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ISSUED BIMONTHLY

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Geological Society of Malaysia

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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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Occurrence, subdivision and petrochemistry of mafic dykes from the Perhentian islands

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50603, Kuala Lumpur

Abstract: Mesozoic mafic dykes in the Perhentian islands and their surrounding area can be divided into two based on their field occurrence, i.e. the older and younger dykes. The older dykes are synplutonic to their felsic host and the younger dykes postdate their felsic host. Synplutonic features shown by the older dykes are recrystallisation of the dyke with the production of amphibolite or hornfelsic texture, back veining into the dyke and dismemberment of the dyke into trains of amoeboid enclaves. All these features suggest that hot mafic dyke magma intruded into the mobile semi solid felsic magma. The younger dykes, which are more abundant, are mainly doleritic in composition and are similar to those found throughout the Eastern Belt. They are made up of plagioclase, clinopyroxene, amphibole, iron ore and chlorite. Geochemical study shows that the dykes formed in a continental within plate tectonic setting.

Abstrak: Daik mafik yang berumur Mesozoik di Pulau Perhentian dan kawasan sekitarnya boleh dibahagikan kepada dua berdasarkan kepada kewujudan lapangan iaitu daik tua dan daik muda. Daik tua adalah sinplutonik dengan host felsiknya dan daik muda adalah 'postdate' dengan host felsiknya. Ciri-ciri sinplutonik yang ditunjukkan oleh daik tua ialah penghabluran semula daik dengan pembentukan tekstur amfibolit dan honfelsik, 'back veining' kedalam daik dan pemisahan daik kepada enclave ameboid. Kesemua ciri-ciri ini mencadangkan bahawa magma panas daik mafik telah menerobos kedalam magma felsik yang separa menghablur. Daik muda, yang lebih banyak dijumpai, adalah berkomposisi doleritik dan sama dengan daik-daik yang di temui di Jalur Timur. Mineralogi daik ini terdiri dari plagioklas, klinopiroksin, amfibol, mineral opak dan klorit. Kajian geokimia menunjukkan yang daik muda ini terbentuk di sekitaran tektonik dalam plata pada sekitaran benua.

INTRODUCTION

One of the Mesozoic igneous events in the Eastern Belt of Peninsular Malaysia is the intrusion of mafic magmatism as dykes. These dykes are without doubt the most neglected aspect of the igneous province in Peninsular Malaysia. The dykes, intruding both intermediate to felsic igneous rocks and older layered rocks, are widespread, not only in the mainland but also in several islands off the East Coast of Peninsular Malaysia (Haile *et al.*, 1983; Azman, 1992, 2000a, b; Azman *et al.*, 1998). Despite being abundant in many parts of the area, they have to date received little consideration in regional models. A complete field and geochemical based study, which comprises data for the dykes in this region, does not, as yet, exist. Such a study is an important step to fully constrain the wholly mantle derived magma composition which were available throughout the second half of the Mesozoic time.

This paper will present data of an ongoing research on the mafic dykes from the Perhentian islands, Terengganu (Fig. 1). The dykes extensively intruded both metasediments and

igneous rocks of the islands (Fig. 1). This paper will describe the field occurrence, subdivision and provide a preliminary geochemical data of the dykes in this area. The dykes will be divided into two namely older and younger dykes. The older dykes occur synplutonicaly with their host rock whereas the latter postdates the host rock. Studies show that the younger ones are more abundant and are found intruding the Eastern Belt igneous and sedimentary rocks.

GENERAL GEOLOGY

The Perhentian islands are situated at the northern part of the Eastern Belt of Peninsular Malaysia and west of the Tertiary Malay Basin. The Perhentian islands consist of several islands, the biggest of which are Perhentian Kecil and Perhentian Besar (Fig. 1). The area is underlain by metasedimentary rocks and intruded by a series of igneous rocks ranging from granitic to syenitic compositions. They are considered as part of Eastern Belt magmatism of Peninsular Malaysia (Cobbing and Mallick, 1987). The metasedimentary rocks are represented by slate, quartzite, pelitic hornfels and calc-silicate hornfels (Azman, 1992; Azman and Khoo, 1998).

The Perhentian area is underlain by two main types of igneous phases namely the Perhentian Kecil syenite and the Perhentian granite, which intruded the metasediments. The Perhentian Kecil syenite forms a circular outcrop at the central part of Perhentian Kecil Island. Although from the map, it appears to intrude the surrounding granite body, field evidence shows that the Perhentian granite is relatively younger than the Perhentian Kecil syenite (Azman and Khoo, 1998). The pluton consists of a variety of igneous rocks ranging in composition from syenitic to monzonitic and even gabbroic. In terms of percentage, the syenitic rock total almost 90% of the pluton.

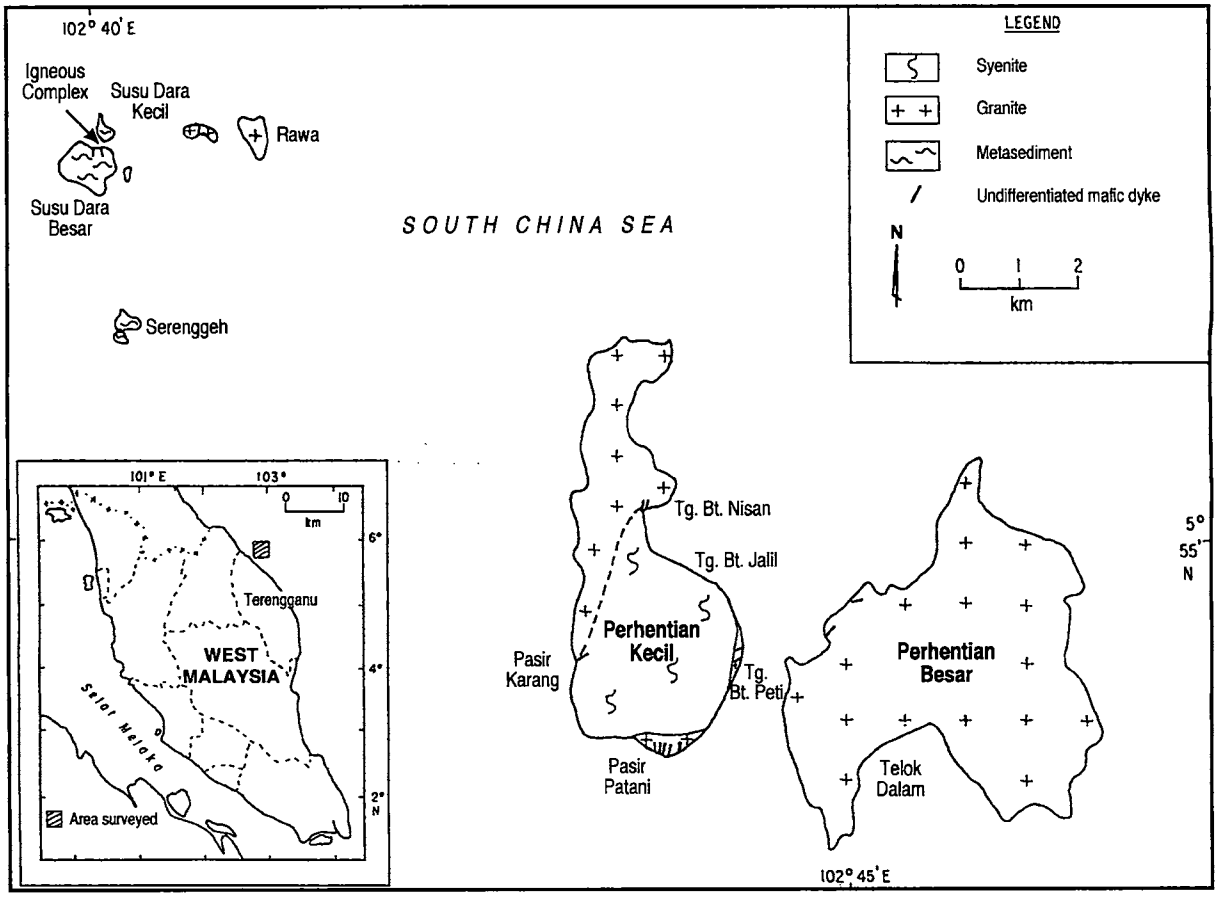

Figure 1. Geological map of the Perhentian islands and their surrounding area.

Epidote nodules and veins (thickness from 2 to 5 cm) can be seen throughout the pluton. The Perhentian granite has been divided into 2 varieties by Cobbing and Mallick (1987) namely hornblende-bearing and hornblende-free granite. The main body of Perhentian granite consists of medium to coarse grained biotite granite (hornblende-free granite) exposed along the coast of Perhentian Besar island, northern and southern parts of Perhentian island and the whole of Rawa island (Fig. 1). Microgranite and granite porphyry are found at the contact with Perhentian Kecil syenite. Occasionally the microgranite contains pegmatite patches characterized by large plates of muscovite, biotite and K-feldspar. Field, petrography and chemical evidence suggest that the Perhentian Kecil syenite and Perhentian granite are not co-magmatic (Azman and Khoo, 1998; Azman, 2001, in press).

FIELD OCCURRENCE OF THE MAFIC DYKES

The best dykes' exposure can be found along the coastal area. In general the dykes can be divided into two groups based on the relative age to the host rock. They are the older and the younger dykes. The older dykes are coeval to their felsic host and younger dykes postdate their felsic host. The latter is more abundant and found in all six Perhentian islands.

The older dykes occur in the eastern part of the Perhentian Kecil island and only found intruding into the Perhentian Kecil syenite. Their width varies from a few cm to 20 cm and length up to several meters and are marked by necking and disrupting or pinching and swelling along their length (Fig. 2). Other synplutonic features shown by the dykes are recrystallisation of the dyke with the production of amphibolite or hornfelsic texture, back veining into the dyke and dismemberment of the dyke into trains of amoeboid enclaves (Azman, 1998). Inclusion of the host material in the dykes suggest that the quenched dykes carapace were sometimes breached by host vein material which broke up into globules on penetrating the more fluid interior of the dykes. All these features suggest that hot mafic dyke magma intruded into mobile semi solid felsic magma.

The younger dykes are green to dark green in colour with average thickness ranging from 10 cm to 3 meters. A total of 23 younger dykes were found to intrude all the three main rock types in the study area. The thicker dykes commonly show chilled margins and a regular inward increase of grain size. Angular to sub angular inclusions of granitic host up to 0.5 m across are occasionally found in the dykes. In the Perhentian Besar Island, at Pasir Tiga Ruang, three dykes converge to form a dyke. The dykes are sometimes intruded by yellowish green epidote veins with average thickness of 15 cm. Amygdales filled with calcite, zeolite, quartz and analcite are sometimes found in the dykes.

PETROLOGY

Older dykes

The dykes consist of plagioclase, biotite, hornblende, clinopyroxene and quartz. In thin section, the dykes show an amphibolitic texture (suggesting their basic origin) or sometimes hornfelsic texture. Detailed inspection of sawn slabs of the sample from Tanjung Batu Sireh show that the dyke is banded. It consists of alternating greyish non-biotite and reddish grey biotite-bearing bands. A syenitic back-vein up to 1 cm in thickness can be seen cutting the dykes. The vein is made up of subhedral to anhedral K-feldspar set in relatively finer grained hornblende, biotite, opaque phase and sphene. The grain size of the vein is up to 2.5 mm, compared to the dykes, usually less than 0.3 mm. Flow texture produced by alignment of hornblende and sphene is well developed in the vein (Fig. 3). Evidence of plastic deformation shown by sphene crystals may suggest that the veining occurred in a semi-solid condition (Fig. 4). These imply that the syenitic magma has already crystallised when it came into contact with the dyke magma. The flow alignment is commonly parallel to the vein margin. The dyke minerals also show strong flow alignment. Interestingly, the alignment of the minerals in the dykes curve following the crenulate outline of the vein (c.f. Vernon, 1991).

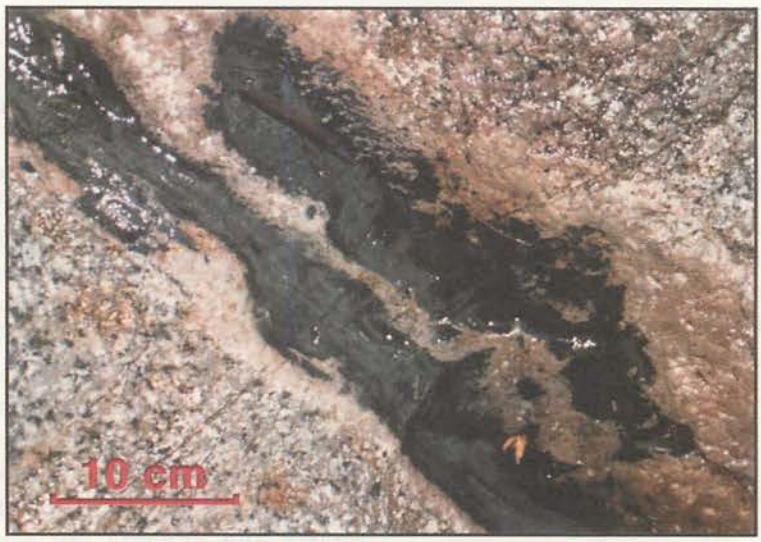

Figure 2. Photograph of the synplutonic dyke found in Tanjung Batu Peti showing irregular shape and pinching along its length. Location: Eastern part of the Perhentian Kecil island.

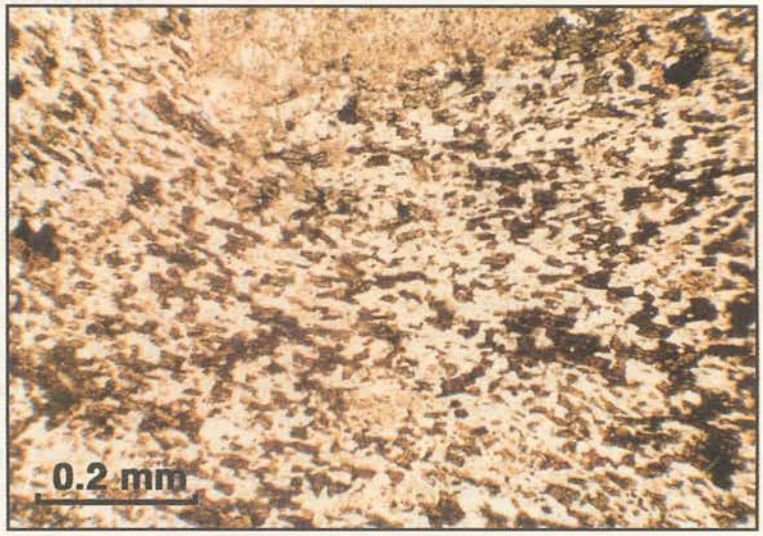

Figure 3. Photomicrograph of flow texture around K-feldspar inclusion.

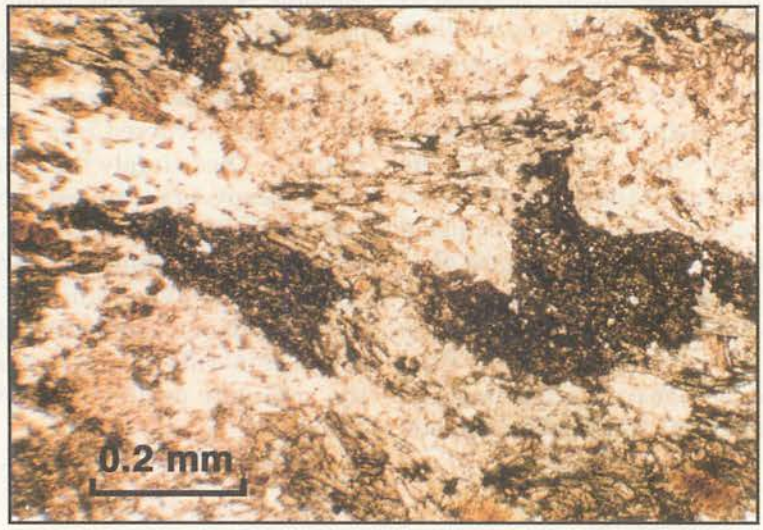

Figure 4. Photomicrograph of deformed sphene in syenitic vein.

Younger dykes

The dyke rocks are made up of plagioclase, clinopyroxene, amphibole, iron ore and chlorite. In general the texture is either intergranular or subophitic. The rocks are often chloritised to varying degrees and in the most extreme case contain up to about 60% modal chlorite. Pale green fibrous uralite may be present within chlorite. MacDonald (1967) suggested that both chlorite and uralite are late magmatic phases. Plagioclase crystals occur as small subhedral to euhedral laths, which do not show any preferred orientation. The crystals sometimes show twinning but rarely zoning. Clinopyroxene, mainly augite, generally subhedral to anhedral, occurs as interstitial grains between plagioclase laths forming a typical doleritic texture. Lamprobolite (basaltic hornblende) if present, is usually less than 5%. This mineral is characterised by its brown colour. Common pleochroism is X = light yellow; Y = brown and Z = dark red brown. In some samples, euhedral to anhedral iron ore can constitute up to 10%. MacDonald (1967) showed that ilmenite is the main iron ore type in the quartz dolerite from the Eastern Belt. In rare cases, some interstitial calcite may occur.

DISCUSSION

Textural constraints on the age of the older dykes

The phenomenon of disruption of a mafic dyke within a felsic host is ubiquitous. It has been discussed in some detail by many authors (e.g. Roddick and Armstrong, 1959; Moore and Hopson, 1961; Kumar, 1988; Pitcher, 1991). Most of the descriptions can be matched to the examples described in this paper. The field features shown by the older dykes suggests that the dyke intrusion is coeval to its host. Lobate to crenulate contact and necking of the dykes suggest that the dyke magma was injected into the mobile semi solid syenitic magma. This is evident from the flow texture developed in both dykes and back vein. Plastic deformation shown by some of the minerals in the syenitic vein (e.g. sphene) suggest that the early crystallised mineral was dragged by the magmatic flow. Occurrence of syenitic inclusions in the dykes suggests that the quenched dykes carapace were sometimes breached by syenitic vein material which broke up into globules on penetrating the more fluid interior of the dykes (Bussell, 1991). Occurrence of fine grained or pegmatitic borders of syenitic composition suggests contraction of dyke magma after cooling. This gave rise to syenitic liquid filling the marginal area of the dyke. The amphibolitic or hornfelsic texture of the dykes suggest that they have undergone metamorphism. The texture may have been the result of metasomatism caused by differences in the concentration gradient of certain elements between the dyke and the host interface.

Tectonic setting of the younger dykes

This section will discuss some of the tectonic aspects of the younger dykes based on the geochemical data. Geochemical data discussed in this section are taken from Azman *et al.* (1998). Numerous studies have shown that immobile element compositions of basaltic rocks can be used to determine chemical affinities and tectonic setting, even after alteration (Pearce and Cann, 1973; Winchester and Floyd, 1976; Meschede, 1986). Many of the diagrams use high field strength elements such as Ti, Zr, Y and Nb and P which are thought to be relatively immobile in aqueous fluids unless there are high activities of F^-. On a plot of Zr/Y and Ti/Y (Fig. 5), the majority of the samples plot in the within plate basalt field. On a plot Ti/100–Zr–Yx3 ternary diagram (Fig. 6), most of the samples plot mainly on the within plate basalt-island arc tholeiite line. The tholeiitic nature of the dykes magma is also supported by the petrographic and geochemical studies, for example the normative plot which established that the dykes range in composition from olivine tholeiite to quartz tholeiite (Azman *et al.*, 1998). This is also true for the dykes from Terengganu mainland (Azman *et al.*, in prep).

Hence, the chemical data indicate that the dolerites are formed in a continental within plate tectonic setting. The magmatic affinities and tectonic setting of the presently studied dykes is similar to the dolerites in the Kuantan area (central Eastern Belt) which also range in composition from olivine tholeiite to quartz

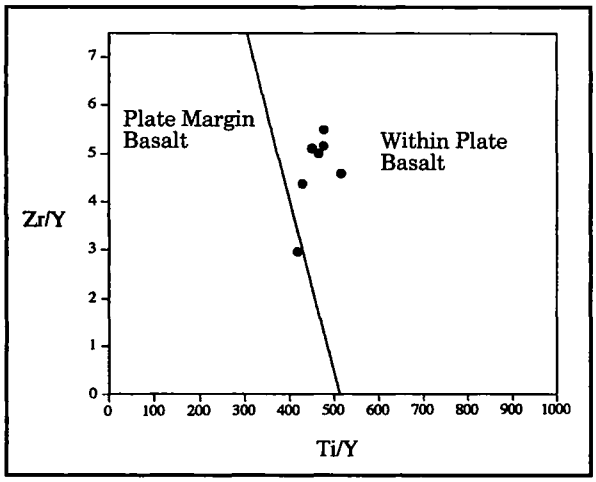

Figure 5. Zr/Y vs Ti/Y plot of the mafic dykes from the Perhentian islands.

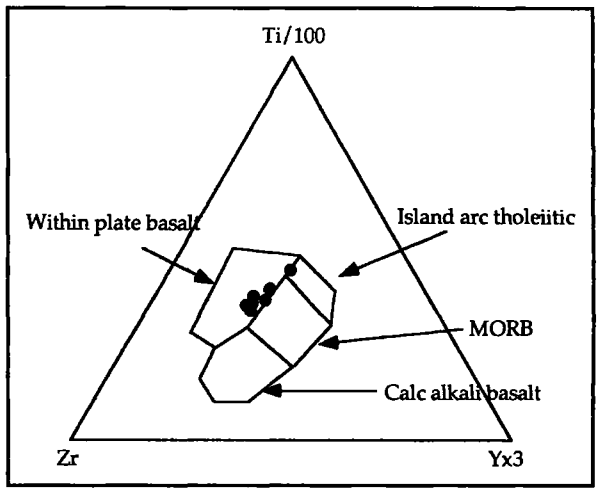

Figure 6. Ternary plot of Ti/100-Zr-Yx3. Fields from Pearce and Cann (1973).

tholeiite and bear affinities to the tholeiites of continental setting (Chakraborty, unpublished work, in Sita Ram *et al.*, 1980). Regionally, the tectonic setting of the dykes is similar to the Upper Paleozoic volcanic rocks from Chiang Mai belt, northern Thailand (Barr *et al.*, 1990) and Upper Cenozoic basaltic rocks of Thailand, Kampuchea and Vietnam (Barr and James, 1990).

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Manuscript received 15 April 2001

PERTEMUAN PERSATUAN
Meetings of the Society

Ceramah Teknik (Technical Talk)

MALAM Jurutera II
Engineers Night II

Wednesday, 16 May 2001
Department of Geology
University of Malaya

Design of embankments in soft clays

TAN YEAN CHIN

Design of marine structures: geotechnical & environmental aspects

LEE ENG CHOY

Slopes in hill-site development

YEE YEW WENG

Laporan (Report)

Three "young" engineers presented talks to members of GSM at this event.

1. Ir. Tan Yean Chin (Gue & Partners)
   Design of embankments in soft clays
2. Ir. Lee Eng Choy (dpi Konsult)
   Design of marine structures: geotechnical & environmental aspects
3. Ir. Yee Yew Weng (Arup Perunding)
   Slopes in hill-site development

Ir. Tan Y.C. gave a comprehensive discussion on the design of embankments on soft clays, including types and modes of failures, case histories, analysis, etc. The Muar trial embankment was also used as illustration.

Ir. Lee E.C. presented various geotechnical and environmental considerations in the design of marine structures such as wharfs, ports, etc. Corrosion of concrete structures due to the high chloride environment was highlighted. The interesting phenomenon of "breathing" structures and "suffocating" structures was introduced, much to the amusement of the audience.

Ir. Yee Y.W. discussed in great detail the application of caissons in foundation and slope stabilization works in Malaysia, with examples from the Genting Highlands. Construction method, analysis, advantages, cost comparisons, etc. were presented, and amply supported by case histories and field data.

All presentations were followed by lively discussions and questions from the floor.

About 20 people were present.

Tan Boon Kong
Chairman
Working Group on Engineering Geology & Hydrogeology

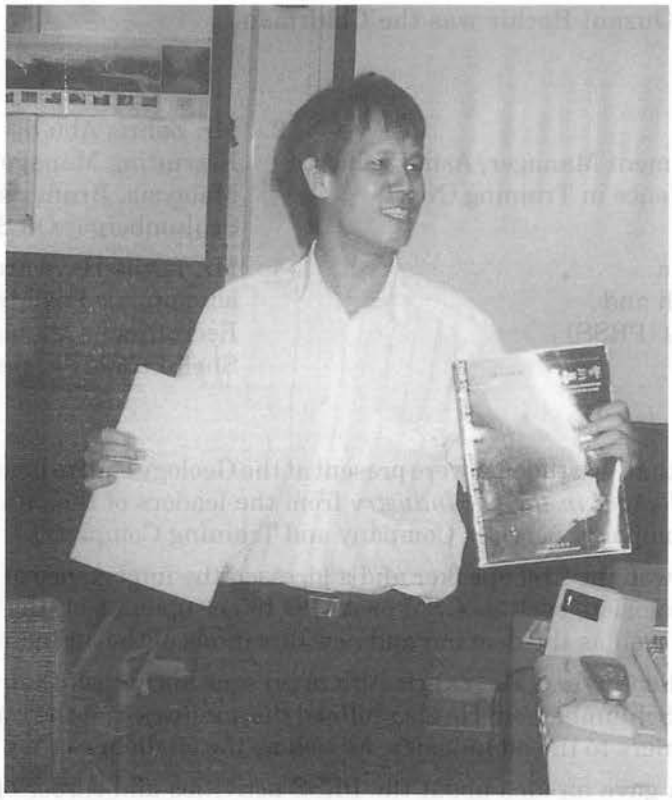
Geology of the three gorges on the Changjiang (Yangtze) River — a CD presentation

LEE CHAI PENG

Laporan (Report)

Dr. Lee Chai Peng, who was recently in China, gave an audio-visual presentation of the geology of the famous three gorges of the Yangtze River, on a CD he obtained on the trip, on Monday 18 June 2001 at 5.30 pm at the Geology Department, University of Malaya.

It turned out to be a very informative presentation.



Report on the AAPG Student Chapter and GSM Talk June 24, 2001

Career Opportunities and Career Challenges in the Oil Industry

The talk was organised as a monthly activity of the AAPG Student Chapter in collaboration with the GSM. Mr. Ouzani Bachir was the Chairman.

Speakers

1. Mr. Peter Lloyd
   Business Development Manager, Asia-Pacific
   Network of Excellence in Training (NexT)
2. Mr. Zahris Abu
   Recruiting Manager
   Malaysia, Brunei & Philippines
   Schlumberger Oil Services
3. Dr. Mazlan Madon
   Petronas Research and
   Scientific Services (PRSS)
4. Mr. Leslie Hayward
   accompanied by Mr. Denis Tan
   Recruitment Manager
   Shell People Services

Program

- At 9.30 am more than 40 students were present at the Geology Hall to hear *Career Opportunities and Career Challenges in the Oil Industry* from the leaders of the oil industry (National Oil Company, Oil Company, Services Company and Training Company).
- Mr. Peter Lloyd was the first speaker and addressed the importance of being a member of an association of geologists such as GSM or AAPG to get updates on the ongoing research and achievements as well as the demand and new directions of the oil industry.
- The Chairman then invited Mr. Zahris Abu to present his speech that was focused on career opportunities in Schlumberger. He also defined the qualities that the companies are expecting from the new comers to the oil industry, as well as the challenges they could face.
- Dr. Mazlan then gave an idea about the PRSS activities and career opportunities available especially with worldwide expansion of Petronas.
- Mr Leslie Hayward was the last speaker. He introduced Shell activities in Malaysia and worldwide. Mr. Hayward showed the different opportunities available in Shell and explained the new human resources strategy adopted by Shell.
- At around 12.30 pm the Chairman Ouzani invited Dr. Azhar, Head of Geology Department, to close the session and present tokens of appreciation to the speakers.
- All those present were then invited for tea at the 1st Year Lab.

Ouzani Bachir
President of the AAPG Student Chapter

Career Opportunities and Career Challenges in the Oil Industry

Annual Geological Conference 2001

Pan Pacific Resort, Pangkor Island
Perak Darul Ridzuan

2–3 June 2001

Laporan (Report)

Persidangan Tahunan Geologi 2001 telah diadakan pada 2–3 Jun 2001 di Pan Pacific Resort, Pulau Pangkor, Perak. Persidangan tahun ini telah disertai oleh 189 peserta dari pelbagai institusi geosains dan syarikat swasta. Persidangan ini telah dirasmikan oleh Y.B. Dato' Ho Cheng Wang — Ahli Mesyuarat Majlis Kerajaan Negeri Perak yang mewakili Y.A.B. Menteri Besar Perak. Buat pertama kalinya, Persidangan Tahunan Geologi telah dirasmikan pada waktu malam, iaitu sempena Jamuan Malam Persidangan sumbangan Kerajaan Negeri Perak pada malam 1 Jun 2001.

Sebanyak 51 kertas kerja telah diterima untuk pembentangan dalam Persidangan Tahunan Geologi 2001. Agak menarik sekali, kertas kerja ini datang dari tidak kurang 10 institusi pengajian tinggi/penyelidikan dan 7 syarikat swasta. Malah Persidangan ini juga telah turut menarik penyertaan peserta luar negara. Peningkatan sumbangan daripada Jabatan Mineral dan Geosains, juga begitu ketara sekali pada pesidangan kali ini. 30 kertas kerja telah dibentangkan secara lisan dalam persidangan ini dan selebihnya 21 kertas telah dibentangkan secara poster. Pembatasan jumlah kertas lisan dilakukan bagi memberikan peluang kepada peserta mengikuti semua pembentangan dengan selesa tanpa perlu membuat pilihan. Walaupun cara ini telah meningkatkan jumlah kertas yang terpaksa dibentang secara poster, namun penganjur telah memberikan waktu yang agak panjang untuk sesi pembentangan poster. Selain membataskan kertas untuk pembentangan lisan, penganjur juga membataskan kertas utama kepada dua kertas yang meliputi aspek hiliran dan huluan dalam pengeksploitasian sumber bumi. Kertas utama persidangan kali ini disampaikan oleh Ketua Pengarah Jabatan Mineral dan Geosains dan Pengarah Pusat Remote Sensing Negara. Sebanyak 48 kertas penuh telah diwasit dan telah dicetak sebagai naskah prosiding.

Sempena tema persidangan ini *"Mempertingkatkan sumbangan geosaintis dalam pembangunan Malaysia"*, satu forum telah diadakan sebelum sesi pembentangan kertas teknikal dimulakan. Ahli panel forum telah dipilih bagi mewakili pelbagai sektor atau industri yang berasaskan geosains termasuk industri petroleum, industri perlombongan, juru runding, akademik, Jabatan Mineral dan Geosains dan Institut Geologi Malaysia selaku badan bukan kerajaan. Selain sumbangan Jamuan Malam Persidangan oleh Kerajaan Negeri Perak, Persidangan Tahunan Geologi 2001 turut ditaja oleh Malaysia Mining Corporation, Esso Production Malaysia Inc., Specific Resources Sdn Bhd dan Perak-Hanjung Simen Sdn. Bhd.

Mohd Shafeea Leman

Annual Geological Conference 2001

Pan Pacific Resort, Pangkor Island
Perak Darul Ridzuan

2–3 June 2001

Ucapan Alu-aluan oleh Prof. Madya Dr. Mohd Shafeea Leman, Pengerusi Jawatankuasa Penganjur Persidangan Tahunan Geologi 2001

Yang Dihormati Tuan Pengerusi Majlis,

Y.A.B. Dato' Seri Di Raja Mohd Tajol Rosli Tan Sri Ghazali
Menteri Besar Perak Darul Redzuan,

Yang Berusaha Dr. Abdul Ghani Rafek
Presiden Persatuan Geologi Malaysia,

Ahli-Ahli Yang Berhormat,

Tuan-Tuan dan Puan-Puan serta hadirin yang dihormati sekelian.

Assalamualaikum Warahmatullahi Wabarakatuh dan Salam sejahtera,

Terlebih dahulu saya mengucapkan selamat datang ke Persidangan Tahunan Geologi 2001, yang julung kalinya diadakan di Pulau Pangkor yang indah ini. Saya ingin mengucapkan ribuan terima kasih kepada *Y.A.B. Dato' Seri Di Raja Mohd Tajol Rosli Tan Sri Ghazali, Menteri Besar Perak Darul Redzuan* kerana sudi hadir ke Majlis pada malam ini dan seterusnya merasmikan persidangan kita kali ini. Saya juga mengucapkan ribuan terima kasih kepada *Dato' Seri Di Raja Mohd Tajol Rosli Tan Sri Ghazali* dan *Kerajaan Negeri Perak Darul Redzuan* kerana sudi menjamu para peserta pada malam yang berbahagia ini.

Pada kesempatan ini, izinkan saya mengucapkan ribuan terima kasih kepada Malaysia Mining Corporation Bhd. yang merupakan penaja utama dalam menjayakan Persidangan Tahunan Geologi 2001 ini. Terima kasih juga diucapkan kepada Specific Resources Sdn Bhd dan Projek Lebuhraya Utara Selatan Berhad (PLUS) sumbangan dan sokongan mereka. Terima kasih juga ditujukan kepada Jabatan Mineral dan Geosains, Universiti Malaya, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia dan Institut Geologi Malaysia kerana sudi bekerjasama dalam menjayakan persidangan ini.

Para hadirin yang saya hormati sekalian, seperti tahun lepas, pada Persidangan tahun ini, prosiding kertas kerja telah diterbitkan dan akan diedarkan kepada para peserta semasa pendaftaran. Di sini saya mengucapkan ribuan terima kasih kepada semua penyumbang, pentasyih sepakar dan ahli jawatankuasa kecil penyunting yang telah bertungkus lumus untuk

memastikan prosiding tersebut diterbitkan untuk diedarkan kepada semua peserta seperti yang dijanjikan. Saya juga amat terhutang budi kepada semua ahli Jawatankuasa Penganjur, yang walaupun sibuk dengan tugas resmi masing-masing, masih sanggup meluangkan masa untuk membantu menjayakan persidangan ini. Semoga usaha gigih kalian akan terbalas dengan tercapainya objektif dan matlamat persidangan selama dua hari ini.

Akhir kata, saya sekali lagi mengucapkan ribuan terima kasih kepada *Y.A.B. Dato' Seri Di Raja Mohd Tajol Rosli Tan Sri Ghazali, Menteri Besar Perak Darul Redzuan*, kerana sudi menghadiri majlis ini dan merasmikan persidangan tahunan kali ini.

Sekian, terima kasih.

Annual Geological Conference 2001

Pan Pacific Resort, Pangkor Island
Perak Darul Ridzuan

2–3 June 2001

Ucapan Prof. Madya Dr. Abdul Ghani Rafek, Presiden Persatuan Geologi Malaysia sempena Majlis Perasmian Persidangan Tahunan Geologi 2001

Yang Dihormati Tuan Pengerusi Majlis,

Yang Berhormat Dato' Ho Cheng Wang
Ahli Majlis Mesyuarat Kerajaan Negeri merangkap Pengerusi Jawatankuasa Kesihatan, Sains, Teknologi dan Alam Sekitar Negeri Perak, mewakili Y.A.B. Dato' Seri Di Raja Mohd Tajol Rosli bin Tan Sri Ghazali, Menteri Besar Perak Darul Ridzuan,

Yang Berusaha, Dr. Mohd Shafeea Leman
Pengerusi Jawatankuasa Penganjur, Persidangan Tahunan Geologi 2001,

Ahli-Ahli yang Berhormat,

Para jemputan,

Rakan-rakan geologis,

Tuan-Tuan dan Puan-Puan para hadirin yang dihormati sekalian,

Assalamualaikum dan salam sejahtera,

Saya bersyukur kepada Allah SWT kerana dengan limpah kurniaNya dapat kita bersama pada malam yang indah ini. Saya mengucapkan terima kasih kepada *Yang Berhormat Dato' Ho Cheng Wang yang mewakili Y.A.B. Menteri Besar Perak Darul Redzuan),* kerana sudi meluangkan masa untuk bersama kita pada Majlis yang berbahagia ini dan seterusnya merasmikan Persidangan Tahunan Geologi 2001. Selamat datang ke Persidangan Geologi 2001 juga saya ucapkan kepada Tuan-Tuan dan Puan-Puan yang saya hormati sekelian.

Walaupun Persidangan Tahunan Geologi ini merupakan kali pertama diadakan di Pulau Pangkor, tetapi Negeri Perak telahpun menjadi tuan rumah pada tahun 1990. Persidangan Tahunan Geologi 2001 merupakan persidangan yang ke-15; satu tradisi yang telahpun dimulakan pada tahun 1986. Dalam Persidangan kali ini, sebanyak 48 kertas kerja penuh telah diterbitkan dalam Prosiding Persidangan, hasil penyelidikan dan penyiastan geologi dalam lapan bidang tema program saintifik persidangan. Persidangan kali ini lebih menumpukan kepada pengeksploitasian dan pengurusan secara optimum sumber bumi dalam menyokong pembangunan

negara, bertepatan dengan tema persidangan "Enhancing the Contribution of Geoscientists in the Development of Malaysia" atau "Mempertingkatkan Sumbangan Geosaintis dalam Pembangunan Malaysia". Pembatasan sesi teknikal kepada satu sesi, diharapkan dapat menghasilkan suasana persidangan yang lebih selesa dan memberikan peluang kepada para peserta mengikuti kesemua sesi tanpa perlu membuat pilihan. Pemberian masa yang lebih lama untuk sesi poster pula, diharapkan dapat memberi lebih peluang kepada para peserta meneliti poster-poster yang disediakan.

Satu forum akan diadakan bagi membincangkan tema persidangan. Forum ini dianjurkan bersama dengan Institut Geologi Malaysia dan disertai oleh perwakilan dari beberapa institusi berasaskan geosains, Jabatan Mineral dan Geosains Malaysia, universiti dan badan bukan kerajaan. Resolusi forum ini akan diedarkan kepada semua pihak yang berkaitan dengan Geosains.

Tuan-Tuan dan Puan-Puan,

Persidangan seperti ini tidak dapat diadakan tanpa sokongan dan bantuan beberapa pihak. Izinkan saya mengambil kesempatan ini untuk merakamkan penghargaan dan terima kasih kepada YAB Dato' Seri Menteri Besar Perak, Y.B. Dato' Ho Cheng Wang dan Kerajaan Negeri Perak, Malaysian Mining Corporation, ESSO Production Malaysia Inc., Specific Resources Sdn Bhd., Perak-Hanjung Simen Sdn. Bhd., Jabatan Mineral dan Geosains, Universiti Malaya, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia, Institut Geologi Malaysia, Dr. Mohd Shafeea Leman dengan jawatankuasa beliau, semua penyumbang kertas kerja, pentaksih sepakar dan semua peserta persidangan.

Akhir sekali saya memohon ma'af atas segala kekurangan Persidangan ini.

Sekian, terima kasih.

Annual Geological Conference 2001

Pan Pacific Resort, Pangkor Island
Perak Darul Ridzuan

2–3 June 2001

Opening Address by Y.A.B. Dato' Seri Di Raja Mohd Tajol Rosli Tan Sri Ghazali, Menteri Besar Perak Darul Ridzuan

Teks Ucapan Y. A. B. Dato' Seri Di Raja Mohd Tajol Rosli bin Tan Sri Ghazali, Menteri Besar Perak di Majlis Perasmian pada 1 Jun 2001

Yang Dihormati Tuan Pengerusi Majlis,

Yang Berusaha Dr. Abdul Ghani Rafek, Presiden Persatuan Geologi Malaysia,

Yang Berusaha Dr. Mohd Shafeea Leman, Pengerusi Jawatankuasa Penganjur Persidangan,

Tuan-Tuan dan Puan-Puan hadirin yang dihormati sekalian

Assalamualaikum dan Salam Sejahtera.

Saya berasa amat gembira kerana Persatuan Geologi Malaysia telah sekali lagi memilih untuk bersidang di Negeri Perak Darul Redzuan. Saya juga turut gembira kerana diberi kesempatan untuk berucap kepada para peserta persidangan yang terdiri daripada geosaintis dari universiti tempatan dan juga mereka yang berkhidmat dengan agensi Kerajaan, Badan-Badan Berkanun dan dari sektor swasta. Saya ucapkan selamat datang ke Negeri Perak Darul Redzuan.

Saya difahamkan Persidangan Tahunan Geologi kali ini adalah yang ke-15 diadakan dan kali kedua ianya dianjurkan di Negeri Perak. Saya percaya suasana Pulau Pangkor dengan alam sekitar yang indah, nyaman dan tenteram akan mfô÷antu Tuan-Tuan dan Puan-Puan melahirkan ide-ide lebih bernas, untuk meningkatkan kefahaman akademik dan profesyen geosaintis, dan selanjutnya untuk meningkatkan sumbangan geosaintis dari pelbagai disiplin dalam pembangunan negara.

Kehadiran Tuan-Tuan dan Puan-Puan di sini, jelas menunjukkan betapa pentingnya persidangan ini bukan saja kepada Persatuan Geologi Malaysia malah kepada negara. Tidak boleh dinafikan bahawa Tuan-Tuan dan Puan-Puan merupakan aset penting kepada negara. Penglibatan Tuan-Tuan dan Puan-Puan secara langsung di dalam penjelajahan dan pembangunan sumber tabii seperti petroleum, gas, air tanah, mineral logam, mineral industri dan sebagainya telah banyak menyumbang kepada kekayaan negara. Memandangkan kebanyakan sumber tabii tidak dapat diperbaharui, maka sebahagian daripada tanggungjawab Tuan-Tuan dan

Puan-Puan adalah untuk memastikan penggunaan sumber tersebut dilakukan secara mampan supaya dapat dimanfaatkan oleh generasi kini dan generasi kita yang akan datang.

Sumbangan Tuan-Tuan dan Puan-Puan amat kritikal bagi mengelakkan kejadian bencana seperti tanah runtuh, amblesan, hakisan, banjir dan banjir kilat serta bagi menentukan kesesuaian tapak dalam projek pembangunan. Sumbangan tersebut penting bagi memastikan kesejahteraan masyarakat terjamin dalam mencapai pembangunan yang mampan ketika negara bergerak pantas menuju ke era negara maju. Di samping itu, Tuan-Tuan dan Puan-Puan juga memainkan peranan penting dalam pemuliharaan alam sekitar bagi menjamin pembangunan mampan terlaksana.

Bagi Negeri Perak Darul Redzuan, pembangunan negeri ini memang berkait rapat dengan eksploitasi sumber tabii bumi yang telahpun mula diusahakan lebih se abad yang lalu. Saya pasti, terlalu banyak pengalaman pahit-manis dan suka-duka yang telah dialami oleh geosaintis pelbagai generasi, dalam usaha mereka memakmurkan Negeri Bijih Timah ini. Jika dahulu bijih timah menjadi sumber kekayaan Negeri Perak, kini mineral industri seperti batu kapur, pasir silika dan lempung telah memainkan peranan yang sangat penting dalam menjana pertumbuhan ekonomi negeri ini.

Saya difahamkan, geopelancongan, dengan berkonsepkan pengeksploitasian tanpa musnah sumber bumi dan landskap mempunyai potensi yang cerah sebagai penyumbang kepada pembangunan ekonomi Negeri Perak Darul Redzuan.

Tuan-Tuan dan Puan-Puan,

Dalam menghadapi cabaran alaf baru ahli geosaintis perlu menjadi lebih proaktif sebagai agen pembangunan yang menyumbang kepada pembuatan dasar dengan menyuarakan pendapat dan memberi nasihat bila difikirkan perlu. Di samping itu, geosaintis juga perlu menjaga mutu kerja secara lebih profesional supaya produk yang dihasilkan tidak diragui. Saya percaya kelulusan "Akta Profesional Geologis" yang kini sedang dikaji dan dihalusi oleh Pihak Peguam Negara akan membantu mengawal profesion geosaintis. Semoga dengan kelulusan akta tersebut, kepentingan masyarakat akan lebih terjamin, kerana tidak akan berlaku lagi kemungkinan kerja-kerja geologi dilakukan oleh mereka yang tidak berkelayakan. Saya difahamkan bahawa suatu forum telah dirancang pada pagi esok untuk membincangkan kaedah-kaedah menyerlahkan sumbangan geosaintis terhadap pembangunan negara. Saya harap semua peserta dapat mengambil kesempatan ini untuk berdialog dan mendapatkan konsensus tentang kerjasama yang perlu dilakukan semua pihak bagi meningkatkan sumbangan geosaintis terhadap pembangunan negara.

Saya mengambil kesempatan mengucapkan tahniah atas segala kejayaan yang telah dicapai oleh geosaintis sehingga kini. Tahniah juga ucapkan kepada Persatuan Geologi Malaysia atas kejayaan penganjuran persidangan ini. Dengan itu, saya menyeru supaya Tuan-Tuan dan Puan-Puan menggunakan peluang bersidang di Pulau Pangkor untuk melahirkan ide-ide lebih bernas bagi menghadapi cabaran pada abad yang ke 21 dalam membantu usaha pencapaian pembangunan mampan di Malaysia.

Buat mengakhiri ucapan, saya sekali lagi mengucapkan ribuan terima kasih kepada pihak penganjur kerana sudi menjemput saya merasmikan majlis ini.

Dengan ini, saya dengan sukacita menyempurnakan dan merasmikan Persidangan Tahunan Persatuan Geologi Malaysia 2001.

Sekian. Selamat Bersidang.

Annual Geological Conference 2001

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Annual Geological Conference 2001

Pan Pacific Resort, Pangkor Island
Perak Darul Ridzuan

2–3 June 2001

Programme — Opening Ceremony

FRIDAY (1 June 2001)

19.50 : Arrival of Participants and Guests

19.55 : Arrival of Y.A.B. Dato' Seri Di Raja Mohd Tajol Rosli Tan Sri Ghazali, Menteri Besar Perak Darul Redzuan.

20.00 : Welcoming Address by Prof. Madya Dr. Mohd Shafeea Leman, Pengerusi Jawatankuasa Penganjur Persidangan Tahunan Geologi 2001.

20.10 : Address by Prof. Madya Dr. Abdul Ghani Rafek, Presiden Persatuan Geologi Malaysia.

20.20 : Opening Address by Y.A.B. Dato' Seri Di Raja Mohd Tajol Rosli Tan Sri Ghazali, Menteri Besar Perak Darul Ridzuan.

20.40 : Dinner (Sponsored by the State Government of Perak Darul Ridzuan)

Official Dress — Batik

Annual Geological Conference 2001

Pan Pacific Resort, Pangkor Island
Perak Darul Ridzuan

2–3 June 2001

Scientific Programme

SATURDAY (2 June 2001)

Forum on Enhancing The Contribution of Geoscientists in the Development of Malaysia

The forum is jointly organised by the Geological Society of Malaysia (GSM) and the Institute of Geology Malaysia (IGM) with the aim of:

- Evaluating the current status of geoscience education to optimise graduate capability,
- Identifying mechanisms to strengthen R&D in higher learning institutions, public and private sectors
- Identifying strategies to increase the contribution of geoscience in the development of Malaysia
- Identifying mechanisms of disseminating information regarding the contribution of geoscience to non-geoscientists.

The resolutions from this meeting will be documented and utilised by the GSM and IGM in drawing up their programmes in the future.

08.30 – 08.40	**Welcoming Address** Chairman, Dr. Abd. Ghani Rafek, President, Geological Society of Malaysia
08.40 – 08.50	**The New Roles of Geoscientists in the Petroleum Industries** Mr. Abdul Samad Nordin, Petronas Carigali
08.50 – 09.00	**The New Roles of Geoscientists in the Mining Industries** Mr. Shamsul Baharin Saim, Malaysia Mining Corporation Berhad
09.00 – 09.10	**The New Roles of Geoscientists in Engineering Geology** Mr. Ng Chak Ngoon, Subsurface Engineering Sdn Bhd
09.10 – 09.20	**The New Roles of Geoscientists in Institutions of Higher Learning** Dr. Wan Fuad Wan Hassan, Universiti Kebangsaan Malaysia
09.20 – 09.30	**The Role of the New Department of Mineral and Geosciences** Haji Ab Halim Hamzah, Department of Mineral and Geosciences
09.30 – 09.40	**The Role of IGM towards Recognition for the Geosciemce Profession** Mr. Chu Ling Hing, Department of Mineral and Geosciences
09.40 – 10.00	**Discussion**
1000 – 1100	***Tea Break*** **& Poster Session A**

Annual Geological Conference 2001

Pan Pacific Resort, Pangkor Island
Perak Darul Ridzuan

2–3 June 2001

Scientific Programme

SATURDAY (2 June 2001)

TECHNICAL SESSION I

MINERAL & ENERGY RESOURCES

1100 – 1130 : **KEYNOTE I — Chu Ling Hing & Azimah Ali**
The Industrial Mineral-based Industry of Malaysia: Current Status and Prospects

1130 – 1150 : **Wan Fuad Wan Hassan & Heru Sigit Purwanto**
Perubahan Batuan Dinding berkaitan dengan Pemineralan Emas di Penjom Gold Mine, Pahang, Malaysia

1150 – 1210 : **Sonny LimTeng Chye, Sharafuddin Mohamad, Mona Sulaiman, G.H. Teh & Jasmi Hafiz Abdul Aziz**
Geology, Structure, Mineralization and Geochemistry of the Penjom Gold Deposit, Penjom, Pahang

1210 – 1230 : **G.H. Teh, Mahat Sibon & Mohd Sazani Saarani**
Characterization, Geochemistry and Possible Usage of the Limestone Hills in the Kinta Valley, Perak

1230 – 1250 : **Othman Ali Mahmud, H.D. Tjia & Mohd Idrus Ismail**
Interpretation of Newly Acquired Aerogravity Data Enhances the Prospectivity of the Tinjar Province Onshore Sarawak

1250 – 1310 : **Wan Hasiah Abdullah**
A Petrographic Comparison of Oil-Generating Coals from the Tropics and Non Oil-Generating Coals from the Arctic

1310 – 1420 : ***Lunch & Prayer Break***

Annual Geological Conference 2001

Pan Pacific Resort, Pangkor Island
Perak Darul Ridzuan

2-3 June 2001

Scientific Programme

SATURDAY (2 June 2001)

TECHNICAL SESSION II

STRUCTURAL GEOLOGY & TECTONICS
SEDIMENTOLOGY & STRATIGRAPHY

1420 – 1440 : **H.D. Tjia**
Wrench Tectonics in Sundaland

1440 – 1500 : **Ibrahim Abdullah**
Gaya Struktur Kawasan Cendering - Rhu Rendang, Marang, Terengganu: Satu Cadangan Kehadiran Batuan Pra-Karbon di Jalur Timur Semenanjung

1500 – 1520 : **Basir Jasin & Zaiton Harun**
Some Triassic Radiolarians from the Kodiang Limestone, Northwest Peninsular Malaysia

1520 – 1540 : **Lee Chai Peng**
Occurrences of *Scyphocrinites* Loboliths in the Upper Silurian Upper Setul Limestone of Pulau Langgun, Langkawi, Kedah and Guar Sanai, Berseri, Perlis

1540 – 1600 : **Che Aziz Ali**
Evolusi Delta Sungai Pahang: Bukti-bukti Permukaan dan Bawah Tanah

1600 – 1620 ***Tea Break***

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2–3 June 2001

Scientific Programme

SATURDAY (2 June 2001)

TECHNICAL SESSION III

PETROLOGY & GEOCHEMISTRY
MINERAL & ENERGY RESOURCES

1620 – 1640 : **Azman Abd Ghani**
Some Problems with the Classification of the 'S' Type Granite with Particular References to the Western Belt Granite of Peninsular Malaysia

1640 – 1700 : **Mohd Rozi Umor & Hamzah Mohamad**
Penamaan Semula Kompleks Stong kepada Unit Stratigrafi Suit Stong berdasarkan Cerapan Lapangan

1700 – 1720 : **Azimah Hussin & Mohamad Md Tan**
Batu Kapur Formasi Chuping dan Batu Kapur Monsal Dale: Petrografi dan Geokimia Dua Sumber Karbonat bagi Simen Portland

1720 – 1740 : **Zakaria Hussin**
Plumbogumit dan mineral-mineral lain yang ditemui berasosiasi dengan emas di Lubuk Mandi, Marang, Terengganu, Malaysia

Annual Geological Conference 2001

Pan Pacific Resort, Pangkor Island
Perak Darul Ridzuan

2–3 June 2001

Scientific Programme

SUNDAY (3 June 2001)

TECHNICAL SESSION IV

GEOSCIENCE TOOLS & TECHNIQUES

0830 – 0900 : **KEYNOTE II — Nik Nasruddin Mahmood, Loh Kok Fook, Jimat Bolhassan & Jasmi Ab. Talib**
Remote Sensing and Geosciences: Current Status and Future Challenges

0900 – 0920 : **Mohd Azmi Ismail, Khairul Anuar Mohd Nayan, Abdul Rahim Samsudin & Abdul Ghani Rafek**
Spectral-analysis of Surface-waves Method: An Initial Assessment and Its Potential Use in Geology

0920 – 0940 : **Bashillah Baharuddin, Abdul Rahim Samsudin, Abdul Ghani Rafek & Mohd Tadza Abdul Rahman**
Kaedah Keberintangan Elektrik dalam Pemetaan Intrusi Air Masin di Kerpan, Kedah

0940 – 1000 : **Umar Hamzah, Abdul Rahim Samsudin, Rahman Yaacup, Abdul Ghani Rafek, Mohd Hafizal Mad Zahir & Lakam Mejus**
Teknik Geofizik dalam Kajian Tanah Runtuh di Kawasan Bau, Sarawak

1000 – 1100 : ***Tea Break*** **& Poster Session B**

Annual Geological Conference 2001

Pan Pacific Resort, Pangkor Island
Perak Darul Ridzuan

2–3 June 2001

Scientific Programme

SUNDAY (3 June 2001)

TECHNICAL SESSION V

GEOSCIENCE TOOLS & TECHNIQUES
ENGINEERING GEOLOGY & HYDROGEOLOGY

1100 – 1120 : **Samsudin Hj Taib, Khairun Niza Baharaldin & Azman A. Ghani**
Source of the Batu Pahat Magnetic Anomaly

1120 – 1140 : **Ismail C. Mohammad, Abdul Rahim Samsudin & Abdul Ghani Rafek**
Penggunaan Bersama Data Geofizik dan Geologi dalam Kajian Akuifer Aluvium Pantai, Kawasan Pekan-Rompin, Pahang

1140 – 1200 : **Tan Boon Kong & Azwari Huslan Mohd**
Physico-chemical Properties of Carbonaceous Shale Soils in the Yong Peng area, Johor

1200 – 1220 : **Abdul Ghani Rafek, Abdul Rahim Samsudin, Rahman Yaacup, Umar Hamzah & Khairul Anuar Mohd Nayan**
Pencirian Geofizik dan Geologi Kejuruteraan Profil Luluhawa Syis Kuarza-Mika di km 67, Lebuhraya Timur-Barat, Malaysia

1220 – 1240 : **Chow Weng Sum**
Minor and Trace Metals in Slurry Slime in Mined-out Ponds in the Kinta Valley, Perak

1240 – 1300 : **Tajul Anuar Jamaluddin & Ahmad Nizam Hassan**
Engineering Geology of Slopes for the Preparation of EIA Reports — A Case Study from the Proposed Site for a National Secondary School at Ringlet, Pahang Darul Makmur

1300 – 1440 : ***Lunch / Prayer Break***

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2–3 June 2001

Scientific Programme

SUNDAY (3 June 2001)

TECHNICAL SESSION VI

ENGINEERING GEOLOGY & HYDROGEOLOGY
ENVIRONMENTAL GEOLOGY & CONSERVATION GEOLOGY

1420 – 1440 : **Baba Musta, Khairul Anuar Kassim & Mohd Razman Salim**
Mineralogical Development in a Lime Treated Clayey Sand Soil

1440 – 1500 : **J. Shamshuddin**
The Charge Properties of Highly Weathered Tropical Soils

1500 – 1520 : **Ros Fatihah, Peter Smart & Yeap Ee Beng**
Preliminary Uranium Series Dates on Speleothem in the Kinta Valley and its Significance in the Karst Landscape Evolution

1520 – 1540 : **Askury Abd Kadir, Mohd Yusof Abdullah & Kamal Roslan Mohamed**
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1600 – 1620 : **CLOSING CEREMONY**

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Abstracts of Papers

Keynote Paper

The industrial mineral-based industries in Malaysia — current status and prospect

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The industrial mineral-based industry in Malaysia can be broadly grouped into three catagories, viz, rock-based, clay-based and sand-based. During 1999, from a total amount of RM17.0 billion worth of mineral-based products manufactured, RM7.3 billion originated from the industrial mineral sector, while the remaining RM2.8 billion came from tin smelting and RM6.9 billion from the basic iron and steel industries. The clay-based industry is well developed, producing a wide range of products to cater for the construction, domestic and industrial consumers both locally as well as abroad. The clay-based products include activated clay, advanced ceramic, ceramic decorativeware, ceramic former, ceramic tiles, clay brick, clay pipe, refractory bricks, roof tile, rough pottery, sanitaryware and tableware. In 1999, the total output from these manufacturers was estimated at RM1.4 billion. The sand-based manufacturers include those producing filter sand, glass, silicon and sodium silicate. In 1999, a total of 42 manufacturers were involved in this sector. The total output from these manufacturers was estimated at RM2.3 billion. The glass industry, as part of the sand-based industry, is fairly well-developed with highly automated manufacturing processes. It produced a wide variety of products including container glass, domestic glassware, optical lenses, sheet glass, glass funnels and panels for cathode ray tubes, etc. However, most of the higher end silica products, such as optical and ophthalmic glasses use imported blanks. The rock-based manufacturers produced a variety of products from essentially granite and limestone. In 1999, the total output from these manufacturers was estimated to be around RM3.6 billion. Dimension stone is mainly produced from locally obtained granite and limestone. Cement, lime, limestone powder and terrazzo constitute value-added products produced from limestone. Whilst demand for traditional

rock tiles has dwindled owing to stiff competition from ceramic tiles, the limestone powder industry is at present, expanding rapidly with the production of coated ground calcium carbonate (GCC) as well as precipitated calcium carbonate (PCC). They offer stiff competition to the kaolin producers for use as fillers. The issues pertaining to these sectors include their pertinent linkage to the construction growth, promotion of the Investments Act 1986, value-adding capabilities, export market and globalisation/open market. With globalisation, free-trade, open-market system and AFTA coming into force soon, Malaysia's industrial mineral based-industries will face stiff competition from our neighbouring countries where cheap labour and low fuel costs are readily available. High productivity, advanced technology, quality of products and the search for new markets will to a certain extent determine the success of our industries in the globalised market.

Perubahan batuan dinding berkaitan dengan permineralan emas di Penjom Gold Mine, Pahang, Malaysia

WAN FUAD WAN HASSAN DAN HERU SIGIT PURWANTO

Program Geologi, Fakulti Sains dan Teknologi
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Penjom in Kuala Lipis, Pahang, is an active mining area. The bedrock of the area consists of volcanoclastic rocks (tuff and lithic tuff) and sedimentary rocks (sandstone, siltstone and limestone), being part of the Permian Gua Musang formation. The volcanics and sedimentary sequences are later being intruded by microgranite, rhyodacite and quartz veins. The main mineralization in the area is gold, associated with pyrite, chalcopyrite, galena, arsenopyrite and sphalerite which is generally found in the alteration zones. Wall rock alteration in Penjom is due to the interaction of hydrothermal activity, igneous intrusions, quartz veins and fault zones. Three dominant types of alteration recognized are silicification, argillic alteration and chloritisation, marked by a prolific development of secondary minerals over the primary minerals. Silicification is marked by the development of secondary quartz, generally around the intrusions. Argillic alteration is marked by the development of clay minerals such as montmorillonite and illite and limonite generally around the intrusions and fault zones outside the silicified zone. Chloritic alteration is marked by the presence of chlorite, epidote and carbonate, developed generally in the outer-most zone outside the silification and argillic zones.

Geology, structure, mineralisation and geochemistry of the Penjom gold deposit, Penjom, Pahang

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The Penjom Gold Mine lies within Permian rocks dominated by tuffs and sediments of the Padang Tengku Formation striking E-W with a 30° dip south, close to eastern boundary with the Triassic. A series of early intruded felsite sills have helped unravel the complex structural history of the mine.

The thrusting and assymetric folding of the Penjom Thrust cut by a series of N-S faults together with intense graphite alteration have controlled gold mineralisation. The favourable gold depositional sites are diverse and comprise dilational, chemical contrast and competency contrast sites. The diverse styles of mineralisation give rise to diverse widths, grades and orientations of individual ore zones.

The gold mineralising episode, which is associated with and overprints an earlier deposition of pyrite and arsenopyrite, was accompanied by quartz, carbonate and minor amounts of galena and sphalerite. EPMA analyses of the gold show slight variations in fineness from the three main centres of mineralisation, namely, Kalampong East/Hill Six, Jalis and Manik. EPMA study also revealed a gold-bearing graphite-ankerite-quartz intrusive rock.

Characterisation, geochemistry and possible usage of the limestone hills in the Kinta Valley area, Perak

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The primary purpose of the characterisation of the limestone hills in the Kinta Valley is to determine their physical and geochemical characteristics with the aim of ascertaining their most appropriate economic or industrial usage. The limestone (or more appropriately termed *marble*) has very varied usage depending on their chemical and physical characteristics.

The limestone hills in the Kinta Valley extend from Gunung Temelang near Tg. Rambutan in the north to Gunung Gajah, near Kuala Dipang to the south, a distance of about 30 km. The marble outcrops in the Kinta Valley, in fact, form 3 groups of limestone hills trending more-or-less north-south.

The main physical characteristics that were considered for each hill included colour, presence of fractures, joints or veins, texture or pattern, grain size, resistance to weathering, contamination and foreign material (such as chert nodules, quartz, etc.).

For their geochemical characteristics, the limestones were analysed for their $CaCO_3$, $MgCO_3$, SiO_2, Fe_2O_3 and Al_2O_3 contents. A thorough petrographic study was also carried out to determine whether they are calcitic or dolomitic and to detect the presence of other minerals which could jeopardise their quality and usage. Other than their $CaCO_3$ and $MgCO_3$ contents, the contents of Al_2O_3, SiO_2 and Fe_2O_3 are generally very low in the limestone samples; Al_2O_3 usually less than 0.25%, SiO_2 less than 0.55% and Fe_2O_3 less than 0.3%.

Geochemical analyses show that each limestone hill in the Kinta Valley has, generally, a distinctive, more-or-less homogeneous chemical composition throughout, except for Gunung Tempurung and Gunung Lanno. Hills with unusually high $CaCO_3$ content include Gunung Sepah (average 99.0%), Gunung Terendum (average 96.46%), Gunung Panjang (average 95.6%), Gunung Sentang (average 98.75%), Gunung Tasek (average 98.20%), Gunung Lang (average 97.35%), Gunung Mabella (average 98.3%), Gunung Rapat (average 96.8%), Gunung Karang Besar (average 97.8%), Gunung Merawan (average 97.1%), Gunung Toh Sembilan (average 95.5%), Gunung Pua (average 97.8%), Gunung Sin (average 97.9%) and Gunung Pipit (average 96.8%). Those with unusually high $MgCO_3$ content include Gunung Ayer Hangat (average 43.32%), Gunung Layang-layang (average 53.90%), Gunung Ginting (average 41.47%). Gunung Tambun (average 40.30%), Gunung Bercham (average 39.50%) and Gunung Temelang (average 38.80%), Gunung Keroh (average 40.7%), Gunung Kandu (average 40.8%) and Gunung Mesah (average 40.3%).

Based on their physical and chemical characteristics, the limestone resources in the Kinta Valley area that can be utilised as raw material for decoration like dimension stones, terrazzo or marble chips include Gunung Rapat, Gunung Lanno, Gunung Mabella, Gunung Sin, Gunung Tempurung and Gunung Terendum. In industries that require high calcium contents like cement, agricultural fertilisers, ammonia powder, animal feed, calcium carbide, the ideal hills are Gunung Datuk, Gunung Panjang, Gunung Rapat, Gunung Lanno, Gunung Karang Besar, Gunung Merawan, Gunung Toh Sembilan, Gunung Pua, Gunung Sin, Gunung Pipit, Gunung Sepah and Gunung Tempurung (south). In industries that require high $MgCO_3$ contents like magnesium fertilisers, glass, Gunung Air Hangat, Gunung Layang-layang, Gunung Keroh, Gunung Kandu, Gunung Mesah, Gunung Tempurung (north) should be considered. For use as aggregate and concrete most of the hills can be exploited except Gunung Karang Besar, Gunung Keroh, Gunung Kandu, Gunung Mesah. Finally for conservation in terms of religion, tourism and preserving the environment, Gunung Cheroh, Gunung Lang, Gunung Panjang, Gunung Datok, Gunung Rapat, Gunung Tempurung and Gunung Terendum are potential candidates.

Interpretation of newly acquired aerogravity data enhances the prospectivity of the Tinjar Province, onshore Sarawak

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The first commercial field in Sarawak, the Miri field was discovered in the onshore part in 1910. After this discovery further exploration work on the onshore area was hampered by lack of significant or commercial discovery despite extensive drilling. These exploration activities were concentrated in the north-eastern and south-western parts of Sarawak. In the north-central part of the Sarawak onshore (designated as the Tinjar Province) only a few wells were drilled with some oil and gas shows. For a total of 12 wells drilled in the area covering almost 25,000 km^2, the Tinjar Province is considered underexplored. One major reason that the area was excluded from the early days of exploration is that it was assumed to possess a shallow basement as result of active uplifting and erosion during Oligocene-Miocene time. Lack of sediment thickness and shallow burial were also considered as negative factors for hydrocarbon expulsion and migration. However, this claim on shallow basement was not supported by any seismic or good gravity and magnetic data. In late 1996 a PMU/PRSS team began a study of the hydrocarbon potential of the Tinjar Province. Based on fieldwork, interpretation and review of SAR (Synthetic Aperture Radar) images and the existing geological data, the study concluded that the area has potential for hydrocarbon entrapment, which warrants further investigation. As a continuation from the study, a gravity survey was undertaken to further explore the area and to determine depth to the basement. In 1998 a total of 4653-line km of new aerogravity and magnetic data were acquired over the Tinjar Province. The data were later merged and processed with the previously acquired data in the adjacent areas (to the east a total 3,080 km of gravity and magnetic data acquired by OPIC in 1990, and to the west a total of 3,224 km of gravity data acquired by Idemitsu in 1991). Combined, this information provides a good coverage of gravity data over the Sarawak onshore area. Marine gravity results over the Balingian province were also integrated to provide an analogue to the onshore data interpretation. The study showed fairly good sediment thickness of up to 5,000 m in the Tinjar Province and the surrounding area. The gravity data detected and defined a series of highs and lows trends, major faults and other elements of the basement that can create structural and stratigraphic traps in the overlying Oligocene-mid Miocene clastics. The location, areal extent and sources of density contrasts causing residual gravity anomalies were also identified. A series of structural highs and gentle folds associated with thrusted basements are excellent targets for hydrocarbon accumulations. In general, the gravity data acquired recently provide a guide in delineating areas for future exploration activity in the north-central part of the Sarawak onshore.

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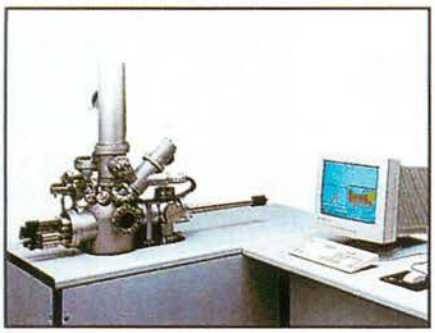

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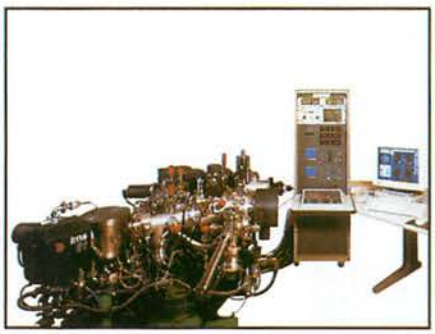

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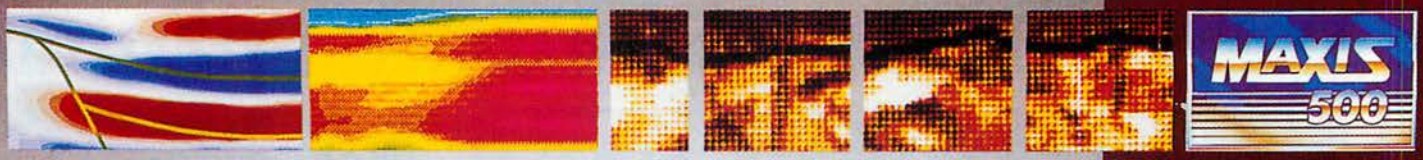

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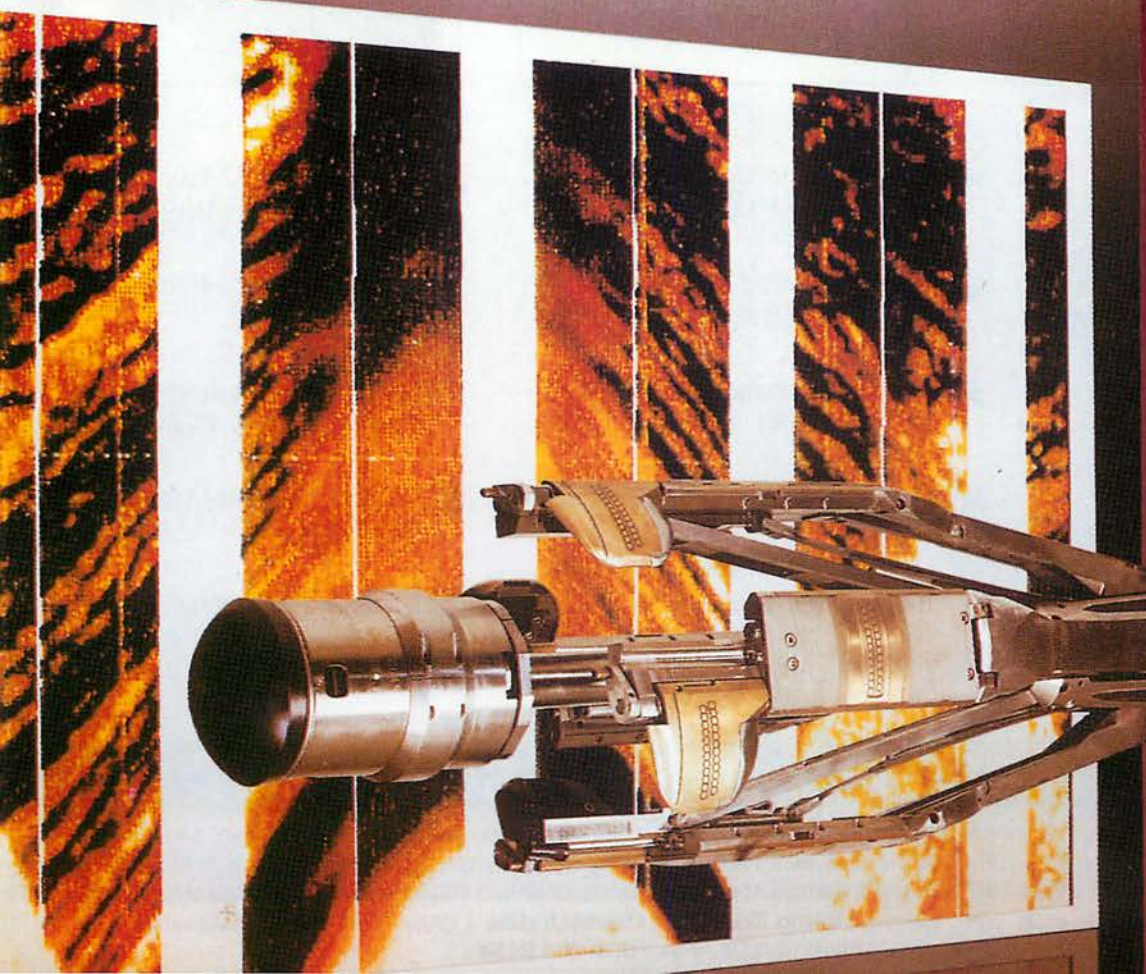

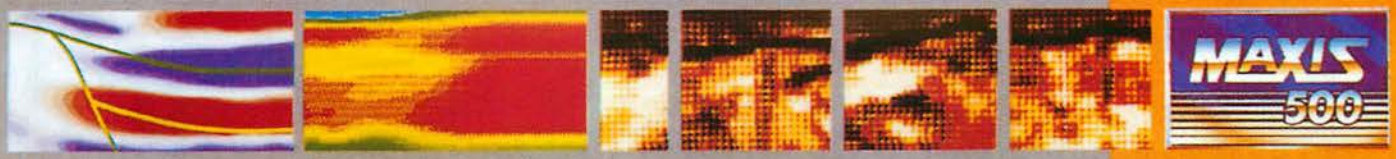

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A petrographic comparison of oil-generating coals from the tropics and non oil-generating coals from the arctic

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This paper discusses the findings of a comparative study of microscopically recognisable oil-generative features observed in coals from two presently extreme climatic conditions: the arctic and the tropics. The samples investigated are from Spitsbergen, Svalbard and from Sarawak, Borneo. Both sets of coals are of Tertiary age and both were deposited in a lower coastal plain setting. The Palaeocene-Eocene coals of Spitsbergen were deposited in temperate to subarctic conditions while the Miocene coals of Sarawak were deposited in subtropical to tropical conditions. Features associated with oil-generation from the Sarawak coals include a widespread occurrence of exsudatinite veins and oil globules/haze. Hydrocarbon generation is often observed to be associated with the occurrence of a high abundance of framboidal pyrite. Coals from Spitsbergen, on the other hand, lack the oil generative features described above. Although the occurrence of oil-smears can be observed, they are not extensive and exsudatinite is rarely observed. To date, no significant oil accumulations of terrestrial origin have been discovered on or around the island of Spitsbergen. In contrast, offshore Sarawak is a prolific oil and gas producing province. Considering that the terrestrially-derived oils of the Balingian Province are sourced from stratigraphic equivalent sequences to the onshore coal-bearing sequences investigated here, it is clear that microscopical features are good indicators for the recognition of oil-prone coals.

Wrench tectonics in Sundaland — subsurface and offshore evidence

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Wrenching is widespread in Sundaland. Convincing evidence from onshore mapping is now combined with lesser known information from the subsurface and from the offshore. Maximum principal stress (S_H) directions were determined from wrench patterns, well-bore breakouts, and first-motion of major earthquakes occurring in the last century. Most of Sundaland is currently subjected to north-south S_H. Towards its margins the stress trajectories deviate from the meridian, probably as result of interference with S_H of the convergence of adjoining megaplates and the southeast extrusion of Indosinia. From at least the late Oligocene onward Sundaland has been the focus of converging plates and subplates. Fracture zones that are suitably orientated with respect to the convergence direction in various parts of the region responded by wrenching. Until approximately the onset of Mid-Miocene most wrenching was transtensional forming pullapart depressions and modifying the structuration of the large depocentres: the backarc basins of Sumatra-Java, the aulacogens Malay-Penyu-West Natuna,

and the forearc/marginal basins Soikang-Sarawak-NW Sabah-East Kalimantan. Cessation of spreading in the Philippine Sea and Caroline basins by Mid-Miocene changed the wrenching into transpressional structures that was accompanied by slip-sense reversals and substantial structural inversion.

Gaya struktur kawasan Cendering-Rhu Rendang, Marang Terengganu: satu cadangan kehadiran batuan Pra-Karbon di Jalur Timur Semenanjung

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The structure of the Cendering-Rhu Rendang area is dominated by a major anticline, plunging towards approximately N 170°E. At several localities, the folds were modified by reverse and thrust faults to produce asymmetrical and overturned minor folds. Other than that, slump folds and crenulation folds with axes trending almost north-northwest are also found. Based on the fold axis similarities of the major and crenulation folds, it is believed that the rocks in this area have suffered coaxial superimposed folding. The ENE fault displaced the axis of the major anticline which is known as Panji Anticline dextrally. The structure style at Bukit Cendering and Kampung Rhu Rendang has a regional trend different from the rest of the area. Further more the structure at these two sub-area are more complicated. These differences is interpreted to be due to the rock on the eastern side of the area is older (pre-Carboniferous) and separated from the western side by a westwards thrusting fault.

Some Triassic Radiolarians from the Kodiang Limestone, northwest Peninsular Malaysia

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The clastic and radiolarian chert sequence at the base of Bukit Kechil, is the only clastic interval in the Kodiang Limestone. The chert yielded eleven taxa of radiolarians i.e. *Entactinosphaera chiakensis, Entactinosphaera* sp,. *Entactinia nikorni, Thaisphaera minuta, Cenosphaera andoi, Cenosphaera* sp., *Pantanellium ? virgeum, Pantanellium* sp., *Acanthosphaera* sp A, *Acanthosphaera* sp B, and *Acanthosphaera* sp C. This assemblage is indicative of late Spathian age, Early Triassic. The sequence was deposited in a deeper environment compared to the limestone. The Kodiang Limestone was deposited on an unstable shelf environment.

Occurrences of *Scyphocrinites* loboliths in the Upper Silurian Upper Setul limestone of Pulau Langgun, Langkawi, Kedah and Guar Sanai, Berseri, Perlis

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Scyphocrinites loboliths, the bulbous floats attached to the roots of a Late Silurian to Early Devonian crinoid, have been found within the Upper Silurian Upper Setul limestone along the beach north of Telok Memplam, Pulau Langgun, Langkawi, Kedah and in limestone blocks from an earth quarry at Guar Sanai, near Guar Jentik, Berseri, Perlis. The loboliths belong to the plated type characterized by having plated chamber walls, fewness of internal chambers and the presence of chamber openings near the axil of the primary root.

Evolusi Delta Sungai Pahang: bukti-bukti permukaan dan bawah tanah

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The Pahang River Delta represents a young delta system developing under tropical climatic regime. The delta is believed to have started during the early Holocene time when the sea was at it highest level. The protodelta began at about 40 km inland in a cone-shaped embayment. The delta has prograded out and changed shape and location several times following the fluctuation of sea-level(?). This changes have produced at least four delta lobes as recognized from aerial photographs and topographic maps. Evidence from subsurface shows that the delta was initially dominated by clay which has been deposited in restricted environments such as lagoon and mangrove swamp. Thick sand bodies are found at the very top part of the sequence forming the present day beach ridges on the surface.

Some problems with the classification of the 'S' type granite with particular reference to the Western Belt granite of Peninsular Malaysia

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The Peninsular Malaysian granites have been grouped into two granite provinces namely Western and Eastern Belt granites. The Western Belt has been considered as constituting an exclusively 'S' type granite. The 'S' type features in the granites are, (a) high initial $^{87}Sr/^{86}Sr$ isotope ratio > 0.710, (b) low Na_2O content, < 3.2% Na_2O in rocks with ~ 5% K_2O, (c) narrow range of felsic rock (SiO_2: 65.95 to 77.4%), (d) high K_2O/ Na_2O ratio, 1.4–2.8 ('S' type: 0.9–3.2), (e) usually ilmenite bearing and (f) contain pelitic or quartzose metasedimentary xenoliths. However, detailed study of published and unpublished field and geochemical reports reveal that the Western Belt granite shows mixed 'I' and 'S' type features and thus the batholiths cannot be designated as exclusively 'S' type. The 'I' type features are (a) Al-rich minerals such as sillimanite and cordierite are absent, (b) occurrence of primary wedge sphene and pale green amphibole especially in the northern part of the batholith, (c) occurrence of pinkish K-feldspar crystals (usually as phenocrysts), (d) occurrence of mafic, hornblende bearing enclaves, (e) increasing ACNK values with SiO_2, (f) showing a similar trend to the 'I' type granite in P_2O_5 vs Rb and A-B plots. Implication of this study indicates that the Western Belt granite is not solely derived from metasediments. The study favours a mixed origin of crustal material such as metapelites, greywackes and metaigneous rocks.

Penamaan semula Kompleks Stong secara stratigrafi kepada unit Suit Stong berdasarkan cerapan lapangan

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The reassignment of Stong Complex to Stong Suite proposed here is based on field observations on the setting and relationship of various rock types. Based on the Malaysian Stratigraphic Guide, the Stong Complex is more suitable to be ranked as a suite. The proposed Stong Suite can be divided into three lithodemic units, namely the Noring Granite, Kenerong Leucogranite and Berangkat Tonalite. All this lithodemic units are mappable in the field. Each unit has its own set of rock grouped together in the same intrusive body, probably being emplaced at almost the same time.

Batu kapur Formasi Chuping dan batu kapur Monsal Dale: petrografi dan geokimia unsur major dua sumber karbonat bagi simen Portland

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Chuping Formation limestone and Monsal Dale limestone are two carbonate resources for the manufacture of Portland cement. The petrography of both rocks is diffrentiated by their lithofacies. The Chuping Formation limestone at CIMA Quarry consists of three facies of biomicrite, biopelmicrite and biosparite. Whereas biomicrite and biomicsparite are two identified facies of Monsal Dale limestone. The geochemistry of these two commercial resources are controlled primarily by the carbonate components.

Plumbogumit dan mineral-mineral lain ditemui berasosiasi dengan emas di Lubuk Mandi, Marang, Terengganu, Malaysia

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Plumbogumit merupakan mineral yang baru ditemui di lombong emas Lubuk Mandi, Terenggânu, Malaysia. Ia didapati berasosiasi dengan emas. Emas ada yang wujud bebas (free gold) dan ada yang berasosiasi dengan mineral lain seperti arsenopirit, pirit, galena, sfalerit, kalkopirit dan besi oksid.

Penentuan mineral adalah dengan menggunakan alat SEM (scanning electron microscope), XRD (X-Ray Diffraction), selain dari mikroskop bijih. Mineral yang dikesan mengandungi unsur-unsur Pb, Al dan P telah dilakukan mikroanalisis dengan alat SEM dan penentuan dengan alat XRD, mendapati bahawa mineral tersebut adalah Plumbogumit: $PbAl_3(PO_4)_2(OH)_5.H_2O$ atau (lead aluminium phosphate hydroxide hydrate).

Emas ada antaranya bebas mengisi rekahan dan rongga dalam telerang kuarza. Emas juga ada yang berasosiasi dengan mineral lain dengan mengisi rekahan dan ruang dalam mineral seperti arsenopirit, pirit, besi oksid dan galena.

Keynote Paper

Remote sensing and geoscience: current status and future challenges

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The integrated use of remote sensing and related technologies is commonly applied to multi-disciplinary analysis in Malaysia. Many models and processing techniques have been developed for this purpose. MACRES, the focal point for providing as well as using remote sensing and related technologies to cover a wide spectrum of applications in the country, has developed among others the National Resources and Environmental Management System (NAREM) for interactive integrated spatial data analysis and modeling. NAREM is a dedicated system for the input, validation, management and analysis of integrated spatial data. Several integrated natural resources and environmental application packages have been developed under NAREM which will be put into operational use in the near future. This paper highlights the application of geo-science packages developed under NAREM which include groundwater potential zoning, soil erosion risk assessment and landslide hazard zonation. The paper also touches on the future directions in the use of remote sensing data for geo-hazard and geo-botanical studies in line with the availability of new generation satellite data at present and in the near future.

Spectral-Analysis-of-Surface-Waves method: an initial assessment and its potential use in geology

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The Spectral-Analysis-of-Surface-Waves (SASW) method for profiling the subsurface non-destructively is discussed. The method assumes that the subsurface structures consist of a stack of horizontally homogeneous layers. Transient impact source on the ground surface is used to generate Rayleigh wave of different frequencies into the medium. From analysis of phase information for each frequency, the velocity of the waves is determined between two receivers. Initial results of the SASW measurements on flexible and rigid pavement systems are presented.

Kaedah keberintangan geoelektrik dalam pemetaan intrusi air masin di Kerpan, Kedah

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Lately, groundwater contamination has become a public concern. It comes from many activities such as industrial, domestic and agriculture. Seawater intrusion is not a new issue, and has only now started to draw attention from lots of parties since it is also a contributor to groundwater contamination. Therefore a study about seawater intrusion is carried out and the selected area is Kerpan, Kedah. The objectives were to map seawater intrusion and to find the best techniques for contamination investigation. This information is useful particularly in agriculture because any contamination caused by chlorine (seawater) intrusion can affect crops production. For the Kerpan Project, two electric resistivity survey instruments, the Terrameter SAS 4000 and SAS 300C were used. SAS 4000 provides two-dimensional resistivity profiles. These profiles have the capability to assess a comprehensive geological interpretation by examine subsurface electric characteristics such as resistivity, permitivity and chargeability. SAS 300C on the other hand provided sounding data (vertical structure – 1-D profiles only) which can also be used to determine subsurface layering. Resistivity values for seawater is less than 10 ohm.m whilst freshwater around 10–100 ohm.m. Result from the sounding technique showed that seawater exists in the study area.

Teknik geofizik dalam kajian tanah runtuh di kawasan Bau, Sarawak

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Limestone terrain or karst is susceptible to surface collapse or subsidence which could cause damage to property and loss of life. Surface depressions in the limestone terrain which is always covered by alluvium may be caused by solution in the limestone. Dissolution of the limestone always take place along discontinuities or cracks and cavities which are filled up by rain water or subsurface solution. Therefore it is necessary to investigate the possibility of collapse before any project in limestone areas is carried out. This paper presents a few surface geophysical techniques to detect subsurface cavities and cracks in collapsed limestone in the Bau area, Sarawak. These techniques include seismic refraction, seismic reflection and geoelectrical imaging. ABEM Terraloc MK3 seismograph together with 100 Hz frequency detectors are used

for the seismic work. Sound wave energy is produced by impinging a 5 kg sledgehammer on a squared steel plate placed on the tarmac road. A total of 24 detectors which are linearly arranged with the source are used to receive signals returning to the surface. These signals are then processed to produce profiles of distance versus depth and 2-D seismic sections. Velocity values calculated are used for rocks and structural interpretations. On the other hand, ABEM AC Terrameter is the instrument used in the geoelectrical survey together with a total of 50 steel rods representing electrodes for injecting currents into the ground and measuring the potential difference between them. Final 2-D pseudosection shows the resistivity distribution laterally and vertically. This variation is used for interpreting the earth material and the type of water content in it. In this study, the three techniques were tried in order to detect any possible cavity or cracks underneath a peripheral shaped cracks on the tarmac road. These techniques have more or less been able to detect the presence of a sinkhole with faults surrounding it underneath the cracks. Depth and width of the cavity is about 7–10 m.

Source of the Batu Pahat magnetic anomaly

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An almost circular magnetic anomaly north of Batu Pahat town is made up of a pair of magnetic high and magnetic low. It is a typical magnetic anomaly at this magnetic latitude with magnetization in the earths field direction where the magnetic high is situated to the north and the magnetic low to its south. The magnetic anomaly has been generally associated to the Batu Pahat granite which outcrops east, west and south of the town. However, the location of the anomaly only at the northern tip of the granite mass suggest that it is not the source. The geological study indicates that gabbro is present within this magnetic anomaly area. Modelling of the anomaly indicates that two source bodies produce the anomaly. The first is situated where the gabbro is located and the second body is located slightly to the north. This location was formally a bauxite mine. The first has its top at about 50 to 100 meters depth while the second body has its base at less than 100 meters. The deeper body is presumably associated with the gabbro while the second body is probably of sedimentary origin. The Batu Pahat residual magnetic anomaly map suggest that the short wavelength anomalies present are associated with shallow fracture system having orientation similar to that of the existing faults trend in the granite.

Penggunaan bersama data geofizik dan geologi dalam kajian akuifer aluvium pantai, kawasan Pekan-Rompin, Pahang

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A significant lowering of the groundwater level was identified at Pekan District due to large amounts of groundwater being pumped out from the coastal alluvial aquifer of the area. An increasing trend of salinisation of fresh water was also observed in the production wells of Nenasi Waterworks. Geophysical surveys were planned as part of the studies to gain basic hydrogeological information of the area besides identifying the problem. Reconnaissance geophysical survey was conducted using the transient electromagnetic technique to determine the brackish/salt water boundary. The result of the survey which was correlated together with geological data such as well log information, water level and groundwater chemistry data, have provided valuable hydrogeological information of the area and successfully identified the basal extent of the brackish/salt water boundary for further studies.

Physico-chemical properties of carbonaceous shale soils in the Yong Peng area, Johor

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Residual soils of carbonaceous shale in the Yong Peng area have been analysed for their physico-chemical properties. Results indicate that the carbonaceous shale soils are characterised by their predominantly silty nature, low plasticities, generally low compacted densities, highly acidic pore fluids (low pH's), and intermediate dispersivity behaviour. These results indicate similarities in soil properties to graphitic schist soils found in the Melaka and Rawang areas.

Pencirian geofizik dan geologi kejuruteraan profil luluhawa syis kuarza-mika di km 67, Lebuhraya Timur-Barat, Malaysia

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Mapping of the weathering profile and determination of weathering grade were correlated with a refraction seismic survey and geoelectrical resistivity imaging of a quartz mica schist rock slope at km 67, east-west highway, northern Peninsular Malaysia, to obtain the true P-wave velocities (Vp) and specific geoelectrical resistivities for each weathering grade. Fresh and slightly weathered rock (grade I and II) is characterised by high Vp values ranging from 2,300 m/s to 5,300 m/s. The intensity and extent of discontinuities influence the Vp values, where lower Vp values are obtained for highly fractured zones. Grade III has Vp values between 1,200 m/s to 2,300 m/s with Vp values between 250 m/s to 1,200 m/s for grade VI, V and IV. The range of specific geoelectrical resistivities is <2,525 ohm.m for grade VI and V, 2,526 ohm.m to 5,025 ohm.m for grade IV, 5,026 ohm.m to 7,025 ohm.m for grade III dan more than 7,025 ohm.m for grade II and I.

Minor and trace metals in slurry slime in mined-out ponds in the Kinta Valley, Perak

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The Kinta Valley was renowned as the largest tin field in the world and up to 1989, there were 70,158 hectares of land under mining leases. Thereafter, the tin mining industry took a down-turn due to falling tin metal prices and what is left of the industry is now mined-out land with abundant abandoned ponds. Stretching from Pengkalan near Ipoh to Kampar in the south over a distance of 42 km, there is a total of 1,194 mined-out ponds. About 66.7% of these ponds have slurry slime at the pond bottoms, with thickness varying from 0.1 m to 7.0 m. Many of these abandoned ponds are used for the rearing of fish and ducks, or are cultivated with lotus plants. Slime is occasionally admixed with tailing sand for agricultural purposes. As such, should the slime be contaminated with heavy metals the food chain will be affected. Slime from eight ponds in the Kinta Valley was tested for minor and trace metals. Most of the slime contained higher concentrations of uranium and other trace heavy metals such as Sn, Hg, Sb,

Bi and Cd as compared to the norm in the earth's crust or stream sediments. Amongst the eight test ponds, slime from Pond B81 contained relatively higher concentrations of minor, radioactive and trace metals. Slime from Pond B81 should not be utilised as fill material as the concentration of as is above the trigger concentration and threshold value. It should also not to be used for the planting of crops as the level of zinc is high.

Engineering geology of slopes for the preparation of EIA reports — a case study from the proposed site for a national secondary school at Ringlet, Pahang Darul Makmur

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The site for the proposed National Secondary School at Ringlet, Cameron Highland is situated in a rugged hilly terrain underlain by granite and schist. The proposed school buildings is sited in a V-shaped valley because of the difficulty in getting flat or low-lying ground in the tropical highland areas such as Ringlet. Thus, existing slopes have to be cut to create room for the school building. The engineering geological study for slopes presented in this paper forms part of the geological input required for the preparation of an environmental impact assessment (EIA) report prior to approval by the local authority. To assess the stability of the existing and future cut slopes, structural geological mapping has been carried out by collecting data of relict structures in the intensely weathered and restricted outcrops. The study area has been arbitrarily divided into 3 structural domains, i.e Domain A, B and C. In the kinematic slope stability analysis, it is assumed that slopes in each structural domain contain similar structural style and orientation. Results of the anaysis indicates that most of the slopes in the study area have variable potential to undergo wedge and/or planer failures. This is evident in the field by some occurrences of wedge/planar failures, although they are of relatively small-scale. The risk of slope failures can be reduced if the proposed slopes are cut in the orientations and gradients recommended in this study.

Mineralogical development in a lime treated clayey sand soil

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Three samples of lime treated clayey sand soils and a control sample were cured for one month at room temperature before being analysed using X-Ray Fluorescence (XRF), X-Ray Diffraction (XRD) and scanning electron microscopy (SEM). The XRF data shows high abundances of SiO_2 (73.57%–80.45%), Al_2O_3 (10.77%–11.09%), L.O.I (4.38%–7.38%), Fe_2O_3 (2.32%–2.88%), K_2O (0.88%–1.03%) and CaO (0.03%–4.20%), whereas the other major elements are lower than 1.00%. The treated samples with 2% and 6% of lime show an increasing concentration of CaO about 1.41% and 4.20% respectively. The X-ray diffractograms and scanning electron micrographs detected the appearance of quartz and kaolinite in the control soil as well as in the treated soil samples. The development of new cementitious minerals in treated soil appear in low intensities in the X-ray diffractograms, due to their low crystalization. Scanning electron micrographs also show the development of new cementitious minerals, and modification of the surface micromorphology of the treated soil due to increasing concentration of lime.

The charge properties of highly weathered tropical soils

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Phyllosilicates are the major minerals of soils. These minerals change to oxides or hydroxides on weathering in tropical environments. Charges are developed in the phyllosilicates via isomorphic substitution of Si by Al; these termed negative permanent charges. In highly weathered tropical soils, oxides or hydroxides are predominant. The minerals become positively charged when the soil pH is lowered. In such soils, negative charges develop when soil pH increases. Hence, it would be possible to change charges in soils by agronomic manipulation. In soils dominated by oxides, positive charges in the B-horizon can be higher than negative charges.

Preliminary uranium series dates on speleothem in the Kinta Valley and its significance in the karst landscape evolution

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Uranium series dating technique has been used in dating cave materials and give estimation of up to 500 ka. The $^{230}Th/^{234}U$ method has been proven to be the most versatile and useful of all the uranium series methods and has been applied to a wide range of materials including speleothems in which the optimal range being around 350 ka using the alpha spectrometer and 500 ka for mass spectrometer. This technique has been used in dating speleothem samples from Kinta Valley caves. The preliminary ages obtained show some indications that it can be correlated to the rate of denudation in this area. These ages when combined with the rate of denudation and studies of slope processes will help in better understanding the evolution of karst landscape.

Pendekatan geologi dalam penafsiran sejarah Kesultanan Terengganu

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The discovery of the use of Bukit Biwah limestone and light grey granite as gravestone at the Royal graveyard located at Bukit Keledang provides a new insight into the history of the Sultanate of Terengganu. The assemblages of gastropod, foraminifera, coral and algae in the construction material similar to the Bukit Biwah limestone suggests that Kuala Berang was the administration centre for rulers in the past. This discovery will help archaeologists in their exploration for artifacts along Sungai Terengganu to strengthen the current ideas on the history of the Terengganu Sultanate. Thus, Bukit Keledang can be developed as an interesting geosite with a strategic location to attract visitors.

Inventori sumber warisan geologi dan landskap Negeri Kelantan

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The inventory of geological heritage resources in Kelantan has been conducted and the identified resources were classified into geological and landscape diversity categories. Geological diversity consists of variety in rock, construction material and minerals. Meanwhile, landscape diversity is classified into mountain, hill, plain and coastal landscapes.

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Abstracts of Posters

Influence of paleostresses in controlling the gold mineralization in Lubok Mandi area, Peninsular Malaysia

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The geology of Lubok Mandi area, Terengganu is very interesting especially its geological structures which control the overall geology of the area. A detailed geological study was conducted at part of the PCCL Sdn Bhd Gold Mine that show very good rock exposures. The underlying bedrock is dominated by metasedimentary (slate and phyllite) and volcanic rocks (tuff, tuff lapilli and litihc tuff), calcareous sandstone which in some places are carbonaceous. This rock formation of Middle Carboniferous to Permian in age, is cut by dacite intrusion and quartz veins. The major geological structural trends in the Lubok Mandi area are aligned in WNW-ESE and NNW-SSE directions These structural trends were intercepted by several fault zones which could be classified as either thrust right lateral slip fault and sheared or right lateral slip fault zones. The directions of N(300°–320°)E or WNW-ESE show thrust right lateral slip faults and most of the high angle faults in the directions N(345°–355°)E or NNW-SSE show right lateral slip, while those in N(045°–060°)E or NE-SW directions indicate right lateral slip faults. The mineralization in the quartz veins and wall rocks was also related to the intensive alteration by silicification, argillization and propilitization (chloritization) dominantly around the right lateral fault zones (NNW-SSE). The stress history or paleostresses in the area, which were operating at the time or after the formation of the fault planes, determined the movement or slip that took place on the fault planes. At the same time the paleostresses also governed the orientation of the gold-quartz veins which are related to the gold mineralizations of the area. Paleostresses determination or reconstructionis was done by using all the available slip data of the meso structures observed on the fault planes. The paleostress history is constructed based on the cross-cutting relationship and the displacement of the fault zones. Generally, the gold

mineralization in the quartz veins is related to and follow the NNW-SSE fault and shear zones. Among the common minerals observed are chalcopyrite, arsenopyrite, sphalerite, goethite and pyrite. Based on the fault slip data of the meso-structures (fault planes, pitch and pitch directions), the direction of paleostress was obtained. The first paleostress that was acting from NNE-SSW (s_1 = 10°–11°, N183°–198°E) controlled the formation of WNW-ESE thrust fault zones and quartz veins, while the second was NE-SW (s_1 = 04°–16°, N194°–203°E) controlled the NNW-SSE right lateral fault zones and quartz veins. The third paleostress was acting from ENE-WSW (s_1 = 18°–21°, N 232°–236°E) and is related to the NE-SW right lateral fault zones. The WNW-ESE and NNW-SSE quartz veins are related to the compressional paleostresses. The NNW-SSE quartz veins related to the right lateral slip fault zones are high-grade gold mineralization, especially those in the form of quartz breccia.

Structural style of Cyberjaya and Putrajaya, Selangor

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Rock cores from Putrajaya consists of various materials including calc-silicate hornfels, granite, carbonaceous schist and quartz-mica schist. Sheared materials were common and difficult to trace. In order to appreciate the geology of this area, especially the structural geology, outcrops in the adjacent areas were assessed. The Cyberjaya and Putrajaya areas have experienced several phases of deformation.

A palynological study on an Early Cretaceous rock sequence at Bukit Belah, Batu Pahat, Johor

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The palynomorph assemblage from a rock sequence exposed at Bukit Belah, Batu Pahat, Johor is interpreted to be of Early Cretaceous age. The assemblage is characterised by the presence of some significant species such as *Cicatricosisporites australiensis*, *C. ludbrooki* and *Reticulatisporites pudens*, and it closely resembles the *Speciosus* Assemblage which was reported from lower Cretaceous strata (Valanginian-Aptian). Based on its similarity in having some common species with that of the older assemblage, therefore, the present palynomorph assemblage is suggested to be correlated with the lower part of the *Speciosus* Assemblage (Valanginian-? Hauterivian).

Some Radiolarians from the bedded chert of the Kubang Pasu Formation

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An assemblage of radiolarians were discovered from a chert sequence exposed at Bukit Binjal, Kedah. Eight taxa were recognized; *Entactinia variospina* (Won), *Entactinia? inaequoporosa* Won, *Callela hexatinia* Won, *Callela* cf. *parvispinosa* Won, *Treanosphaera hebes* Won, *Cubaxonium? octaedrospongiosum* Won, *Duplexia? foremanae* (Ormiston & Lane) and *Duplexia parviperforata* Won. This assemblage indicates an age of late Tournaisian, Early Carboniferous. The chert was deposited on the outer continental shelf of a passive margin during the period of high siliceous productivity.

Conglomerate from Setia Jasa near Temerloh, Pahang, Peninsular Malaysia: its stratigraphic position and depositional environment

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A thick sequence of conglomerate, tuffaceous sandstone and shale/mudstone largely exposed at the Setia Jasa area is described. The matrix-supported conglomerate of very well rounded clasts conformably overlies pebbly mudstone and shows a gradual change in matrix grain size from clay to sand. An Anisian (early Middle Triassic) age is indicated for a whole sequence by the presence of an ammonoid *Paraceratites* sp. found in a lower shale bed. Sedimentological features suggest that the conglomerate and underlying sandstone/shale sequences were possibly deposited in a relatively deep marine environment, and probably belong to the Semantan Formation.

Geology of the Semenyih Granite

MUHAMMAD BARZANI GASIM[1], WAN NOR AZMIN SULAIMAN[2], MOHD. ISMAIL YAZIZ[2], ABD. RAHIM SAMSUDIN[1] AND WAN ZUHAIRI WAN YAACOB[1]

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The Semenyih Granite is located in Mukim Semenyih, Hulu Langat. It was tectonically emplaced during the Late Mesozoic period. This granite intrudes Jelebu Schist in the northeast and Kajang Formation in the southwest. The mineral composition of the Semenyih Granite consists of 60–70% potash feldspar; 15–20% quartz; 5–15% plagioclase (oligoclase); 5–10% mica and 5% accessory minerals. The Semenyih Granite is divided into the Semenyih and Beroga Granites. Beroga Granite has medium to coarse grain texture and dark grey in color while Semenyih Granite has fine to medium grain texture and pale grey to light brown in color. The second texture formation due to tectonic events such as rotation of the crystal lattice, slip and rearrangement at grain boundaries, micro fractures and faults and fluid-filled micro fracture was observed under microstructure study. The microscopic evidence of deformation is compared with the macroscopic phenomenon of the Semenyih Granite. The northeastern area rock is characterized by cataclasites, strike –slip faults and highly fracture zones. It may be due to deformation after cooling or due to latest emplacement of this granite body, but the impact was lesser in the southwestern area. Field observations that the Semenyih Granite is highly weathered and severely eroded with landslides and rock falls occurrence locally, especially from Semenyih town to Sg. Lui road.

In situ measurement of geoelectrical resistivity in relation to weathering profile of a sedimentary rock mass at Lubuk Paku, Pahang: a case study

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2-D geoelectrical resistivity imaging using the Wenner configuration was conducted to investigate the weathering profile of a sedimentary rock cut slope at Lubuk Paku, Pahang. The rock which belongs to the Tembeling Formation was cut into three terraces and it consists of, from bottom to top, thick layers of basal conglomerate, massive pebbly sandstone and highly weathered shale. The resistivity imaging results show that the rock cut slope can be characterised into several zones of low, moderately low, moderately high and high resistivities. The low resistivity zone which has resistivity values ranging from 150 to 500 Wm is associated with the residual soil with high water content. It is classified as grade VI according to the IAEG (1981)

weathering index with an average layer thickness of about 1.8 m. A moderately low resistivity zone with weathering index of grade V shows resistivity values ranging from 650 to 800 Wm. This layer appears to have low water content and its thickness varies from 1.1 to 1.7 m. Weathered rock material of grade IV shows resistivity values ranging from 800 to 1,200 Wm. A zone of moderately high resistivity is represented by the weathered rock mass of grade III. The resistivity value for this particular zone is relatively high and ranges from 1,232 to 2,000 Wm. This zone is dominated by a slightly weathered layer of pebbly sandstone. A slightly weathered rock of grade II represents the high resistivity zone with values ranging from 2,000 to 3,000 Wm. This zone is correlated well with the massive and solid rocks of basal conglomerate and pebbly sandstone. The results of the present study illustrate empirically that the geoelectrical resistivity values decrease as the weathering grades of the rock material increase. The presence of discontinuities and fractures in the rock mass appears to have lowered the overall resistivity of the rock mass. This empirical correlation could be used to map zones of different grades of weathered sedimentary rock mass and to study other subsurface geological structures related to slope cuts.

Penganggaran sekitaran sedimen di delta Pahang dengan teknik seismos pantulan

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Up to 180 m thickness of Quaternary deposits overlying granitic bedrock have been delineated by geophysical seismic reflection survey. Emulex 150 and electric detonators were used to produce the source of energy. A total of 24 units of 100 Hz frequency detectors were linearly arranged with the explosive source to receive the waves reflected from each subsurface geological boundary of different acoustic impedance. The received signals were recorded by ABEM Terraloc MK III seismograph. These data were then processed to produce seismic sections used in the interpretation. The seismic sections are correlated with the boreholes for geological interpretations. Based on borehole logs, the deposits are subdivided into a younger 30 m thickness of Holocene greenish marine clay overlying the older 70–80 metres thickness of Pleistocene stream sediments. Since no seismic information is obtained from depth shallower than 30 m, interpretation for this part is totally based on borehole log. The Pleistocene deposits at depth greater than 30 m are represented by chaotic seismic facies in the Temai Hilir and Kuala Pahang seismic sections. These features are interpreted as numerous cut and stacked channels of low and high sinuosity representing braided alluvial system together with flat flood plain deposits.

Remote sensing and geographic information system (GIS) approach in groundwater potential zone mapping in hardrock terrain: a case study of the Langat Basin, Selangor

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The advantages of remote sensing images in projecting ground surface features of a wide area and the ability of the geographic information system (GIS) to integrate several layers of data of certain area are used in producing the groundwater potential map of the Langat Basin. By using the GIS technique, all groundwater related data in hardrock terrain, consisting of lineaments and land use information depicted from remote sensing images are integrated with other auxiliary data such as topographic elevation, topographic gradient, annual rainfall, soil type, drainage density and lithology of the area. As a result, a derived map which demarcate the study area into very high, high, moderate, low or very low groundwater potential zones is produced. The map indicates that hardrock terrain that was previously mapped as low to very low potential actually possess moderate to high groundwater potential. Since the derived groundwater potential zone map is very useful, and can be produced quickly, it is suggested that this method be applied in the early stages of groundwater exploration to locate target areas in hardrock terrain, before further detailed investigation.

Epithermal gold-copper mineralization, late Neogene calc-alkaline to potassic calc-alkaline magmatism and crustal extension in the Sunda-Banda arc

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The majority of gold-copper mineralization along the Sunda-Banda arc belongs to low-sulfidation epithermal type. Studies by previous authors suggest that mineralization environment changes from low-sulfidation epithermal in the western segment of the arc, minor porphyry and high-sulfidation epithermal to submarine stratiform deposit in the eastern region. It seems that the nature of geologic setting and magmatic evolution exert a profound influence on the

mineralization environment. Most epithermal mineralization are hosted by stratovolcanoes and are associated with old caldera complexes controlled by strike-slip faults and graben subsidence. The present available K-Ar ages of mineralization suggest that the process is related to primarily Late Neogene volcanic eruption of fine silicic pyroclastics of calc-alkaline to potassic calc-alkaline affinity.

Petrogenesis of Perhentian granite and Perhentian Kecil syenite from the Perhentian Island, northeastern Peninsular Malaysia: evolution of two contrasting magmas

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The Perhentian complex consists of two plutons, the younger Perhentian granite and the older Perhentian Kecil syenite. They form a reversely zoned complex where the syenitic rock is rimmed by the granitic rock. The former ranges in composition from syenite to monzonite to gabbroic rocks whereas syenogranite dominates the latter pluton. The syenitic rocks are characterized by an extended composition of lower SiO_2 (46 to 66 %) compared to the Perhentian granite (> 70.9 % SiO_2) and have significantly high Al_2O_3, TiO_2, Fe^{tot}, MnO, MgO, CaO, P_2O_5, Sr, Ba and V compared to the granitic rocks. Petrology and geochemical datas indicate that both rocks are individual melt probably derived from a different sources. It is suggested that the syenitic magmas formed by hydrous melting of lower crust probably as a result of underplating by, or intrusion of mantle derived basaltic magma. The strong enrichment of large ion lithophile elements (Sr and Ba) is probably related to transfer of enriched (hydrous?) fluids from the mantle into the lower crust, and possibly initiated melting to form the syenites. In contrast to the Perhentian Kecil syenite, the Perhentian granite has no mafic association. The felsic nature of the Perhentian granite suggests that it may be derived from an SiO_2 rich source or may represent a minimum melt, the first melt produced from a solid containing plagioclase-K-feldspar-quartz.

Occurrence, field relations and petrochemistry of mafic dykes from the Kenyir area, central Terengganu: preliminary observation

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The Kenyir lake is located in the western side of the Terengganu state, about 17 km from Kuala Berang, the nearest township. This paper will focus on the mafic dykes that occur at the eastern part of the Kenyir lake area. Intrusion of the mafic dykes in the study area are apparently controlled by a pre-existing NE-E trending fracture. The trend is similar to the regional mafic dykes trend in the Eastern Belt. The silica content of the dykes are between 48.8 to 58.8% and can be classified as basalt-basaltic andesite and basaltic trachyandesite on a TAS diagram. The chemical data indicate that the dykes are tholeiitic, and formed in a continental within plate tectonic setting.

Geokimia Tonalit Berangkat dan Leukogranit Kenerong sebagai petunjuk kepada pembentukan dan asalan magma Kompleks Stong, Kelantan

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Two main components of the Stong Complex in the order of decreasing age are Berangkat Tonalite and Kenerong Leucogranite. The concentration of 10 major elements and 9 trace elements of 14 representative samples from these two components were analyzed using X-Ray Fluorescence (XRF). The purpose of this study is to identify their genesis and the origin of the magma, whether it is from the Main Range Granite Batholith or from the Eastern Belt Granite. Analysis of major elements were carried out using Harker, AFM and A/CNK diagrams, while trace elements were divided into two groups, the LIL elements (large ion lithopile elements) and the trace transition metal. The Harker diagrams show both positive and negative corelation. The negative corelation shows that the Al_2O_3, Fe_2O_3, MnO, TiO_2, MgO, P_2O_5 and CaO decrease in concentration with increasing SiO_2. The positive corelation indicates that the Na_2O and K_2O increase in concentration with increasing SiO_2. These suggest that the Berangkat Tonalite and Kenerong Leucogranite originated from the same magma that had undergone differentiation. The trend of magma differentiation from Berangkat Tonalite to Kenerong Leucogranite is indicated from major and trace element analysis. Both Berangkat Tonalite and Kenerong Leucogranite are more felsic in nature containing high alumina (peraluminous) and the magma

is of calc-alkaline series. The Stong Complex is from I-type granites suggesting that they are part of the Eastern Belt Granite.

Asalan zenolit di dalam pluton Granit Noring, Kompleks Stong, Kelantan

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The Stong Complex in the study area is represented by granitic rocks exposed along the TNB road heading towards Sg. Terang pumping station and Lata Lubuk Gajah. These granite rocks are known as Noring Granite. Field observation shows that there are five rock types in the area. They are porphyritic granite, microgranite, phyllite, tuffaceous sandstone and xenolith of sedimentry origin. Xenoliths are widespread within the Noring Granite. Petrographic study shows close similarity between the xenoliths and the metasediments. Therefore, it is important to know the origin of xenoliths in the Noring granite. Three approaches were used in this study that is by using field observations, petrographic study and geochemical relationship. Petrographic study shows that the granite consists of quartz, alkali feldspar, plagioclase and biotite. Results from data ploted on the AFM diagram suggest that the xenoliths within the Noring Granite originated from the Gua Musang Formation.

Komplek Stong: kajian geokimia ke atas batuan Granit Noring dan Leukogranit Kenerong di Kampung Renyok, Jeli, Kelantan

NUR HUDA MOHD JAMIN DAN MOHD ROZI UMOR

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Geochemistry of the Stong Complex at Kampung Renyok, Jeli, Kelantan, has been studied to determine the chemical behaviour, correlation and crystallisation history of Noring Granite and Kenerong Leucogranite. The Stong Complex consists of three rock units namely the Berangkat Tonalite, the Noring Granite and the Kenerong Leucogranite. However, this study concentrated on the Noring Granite and the Kenerong Leucogranite. The geochemical data were interpreted using the Harker diagram, ACNK diagram and AFM diagram. The results suggest that the Noring Granite and Kenerong Leucogranite are high K calk-alkaline rock and peraluminous with I-type granitic rock. The differentiation trend is from the Noring Granite to Kenerong Leucogranite, suggesting that the Noring Granite crystallised before the Kenerong Leucogranite. Analysis on trace elements shows substitution of major elements by trace elements. Based on the above, it is interpreted that both granites crystallised from the same crustal magma through several series of differentiation. The original magma was regarded as basic in nature and had undergone differentiation before evolving into felsic magma.

Komposisi unsur surih dan major di dalam tanihatas di sekitar kawasan bukit batu kapur Bukit Jernih, Kangar, Perlis

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Composition of minor and major elements in soils (topsoil and profile) in the vicinity of limestone hills at Bukit Jernih, Kangar, Perlis was determined. Minor elements that were determined included As, Ba, Ce, Co, Cr, Cu, Ni, Pb, Rb, Sr, V, Zn and Zr. In decreasing order, the minor elements concentration are Zr, Ba, Cr, V, Ce, Zn, Ni and Pb with their respective composition of 774 μgg^{-1}, 396 μgg^{-1}, 325 μgg^{-1}, 233 μgg^{-1}, 213 μgg^{-1}, 152 μgg^{-1}, 110 μgg^{-1} dan 100 μgg^{-1}. Concentration of the other minor elements in soil was less than 100 μgg^{-1}. Composition of minor elements in soil profile was decreasing with depth, however the amount of change was not significant. Composition of major elements in soils that was studied included SiO_2, Al_2O_3, Fe_2O_3, TiO_2, CaO, MgO, MnO, Na_2O, P_2O_5, and K_2O. Silica constitutes the highest concentration in limestone soil. This is followed by Al_2O_3, Fe_2O_3, CaO, MgO, MnO, Na_2O, P_2O_5 and K_2O in decreasing order. The formation of Al_2O_3 in soil is three to four times greater than the formation of Fe_2O_3. In the soil profile, minor elements were found to accumulate at around 20–60 cm depth.

A geomorphological approach in predicting environmental impacts of proposed development in hilly terrain

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Classification of slopes and the associated risk by means of slope angle alone is often not adequate to give appraisal on possible risk and environmental impacts. This is mainly because the geomorphic processes that take place differ with locations. This paper presents an example of geological studies with emphasis on geomorphology for an EIA report, which has been conducted recently at the proposed site of Ringlet National Secondary School, Cameron Highland, Pahang Darul Makmur. The study area is a sub-catchment within the larger catchment area of Sungai Bertam. The geology of the area consists of granitic and schist bedrock, which is locally unconformably overlain by alluvial/colluvial deposits notably in the valley floor. Natural slopes in the study area were divided into 9 geomorphic units based on the predominant geomorphic and pedogenic processes. Each geomorphic unit mapped has distinctive geomorphic processes and problems. In this way, prediction of the associated environmental impacts and

planning for mitigation and abatement measure can be executed more effectively. Amongst the significant environmental impacts predicted due to the development activities in this area include landslide, erosion and associated problems, disaggregation, compaction and pollution, notably during the site clearing and construction phase. However, with well-planned mitigation measures, such as slope stabilisations, minimising slope cuttings, provision of vegetative covers and siltation traps, the impacts can be greatly reduced and minimised.

Perubahan zon pinggir pantai dan implikasinya di Kuala Selangor, Malaysia

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Abiotic changes and physical processes occurring in the coastal zone have deteriorated the natural environment within Kuala Selangor district. Shoreline movement towards the continent contributed to soil loss thus affecting agricultural land. Physical processes, especially erosion and deposition, coupled with changing activity associated with human land-use, have affected infrastuctures and destroyed the mangrove ecosystem in Kuala Selangor. Integrated coastal zone management, efficient legislation implementation and the improvement of public awareness are needed to solve the problem. Futhermore, complete information system support and continuous coastal zone monitoring are important to safeguard the coastal zone sustainability in Kuala Selangor.

Pembandaran mampan: penggunaan pendekatan geosains dalam proses perancangan guna tanah di Malaysia

ROHAYU CHE OMAR[1], IBRAHIM KOMOO[1] DAN HALIMATON SAADIAH HASHIM[2]

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[2]Jabatan Perancangan Bandar dan Desa Selangor

Sustainable urbanization can be accomplished by developing the geoscience concept in landuse planning. Geoscience concepts have been developed based on environmentally sensitive areas for Selangor. This concept comprises three principal components and their associations i.e. (a) natural heritage value (geodiversity); nature site/geosite and man-induced site; (b) life support system (natural resource): water resources, minerals/rocks/aggregates and; (c) geohazard risk: slope failure, site stabilization, erosion, siltation, flood, man-induced instability, industrial

and natural pollution. The principal components and their associated environment is extrapolated using the information matrix approach, which is usually used in the evaluation of rational planning. The results are compared with the principal components and their associations from the Wales and England as well as ideal estimated values. The analysis will list an approach, which can be used for intergrating geoscience information in more holistic planning processes and assisting in the formulation of an instrument for landuse development.

An approach to joint roughness measurement in rock — a comparative study

MOHD FOR MOHD AMIN, TEO KING BENG, MUSHAIRRY MUSTAFFAR, HO CHIN KUN AND LOH TAR HER

Fakulti Kejuruteraan Awam
UTM Skudai

Surface texture dictates the degree of roughness of a joint surface. Surface roughness on the other hand, has a significant effect on joint strength particularly, the frictional component of shear strength and surface contact during shear. Joint roughness is therefore, an important aspect to be considered when dealing with joint shear strength. The present approach in obtaining the surface texture of a joint is through the use of profiler. However, the measurement process is laborious and time consuming.

This paper highlights a study on the suitability of *close-range digital photogrammetry*, as an alternative method for measuring surface texture. Specifically, this paper presents the usage of area-based image matching approach. Initial findings give promising indications on the suitability of this method. Apart from being semi-automated, it also exhibit positive characteristics, in terms reliability and practicality.

Influence of discontinuity sets on slope failures at Pos Selim Highway, Malaysia

AZIMAN MADUN AND HUSAINI OMAR

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The types of discontinuity of studied slopes are joints and foliations. The discontinuity sets in all the locations have maximum pole intensity of more than 8%. Several sets of discontinuities are recorded at each location. The stereographic plot of the discontinuities set revealed that most of the rock slopes have the potential to fail in the mode of wedge, planar and toppling, as well as the combination of more than one mode of failure. Potential wedge failure is found at seven locations, potential planar failure at five locations and potential toppling at four locations.

BERITA-BERITA PERSATUAN
News of the Society

KEAHLIAN (Membership)

The following applications for membership were approved:

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1. Mohd Azmi Ismail
   MINT, Bangi, Selangor.
2. Ismail C. Mohamad
   Jabatan Mineral & Geosains Malaysia, Ipoh, Perak.
3. Thangaraju Rajasekaran
   124 Jalan Tun Sambanthan, Brickfields, 50470 Kuala Lumpur.
4. Zainal Abidin Hasan
   MACRES, No. 13, Jalan Tun Ismail, 50480 Kuala Lumpur.

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1. John Mark A/L Anthoa @ Anthuvan
   Jabatan Geologi, Universiti Malaya, 50603 Kuala Lumpur.
2. Ummi Farah Mohd Rosli
   Jabatan Geologi, Universiti Malaya, 50603 Kuala Lumpur.
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   Jabatan Geologi, Universiti Malaya, 50603 Kuala Lumpur.
6. Patrick Gou
   Jabatan Geologi, Universiti Malaya, 50603 Kuala Lumpur.
7. Tiong Chiong Ngu
   Program Geologi, Universiti Kebangsaan Malaysia, 43600 Bangi.

PETUKARAN ALAMAT (Change of Address)

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

1. Adi Suprapto
PSL-UNPAK (Pusat Studi Lingkungan Universitas Pakuan), Environmental Research Centre, Pakuan University, Bogor, Jl. Pakuan Raya, Bogor 16110, Indonesia.
2. James Bujang S.
Lot 957, Jalan Terusan Utama, Pujut 4, 98000 Miri, Sarawak.
3. C. Dickinson
The International School of Penang (Uplands0, Kelawei Road, Pulau Tikus, 10250 Penang, Malaysia.
4. Abdul Hadi bin Abdul Rahman
Jab. Mineral & Geosains Terengganu, Tkt. 2 Kompleks Taman Selera Tanjung, Peti Surat 50, 20906 Kuala Terengganu, Terengganu.
5. Aziman Bin Madun
No. 12, Lorong TMJ 7, Taman Maran Jaya, 26500 Maran, Pahang.
6. David Bowling
Regional Manager — KL Office, Cambrian Consultants Ltd., Unit 5A, Level 5, Menara Chan, 138 Jalan Ampang, 50450 Kuala Lumpur.

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The GSM is seeking the address of the following member. Anyone knowing the new address please inform the Society.

1. Charlie Lee
Sarawak Shell Bhd., EPS-WS1, 98100 Lutong, Sarawak.

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PERTAMBAHAN BAHARU PERPUSTAKAAN (New Library Additions)

The Society has received the following publications:

1. Oklahoma Geology notes, vol. 60, nos. 3 & 4, 2000
2. American Museum Novitates, no. 3330 & 3331, 2001
3. Geologica Belgica, vol. 3, nos. 1–2, 2000
4. System and boundary conceptualization in ground-water flow simulation, 2000
5. AAPG Bull. vol. 85, no. 5, 2001
6. Science Reports of the Institute of Geoscience, Univ. of Tsukuba, vol. 22, 2001
7. Geoscience, vol. 14, no. 3 & 4, 2000
8. Earth Science Frontiers, vol. 7, nos. 3 & 4, 2000 & vol. 8, nos. 1 & 2, 2001
9. USGS Professional Paper: 2000: no. 1617, 1624, 1500-K-R.
10. USGS Circular: 2000: nos. 1201, 1216.

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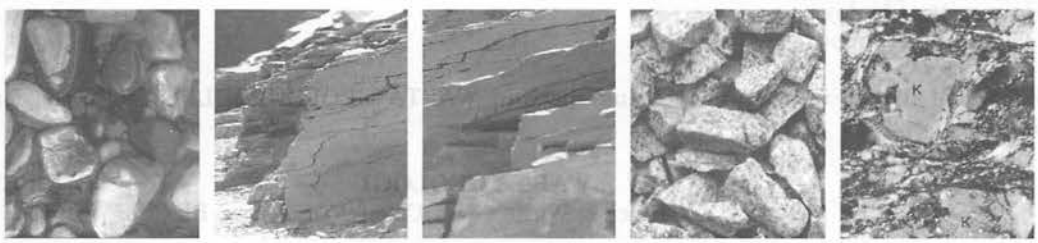

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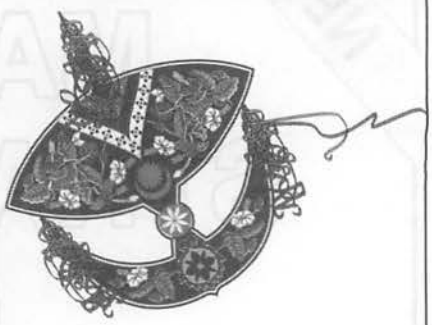

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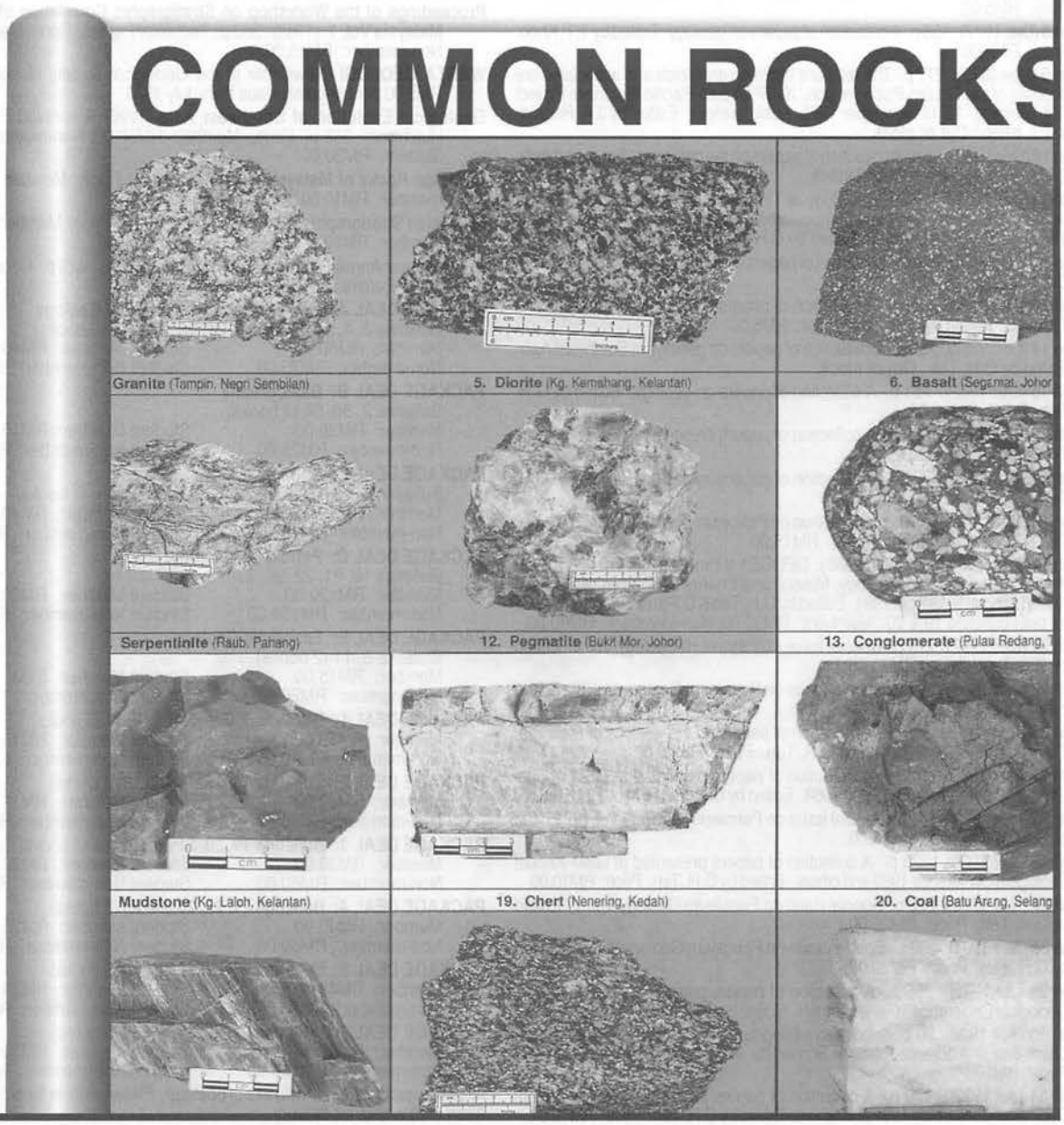

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INTERNATIONAL ASSOCIATION OF ENGINEERING GEOLOGY AND THE ENVIRONMENT (IAEG), "Engineering Geological Problems of Urban Areas" (International Symposium), Ekaterinburg, Russia. (Contact: Secretariat, "EngGeolCity-2001, UralTISIZ 79, Bazhov str., Ekaterinburg, Russia 620075. Tel: +7 3432 559772; Fax: +7 3432 550043; E-mail: UralTIS@etel.ru)

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PALEOFORAMS 2001 (International Conference on Paleozoic Benthic Foraminifera), Middle East Technical University, Ankara,

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Two copies of the text and illustrations must be submitted. The scripts must be typewritten double-spaced on paper not exceeding 210 x 297 mm (or 8.27 x 11.69 inches, A4 size). One side of the page must only be typed on.

Figure captions must be typed on a separate sheet of paper. The captions must not be drafted on the figures. The figure number should be marked in pencil on the margin or reverse side.

Original maps and illustrations or as glossy prints should ideally be submitted with sufficiently bold and large lettering to permit reduction to 18 x 25 cm: fold-outs and large maps will be considered only under special circumstances.

Photographs should be of good quality, sharp and with contrast. For each photograph, submit two glossy prints, at least 8 x 12.5 cm and preferably larger. Use of metric system of measurements (SI) is strongly urged wherever possible.

An abstract in English which is concise and informative is required for each paper.

References cited in the text should be listed at the end of the paper and arranged in alphabetical order and typed double-spaced. The name of the book or journal must be in *italics*. The references should be quoted in the following manner:

HAMILTON, W., 1979. Tectonics of the Indonesian region. *U.S. Geological Survey Professional Paper 1078*, 345p.

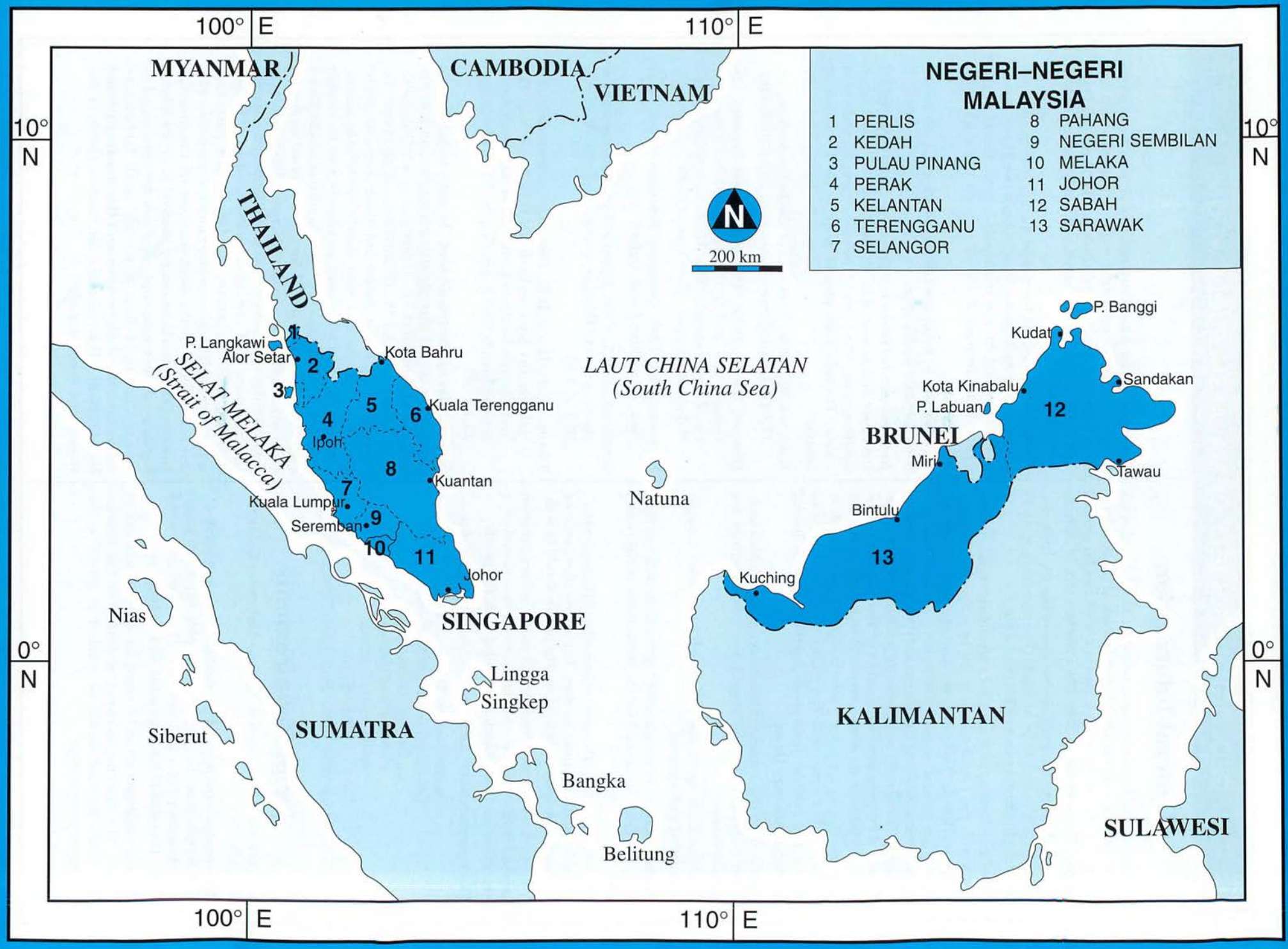
HOSKING, K.F.G., 1973. Primary mineral deposits. *In* Gobbett, D.J. and Hutchison, C.S. (Eds.), *Geology of the Malay Peninsula (West Malaysia and Singapore).* Wiley-Interscience. New York, 335-390.

HUTCHISON, C.S., 1989. *Geological Evolution of South-east Asia*. Clarendon Press, Oxford. 368p.

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

TAYLOR, B., AND HAYES, D.E., 1980. The tectonic evolution of the South China Sea basin. *In:* D.E. Hayes (Ed.), The Tectonic and Geologic Evolution of Southeast Asian Sea and Islands, Part 2. *Am. Geophy. Union Monograph 23*, 89-104.

Submission of electronic text. In order to publish the paper as quickly as possible after acceptance, authors are requested to submit the final text also on a 3.5" diskette. Both Macintosh and PC (DOS/Windows) platforms are supported. Main text, tables and illustrations should be stored in separate files with clearly identifiable names. Text made with most word processors can be readily processed but authors are advised to provide an additional copy of the text file in ASCII format. Preferred format for illustration is Encapsulated PostScript (EPS) but authors may submit graphic files in their native form. It is essential that the name and version of softwares used is clearly indicated. The final manuscript may contain parts (e.g. formulae, complex tables) or last-minute corrections which are not included in the electronic text on the diskette; however, this should be clearly marked in an additional hardcopy of the manuscript. Authors are encouraged to ensure that apart from any such small last-minute corrections, **the disk version and the hardcopy must be identical**. Discrepancies can lead to proofs of the wrong version being made.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9 NEGERI SEMBILAN
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11 JOHOR
12 SABAH
13 SARAWAK
P. Langkawi
Alor Setar
Kota Bahru
Kuala Terengganu
Ipoh
Kuantan
Kuala Lumpur
Seremban
Johor
SELAT MELAKA
(Strait of Malacca)
LAUT CHINA SELATAN
(South China Sea)
Natuna
P. Banggi
Kudat
Kota Kinabalu
Sandakan
P. Labuan
BRUNEI
Miri
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Bintulu
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