletin 27 (1990). 292 p. Special Issue on Petroleum Geology Vol. V. Edited by G.H. Teh. Price: M\$40.00.

Bulletin 28 (1990). 292 p. Special Issue on Petroleum Geology Vol. VI. Edited by G.H. Teh. Price: M\$40.00.

Field Guide 1 (1973). A 7-day one thousand mile, geological excursion in Central and South Malaya (West Malaysia and Singapore). 40 p. by C.S. Hutchison. Price: M\$5.00.

Abstracts of papers (1972). Regional Conference on the Geology of Southeast Asia, Kuala Lumpur, 1972. 64 p. 8 figs, 3 tables, many extended abstracts. Edited by N.S. Haile. Price: M\$6.00.

Proceedings of the Workshop on Stratigraphic Correlation of Thailand and Malaysia Vol. 1. (1983). Technical Papers. 383 p. Price: M\$25.00 (Members: M\$12.00).

WARTA GEOLOGI (Newsletter of the Geological Society of Malaysia). Price: M\$5.00 per bimonthly issue from July 1966.

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GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATIONS

General Information

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

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 *Buletin*. 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.

Authors must agree not to publish elsewhere a paper submitted to and accepted by the Society.

Authors alone are responsible for the facts and opinions given in their papers and for the correctness of references etc.

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, 59100 Kuala Lumpur, 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 *Buletins* 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.

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