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(GEOLOGICAL SOCIETY OF MALAYSIA)

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CATATAN GEOLOGI (Geological Notes)

Seismicity of South East Asia: January – March 2005

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50603 Kuala Lumpur

ABSTRACT

There has been much interest in the regional seismicity of South East Asia after the great Northern Sumatra Earthquake of December 26, 2004. This short note looks at the seismicity distribution of the area using the National Earthquake Information Centre's web data from January till March of 2005. The study focuses on magnitude and depth distributions, and how the seismicity is related to the tectonic features in the area.

Aftershocks from the great quake have given rise to most of the tremors. The area has remained dynamic and activity is expected to continue in the next few months given the size of the quake. Other earthquakes are related to the Pacific Ring of Fire that is situated in the eastern part of this region. The majority of the quakes are of shallow depths, caused by low angle subduction. Other tectonic features that contribute to the seismicity of the area are faults and spreading rift zones.

INTRODUCTION

The study area, bounded by latitudes 25°N and 12°S, and longitudes 90°E and 135°E, encompasses most of South East Asia. The data used is from the United States Geological Survey's (USGS) National Earthquake Data Centre (NEIC) Website (www.neic.usgs.gov) for the period of January to March 2005. It is to be noted that there are limitations to this database due to the nature of the seismic network used in the location program. The World Wide Seismic Station Network (WWSSN) covers most of South East Asia but there are still some areas, such as the Indian Ocean, that do not have any station. This makes it difficult for the program to precisely determine certain parameters such as the focal depth and magnitude. There are also some earthquakes in the database that do not have either depth or magnitude information. The minimum magnitude recorded is 3.5. Data is also available from the Malaysian Meteorological Services (MMS) website. This data complements the NEIC data; though for simplicity's sake and to avoid confusion, only the NEIC data was used.

GENERAL SEISMICITY

In total, there were 2650 earthquakes recorded in the study area in the first three months of 2005. The bulk of this activity (2244 or 85%) comes from the aftershocks close to the site of the Great Quake of 2004. This magnitude 9 earthquake on 26 December 2004 in Northern Sumatra was the fourth largest in the world with a tsunami that killed more than 250,000 people. 1465 quakes were recorded in January 2005, followed by 427 in February and 758 in March (Figure 1). The increase in activity in March was due to the occurrence of another great earthquake in this region, a magnitude 8.7 that was located south of the magnitude 9 quake and two major earthquakes (Mw 7.1) in the eastern part of South East Asia.

In the west, the earthquakes are located along the subduction zone between the Eurasia and Indo-Australian tectonic plates while in the east, they are located within the Pacific Ring of Fire. Several active faults and plate boundaries can be found in the study area. The seismically active areas are found from the southern tip of Myanmar, through the west of Sumatra, down to the south of Java, up again through the sea between Sulawesi and New Guinea and all the way to north of the Philippines. A subduction zone with the Indian Plate going under the Sunda Plate (Hutchinson, 1996) is marked by the Sunda trench, which runs from west Sumatra to the south of Java Island. A right lateral fault running through the west coast of

Sumatra and a rift zone in the Andaman Sea also influence the seismicity of the area close to the epicentre of the December 2004 quake. There are also spreading ridges and active trenches in the east, in addition to an active fault zone that runs through the Philippine Islands and a back-arc under-thrust south of Sulawesi.

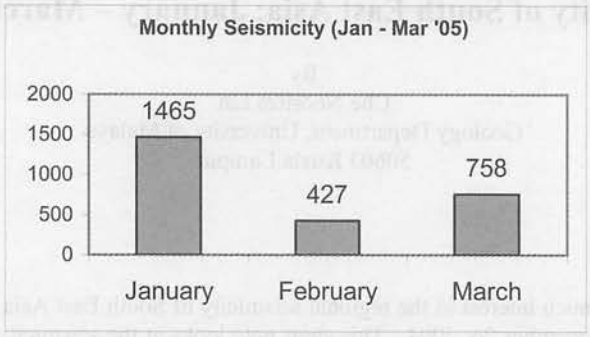

Figure 1. Monthly Seismicity

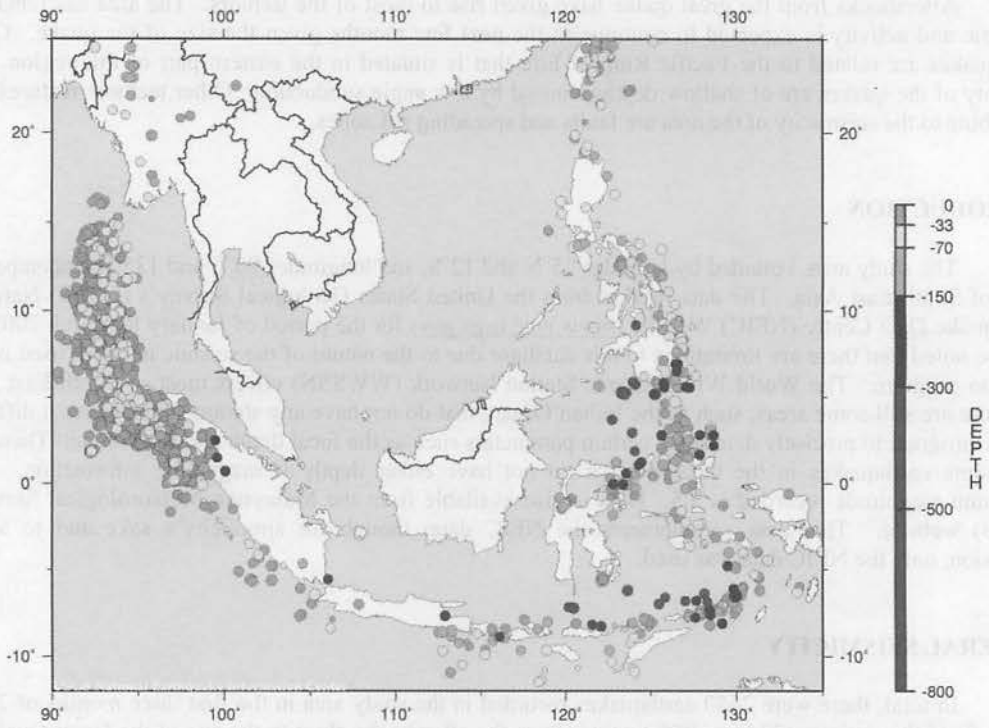

Figure 2. Seismicity of South East Asia: January – March 2005

MAGNITUDE DISTRIBUTION

The reported magnitudes are mostly body-wave magnitudes (Mb), as surface-wave magnitudes (Ms) and moment magnitude (Mw) are usually only calculated for the larger ($M > 5.5$) earthquakes. There may also be some discrepancies but since only one database is used, the error should be small.

Most of the earthquakes had magnitudes of less than 5 (Table. 1). There were quite a few moderate and strong quakes during this time. The number of earthquakes decreased by a factor of ten for each increase in the order of the magnitude; this is consistent with world seismicity data. The largest event during this period is a Mw 8.7 that occurred on March 28, 2005 (Table 2). This quake increased the

seismicity in this area by having its own aftershocks. There were also two major events (Mw 7.10) within this period; one was located in the Banda Sea while the other was located south of Mindanao. Even though all three quakes are associated with active trenches, the latter two quakes had deeper foci and did not generate as many aftershocks.

Magnitude	Classification	Frequency	%
< 4.9	Minor to Light	2263	86.11
5 - 5.9	Moderate	343	13.05
6 - 6.9	Strong	19	0.72
7 - 7.9	Major	2	0.08
8 and higher	Great	1	0.04
	Total	2628	

Table 1. Magnitude Distribution

Date	Latitude	Longitude	Magnitude (Mw)	Depth (km)
05/02/2005	5.29	123.34	7.1	524
02/03/2005	-6.53	129.93	7.1	201
28/03/2005	2.09	97.11	8.7	30

Table 2. Significant events

DEPTH DISTRIBUTION

Most of the events in this area were of shallow depths (less than 33 km) (Table 3). It should be noted that as there were some unresolved depths reported as shallow events, the number may be slightly inflated. These shallow tremors are consistent with seismicity near a subducting plate boundary and transform faults. The deepest event recorded had a focal depth of 642 km, occurring south east of Sulawesi, some 500 km north of the Sunda trench. The deeper events are usually located away inwards, on the upper plate side, from subduction boundaries.

Depth	Classification	Frequency	%
< 33 km	Shallow	2219	83.80
34 - 150 km	Intermediate	372	14.05
> 150 km	Deep	57	2.15
	Total	2648	

Table 3. Depth Distribution

CONCLUSION

The seismicity of South East Asia is dominated by subduction at the boundary of the Eurasia – Indo – Australia plates as well as along that segment of the Pacific Ring of Fire that runs through the eastern part of the region. During the period of January to March, 2005, aftershocks of the great Sumatra quake of December 26, 2004 contributed to most of the activity. Most quakes had magnitudes of less than 5 with foci depths of less than 33 km and were located near subducting plate boundaries.

ACKNOWLEDGEMENT

The author wishes to acknowledge the USGS, NEIC and the Seismology Division of the MMS for making the data available for this study.

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Manuscript received 20 August 2005

PERTEMUAN PERSATUAN (Meetings of the Society)

Annual Geological Conference 2005
Allson Klana Resort, Seremban, Negeri Sembilan
4-5 June 2005

Programme

Saturday, 4 June 2005

0800–0830	Registration
0830–0930	Opening ceremony
0930–1000	Keynote Paper I : Popularising Geology – Presenting The Past, Present And Future In The Earth Sciences by Associate Prof. Dr. Lee Chai Peng
1000-1030	Tea break
	Technical Session I - Engineering geology and hydrogeology
1030-1050	Physico-chemical properties of residual soils of the Kenny Hill Formation in the Shah Alam area, Selangor (Tan Boon Kong)
1050-1110	Beberapa sifat fizik dan mekanik batuan granit berbutir kasar Kuala Kubu Bharu (Lee Chun Rhen, et al.)
1110-1130	Beberapa sifat fizik dan mekanik batuan granit berbutir sederhana sehingga kasar Bukit Fraser (Mohammad Hazlan Marjani, et al.)
1130-1150	Penerapan teori blok untuk analisis kestabilan cerun batuan Bukit Fraser di Pahang, Malaysia (Haswanto & Abd. Ghani Md. Rafek)
1150-1210	Blasting-induced rock slope instability in Senai, Johor - a case study (Abd. Rasid Jaapar)
1210-1230	Engineering geological problems of the Kundasang area (Rodeano Roslee)
1230-1250	Pencirian geofizik dan geomekanik jasad batuan basalt di kawasan Pantai Batu Hitam, Kuantan, Pahang (Abdul Ghani Rafek & Nor Azrina Mohd. Amin)
1250–1400	Lunch/prayer break
	Technical Session II - Environmental geology
1400-1420	Characteristics of leachate at Air Hitam sanitary landfills in Puchong, Selangor (Norlailatul Zuraidah Mohd. Radzuan, et al)
1420-1440	The retention capability of soils as natural clay liner for landfill system using leaching column test and selective sequential extraction analysis (Nurita Ridwan et al)
1440-1500	The relationship between morphometry and hydrologic properties of the Semenyih River Basin and their significance (Muhammad Barzani Gasim)
1500-1520	Sifat kimia tanah serta keupayaan penjerapan logam berat oleh tanah di sekitar, Negeri Selangor (Suzana Ismail et al)
1520-1540	Kitaran aggregat: kajian kes kehilangan kerugian di kuari dan tapak binaan (Victor Wong)
1540-1600	Tea break
	Technical Session III - Petrology & geochemistry
1600-1620	Highly evolved S-type granite: Selim granite, Main Range Batholith, P.M. (Azman A. Ghani)
1620-1640	Pengezonan batuan dan penaburan mineral bijih dalam longgokan skarn di Bukit Botak, kajian dari segi petrologi, mineralogi bijih dan geokimia (Goh, S.H., et.al,)
1640-1700	Petrology and geochemistry of the Sempah volcanic complex: P.M. (Azman A. Ghani & Navpreet Singh)
1900–2100	Dinner (sponsored by the State Government of Negeri Sembilan

Technical Session III - Petrology & Geochemistry

0830-0850	Geochemical characteristics of S- and I-type granites: example from P.M. granites (Azman A. Ghani)
0850-0910	Penentuan usia batuan igneus Pulau Pangkor dengan kaedah K/Ar mineral biotit (Mohd Rozi Umor, et al)
0910-0930	Geochemistry of Jawa & Panchor granite: the most northern granitic bodies of the boundary range batholith (Azman A. Ghani & Mohd. Irfan Abadi)
0930-1000	Tea break

Technical Session IV - Sedimentology, stratigraphy & paleontology

1000-1030	**Keynote Paper II** – Permo-Triassic Radiolarian biostratigraphy of the Semanggol Formation by Prof. Dr. Basir Jasin.
1030-1050	Depositional controls on the petrophysical and reservoir characteristics of the shallow marine sandstone bodies of the Miri Formation (Middle Miocene), Sarawak (Hatem S.A. Abieda, et al)
1050-1110	A sedimentological and palaeontological study along Kuala Tekai-Kuala Tahan of Tembeling River, Jerantut, Pahang (Ainul Rubizah Ariffin, et al)
1110-1130	Some Upper Mesozoic palynomorphs from the Tekai River area, Jerantut, Pahang (Sharifah Shahira Wafa Syed Khairulmunir Wafa)

Technical Session V - Structural geology and Conservation

1130-1150	Sustainable mining of the clay resources in Peninsular Malaysia (Khor Peng Seong)
1150-1210	Geology in the Quran 2: Environmental impact of volcanic activities/earthquakes/ tsunamis (Mokhtar Ghani)
1210-1230	Kayu terpetri : Satu khazanah tersembunyi (Askury Abd. Kadir)
1230-1250	Zon sesar lebir: cerapan di sepanjang Sungai Lebir, Kelantan (Jatmika Setiawan & Ibrahim Abdullah)
1250-1400	Lunch/Prayer break

Technical Session VI – Geoscientific tools & techniques.

1400-1420	Terrain features mapping using aerial photographs and digital elevation model (DEP) in Cameron Highlands, Pahang (Mohamad Abd. Manap, et al)
1420-1440	Pemetaan akuifer dengan teknik geoelektrik di Sungai Kelambu, Banting, Selangor (Dayang Suraya Sirat, et al)
1440-1500	Geology & Geomorphology of Lake Linumunsut, Tongod, Sabah (Felix Tongkol)
1500-1520	Penggunaan gelombang Rayleigh untuk mengukur penandu mutu jasad batuan (PMB) (Abdul Rahim Samsudin)
1520-1540	Kajian ramalan hakisan tanah menggunakan perisian terbuka 'Geographical resource analysis support system' (GRASS) di daerah Barat Daya, Pulau Pinang (Mohd. Firuz Ramli et. al)
1540-1620	Closing ceremony
1620-1700	Tea

Annual Geological Conference 2005
Allson Klana Resort, Seremban, Negeri Sembilan
4-5 June 2005

UCAPAN PRESIDEN, PERSATUAN GEOLOGI MALAYSIA, PROF. MADYA DR. LEE CHAI PENG DI PERSIDANGAN TAHUNAN GEOLOGI 2005

Yang Berusaha Saudari Pengerusi Majlis,

Yang Berbahagia Tuan Hj. Yunus Abd. Razak, Timbalan Ketua Pengarah, Jabatan Mineral dan Geosains Malaysia,

Yang berusaha Pengerusi Jawatankuasa Penganjur Persidangan, Tuan Hj. Askury Abd. Kadir.

Yang berusaha Tuan Hj. Ismail Ahmad, Pengelola Persidangan Tahunan Geologi 2005 dan Pengarah, Jabatan Mineral dan Geosains Negeri Sembilan dan Melaka,

Tuan-tuan dan puan-puan para hadirin yang dihormati sekalian.

Selamat pagi dan salam sejahtera. Terlebih dahulu saya ingin bersyukur kepada Tuhan Pencipta Alam Semesta yang begitu indah ini kerana memberi berkatNya kepada kita semua supaya dapat berkumpul di sini untuk dalam majlis perasmian Persidangan Tahunan Geologi 2005.

Saya ingin mengucapkan ribuan terima kasih kepada Tuan Hj. Yunus Abdul Razak kerana sudi datang merasmikan persidangan ini. Saya bagi pihak Persatuan Geologi Malaysia mengucapkan Selamat Datang kepada tuan-tuan dan puan-puan yang dihormati sekalian ke persidangan tahunan ini.

Persidangan Tahunan Geologi 2005 ini merupakan persidangan kali Ke-19 yang dianjurkan oleh Persatuan Geologi Malaysia dari permulaan sampai ke sekarang. Persidangan ini sangat unik dan amat bermakna kerana Negeri Sembilan merupakan destinasi terakhir persatuan mengadakan persidangan tahunan dalam menjelajahi semua negeri di Malaysia. Tempat Persidangan Ke-19 di Seremban ini merupakan venue yang paling dekat dengan Kuala Lumpur. Oleh kerana itu, kehadiran pada kali ini agak sedikit, mungkin ahli-ahli Persatuan Geologi memilih tempat yang lebih jauh sebagaimana persidangan yang lepas untuk menikmati suasana cuti bersama keluarga.

Saya merasa sangat gembira mengadakan persidangan tahunan ini di Negeri Sembilan kerana kita dapat bukan sahaja menggenapkan hajat mengadakan persidangan tahunan di semua negeri di Malaysia, tetapi juga memberi peluang kepada ahli-ahli kita untuk melawat Seremban yang mungkin kita selalu "bypass" sahaja bila hendak pergi ke Port Dickson atau tempat lain. Banyak tempat yang anda dapat lawati di seremban ini. Tengok sahaja hotel kita ini, ianya dikelilingi taman yang indah dan amat sesuai untuk riadah bersama keluarga.

Tak sama dengan persidangan tahunan yang lepas, sambutan kali ini berkurangan dengan hanya 30 kertas kerja yang akan dibentangkan sepanjang dua hari persidangan ini. Saya berharap, ini hanya untuk tahun ini sahaja dan bilangan kertas yang akan dibentangkan akan bertambah pada persidangan yang akan datang, terutamanya persidangan tahun depan yang akan dianjurkan bersama dengan Jabatan Geologi, Universiti Malaya untuk meraikan 100 Tahun Universiti Malaya.

Saya ingin mengambil kesempatan ini untuk merakamkan penghargaan dan mengucapkan ribuan terima kasih bagi pihak Persatuan Geologi Malaysia kepada semua pihak atas sokongan dan bantuan yang dihulurkan untuk menjayakan persidangan ini, terutamanya kepada:-

Y.A.B. Mentri Besar Negeri Sembilan dan Kerajaan Negeri Sembilan atas sumbangan penajaaan majlis makan malam persidangan ini,
Tuan Hj. Askury Abd. Kadir, Tuan Hj. Ismail Ahmad dan Jawatankuasa Penganjur Persidangan,
Dr. Iskandar Taib dan ahli-ahli Jawatankuasa Penyunting yang membantu mengeluarkan Buletin khas No. 51 untuk persidangan dalam masa yang singkat,
Penderma-penderma,
Pembentang-pembentang kertas dan pengerusi-pengerusi sesi,
Pn. Anna Lee dan En. Mohd Aizad Morad bersama semua yang membantu menjayakan persidangan ini dan akhir sekali kepada semua perserta persidangan ini.

Sokongan padu yang diberi oleh anda semua kepada saya sebagai Presiden, Persatuan Geologi Malaysia pada tahun lalu sangat dihargai. Akhir sekali, saya memohon ma'af jika terdapat apa-apa kekurangan semasa berlangsungnya persidangan ini.

Sekian. Terima kasih.

Annual Geological Conference 2005
Allson Klana Resort, Seremban, Negeri Sembilan
4-5 June 2005

UCAPAN PERASMIAN PERSIDANGAN TAHUNAN GEOLOGI 2005, PERSATUAN GEOLOGI MALAYSIA DI ALLSON KLANA RESORT, SEREMBAN PADA 4 JUN 2005 OLEH KETUA PENGARAH, JABATAN MINERAL DAN GEOSAINS MALAYSIA, TUAN HJ. YUNUS BIN ABDUL RAZAK

Yang dihormati, Puan Pengerusi Majlis,

Yang berusaha Dr. Lee Chai Peng, Presiden Persatuan geologi Malaysia.

Yang berusaha Tuan Hj. Ismail Ahmad, Pengelola Persidangan Tahunan Geologi 2005.

Dif-dif kehormat, tuan-tuan dan puan-puan hadirin yang dihormati sekelian.

Assalamualaikum WBT dan salam sejahtera.

Selamat Datang ke Negeri Sembilan Darul Khusus yang terkenal dengan Adat Perpatih ala Minangkabau yang diwarisi sejak berzaman. Saya turut merasa gembira kerana diberi kesempatan untuk berucap kepada para peserta Persidangan Tahunan Geologi 2005 yang terdiri daripada Ahli-ahli Geosains seluruh negara dari agensi kerajaan, universiti tempatan, badan-badan berkanun dan sektor swasta.

Saya juga difahamkan bahawa persidangan tahunan ini merupakan kali yang ke-19 dan negeri terakhir dalam putaran penganjuran seluruh Malaysia sejak ianya diperkenalkan. Persidangan kali ini dihadiri hampir 50 orang peserta yang akan menonjolkan ide-ide baru yang bernas demi meningkatkan kualiti akademik dan profesyen ahli geologi. Usaha penerusan aktiviti persatuan ini adalah untuk manfaat ahli dan penyelidik agar hasil kerja dapat dikongsi secara meluas. Konsep perkongsian maklumat amat bermakna untuk perancang dan penggubal dasar ke arah pembangunan negara selaras dengan tema persidangan iaitu "Geology : Development and Conservation". Kehadiran dan komitmen tuan-tuan dan puan-puan mempamerkan peri pentingnya persidangan sebagai salah satu platfom percambahan ilmu geologi walaupun terpaksa mengorbankan hari cuti umum bersama keluarga.

Tuan-tuan dan puan-puan,

Komuniti geologi yang hadir pada hari ini merupakan tenaga penting, terlibat secara langsung di dalam penjelajahan dan pembangunan sumber asli kekayaan negara seperti mineral, petroleum, gas, air tanah dan sebagainya. Memandangkan sumber asli tidak dapat diperbaharui, maka sebahagian daripada tanggungjawab tuan-tuan dan puan-puan untuk mempastikan supaya tidak berlaku kemajiran agar ianya dapat digunapakai secara optimum serta mapan demi manfaat generasi kini dan akan datang. Usaha yang lebih komprehensif untuk mengenalpasti sumber asli perlu diperhebatkan di samping menambah-nilai sumber sediada melalui R&D. Sekiranya berjaya sudah pasti industri berasaskan mineral negara akan berkembang dengan lebih pesat tanpa kebergantungan kepada formulasi eksport yang boleh merugikan negara. Dengan itu, kita akan lebih kompetitif dalam pasaran global dalam mengharungi gelombang WTO dan APEC.

Tuan-tuan dan puan-puan yang dihormati,

Mesyuarat Majlis Persatuan Geologi Malaysia telah bersetuju pada dasarnya untuk menghidupkan kembali Simposium GEOSEA yang dijangka pada tahun 2007 di Kuala Lumpur, dengan Malaysia bertindak sebagai negara pemula. Walau bagaimanapun, ianya bergantung sepenuhnya kepada komitmen negara-negara ASEAN lain. Kenapa 2007 dipilih? Pada masa itu PGM telah mencapai usia 40 tahun atau usia matang yang boleh membuat keputusan yang betul dan tepat. Saya jangkakan menjelang usia 40 tahun PGM menjadi satu

NGO yang disegani di peringkat serantau dan antarabangsa. Jabatan Mineral dan Geosains serta Kementerian Sumber Asli dan Alam Sekitar amat komited dan akan memberi bantuan sewajarnya demi menjaya dan menghidupkan kembali simposium serantau tersebut.

Tuan-tuan dan puan-puan,

Alam sekitar berkualiti merupakan aset yang tidak ternilai yang perlu dinikmati dan dipelihara sebaik mungkin. Penglibatan tuan-tuan dan puan-puan amat bertepatan dalam menangani komplikasi yang muncul agar setiap sumber, seperti air yang ada di permukaan dan bawah tanah tidak tercemar. Begitu juga dengan pengurusan bencana, ianya menjadi kritikal dan penting pada hari ini serta menjadi masalah sejagat. Kajian geobencana berlandaskan elemen-elemen geologi kejuruteraan di kawasan sensitif perlu diadaptasikan secara komprehensif serta dapat digunapakai sepenuhnya oleh perancang gunatanah. Semoga ianya dapat mengurangkan bencana alam yang melibatkan kehilangan nyawa dan harta benda.

Sejak sekian lama, negara kita terletak dalam zon selamat gempabumi, namun begitu kejadian yang berlaku di Acheh pada 26 Disember 2004 telah membuka lembaran baru kepada geologi negara. Ekoran dari itu, bumi di rantau kita masih lagi belum stabil dan banyak lagi aktiviti seismik yang berlaku dari semasa ke semasa sehingga menimbulkan suasana kurang selesa kepada penghuni-penghuni bangunan tinggi di Lembah Kelang, Pulau Pinang dan Johor Bahru. Saya banyak mendengar rungutan dari Ahli-ahli Geologi yang JMG membisu seribu bahasa dalam menangani permasalahan tersebut. Ingin saya jelaskan, walaupun fenomena gempabumi terangkum di dalam geologi, tetapi tugas dan tanggungjawab dipikul secara total oleh Jabatan Meteorologi Malaysia, dulunya Jabatan Perkhidmatan Kajicuaca. Kita memang tahu bagaimana gempabumi terjadi, tetapi peralatan untuk mengesannya dibawah kawalan mereka. Walau bagaimanapun, JMG memang bekerjasama rapat dengan menganggotai jawatankuasa teknikal yang dibentuk. Oleh sebab itu, sebarang kenyataan hanya dikeluarkan oleh mereka sebagai agensi bertanggungjawab. Kita mengharapkan agar dimensi ini akan berubah pada masa depan apabila diberi kelebihan kepada geologi untuk menangani hal ehwal gempabumi dan tsunami.

Sebagai usaha proaktif pihak JMG telah menjemput Jabatan Geologi UKM, Jabatan Geologi UM, Persatuan Geologi Malaysia, Institut Geologi Malaysia dan Jabatan Meteorologi Malaysia untuk duduk semeja bagi membincangkan langkah terbaik untuk turun padang bagi program kesedaran awam terhadap gempabumi dan tsunami. Walaupun ianya agak terlambat sedikit, tetapi usaha berterusan akan dibuat di seluruh negara dengan bantuan media massa elektronik dan cetak, sehingga masyarakat betul-betul memahami fenomena sebenar kejadian serta langkah menanganinya. Saya yakin dan menaruh penuh kepercayaan bahawa usaha ini akan membuahkan hasil melalui penglibatan dan komitmen tinggi semua pihak termasuk agensi kerajaan, universiti, institusi latihan, sektor korporat dan masyarakat secara keseluruhannya.

Tuan-tuan dan puan-puan yang dihormati,

Ingin saya maklumkan di sini bahawa Draf Rang Undang-undang Geologi yang dimulakan oleh IGM dan PGM telah sampai ke peringkat kertas kabinet, di mana memo Jemaah Menteri telah dikeluarkan sebelum dibentangkan ke Parlimen. Kita mengharapkan agar proses pembentangan akan berjalan lancar supaya dapat diluluskan dengan segera. Saya berharap, semua warga geologi bersabar dan memahami akan kelewatan yang dialami, terutamanya disebabkan oleh proses peralihan dan transisi dari Kementerian Perusahaan Utama kepada Kementerian Sumber Asli dan Alam Sekitar pada 27 Mac 2004.

Baru-baru ini kita telah dikejutkan dengan MS5930 - Code of practice for site investigation yang digubal oleh jawatankuasa di bawah CIDB yang telah dibuka untuk komen awam sehingga 31 Mei 2005. Draf kod yang nyata tidak menyebelahi warga geologi telah dibincangkan pada 24 Mei 2005 di Jabatan Geologi UM demi memartabatkan profesyen geologi pada masa hadapan. Terima kasih atas usaha murni tersebut. Satu cadangan komprehensif telah dikemukakan oleh tenaga penggerak dari PGM, IGM dan JMG pada 31 Mei 2005 untuk pertimbangan Jawatankuasa Induk tersebut. Kita mengharapkan agar kod yang betul dan adil dikeluarkan untuk kepentingan semua pihak.

Tuan-tuan dan puan-puan,

Bekerja bersama-sama atau smart partnership merupakan halatuju JMG yang amat jelas. JMG akan meningkatkan usaha untuk mengetengahkan geologi dalam perancangan dan pembangunan serta pemuliharaan. Selaras dengan itu,

penglibatan aktif tuan-tuan dan puan-puan dalam Persatuan Geologi Malaysia dan Institut Geologi Malaysia amat diperlukan demi merealisasikan hasrat dan cita-cita tersebut.

Akhir kata saya mengucapkan selamat bersidang selama dua hari di resort yang di kelilingi taman yang amat menenangkan fikiran untuk bertukar-tukar pendapat dan buah fikiran. Semoga persidangan kali ini berjalan dalam suasana tenang, harmoni penuh setiakawan.

Dengan lafaz yang suci "Bissmillah hi Rahman ni rahiim" saya merasmikan Persidangan Tahunan Geologi 2005.

Annual Geological Conference 2005
Allson Klana Resort, Seremban, Negeri Sembilan
4-5 June 2005

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Allson Klana Resort, Seremban, Negeri Sembilan
4-5 June 2005

ABSTRACT OF PAPERS

Popularising Geology – Presenting The Past, Present And Future In The Earth Sciences

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Abstract: The Earth Sciences have come a long way since the birth of Geology as a systematic scientific study of the earth about 250 years ago. From its early start in Europe where the two principally opposing schools of uniformitarianism popularised by James Hutton and Charles Lyell and the catastrophists led by Georges Cuvier, it has developed into a modern science backed up by the most sophisticated of equipment to explain the earth's evolution through plate tectonics. All of these is most fascinating to the geologists but often is lost to the layman because of the specialised language that is often used.

There is a need to explain such lofty concepts in terms that are both attractive and understandable so that the history of the universe, the earth and its inhabitants can be put within his grasp. From its history, we need to bring him to the present and show him how geology affects his life and also to the future to show him how he and his descendants will be affected by the choices he makes concerning the earth today.

This then is the task of the geologist in popularising his science and helping his fellowman to know the earth better. It is not an easy task but it can be a fulfilling and noble one if we put our hearts to it and begin to see things from a layman's perspective. We then draw him into our world of geology by presenting to him with various examples of how we study, understand and apply our knowledge of the earth.

An opportunity to do so was in my recent plenary lecture titled MAKING ROCKS TALK – DECIPHERING THE PAST, UNDERSTANDING THE PRESENT AND PREPARING FOR THE FUTURE at the COSTAM Malaysian Science and Technology Congress in April this year. The Society has invited me to present it as a keynote at this conference.

Physico-Chemical Properties Of Residual Soils Of The Kenny Hill Formation In The Shah Alam Area, Selangor

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Abstract: Residual soils of the Kenny Hill formation in the Shah Alam area, Negeri Selangor, have been analysed for their physico-chemical properties. Since the Kenny Hill formation comprises two distinct lithologies, namely phyllite and quartzite, the residual soils derived need to be differentiated accordingly. Test results indicate that the residual soils of phyllite (as compared to quartzite) are characterised by their more clayey nature, higher plasticities and lower compacted densities. In terms of pore fluids chemistry, both types of soils show similar results, namely: slightly acidic pore fluids, low cations and anions contents, and non-dispersive nature.

Beberapa Sifat Fizik Dan Mekanik Batuan Granit Berbutir Kasar Kuala Kubu Bharu

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Abstrak: 40 sampel batuan granit berbutir kasar daripada Kuala Kubu Bharu telah dikumpulkan daripada 14 lokaliti di sepanjang singkapan jalan daripada Taman Bukit Bunga hingga ke kampung Pertak. Sampel-sampel teras selinder dan blok empatsegi telah disediakan daripada sampel lapangan tersebut untuk menjalani ujian halaju sonik dan mekanik setelah pengukuran beberapa sifat fizik. Nilai purata porositi berkesan sampel-sampel

tersebut ialah 1.33 % manakala purata ketumpatan kering dan tepu adalah 2542 dan 2555 kg/m3. Spesifik graviti yang dihitung berjulat 2.1-2.9. Halaju denyut ultrasonik min gelombang P dan S yang melalui bahan batuan yang diuji ialah 5359 m/s dan 2890 m/s. Ujian-ujian mampatan sepaksi menunjukkan purata kekuatan mampatan sepaksi sampel yang bernilai 138.6 Mpa. Nilai purata bagi indeks kekuatan beban titik Is(50) pula ialah 5.63. Oleh itu perkaitan kekuatan mampatan sepaksi dengan kekuatan beban titik ialah dengan faktor multiplikasi 25.

Beberapa sifat fizik dan mekanik batuan granit berbutir sederhana sehingga kasar Bukit Fraser

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Abstrak: 74 sampel batuan granit berbutir sederhana sehingga kasar daripada Bukit Fraser telah dikumpulkan dari 18 daripada 22 lokaliti di sepanjang singkapan jalan gap baru. Sampel-sampel teras silinder telah disediakan daripada sampel lapangan tersebut untuk menjalani ujian halaju sonik dan mekanik setelah pengukuran beberapa sifat fizik. Ketumpatan kering berjulat antara 2.4g/cm2-2.7 g/cm2. Pengukuran makmal menunjukkan halaju denyut ultrasonik untuk gelombang mampatan (P) dan ricih (S) adalah meluas antara 3228m/s sehingga 6000m/s dan 1700m/s sehingga 3400m/s Ujian kekerasan skleroskop menunjukkan bacaan mod purata sekitar 70-74. Manakala ujian indeks beban titik pula adalah sekitar 0.5-9MPa. Ujian regangan pula menunjukkan bacaan 3-10MPa. Semua sampel batuan yang digunakan dalam ujian adalah segar sehingga terluluhawa iaitu bergred I sehingga III.

Penerapan teori blok untuk analisis kestabilan cerun batuan Bukit Fraser di Pahang, Malaysia

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Abstrak: Jasad batuan granit di kawasan Bukit Fraser, Pahang, Malaysia mempunyai pencirian ketakselanjaran major dan minor. Ketakselanjaran sudah dipetakan disekitar lebuh raya Bukit Fraser. Ketakselanjaran utama yang digunakan untuk analisis cerun batuan dengan menggunakan teori blok. Teori blok yang diterapkan digunakan untuk melakukan identifikasi perbedaan antara bentuk blok yang ditemukan di kawasan penyelidikan dan menghitung sudut aman dari cerun batuan. Orientasi dari ketakselanjaran utama yang terjadi di kawasan telah dianalisis . Analisis dilakukan dengan stereo –plot dan selajutnya analisis menggunakan teori blok untuk menentukan bentuk key-block (bentuk 1) dan juga key-block potensial (bentuk II) dari daerah cerun batuan tersebut. Tujuan kajian ini adalah untuk menentukan sudut aman untuk cerun batuan di lokasi Bukit Fraser.

Blasting-induced rock slope instability in Senai, Johor – a preliminary post-construction assessment

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Abstract: A new railway line was constructed recently in the state of Johor, Malaysia to link the Senai Airport and the newly built Tanjung Pelepas Port. Its alignment transverses some hilly terrain and thus resulted in the formation of a number of major cut slopes. One of them is a 35m high slope near Senai, Johor, which is cut in bedrock of the Late Cretaceous-Early Tertiary Pulai Granite. A preliminary post-construction geological assessments carried out on the rock slope indicate that most of the unstable elements are mainly due to excessive and poor blasting practice. Overblasting has resulted in widening of major joints, excessive overbreaks, unstable and loose overhanging blocks. Results of kinematic stability analysis on the discontinuities indicate that the rock slope has the potential to undergo planar, wedge and toppling failures. Rock falls could also take place by over toppling. Excessive overbreaks and fragmentation of the rock mass could be minimised if a proper geological

appraisal on the bedrock was carried out beforehand, and suitable blasting practice adopted during the excavation works. Based on the results of this study, it was recommended that remedial measures should be undertaken in two different phases. Phase 1 is to scale off all the loose, potentially unstable blocks. This should be followed by phase 2 if necessary, i.e. fixing of wire netting, rock fall protection system or rock dowels.

Engineering Geological Investigation on Slope Failure along Bundu Tuhan to Kundasang road, Sabah, Malaysia

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Abstract: This study focused on the engineering geological investigation on slope failure along Bundu Tuhan to Kundasang road, approximately 84th km to 96th km from Kota Kinabalu city, Sabah. The area is underlain by the Trusmadi Formation (Palaeocene to Eocene age), the Crocker Formation (Late Eocene to Early Miocene age) and the Pinousuk Gravel (Upper Pleistocene to Holocene age). These rock units are carved by numerous lineaments with complex structural styles developed during series of regional Tertiary tectonic activities. The tectonic complexities reduced the physical and mechanical properties of the rocks and produced intensive displacements in substrata, resulting in intensive high degree of weathering processes and instability. The weathered materials are unstable and may cause depression and sliding induced by high pore pressure subjected by both shallow and deep hydrodynamic processes. In this study, a total of 43 selected critical slope failures were studied. This study classified the slope failures into two main groups: soil slope failures and rock slope failures. Failures in soil slopes (including embankments) total 35 (81 %) whereas 8 failures (19 %) of rock slope. Soil slope failures normally involved large volume of failed material compared to rock slopes, where most failures are small to large size. Of the 35 failures in soil slopes, 31 (89 %) are embankment failures making them 72 % of all types of failures. Physical and mechanical properties analysis for one hundred twenty four (124) soil samples indicated that the failure materials are mainly consists of clayey loamy soils, which characterized as low to intermediate plasticity content (8 % to 27 %), very high to medium degree of swelling (3.76 to 12.68), low to high water content (3.35% to 36.31%), low permeability (9.66 X 10-3 to 4.33 X 10-3), friction angle (ϕ) ranges from 7.70° to 35.50° and cohesion (C) ranges from 0.36 kPa to 25.13 kPa. The rock properties characterization for eight (8) rock samples indicated that point load strength index ranges from 0.33 mPa to 0.52 mPa (moderately week) and uniaxial compressive strength ranges from 7.81 mPa to 12.57 mPa (moderately week). Evaluation of 60 boreholes data in the study area reveals that the depth of the groundwater table ranges from 1.90 m (6 feet) to 11.20 m (35 feet) deep. The groundwater level in the study area fluctuates even within a short period of any instability of climatic change. Engineering geologic evaluation of the study area indicates that the slope failures took place when rock and soil materials are no longer able to resist the force of gravity. These decrease the shear strength and increase the shear stress resulting failures, which is due to internal and external factors. Internal factors involve some factors change in either physical or chemical properties of the rock or soil such as topographic setting, climate, geologic setting and processes, groundwater condition and engineering characteristics. External factors involve increase of shear stress on slope, which usually involves a form of disturbance that is induced by man includes removal of vegetation cover, induced by vehicles loading and artificial changes or natural phenomenon such as tremors. Development planning has to consider the hazard and environmental management program should be implemented. This engineering geological study may play a vital role in slope stability assessment to ensure the public safety.

Pencirian geofizik dan geomekanik jasad batuan basalt di kawasan Pantai Batu Hitam, Kuantan, Pahang

Abdul Ghani Rafek dan Nor Azrina Mohd. Amin

Abstrak: Kaedah sismos biasan, keberintangan geoelektrik, ultrasonik, dan tukul Schmidt telah digunakan dalam pencirian geofizik dan geomagnetik batuan basalt di Pantai Batu Hitam, Kuantan. Batuan tersebut terdiri daripada basalt jenis Basanit. Kaedah seismos biasan dapat mengesan tiga lapisan bawah tanah. Lapisan pertama mempunyai halaju V_p 221 ms^{-1} dan keberintangan geoelektriknya adalah 255 ohm-meter dengan kedalaman berjular 1.33-1.67m yang mewakili pasir pantai. Lapisan kedua mempunyai halaju 2060 ms^{-1} serta keberintangan 113 ohm-meter dengan ketebalan geoelektrik 4.1 m. Halaju yang rendah ini disebabkan kehadiran kekar-kekar

pada jasad batuan basalt. Keberintangan lapisan ketiga ialah 24 ohm-meter. Keberintangan yang relatif rendah mungkin disbabkan kemasukan air masin kedalam rongga-rongga dan retakan jasad basalt. Ujian ultrasonik mendapati halaju VPsonik basalt adalah 3442 ms-1 dan berdasarkan kaedah Formaintraux (1976), nilai V_t. basalt ialah 5000 ms-1. IQ% ialah 69% dan ditafsirkan mempunyai darjah rekahan yang sederhana. Ujian tukul Schmidt menganggarkan kekuatan mampatan sepaksinya ialah 230 MNm^{-2}.

Characteristics of Leachate at the Air Hitam Sanitary Landfill in Puchong, Selangor

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Abstract: The Air Hitam sanitary landfill in Puchong, Selangor currently receives 3000 ton/day of solid waste. The landfill has been in operation since November 1995, in what was formerly a valley area. The purpose of this study is to determine the characteristics for leachate from lined landfill in helping to develop more useful quality leachate database for other landfills where leachate treatment must be designed in advance. The composition of leachate varied depending mainly upon their sampling points. It was found that the leachates possessed a typical characteristic; that is young leachate (AH3) at Air Hitam sanitary landfill was generally characterized by higher values of leachate characteristics. The concentrations of Na+ and K+ were exceptionally high, 8160 ~ 20166.7 mg/l for Na+ and 3416.333 to 7916.667 mg/l for K+. Heavy metal concentrations were found to be relatively low for Mn (0.001 ~ 0.005 mg/l), Cd (0.002 ~ 0.006 mg/l), Cu (0.046 ~ 0.095 mg/l) and Cr (0.046 ~ 0.175 mg/l) while those of Fe (1.447 ~ 3.627 mg/l), Zn (0.110 ~ 0.242 mg/l), Pb (0.050 ~ 0.217 mg/l) and Ni (0.085 ~ 0.167 mg/l) were relatively higher. The values of sulfate also varied for leachate samples with values between 218.75 to 993.75mg/l. The concentrations of ammoniacal nitrogen in leachate samples were 107.5 up to 419.17 mg/l. Although heavy metals determined were comparatively low and heterogeneously distributed in and around the landfill, the site is a source of contaminants to the monsoon drains and directly to the river. Low COD value was found in ground water sample indicating that the groundwater was not polluted by leachate at the Air Hitam sanitary landfill.

The retention capabilities of soils at Batang Berjuntai and Ampar Tenang as natural clay liners for landfill systems using leaching column test and selective sequential extraction analysis

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Abstract: Clay liners have the ability to interact chemically with leachate. If suitable clay liner can be identified, it can help to attenuate the migration of leachate to groundwater and surface water. In this study, leaching column tests were used to determine the retention capability of heavy metals for two types of soils collected adjacent to a landfill in Selangor. The active landfill sites chosen are Kg. Hang Tuah in Batang Berjuntai (HMS) and Ampar Tenang, Sepang (ARA) where the HMS samples are metasediment soil and ARA samples are river alluvium soil. Selective sequential extraction (SSE) was used to study the retention mechanisms of heavy metals in the soil columns obtained from leaching column test experiments. Acid digestion was later used to check the validity of the SSE results. Breakthrough curves for metasediment soil from Kg. Hang Tuah show good retention of heavy metal ions with relative concentration, Ce/Co (10-1 - 10-5) compared to river alluvium soil from Ampar Tenang with relative concentration, Ce/Co (10-1 - 10-4). This corresponds with the pH of the effluents and the pore fluid where the HMS samples are more alkali compared to ARA samples. Generally, HMS and ARA samples have same ranked order of buffering capacity; Cu>Zn>Pb>Ni. The distribution of the heavy metals with soil constituents are ranked in the following phases: Exchangeable > Carbonates > Hydroxides > Residuals > Organics

The Relationship between Morphometry and Hydrologic Properties of the Semenyih River Basin and Their Significance

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Abstract: A study was carried out to evaluate the characteristics of surface landforms of the Semenyih River Basin. The study was based on quantitative measurements of land surface geometry such as topography, basin area, basin shape, slope angles, drainage patterns, stream lengths and stream frequency of the 36 sub catchments in the basin. Field observations showed that the study area generally consists of weathered rock, with a high permeability soil cover and dominated by sand particles. The bedrock in the Semenyih Basin is characterized by a large number of discontinuities due to the development of structures such as folds, joints and faults due to past tectonic events. The morphometry of drainage density and bifurcation ratio shows that the Semenyih Basin can be characterized as a homogenous rock, with high permeability and sparse vegetation and is dominated by high rates of infiltration and sub-surface flow. From the available hydrological data, it was interpreted that only 35% to 45% of the total rainfall was transformed into surface runoff and the rest (55% to 65%) as seepage into the ground after evaporation and interception. Five main tributaries, namely Sg. Lalang, Sg. Batangsi, Sg. Tekala, Sg. Rinching and Sg. Saringgit were identified as significantly contributing to the Semenyih River.

Sifat Kimia Tanah Serta Keupayaan Penjerapan Logam Berat Oleh Tanah Di Sekitar Negeri Selangor

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Abstrak: Kajian sifat kimia tanah serta keupayaan penjerapan logam berat plumbum (Pb), kuprum (Cu) dan nikel (Ni) oleh tanah baki granit dari Broga (BRGr), tanah metasedimen terluluhawa dari Air Hitam (AHMs), tanah endapan sungai dari Ampar Tenang (ATRa) dan tanah metasedimen dari Kalumpang (KLMs) dilakukan dengan menggunakan kaedah Batch Equilibrium Test (BET). Sifat kimia tanah ditentukan dengan ujian nilai pH, kandungan bahan karbonat, kandungan bahan organik dan keupayaan pertukaran kation (CEC). Tanah KLMs mempunyai nilai pH yang paling tinggi yang berjulat dari 5.45-5.79, manakala pH terendah pada tanah ATRa yang berjulat 3.96-4.08. Tanah BRGr mempunyai kandungan bahan karbonat (0-0.2%), organik (0-0.1%) serta nilai CEC (1.37-1.89meq/100g) yang terendah manakala yang tertinggi adalah tanah ATRa dengan kandungan karbonat (7.25-8.20%), organik (12.04-13.05%) dan CEC (6.68-8.48meq/100g). Bagi ujian penjerapan, terdapat beberapa faktor yang mempengaruhi kadar penjerapan logam berat oleh tanah seperti faktor perubahan kepekatan, perubahan masa, perubahan kedalaman, perubahan nilai pH, dan kesan penambahan kandungan komponen tanah iaitu bahan berkapur, bahan organik dan bahan amorfus. Keupayaan penjerapan Pb oleh tanah; ATRa> KLMs> BRGr> AHMs, penjerapan Cu oleh tanah; ATRa> BRGr> AHMs> KLMs dan penjerapan Ni oleh tanah; ATRa> AHMs> BRGr> KLMs. Keselektifan logam berat untuk penjerapan oleh keempat-empat jenis tanah: Pb> Cu> Ni.

Kitaran Aggregat : Kajian Kes Kehilangan-Kerugian Di Kuari Dan Tapak Binaan

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Abstrak: Pertumbuhan ekonomi pesat telah menyumbang kepada pembangunan industri pembinaan di Lembangan Langat dan meningkatkan permintaan untuk bahan binaan aggregat. Penilaian kitaran aggregat dijalankan untuk lembangan ini dengan permulaan daripada proses pengekstrakan di kuari kepada proses penggunaan di tapak binaan sehinggalah pembuangan akhirnya. Kajian kes dijalankan di sebuah tapak kuari dan tapak pembinaan dengan mengambilkira kehilangan-kerugian ke atas alam sekitar fizikal. Hasil yang diperolehi

menunjukkan kehilangan-kerugian yang disumbangkan daripada aktiviti pengkuarian sebanyak 42,200 tan setahun sementara kehilangan daripada tapak binaan boleh diabaikan. Kajian juga mendapati wujudnya penggunaan semula bahan buangan aggregat di tapak, namun bahan aggregat daripada kuari tidak dikitar semula disebabkan oleh kekurangan permintaan.

Highly evolved S type granite : Selim Granite, Main Range Batholith, Peninsular Malaysia

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Abstract: The Selim granite consists of coarse grained porphyritic biotite granite to medium to fine grained granite. Both granites overlap in many of the major element contents especially SiO2. The coarse grained porphyritic biotite granite has higher Fe2O3 and Na2O and has lower FeO compared to the medium to fine grained granite. Ba and Rb increases from the coarse grained porphyritic granite to equigranular medium to fine grained granite. Both granites are controlled by the same mineral assemblage during magmatic evolution that is K-feldspar, plagioclase and biotite. REE profile show that both granites may represent the evolved part of the Western Belt Granite. In all patterns, four elemental groups (La–Nd, Nd–Gd, Gd–Er, Er–Lu) form four distinct convex patterns. This pattern also known as tetrad REE effects, are not observed in common rock types, but are well documented in highly differentiated rocks with strong hydrothermal interaction (including pegmatite). The tetrad effect develops parallel to granite evolution, and significant tetrad effects are strictly confined to highly differentiated samples. The strong decrease of Eu concentrations in highly evolved rocks suggests that Eu fractionates between the residual melt and a coexisting aqueous high-temperature fluid. The effect has been progressively recognized, particularly for granitic rocks which have undergone high degree of fractional crystallisation, hydrothermal alteration and mineralization This feature is magmatic, inherited from crystallization of melt with the tetrad effect already produced and hardly be formed by post-magmatic water–rock interaction.

DALAM LONGGOKAN SKARN DI BUKIT BOTAK: KAJIAN DARI SEGI PETROLOGI, MINERALOGI BIJIH DAN GEOKIMIA

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Abstrak: Kajian pengelasan longgokan skarn di Bukit Botak dilakukan dengan berdasarkan data petrologi, mineralogi bijih dan geokimia. Secara keseluruhannya, longgokan ini boleh dikelaskan kepada jenis skarn kalsik yang biasanya didominasi dengan piroksen, wollastonit dan garnet. Lubang gerudi M15 sedalam 391 m dipilih dari bahagian zon A yang kaya dengan Cu dan Au. Sebanyak 36 sampel keratan nipis dan 32 sampel irisan gilap telah disediakan untuk kajian petrologi dan mineralogi bijih. Sebanyak 58 sampel telah dipilih untuk analisis AAS dan ICP bagi 17 unsur logam yang utama. Skarn yang dicerap dalam lubang gerudi M15 dapat dibahagikan kepada dua bahagian, bahagian A yang kaya dengan mineral bijih (45 – 65 %) dan bahagian B yang kurang mineral bijih (3 -15 %). Bahagian A terdiri sepenuhnya daripada eksoskarn piroksen (zon 1), dan bahagian B dibahagikan kepada empat zon yang utama, zon 2 dan zon 3 terdiri daripada hornfels dan hornfels yang kaya kuarza. Zon 4 adalah terdiri daripada skarnoid yang nipis dan zon 5 adalah jenis eksoskarn garnet yang berselang lapis dengan hornfels. Manakala zon 6 merupakan batuan batolitos metasedimen bagi skarn ini, iaitu batuan filit yang berasal dari Lapisan Seri Jaya. Hasil kajian menunjukkan kebanyakan mineral bijih menumpu dalam zon eksoskarn piroksen berbanding dengan eksoskarn garnet dan hornfels. Emas didapati wujud dalam kepekatan yang tinggi dalam eksoskarn piroksen dan sangat sedikit dalam eksoskarn garnet dan hornfels. Manakala, kehadiran timah adalah tertumpu dalam hornfels sahaja, dan tidak di kesani dalam eksoskarn piroksen. Di samping itu, Satu model pembentukan batuan skarn telah dicadangkan bagi longgokan Bukit Botak, ia terdiri daripada 5 peringkat yang utama, iaitu I) penerobosan magma yang menghasilkan hornfels; II) penyusupan larutan hidroterma yang membentuk endoskarn dan eksoskarn piroksen; III) penyusupan yang seterusnya membentuk proksimal eksoskarn garnet; IV) penyejukan berlaku dan proses "retrograde" bermula, mineral mula mengendap; V) pengendapan emas dalam telerang.

Petrology and geochemistry of the Sempah volcanic complex : Peninsular Malaysia

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Abstract: The Sempah volcanic complex is characterized by a sequence of tuffs, rhyolite lava and an orthopyroxene bearing subvolcanic unit exposed along the Selangor-Pahang state boundary. Previous radiogenic dating of the complex using Rb-Sr method yield ages in the range of 211 to 219 Ma and suggests that it may be temporally related to the Triassic Main Range Granites. The two main rock types of the complex are rhyolite and orthopyroxene-bearing rhyodacite. They are porphyritic and have similar phenocryst assemblage (quartz, biotite, K-feldspar and plagioclase) except for the presence of hypersthene in the orthopyroxene-bearing rhyodacite. Geochemically both units are peraluminous, high-K calc alkaline and display S type affinities. Both rhyolite and orthopyroxene rhyodacite are inferred to be individual batches of melt. Although they have very similar SiO2 content, the two groups display contrasting trends for many of the trace and major element diagrams. High $^{87}Sr/^{86}Sr$ isotope values, different mineral extract proportion in the major elements modelling and non-horizontal trend on the $^{87}Sr/^{86}Sr$ vs.1/Sr plot preclude crystal fractionation as the main process operating in the complex. Modelling confirms that the cause of the chemical diversity between both rocks can be explained by combined assimilation – fractional crystallization (AFC) and that approximately 20% of both magmas were contaminated during emplacement. It is inferred that the water content of the orthopyroxene rhyodacite magma was between 2.5 to 3 % with pressure regime of 3 – 4 kbar and a temperature approximately 800 - 900oC when rapid quenching of the groundmass occurred. The rhyolite magma, however was generated at shallower crustal levels, probably between 700 - 800°C.

Geochemical characteristics of S- and I-Type Granites: Example from Peninsular Malaysia granites

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Abstract: The Peninsular Malaysian granites are distributed into three parallel belts, i.e. Western, Central and Eastern belts. They have been grouped into two granite provinces; a Western province consisting of granites confined to the Western Belt with an age range from 200 to 230 Ma and the Eastern province consisting of granites from both the Eastern and Central belt and aged from 200 to 264 Ma. A first order difference between the Western and Eastern Belt Granites of Peninsular Malaysia is the S type nature of the former. This is contrast with the expanded compositional nature of the Eastern Belt rocks where I type; S type granitoids and mafic rocks are all recognized. Among the other geochemical difference between these two granitoids province are expanded nature of the Eastern Belt Granite, low Na2O and high Th, U, Sn, Pb and Cs of Western Belt Granite compared to the Eastern Belt Granite. Both Western and Eastern belt granitic magmas are controlled by different mineral proportion (Western Belt Granite: K-feldspar, plagioclase and biotite and Eastern Belt granite: hornblende, K-feldspar, plagioclase, biotite)

Penentuan Usia Batuan Igneus Pulau Pangkor dengan kaedah K/Ar mineral Biotit

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Abstrak : Satu kajian semula bagi menentukan usia mutlak batuan igneus Pulau Pangkor telah dilakukan secara teliti dengan menggunakan kaedah K/Ar mineral biotit. Kajian ini bertujuan memastikan usia sebenar batuan igneus Pulau Pangkor setelah mendapati kajian terdahulu menunjukkan julat usia yang besar dari Perm, Trias, Jura hingga Kapur. Dua sampel mewakili batuan igneus Pulau Pangkor, terdiri daripada granit berbutir kasar berfenokris, yang merupakan batuan dominan di Pulau Pangkor telah dianalisis. Ia dinamakan sebagai Sampel P19 di Bandar Pangkor dan sampel S10 di Tanjung Teluk Dalam dengan usia yang diperolehi masing-masing 176.19 + 2.03 juta tahun (Jura Tengah) dan 177.03 + 2.03 juta tahun (Jura Tengah). Keputusan ini menunjukkan

keselarasan dengan usia batuan igneus di Jalur Barat. Oleh itu, batuan igneus di Pulau Pangkor boleh disimpulkan terkelompok di dalam Jalur Barat.

Geochemistry of Jawa and Panchor granite: the most northern granitic bodies of the Boundary Range Batholith

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Abstract: The Panchor and Jawa granites are two isolated granitic bodies located at the north of the Boundary Range Batholith. They consist of coarse, K-feldspar megacrystic, biotite hornblende granite with some incipient two-phase variation in the Jawa granite. Mineralogy of both Panchor and Jawa granites in decreasing abundance are K-feldspar, quartz, plagioclase, biotite, allanite, zircon, apatite and hornblende. Both granites show many I type feature such as (i) mafic minerals are invariably hornblende and biotite, (ii) muscovite, garnet and cordierite are absent, (iii) accessory minerals present include sphene, allanite and apatite (iv) monazite is not present, (v) sedimentary xenoliths are very rare and (vi) Na2O is greater than 3.2% in rocks with approximately 5% K2O. Both granites also show many geochemical differences, which suggests that they are made up of individual batches of melt. Both Panchor and Jawa granite magma seems to be controlled by different mineral proportion during magmatic fractionation, thus, the Panchor granite is controlled by K-feldspar and biotite whereas in the Jawa Granite, plagioclase and K-feldspar are important phases in magmatic evolution. However the continuous trend shown by the Jawa and Panchor granites and the other Boundary Range Granites in Rb/Sr vs SiO2, Sr vs CaO and and P2O5 vs SiO2 diagrams suggest that a connection exists between all the rocks at some stage of their magmatic evolution.

PermoTriassic Radiolarian Biostratigraphy of the Semanggol Formation, south Kedah, Peninsular Malaysia.

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Abstract : A total of sixty-four radiolarian species were successfully retrieved
from forty-seven siliceous rock samples collected at an extensive outcrop exposed approximately 4.5 km east of Kuala Ketil, south Kedah. Thirty-seven species of Permian and twenty-seven species of Triassic radiolarians were identified respectively. Five Permian radiolarian assemblage-zones were recognized i.e. *Pseudoalbaillella scalprata m. rhombothoracata* Zone, *Follicucullus monacanthus* Zone, *Follicucullus porrectus* Zone, *Neoalbaillella ornithoformis* Zone and *Neoalbaillella optima* Zone and four Triassic radiolarian assemblage-zones were identified i.e. *Entactinosphaera chiakensis* Zone, *Triassocampe coronata* Zone, *Triassocampe deweveri* Zone, and *Oertlispongus inaequispinosus* Zone. The oldest radiolarian biozone is *the Pseudoalbaillella scalprata m. rhombothoracata* Zone, which indicates Sakmarian, Early Permian. The youngest zone is the *Oertlispongus inaequispinosus* Zone, Ladinian, Middle Triassic.

Depositional controls on petrophysical properties and reservoir characteristics of Middle Miocene Miri Formation sandstones, Sarawak

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Abstract: Rock exposures around the town of Miri, Sarawak, belonging to the Miri Formation (Middle Miocene strata), represent the uplifted part of the subsurface sedimentary strata of the Miri oilfield. Data derived from outcrop studies concerning facies and sand body characteristics, and petrophysical properties are crucial for subsurface reservoir characterization and modeling of hydrocarbon reservoirs deposited in similar settings. The aim of this paper is to integrate lithofacies and petrophysical properties of Miri sandstones, in order to characterize and quantify the Miri reservoirs.
The Miri Formation consists of a wide range of siliciclastic, tide-generated and storm-and wave- generated facies. Twelve lithofacies have been identified and grouped into two major facies associations: (i) the estuarine, tide-

dominated, and (ii) the shoreface-offshore transition, storm-and wave-dominated facies associations. The estuarine lithofacies are characterized by distinct and diagnostic tidal signatures; tidal dune cross-bedding with mud draped cosets and foresets including mud couplets, bidirectional (herringbone) cross-bedding, rhythmic stratifications, flaser bedding, wave bedding and lenticular bedding. Shoreface-offshore transition, storm-and-wave facies association is represented by sandstone bodies with evidences of storm and wave generated sedimentary structures; swaley cross-stratified sandstones, amalgamated hummocky cross-stratified sandstones, bioturbated sandstones and mudstone inter-bedding with parallel stratified to hummocky cross-stratified sandstone.

Petrophysical properties were determined for six sandstone lithofacies: (i) Lithofacies A (multiple stacked trough cross-bedded sandstone, tidal channels and bars, estuary mouth), (ii) Lithofacies B (parallel-bedded sandstone of estuary upper flow sand flat), (iii) Lithofacies F (homogeneous coarse sandstone, outer estuarine tempestites), (iv) Lithofacies G (swaley cross-stratified, upper-to-middle shoreface sandstone), (v) Lithofacies I (fine-grained bioturbated sandstone of the lower shoreface) and (vi) Lithofacies L (fine-grained, hummocky cross stratified sandstone, offshore transition).

These lithofacies are characterized by a wide range of permeability values, which vary by several orders of magnitude (0.35 to 287 md), while porosity vary by only a few percent. Lithofacies A and F recorded the best reservoir properties; porosities are 23.3-29.7% and permeabilities are 9.64-287 md. Lithofacies G shows a wide range of porosity and permeability values that range from high to low reservoir properties; porosities are 23.5-27.5% and permeabilities are 3.4-45 md. Lower shoreface and offshore transition (lithofacies I and L respectively) display the lowest reservoir properties; porosities are 13.5-24.5 % and permeabilities are 0.35-3.4 md. In general, high reservoir quality of Miri sandstones is associated with coarser grain size, low clay contain and better sorted grains. Extensive clay drapes, bioturbation, and increasing proportion of very fine grains content result in significant decrease in permeability in both tide-generated and wave-generated lithofacies.

Sedimentological and palaeontological study along the Kuala Tekai-Kuala Tahan stretch of Tembeling River, Jerantut Pahang

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Abstract: The rock succession which is exposed along the riverbank from Kuala Tekai to Kuala Tahan of Tembeling River was mapped and interpreted by previous workers as part of the Semantan Formation. However, detailed sedimentological and palaeontological study which was carried out during this study distinguished the succession into the Semantan Formation and the Mangkin Sandstone Formation of the Tembeling Group. The Semantan Formation consists of three major sedimentary facies, namely; laminated siltstone interbedded with shale facies, laminated carbonaceous shale facies, and graded bedding sandstone facies. Four major sedimentary facies were identified in the rock succession of the Mangkin Sandstone Formation. These are pebbly sandstone interbedded with sandstone facies, massive sandstone facies, interbedded sandstone and siltsone facies and interbedded sandstone and mudstone facies. The discovery of fairly well-preserved palynomorphs in the studied rock succession can be utilised in interpreting the age of the rocks. Some twenty palynomorph taxa were identified which include Retitriletes circolumenus, Lycopodiumsporites sp., Lycopodiumsporites eminulus, Klukisporites variegatus, Neoraistrickia truncates and Cyathidites punctatus. The identified palynomorph assemblage is comparable to Stylosus Assemblage of Neocomian-Aptian age.

Some Upper Mesozoic palynomorphs from the Tekai River area, Jerantut, Pahang

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Abstract: A palynological study was carried out on rock succession which is exposed along Sungai Tekai, Jerantut, Pahang. Some fairly well-preserved palynomorphs were identified in a rock succession which is part of the Mangkin Sandstone Formation of the Tembeling Group. Sandstone is the dominant lithology in this area together with siltstone, mudstone, shale and conglomerate of various thicknesses, and interpreted to be deposited in a fluvial enviroment. The observed palynomorphs are assigned to twenty one genera which include the commonly observed genera namely Stereisporites, Biretisporites, Cycadopites, Laevigatosporites and

Lycopodiumsporites. The identified palynomorph assemblage from this area is comparable with the Speciosus Assemblage of late Lower Cretaceous age.

SUSTAINABLE MINING OF THE CLAY RESOURCES IN PENINSULAR MALAYSIA

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Abstract: Sustainability in the mining of clay depends on the nature of the resource, its usage, extraction practices, and the reuse of land affected by mining. Although there are abundant clay resources in Peninsular Malaysia, much of the clay is common clay used in large volumes for simple structural products like bricks, pipes, roof tiles and flower pots. Other, less common clays have special properties that enable them to be used in higher value products. Sustainable extraction of our clay resources will depend on using the appropriate clay for a given application, avoiding the use of high value clays for the production of low value products, and avoiding excessive digging and ground disturbance during extraction. Most clay resources that have been identified occur in thin layers and at shallow depths (less than 10 metres). Mining is extensive rather than intensive. If large volumes of clay are extracted, land areas affected can be substantial. Mining without adequate knowledge of clay quality can result in ad-hoc digging and the excessive disturbance of large areas in the search for the right clay. With good knowledge of the deposit and proper planning, clay can be extracted with minimal disturbance to the land. Different types of clay can be identified and marketed reducing waste and increasing returns. The land can be properly landscaped and reused. Some extraction takes place in areas being developed, and the land is built on immediately after the clay is removed. Sometimes, development moves faster that the ability of industry to use the clays. Good clay should be properly stockpiled and conserved; otherwise it may go to waste or become inaccessible. Optimizing usage, minimizing the environmental impact of extraction, and the quick return of land to other productive uses contribute towards the sustainable development of the clay resources.

Geology In The Quran 2: Enviromental Impact Of Volcanic Activities / Earthquakes / Tsunamis

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Abstract: Geology in general as found in the Quran was briefly presented during Poster Session B, Annual Geological Conference 2004, Kangar. In this current paper, other verses in the Quran more specifically applicable to volcanic activities, earthquakes and tsunamis are given. Interpretations from a geologist's point of view are made, which are considered more logical compared to previous interpretations by non-geologists. Specific references are made to: 1.The Aceh earthquake and tsunami on 26th December, 2004 (more than a quarter million loss of lives), and 2. The earthquakes in Iran on 22nd February, 2005 (more than 400 loss of lives). It is quite conclusive that the Quranic verses considered are related to geological phenomena involving volcanic activities, earthquakes and tsunamis. There is no doubt that remedial actions will be taken to restore the damages created by the recent tsunamis. More research will be carried out as an effort to find ways to reduce loss of lives and property damage, for example, the tsunami early warning system, but above all, a strong call is made to mankind to pay very serious attention to religious and moral issues.

KAYU TERPETRI DI SARAWAK: SATU KHAZANAH TERSEMBUNYI

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Abstrak: Kayu terpetri Sarawak wujud di dalam Formasi Batu Pasir Kayan berusia Tertier terletak berhampiran dengan Banjaran Bungo. Kayu-kayu telah terawet dalam jutaan tahun melalui proses pempetrian yang menukarkan kayu kepada silika (opal dan kalsedoni). Kayu tersilika amat unik kerana kepelbagaian warna dan pengawetannya di mana struktur sel dan tekstur asal kayu masih dikekalkan. Usaha

badan-badan kerajaan berkaitan amat diperlukan ke arah pemuliharaan khazanah tersembunyi milik negara ini untuk generasi akan datang.

ZON SESAR LEBIR - Kajian di sepanjang Sungai Lebir, Negeri Kelantan

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Abstrak: Menurut Tjia (1985), struktur geologi di Semenanjung Malaysia dibahagi menjadi 4 (empat) mandala, iaitu Mandala Zon Timur, Mandala Zon Tengah, Mandala Zon Barat dan mandala Zon Baratlaut. Mandala Zon Timur dipisahkan oleh sesar Lebir dengan mandala Zon Tengah manakala mandala Zon Tengah dipisahkan oleh garisan Bentong dengan Mandala Zon Barat. Sesar-sesar utama yang terjadi di Semenanjung Malaysia dimulai dengan sesar yang paling tua dijumpai di Langkawi iaitu Sesar Sungkup Kisap yang diperkirakan berumur Perm Akhir, diikuti oleh Sesar Bokbak, Sesar Lebir, Sesar Kuala Lumpur, Sesar Bukit Tinggi, Sesar Chegar-Benta dan Sesar Kledang yang berusia Trias.
Tulisan ini membahaskan tentang kajian zon Sesar Lebir dengan data terperinci sepanjang Sungai Lebir kawasan Negeri Kelantan. Aw (1967), menggambarkan adanya daik ignimbrit sepanjang 20 km berhampiran Temangan, Kelantan dan Burton (1967a), berpendapat bahawa daik tersebut menipis ke arah utara manakala ke arah selatan selari Sungai Lebir sepanjang 150 km. Menurut Tjia (1972), bahawa Sesar Lebir berupa sesar mendatar kiri dan secara morfologi berupa sesaran blok. Pada kajian ini disimpulkan terjadi sekurang-kurangnya didapati tiga kali canggaan yang melibatkan zon Sesar Lebir. Canggaan pertama dengan σ1 berarah timurlaut (TL)-Baratdaya (BD) menghasilkan sesar berjurus kemiringan U(340o-0o)T/60o-80o berupa sesar sinistral songsang dengan kemiringan ke barat baratdaya - timur timurlaut. Canggaan kedua dengan daya mampatan (σ1) berarah Utara baratlaut (UBL)-Selatan tenggara (STG) menghasilkan sesar konjugat berjurus Barat-Timut (B-T) dan barat baratlaut (BBL) - timur tenggara (TTG). Canggaan ketiga dengan daya mampatan (σ1) berarah hampir barat-timur (B-T) dan menghasilkan sesar dekstral songsang dan sesar sinistral songsang berjurus tenggara (TG) dan Timurlaut (TL) dengan kemiringan ke arah baratdaya (BD) dan tenggara (TG).

Terrain Features Mapping Using Aerial Photographs And Digital Elevation Model (Dem) In The Cameron Highlands, Pahang

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Abstract: Conventional geological terrain mapping conducted by the Department of Minerals and Geoscience is based mainly on field surveys. Especially for remote areas, it can be very time consuming. Recent developments in remote sensing and Geographical Information Systems (GIS) have led to the development of more advanced methods for the construction of geological terrain maps. Aerial photographs draped over a digital elevation model (DEM) can be used to accurately delineate geological terrain features. This study affirms that the use of aerial photographs and DEM as an efficient, reliable, reproducible and effective technique for geological terrain mapping.

Pemetaan akuifer dengan teknik geoelektrik di Sungai Kelambu, Banting, Selangor.

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Abstrak: Pengukuran keberintangan secara menegak dan secara 2D telah dilakukan di Sungai Kelambu, Banting untuk memetakan lapisan dan jenis air yang terdapat dalam akuifer pasir serta endapan yang berada di sekitarnya. Pengukuran keberintangan menegak dilakukan di sebanyak 29 stesen manakala pengukuran keberintangan 2D

dilakukan disebanyak 9 profil. Keberintangan sebenar yang diperolehi menerusi permodelan songsang telah dikorelasikan dengan data lubang gerudi yang berhampiran untuk memudahkan pentafsiran. Berdasarkan pentafsiran, lapisan lempung didapati berkeberintangan 8-180 ohm.m dan tebal purata 15m berada di atas lapisan akuifer pasir berkeberintangan 40-800 ohm.m dan tebal 35-87m. Lapisan pasir ini terendap di atas metasedimen yang berjulat keberintangan 600-800 ohm.m. Selain daripada fakta keberintangan dan ketebalan, taburan stesen kajian telah memungkinkan pembinaan peta kontur untuk melihat taburan ketebalan dan keberintangan lapisan akuifer. Peta kontur ketebalan menunjukkan bahagian akuifer yang paling tebal terletak di bahagian tengah dan tenggara kawasan kajian. Oleh kerana julat keberintangan akuifer ini berkisar diantara 40-800 ohm.m, ini bermakna akuifer tersebut berkandungan air segar hingga payau.

Geomorphology And Geology Of Lake Linumunsut, Tongod, Sabah

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Abstract: Lake Linumunsut in central Sabah is a drowned river valley caused by landslide debris damming one of Namatoi River tributaries. The lake sits on mudstone layers of Kapilit Formation deposited about 12-15 million years ago. The morphology of the lake has changed slightly over the last 30 years due to siltation. The lake is filled with mud and very fine-grained sands up to 3 meters thick eroded from the mudstone and thin sandstone in the catchments area. The lake will not be completely filled up with sediments in the near future as the unsettled mud is easily flushed out from the lake during heavy rain. However the morphology of the lake will change drastically once stream down cutting along Linumunsut River reach the bottom of the lake.

Penggunaan gelombang Rayleigh untuk mengukur Penanda Mutu Jasad Batuan (PMB)

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Abstrak: Penanda Mutu Batuan (PMB) telah digunakan oleh jurutera untuk mengukur mutu jasad batuan. Nilai PMB ini mempunyai hubungan secara empirikal dengan keamatan dan frekuensi retakan serta darjah luluhawa pada jasad batuan. Kaedah konvensyenal bagi mengukur indeks PMB adalah berdasarkan kepada peratus jumlah teras gerudi yang diperolehi semasa penggerudian. Kertas kerja ini membincangkan hasil pengiraan nilai PMB jasad batuan tanpa lubang gerudi. Dalam teknik ini, halaju gelombang ricih ($V_{s\beta}$) yang diukur melalui kaedah Analisis Spektrum Gelombang Rayleigh beserta halaju gelombang ricih ($V_{s\mu}$) yang diperolehi dimakmal melalui ujian ultrasonik terhadap sampel teras batuan telah digunakan bagi mengira nilai PMB mengikut persamaan yang dicadangkan oleh Suharsono et al.(2004), iaitu:

$$\delta = \left[\frac{(V_{s\mu} - V_{s\beta})^2}{(V_{s\mu} + V_{s\beta})^2} \right]^2$$

PMB (%) = 100(1-δ), dimana

Pengukuran nilai PMB telah dijalankan keatas jasad batuan igneus dan metasedimen di enam tapak kajian iaitu tiga kawasan di sekitar Selangor [Sungai Tekala (batuan granit), Bukit Permai (batuan granit) dan Bukit Bandaraya Shah Alam (batuan metasedimen)], dua kawasan di Pulau Langkawi [Durian Perangin (batuan syal) dan Teluk Kok (batuan granit)] serta satu kawasan di Lanchang, Pahang (batuan riolit dan daik andesit). Nilai PMB yang perolehi menunjukkan batuan granit di Sungai Tekala adalah sangat lemah ke lemah sehingga kekedalaman 18m. Manakala granit di Bukit Permai mempunyai mutu batuan yang sangat lemah kelemah sehingga kedalaman 5m dan daripada kedalaman 5 hingga 16m, jasad batuan menunjukkan mutu seherdana kuat. Batuan Granit di Teluk Kok, Langkawi pula bersifat sangat lemah ke sederhana kuat sehingga kekedalaman 4m dan diantara kedalaman 4m dan 13m jasad batuan ini menunjukkan mutu yang kuat. Batuan metasedimen di Bukit Bandaraya Shah Alam menunjukkan mutu batuan yang sangat lemah ke sederhana kuat sehingga kekedalaman 4m dan di bawah paras ini, jasad batuan bertukar kepada kuat dan sangat kuat. Mutu batuan metasedimen di Durian Perangin pada amnya sangat lemah kelemah sehingga kekedalaman 11m dan batuan dibawah paras ini bermutu kuat. Jasad batuan riolit di Lanchang pula menunjukkan mutu yang sangat lemah sehingga kekedalaman 3m daripada permukaan.

Kajian Ramalan Hakisan Tanah Menggunakan Perisian Terbuka 'Geographical Resource Analysis Support System' (GRASS) di Daerah Barat Daya, Pulau Pinang

Mohammmad Firuz Ramli[1], Mohd Kamil Yusoff[1], Mohamad Abd. Manap[2] dan Majilah Basiron[1]

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ABSTRAK: Kajian yang dijalankan ini bertujuan meramal hakisan tanah di Daerah Barat Daya, Pulau Pinang. Persamaan Menganggar Kehilangan Tanah (RUSLE) digunakan untuk meramal potensi hakisan tanah melalui perisian "Open source" atau terbuka 'Geographical Resource Analysis Support System' (GRASS). Faktor erosiviti (R), faktor erodibiliti (K), faktor topografi (LS), faktor pengurusan tanah (C), dan faktor pengurusan tanaman (P) dalam RUSLE dianalisa menggunakan GRASS untuk menghasilkan peta potensi hakisan tanah. Daripada hasil kajian menunjukkan majoriti kawasan kajian mempunyai potensi hakisan yang rendah. Hasil kajian juga menunjukkan aplikasi RUSLE dan GRASS untuk kajian hakisan tanah.

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2. American Museum Novitates, nos. 3454, 3455, 3458 & 3461, 2004.
3. American Museum of Natural History, Bulletin nos. 284, 285, 286 & 287, 2004.
4. A new specimen of 'Apatosaurus Ajav' (Sauropoda: Diplodocidae) from the Morrison Formation (Upper Jurrasic) of Wyoming, USA
5. Episodes, vol. 28, no. 2, 2005.

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Three 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.

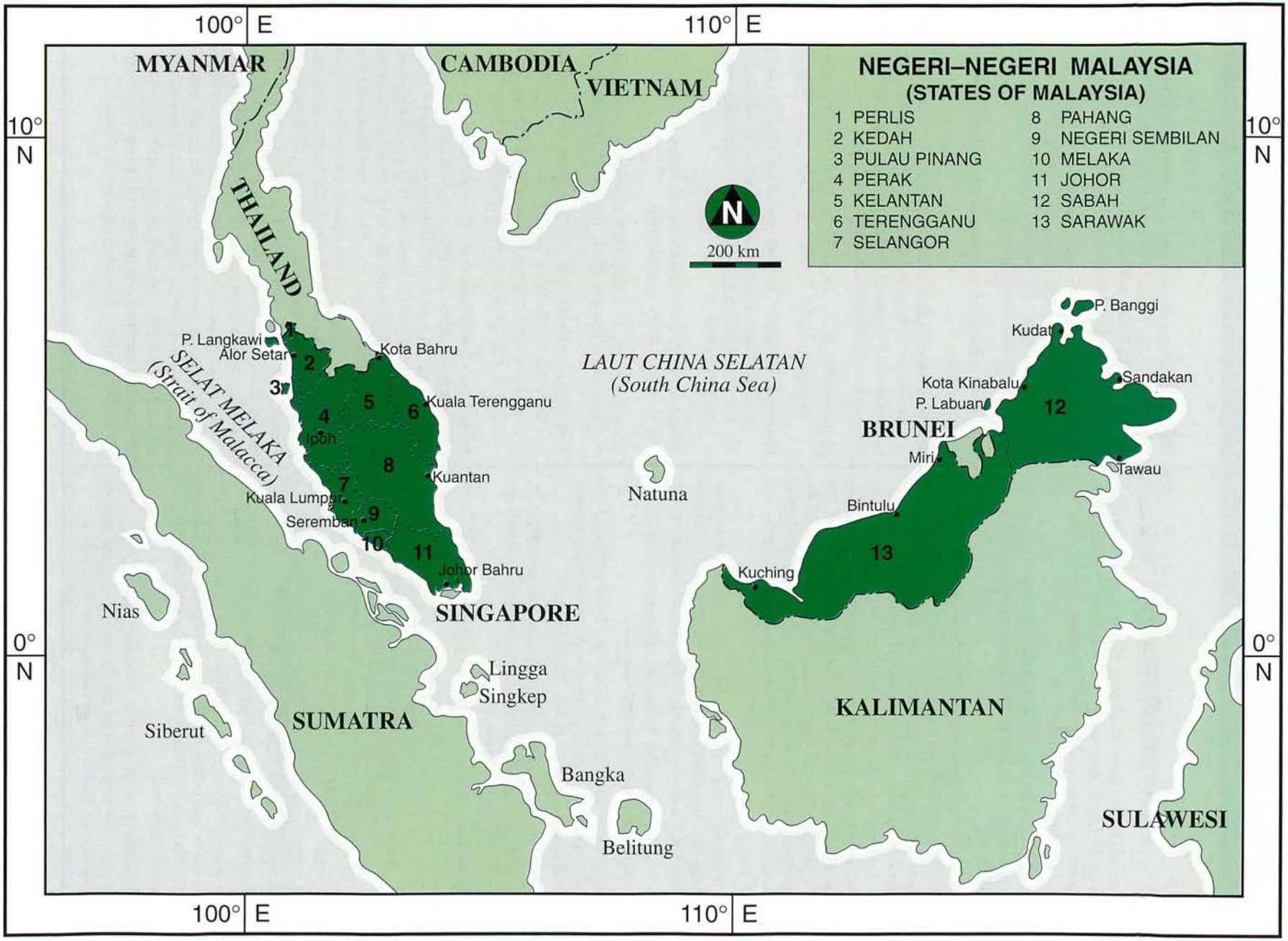
HOSKING, K.F.G., 1973. Primary mineral deposits. *In:* Gobbett, D.J. and Hutchison, C.S. (Eds.), *Geology of the Malay Peninsula (West Malaysia and Singapore).* Wiley-Interscience, New York, 335-390.

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 or Compact Disk. 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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MYANMAR
CAMBODIA
VIETNAM
THAILAND
NEGERI–NEGERI MALAYSIA
(STATES OF MALAYSIA)
1 PERLIS
2 KEDAH
3 PULAU PINANG
4 PERAK
5 KELANTAN
6 TERENGGANU
7 SELANGOR
8 PAHANG
9 NEGERI SEMBILAN
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P. Langkawi
Alor Setar
Kota Bahru
Kuala Terengganu
Ipoh
Kuantan
Kuala Lumpur
Seremban
Johor Bahru
SELAT MELAKA
(Strait of Malacca)
LAUT CHINA SELATAN
(South China Sea)
Natuna
P. Banggi
Kudat
Kota Kinabalu
Sandakan
P. Labuan
BRUNEI
Miri
Tawau
Bintulu
Kuching
SINGAPORE
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Lingga
Singkep
SUMATRA
Siberut
Bangka
Belitung
KALIMANTAN
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