

# PERSATUAN GEOLOGI MALAYSIA

# WARTA GEOLOGI

## NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MALAYSIA

Jil. 21, No. 6 (Vol. 21, No. 6)

Nov-Dec 1995

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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.

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## **Weathering features of a granitic outcrop at Sungai Batu, Penang**

LIM TOW HO  
4, Solok Scott  
Penang

### **INTRODUCTION**

Sungai Batu, is a kampung located at the south-eastern corner of Penang Island. Located near the kampung, towards the beachfront is a granitic outcrop that is exposed. The granitic outcrop is a weathered biotite granite. This note attempts to describe weathering features of the granite with emphasis on how it alters the original rock. References on weathering had been made, namely Summerfield (1991) and McLean and Gribble (1988).

### **TROPICAL WEATHERING**

Weathering of rocks can be subdivided into physical weathering, chemical weathering and biological weathering. In our tropical climate, the abundant rainfall plays a very important role in the weathering process. Altogether water plays a vital role in weathering, through processes named hydration and erosion. The joints and faults in the granite also play important roles since it is along those planes that water seeps in. Often the boulders and corestones in a weathering profile were originally demarcated by failure planes.

### **WEATHERED GRANITE**

The original granite is a biotite granite but the granitic outcrop occurs as a moderately weathered granite or Grade III. In a moderately weathered rock, less than half of the rock material is decomposed and discoloured rock

occurs as a continuous framework. Figures 1 and 2 show the exposed granitic outcrop examined. The overall area where the granitic outcrops is approximately 3,000 sq m.

On top of the outcrop, there occurs rock boulders and in Figure 1, there appears to be parallel grooves in the lower section of the rock mass. The overall geomorphology of the outcrop is a small rounded hill with uneven surfaces. It is obvious that rainwater together with the failure plains had played major roles in shaping its recent form.

The overall colour of the granitic outcrop is grey, from light grey to dark grey. However upon scrapping the surface of the rock with a knife, the rock materials uncovered appear to be more colourful with colours of white, red, grey, brown and yellow. This shows that the granitic outcrop is covered by a grey crust of 1 to 2 cm in thickness. Just beneath the grey crust are weathered materials that are softer and more colourful than the crust.

The earth constituents of the outcrop are quartz, weathered feldspars, iron oxides, aluminium oxides, titanium dioxide and clay minerals. Of all the original minerals, quartz is the most intact one left behind occurring as small scattered grains. Quartz is very resistant to weathering being the most stable having crystallized at the lowest temperature. Many weathered feldspars occur too and are highly discoloured and fractured. However in some feldspar phenocrysts the original crystal form

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# BULETIN PERSATUAN GEOLOGI MALAYSIA

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**BULLETIN OF THE GEOLOGICAL SOCIETY OF MALAYSIA**

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**Annotated bibliography of the geology of the  
South China Sea and adjacent parts of Borneo**

Emphasis on publications relevant to Petroleum Geology

Compiled and annotated by  
**N.S. HAILE**

Edited by  
**G.H. TEH**



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50603 Kuala Lumpur, MALAYSIA

# CATATAN GEOLOGI

## Geological Notes

### Weathering features of a granitic outcrop at Sungai Batu, Penang

LIM TOW HO  
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Penang

#### INTRODUCTION

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**Figure 1.** The weathered granitic outcrop at Sungai Batu, Penang.



**Figure 2.** Another view of the weathered granitic outcrop.

is still intact. The dark minerals such as biotite and tourmaline are altered to iron oxides, aluminium hydroxides and titanium dioxides. They occur as black and reddish-black grains.

The finest materials present are the clay minerals. They are the final products of tropical weathering and kaolinite is the most abundant variety.

The granitic outcrop is only moderately weathered and in terms of rock strength it is still strong. Repeated blows by a hammer only managed to dislodge a small section of the rock mass and it being the near surface section.

## CONCLUSION

The exposed granite at Sg. Batu, Penang is a moderately weathered granite. In this outcrop it is physical and chemical weathering that had played major roles. In these weathering processes the main agent had been rainwater.

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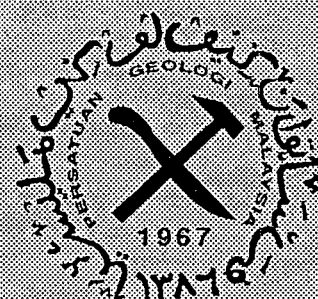
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## Flake duplexes in Crocker turbidites of Tamparuli, Sabah

AZLAN MOHD SABIRIN<sup>1</sup>, JAAFAR UNIR<sup>1</sup>, MOHD FADZIL YUSOFF<sup>1</sup>,  
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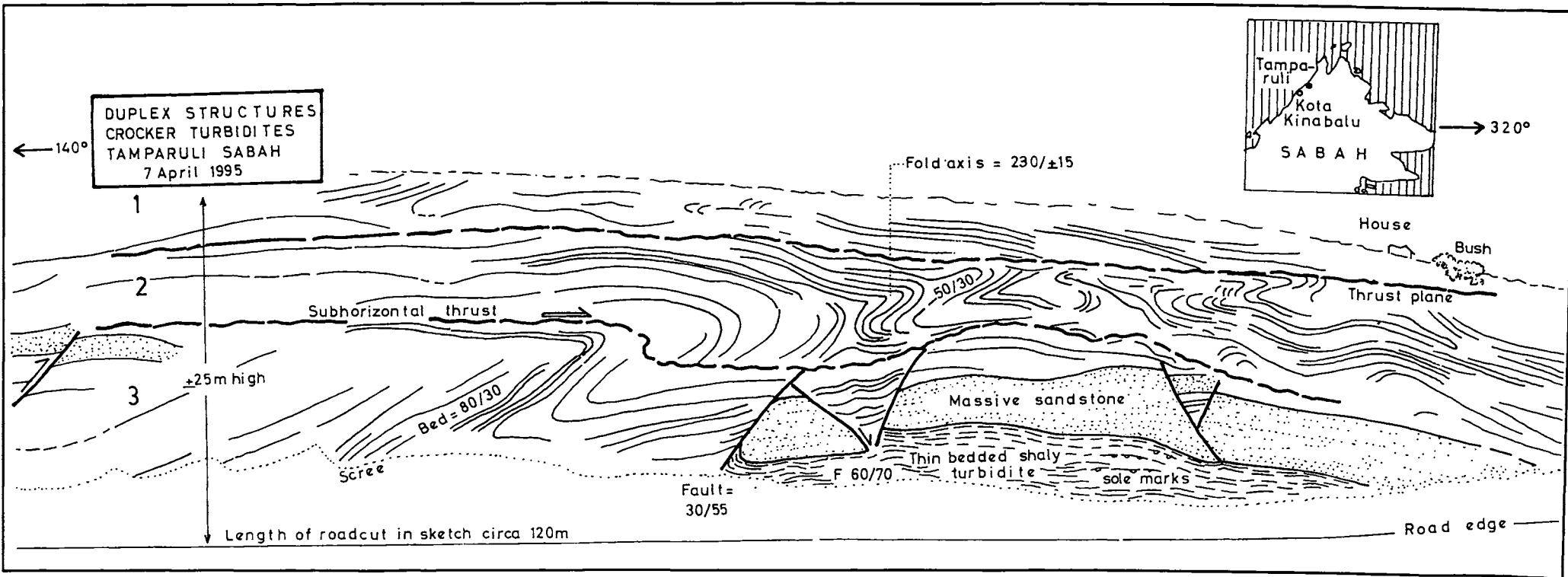
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In early April 1995, our field party studied a long roadcut near Tamparuli, Sabah, where strongly deformed Crocker sediments are exposed (Figs. 1 and 2). The well-stratified sediments consist of three lithological units. Most are dm-thick interbeds of sandstone and shale turbidites that include occasional thicker beds of several decimetres. The second rock type is a massive bedded sandstone band, slightly more than 2 m thick. Weakly developed laminations occur within this bed which overlies a sequence of thin-bedded shaly turbidites. The thick sandstone bank was probably emplaced through gravity sliding onto the shaly turbidites. Evidence consists of thin layer of shaly turbidite wrapping around an edge of the sandstone slab (to the right of the 30/55 fault on Fig. 1). Sole markings among which medium-sized flute and groove casts are common, adorn the bottom surface of sandstone layers and indicate stratigraphic facing with certainty (Fig. 1). The Crocker Formation is of late Eocene to earliest Miocene age (Geological Survey of Malaysia, 1985) and is regarded as an accretionary wedge complex in association with subduction of the South China Sea plate beneath Borneo (Hamilton, 1979). Active subduction took place between 32 and 17 Ma as is indicated by the east-west magnetic stripes in the South China Sea floor (Taylor and Hayes, 1982). Prior to 32 Ma (late Early Oligocene), and older episode of subduction by the same plate under Borneo must have already taken place (Ru and Pigott,

1986; Briais *et al.*, 1993).

The large structures in this roadcut are overturned to recumbent folds, high-angle normal faults (a few are associated with shallow grabens), reverse faults of moderate dips and thin, subhorizontal fault zones. The latter type probably represents the tread of ramp-tread-ramp in a stepped-fault system (Fig. 1). The figure also shows that the structures constitute a duplex, in which thrust sheets are separated by low-angle (in our case subhorizontal) faults. In duplexes, the higher thrust unit moved earlier than the next lower thrust unit. In this outcrop the numbers 1, 2 and 3 indicate the sequence of activity of the corresponding structural unit. As far as we know, *this is the first record of duplex structures in the Crocker Formation*. The commonly known structural style of the formation consists of low to moderate-angle reverse faults, imbricated structures, large and outcrop-scale overturned to recumbent folds verging in general NW direction (Tjia, 1974; Kadderi Md Desa and Ibrahim Komoo, 1989; Tongkul, 1989). The Tamparuli outcrop also shows that tectonic transport had been towards NW.

The subhorizontal attitudes of the thrust faults suggest that at least for this zone of Crocker beds, thrusting had been thin-skinned (in the meaning as discussed by Coward, 1983). The Tamparuli outcrop further demonstrates the very thin character of the thrust units,



**Figure 1.** Part of the long roadcut west of Tamparuli at road sign 42 km to Kota Belud showing flake duplexes in Crocker turbidites. Thrust unit 1 was emplaced earlier and rode on the back of thrust unit 2 when this was active. In turn thrust units 1 and 2 were carried by thrust unit 3 during a later activity. Tectonic transport was towards northwest.



Figure 2. Panoramic view of the roadcut. Compare with Figure 1 for scale.

each of which is less than 10 metres thick. An appropriate name for the Tamparuli structure would be *flake duplex*.

As field geologists in humid tropical terrains have experienced, roadcut outcrops deteriorate rapidly within a few years. This is the third compelling reason to put our observations on record.

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## **PERTEMUAN PERSATUAN** **Meetings of the Society**

### **Ceramah Teknik (Technical Talk)**

## **Application of surface penetrating microwave (SPM) technique**

**N. NARENDRANATHAN**

### **Laporan (Report)**

Mr. N. Narendranathan, Managing Director of AL Technologies (S) Pte. Ltd., gave the above talk on 22nd November 1995 at the Geology Department, University of Malaya.

Surface penetration microwave (SPM) technique is a geophysical, subsurface testing/detection method which has gained much ground, in terms of its applications, over the last two decades or so.

Utilizing radar technology, SPM technique has the advantages of being quick, accurate, non-destructive and economical. For instance, the technology enables the precise position of boreholes or test pits to be determined prior to drilling and/or excavation, thus reducing the number, and therefore the cost, of drilling/digging of boreholes or test-pits. In addition, it safeguards the health and well-being of the workers involved in construction or site-remediation work, particularly where sites contain buried hazardous substances or chemicals.

Under the right conditions, SPM technique has been employed in the survey or mapping of such things as man-emplaced objects (the sizes, locations and depths of such objects being revealed) as well as natural subsurface conditions. As such, it has widespread applications in various fields, namely, archaeology, forensic science, geology, hydrology, civil/structural engineering, environmental engineerings, etc.

AL Technologies has utilized SPM techniques since the 1980s and is a pioneer in this application. State of the art technology applications have been further developed by work carried out under a research grant from the National Science & Technology Board in Singapore.

AL Technologies has now successfully applied SPM techniques in solving technical problems in the geotechnical, civil, structural and environmental sections.

In summary, non-destructive, SPM technology is an extremely effective, precise, fast and inexpensive means of identifying and mapping natural subsurface targets such as limestone caves, aquifers and underground streams or foreign man-made objects like buried waste drums, landfill sites, etc.

Besides other facets of modern-day society, applications for SPM are numerous in the hydrogeological as well as in the civil and structural engineering fields.

SPM applications in the area of environmental engineering are essentially in site characterization, detection of isolated underground waste sources as well as in the mapping of underground contaminant/chemical plumes in the soil and groundwater mediums.

AL Technologies (S) Pte. Ltd. is currently conducting research into applications of SPM in the detection of hydrocarbon plumes in the groundwater media as well as in the inherent soils of Singapore and the South East Asian regions.

Apart from the above, SPM technology is considered a cost-effective method in the testing, evaluating/assessment and monitoring of various engineering problems that we face today. The non-destructive element of the SPM technique enhances the cost effective nature of this technology.

G.H. Teh

## **Using subsurface pressure and fluids data as an exploration tool**

HUGH W. REID

### **Laporan (Report)**

Mr. Hugh Reid gave the above talk on 28 November 1995 at the Geology Department, University of Malaya. Mr. Reid operates an international petroleum consultancy based in Calgary, Canada which specializes in Hydrodynamics Studies and DST Interpretation. His regional pressure studies have covered areas in North Africa, Indonesia and North America. He gives seminars to the petroleum industry and is a past president of the Canada Well Logging Society.

### **Abstrak (Abstract)**

Pressure and fluids data are routinely used by reservoir engineers in producing fields but are rarely looked at by explorationists (other than RFT pressure/depth plots). This talk will illustrate how geologists may utilize this type of data directly and indirectly as an **oil & gas finding tool**.

Recent examples from Canada and elsewhere will be shown where simple plots of reservoir pressure vs. depths were instrumental in identifying huge gas fields, previously thought to be isolated small unconnected pools.

Other concepts discussed included: 1. How areas of underpressure or pressure "sinks" favour hydrocarbon accumulation. 2. How the direction of water flow in a reservoir (updip or downdip) affects the trap holding capacity of stratigraphic traps (downdip flow enhances weak barriers, whereas updip flow will tend to flush hydrocarbons from the trap). 3. How the old fifties concepts of tilted oil/water or gas/water contacts due to hydrodynamic flow are now being found to be valid today in S.E. Asia e.g. Mahakam Delta Kalimantan, Indonesia and Torro Formation, Papua New Guinea.

G.H. Teh

# Ceramah Teknik (Technical Talk)

N. NARENDRANATHAN



HUGH W. REID

## Site Visit to Karak Highway & the New Genting Sempah Tunnel

This site visit, arranged by the Working Group on Engineering Geology & Hydrogeology, was held on Saturday 2 December 1995. There were limited places for the visit and a few unfortunately had to be turned away. The bus-load of participants left Geology Department, Universiti Malaya at 8.15 am, to be in time for the briefing at Malaysia-Thai Development (MTD) Construction Sdn. Berhad's Site Office near the Genting entrance of the Karak Tunnel.

Fortunately for a large number of the participants, breakfast was provided before the briefing! Starting off the briefing, Mr. Steve Rogers, the Project Director, gave some background on the privatisation of the Kuala Lumpur-Karak Highway Project and specifications of the tunnel. Next Dr. Ghani Rafek, the Consultant Geologist, elaborated on the geology, material strength, excavation method, tunnel support and blast vibration monitoring. After that both experts answered queries from the participants.

This new tunnel at Genting Sempah runs parallel and to the north of the existing tunnel from km 37.146 to km 37.940, a length of approximately 974 m. Under normal operations the new tunnel will provide 2 lanes for uni-directional traffic flow. However for maintenance or emergency conditions, it may provide bi-directional flow (see also item under 'Local News' in this issue).

The rock present at the new tunnel excavation is a Quartz Porphyry or Rhyolite Porphyry, a volcanic rock of shallow intrusive origin. The porphyritic textured rock exhibit high to medium alteration with uniaxial compressive strength of 4 to 60 to 220 Mpa.

The system of excavation is the New Austrian Tunnelling Method (NATM) of drill and blast, driven on the "heading and benching" method where heading and benching are excavated in separate operations. The NATM require different degrees of support for different rock class, and the Norwegian Geotechnical Institute (NGI) rock classification system has been adopted to determine the rock class. The tunnel supports range from steel set, rock bolt, fibermeshed shotcrete and wire mesh in various combinations depending on the rock class.

An extensive blast monitoring programme is being undertaken to ensure that blasting operations at the new tunnel do not have a detrimental effect on structures like the existing tunnel, roads, cutslopes, houses and restaurants in the vicinity.

At 10 am the participants were taken to the KL-end (or west-end) of the proposed tunnel to have a first-hand look at the cut-slopes and slope stabilization works in progress (before tunnel excavation). Next the participants were taken into the new tunnel at the Genting-end (or east-end) where approximately 63% of the tunnel excavation work has been completed on the heading and 35% on benching.

After a thorough clean-up of the mud from the tunnel visit, the participants were driven to Selesa Homes Resort for a welcomed buffet lunch in pleasant surroundings, courtesy of MTD.

G.H. Teh

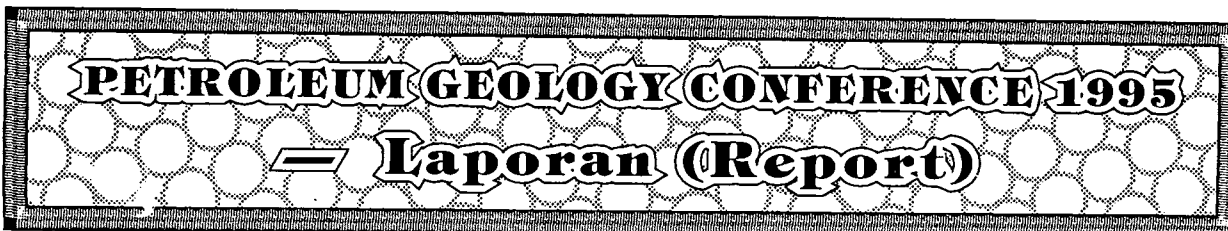


# Site Visit to Karak Highway & the New Genting Sempah Tunnel



## Captions to photos

1. Dr. Ghani Rafek elaborating on the rock strength.
2. Mr. Steve Rogers briefing participants on the highway.
3. Tan Boon Kong with a question for Dr. Ghani.
4. Mr. Rogers answering a query.
5. Dr. Ghani showing where the tunnel will be excavated.
6. Participants having a good look at the slope stabilisation in progress.
7. A closer look at the site for tunnel excavation.
8. Dr. Ghani briefing participants at the entrance to the new tunnel.
9. A closer look the support in the new tunnel.
10. At the site of benching activities.
- 11-12. Buffet lunch. What a treat!

A decorative banner with a patterned background. The text 'PETROLEUM GEOLOGY CONFERENCE 1995' is written in a bold, serif font at the top. Below it, a horizontal line is followed by the word 'Laporan' in a smaller font, and then '(Report)' in a larger, bold, serif font.

**PETROLEUM GEOLOGY CONFERENCE 1995**  
— **Laporan (Report)**

The Petroleum Geology Conference '95, the 18th in the series (*conference* being more appropriate and perhaps an upgrade from the ever popular *Petroleum Geology Seminar*) proved to be as popular as ever. A total of 432 registered participants turned up for the Conference this year at the Concorde Hotel, Kuala Lumpur on the 11th & 12th December 1995.

Due to unforeseen circumstances the guest-of-honour YB Dato' Mohamad Idris Mansor, Senior vice-President, PETRONAS and Managing Director & CEO Petronas Carigali Sdn. Bhd. was not able to be present. He was, however, ably represented by En. Ahmad Said, General Manager, Exploration Division, Petronas Carigali Sdn. Bhd. and a former President of the Society.

Dr. Khalid Ngah, in his Welcoming Address, enlightened the participants on the mission of the Geological Society of Malaysia to promote and enhance geological knowledge for the benefit and growth of the country.

In the Opening Address, YB Dato' Mohamad Idris foresee that intensive exploration efforts will be needed to increase the nation's oil and gas reserves. In this respect, new play concepts need to inject a lease of life to our exploration acreages that include the frontier areas. He called on oil and gas companies to pool their resources to enhance a cost-effective and efficient approach to a successful exploration venture. He hoped that PETRONAS can entice the oil companies to a new round of exploration activities.

A total of 26 oral presentations and 5 posters were presented over the 2-day Conference. In addition there were 2 Keynotes Papers, one by Tan Ek Kia of Shell and other by John Willot of Exxon. Mr. Zainuddin Yusoff was presented a momento for having the best poster at the 1994 AAPG-GSM International Conference held in Kuala Lumpur.

It is heartening to note that besides the strong support for the Conference from the local oil companies, there was in the audience the good turnout of student members from the local universities, Universiti Malaya, Universiti Kebangsaan Malaysia and in particular the bus-load from Universiti Sains Malaysia, Penang, which was organised by their popular lecturer, Dr. L.S. Leong.

This year, for the first time at the Petroleum Geology Conference, there was an exhibition by 12 companies who displayed their various computer-aided and other techniques in the oil exploration industry. This proved to be a major attraction in addition to drinks provided by Schlumberger and Digicon at the exhibition site. The Organising Committee, under the Chairmanship of Hoh Swee Chee, should be commended on coming up with a highly successful and well-organised conference and exhibition.

G.H. Teh

**Welcoming Address by Dr. Khalid Ngah,  
President Geological Society of Malaysia at  
the Petroleum Geology Conference 1995 on  
December 11, 1995**

*Yang Berusaha Encik Ahmad Said, Acting for Y. Bhg. Dato Mohamad Idris Mansor, Senior Vice President, Petronas, and Managing Director Carigali;*

*Invited Guests, Ladies and Gentlemen,*

Assalamualaikum and a very good morning to you;

I am so very pleased to see so many of you here, coming to this annual event of the Geological Society of Malaysia, The Petroleum Geology Conference.

Really, this event started 18 years ago, and as of two years ago, it was still called "The Petroleum Geology Seminar". At these seminars, petroleum geologists who worked for oil companies operating in Malaysia, met and discussed areas of common interest, in the hope that the experiences gained by each other in the exploration for oil and gas in the country, could be shared so that risks could be reduced, and mistakes avoided. The event received bigger attention each subsequent year, and it continuously gained support from all sectors: individuals and local, regional and international companies. Topics discussed were current, and because these topics were the very focus of interest to many, they have attracted individuals and companies from outside the country. I am very proud to say that we have with us this morning prominent individuals and representatives of prominent companies operating not only in this region, but also elsewhere. Today, the event has become so internationalised that the Council decided to call this meeting "A Conference". So, today you are attending the 18th Petroleum Geology Seminar, and the first Petroleum Geology Conference organised by the Society. By the look of the response of the papers which attracted prominent individuals and companies, and the increasing number of exhibits, I believe it has the potential one day, to be called "A Convention".

This is a big crowd, and I believe this one of the biggest crowds we have had. I have been told just now that there are 432 of you here in this hall.

For some of you who come from abroad, I wish to take this opportunity to welcome you to Malaysia, and to Kuala Lumpur, and have a pleasant stay. For the rest of you who are from here, I extend you a warm welcome to the Conference.

I am also very pleased to announce, that the response to the call for papers has been overwhelming. A total of 56 papers were received, competing for 26 slots: 12 today and 14 tomorrow. I wish to thank Encik Hoh and his able team, who have worked so hard to organise this meeting. The team was faced with a very difficult task: to select 26 papers among the best of the 56 papers, and yet make everybody happy. I can imagine the dilemma they were in; I hope that those whose papers have not been selected should not be discouraged, as the Society plans to organise a bigger Conference next year, and they could still submit them for consideration.

The Geological Society of Malaysia has a mission, and this mission is to promote and enhance geological knowledge for the benefit and growth of the country and indeed it is not an easy mission. It needs people and money. Although there have been many who were and are willing to serve the Society, money has not been easy to get. A lot of voluntary, sincere and dedicated work have been rendered by the Council Members to transform the Society to what it is today: a Society with a good size of members and financially stable. Primarily, the money has been raised through generous contributions. The Society's approach on the promotion of earth science awareness has been through the organisation of conferences, seminars, workshops and field trips, and recently, it has set up a committee with the responsibility to bring the science to schools. And already awareness seminars and lectures have been conducted. All these activities are performed every year with no profit in sight, except for the Petroleum Geology Conference, and on the other hand many activities are subsidised. If additional money is made, this money and the money at hand, is used to finance the Society's publications (Bulletins and Newsletters), beside subsidising lectures and field trips. Some of the students you find in this hall came all the way from Penang and their transportation has been fully supported by the Society. This is our way of promoting interest, and this is our way of promoting the science.

I wish to express my sincere appreciation and gratefulness to the sponsors of this Conference, without which we might have to charge registration fees of more than RM50.00, and without which we would not be able to see so many independent individuals who are not company-sponsored. I wish to thank all companies for their generous sponsorship. I hope you will appreciate how we have utilised your contributions, and hopefully, next year when we call for another Conference, you will not hesitate to contribute more than usual for the good cause.

Lastly, I wish this 2-day Conference a success.

Thank you.

### Petroleum Geology Conference 1995 Captions to Photos

1-3	At the Registration Desk.	37	Richard Murphy on Petroleum Systems of SE Asia.
4	The President with the Welcoming Address.	38	Elio Poggialiomi with his presentation.
5	Mr. Ahmad Said reading the Opening Address.	39	Enik Haugane on SEAS-95.
6	A momento for Zainuddin Yusoff.	40	Peter Abolins with a joint paper.
7-19	The large turnout.	41	W.H. Borland with his presentation.
20	E.K. Tan with his Keynote Paper.	42	Harun Mohd Noor on Project Express.
21	Jawati Abu Naim on Integrated Petroleum Systems.	43	Jamal Jamil on the Malay Basin.
22	K.R. Chakraborty with his presentation.	44	Leong Lap Sau stressing a point.
23	E.R. Telatovich on AVO behaviour.	45	Boniface Bait on the use of horizontal wells.
24	Sahalan Abd. Aziz with his paper.	46	H.D. Tjia with his paper.
25	Simon Irwin on the ALF.	47	A Hanif with a question.
26	Douglas Waples on rock-eval-type pyrolysis.	48	Ajaib Singh on a joint resources study.
27	Nick De'Ath on the Cusiana Field.	49	Organising Chairman S.C. Hoh presenting Mahadir Ramly with a momento.
28	C.S. Hutchison with his paper.	50	Abd Rahim gets a momento for his poster.
29	Idrus Mohd Shuhud on AVO analysis.	51	A momento for Senusi M. Harsha for his poster.
30	Abdurrazagh Ahmad Ezzeddin on the Khuff Field.	52-53	Discussions over tea.
31	Mohd. Tahir Ismail with his paper.	54-56	Lunch time.
32	Robert Wong on the SE Collins Field.	57-60	At the Ice Breaker Reception.
33	John Willot with his Keynote Paper.	61-64	The big crowd at the Poster Session.
34	Jeff Lobao on SB-1 Block.	65-72	Busy visitors to the Exhibition.
35	Clive Foss with his paper.		
36	Mark Sams on sandstone properties.		

# PETROLEUM GEOLOGY CONFERENCE 1995



**Opening Address by YB Dato' Mohamad Idris Mansor, Senior Vice-President, PETRONAS & Managing Director & CEO, Petronas Carigali Sdn. Bhd. at the Petroleum Geology Conference 1995 on December 11, 1995**

*Yang Berusaha, Dr. Khalid Ngah, President of the Geological Society of Malaysia, En. Hoh Swee Chee, Organising Chairman of the 1995 Petroleum Geology Conference,*

*Distinguished guest, participants, ladies and gentlemen;*

Assalamualaikum and good morning to all.

First of all, I must say that I am privileged to be present here in the midst of prominent geoscientists and experts of the oil and gas industry and also to be invited to deliver this opening address in the 18th Petroleum Geology Conference organised by the Geological Society of Malaysia. I would like to take this opportunity to extend my warmest welcome to those who have travelled from abroad to be here with us today. "Selamat Datang ke Malaysia" as we commonly greet visitors to our country.

1995 sees the Malaysian petroleum industry in its 85th year since all began with the discovery of the Miri field back in 1910. The Malaysian petroleum industry has since then undergone an impressive series of changes to cope with the upturns and downturns of the global petroleum industry. Today, we have to cope with the many challenges facing the industry vis a vis the soft crude oil price outlook, rising capital and operating costs, exploration and capital expenditure cutbacks by oil companies and increasing environmental awareness.

Nevertheless, it is heartening to note that under the current investment climate, the interest in petroleum geology has not waned. In fact, I was told by the organiser that there has been an overwhelming response to their call for papers but in view of the duration of the seminar, many good technical papers could not be accommodated.

Let me touch briefly on the exploration efforts and the achievements that we have so far recorded in Malaysia. As of 31 October 1995, a total of slightly over a million line km of seismic data have been acquired and 930 exploration wells drilled which have led to the discovery of 123 oil fields and 208 gas fields (both small and big). As compared to the world average wildcat success ratio of 1 in 10, Malaysian exploration efforts can be considered very successful with an enviable average success ratio of 1 in 6 for oil exploration. The total hydrocarbon reserves discovered to date stands at over 7 billion barrels of oil and over 90 trillion SCF of gas. Net of production, the remaining reserves stand at over 4 billion barrels of oil and 85 trillion SCF of gas. In the world reserves ranking, Malaysia is placed amongst the top 20 for both oil and gas.

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at a production level of about 650,000 BOPD and 2.6 billion SCFGPD. Our national demand for crude oil currently runs at 50% of daily production. The current domestic supply and demand balance indicates that Malaysia will in all probability be a net importer of oil by the middle of the next decade; this is assuming no new fields are found and no new field development takes place.

To prolong our net exporter status, we have to increase the nation's oil and gas reserves. To do that we foresee that intensive exploration efforts will be needed to mature the remaining structures that are increasingly becoming subtle and risky into drillable prospects. More importantly, we will have to develop and mature new play concepts to inject a new lease of life to our exploration acreages. Besides this, we have not forgotten our frontier areas. Our exploration activities have now gone beyond the continental shelf into the deep water areas. Two wildcat wells have been drilled to date in the deepwater acreage with more activities planned for future years. It is my fervent hope that the shift from the traditional mind set to more innovative and unconventional play concepts, new and more encouraging discoveries will be made. Towards this end, the service sector can also play an important role in bringing into Malaysia new technologies to assist us in our continuing efforts in the search for hydrocarbons.

Traditionally, in the oil and gas industry, exploration is carried out by oil companies very much by themselves, but today many have realised that it is actually more beneficial to form synergistic alliances with other companies. The stronger aspects of a particular company can compensate for the shortcomings of the ally which may have its strength in other fields of expertise. The pooling of resources together will not only enhance the chances of a successful exploration venture but more importantly, it may be a more cost-effective and efficient approach to exploration especially under the current soft crude oil price outlook. Unlike before when oil was the focus of the PSC contractors operating in Malaysia, gas has attracted a lot of interest in recent years as it has proven to be the preferred energy source in this region. The presence of a ready market coupled with its status of being environmentally friendly and a cleaner fuel alternative, has resulted in oil companies relooking at Malaysia's gas potential.

With many of our PSCs reaching the tail end of the Exploration Period, it is a challenge now for PETRONAS to entice oil companies into another round of exploration activities. Against the background of diminishing field sizes, escalating costs and the soft crude oil price outlook, we are looking for ways and means to assist companies to bring on-stream discoveries with a reasonable return on their investment.

Ladies and gentlemen, once again I reiterate the need for us to be innovative in developing new play concepts and to be aggressive in using state of the art techniques in our exploration efforts. I trust this seminar will provide many opportunities for us to do that in view of the diverse high quality technical paper to be presented and the impressive displays set up in the poster session. I hope that you will take advantage of this seminar to share and exchange your experience. The wealth of information to be gained from sharing and exchanging will benefit us all in our search for oil and gas.

With that note, it is my pleasure to declare the 18th Petroleum Geology Conference open.

Thank you.

# PETROLEUM GEOLOGY CONFERENCE 1995

## Programme

### 11th December 1995 (Monday)

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- 08:00 : Registration
- 08:50 : Arrival of Invited Guests
- 09:00 : Welcoming Address by Dr. Khalid Ngah  
President, Geological Society of Malaysia
- 09:15 : Opening Address by YB Dato' Mohamad Idris Mansor,  
Senior Vice-President, PETRONAS & Managing Director & CEO, Petronas  
Carigali Sdn. Bhd.
- 09:30 : **Coffee Break**
- 10:00 : **Keynote Paper 1:** The outlook of Malaysian E&P industry in the next  
century  
*Tan Ek Kia (SSB)*
- 10:25 : **Paper 1:** Integrated petroleum systems  
*Jawati Abu Naim (EPMI)*
- 10:50 : **Paper 2:** Causative mechanism of Tertiary basin development in northern  
Sunda Shelf region  
*K.R. Chakraborty (UM)*
- 11:15 : **Paper 3:** AVO behavior on seismic data from offshore Borneo  
*E.R. Telatovich, K.B. Lim, M.J. Zainuddin, J.C.S. Ting, G.V.K. Pang and B.H.  
Chiem (SSB)*
- 11:40 : **Paper 4:** Overview of pre-Tertiary hydrocarbon potential, onshore and  
offshore Peninsular Malaysia  
*Sahalan Abd Aziz<sup>1</sup>, H.D. Tjia<sup>2</sup>, Abd Rahman Eusoff<sup>1</sup>, Jamaal Hoesni<sup>2</sup>, Mohd Idrus  
Ismail<sup>1</sup> and Liew Kit Kong<sup>2</sup> (<sup>1</sup>EMD, Petronas, <sup>2</sup>PRSS)*
- 12:05 : **Paper 5:** Detecting leaking oilfields with ALF, the airborne laser  
fluorosensor: Case histories and latest developments  
*Alan Williams (World Geoscience, UK)*
- 12:30 : **Lunch Break**
- 14:00 : **Paper 6:** Developing consistent and reasonable kerogen kinetics using rock-  
eval-type pyrolysis  
*Douglas W. Waples and Mahadir Ramly (PCSB)*
- 14:25 : **Paper 7:** The Cusiana Field in Colombia  
*Nick De'Ath (Triton Energy Corporation)*

- 14:50 : **Paper 8:** The Sarawak and Sabah Orogenies  
*Charles S. Hutchison*
- 15:15 : **Paper 9:** AVO analysis of a 2D seismic line in Malay Basin  
*Dashuki Mohd and Idrus Mohd Shuhud (PRSS)*
- 15:40 : **Tea Break**
- 16:10 : **Paper 10:** Seismic modelling in the Khuff-Field, Sirte Basin, Libya  
*Abdurrazagh Ahmed Ezzeddin, Abd Rahim Samsudin (UKM)*
- 16:35 : **Paper 11:** Relationship of structural timing and hydrocarbon migration in the Malay Basin  
*Mohd Tahir Ismail (EPMI)*
- 17:00 : **Paper 12:** Seismic sequence stratigraphic interpretation enhances remaining hydrocarbon potential of the SE Collins Field  
*Robert Wong Hin Fatt (Petronas)*
- 17:30 : **Close of Day One**
- 19:00 : **Ice Breaker Reception**

## 12th December 1995 (Tuesday) --- ---

- 08:30 : **Keynote Paper 2:** Geoscience technology trend and challenges  
*John A. Willot (Exxon Production Research Co.)*
- 08:55 : **Paper 13:** Integrated sequence stratigraphic interpretation of the SB-1 Block, offshore Sabah  
*Patrick-Allman Ward<sup>1</sup>, Mohamed Yazid Mansor<sup>2</sup> and Jeff Lobao<sup>1</sup> (<sup>1</sup>SSB/SSPC, <sup>2</sup>EMD, Petronas)*
- 09:20 : **Paper 14:** A high resolution aeromagnetic survey to image low angle transfer faults within the JDA area of the northern Malay Basin  
*Clive A. Foss (Encom Tech, Australia)*
- 09:45 : **Paper 15:** The effect of clay and gas on the elastic properties of sandstones  
*Mark Sams<sup>1</sup> and Martijn Andrea<sup>2</sup> (<sup>1</sup>PRSS, <sup>2</sup>Imperial College, London University)*
- 10:15 : **Coffee Break**
- 10:45 : **Paper 16:** Petroleum systems of Southeast Asia  
*Richard W. Murphy (UK)*
- 11:10 : **Paper 17:** The integrated approach to reservoir evaluation — myths and realities  
*Elio Poggialiomi (Entec)*
- 11:35 : **Paper 18:** SEAS-95, the First International Seismic Programme in the South China Sea  
*Erik Haugane (Nopec, Singapore)*
- 12:00 : **Paper 19:** Aspects of oil generation from coals: A Sarawak case study. The importance of exsudatinitic and variations in organic facies characteristics  
*Wan Hasiah Abdullah<sup>1</sup>, Mohammad Jammal Hoesni<sup>2</sup> and Peter Abolins<sup>2</sup> (<sup>1</sup>UM, <sup>2</sup>PRSS)*

12:30 : **Lunch Break**

14:00 : **Paper 20:** Improving depth prediction accuracy of quantified drilling hazards  
*W.H. Borland and W.S. Leaney (Schlumberger)*

14:25 : **Paper 21:** PROJECT EXPRESS (A fast-track 3D seismic program)  
*Harun Mohd Noor (EPMI)*

14:50 : **Paper 22:** Geology and play types of Malay Basin western margin  
*Jamal Jamil, Abdul Rahman Eussof, Muzamal Abdul Ghani (EMD, Petronas)*

15:15 : **Paper 23:** Investigation of DMO algorithms during test-line processing: some recommendations  
*Ng Tong San<sup>1</sup>, Mohd. Hashim Abas<sup>1</sup> and Leong Lap Sau<sup>2</sup> (<sup>1</sup>PETRONAS Carigali Sdn. Bhd., <sup>2</sup>USM)*

15:40 : **Tea Break**

16:10 : **Paper 24:** Using horizontal wells to develop the lower coastal plain channel sands in the Balingian Province, offshore Sarawak  
*Boniface Bait and Norazlam Norbi (SSB)*

16:35 : **Paper 25:** Tectonics of deformed and undeformed Jurassic-Cretaceous strata of Peninsular Malaysia  
*H.D. Tjia (PRSS)*

17:00 : **Paper 26:** Integrated technical approach and results of the Tiong-Kepong joint resources study  
*Ajaib Singh<sup>1</sup>, Shaharuddin Aziz<sup>2</sup>, Edwin J. Bomer<sup>1</sup> (<sup>1</sup>EPMI, <sup>2</sup>PCSB)*

17:30 : **Close of Conference**

## POSTER SESSION

**Poster 1:** A deep seismic section across the Malay Basin: Processing of data and tectonic interpretation  
*Abd Rahim Md. Arshad, Dashuki Mohd and H.D. Tjia (PRSS)*

**Poster 2:** Sequence stratigraphic and diagenetic controls on pore-type development: A new perspective from petrographic image analysis  
*Mohd Fauzi Abdul Kadir and Mohammad Yamin Ali (PRSS)*

**Poster 3:** Geochemistry of gases in the Malay Basin  
*Douglas W. Waples and Mahadir Ramly (PCSB)*

**Poster 4:** Source rock studies on Luconia carbonate shelf  
*Michael Carter (Mobil) and Peter Abolins (PRSS)*

**Poster 5:** Preliminary stratigraphic study on Attahaddy Field, Sirte Basin, Libya  
*Senusi M. Harsha, Abdul Rahim Samsudin, M.Z. Farshori and Basir Jasin (UKM)*



**PETROLEUM GEOLOGY CONFERENCE 1995**  
**Abstracts of Papers**

*Keynote Paper 1*

**The outlook of Malaysian E&P Industry in the next century  
in the next century**

TAN EK KIA

Sarawak Shell Berhad  
Sabah Shell Petroleum Company Limited  
Lutong

The Malaysian E&P industry started with the first commercial oil discovery in 1910 in Miri. Although oil and gas are now found in five of the seven Tertiary basins, commercial production takes place in only three basins, namely, Malay, Sarawak and NW Sabah basins. The country's total hydrocarbon reserves are estimated to be 4.3 billion barrels oil and 84 TCF gas. With current production rates of ca. 650,000 barrels/day oil and ca. 3 billion scf/day gas, the oil reserves will last another 18 years whereas the gas reserves will last another 40 years, unless additional significant reserves are found.

Although exploration drilling shows an increasing trend post-1985 PSC compared to the post-1976 PSC and earlier periods, new potentially commercial hydrocarbon reserves are discovered only with proven hydrocarbon provinces. The results indicated that within the proven hydrocarbon provinces (1) the established plays with the easy hydrocarbons have been found and remaining prospects associated with such plays are in general small, and (2) there is some considerable scope for additional gas reserves in these plays.

The long-term future of the E&P industry in Malaysia lies principally in the exploration for new oil and gas reserves in near-field areas and alternative deeper plays in proven hydrocarbon provinces, and in high risk, harsh deepwater frontier areas.

Four key factors, namely, fiscal regime, cost-efficiency, technology and human resources, determine the necessary environment required to foster a strong and healthy E&P industry in Malaysia.

The contractual and fiscal regimes in many countries still reflect the economic climate of the late 1970s and early 1980s. Since the economic environment for the world-wide E&P industry is now much harsher, better and more flexible contractual and fiscal terms are required to sustain a healthy E&P industry in Malaysia.

The industry today is faced with decreasing returns on investment. The main challenge will be to increase the margin between oil price and cost. Oil price is controlled by market perceptions and forces over which the industry in Malaysia has little or no control. However, the industry has control over its capital and operating costs. It must, therefore, reduce its cost base in order to maintain or even enhance margins.

Some of the key technologies that have great impact on the industry include 3D seismic which are being used increasingly in exploration, appraisal and development, and integrated basin modeling technology. These, together with advanced petrophysical techniques, and better reservoir modeling and simulation, allow the explorers and the petroleum engineers to recover

more reserves, increase production rates and reduce development costs. Deepwater exploration and development, although at the frontiers of technology, are technically viable but will require commensurate fiscal terms to ensure commercial viability of any discoveries. Technological innovations are required to drive down further the technical unit cost of deepwater exploration and development, making accessible potentially large hydrocarbon volumes in deepwater areas.

The industry requires high quality people with more experiences to meet the challenges ahead. There is a need to develop and nurture a workforce that is creative, effective, efficient and flexible. Part of the contribution of an international E&P industry to the economy of Malaysia is the development of a cadre of trained professional national staff, offering opportunities for selected staff to broaden their experience by working in different countries.

The future of the E&P industry in Malaysia in the 21st Century will likely continue to grow. The industry's success, however, will depend on how the PSC contractors, service contractors, PETRONAS and the Government work together as partners in the continuing search for and prudent development of the hydrocarbon resources. The challenge to the partnership is how to operate in cost-efficient, safe and environmentally friendly manner, using the most up-to-date technology, while ensuring adequate financial returns to shareholders and the nation.

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*Paper 1*

## **Integrated petroleum systems**

JAWATI ABU NAIM

ESSO Production Malaysia Inc.

With exploration maturity, opportunities in the Malay Basin are becoming limited and risky. Prospect sizes are small and are difficult to find and new geologic plays have to be scooped out with innovative ideas.

An integrated petroleum systems approach is key to today's challenging exploration environment. Integration of various state-of-the art geoscience technologies has resulted in identification of key controlling elements for a successful exploration program. This approach integrates all of these key play elements of source, maturation, migration, structural timing and reservoir into a comprehensive exploration model that represents the petroleum system.

Current and future exploration and development opportunities in the Malay Basin can be more accurately analyzed by using this integrated petroleum systems approach.

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*Paper 2*

## **Causative mechanism of Tertiary basin development in northern Sunda Shelf region**

K.R. CHAKRABORTY

Department of Geology  
University of Malaya  
59100 Kuala Lumpur

Tertiary basins in the northern Sunda Shelf region including the oceanic South China Sea Basin appear to be related by a common genetic process, but the causative mechanism of their development remains a contentious issue. Recent accumulation of geological and geophysical data are equivocal and have led to conflicting interpretations.



A popular model that relates the origin of the basins to the sinistral strike-slip motion effected by a collision of India with Asia (extrusion tectonics) is untenable. Apart from the inherent weakness of the extrusion hypothesis itself, the strike-slip model fails to explain a variety of critical geological observations including (i) the timing of basin initiation, (ii) the orientation and triple junction distribution pattern of the basins, (iii) the temporal and spatial aspects of igneous activities, (iv) the direction of stretching incompatible with the sense of strike-slip motion, (v) the very wide area over which the basins developed, and (vi) the development of basins away from known strike-slip structures. The strike-slip motions, however, might have played modifying roles in some individual basins.

The above features as well as the available heat flow data and subsidence histories of some basins suggest a hot spot-related taphrogenic model that involves episodic uplift and rifting. Two distinct phases of basin development are discernible that are evidently linked to two thermal events (Cretaceous and late Tertiary) that are manifested by significant igneous activities. The relationships between igneous activities, uplift, rifting and subsidence histories are, however, subtle and complex, and do not readily fit into the standard characteristics of active or passive rifting models.

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*Paper 3*

## **AVO behavior on seismic data from offshore Borneo**

**E.R. TELATOVICH, K.B. LIM, M.J. ZAINUDDIN, J.C.S. TING, G.V.K. PANG AND  
B.H. CHIEM**

Sarawak Shell Berhad  
Lutong

The use of AVO diagnostics has become a routine part of the exploration program within SSB/SSPC. As in other parts of the world, recognition of its potential use as risk reduction tool within this geographic region has led to AVO's growing role as a viable hydrocarbon detection tool. Any fully-integrated interpretation project in today's difficult economic and technical climate requires the judicious use of all available diagnostic tools, including AVO.

Calibrated by verified AVO responses over known oil and gas fields, confidence in extending the technique to untested areas grows with an ever increasing understanding of both the capabilities and limitations of its usage. AVO modeling and Gassmann substitution have provided a framework for understanding what is observed and what can or cannot be observed on seismic. Differences in rock properties, for both reservoir and sealing lithologies, manifest themselves in different ways. AVO expressions are observed to change as a function of location within the basin and along a horizon.

AVO modeling early in the seismic acquisition and processing design phase can save valuable time and money if the appropriateness of AVO diagnostic generation is assessed and planned for. Value can be added to the interpretation through the use of AVO attribute sections. Additionally, troublesome seismic to well tie discrepancies can be reconciled by using full-offset synthetics. A wealth of vendor and proprietary software products enables easy and timely analysis of both 2D and 3D data.

For optimal use of AVO diagnostics, special attention must be given to ensuring that the seismic acquisition and processing retain "true relative" amplitudes, particularly when working with older seismic data. Multiple rejection is a key processing step and must be used with caution.

## Overview of pre-Tertiary hydrocarbon potential, onshore and offshore Peninsular Malaysia

SAHALAN ABD AZIZ<sup>1</sup>, H.D. TJIA<sup>2</sup>, ABD RAHMAN EUSOFF<sup>1</sup>, JAMAAL HOESNI<sup>2</sup>, MOHD IDRUS ISMAIL<sup>1</sup> AND LIEW KIT KONG<sup>2</sup>

<sup>1</sup>Exploration Management Department  
PETRONAS

<sup>2</sup>PETRONAS Research & Scientific Services Sdn. Bhd.  
Lot 1026 PKNS Industrial Estate  
54200 Ulu Klang, Selangor

Conventionally, the Tertiary basins around Peninsular Malaysia are viewed as hydrocarbon prospective and the pre-Tertiary is generalised as metasediments that were regionally metamorphosed and intruded by granites and therefore unprospective. This view is held primarily because of major igneous intrusions in the Permian and late Triassic and some in the Jurassic-Cretaceous which even though limited have been used to explain the non-prospectivity of the Late Mesozoic in the offshore region.

Our field investigations show that the Triassic and Jurassic/Cretaceous are not metasediments and for this, we have developed tectonic models to account for the possibility of hydrocarbon potential in the Triassic and Jura/Cretaceous plays. Geological and tectonic models were developed in conjunction with analyses and modelling of gravity and magnetic data, interpretation of Landsat imageries and offshore seismic data in addition to field investigations. The basement consists essentially of the regionally metamorphosed Palaeozoic sequences which have been intruded and multi-deformed.

The Triassic (Semantan and Gemas Formation) are slope and deepwater sandstones and shales, with major tuffaceous components deposited in possible extensional basins. These beds have been zonally folded and are structurally complex due to both tectonism and early or late slumping phases within an overall compressive regime in the region, associated with widespread, late igneous intrusion in the Western Belt.

The Jurassic-Cretaceous continental sequences of conglomerates, cross-bedded and often conglomeratic sandstones interbedded with, sometimes coaly, shales were deposited in braided streams, fluvial channels, and distributary channels leading into lake/restricted marine setting. These sequences were mildly to moderately affected by wrenching.

Several structural terrains are recognised in the offshore Johor Platform by combined means of seismic and aeromagnetic data. Terrain 1 is an area of mainly gentle folding, extensional faults and rollovers and is considered as probable Triassic (and/or Jurassic-Cretaceous) marine to shallow marine deposits of the East Malaya Block, a continental block east of the Central Belt. Terrain 2 is a complex structural zone affected by the extension of the NW-SE wrenching of the KL-Endau Fault Zone. Terrain 3 is underlain by shallow Tertiary grabens, whilst Terrain 4 has similar magnetic signature that could be suggestive of small, Mesozoic basin. Focus of the study on the pre-Tertiary prospectivity are on the Terrain 1 and look-alikes in offshore Peninsular Malaysia. It is also believed that hard seismic reflections at pre-Tertiary top is weathering effect, as opposed to top surface of metasediments, based on field observation of extensive weathering in tropical climate.

Poroperm studies, petrography, geochemistry and biostratigraphy analyses are currently being conducted.

*Paper 5***Improving depth prediction accuracy of quantified drilling hazards**

W.H. BORLAND AND W.S. LEANEY

Schlumberger

Under-compacted shales are often associated with over-pressured formations. These shales have excess water and tend to be mechanically weak, thus the safe mud window for drilling the under-compacted interval can be quite narrow. Efficient and safe drilling operations require accurate depth predictions of these over-pressured formations as well a knowledge of the magnitude of the over-pressure. In this paper we describe a technique which combines the best aspects of conventional Vertical Seismic Profile (VSP) and Reverse Vertical Seismic Profiles (RVSP) to detect under-compacted shales and predict formation pressures to locate drilling hazards below TD.

The excess water in the under-compacted shales will have a lower acoustic impedance than expected from the compaction trend. Shales that depart from the compaction trend may indicate potential drilling hazards below. Conventional VSPs provide at discrete intervals in the well, high quality reflection data which can be used to accurately predict acoustic impedance below the bit. This acoustic impedance is then interpreted to provide both the location (in time and depth) of the drilling hazard and the mud weight necessary to contain it. The two way time estimate of the hazard location is usually quite accurate but the depth estimate is less certain due to the estimation of formation velocities below TD. The RVSP using the drill bit as a source, provides a continuous time versus depth relationship while drilling. This time versus depth is used to continually update the conventional VSP depth prediction of the drilling hazard and thus provide the most accurate depth of the hazard prior to its penetration.

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*Paper 6***Developing consistent and reasonable kerogen kinetics using rock-eval-type pyrolysis**

DOUGLAS W. WAPLES AND MAHADIR RAMLY

PETRONAS Carigali Sdn. Bhd.  
Wisma Peladang, Jalan Bukit Bintang  
P.O. Box 12407  
50776 Kuala Lumpur

Although determination of kinetic parameters for individual source-rock samples is currently very popular, the accepted mathematical method of deconvolving raw pyrolysis data in order to obtain activation-energy distributions and frequency factors, will often yield results which are not chemically or physically reasonable. The inadequacy of such kinetic parameters is demonstrated here, using a data set consisting of a number of samples of the same kerogen type, but at different levels of maturity. Use of these incorrect kinetic parameters in modeling studies, can lead to disastrous errors in predictions of hydrocarbon generation under subsurface conditions.

We also briefly outline general aspects of an alternative new method of determining kinetic parameters from raw pyrolysis data. This method is based much on the laws of thermodynamics and on empirical data about chemical reactions, rather than on mathematical curve fitting.

Kinetic parameters derived using our method are more internally consistent, both for samples at the same maturity level, and for samples at different maturity levels. They are also more consistent with the kinetics of vitrinite reflectance. When applied in modelling studies under geologic conditions, they will give much more realistic answers than kinetic parameters determined by the standard mathematical method.

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*Paper 7*

## **The Cusiana Field in Colombia**

NICK DE'ATH

Triton Energy Corporation

*In geology the present is the key to the past — but the discovery history of the Cusiana Field is the key to future, 'frontier', exploration.*

The Cusiana Field in Colombia is the largest discovery in the Western Hemisphere in the past 20 years and the largest in the 80 year old history of the Colombian oil industry. The area attracted exploration attention in the 60's and 70's and the Cusiana and Cupiagua accumulations were actually penetrated — so why were they not discovered? When Triton acquired the acreage in 1982, potential farminees were not attracted by the Cusiana feature and 2 farmin wells were drilled on different play types in the Licence. In the late 80's, on two separate occasions, over 120 companies declined the opportunity to drill a Cusiana farmin well; on the 2nd occasion, even after the Cusiana 1 discovery well had been drilled.

The critical technological and commercial factors influencing the discovery history will be presented, as will perceptions on the political/economic climate and exploration prospectivity. A summary of the petroleum geology will be described and development activities will be brought up-to-date.

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*Paper 8*

## **The Sarawak and Sabah Orogenies**

CHARLES S. HUTCHISON

c/o Geological Society of Malaysia  
Department of Geology, University of Malaya  
59100 Kuala Lumpur

The Danau Sea, in which the Cretaceous through Upper Eocene turbiditic Rajang and Embaluh groups of Sarawak and northern Kalimantan and the generally shallower marine Selangkai Formation of north-central Kalimantan were deposited, was eliminated in Late Eocene time by the Sarawak Orogeny. The Rajang Group is predominantly composed of the Belaga Formation of the Sibu Zone but also forms extensive inliers within the Miri Zone known as the Kelalan and Mulu formations. The Rajang Group extends into Sabah as the Sapulut, Trusmadi and East Crocker formations. The Orogeny resulted in welding of the Schwaner Mountains of central Kalimantan onto the Nansha Block of the present South China Sea via the Luconia, Miri and Sibu zones. Igneous events, such as the Arip Volcanics, were associated with the orogeny. The South China Sea did not yet exist in Late Eocene time, so that the Sarawak Orogen was an integral part of the greater Sundaland landmass, which extended southwards to Java and eastwards to western Sulawesi, where its continuity was interrupted by the Eocene Celebes Sea marginal basin.

The Sarawak Orogeny is dated Upper Eocene by a spectacular unconformity between continental or shallow marine flat-lying strata and underlying steeply dipping Rajang Group turbidites, seen on the Tatau Horst, at Batu Gading and along the Lupar Line, where the base of the predominantly continental Ketungau Basin is now in fault contact with the pre-unconformity Rajang Group.

The Oligocene through Lower Miocene turbiditic West Crocker and Temburong formations were provenanced from the south from the eroding Rajang Group landmass of the Sarawak Orogen. The sedimentation pattern remains to be worked out but must include the contemporaneous sand dominated Meligan Formation of east Brunei, deposited in a delta plain and braided river environment, and the plant-rich Kelabit Formation of east Sarawak. The deep basin in which the West Crocker and Temburong formation turbidites were deposited must be related to the South China Sea marginal basin, which was spreading at exactly the same time. The West Crocker and Temburong formations were deformed and uplifted to form the Crocker Ranges in the Middle to Upper Miocene, dated by the Deep Regional to Shallow Regional unconformities of the coastal and offshore region of Sabah. This Sabah Orogeny was associated with igneous events at Mount Kinabalu and farther south at Long Laai in Kalimantan. The effects of the Sabah Orogeny are widespread, especially as far west as the southern Malay Basin and the West Natuna region. In the Pearl River basins, the tectonic event is known as Dongsha Movement. The Sabah Orogeny inversions created new mountainous landmasses which were rapidly cannibalized to give deltas such as the Baram, the fluvial system being directed into extant depocentres closely ahead of the tectonic fronts.

*Paper 9*

## AVO analysis of a 2D seismic line in the Malay Basin

DASHUKI MOHD AND IDRUS MOHD SHUHUD

PETRONAS Research & Scientific Services Sdn. Bhd.

Lot 1026 PKNS Industrial Estate

54200 Ulu Klang

Selangor

A regional 2D seismic line from the Malay Basin was processed and analysed to identify possible hydrocarbon accumulation in deep prospects within the Group L and M using Amplitude Variation with Offset (AVO) analysis.

The data analyses were carried out in two stages:

- Relative amplitude processing of seismic data to preserve amplitude information and remove noise, and
- AVO analysis to predict the presence of hydrocarbon.

Relative amplitude processing involved 2:1 trace decimation, t-squared scaling for geometric spreading correction, spiking deconvolution, velocity analyses at every 1 km interval, Radon velocity filtering and NMO correction. The NMO corrected CMP gathers were used for AVO analysis.

The AVO analysis was carried out in three parts:

- AVO reconnaissance using different type of techniques such as instantaneous amplitude plots, gradient stack and range limited stacks,
- AVO analysis within the known K-sand gas reservoir at well, and
- AVO analysis beyond the well interval.

The results show that an AVO response can be observed from prestack data within the K-sand and is due to the presence of gas. These results were used to validate other AVO anomalies identified from the same dataset. The study suggests that AVO techniques can be used to identify possible hydrocarbon accumulations in the Malay Basin, however the extent of the accumulation cannot be determined based only on a single line. It is recommended that further analyses be carried out on a number of lines from the same area.

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*Paper 10*

## **Seismic modelling in the Khuff Field, Sirte Basin, Libya**

ABDURRAZAGH AHMED EZZEDDIN AND ABD RAHIM SAMSUDIN

Jabatan Geologi  
Fakulti Sains Fisis dan Sains Gunaan  
Universiti Kebangsaan Malaysia

The applicability of seismic modelling for a re-evaluation of geological interpretation has been investigated on Khuff Field, Sirte Basin, Libya. The Khuff-Field is located in the Kotla graben which is adjacent to the Dahra and Beda Platforms and the Zella and Marada Troughs. These features developed in response to pre-Late Cretaceous rifting and controlled the sedimentary depositional patterns during the Late Cretaceous and Early Tertiary. A seismic modelling software was used to build a geological model and to validate the geological interpretation. The validation was done by simulating propagation of seismic energy through the model to generate and test seismic model over the internal structure of a thick carbonate deposits of the Upper Cretaceous (Maastrichian) to Eocene sediments, in order to understand the distribution of the facies and their relationship to structural features in the area. The resulting synthetic records were processed and stacked. Comparison between the synthetic and the real section was encouraging. This demonstrated that the use of a seismic modelling technique is applicable to the Khuff Field.

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*Paper 11*

## **Relationship of structural timing and hydrocarbon migration in the Malay Basin**

MOHD TAHIR ISMAIL  
ESSO Production Malaysia Inc.

One of the key elements controlling hydrocarbon migration and distribution in the Malay Basin is structural timing. When integrated with timing of oil and gas generation, structural timing will determine whether a particular trap contains oil and gas or gas only.

The compressional structural analysis of the discovered fields in the basin shows that the primary structural events occur at different times throughout the basin. Structuring began in the eastern part of the basin and became progressively younger to the west.

The onset of hydrocarbon generation and migration is temperature dependant and varies across the basin. Integrating the relationship of structural timing and complexity with the onset of hydrocarbon generation explains the current distribution of oil and gas fields. Oil fields are largely in the southeast portion of the basin where structuring is earlier than the onset of

oil maturation. In the northeast portion of the basin structuring occurred when the primary source rocks were in the gas generative window.

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*Paper 12*

## **Seismic sequence stratigraphic interpretation enhances remaining hydrocarbon potential of the SE Collins Field**

ROBERT WONG HIN FATT

PETRONAS, Exploration Management Department

The SE Collins Field is a marginal oil field that was discovered in 1972. It is located within the complexly faulted central portion of the Inboard Belt of the NW Sabah Basin. The field is an elongated, 8 km by 1.5 km, N-S anticlinal structure supported by reverse faults on the north, west and south. The north and central culminations have been tested to be hydrocarbon bearing. The main reservoirs are the Middle Miocene lower Stage IVA sands.

High quality, close grid seismic data were acquired over the field in 1989. This has enabled seismic sequence stratigraphic interpretation to be carried out. The study has resulted in the identification of two third-order sequences within the Stage IVA. The lower sequence consists of two systems tract — transgressive and highstand. The upper sequence comprises another two systems tract — lowstand and transgressive.

This work has led to a better understanding of the stratal patterns within the two sequences and hence, the distribution of the reservoirs and seals. The main reservoirs and seals have been correlated and mapped and the reserves estimated. The proven reserve was assessed to be more than twice the amount that was initially predicted. The untested southern culmination is perceived to contain hydrocarbons reservoired in mainly coastal to shallow sands of the upper sequence of the Stage IVA.

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*Keynote Paper 2*

## **Geoscience technology trends and challenges**

JOHN A. WILLOT

Exxon Production Research Co.  
P.O. Box 2189  
Houston, Texas 77001, U.S.A.

Uncertainty in future oil prices underscores the need to develop technology that will improve our ability to reduce technical uncertainty in our investment decisions, to profitably add reserves, to lower all costs and to create new opportunities. Exxon's view is that cost-effective new technology is not just important, but critical to future upstream success.

Geoscience technology is developing rapidly and is leading to improved understanding of fundamental geologic processes. Advances in computing technology enhance visualization and solutions to three dimensional problems. New tools now accurately combine vast volumes of information to improve our understanding of the subsurface. Exxon understands the importance of new technology to the upstream business and is committed to provide value-added research. Through implementation of focused business strategies, including development and application

of technology, we have improved our upstream performance in exploration and development over the last ten years.

Since the current price environment provides little tolerance for mistakes, we need the best possible definition of the hydrocarbon resources before committing to exploration or development. Furthermore, we must do this at the lowest possible cost, and in a safe and environmentally acceptable way. New geoscience technology is improving the quality of seismic data and attribute analysis while reducing acquisition costs. Improved tools for reconstructing basin histories, predicting hydrocarbon generation, migration and trapping of oil and gas have improved wildcat success. New fundamental understanding of reservoir depositional environments, facies relationships and quality has had a significant impact on finding, developing and efficiently producing hydrocarbon resources around the world.

Keys to future success will include improved understanding of geologic processes at a fundamental level with high-resolution tools. Successful technology transfer often requires people movement between research and operating affiliates. New technology development must add near-term value and address specific needs of operating units. However, appropriate balance must be maintained between short and longer term breakthroughs. Geoscience technology is advancing very rapidly, but with customer-focused technology development, and close cooperation between research and operating affiliates, new technology can positively impact earnings and profits.

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*Paper 13*

## **Integrated sequence stratigraphic interpretation of the SB-1 Block, offshore Sabah**

**PATRICK ALLMAN-WARD<sup>1</sup>, MOHAMED YAZID MANSOR<sup>2</sup>  
AND JEFF LOBAO<sup>3</sup>**

<sup>1</sup>SSB/SSPC, now SPDC

<sup>2</sup>PETRONAS

<sup>3</sup>SSB/SSPC

The Tertiary stratigraphy of NW Borneo has been subdivided into Stages, based upon the occurrence of regional unconformities or disconformities in the Inboard Area. Sparse well control has limited the application of biostratigraphy in constraining the seismic picks of the conformable equivalents of the Stage boundaries further offshore. In order to achieve a consistent stratigraphic framework linking the Inboard with the Outboard Area, an integrated mapping project was carried out.

The seismostratigraphical analysis of key regional dip- and strike lines, calibrated by well data, has allowed the mapping of chronostratigraphically equivalent horizons from the shelf into the deepwater. The interpretation of sequence boundaries (and maximum flooding surfaces) from seismic data has resulted in a much higher degree of resolution than conventional biostratigraphy in this area offshore Sabah. The regional correlation of the sequence boundaries, which has tied in all the available biostratigraphic data, has enabled chronostratigraphically consistent horizons to be mapped across the SB-1 Block with reasonable confidence. The mapping of the sequence boundaries enables a direct correlation to be made between the observed turbidites and the shelf edge processes leading to their formation. Age dating of the



sequence boundaries permits correlation with the published eustatic sea-level curves. This indicates that in Sabah, relative sea-level was predominantly tectonically controlled. However, phases of important turbidite development also correspond to periods of major eustatic sea-level fall.

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*Paper 14*

**A high resolution aeromagnetic survey to image low angle transfer faults within the JDA area of the northern Malay Basin**

CLIVE A. FOSS

Encom Tech  
Australia

CTOC flew a high resolution aeromagnetic survey in the (correct) anticipation of problems in resolving low angle transfer faults from the seismic data. These faults connect the main north-south trending normal faults and are of prime importance in delineating prospects.

The survey of 40 x 40 km was flown along north-south flight lines with a spacing of 400 metres and at an elevation of 120 metres. An enhancement processing undertaken to reduce some artefacts passed by the conventional processing succeeded in resolving coherent features within a 2,500 metre residual separation with a total amplitude range across the map of only 0.3 nT.

The map shows a fabric of linear anomalies with predominantly WNW-ESE trend, wavelengths of 1 to 2.5 km, lengths of 2 to 7 km, and peak to trough amplitudes of 0.05 to 0.2 nT. A possible but unproven explanation for these anomalies is that they are due to biogenic magnetite created where gas has leaked from faults into near-surface sediments. There are indications of shallow gas on the seismic sections, but there is not a one-to-one correlation between the seismic indicators and the magnetic anomalies. Modelling of two of the sharpest magnetic anomalies locates source bodies within the top 400 metres of section. A steady state model can be invoked to explain the range of anomalies as due to source bodies which are created near-surface and then are buried and subjected to diagenetic changes.

Faults interpreted from the map can be sorted into four groups, several of which have a quasi-regular spacing. The more prominent fault directions are a possibly conjugate set of northeast and northwest trends. When these faults are plotted together with the faults derived from the seismic mapping several interesting relationships are observed. There are in particular many examples of 'seismic' faults terminating against 'magnetic' faults. The wide range in direction of the faults imaged by the aeromagnetic survey, and the control which some of them have apparently exercised on the development of the major normal faults suggests that they may be basement related. The magnetic expression by which these faults have been mapped is however high within the sedimentary section, suggesting that there has been reactivation of basement faulting possibly through to quite recent times. The combined aeromagnetic and seismic fault pattern map gives the most complete image of the structure of the study area and justifies the integration of the aeromagnetic survey within the exploration program.

## The effect of clay and gas on the elastic properties of sandstones

MARK SAMS<sup>1</sup> AND MARTIJN ANDREA<sup>2</sup>

<sup>1</sup>PETRONAS Research & Scientific Services Sdn. Bhd.  
Lot 1026 PKNS Industrial Estate  
54200 Ulu Klang  
Selangor

<sup>2</sup>Imperial College  
London University

Compressional and shear velocities of rocks can now be measured routinely by borehole logging. The additional information provided by the shear data can help to identify lithology and pore fluid type. In order to interpret this data quantitatively and to predict the effects of changes in reservoir properties on AVO, numerical models are required. Because sandstone reservoirs are invariably heterogeneous in terms of clay abundance, porosity and water saturation it is necessary to examine the effects of these variations on the elastic properties of sandstones. Four schemes are designed to represent four styles of clay; structural, interstitial, laminar and dispersed clay. Various modelling techniques such as the self consistent method, Kurster-Toksoz, differential effective medium modelling, Backus averaging and Voigt-Reuss-Hill averaging are employed within these schemes. Water saturation is modelled with the Biot-Gassman equations. The models indicate that the style of clay plays an important role in determining the elastic properties of sandstones. They also show that clay has different effects depending on the water saturation.

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*Paper 16*

## Petroleum systems of Southeast Asia

RICHARD W. MURPHY

34 Bridge St.  
Walton-on-Thames  
Surrey KT12 1AJ

Sunda, the Southeast Asia pre-Tertiary core, comprises a collage of lenticular continental fragments, magmatic arcs, oceanic assemblages and mélanges which originated in eastern Gondwana and have migrated northward to accrete at the southern margin of Eurasia. The principal collision was Late Triassic (Carnian/Norian) in age. Other internal and peripheral collision/ accretion events have occurred in Triassic, Cretaceous and Tertiary times.

Post-consolidation Sunda contained a large Mesozoic megabasin, largely continental with compressive marine margins on the west, south and east. At the close of Cretaceous time Sunda stood above sea-level.

Tertiary basins of Sunda are small rift/sag basins formed during extrusion phases following INDA/EURA collision. The main times of basin formation were Late Eocene (Sumatra and West Java basins) and Mid Oligocene (Sunda rift basins), although Paleocene rifting had already splintered the margins of the former Cretaceous landmass.

There are two main petroleum systems with a number of variation on the central themes:

1. Rift/sag basins with source rocks in lacustrine Oligocene shales near the top of the rift

cycle and reservoirs dominantly in the overlying sag cycles, either coastal plain sandstones or grain limestones and reefs. Regional seals are provided by blanket shales of the Neogene wedge middle. Gentle folding may be present at the top of the Paleogene half-cycle (Sumatra). Inversion takes place from Middle Miocene to Pliocene, which is also the dominant time of maturation and migration. Geothermal gradients are high.

2. Delta sag basins flank the uplifted compressional arc-collision terrane of central Borneo. Upper Miocene-Pliocene quartz-rich reservoirs, in both coastal plain and turbidite facies, owe their excellent poroperm qualities to their provenance in quartz-rich Crocker type flysch sandstones of the collision zone. Source rocks are shales and coaly shales interbedded with the reservoirs. Reefs are only productive in special circumstances; i.e., when overlying a source rift basin. Seals are local transgressive shales. Heat flow is moderate to cold. The delta sags developed over both accretionary prisms (Northwest Borneo) and rift margins (Kutei Basin).

Microcontinents in collision with the Borneo-Palawan trend are largely gas-prone. With source rocks either rift basins within the microcontinent (Palawan) or lying between it and the Borneo core (Luconia). Reservoirs are mainly carbonates.

Hydrocarbons in eastern Southeast Asia are less well developed than in Sunda. Rift-sag basin-forming cycles are followed by drift and collision events, with the main source rocks in sag/drift shales and main reservoirs in upper drift elements and post-collision molasse.

#### *Paper 17*

## **The integrated approach to reservoir evaluation — myths and realities**

ELIO POGGIAGLIOLMI

Entec

There is general consensus among oil and service companies, that total integration of all available data, by a multi-disciplinary team is a more cost effective and productive method of reservoir evaluation than the conventional isolated piecemeal approach. To this end, multi-disciplinary teams formed to work on specific fields are a common occurrence. These teams are composed of individuals that not only belong to different disciplines but also to different cultures.

“Brain storming” sessions are often considered the most effective means to promote communication, by breaking down culture barriers and encouraging interdisciplinary cross-fertilization. Unfortunately, brain storming can be at best a palliative because most of the effort by the team members is dedicated to carrying out tasks related to their specific area of expertise. For example, the geophysicist deals with the various aspects of seismic data, the log analyst with borehole data etc. These tasks are normally carried out independently and with a minimum of communication and interaction among the team members. Often the segregation of tasks is attributed to the lack of integrated software and insufficient knowledge of disciplines outside the individuals area of expertise. A typical example, resulting from this segregation of tasks is the use of 3D seismic surveys. Normally, these are used to obtain accurate geometric definition of the reservoir — a task with which the geophysicist feels very much at home! However, the full potential of 3D to obtain a quantitative knowledge of the porosity, fluids and lithological distribution is very much neglected, since this will involve not only seismic, but also the contribution from log analysts, petrophysicists, geologists and engineers. Such contribution

must not be a collection of piecemeal results by team members, e.g. structure maps, geological models, formation evaluation results etc. For integration to be meaningful, it must start from raw measurements with each member of the team working together throughout all stages of the data processing. Total interaction and feedback must take place through integrated software and effective human communication. The work areas must be shared among the team members without any physical barriers. This encourages human communication and exchange of ideas. Unless this approach is adopted, the available data is under-utilized, thereby reducing the cost effectiveness and productivity.

Another obstacle on the path to integration is budgetary segregation. Budgets are assigned to carry out individual tasks within exploration, development or production. Very seldom are integrated budgets available to carry out simultaneously a multitude of tasks. This is one of the main reasons why there is lack of motivation on the part of the service industry, to invest resources for a more integrated approach.

For the integration to be useful and cost effective, it must meet the following criteria:

- assign field specific integrated budgets.
- multi-disciplinary training of team members.
- provide software designed "to force" each user to utilize data and results from other users.
- start integration from raw measurements.
- provide common work areas for the team.

In conclusion, total integration when properly carried out can bring the following benefits:

- full and efficient use of available information.
- more accurate and reliable results.
- cost effectiveness and added value.
- effective use of all available resources.
- systematic solution to the problem in hand.
- possibility of solving otherwise intractable and/or non-unique problems.
- better bottom line budget control.

Case history examples will be given, to illustrate the results obtained, by adopting a fully integrated approach to reservoir evaluation.

*Paper 18*

## **SEAS-95, the First Commercial International Seismic Programme in the South China Sea**

ERIK HAUGANE

Nopec  
Singapore

PGS Nopec's extensive experience in the North Sea, where the realisation that regional geophysical data along with the integration of existing data from neighbouring countries has led to the development of successful geological models, has drawn us to conclude that the South China Sea is a prime area for the such a programme. In this light, PGS Nopec has generated a project and procured the authorisation from several national authorities to acquire a multi-national regional seismic grid in the southeastern part of the South China Sea. The driving philosophy is that seismic coverage unconstrained by PSC boundaries or national borders will enable the oil industry to compare different sedimentary basins and to build a consistent structural model, incorporating all existing knowledge. The resulting project has been named

the "South East Asia Supertie", or "SEAS" for short.

This new concept, the first in the region's history, involved the dynamic contribution of farsighted representatives within the State oil companies and directorates. It has been an honour for PGS Nopec to work with such personnel. In particular, the efforts of PETRONAS have been instrumental in changing the attitudes necessary to procure the seismic work permits. These, in turn, have ploughed new ground in Peninsular and Eastern Malaysia.

The SEAS-95 project has been supported, professionally as well as financially, by the oil industry. The Norwegian state oil company, STATOIL has sponsored the programme thus enabling PGS Nopec to deploy the necessary resources required to pull the programme together. Ultimately, the project is financed via license sales where the purchaser obtains the right to use the data.

After three years of extensive planning and negotiations, a final grid of 8,500 km stretching across Malaysian, Vietnamese and Indonesian waters was acquired in the summer of 1995. The longest seismic profile is close to 700 km in length. The result is that explorationists are now able to construct profiles between any and all the major sedimentary basins in the southern South China Sea. Seismic data profiles have been recorded for 8, 10 and 14 seconds of two-way time. This unique dataset has revealed features which, to date, have been unidentified due to the limitations of conventionally designed seismic programmes. Through the integration of a consistent dataset, the petroleum plays in the Malay, Penyu and Sarawak Basins can now be directly compared to the West Natuna, Nam Con Son and Cuu Long Basins.

#### *Paper 19*

### **Aspects of oil generation from coals: A Sarawak case study. The importance of exsudatinitite and variations in organic facies characteristics**

WAN HASIAH ABDULLAH<sup>1</sup>, MOHAMAD JAMAAL HOESNI<sup>2</sup>  
AND PETER ABOLINS<sup>2</sup>

<sup>1</sup>Department of Geology  
University of Malaya

<sup>2</sup>PETRONAS Research & Scientific Services Sdn. Bhd.  
Lot 1026 PKNS Industrial Estate  
54200 Ulu Klang  
Selangor

Coals from the onshore Tertiary Nyalau Formation, Bintulu area, and from offshore Balingian Province were sampled and subsequently subjected to detailed organic petrological and organic geochemical study. Thus study discusses the following aspects:

- 1) petrographic evidence of early hydrocarbon generation from exsudatinitite,
- 2) probable precursors to the exsudatinitite,
- 3) biomarker distributions of the coal extracts, and
- 4) oil to source correlations.

Petrographically the onshore coals can be subdivided into two groups: one group of coals contains higher abundances of exsudatinitite whereas the other group of coals contains only trace amounts of exsudatinitite. Gas chromatograms (GC) of the saturated hydrocarbon fractions of all the coals display a bimodal n-alkane distribution, high pristane/phytane ratios, and a strong



## Schlumberger's New Fullbore Formation MicroImager Doubles Your Coverage With Core-Like Clarity

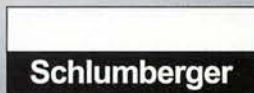
The FMI\* fullbore electrical imaging tool makes evaluation of complex reservoirs simpler and quicker than ever before. Its 192 microelectrical sensors give you twice the coverage of previous tools and improved spatial resolution, to 0.2 inches.

The fullbore images enable direct structural analysis and characterization of sedimentary bodies even in extremely complex sequences. The fine detail provided by FMI images allows determination of paleocurrents and rock anisotropy, including the recognition of permeability barriers and paths. And determination of net-to-gross ratio in thin bed sand/shale sequences is automatic.

Understanding the internal structure of the rock can confirm hypotheses regarding its geological evolution and can provide valuable clues to geologists and engineers regarding local porosity and permeability changes. This is possible with the enhanced textural analysis from the new high-resolution sensors, as well as detailed evaluation of fracture networks and other secondary porosity.

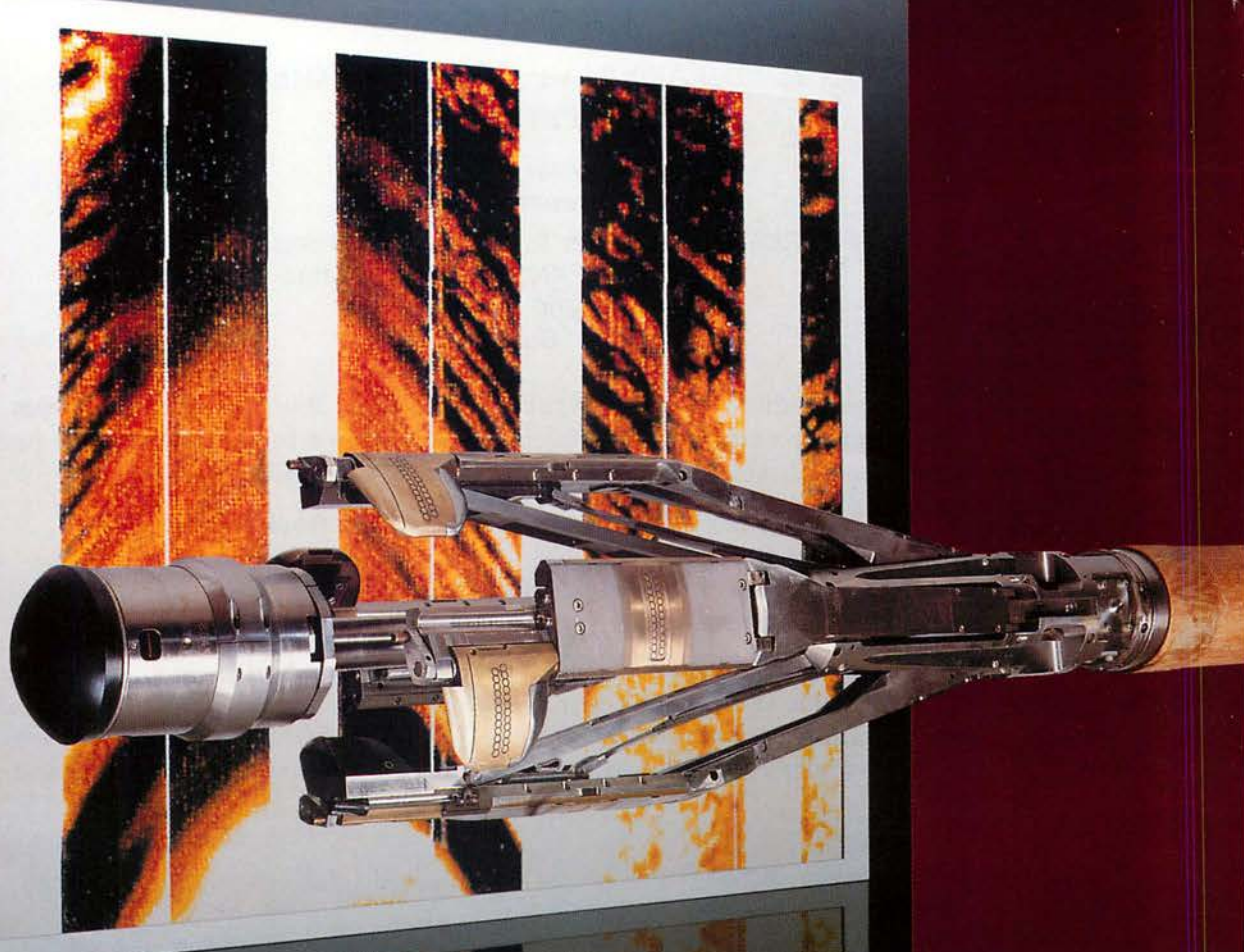
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odd to even predominance of normal alkanes in the n-C<sub>27</sub> to n-C<sub>33</sub> range. However, GCMS analysis shows that although all the samples contain abundant bicadinanes, 18 $\alpha$ -oleanane (and several other triterpane compounds) is abundant in only the exsudatinitite-rich coals.

The above observations were verified by studies of coal bearing sequences of the Balingian Province of offshore Sarawak. The onshore Nyalau Formation is considered to be stratigraphically equivalent to the Cycle I and Cycle II sequences of offshore Sarawak. This is supported by the organic facies characteristics recognised in this study.

The occurrence of particular maceral and biomarker assemblages is governed, in part, by organic matter source input. Factors other than source input, however, can also play a role. The two coal groups discussed above also correspond to two different maturity ranges: the exsudatinitite-rich coals being lower maturity (0.45% to 0.50% vitrinite reflectance) and the exsudatinitite-poor coals being of relatively higher maturity (approximately 0.75% vitrinite reflectance). Coals of different thermal maturity are known to exhibit different maceral assemblages; labile maceral types breaking down at particular maturity levels. The maceral exsudatinitite exhibits such behaviour. It is suggested here that at maturity levels of less than 0.60% Ro the presence of exsudatinitite is strongly controlled by the source input of organic matter. However, at maturity levels greater than 0.60% the effect of thermal maturity on exsudatinitite has to be considered. The relative roles of thermal maturity and source input (hence depositional environment) to the presence of exsudatinitite therefore require further study.

Two main oil types have been recognised in areas of offshore Sarawak. These two oil types correlate quite well, on the basis of biomarker assemblages, to the two coal types discussed above. This study suggests that the oleanane-rich oils in the Balingian Province are likely to be sourced from exsudatinitite-rich coals whereas the oleanane-poor oils are likely to be sourced from exsudatinitite-poor coals.

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*Paper 20*

## **Detecting leaking oilfields with ALF, the airborne laser fluorosensor: Case histories and latest developments**

ALAN WILLIAMS

World Geoscience (UK) Limited  
3 Walnut Tree Park  
Walnut Tree Close  
Guildford  
Surrey GU1 4TR, UK

The majority of the world's onshore oilfields leak small amounts of petroleum as surface seeps (Clarke and Cleverly, 1991). Seeps mark the ends of migration pathways and in unexplored basins, they provide vital clues in the hunt for the oilfields of the future. ALF, the Airborne Laser Fluorosensor, is an airborne geochemical tool capable of detecting very low concentrations of seeped petroleum at the ocean surface, equivalent to micro-seepage levels detected by conventional surface geochemical tools (gravity coring, etc.). The system has detected oil and condensate films as thin as 0.01  $\mu$ m (microns), an order of magnitude less than observed by the human eye or by passive satellite or airborne sensors as below 0.1  $\mu$ m, oil films are invisible. ALF also identifies the phase of the seeping petroleum i.e., light oil/condensate, normal or heavy oil.

ALF results from two contrasting deep-water basin settings and from one shallow-water basin are discussed, viz.



- the Gulf of Mexico Slope, a deep-water structured passive margin with high seepage rates.
- the Faeroe Basin, West of Shetlands, a deep-water unstructured passive margin with low seepage rates.
- the East Irish Sea basin, a shallow-water, uplifted rift basin with low seepage rates.

In each basin, ALF data were integrated with sub-surface data (principally seismic and high-resolution magnetics) to generate:

- a map of the limits of the play-fairways.
- a prediction of the phase of the trapped hydrocarbons.
- a reduction in play-fairway risk.

*Paper 21*

## **PROJECT EXPRESS (A fast-track 3D seismic program)**

HARUN MOHD NOOR

ESSO Production Malaysia Inc.

ESSO Production Malaysia Inc. (EPMI) acquired four 3D surveys totalling 35,000 full fold kms with an aggressive project turnaround time to meet the needs for an accelerated reserve analysis and development planning for gas fields in Malaysia. To meet these challenges, PROJECT EXPRESS was designed to complete acquisition, processing and loading the 3D data onto GEOQUEST workstations within 30 days after the last shot-point for each survey. The normal turnaround time for 3D data acquisition and processing in Malaysia is generally between 6–7 months. Extensive preparation and contingencies were laid out during pre-survey planning between EPMI, EEC and geophysical contractor (GECO). All anticipated risk areas in data acquisition, processing and data loading were addressed and back-up plans were in place, resulting in a successful operation.

*Paper 22*

## **Geology and play types of Malay Basin western margin**

JAMAL JAMIL, ABDUL RAHMAN EUSOFF, MUZAMAL ABDUL GHANI

PETRONAS, Exploration Management Department

Basin development in offshore areas east of Peninsular Malaysia by crustal extension began in Late Eocene due to a number of structural mechanisms triggered by the collision of Indian indenter against South Asia towards the west, that propagated extrusion tectonics of Indo-China (Tapponier *et al.*, 1982 and 1986) and clockwise rotation of SE Asia (Daly *et al.*, 1992).

West of the Malay archipelago included from north to south the Pattani Basin (and numerous Thai Cenozoic intermontane basins), Piong sub-basin, Malay Basin centre, Southeastern Malay Basin and Angsi-Duyong sub-basin and, further to the south is the Penyu sub-basin. These are characterised by dominantly N-S faulting in the north (over Patani Basin and various intermontane basins and Piong sub-basin), and provinces of early E-W trending grabens and overlying Middle to Late Miocene E-W trending compressional anticlines. There are various evidences to suggest the presence of deep seated reverse faults that provide suggestions of

crustal wrenching. The study area in the western flank of the Malay Basin has been divided into Northwestern Platform, Kelantan ramp, Terengganu ramp, and Tenggol Arch.

Based on interpretation of 1993 deep regional seismic lines, it is found that the asymmetry of the basin found across the basin centre is not present towards the north and this has implications on the migration of the hydrocarbon towards the western flank. The presence of seismic amplitudes and seismic packages suggesting sand development has supported the possibility of plumbing towards both side of the basin margin.

During Oligocene-Miocene times, the inter-play between sea-level changes and structural subsidence is an important element along the steep western hinge line. Across the hingeline, there are geometric packages akin to slopefans with prograding complexes (lowstand) and transgressive systems tracts, although the packages were deposited largely within continental setting with restricted marine influences. As a result of the so-called yo-yo tectonism, the Middle Miocene sequences occurring more along the western ramp areas were deposited within an overall transgressive system tract which possibly also contain several layers of lowstand wedges. Additionally, the overall transgressive Middle Miocene sequences is important in providing regional seal overlying stratigraphic pinchout plays.

While a number of oil fields have been discovered on the eastern flank in traps formed by N-S basement-controlled faults, graben controlling faults and stratigraphic plays, the western flank appear to be noticeably lacking in the N-S faults. Traps are however found as drapes over topography formed by lowstand stratigraphic sands close to the basin margin, drapes over horsts blocks close to half grabens and over older synrifts (Northwest Platform and Tenggol Arch respectively). Fault traps are related to older basement faulting (Kelantan ramp), or younger strike-slip inversions near the grabens. Sedimentary traps are related to stratigraphic pinchouts (Terengganu ramp) and lowstand wedges (Kelantan ramp). Deeper prospects are present across the basin hinge but are highly dependant on poroperm, organic maturity and high pressure.

*Paper 23*

**Investigation of DMO algorithms during test-line processing:  
some recommendations**

NG TONG SAN<sup>1</sup>, MOHD. HASHIM ABAS<sup>1</sup> AND LEONG LAP SAU<sup>2</sup>

<sup>1</sup>PETRONAS Carigali Sdn. Bhd.  
Wisma Peladang, Jalan Bukit Bintang  
P.O. Box 12407  
50776 Kuala Lumpur

<sup>2</sup>Geophysics Program, School of Physics  
Universiti Sains Malaysia  
11800 Penang

Seismic data processing utilizes a large suite of processes beside the skeletal needs of velocity analysis, forming a CMP stack, signal enhancement and image focusing to produce an interpretable seismic section. DMO has often been acclaimed as an industrial standard without which the stacked section would necessarily be "low tech". The purpose of this study is to isolate elements in the choice of DMO algorithms during test-line processing which might lead to a more efficient turn-over time. We summarise next in brief some practical aspects of the DMO algorithms encountered a couple of years ago in this region and to recommend a comparative procedure for quality control peculiar to our data sets.

The Dip Movement processor in seismic data processing, or partial migration before stack is an auxiliary data processing correction that attempts to improve the quality of a seismic stack in the presence of reflection point smearing and conflicting dips. Performed correctly, velocity analysis after DMO is supposedly independent of dips and thus would allow an easier decision in, and perhaps more "correct" velocity pick. DMO algorithms available sometime back in this region are essentially Fourier transform methods, usually with some logarithmic stretch formulation or Integral/Summation (Kirchhoff-style) methods with provisions for spatial aliasing and dip constraints. Fourier transform methods are efficient and best applied to seismic data that are uniformly sampled in space. Kirchhoff-style methods are implemented instead with one input and one output trace at a time and are well suited for irregular survey geometries, missing shots, wide swaths, large variations in source-receiver distances and azimuths, large cable feathering angles, etc.

We recommend during test-line evaluation to compare the velocity spectrum at a preselected CDP location without DMO from the same location with DMO. A "better" velocity pick should be evident in the latter. We recommend next to subtract (a) the stacked section and (b) migrated section without DMO from the same with DMO. Assuming all non-DMO processing are identical, the different sections should contain no horizontal reflections i.e. DMO should not in any way alter horizontal reflections. Diffraction hyperbolas will be better preserved with DMO in (a). Fault definitions are enhanced after migration with DMO in (b) because of this preservation. Lastly DMO should not be used solely for suppressing high velocity linear noise and lessening back scattered energy. Other filtering options are available.

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*Paper 24*

## **Using horizontal wells to develop the lower coastal plain channel sands in the Balingian Province, offshore Sarawak**

BONIFACE BAIT AND NORAZLAM NORBI

Sarawak Shell Berhad  
Lutong

Horizontal wells provide multiple challenges to optimise oil field development of lower coastal plain channel sand bodies in the Balingian Province, offshore Sarawak. This paper discusses the geological uncertainties in planning and executing the horizontal well development of two oil fields. The main uncertainties include seismic/structural mapping, fault sealing potential, sand distribution and fluid distribution. The discussion progresses from drainage planning to drilling results and highlights the impact of the uncertainties and how they were mitigated.

There are several objectives of applying horizontal wells in these channel sands. In one field, a dip-oriented horizontal well was used to salvage the development of a 45–70 feet thick oil column within isolated accumulations resulting from discontinuous channels occurring in several fault blocks. In the other field, with some 380 feet of oil column, horizontal wells were used to penetrate long sections of reservoir sands and to develop different fault blocks. The tail parts of these wells were used to appraise a stratigraphically younger reservoir unit.

The main producing reservoirs are of Early Miocene lower coastal plain sequences. These sands were deposited in fluvial channels, crevasse splays and mouthbars. Core data from both exploration, appraisal and development wells, including pilot holes, were extensively used to model the reservoir sand bodies in order to ascertain their orientation and depositional trends.

## **Tectonics of deformed and undeformed Jurassic-Cretaceous strata of Peninsular Malaysia**

H.D. TJIA

PETRONAS Research & Scientific Services Sdn. Bhd.  
Lot 1026 PKNS Industrial Estate  
54200 Ulu Klang  
Selangor

The Jurassic-Cretaceous (JK) strata in Peninsular Malaysia occur as folded sequences (Tembeling Group, Koh Formation, Bertangga Sandstone) but also as undeformed, slightly tilted strata (Gagau Group, Ulu Endau Formation, Panti Sandstone). In recent years, some workers have claimed that the middle-upper Triassic strata (Semantan Formation, Gemas Formation) exhibit structural styles similar to the folded JK strata. This led them to suggest that the upper Triassic-lower Jurassic Titiwangsa granitoid complex resulted from anorogenic emplacement, and that the latest major deformation in the peninsula was of Cretaceous-Tertiary age. This hypothesis does not explain: (1) the regional extent of late Triassic to early Jurassic granitoids throughout continental Southeast Asia and Sundaland; (2) the occurrence of deformed strata adjacent to some of the granitoid bodies; (3) sharply bounded, thin thermal aureoles consisting of cross-cutting contacts with country rock; (4) the absence of regional cleavage in the JK strata in contrast with its presence in the older Triassic rocks. A study of good quality, remotely-sensed images covering Peninsular Malaysia has resulted in the following conclusions: (a) the JK Koh, Tembeling and Bertangga Sandstone sequences were laid down in pull-apart depressions; (b) these depressions were developed through dextral slip motions on its major, bounding faults that trend north-south; (c) after the depressions were filled, dextral strike-slip motions continued in a transpressive regime which caused the sediment fill to be deformed into NNW-striking drag folds (These strike-slip movements persisted until middle Eocene as reset ages of cataclastics from major fault zones of the peninsula seemed to indicate); (d) the JK-strata (Gagau, Panti Sandstone) outside the influence of renewed fault movements remained essentially undisturbed; (e) the structural style of the JK-strata is favourable for the entrapment of hydrocarbons, if source material are present. This study further re-establishes the widely accepted concept that during late Triassic-early Jurassic time, Southeast Asia experienced strong tectonic deformation that was accompanied by the emplacement of the Titiwangsa and coeval granitoid complexes.

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## **Integrated technical approach and results of the Tiong-Kepong joint resources study**

**AJAIB SINGH<sup>1</sup>, SHAHARUDIN AZIZ<sup>2</sup>, EDWIN J. BOMER<sup>1</sup>**

<sup>1</sup>Esso Production Malaysia Inc.

<sup>2</sup>PETRONAS Carigali Sdn. Bhd.  
Wisma Peladang, Jalan Bukit Bintang  
P.O. Box 12407  
50776 Kuala Lumpur

The Joint Resource Study (JRS), a combined effort by Petronas, Petronas Carigali, and Esso Production Malaysia Inc., was initiated in 1993 to create a multidisciplinary team approach to determining remaining potential and optimal reservoir depletion plans for twelve oil fields in the Malay Basin. Integrated technical teams comprising of professionals from the three companies systematically upgraded the technical understanding of each major reservoir in the twelve fields with application of the latest geoscience technology.

Tiong and Kepong field, located in the south-eastern part of the Malay Basin approximately 260 km east of Kerteh, were studied by a JRS multidisciplinary team to assess the potential of undrained hydrocarbons, and reservoir engineering data to delineate prospective reserves in a stratigraphic trap in the marginal marine J-18/19 reservoirs. A seismic amplitude anomaly in the saddle between Tiong and Kepong field highlighted the need for an integrated study. Detailed interpretation of recently acquired and existing 2D seismic data established an area of strong amplitude response and allowed reservoir thickness prediction based on isochronal mapping. Seismic modelling supported a correlation of strong seismic amplitude with thick, high-quality hydrocarbon filled sand. A strong Amplitude vs. Offset (AVO) seismic response was also seen in the target interval. Core data was integrated with well log expression to help build a detailed geologic facies model in the context of the regional sequence stratigraphic framework. A through understanding of the distribution and sealing nature of interbedded shales within the J-series was also required to ensure the production from existing wells in Tiong field which is from the underlying J-20/21 reservoir unit, which was initiated in 1983, had not drained the prospective area. An upcoming well will test the integrated model that the JRS team has created and confirm the viability of a proposed development program.

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**PETROLEUM GEOLOGY CONFERENCE 1995**  
**Abstracts of Posters**

*Poster 1*

**A deep seismic section across the Malay Basin: Processing of data and tectonic interpretation**

ABD RAHIM MD. ARSHAD, DASHUKI MOHD AND H.D. TJIA

PETRONAS Research & Scientific Services Sdn. Bhd.  
Lot 1026 PKNS Industrial Estate  
54200 Ulu Klang, Selangor

A regional 2D seismic line across the Malay Basin was processed and analysed to improve the deep structural image of the subsurface. The line is about 185 km long, trending from SW to NE and was recorded down to 12 seconds. A total of 480 receivers with 12.5 m receiver spacing were used in the survey resulting in 6,000 m of streamer length. During preprocessing, the data set was sampled from 4 ms to 8 ms and decimated to 3:1. Hence the Nyquist frequency of the data reduces to 62.5 Hz and the number of channels to 160, which are adequate for this processing objective. The 80-fold coverage remains unchanged.

Seismic inversion, using a combined scheme of prestack travel time inversion and post stack depth migration was carried out to estimate a velocity depth model for the line. The approach is a model-based technique where depth migration is an integral part of the velocity estimation procedure. Significant improvements have been achieved in imaging the deep structural pattern across the line down to about 9 seconds which is equivalent to about 15 km. Major faults, especially within the areas masked by gas effect, were also clearly resolved.

Study of the processed line has arrived at the interpretation that, (1) the basin fill exceeds 14.5 km in thickness, (2) the basement on the flanks is composed of an upper and a lower rock complex, (3) the arcuate and concentric seismic layering on the northeastern flank of the basin may represent granite cupolas intruded into the lower complex of its basement. Nine major, basement-reaching fault zones were identified. Along the centre of the Malay Basin runs the Axial Malay fault zone, an interpreted extension of the Three Pagodas fault. Very steep to vertical fault zones form the SW and NE boundaries of the basin below the Oligocene(?) sequence represent the rifted margins. Much gentler basement slopes of the flanks above this horizon are consistent with the sagging due to thermal cooling and sediment loading following the rifting phase. The pre-Oligocene(?) sequences are stronger deformed than the overlying beds. The majority of the main fault zones display flower structures, while the Axial Malay fault zone is associated with the strongest expression of structural inversion. This deep seismic section corroborates our interpretation that the Malay Basin originated as a rift, at least 60 km wide, possibly representing one of the rift arms of the Cretaceous-Tertiary Malay dome and that its development had been strongly modified by transcurrent movement along major fault zones, especially along NW-SE.

*Poster 2*

## Sequence stratigraphic and diagenetic controls on pore-type development: A new perspective from petrographic image analysis

MOHD FAUZI ABDUL KADIR AND MOHAMMAD YAMIN ALI

PETRONAS Research & Scientific Services Sdn. Bhd.  
Lot 1026 PKNS Industrial Estate  
54200 Ulu Klang  
Selangor

In the history of oil and gas exploration and production, geologists have difficulties in communicating with engineers as the results of geological studies are more descriptive in nature. The engineers like to play with numbers. This paper will highlight how Statistical Image Analysis Technique provides a good universal solution to geologists and engineers when they attempt to characterise reservoirs. In this paper, a study of reefal carbonate reservoir will be used as a case study.

The growth of carbonate reefs is mainly controlled by sediment inputs and sea-level changes, and is best developed during a slow rise in sea-level. This development phase also represents a period of extensive early marine diagenesis. A sea-level drop will subject the reefs to subaerial exposure, and if the carbonate supply is consistent, the reefs will prograde laterally. The top of the reef remains as a hiatus and forms an unconformity. The best pore development would probably take place during this period when the reefs are subjected to fresh water movement.

Pore-types of several carbonate buildups were examined using petrographic image analysis technique. The results show that high order sequence boundaries and diagenesis are the fundamental controls on pore type development. Five pore types were statistically classified, which can be regionally explained in terms of sequence stratigraphic principle and diagenesis, and provide an alternative tool to better characterise the reservoirs to enable the geologists to communicate with the engineers.

*Poster 3*

## Geochemistry of gases in the Malay Basin

DOUGLAS W. WAPLES AND MAHADIR RAMLY

PETRONAS Carigali Sdn. Bhd.  
Wisma Peladang, Jalan Bukit Bintang  
P.O. Box 12407  
50776 Kuala Lumpur

Three end-member gas types, which are biogenic gas, thermal gas, and basement gas have been identified in the Malay Basin, by using compositional and carbon-isotope data for C<sub>1</sub>-C<sub>3</sub> hydrocarbons and CO<sub>2</sub>. The thermal gas was divided into two subgroups: "normal" thermal gas originating at relatively shallow depths, and "deep" thermal gas from more-deeply buried source rocks.

Most gases in the Malay Basin are composed of mixtures of two or three end members. Gases with a significant biogenic component are limited to the northeast corner of the basin, and do not appear to offer an important exploration target in the Malay Basin.

Gases dominated by the basement-sourced CO<sub>2</sub>, are found along a discontinuous trend from Dulang to Ular, and along another near the Bunga Pakma, Bunga Orkid and Bunga Raya wells. Because these gases have migrated vertically from the basement, they dominate only where extensive fault systems extend all the way to the basement. Some gas accumulations along this trend are very large and they are at risk of being dominated by basement-sourced CO<sub>2</sub>.

The gas in the north central part of the basin appears to be mainly of "normal" thermal origin. Accumulations are of moderate size. Lack of contamination by basement gas and "deep" thermal gas in this area, suggests a lack of deep faults. Lack of fault-related vertical migration pathways limits the volume of hydrocarbon gas in this area, and thus downgrades its exploration potential except where there is local evidence for deep vertical faults.

"Deep" thermal gas seems to dominate over "normal" thermal gas in the large accumulations. This observation suggests that the key to finding large gas reserve is the presence of vertical faults which drain the deep source rocks in which the "deep" thermal gas was generated, but which do not extend all the way to basement. The region between Damar and Tujoh, where large reserves are present with only moderate amounts of CO<sub>2</sub> may serve as a model for this type of migration. Integration of these data with analysis of structural styles should provide important guidelines for future gas exploration in the Malay Basin.

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*Poster 4*

## Source rock studies on Luconia carbonate shelf

MICHAEL CARTER<sup>1</sup> AND PETER ABOLINS<sup>2</sup>

<sup>1</sup>Mobil

<sup>2</sup>PETRONAS Research & Scientific Services Sdn. Bhd.

Lot 1026 PKNS Industrial Estate

54200 Ulu Klang

Selangor

A world class petroleum system exists in the Luconia carbonate shelf of offshore Sarawak, Malaysia. Approximately 35 to 40 TCF of gas have been discovered to date in relatively shallow, middle to upper Miocene carbonate reservoirs.

Basin modelling and geochemical analyses have suggested that the source for the Luconia shelf hydrocarbons are from pre-carbonate sediments. Most of the exploration within the Luconia carbonate shelf has targeted the shallow Miocene carbonates, resulting in only six deep pre-carbonate well tests. Of these six wells, no source rocks have been discovered which explain the prolific petroleum system which exists. The pre-carbonate source rock quality is always lean, being classified as a fair to poor source. Only in the extreme southern and southwestern parts of the shelf have thin, rare individual source beds been penetrated. The lack of drilled pre-carbonate source rocks have led to the theory that the source rocks are positioned deep in the stratigraphic section, below what has been drilled to date. A separate theory suggests that even though pre-carbonate sediments are lean, a thick section of these sediments in a generative window can generate substantial amounts of hydrocarbons. Basin modelling in the "Western



Graben" of the northern Luconia shelf tests the viability of these theories and introduces additional theories concerning the location of the source rocks.

In addition to the uncertainty of the stratigraphic position of the Luconia shelf source rocks is the uncertainty of their composition. The generally accepted theory concerning the source rocks of the Luconia carbonate shelf is that they are non-marine. This is based largely upon geochemical analyses of oils from the Luconia shelf carbonate reservoirs. However, recent work by Petronas Research and Scientific Services (PRSS) has demonstrated a contribution of marine source rocks to Luconia hydrocarbons from their analyses on selected condensates from the Luconia shelf. This work suggests that marine source rocks may be responsible for some component of the 35 to 40 TCF of gas in the Luconia carbonate shelf. Paleoreconstructions of seismic over the Western Graben of the northern Luconia shelf addresses the possible existence and contribution of marine source rocks to discovered hydrocarbons.

*Poster 5*

## **Preliminary stratigraphic study on Attahaddy Field, Sirte Basin, Libya**

SENUSI M. HARSHA<sup>1</sup>, ABDUL RAHIM SAMSUDIN<sup>1</sup>, M.Z. FARSHORI<sup>2</sup> AND BASIR JASIN<sup>1</sup>

<sup>1</sup>Department of Geology  
Faculty of Physical and Applied Sciences  
Universiti Kebangsaan Malaysia  
43600 Bangi, Selangor D.E.

<sup>2</sup>5927 Dalcastle Drive  
Calgary Alberta  
Canada T3A 2B2

A preliminary stratigraphic study of the Attahaddy gas field was mainly based on well log data provided by the Sirte Oil Company (SOC) Libya. The Attahaddy gas field is located north-west of concession 6, in the central part of the Sirte Basin, Libya. A total of eight well log sections were used to examine the subsurface geology of the area and to establish their stratigraphic correlation. North-south and east-west stratigraphic correlation were constructed to illustrate lithology and facies relationship among the wells. A total of about 12,500 feet (3,810 m) thick of sedimentary formations were logged. The sediments consist primarily of shale and carbonates with some evaporates. The depositional sequences comprise of the Tertiary, Cretaceous, and Cambro-Ordovician strata. In general, the lithostratigraphy of the Attahaddy Field is represented by eleven formations and groups. The oldest one is Cambro-Ordovician Gargaf Group, and the youngest one is the Miocene Zaggut Group.

The rock successions vary in thickness. The thickness variations of the Upper Cretaceous sections are prominent, because of either non-deposition or erosion of the Bahi or Sirte Formations. The thickness of the Bahi Formation, varies from 38 feet (12 m) in well FF15-6 to 326 feet (100 m) in well FF12-6. The Bahi-Gargaf interval is a principal reservoir representing the most important commercial gas bearing interval in the field. The fundamental portion of the Bahi-Gargaf reservoir interval of the Attahaddy field is represented by the highly fractured and fracture induced (diagenetic) effective porosity bearing quartzites of the Gargaf Group. The thickness of the gas column is more than 2,500 feet (762 m) in some wells. The thick shale of

the Sirte, and limestone of the Kalash Formations were deposited during the Maastrichtian time, when the sea covered the area and formed the first flooding surface. The Sirte shale represents the hydrocarbon source rocks of the Cretaceous reservoirs. By the end of the Cretaceous, the first transgressive Paleocene sea covered the Attahaddy area where a thick sequence of marine sediments (shale, marls and carbonates) was deposited.

A sequence of shale was deposited during Danian time, followed by deposition of shallowing-upward regressive carbonate and evaporates sequences (Kheir, Gir and Gialo Formations) in the Upper Paleocene and Eocene time. The other transgressive cycle covering the area is represented by deposition of the Augila shale during Upper Eocene time. This cycle was followed by the deposition of shallow marine sands of the Oligocene Arida Formation. These sands are interbedded with shale beds particularly in the upper part of the formation. They are very shallow and often with the undifferentiated rocks represented by the Zaggut Group during the Miocene time. This Group is composed of interbedded calcareous shale, sandstone, limestone and beds of anhydrite.

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3. Anuar Abd. Aziz  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
4. Chow Yor Chun  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
5. Faidzul Ahmad  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.

6. Gopikrishnan s/o Balakrishnan  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
7. Hasmizol Hassan  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
8. Jufriady Mender  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
9. Khairul Anuar Ismail  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
10. Khairul Rizal Hj. Mohd Ramli  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
11. Maizatul Shima Abdul Rasad  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
12. Mohammad Rahimy Fitry Ismail  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
13. Mohd. Zaini Ya'cob  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
14. Nor Azam Mat Don Ya  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
15. Paramiswara @ Adnan Zakaria  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
16. Puanesuaran a/l V. Subramaniam  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
17. Rozaidy Yusoff  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
18. Samsamalkan Hasan  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
19. Sile Uvang  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
20. Tham Wing Wai  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
21. Vickneswaren s/o Siva Balasubramaniam  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
22. V. Ramesh s/o Viswambharan  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
23. Abd. Razak Ahmad  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.
24. Jonas Majain  
Makmal Geofizik, Pusat Pengajian Sains Fizik, Universiti Sains Malaysia, 11800 Pulau Pinang.



# Souvenirs For Sale

In Response to requests by members, the Society has now prepared several souvenir items for sale as follows:

	Unit Price (RM)
1. Key Chain (brass with epoxy coating and Society Logo)	6.00
2. Tie Clip (with Society Logo)	7.00
3. Cap (dark blue, with Society Logo)	9.00
4. Hat (dark blue, with Society Logo)	10.00
5. Tie (dark blue with Society Logo)	30.00

Members can purchase/order these souvenir items by contacting:

Anna Lim

Geological Society of Malaysia

c/o Geology Department

University of Malaya

50603 Kuala Lumpur

Fax: (603) 7563900

Tel: (603) 7577036

## BERITA-BERITA LAIN Other News

### Local News

#### Small projects may require EIA reports

Small development projects will be subject to the Environmental Impact Assessment (EIA) under the Department of Environment's (DOE) move to review the conditions and list of prescribed activities stipulated in the existing law.

Science, Technology and Environment Minister Datuk Law Hieng Ding said today the move to review the conditions was necessary in view of the large-scale development taking place throughout the country.

"The move is also to create a more effective environmental management system," he said after launching a forum on *Solid Waste Management and Recycling — The German Solution*.

The event was organised by the Malaysian-German Chamber of Commerce and Industry here.

The review will be based on the DOE's observation of the problems arising from the existing conditions, and a study of the 500 EIA reports it had received from developers to date.

Law said the review to be carried out at the Federal level would include reducing the size of projects requiring EIA. These projects include housing and resort development and forestry activities.

Under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987, conversion of hill forests and development of housing, hill station resort or hotel covering an area of 50 hectares or more require an EIA.

This condition provides a loophole as developers are able to divide their projects into smaller ones to avoid having to do an EIA.

Environmentalists have also argued that cumulative effects of many small projects in an area can be more significant than a single large

project.

Law said the DOE would set up a committee to review the EIA conditions.

It was learnt that the existing Law review committee responsible for drafting the amendments to the Environmental Quality Act 1974 (EQA) would be involved in reviewing the EIA conditions.

Other changes which DOE would look into include increasing the acreage of projects subject to EIA and even exempting certain activities from requiring an assessment.

If a project is subject to EIA, the developer has to outline the mitigative measures to be taken before, during and after construction.

The EIA, which is also to predict environmental consequences of a proposed project, is to ensure that potential problems are foreseen and addressed at an early stage.

There are a total of 57 activities under 19 sectors categorised as prescribed activities for which an EIA is mandatory.

The review of the conditions is in addition to the ministry's proposal to extend the list of prescribed activities subject to EIA.

The ministry wants the EIA to be made mandatory for three more activities such as the development of golf courses, hillslopes and sensitive areas, including former landfills, former mining areas and beaches.

Law said he had presented a paper on the need to include the three activities in the list of prescribed activities at yesterday's Land Council meeting so that State authorities would adopt and implement the proposal.

He said he was acting on the advice from the Attorney-General's Chambers which felt that the proposal should be implemented at State level.

*"I had informed the State authorities that*

they could implement the proposal administratively before the proper legislation is put into place.

*"What they could do is make the EIA a condition for the three activities."*

He said the proposal was well received at the meeting and hoped the respective State Governments would immediately implement it.

To date, he believed only the Sabah Government had begun working on adopting the proposal while Sarawak has its own EIA regulations. The National Land Council was the last channel the ministry had to go through to ensure State Governments implement the EIA regulations for the three additional activities.

Prior to this, Law had received the

endorsement from Menteri Besar and Chief Ministers.

The proposal, which was agreed to by the Cabinet following a spate of landslides and the 1993 Highland Tower tragedy, was supposed to be enforced last year.

However, the ministry could not proceed with the plan as the Attorney-General's Chambers felt that such implementation would lead to problems because they concerned land matters which fell under the jurisdiction of State Governments.

Therefore, the implementation of the proposal had to be done at State rather than Federal level.

NST, 18.11.1995

## Solid waste management firms must fulfil certain conditions

The four companies selected by the Government to undertake the country's solid waste management privatisation programme will be subject to certain conditions including having to prepare an Environmental Impact Assessment (EIA) report for their plants.

Science, Technology and Environment Minister Datuk Law Hieng Ding said today the conditions were to ensure that recycling, treatment and disposal of solid waste in Malaysia were carried out in a proper and efficient manner.

Among others, he said the companies would have to prepare an EIA report and obtain approval from the Department of Environment's (DOE) Director-General before they could implement any project such as constructing treatment or disposal plants.

Law said the companies would also be required to use appropriate technologies to ensure the objective of having an environmentally-sound management of waste was achieved.

*"In this regard, the recovery of useable materials should be given priority in the choice of technologies to prevent conversion of pollution."*

*"Therefore, we need to see the kind of technology the companies plan to use,"* he told reporters.

Earlier, he launched the Forum on Solid Waste Management and Recycling — The German Solution, organised by the Malaysian-German Chamber of Commerce and Industry

here.

The Government, realising the mounting solid waste problem in the country, had decided to turn to privatisation as a solution. It had therefore invited the private sector to submit tenders for the privatisation programme last year.

Law said the technical committee set up by the Housing and Local Government Ministry, of which the DOE was a member, had received and reviewed 28 proposals from various countries.

He said the name of the successful companies would be announced soon.

Housing and Local Government Minister Datuk Dr. Ting Chew Peh had said recently that the Government had selected four companies to manage, dispose of and treat the country's solid waste under a 20-year programme.

Earlier in his speech, Law said the average generation of municipal solid waste in Malaysia per person per day was 0.7 kilogramme and 1.2 kg per person for those living in a city like Kuala Lumpur.

With a population growth rate of between 2.3 per cent and six per cent per year and waste generation rate of between 1.5 per cent and two per cent annually, it is expected that the overall solid waste generation in Malaysia will be about 10.05 million tonnes annually by the year 2020.

*"Malaysia has yet to have a comprehensive and integrated recycling, treatment and disposal of municipal solid waste system."*



*"Solid waste is presently disposed of at dumping grounds which are managed by various local authorities."*

He said improper site selection for dumping grounds and its management and lack of resources and skill had resulted in environmental

degradation, including contamination of underground water, soil and air pollution from open burning of waste.

Law added that the solid waste disposal problem had to be solved in a holistic approach.

*NST, 18.11.1995*

## Natural gas to be major power source

Natural gas is expected to contribute 70 per cent of Malaysia's power demand for generating electricity by the year 2000, Prime Minister Datuk Seri Dr. Mahathir Mohamad said.

Malaysia's continued rapid growth will see an increase of power demand at an average of 10 per cent per annum until the year 2000. In 1990, natural gas only contributed 25 per cent of the country's power needs.

*"Consistent with the Government's strategy to diversify its power sources, the utilisation of natural gas as a major power source will become more important,"* he said when launching the Petronas Gas Landing project in Kampung Gayang, Tuaran, 40 km from here.

The project involves the laying of 65 km of pipeline, upgrading of the existing Erb West offshore gas facilities and the construction of a new onshore gas terminal and related facilities by Petronas Carigali.

The pipeline will transport gas from Erb West offshore gas field, located 65 km north-west of the State capital, to the onshore gas terminal.

The gas and condensate will be separated and treated before being supplied to industrial and commercial consumers.

The project will allow Petronas to embark on gas related industries and gas reticulation project for domestic, commercial and industrial uses in the State capital and other areas in the West Coast.

Dr. Mahathir said the project, scheduled to come on stream by late 1997, would spearhead industrial growth in Sabah especially within the Kota Kinabalu Industrial Park.

Malaysia is fortunate to have been endowed with a substantial source of natural gas, sufficient to meet future demands.

*"The Gas Landing project will be a vital facility to support and stimulate the growth of Sabah's industrial sector."*

The Government has also approved several

independent power producers to cope with the industrial needs of the State.

Besides providing an alternative combustion fuel which is more cost effective and clean for power generating the Petronas gas project will also bring about positive effects to the State's economic growth.

*"The implementation of the project will fulfil the Government's objective to develop the small and medium-scale industries."*

Dr. Mahathir was happy to note the formation of a State Government-Petronas joint committee headed by Chief Minister Datuk Salleh Said to co-ordinate and supervise the petroleum industry in the State.

He said with the commitment of the State Government and the vast experience of Petronas, the committee would be able to achieve its objective of bringing about development and progress to the people and the State.

The Prime Minister said the industrial sector was expected to continue to be the main thrust of Malaysia's development effort to attain the objective of Vision 2020.

Dr. Mahathir hailed the establishment of the BIMP-EAGA group which comprised Mindanao and Palawan in the southern Philippines, Sabah, Sarawak and Labuan in Malaysia, Brunei, and north Sulawesi and west Kalimantan in Indonesia, to hasten economic development in the region.

The formation of the grouping will not only speed up industrial development but will also pave the way for the opening of business and investment opportunities within the East Asean Growth Area (EAGA).

The exploration of oil and gas, telecommunications services, expansion of air services, agriculture and fisheries, logging and tourism are among the potential business and investment opportunities Malaysia could venture into.

*NST, 29.11.1995*

## Varsities to be run like businesses

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Universities that have been corporatised will be run on a more business-oriented approach although they will still be owned by the Government.

Education Minister Datuk Seri Najib Tun Razak said that the reason for the corporatisation of universities under the Universities and University Colleges (Amendment) Bill 1995 was to enable more dynamic management.

Speaking to reporters at the Parliament lobby, he stressed that universities as corporate bodies would be allowed to set up their own companies to manage their funds and generate income.

The Bill was tabled for first reading in the Dewan Rakyat on Monday.

Universiti Malaya (UM) will be the first institution to be corporatised on January 1.

Najib said Universiti Hospital would also be corporatised after UM, adding that the terms and conditions of the staff would be decided later.

Asked whether a doctor lecturing at the university would be allowed to operate his own clinic, Najib said that it would be up to the Board of Directors to establish a policy.

He said that the decision would rest with the National Higher Education Council which would be established under the Act of the same name. The Act will be tabled next month at a special sitting of the Parliament.

*"We want to ensure that staff of the*

*universities concentrate fully on their work,"* he said.

Najib said the student fee structure was still being worked out.

He added that the restrictions on types of student activities would remain.

On whether a professor of Surgery would be paid more than a professor of Malay Studies, Najib said that the process of determining the salary scale would be based on market demand.

*"We have to stop the brain drain,"* he said.

Among the more salient features of the Bill are:

- A board of directors will replace the university council;
- The university can set up a company to manage its funds;
- The size of the university senate will be reduced from over 300 to about 40 to enable decisions concerning academic matters to be made quickly and in a more efficient manner; and
- The abolition of the university court whose function is merely ceremonial.

Following their corporatisation, universities will now be able to enter into business ventures and to acquire and hold investment shares.

The Bill also proposes that the power to deal with a student who has been suspended or expelled from a university shall rest solely with the minister.

*Star, 20.12.1995*

## Shell to spend RM5b on offshore operations

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Sarawak Shell Bhd./Sabah Shell Petroleum Company Ltd. (SSB/SSPC) will invest RM5 billion over the next five years on its offshore operations off Sarawak and Sabah.

Managing director Tan Ek Kia said yesterday some of the money would go towards the building of new platforms for the oil and gas fields M4, F23 and F24 off Sarawak and the Kinabalu Platform near Labuan.

*"Over the last 10 years, we have invested RM12.5 billion on expansion of gas project,"* he said at a Press conference in Miri, Sarawak.

He said SSB/SSPC was gearing itself for the

completion of the Liquefied Natural Gas project (LNG-3) in Bintulu, expected to be operational in 2001.

Petronas Carigali Sdn. Bhd. (PCSB) and the Sarawak Economic Development corporation (SEDC) share 70 per cent equity in LNG-3 while Occidental Petroleum (M) Ltd. (Oxy), Nippon Oil of Japan (Nippon Oil) and SSB/SSPC share the remaining equity.

SSB/SSPC signed an agreement last August with Oxy, Nippon Oil and PCSB for the supply of gas from LNG-3, the latest gas well discovered off Balingian-Bintulu.

Tan said SSB/SSPC would be supplying gas from its LNG-2 project — which would begin operation next year.

LNG-2 involves an investment of RM17 billion, for both the downstream and upstream sectors, while LNG-3 is expected to have the same level of investment.

Tan said SSB/SSPC was one of the suppliers of LNG under the Production Sharing Agreement

(PSA) with Petronas Carigali.

With Japan and Taiwan as the main markets for Sarawak's gas Tan said that SSB/SSPC was expected to deliver 168 "LNG cargoes" this year and some 153,000 drums of crude oil per day for the export market.

Tan said he expected the revenue from the sale of oil and gas to be less this year owing to the less favourable market demand.

NST, 21.12.1995

## 30 km of Malacca coast facing erosion

About 30 km of the northern coast of the State is facing serious erosion due to the natural movement of beach soil.

State Drainage and Irrigation Department (DID) director Che Amran Mohd Yusoff said in an interview that the phenomenon might be due to strong undercurrents.

The areas facing erosion start from Pantai Klebang to Kuala Linggi up north to the Negri Sembilan border while the areas facing "accretion" (increase in sand) begin from Sungai Duyong to the south.

Che Amran said further studies needed to be done to explain the reason behind this rapid movement as this year alone there were four severely affected areas.

The four places badly affected by coastal erosion and which had been classified as Class One (severe erosion which requires immediate attention) are Kampung Tanjung Dahan in Kuala Linggi, Kampung Balik Batu in Tanjung Bidara, Kampung Balik Bukit in Tanjung Keling, Pantai Kundor and Pantai Klebang.

Che Amran said as the last national study on beach erosion was done in 1986, the soil movement might have changed.

*"Therefore, a new and extensive study is needed especially for the west coast as the erosion process here differs from that in the east.*

*"Theoretically, the erosion process in the west coast should be less as it is blocked by Sumatra."*

Che Amran added that the waves striking this side of the coast had been unusually strong this year.

*"For example, when the study was done in*

*1986 the four critical areas had not been listed as severe. However, all that changed within the span of about three months this year when the soil by the beach gave way, resulting in further erosion,"* he said.

On whether the rapid development along the northern side of the coast had any connection to the severe erosion, Che Amran said it was quite difficult to link the two.

*"That is why further studies done on a national basis are required to immediately identify the causes and later propose the possible solutions."*

He said the move by Chief Minister Datuk Seri Mohd Zin Abdul Ghani to have the State Planning Unit study and control development in areas close to the beach was timely.

*"The proposal by the State Government for developers to pay a deposit on reclamation projects so that the funds can be used to finance various projects to stop coastal erosion is also appropriate as the cost of these projects is rather high.*

*"While beach developers spend a lot of money on their projects, there are only a few who institute fail-safe measures to stop erosion. They rely on the Government and it is not totally fair as it involves a lot of money."*

Che Amran said for example, if the department were to institute the "flex-slab" method of placing interlocking concrete bricks, as was done in Pantai Kundor, it would have to spent RM3 million for each kilometre.

He said the other "rock-facing" method entailed placing small stones and boulders along the beach. This costs RM50,000.

NST, 26.12.1995

## Right waste management

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Is there any special concession for Kualiti Alam Sdn. Bhd? *"No, it is business as usual for us"* is the prompt reply of Department of Environment director-general Tan Meng Leng.

Business, to Tan, means getting industries to adopt clean technology and embark on waste minimisation programmes even as the DOE continues in its enforcement. It includes monitoring the generation of 107 types of hazardous and toxic waste listed under the Scheduled Wastes Regulations 1989. Such waste must be inventorised, labelled and stored properly.

*"Industries must not be complacent or cry wolf when they run out of space to store their waste just because KA's services has not come on-stream. They cannot disregard the question of good housekeeping in waste management."*

Having said that, the DOE also recognises the need to ensure that industries do not store their waste indefinitely, thereby saving on treatment and dodging responsibility in waste management.

In the United States, industries are allowed in general to store their waste for up to three months only. Thereafter, they must be disposed of.

Towards this end, the DOE is proposing to use Section 31 (2) of the Environmental Quality Act, which gives the director-general of the DOE the power to "direct the occupier of any premises to emit, discharge or deposit pollutants during periods of day as he may specify ..... and direct the manner in which such occupier shall carry out his trade ....."

*"We do have provisions to compel the industries to dispose of their waste by limiting*

*their storage time,"* says Tan.

He, however, declined to reveal when it will come into force.

As a rule of thumb, about 10 to 20 per cent of all manufactured waste is potentially hazardous. Last year, Malaysian industries generated about 417,000 tonnes of scheduled waste. And over a period of eight years — between 1987 and 1994 — some 125,000 tonnes of waste have been accumulated, waiting for final disposal at KA's WMC.

Besides having to inform the DOE of their waste generated, industries like oil and gas, metal finishing, electronics, chemicals, rubber, plastic, printing and textile, must also comply with the department's regulations on treatment and waste disposal facilities.

The industries must obtain the DOE's written permission and licence to operate six types of premises.

They include sludge farms, off-site recovery facilities, wastewater treatment plants and incinerators. Permits must also be sought for the transportation of toxic waste.

An offender is liable to be prosecuted with a maximum fine of RM10,000 or two years' jail or both. The DOE is now considering more deterrent penalties, following a spate of illegal dumpings.

The industries, however, are allowed to export their waste for disposal. Countries like Britain, the United States, Japan and Singapore are the major destinations for waste disposal. Sludge containing heavy metals, solvents and spent catalysts are some of the waste exported.

*"But the import of waste is not allowed,"* Tan stresses.

*NST, 26.12.1995*

## New Genting Sempah tunnel 60 per cent ready

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The new Genting Sempah tunnel located at kilometre 17 of the Karak-Kuala Lumpur highway is 60 per cent complete and will meet the completion deadline scheduled for July 1997.

The tunnel has reached its 400 metre mark, with only 100 metres more to its halfway point at the end of February.

Upon reaching 500 metres, the workers of Transfield Holdings (Asia) Sdn. Bhd. will start blasting and drilling on the other end of the tunnel.

Transfield is an Australian-based firm given the task of constructing the tunnel by MTD Prime Sdn. Bhd. and MTD Construction Sdn. Bhd., the two concession companies responsible for the Karak Highway expansion.

Excavation of both ends of the tunnel is expected to be completed in June, giving the contractors one year to fit and clean the tunnel.

The work on the tunnel is broken up into two different sections to save time, said the company's project manager Richard Wright.

"When we begin blasting the rocks on the other side, sub-contractors will begin clean-up and material preparations on this side," he said. "They will begin laying the concrete road, fixing the lights and other mechanisms."

The complete dual carriageway will be fully automated (according to international standards) with sufficient lighting, ventilation systems, monetary television circuits and a carbon monoxide monitor. The tunnel, which is 800 metres in length, 10 metres wide and eight metres in height, will be less of a hazard to motorists as traffic will only move in one direction. It will also be kinder to the environment and motorist's health because in a two-way tunnel, the opposing traffic keeps the carbon monoxide and oxygen stagnant, not allowing it to circulate.

With the improved ventilation system and traffic going only one way in the new tunnel, it will be environmentally friendly.

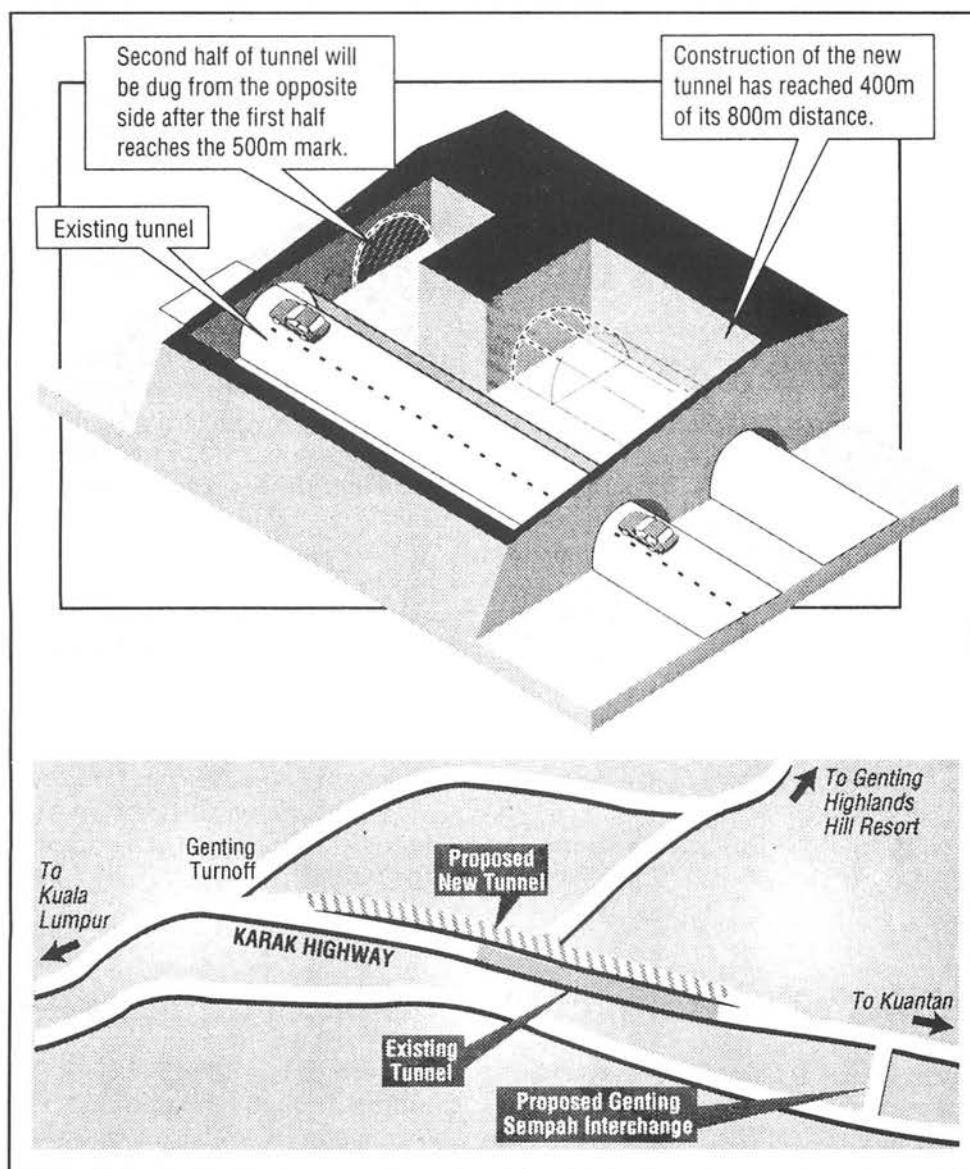
The work of upgrading the six-lane highway from Kuala Lumpur to the tunnels and the four-lane highway from the tunnels to Karak began in October last year. It is built parallel to the old two-way tunnel.

The new tunnel will accommodate all East bound traffic to Kuantan.

Building a tunnel is better than building a road because of the mountainous terrain, Wright said.

Transfield is using the "Australian shortcrete method", which involves controlled blasting and drilling.

This is the first time the method is used for



primary and final lining in Malaysian tunnel construction, Wright said.

Holes measuring between 2.2 and three metres are drilled by using the RM1.5 million Atlas Copco machine.

After the blasting has occurred, the workers use compressed air to apply concrete to the roof, which shapes and smoothens the tunnel.

Transfield job superintendent, Vernon Leatmam, said there is a minimum of three blastings a day.

Leatmam said the explosives used were

emulite explosives, brought from Tenaga Kimia Sdn. Bhd. in Rawang.

The blasting of decomposed granite is done in two stages. First the top half is blasted, then the bottom. The top half can be blasted as far as two metres and the bottom as far as three metres. The extracted rocks, transported with a Caterpillar 966 machine, were crushed and used for road fill.

When the tunnel is completed in 1997, a maintenance crew will be working round the clock.

*NST, 26.12.1995*

## Gua Tempurung comes out of its shell

Imagine a midnight darkness that you could hardly puncture with a flashlight or at times a chill that grips you when you wade through an icy-cold but crystal clear stream or the grunts you make when you crawl through deep crevices between boulders.

And when you stop to look around, you may see relics of the defunct Communist Party of Malaya (CPM) — Chinese characters on the walls of the cave, the food bins, the torture chamber or rather holes for prisoners and the graves of fallen communists.

This, of course, is Gua Tempurung which offers you an exhilarating, challenging and engrossing experience with a lesson in history, to boot.

For those who love an adventure holiday, Gua Tempurung in Perak is not to be missed.

Located in Gopeng district, about 25 km south of here, the limestone cave is a delightful destination for those who want a little "exploration" in their holiday package.

The cave could also leave you gaping in wonder at the shapes of stalactites and stalagmites, built up over thousands of years, and outcrops of high-grade marble.

The cave is part of the Gunung Gajah range which is connected to several other caves — the

Ular, Sanding, Angin, Dinding and Kandu — where the communist terrorists sought refuge from security forces.

Gua Tempurung is different from other caves because of the relics of dark period of history left by the CPM, and, of course, its natural beauty.

The Perak Foundation and a private company have set up Heritage Acres Sdn. Bhd. to promote Gua Tempurung and its surroundings.

Developer Mohamed Noorani Kamarul said facilities like latrines and changing rooms are built outside the cave. Lights are being installed inside the cavern, tracks made and fences erected.

When the tourists come, the company will ensure that not too many enter the cave at any one time.

*"Measures to protect the environment must be carried out immediately as there had been instances where tourists had cut off the stalactites and stalagmites and scribbled graffiti on the walls,"* he said.

Menteri Besar Tan Sri Ramli Ngah Talib is convinced that tourism has the potential to be a significant revenue earner for Perak.

*"Perak has been blessed by nature — it offers holiday-makers the sun, sea and sand as well as lakes, forests, rivers and caves,"* he said.

*Sun, 27.12.1995*

## Department at the forefront of chemical analysis

With the purchase of a state-of-the-art trace metal analyser, the Chemistry Department is set to be at the forefront of chemical analysis in the country.

Its director-general Yeo Hock Siew said here that the Inductively Coupled Plasma Mass spectrometer (ICPMS), which costs almost RM1 million, will go a long way in helping the

department expedite its work.

Trace metals are metals which exist in minute quantities.

The spectrometer, one of only two in the country, was installed in March in the Trace Metal Unit of the Environmental Services (ES) Division and, after several trial runs, has been operational since June.

Yeo said the ICPMS can detect up to 80 elements simultaneously in any one sample and in minute concentrations too, even quantities are small as up to one part per trillion.

*"This is a thousand times more sensitive than the existing Inductively Coupled Plasma Atomic Absorption Spectrometer (ICPAAS) and a million times more than the Atomic Absorption Spectrometer (AAS)."*

The ICPAAS and the AAS can only detect 20 and one element respectively per sample. Thus the ICPMS saves an enormous amount of time besides being able to analyse up to 250 samples per day compared to less than 80 for the others.

Yeo however said rather than supercede the other analysers and make them obsolete, the ICPMS would complement them instead. The varying degree of sensitivity required to detect the elements would allow the selection of a specific analyser.

*"This way we can cut down on costs as the newer machines cost more to run and also breathe life into the older ones."*

With the commissioning of the ICPMS, there are almost RM2 million worth of analytical equipment with various capabilities in the unit. No other laboratory in the country comes close to being equipped with such an array of trace metal analysers.

Yeo said the ES Division was set up almost 20 years ago.

*"Before that, it was under the Health Division, lumped with the Food and Water units."*

The ES Division provides a number of services such as analytical analysis and advisory services. Some of the other services are:

- Water Quality Monitoring Analysis — where water from rivers, lakes, marine sources and the underground are analysed for, among others, traces of metals or Biological Oxygen Demand (BOD) or Chemical Oxygen Demand (COD).
- Sewage, Liquid and Industrial Effluent Analysis — where the alkalinity, acidity, metals and BOD and COD from these effluents are analysed.
- Air Quality Monitoring Analysis — where dust, air and acid rain samples and lead content in gasoline are analysed.
- Industrial Hygiene Analysis — analysis of dust and toxic vapour samples from factories.
- Biological Examination — the identification of plankton as biological indicators.

Yeo said although most of the division's clients are government agencies such as the Department of Environment and Drainage and Irrigation Department, about five per cent are from the private sector.

There is an ES division in each of the department's State offices. They are however, not as thoroughly equipped as the headquarters here and some samples are therefore sent here for analysis.

*"However, we are up-grading their facilities to be on par with us,"* he said.

Yeo also said the department had received the International Standards Organisation/International Electrotechnical Commission Guide 25 accreditation for 22 fields of tests.

This certification means international accreditation for a broad spectrum of testing and calibration activities for laboratories.

*"We are continuously seeking to increase the number of tests accredited,"* he added.

NST, 27.12.1995

## VCs to finalise 3-year degree programmes

Vice-Chancellors of all universities will hold meetings soon to finalise the structure of the new three-year basic degree programmes beginning next academic year, an Education Ministry source said.

This follows a cabinet directive in August to shorten all basic degree courses by a year.

Education Minister Datuk Seri Najib Abdul

Razak had said this was necessary due to the labour shortage.

*"The average age of first-degree holders from local universities will hereby be reduced by a year to 23,"* Najib said.

He said five-year first degree courses will be reduced to four years but no decision had been made on medical courses.

Najib said the government will ensure that the quality of the basic courses is not affected.

*"Students will benefit from shortened courses because aside from starting work younger, they will also save a year's tuition fees,"* he said.

Universiti Pertanian Malaysia English department head Assoc. Prof. Jamali Ismail said today that his department is preparing new curricula for the three-year programmes.

*"To ensure that students complete their studies within three years, our department is preparing intensive courses,"* Jamali told *The Sun* after a closed-door meeting at a hotel here.

*"These courses will be held during the three-month break and are for fresh students. We are also working out exemptions for students who have done similar courses at other institutions,"* he said.

Jamali said Malay and English proficiency courses, compulsory for students at UPM, will also be scrapped to ensure they can complete

their studies within three years.

*"The rationale for removing Malay proficiency courses is that the majority of students come from Malay medium and national-type schools,"* he said.

Meanwhile, Universiti Malaya Academic Staff Union president Assoc. Prof. Mahathir Mohamed Khir said the corporatisation process has only been delayed by "technical problems" which include terms and conditions for the staff.

*"Corporatisation will still take effect early next year, perhaps a delay of one or two months,"* Mahathir said.

UM was originally scheduled to be corporatised on New Year's Day.

Mahathir said the blue-print or corporatisation will be available soon.

He said ministry secretary-general Datuk Dr. Johari Mat has confirmed that there will also be no increase in fees next year.

*Sun, 29.12.1995*

## KLCC tower tilt within accepted tolerance level ---

The tilting of one of the Petronas twin towers in the Kuala Lumpur City Centre (KLCC) project is part of the design and within the tolerance level allowed for skyscrapers, a senior KLCC official said.

The official, who did not want to be named, said as the building goes higher, it will move away from its centre.

*"This is normal and it was in the design specifications from the very start,"* he said.

The official said the building may move between 2.5 cm to 5 cm at various heights.

*"This is expected to happen and safety is not affected in any way,"* he said.

*"The KLCC conducted wind tunnel tests to see how the wind would affect the buildings. We started construction when we were satisfied with the safety aspects,"* he said, confirming the prime minister's statement yesterday that the phenomenon is not worrying.

When completed in the middle of next year, the 88-storey twin towers will be 450 m high.

Institute of Engineers president Dr. Ting Wen Hui told *The Sun* that no building is 100% "dead straight" and there is always some distortion because it is physically impossible to build a building totally straight.

*"In engineering, tall buildings are designed with this tolerance,"* he explained.

Ting said the tolerance levels of high-rise buildings take it into account such factors as wind and the height of the building.

Ting said that in measuring buildings, every system used will give different answers depending on how refined and sophisticated the measurement system is but the rule of thumb allowance for tilting is 2.25 cm for every 330 m.

Association of Consultant Engineers Malaysia president Harry Tan said tall buildings are allowed to tilt and sway and every building is design with this in mind.

Tan said that buildings like the Sears Tower in Chicago and the World Trade Centre in New York are also tilting because of their height.

*Sun, 29.12.1995*





**New Publications**  
**Geological Survey Department, Malaysia**

1. *Annual Report 1994*. Geological Survey Department, Malaysia, 1995. Price: RM40.00. 118 pp., 27 colour/b&w figures, 2 tables, 10 colour plates and 2 coloured geology maps.
2. *Dialogue Session of the Geological Survey of Malaysia with The Private Sector, Sarawak and Sabah, 6th December 1994, Kuching*. Geological Survey Department, Malaysia, 1995. Price: RM50.00  
Nine technical papers on the mineral resources of Sarawak and Sabah, 139 pp.
3. *Seismo-Tectonic Map of Malaysia*. 1994 Edition. Geological Survey Department, Malaysia, 1995. Price: RM150.00.  
Scale 1:1.5 million. Size: 164 x 86 cm. Colour.
4. *Geochemical Exploration of the Kuala Pilah — Gemas Area, Negeri Sembilan* by Ab. Halim *et al.*, 1995. Geological Survey Department, Malaysia. Report EMR 1/95. Price: RM50.00.  
37 pp., 14 figures, 6 tables, 2 colour photos.

All reports and map are available from the Geological Survey Department in Kuala Lumpur, Ipoh, Kuching and Kota Kinabalu.

*Reported by K.K. Khoo  
Corporate Unit  
Geological Survey Dept.  
Kuala Lumpur  
7 November 1995*

## Seminar Geologi Abad Ke-21: Cabaran dan Peluang

### Laporan

Seminar "*Geologi Abad Ke-21: Cabaran dan Peluang*" telah diadakan pada 13–14 Disember 1995 di Kelab Rekreasi Universiti, Universiti Kebangsaan Malaysia, Bangi. Seminar ini anjuran Jabatan Geologi UKM dengan kerjasama Persatuan Geologi Malaysia telah dirasmikan oleh YB Datuk Dr. Fong Chan Onn, Timbalan Menteri Pendidikan Malaysia.

Di dalam kata-kata aluan program seminar, Datuk Dr. Fong berpendapat bahawa *seminar yang akan berkisar di atas tajuk cabaran dan peluang ilmu geologi di masa hadapan ini sangat kena pada masanya. Perubahan bukan sahaja sedang melandai ilmu geologi, malahan sedang melandai semua bidang ilmu dan aspek kehidupan harian.*

*Kementerian Pendidikan amat perihatin terhadap perubahan global ini. Antara langkah-langkah yang diambil oleh Kementerian Pendidikan untuk menyahut cabaran ini ialah mencadangkan Rang Undang-Undang Pendidikan 1995 yang sedang melalui proses kelulusan Dewan Rakyat. Rang undang-undang ini akan meningkatkan mutu pendidikan negara pada taraf dunia dan menjadikan landasan jelas dalam pembentukan generasi akan datang.*

Objektif utama seminar yang ingin dicapai oleh seminar kebangsaan **Geologi Abad Ke-21: Cabaran dan Peluang** ialah untuk merumuskan hala tuju bidang geologi khususnya dan sains bumi amnya, yakni hala tuju yang telah mengambil kira kerelevanannya sebagai agen pengembangan ilmu dan pembangunan negara bagi Abad ke-21 yang bakal menjelang. Dalam menduga hala tuju tersebut, sudah semestinya perkara yang berkait dengan cabaran-cabaran yang ada dan peluang-peluang yang terbuka luas bagi ahli geologi turut diperdebatkan, yang menjadi objektif tambahan bagi seminar ini.

Seminar ini mengandungi sebuah kertas kerja utama bertajuk *Global changes and their impact on university geosciences in the first half of the 21st century* (Charles S. Hutchison) dan 6 kertas undangan bagi tema-tema berikut: Geologi Pendidikan, Geologi Perlombongan, Geologi Petroleum, Geologi Kejuruteraan, Geologi Sekitaran dan Geologi Pengembangan. Setiap tema pula mengandungi beberapa kertas kerja.

G.H. Teh

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Please send the following information to the UMI conference coordinator in the form of a hard copy and computer file (WordPerfect 5.1 or higher, or ASCII), or by electronic mail transmission.

Title of Presentation

Author(s) (starting with main author): Full Name, Title, Affiliation, Full Address, and Telephone/Fax/Email Numbers

Abstract: Any length

Biographical Sketch: One-half page, double-spaced of the main author and speaker

**Deadline for submission is March 31, 1996**

Selection of presentations will be made by the conference chairpersons by early April 1996. Selected authors/speakers will have until the end of June to expand or edit their abstracts and biographical sketches and submit camera-ready photos and figures, if any, for inclusion in the conference material.

Oral presentations from 35 to 45 minutes will be organized for either Monday, October 14, or Tuesday, October 15. Slides (35 mm) and videos (VHS only) may be used to augment presentations.

A hand-out and small exhibit area can be made available for self-contained display units with prior arrangements.

For submission or for more information, please contact the conference coordinator below:

**Ms. Karynee Chong Morgan**  
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c/o Marine Minerals Technology Center  
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Hawaii 96813-5513 USA  
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**Introductory Training Course on Paleomagnetic and Rock  
Magnetic Applications in Geological Sciences**

*November 10–19, 1996*

**International Seminar on Paleomagnetic Studies on  
Paleomagnetic Studies in Himalaya-Karakoram Collision Belt**

*November 20–21, 1996*

**Government of Pakistan  
Ministry of Petroleum & Natural Resources  
Geological Survey of Pakistan  
GEOSCIENCE LABORATORY**

**INTRODUCTORY TRAINING COURSE ON PALEOMAGNETIC AND ROCK MAGNETIC  
APPLICATIONS IN GEOLOGICAL SCIENCES**

The Geoscience Laboratory (GeoLab) of the Geological Survey of Pakistan (GSP) in Islamabad, established as a grant-aid project by the Government of Japan through the Japan International Cooperation Agency (JICA) has been fully functional since October, 1991. It is a modern research complex housing state-of-art equipment relating to several geological disciplines including rock- and paleomagnetism.

As a part of its academic support programme, the GeoLab is organizing an **Introductory Training Course on Paleomagnetic and Rock Magnetic Applications in Geological Sciences (itc-PARMAGS)**, in collaboration with JICA and MinRock Foundation (MRF), during November 10–19, 1996. The course to be held in the premises of the Geoscience Laboratory, Islamabad will be conducted jointly by the Pakistani and the Japanese experts.

**INTERNATIONAL SEMINAR ON PALEOMAGNETIC STUDIES IN HIMALAYA-  
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The GeoLab, in collaboration with JICA, is also pleased to announce that a two-day international seminar is planned to be held in Islamabad on November 20–21, 1996 followed by geological excursions to different research areas of Pakistan. In the seminar, current paleomagnetic & rock magnetic research of Himalaya-Karakoram collision zone, magnetotectonics of collision belts and application study to mineral exploration in collision belts will be presented. A large number of geoscientists from Pakistan and abroad are expected to present their research through oral presentation and poster session.

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**Further Information**


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 Geoscience Laboratory, Geological Survey of Pakistan  
 Shahzad Town, P.O. Box No. 1461  
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- Place** : Auditorium of the Institute of Earth Science, Academia Sinica, Taipei, Taiwan
- Language** : English
- Registration** : If you would like to attend this symposium and/or present an abstract, please contact

Dr. Tung-Yi Lee  
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 Tel.: (886-2)934-7120, Fax: (886-2)933-3315  
 e-mail: t44001@cc.ntnu.edu.tw

and send abstract by March 5, 1996

## KALENDAR (CALENDAR)

### 1996

**March 8-15**

**GEOLOGICAL SURVEYS AND SUSTAINABLE DEVELOPMENT** (Conference to mark the Centennial of the Geological Survey of Egypt), Cairo, Egypt. (M. El. Hinnawi, Geological Survey of Egypt, 3 Salah Salem Road, Abbassiya, Cairo, Egypt. Telefax: 002 02 820 128)

**March 27-29**

**METAL BULLETIN'S 4TH INTERNATIONAL TIN CONFERENCE**, Miami, Florida, USA. (Jackie Gregson, Metal Bulletin Conferences, Park House, Park Terrace, Worcester Park, Surrey, KT4 7HY, UK. Tel: +44 (0)171 827 9977; Fax: +44 (0) 181 337 8943)

**April 24-27**

**NATURAL HAZARDS, LAND-USE PLANNING AND THE ENVIRONMENT** (6th Spanish Congress and International Conference), Granada, Spain. (Clemente Iligaray Fernández, Departamento de Ingeniería Civil, Facultad de Ciencias, Universidad de Granada, Campus Fuentenueva, 18071 Granada, Spain. Phone/Telefax: 34 58 243 367; E-mail: jchacon@ugr.es)

**May 19-22**

**AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS** (Annual Conference), San Diego, California, USA. (AAPG Convention Department, P.O. Box 979, Tulsa, OK 74101, USA. Phone: (918) 584-2555)

**May 27-29**

**GEOLOGICAL ASSOCIATION OF CANADA and MINERALOGICAL ASSOCIATION OF CANADA** (Joint Annual Meeting), Winnipeg, Manitoba, Canada. (G.S. Clark, Department of Geological Sciences, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2. Phone: (204) 474-8857; (204) 261-7581)

**June 2-6**

**4TH CONFERENCE ON PETROLEUM GEOCHEMISTRY AND EXPLORATION IN THE AFRO-ASIAN REGION**, Arusha-Tanzania. (The 4th AAPG Conference

Secretariat, Tanzania Petroleum Development Corporation, P.O. Box 5233, Dar Es Salaam, Tanzania, East Africa. Phone: 255-51-29661/2 & 36086; Fax: 255-51-29663/20775; Telex: 41219 Oil Exp. Attn: Mr. Y.S. Mwalyego, Ms. F.K. Mpanju, Mr. E.A. Kilembe)

**June 3-7**

**EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS and EUROPEAN ASSOCIATION OF PETROLEUM GEOLOGISTS** (EAEG 58th Annual Assembly and EAPG 8th Annual Congress), Amsterdam, Netherlands. (EAPG, Attention of Mr. E. van der Gaag, P.O. Box 298, NL-3700 AG, Zeist, Netherlands)

**June 6-8**

**ASIAN CONFERENCE ON X-RAYS AND RELATED TECHNIQUES IN RESEARCH AND INDUSTRY**, Tronoh, Malaysia. (The Secretariat, ACXRI '96, School of Materials and Mineral Resources Engineering, Universiti Sains Malaysia, Perak Branch Campus, 31750 Tronoh, Perak, Malaysia, Attn: Dr. Zainal Arifin Ahmad. Tel: (605) 3676901 ext. 5545/5501; Fax: (605) 3677444; Email: mrzainal@kcp.usm.MY)

**June 8-9**

**ECONOMIC GEOLOGY AND TECTONICS OF MALAYSIA AND THE SOUTHEAST ASIAN REGION** (Annual Geological Conference '96), Kota Kinabalu, Sabah, Malaysia. (The Organising chairman, Annual Geological Conference 1996, Geological Society of Malaysia, c/o Department of Geology, University of Malaya, 59100 Kuala Lumpur, Malaysia. Phone: (603) 757 7036; Fax: (603) 756 3900)

**June 9-12**

**NORTH AMERICAN PALEONTOLOGICAL CONVENTION** (6th). Washington, DC, USA. (NAPC-VI, c/o Department of Paleobiology, Mail Stop 121, National Museum of Natural History, Washington, DC, 20560, USA)

**June 17-21**

**INTERNATIONAL SYMPOSIUM ON LANDSLIDES** (7th), Trondheim, Norway. (Norwegian Geotechnical Society, P.O. Box 40, Taasen N-0801, Oslo, Norway)

**June 22-29**

**INTERNATIONAL PALYNOLOGICAL CONGRESS** (9th), Houston, Texas. (Dr. Vaughn M. Bryant, Department of Anthropology, Texas A & M University, College Station, TX 77843, USA. Phone: 409 845 5242; Telefax: 409 845 4070; E-mail: glwrenn@lsuvm.sncc.lsu.edu)

**June 27-28**

**MINERALISATION IN THE CALEDONIDES** (The Mike Gallagher Memorial Meeting), Royal Museum of Scotland, Edinburgh. (The Conference Office, The Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR. Phone: +44-(0)171-580 3802; Fax: +44-(0)171-436 5388)

**August 4-14**

**30TH INTERNATIONAL GEOLOGICAL CONGRESS** (30th), Beijing, China. (Prof. Zhao Xun, Deputy Secretary General, 30th IGC, P.O. Box 823, Beijing 100037, P.R. China. Phone: 86 1 8327772; Telefax: 86 1 8328928)

**September**

**MINERALS, METALS AND THE ENVIRONMENT II CONFERENCE**, Prague. (The Conference Office, Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, England. Phone: 0171-580 3802; Fax: 0171-436 5388)

**October 16-19**

**MINERAL DEVELOPMENT IN ASIA PACIFIC — CHALLENGES IN THE 21ST CENTURY**, Jakarta, Indonesia. (Indonesian Mining Association (IMA), Jl. Prof. Dr. Supomo SH. No. 10, Jakarta 12870, Indonesia. Phone: (62-21) 830 3632, 828 0763; Fax: (62-21) 830 3632, 828 0763).

**October 28-31**

**GEOLOGICAL SOCIETY OF AMERICA** (Annual Meeting), Denver, Colorado, USA. (Jean Kinney, GSA Headquarters, Box 9140, 3300 Penrose Place, Boulder. CO 80301, USA. Phone: 303/447-2020. Fax: 303/447-1133)

**November 10-15**

**A WORKSHOP ON TUFFS — THEIR PROPERTIES, USES, HYDROLOGY, AND RESOURCES**, Santa Fe, New Mexico. (Grant Heiken, Earth and Environmental Sciences

Division, EES-1, Los Alamos National Laboratory, Los Alamos, New Mexico, 87545 USA. Phone: 505-667-8447; Fax: 505-665-3285; E-mail: heiken@lanl.gov)

**1997**

**ASSOCIATION OF EUROPEAN GEOLOGICAL SOCIETIES** (10th Meeting), Karlovv Vary, Czechoslovakia. (Geological Society, Burlington House, Piccadilly, London W1V 0JU, UK. Phone: +44 (0) 71 -434 9944)

**CANADIAN INSTITUTE OF MINING, METALLURGY AND PETROLEUM** (99th annual general meeting), Vancouver, British Columbia, Canada. (John Gaydos, Meetings Manager, Canadian Institute of Mining and Metallurgy, 1 Place Alexis Nihon, 1210-3400 de Maisonneuve Boulevard West, Montreal, Quebec H3Z 3B8, Canada. Phone: (514) 939-2710; Telefax: (514) 939-2714)

**1998**

**CANADIAN INSTITUTE OF MINING, METALLURGY AND PETROLEUM** (100th annual general meeting), Quebec, Canada. (John Gaydos, Meetings Manager, Canadian Institute of Mining and Metallurgy, 1 Place Alexis Nihon, 1210-3400 de Maisonneuve Boulevard West, Montreal, Quebec H3Z 3B8, Canada. Phone: (514) 939-2710; Telefax: (514) 939-2714)

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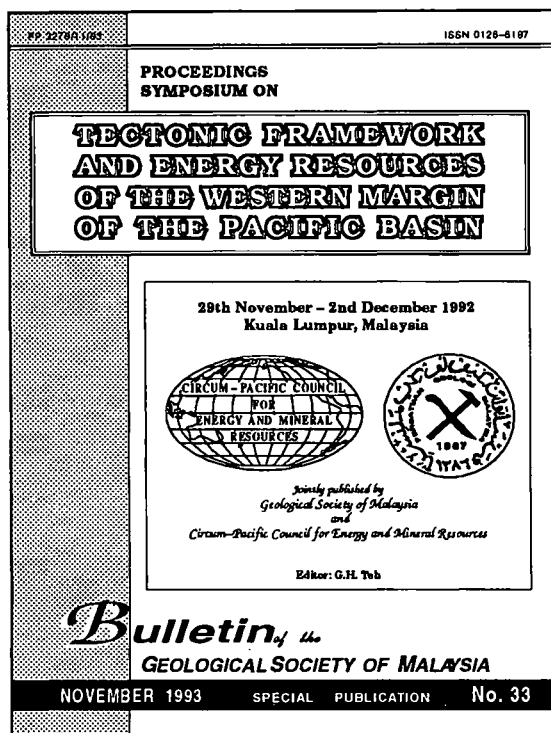
**August 9-15**

**INTERNATIONAL MINERALOGICAL ASSOCIATION: IMA '98** (17th General Meeting) Toronto, Canada. (Professor A.J. Naldrett, Department of Geology, University of Toronto, Canada M5S 3B1. Phone: (461) 978 3030; Telefax: (416) 978 3938; E-mail: ima98@quartz.geology.utoronto.ca)

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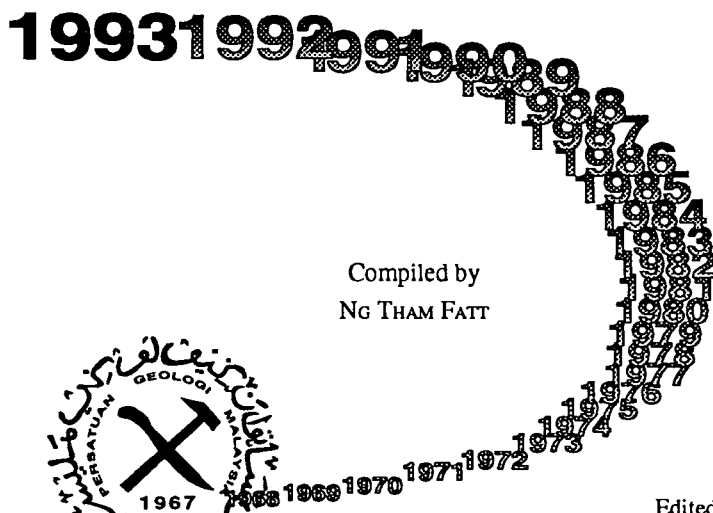
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