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Pembangunan pangkalan data tanah runtuh di sepanjang Lebuhraya Pantai Timur km 160 – km 190, Pahang

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Abstract— Sistem Maklumat Geografi (GIS) telah digunakan secara meluas dalam kajian tanah runtuh. Dalam kajian ini, kaedah GIS telah digunakan untuk menghasilkan peta ramalan potensi tanah runtuh dan juga digunakan sepenuhnya bagi menyediakan data untuk pangkalan data yang berfungsi untuk menyimpan hasil kajian. Keluasan kawasan kajian adalah lebih kurang 600 km^2 di sepanjang km 160 ke km 190 Lebuhraya Pantai Timur (LPT) yang terletak di antara dua daerah, iaitu Maran dan Kuantan, Pahang. Peta ramalan potensi tanah runtuh kawasan kajian dikelaskan kepada empat zon potensi iaitu kawasan berpotensi rendah, sederhana, tinggi dan sangat tinggi. Pangkalan Data Tanah Runtuh yang dibangunkan dengan perisian komersial (Database Management System) bukan sahaja berguna untuk ahli geologi tetapi juga untuk ahli kejuruteraan awam, perancang pembangunan dan kontraktor yang ingin mengetahui potensi bencana tanah runtuh di kawasan kajian. Data yang disimpan di dalam pangkalan data bukan sahaja terhad untuk kajian tanah runtuh tetapi boleh juga digunakan untuk bidang kajian lain seperti hidrogeologi, perancangan guna tanah, hakisan tanah dan tapak pelupusan sampah.

Development of landslide database along km 160 – km 190, East Coast Highway, Pahang

Abstract— Geographic Information System (GIS) has been widely used as an important tool to predict landslide occurrences. In this study, GIS method was used to produce a landslide potential prediction map and was fully utilize to provide data for the database to store information regarding the findings in the study area. The study area is approximately 600 km^2 and is located from km 160 to km 190 of the East Coast Highway situated between the districts of Maran and Kuantan, Pahang. The potential map of the study area was classified into four potential zones namely low, moderate, high and very high potential. The landslide database that was developed using commercial software (Database Management System) serves not only for geologist but also for civil engineers, developers, and contractors who intend to assess the landslide hazard potential of the study area. The data stored in the databases are not restricted only to landslide analysis but are also useful for other fields of research such as hydrogeology, landuse planning, soil erosion and waste disposal site location.

PENGENALAN

Negara kita sering diwarnai dengan senario kejadian tanah runtuh dan sering kali selepas kejadian tersebut, barulah siasatan dijalankan dan lazimnya selepas kejadian ini, barulah pelbagai pihak mengeluarkan pendapat masing-masing berkenaan punca kejadian tersebut.

Dalam kajian Lee & Jasmi (2005), mereka mendapati berlaku peningkatan kejadian tanah runtuh di Malaysia dan kejadian ini kebanyakkannya berlaku pada cerun potongan atau pada tambakan di sepanjang jalan raya dan lebuhraya di kawasan berbukit. Kejadian tanah runtuh menjadi masalah apabila ianya mengganggu aktiviti manusia dan mengakibatkan kerosakkan pada harta benda dan menyebabkan kehilangan nyawa (Jasmi, 2004).

Pembinaan sistem perhubungan di kawasan lemah boleh dielakkan sekiranya terdapat satu sistem yang menyimpan data dan maklumat berkenaan kajian kestabilan kawasan tersebut sebelum ini. Penyiasatan awal atau pra-penyiasatan adalah penting kerana kebanyakkan tanah runtuh dan potensi kegagalan boleh diramal dan kos pencegahan tanah runtuh lebih rendah berbanding kos untuk memulihkan atau membangunkan semula kawasan yang mengalami tanah runtuh (Rib & Ta, 1978).

Manakala Mantovani *et al.* (1996) menyatakan bahawa pendekatan paling mudah untuk pemetaan bencana tanah runtuh adalah berdasarkan kepada tinjauan fotograf udara, kerjalapangan dan sejarah tanah runtuh suatu kawasan yang diperolehi daripada pangkalan data. Menurut Dai *et al.* (2002), tanpa pangkalan data, maklumat-maklumat mengenai suatu kejadian tanah runtuh yang pernah berlaku akan hilang begitu sahaja dan rekod sejarah tanah runtuh adalah penting kerana penilaian kecenderungan tanah runtuh adalah subjektif dan memerlukan maklumat tanah runtuh yang pernah berlaku.

Kertas ini akan membincangkan kelebihan pembangunan pangkalan data tanah runtuh yang menyimpan hasil analisis dan data yang disediakan melalui kaedah Sistem Maklumat Geografi (GIS).

KAWASAN KAJIAN

Kawasan kajian terletak di sepanjang Lebuhraya Pantai Timur (LPT) iaitu di sepanjang 30km bermula dari km 160-km 190 yang terletak di daerah Maran dan Kuantan, Pahang. Keluasan kawasan kajian adalah 600 km^2. Rajah 1 menunjukkan lokasi kawasan kajian.

Kawasan kajian secara umumnya terdiri daripada batuan sedimen dan terdiri daripada Formasi Tembeling, Formasi Semantan dan Lapisan Seri Jaya. Terdapat juga batuan volkanik dan granitoid hadir di sesetengah kawasan kajian. Lebuhraya ini dipilih sebagai kawasan kajian kerana lebuhraya ini baru sahaja dibuka pada tahun 2004. Oleh itu, kajian dilakukan untuk melihat kestabilan cerun-cerun di sepanjang dan sekitar lebuhraya tersebut.

KAEDAH KAJIAN

Metodologi kajian melibatkan tiga peringat utama. Peringkat-peringkat metodologi ini saling berkaitan untuk membentuk satu pangkalan data tanah runtuh yang lengkap daripada segi data dan maklumat. Rajah 2 menunjukkan peringkat-peringkat metodologi kajian secara ringkas.

Pangkalan data yang dibangunkan mengandungi data dan hasil kajian yang diperolehi melalui kaedah GIS dan kerjalapangan. Data untuk perbandingan yang lain seperti fotograf udara dan kajian literatur diambil sebagai data sejarah tanah runtuh. Setelah semua data selesai disediakan dan diproses, pangkalan data yang menggunakan perisian komersial iaitu Microsoft Access dan Visual Basic dibangunkan. Pangkalan data dibangunkan berdasarkan lima fasa pembangunan pangkalan data yang dipetik daripada Abdullah Embong (2000). Fasa pembangunan pangkalan data ini ditunjukkan dalam Rajah 3.

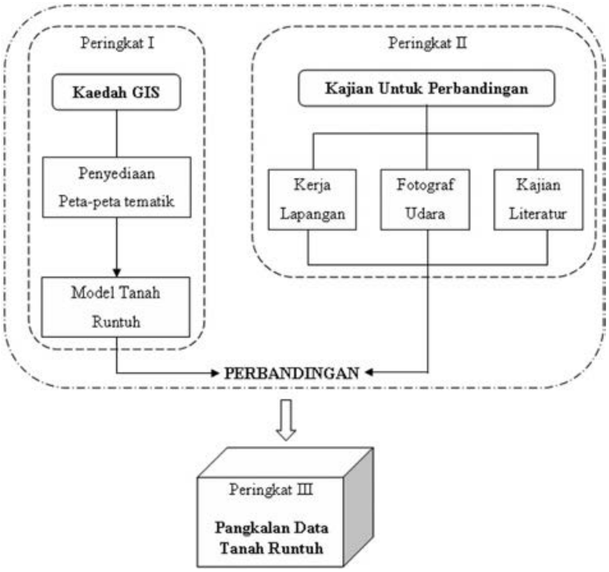
HASIL ANALISIS

Hasil analisis kajian ini boleh dibahagikan kepada tiga bahagian, iaitu:

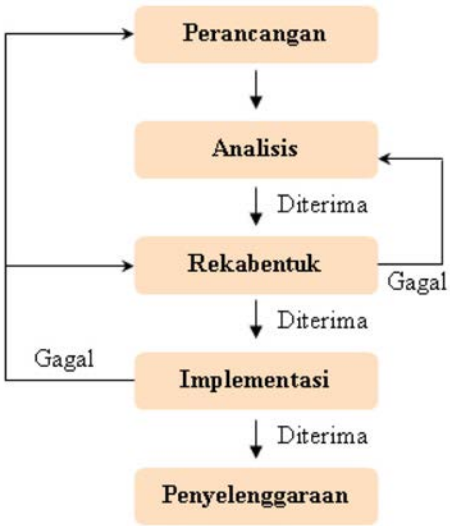
Hasil Kerjalapangan

Hasil daripada kerjalapangan yang dilakukan, didapati terdapat 21 lokasi tanah runtuh. Sebanyak 11 lokasi tanah runtuh dicerap di sepanjang lebuhraya manakala selebihnya terdapat di sekitar jalan raya lama kawasan kajian. Rajah 4 (a, b dan c) menunjukkan beberapa lokasi tanah runtuh yang berlaku di kawasan kajian.

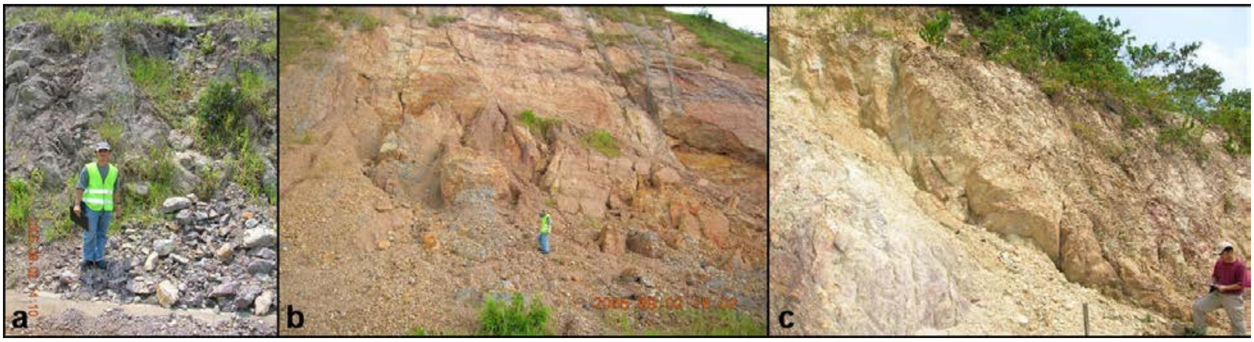
Rajah 1: Peta jajaran Lebuh raya Pantai Timur (LPT) dan lokasi kajian.



Rajah 2: Peringkat-peringkat kaedah umum kajian.



Rajah 3: Carta alir proses fasa pembangunan pangkalan data tanah runtuh kajian (Dipetik dan diubahsuai daripada Abdullah Embong, 2000)



Rajah 4: Lokasi tanah runtuh yang terdapat di kawasan kajian. (a) Tanah runtuh jenis jatuhan batuan di km 165.7. (b) Tanah runtuh jenis gelongsoran tanah dan jatuhan batuan di km 170.9. (c) Tanah runtuh jenis gelongsoran tanah di jalan raya lama kawasan kajian.

Peta Potensi

Sebanyak lapan parameter faktor tanah runtuh digunakan dalam kajian ini untuk menghasilkan peta ramalan potensi tanah runtuh, iaitu litologi, guna tanah, ketumpatan lineamen, jenis tanah, zon penimbal sesar, kecuraman cerun, ketumpatan saliran dan purata hujan tahunan. Pemberat dengan julat skala daripada 10 hingga 50 digunakan untuk menunjukkan pengaruh kelas-kelas yang terdapat dalam setiap parameter kajian terhadap kejadian tanah runtuh.

Kelas dalam parameter kajian yang diberikan nilai 10 bermaksud kelas tersebut mempunyai pengaruh yang rendah terhadap kejadian tanah runtuh, manakala kelas yang diberikan nilai 50 mempunyai pengaruh yang tinggi terhadap kejadian tanah runtuh. Jadual 1 menunjukkan parameter-parameter kajian berserta dengan pemberat yang diberikan kepada setiap kelas yang terdapat dalam parameter-parameter tersebut.

Peta ramalan potensi tanah runtuh yang dihasilkan dikelaskan kepada 4 zon potensi tanah runtuh yakni Zon Potensi Rendah, Sederhana, Tinggi dan Sangat Tinggi. Rajah 5 menunjukkan peta ramalan potensi tanah runtuh yang dihasilkan untuk kawasan kajian. Berdasarkan peta ramalan potensi yang dihasilkan, didapati zon potensi sederhana meliputi 42.63% kawasan kajian dan ini diikuti oleh kawasan berpotensi tinggi (38.96%), sangat tinggi (9.36%) dan zon potensi rendah sebanyak 9.05% (Norbert *et al*., 2006). Jadual 2 menunjukkan zon-zon potensi tanah runtuh kawasan kajian yang dicirikan oleh kelas-kelas yang terdapat dalam setiap parameter yang digunakan dalam kajian.

Berdasarkan lokasi tanah runtuh yang diperolehi daripada kerjalapangan, fotograf udara dan kajian literatur, lokasi tanah runtuh tertabur paling banyak dalam zon potensi sederhana dan diikuti oleh zon potensi tinggi, sangat tinggi dan rendah. Jadual 3 menunjukkan taburan lokasi tanah runtuh dalam setiap zon potensi dalam peta ramalan potensi tanah runtuh.

Pangkalan Data

Pangkalan Data Tanah Runtuh yang dibangunkan menyimpan hasil analisis yang diperolehi daripada kaedah Sistem Maklumat Geografi (GIS). Kaedah GIS dapat meliputi kawasan yang luas dan pelbagai parameter boleh dianalisis sekaligus membolehkan pelbagai maklumat dan data yang padat dan lengkap dimuatkan di dalam pangkalan data. Pangkalan Data yang dibangunkan ini mempunyai dua bahagian utama iaitu, bar menu dan antara muka pangkalan data (Rajah 6).

Bar Menu

Bahagian ini disediakan untuk menempatkan kaitan antara parameter yang digunakan dalam kajian dengan potensi tanah runtuh, simpanan data mentah kajian dan model-model tanah runtuh yang dihasilkan untuk kawasan kajian. Selain itu, kemudahan untuk mencetak serta membuka fail-fail lain juga disediakan. Jadual 4 menunjukkan fungsi kategori item-item yang disediakan dalam bar menu Pangkalan Data Tanah Runtuh manakala Rajah 7 pula menunjukkan item-item yang disediakan dalam bar menu.

Antaramuka Pangkalan Data

Bahagian ini mengandungi lima kategori item yang dilengkapi dengan butang-butang arahan yang akan memaparkan item-item apabila ditekan. Pelbagai item-item berkenaan kawasan kajian, hasil dan perbincangan, lokasi tanah runtuh, laporan dan pandangan kawasan kajian dalam bentuk 3 dimensi disediakan dalam bahagian ini. Jadual 5 menunjukkan fungsi setiap kategori item dalam bahagian antaramuka manakala Rajah 8 menunjukkan item-item yang terdapat dalam antaramuka pangkalan data.

Ciri-ciri Lain Pangkalan Data

Laporan dalam bentuk jadual yang boleh dicetak terus dan paparan lokasi tanah runtuh dalam bentuk borang yang boleh dikemaskini merupakan antara kelebihan pangkalan data ini. Pangkalan data ini juga dilindungi dengan kata laluan untuk mengelakkan penyalahgunaan data dan maklumat yang disediakan dalam pangkalan data ini.

Di samping itu, pengaturcaraan dalam Visual Basic digunakan untuk membuat pangkalan data ini lebih menarik. Data yang disimpan dalam Pangkalan Data Tanah Runtuh ini bukan sahaja boleh digunakan untuk

Jadual 1: Parameter-parameter kajian yang digunakan dalam kajian berserta dengan pemberat yang diberikan kepada setiap kelas dalam parameter kajian.

Parameter (Faktor)	Kelas	Pemberat
Litologi	Batu Pasir	40
	Granitoid	20
	Filit, Sabak & Syal	50
	Batu Pasir, Batu Lodak dan Syal	40
	Volkanik-Perm	40
	Batu Kapur	30
Ketumpatan Lineamen	<1000 m/m^2	10
	1000 m/m^2-2000 m/m^2	20
	2000 m/m^2-3000 m/m^2	30
	3000 m/m^2-4000 m/m^2	40
	>4000 m/m^2	50
Zon Penimbal Sesar	<50 m	40
	50 m-100 m	30
	100 m -150 m	20
	>150 m	10
Ketumpatan Saliran	<1500 m/m^2	50
	1500 m/m^2-2500 m/m^2	40
	2500 m/m^2-3500 m/m^2	30
	3500 m/m^2-4500 m/m^2	20
	>4500 m/m^2	10
Kecuraman Cerun	0-5°	10
	5°-15°	20
	15°-26°	30
	26°-35°	40
	>35°	50
Purata Hujan Tahunan	<1800 mm	10
	1800 mm-2100 mm	20
	2100 mm-2400 mm	30
	2400 mm-2700 mm	40
	>2700 mm	50
Jenis Tanah	Lempung berpasir halus-lempung	40
	Lom lempung berpasir-lempung	40
	Lempung kerikil-lempung	20
	Lempung berpasir kasar-lempung	30
	Lempung-lom lempung	40
	Lom lempung berpasir halus	30
	Lempung berpasir kasar	20
	Lom lempung berpasir	30
	Lempung	50
Guna Tanah	Air	10
	Hutan	20
	Kawasan dibersihkan	40
	Paya	10
	Padang Ternak dan Rumput	30
	Perbandaran	40
	Perlombongan	40
	Pertanian	30
	Tidak diusahakan	30

kajian tanah runtuh tetapi juga boleh digunakan untuk kajian-kajian dalam bidang lain seperti hidrogeologi, pemilihan tapak pelupusan sampah dan perancangan bandar. Data kajian yang telah diseragamkan daripada segi skala dan sempadan kawasan kajian boleh digunakan terus oleh pengguna-pengguna pangkalan data yang ingin menggunakan data tersebut untuk kajian mereka di kawasan kajian yang sama.

Penerangan daripada segi teori tentang bagaimana suatu parameter kajian mempengaruhi kajian tanah runtuh turut disediakan dalam pangkalan data ini. Hasil-hasil kajian disediakan dalam bentuk ringkasan yang padat untuk pengguna melihat hasil analisis serta faktor-faktor yang boleh menyebabkan tanah runtuh di kawasan yang berbeza zon potensi.

Pangkalan data yang dibangunkan menyimpan data dalam bentuk digital untuk memudahkan pengemaskinian data sekiranya terdapat kajian terbaru di kawasan kajian dijalankan. Data dan maklumat-maklumat yang disediakan berdasarkan hasil analisis GIS akan memudahkan para pengguna seperti pemaju dan ahli jurutera untuk mengetahui kawasan yang berpotensi tinggi untuk berlakunya tanah runtuh. Ini bukan sahaja memudahkan penyiasatan dijalankan malah akan dapat mengurangkan kos dan menjimatkan masa.

Data berkenaan kawasan yang telah mengalami tanah runtuh yang disediakan dalam pangkalan data ini akan dapat membantu pihak penyelenggara lebuhraya untuk bertindak memandangkan kedudukan kawasan tersebut telah disediakan dalam pangkalan data. Ini akan memudahkan pemantauan dan kemaskini data seperti sama ada sesuatu kawasan yang mengalami tanah runtuh telah atau belum dibaiki.

Peta ramalan potensi tanah runtuh yang disediakan juga mampu membantu pemaju yang ingin membangunkan kawasan kajian. Peta potensi yang disediakan dapat membantu pemaju untuk memilih kawasan yang sesuai untuk dibangunkan dan seterusnya mengelakkan kerugian yang diakibatkan daripada membangunkan kawasan yang tidak sesuai.

KESIMPULAN

Peta ramalan potensi tanah runtuh yang dihasilkan bagi kawasan kajian boleh digunakan sebagai alat untuk pra-penyiasatan sebelum sebarang kerja-kerja pembinaan seperti sistem perhubungan di kawasan kajian pada masa hadapan.

Pangkalan data yang dibangunkan bukan sahaja dapat menyimpan data hasil kajian malah dapat mengelakkan pertindanan data kajian dan satu sistem pusat penyimpanan data dapat diwujudkan untuk memudahkan penyelidik, pemaju dan konsultan untuk mendapatkan data dan maklumat berkenaan kawasan kajian.

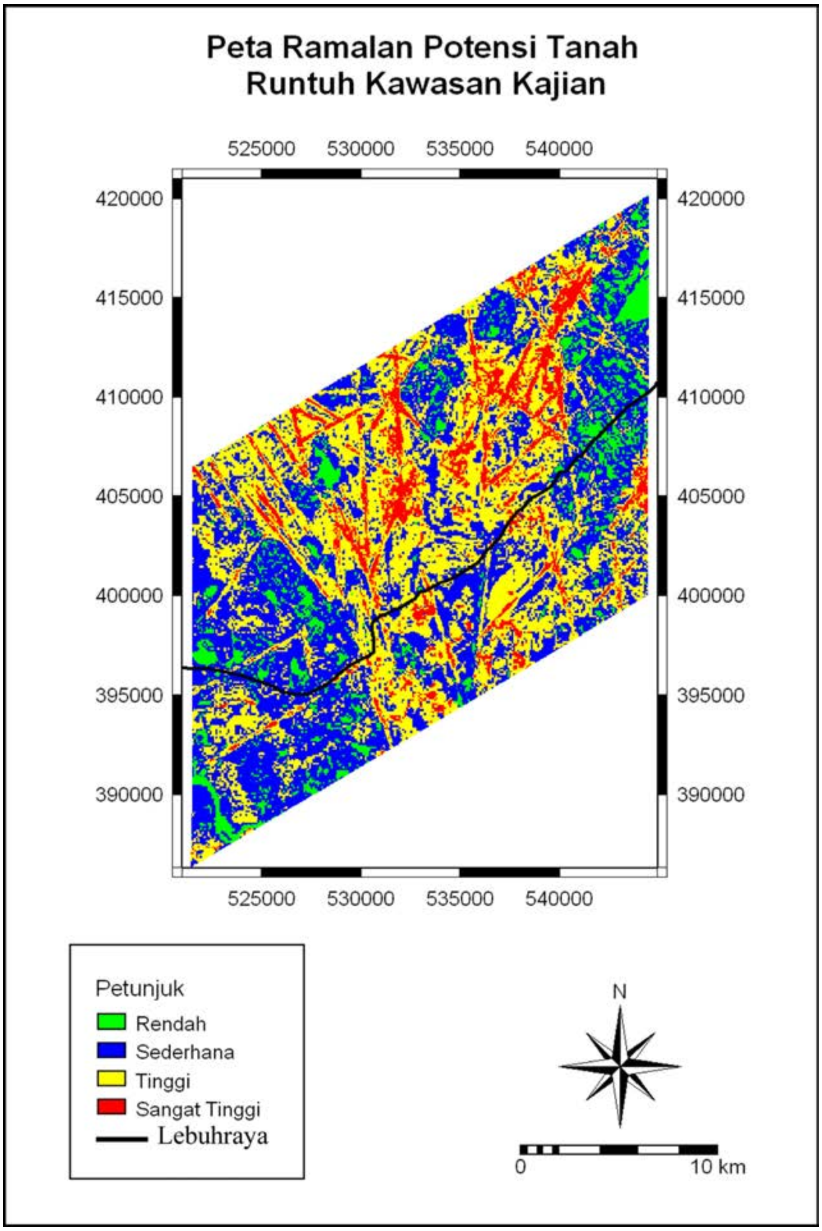
Selain itu, pangkalan data yang dihasilkan adalah mesra pengguna dan data yang disediakan bukan sahaja boleh digunakan dalam bidang kajian tanah runtuh tetapi juga boleh digunakan dalam bidang lain seperti hidrogeologi, pemilihan tapak pelupusan sampah dan hakisan tanah.

PENGHARGAAN

Penulis ingin merakamkan setinggi-tinggi penghargaan kepada Prof. Madya Dr. Abdul Ghani Rafek, pihak MACRES, semua pensyarah dan semua warga UKM yang telah membantu menjayakan projek penyelidikan ini.

Jadual 2: Perkaitan antara parameter-parameter faktor tanah runtuh yang digunakan dalam kajian dengan zon potensi tanah runtuh kawasan kajian.

Ciri / Potensi	Rendah	Sederhana	Tinggi	Sangat Tinggi
Litologi	Granitoid, batu pasir, batu lodak dan syal, batu kapur	Batu pasir, batu lodak, syal, granitoid	Batu pasir, filit, syal, sabak, batuan volkanik	
Guna Tanah	Hutan dan pertanian	Pertanian	Hutan, perbandaran, pertanian,	
Ketumpatan Lineamen	<1000 m/m^2- 3000 m/m^2		1000 m/m^2- > 4000 m/m^2	2000 m/m^2 - > 4000 m/m^2
Jenis Tanah	Lempung berpasir kasar-lempung	Lempung berpasir halus-lempung	Lom lempung berpasir halus-lempung	
Zon Penimbal Sesar	>150 m		< 50 m – 150 m	<50 m
Kecuraman Cerun	0˚-5˚	5˚-26˚	26˚->35˚	>35˚
Ketumpatan Saliran	2500 m/m^2 -4500 m/m^2	2500 m/m^2 -3500 m/m^2	1500 m/m^2 – 3500 m/m^2	
Purata Hujan Tahunan	<1800 mm-2100 mm	1800 mm-2400 mm		



Rajah 5: Peta Ramalan Potensi Tanah Runtuh kawasan kajian.

Jadual 3: Taburan lokasi tanah runtuh pada setiap zon potensi.

Potensi	Bilangan Tanah Runtuh
Rendah	8
Sederhana	52
Tinggi	44
Sangat Tinggi	19
Jumlah	**123**

Jadual 4: Fungsi kategori yang disediakan pada bar menu pangkalan data.

Kategori Item	Fungsi
Fail	Bagi memudahkan pengguna membuka fail lain, mencetak dan keluar dari pangkalan data
Parameter	Penjelasan bagaimana setiap parameter yang digunakan dalam kajian mempengaruhi kejadian tanah runtuh
Sumber Data	Menyediakan sambungan ke bahagian penyimpanan data mentah
Pertanyaan	Maklumat berkenaan pembangun pangkalan data serta memuatkan model-model analisis tanah runtuh yang lain

Rajah 6: Antaramuka utama dan bar menu Pangkalan Data Tanah Runtuh.

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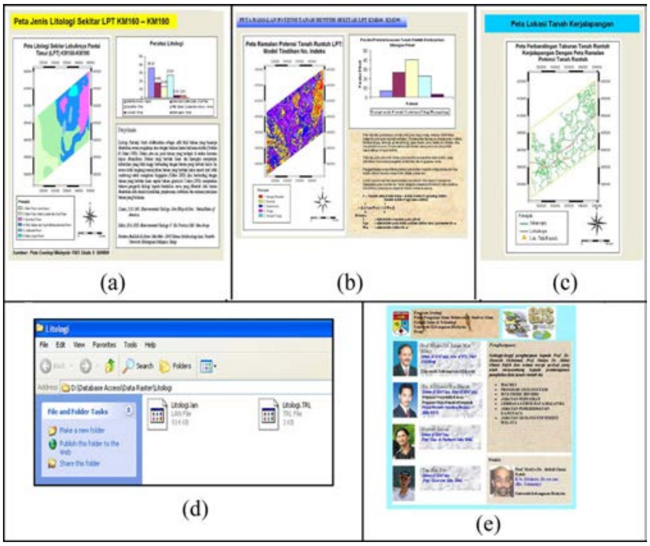
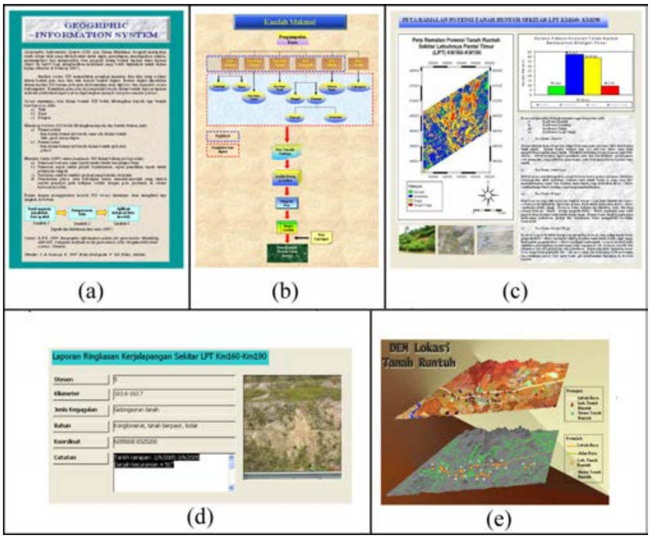
Jadual 5: Fungsi kategori yang disediakan pada antaramuka pangkalan data.

Kategori Item	Fungsi
Teori	Memuatkan ringkasan penerangan tentang konsep-konsep kajian
Info Kawasan Kajian	Penerangan tentang latarbelakang kawasan kajian
Kaedah Kajian	Carta alir metodologi kajian yang digunakan
Lokasi Tanah Runtuh	Lokasi-lokasi tanah runtuh yang dicerap di lapangan
Hasil dan Perbincangan	Perbincangan mengenai peta ramalan potensi tanah runtuh yang dihasilkan berserta dengan data-data perbandingan



Rajah 7: Contoh-contoh item yang terdapat pada bar menu pangkalan data (a) penerangan parameter litologi, (b) model tanah runtuh, (c) data vektor dalam bentuk peta, (d) data mentah dan (e) profil pembangun pangkalan data.



Rajah 8: Contoh-contoh item yang terdapat pada antaramuka pangkalan data (a) teori, (b) kaedah kajian, (c) hasil dan perbincangan, (d) lokasi tanah runtuh kerjalapangan dan (e) model elevasi digit kawasan kajian.

CATATAN GEOLOGI
GEOLOGICAL NOTES

Pemetaan ramalan potensi tanah runtuh di sepanjang km160-190 Lebuhraya Pantai Timur dengan pendekatan Sistem Maklumat Geografi: Kaedah statistik

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Abstrak — Kajian pemetaan ramalan potensi tanah runtuh merupakan komponen asas untuk pengurusan risiko bencana alam dan bertujuan untuk mengenalpasti kawasan risiko kejadian tanah runtuh. Kertas ini menyumbang secara komprehensif mengenai pengezonan ramalan potensi tanah runtuh di sepanjang km 160 hingga ke 190 Lebuhraya Pantai Timur, Pahang dengan pendekatan Sistem Maklumat Geografi. Objektif utama kajian ini adalah untuk menentukan sumbangan atau nilai pemberat pada setiap kelas dalam faktor dan antara faktor-faktor itu sendiri dengan kaedah statistik. Adalah penting untuk mengenalpastikan faktor-faktor penyumbang kepada tanah runtuh dan faktor-faktor tersebut perlu digunakan sebagai parameter input untuk membangunkan peta ramalan potensi tanah runtuh. Parameter-parameter tersebut terdiri daripada darjah kecerunan, ketumpatan saliran, ketumpatan lineamen, zon penimbal sesar, jenis litologi, taburan hujan tahunan, jenis tanah, jenis guna tanah dan jalanraya. Kajian ini menggunakan statistik bernama kaedah Nilai Maklumat. Kaedah ini merupakan suatu kaedah pengelasan potensi tanah runtuh berdasarkan taburan tanah runtuh yang pernah berlaku dengan pengiraan secara matematik. Peta ramalan potensi tanah runtuh dihasilkan berdasarkan kepada kaedah Nilai Maklumat dan diklasifikasikan kepada lima zon potensi tanah runtuh, iaitu sangat rendah, rendah, sederhana, tinggi dan sangat tinggi. Peta-peta ramalan yang dihasilkan kemudiannya dibandingkan secara kualitatif dan kuantitatif dengan data lokasi sejarah tanah runtuh. Kaedah Nilai Maklumat ini adalah berdasarkan ketumpatan tanah runtuh sebenar yang berlaku dan menunjukkan keputusan yang boleh dipercayai dengan "correlation coefficient" bernilai 0.87.

Abstract — Landslide potential prediction mapping is a fundamental component of hazard management and to identify area with high risk of landslides. This paper present the result of a comprehensive study on landslide potential zonation along km 160 to 190 of East Coast Highway, Pahang using Geographic Information System (GIS) approach. The main objective of this research study is to determine the contribution or weightage of each class of the factor and between the factors itself with statistical method approach. It is crucial that the essential factors contributing to landslide is to be identified and used as the input parameters for the construction of landslide potential prediction map. The parameters are slope gradient, drainage density, lineament density, fault zones, types of lithology, rainfall distribution, soil type, landuse and road. This study applied statistical method, namely information value method where it was used as a landslide potential classification tool based on the of distribution of landslide event with matematical calculation. A landslide potential map was developed based on the information value method and classified into five different potential zones namely very low, low, moderate, high, and extremely high. The map produced was qualitatively and quantitatively compared to the location of the historical landslide. The information value method is based on the density calculation of the real historical landslide and showed reliable result with a correlation coefficient value of 0.87.

PENDAHULUAN

Secara umum, GIS merupakan satu set peralatan yang berkeupayaan untuk mengumpul, menyimpan, mengurus, memperolehi, mengubah atau meminda, memapar serta menganalisis data-data ruang daripada dunia sebenar kepada set-set tertentu mengikut kepentingan kajian (Burrough, 1989).

Keperluannya semakin meningkat berikutan dengan peningkatan bencana tanah runtuh akibat daripada pembangunan yang ketara. Di Malaysia, beberapa kajian tanah runtuh dengan menggunakan GIS telah dilakukan oleh Jasmi (1997), Lim *et al*. (2004), Azlikamil *et al*. (2004). Berdasarkan analisis pengezonan potensi bencana tanah runtuh, bencana dapat diramal dan dapat mengurangkan atau meminimumkan kejadian tanah runtuh.

Satu kajian pemetaan ramalan potensi tanah runtuh telah dilakukan di sepanjang Lebuhraya Pantai Timur pada km 160 hingga km 190, Pahang. Keluasan keseluruhan kawasan kajian ialah 504 km^2. Secara umum, geologi kawasan kajian terdiri daripada Lapisan Seri Jaya, Formasi Semantan, Kumpulan Tembeling, rejahan asid intrusif, batuan volkanik dan endapan Kuarterner. Sebahagian besar kawasan kajian bertopografi sederhana hingga tinggi. Purata taburan hujan tahunan bagi kawasan kajian berjulat daripada 1900 mm – 2500 mm.

BAHAN DAN KAEDAH KAJIAN

Dua imej satelit Landsat TM yang diambil pada tahun 2004 (126057, 126058), tiga peta topografi tahun 1992 yang bernombor siri 4158, 4159 dan 4259 (skala 1: 50 000), peta geologi Semenanjung Malaysia tahun 1985 (JMG, 1985), data taburan hujan 2000–2005 Pahang, peta jenis tanah serta peta guna tanah 2002 telah digunakan untuk menghasilkan peta tematik terbitan.

Peta tematik terbitan yang diperolehi adalah seperti darjah kecerunan, ketumpatan saliran, ketumpatan lineamen, zon penimbar sesar, geologi, jenis tanah, guna tanah, jalanraya dan taburan hujan (Rajah 1) yang merupakan faktor penyumbang kepada kestabilan cerun. Kajian ini mengaplikasikan kaedah statistik yang terdiri daripada model nilai maklumat untuk menghasilkan peta ramalan potensi tanah runtuh.

Kaedah statistik ini memerlukan penyediaan satu peta taburan tanah runtuh (Rajah 2) yang dihasil dengan tafsiran 77 fotograf udara 1966 (bernombor siri L73N C52 63-73, L74S C52 156-167, L75S C50 63-72, L76S C50 80-88, L77N C105 144-155, L78S C46 74-80, L78S C33 58-63 dan L79S C33 49-57) yang berskala 1: 25000. Formula untuk kaedah nilai maklumat ditunjukkan seperti berikut:

$$I_i = \ln \frac{S_i/N_i}{S/N}$$

$$= \frac{\textit{Ketumpatan tanah runtuh dalam kelas}}{\textit{Ketumpatan tanah runtuh dalam keseluruhan peta}}$$

Di mana,

I_i = nilai maklumat yang berasosiasi dengan pembolehubah X_i

S_i = nombor piksel dengan tanah runtuh yang berasosiasi dengan pembolehubah X_i

N_i = nombor piksel bagi pembolehubah X_i

S = jumlah nombor piksel dengan tanah runtuh

N = jumlah nombor piksel

Peta ramalan potensi tanah runtuh yang dihasilkan kemudiannya dikelaskan kepada 5 kelas, iaitu sangat rendah, rendah, sederhana, tinggi dan sangat tinggi potensi. Data akhir akan dibandingkan dengan data lokasi kejadian tanah runtuh untuk menunjukkan ketepatan dan kejituan bagi peta potensi yang dihasilkan.

HASIL DAN PERBINCANGAN

Peta ramalan potensi tanah runtuh dan hasil analisis bagi kaedah Nilai Maklumat ditunjukkan dalam Rajah 3, 4 dan Jadual 1. Berdasarkan hasil yang ditunjukkan, didapati bahawa tanah runtuh yang pernah berlaku lebih tertumpu pada zon yang diramalkan potensi sederhana.

Jadual 1: Hasil peratusan zon potensi tanah runtuh bagi kaedah nilai maklumat dan pemberat berdasarkan bukti dengan taburan tanah runtuh pada setiap zon.

	Nilai Maklumat	
Potensi	Bilangan	Peratusan (%)
Sangat Rendah	7	13.9
Rendah	24	36.1
Sederhana	84	46.4
Tinggi	2	1.6
Sangat Tinggi	6	1.9
Jumlah	123	100.0

Walaupun peratusan bagi kawasan yang diramalkan tinggi hingga sangat tinggi adalah rendah, namun ia masih terdapat tanah runtuh yang berlaku di mana bilangan tanah runtuh yang berlaku dalam zon berkenaan adalah tinggi jika dibanding secara relatif dengan keluasannya. Penilaian kejituan bagi model Nilai Maklumat telah dijalankan secara kualitatif dan kuantitatif. Di mana bagi kuantitatif, perbandingan dengan pendekatan kaedah "Correlation Coefficient" telah dilakukan dan ia memberi nilai "Correlation Coefficient" 0.87.

KESIMPULAN

Sebanyak 9 parameter penyumbang tanah runtuh telah dikenalpasti dan digunakan sebagai peta tematik terbitan kajian ramalan potensi tanah runtuh. Parameter-parameter tersebut adalah darjah kecerunan, ketumpatan saliran, ketumpatan lineamen, zon penimbar sesar, geologi, jenis tanah, guna tanah, jalanraya dan taburan hujan. Perbandingan kaedah Nilai maklumat menggunakan "Correlation Coefficient" menunjukkan bahawa kejituan bagi model Nilai Maklumat adalah tinggi dan sesuai digunakan untuk menunjukkan ramalan potensi tanah runtuh di sepanjang km 160-190 LPT.

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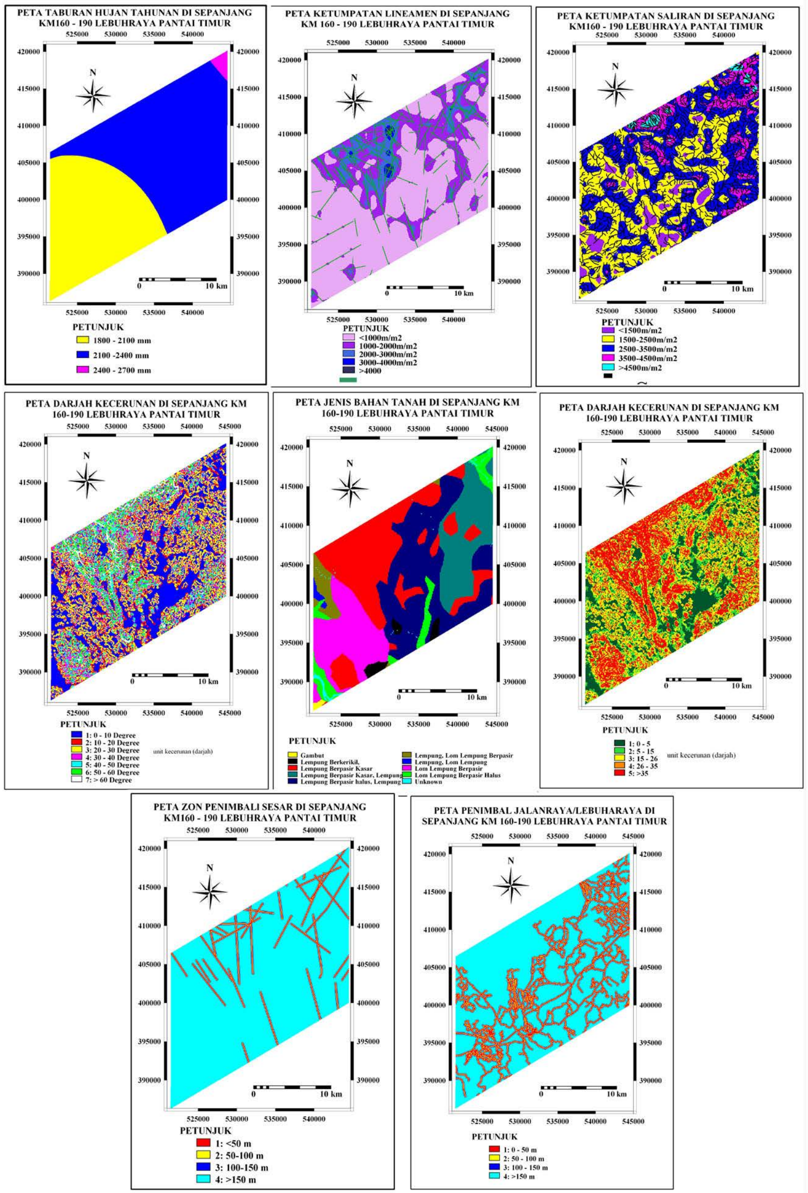
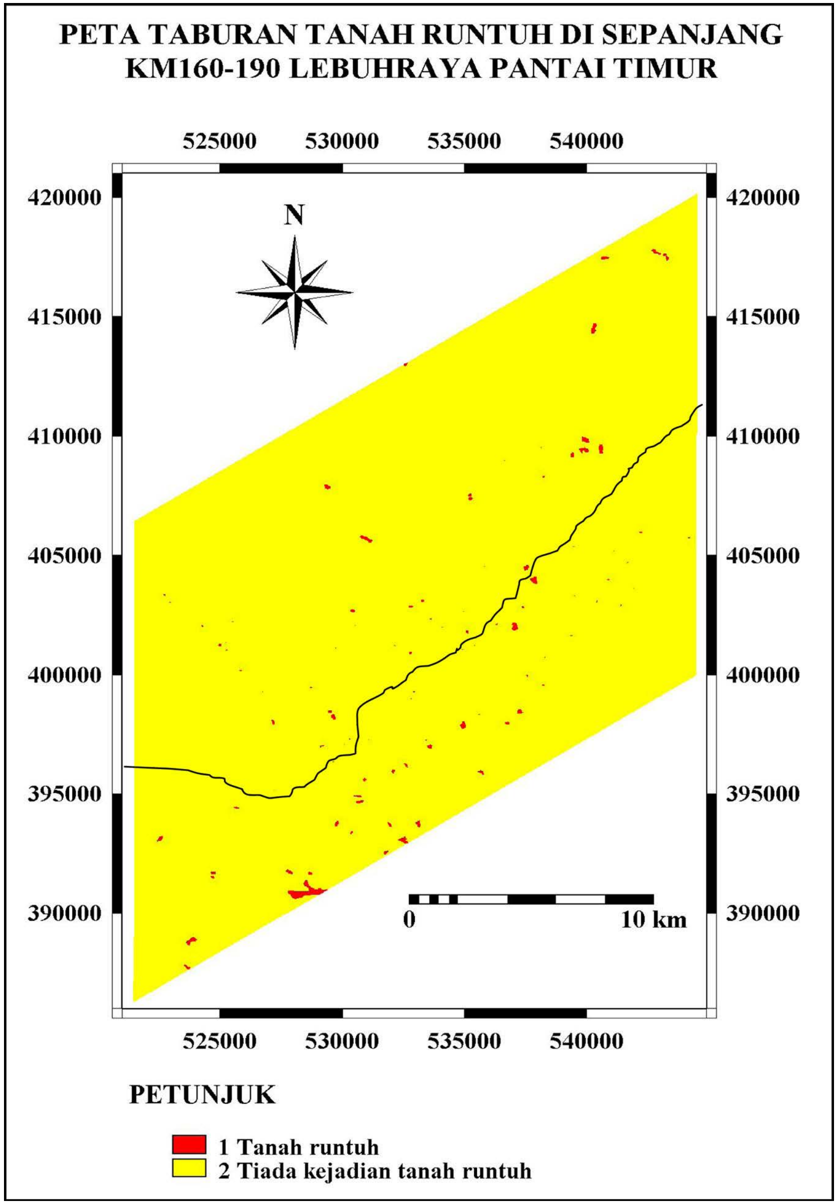
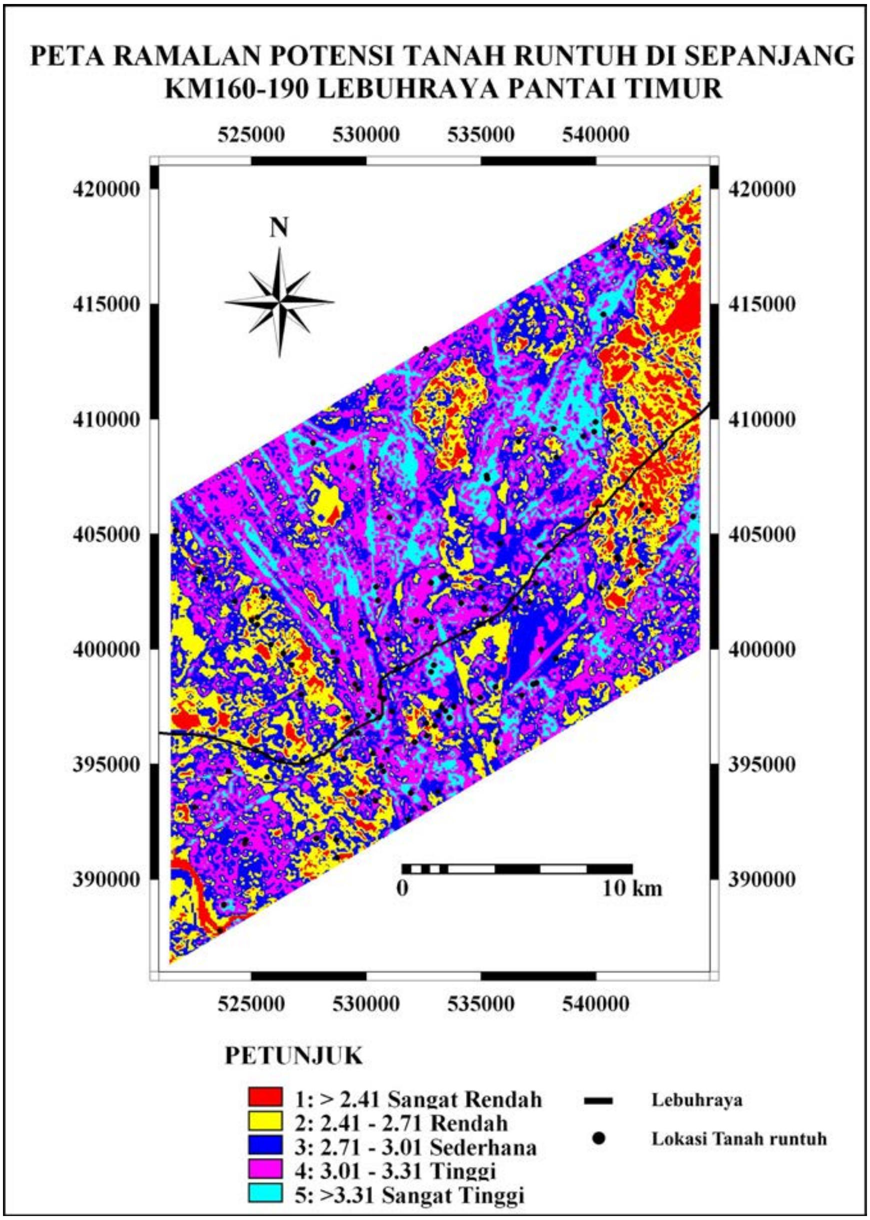


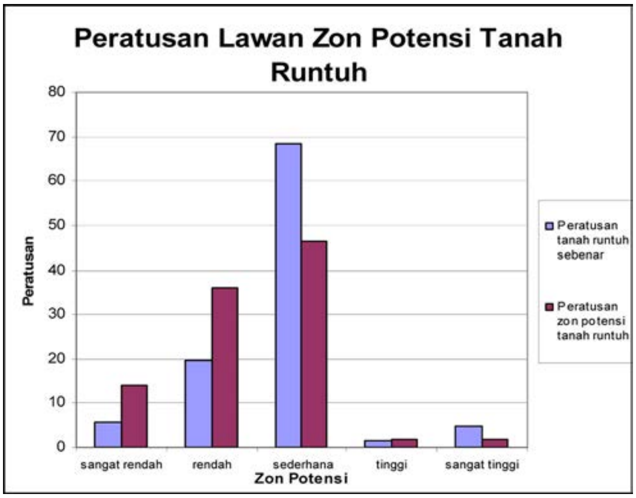
Rajah 1: Peta tematik terbitan yang diperolehi terdiri daripada darjah kecerunan, ketumpatan saliran, ketumpatan lineamen, zon penimbar sesar, geologi, jenis tanah, guna tanah, jalanraya dan taburan hujan



Rajah 2: Peta taburan tanah runtuh yang bertujuan untuk kerja penganalisan secara statistik. Maklumat ini diperolehi daripada penafsiran fotograf udara.



Rajah 3: Peta potensi ramalan tanah runtuh bagi kaedah nilai maklumat dengan lokasi tanah runtuh yang pernah berlaku di kawasan kajian.



Rajah 4: Carta Palang bagi perbandingan antara taburan tanah runtuh dengan keluasan zon potensi.

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Aquifer and ferric spring deposits south of Miri, Sarawak: Impact on facies characterisation of coastal sediments

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Abstract — Observations on artesian springs indicate the presence of at least three groundwater bodies that are chemically distinct. Artesian springs are observed from both high and low iron-content ground waters. Fe^{2+} rich groundwater is rapidly oxidized at surface, and orange deposits of Fe^{3+} minerals are precipitated. These are either parallel-layered, or form concentric ferric conglomerates in coastal caves. Once eroded, Fe-coated pebbles are scattered along the coast and embedded in recent sediments. Similar deposits are also seen in the Late Miocene Lambir and Miri formations. Field observations supportive the idea of a strong tidal influence on the dynamics of aquifers, and iron mobility in coastal areas. Re-deposition of the Fe in oxidized form could be in combination with other metallic cations, anions or even in chelated forms with organics. The reduction and movement of Fe in aquifers, and iron deposits (coated pebbles, filled burrows) could be linked to the facies signature of coastal Miocene rocks, as it does in present-day sediments. This process might be related to the development of source rocks in coastal offshore deposits.

INTRODUCTION

The areas south of Miri are characterized by a plateau, where young alluvial sediments overly the folded and monoclinally dipping Late Miocene to Pliocene Lambir and Tukau clastics (Figure 1A). The uppermost two meters of the plateau sediment is formed by a dark iron oxide stained, and occasionally strongly bleached (podsolized) sand layer. Given that the clastics appear to have undergone several cycles of weathering and lithification, iron in these materials is evidently allochtonous. In addition, it has been often debated to what extent migration of iron-bearing fluids might contribute (directly or indirectly) to the creation of algal source rock in coastal and shallow offshore areas.

The current research was carried out to establish a possible link between fluctuations in ocean tides and the occurrence of springs within a distance of 2 km from the coastline. Another objective was directed to the question if iron deposits, as studied in recent sediments, might qualify as indicator for a specific facies environment.

MATERIALS AND METHODS

The study area is located in the southern part of Miri, Sarawak. The rock formations here comprise the Mid-Late Miocene sedimentary beds of the Lambir and Tukau Formations that contain Fe-concretions or other forms of Fe accumulation. Representative rock and water samples were collected for evaluation, from the Mio-Pliocene sequences and the overlying plateau sands. Emphasis was given to recent spring deposits within the inter-tidal and supra-tidal realms.

Eight water samples were collected using new 250 ml polypropylene containers between the hours of 6:30 am and 10:00 am on the same day. These were refrigerated and sent for analyses within 24 hours of collection. Most of the samples were brownish in color, a few were colorless. A simple analysis was carried out in the Sarawak Shell Berhad laboratory, but these data have not been released for publication to date. Therefore, the results of the analyses are not presented in this paper. Qualitative observations from 2005 onwards were carried out by the senior author on the brown slicks that were seen appearing on the Kampong Sewajaya lake, which is located ca. 7 m above sea level. The preliminary results of the ongoing study are presented here.

RESULTS AND DISCUSSION

Aquifers and Iron Migration

The area south of Miri receives some 5000 – 8000 mm of annual rainfall, which leads to a rapid washout of topsoil layers. As shown in Figure1B, three aquifer layers are observed:

1. Seawater: changing from fully marine to brackish water, and even freshwater depending on the discharge of the Batang Baram; the rapid changes in salinity

Figure 1A: Aerial view of the coastal section SW of Miri. Gently dipping sediments of the Miri and Tukau formations are overlain by terraces and young alluvial sediments upon two unconformities. The cover layer on terraces are often completely bleached, or alternatively, dark coated with iron oxide.

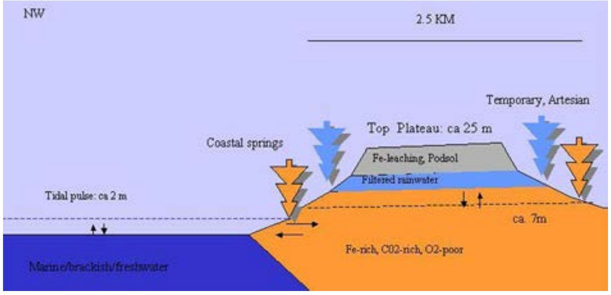

Figure 1B: Simplified coastal NW-SE section, near Kampong Siwak Jaya.

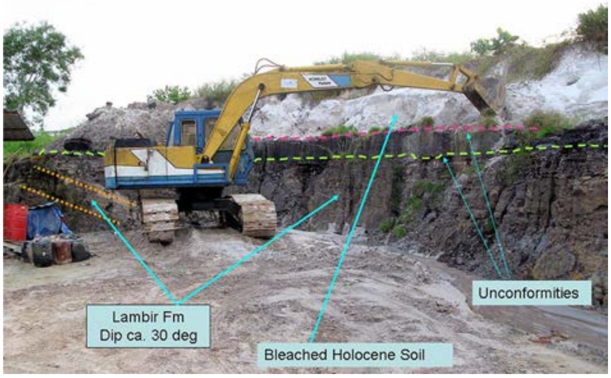

Figure 2: Soil profile as seen in an outcrop of the Sungai Rait valley. The uppermost layer of the profile is formed by white, bleached sand, indicating that all iron content has been removed.

Figure 3: As high-tide approaches, a very thin shiny layer of orange-colored Fe^{3+} minerals forms on the lake's surface. In local folklore, these eruptions of red or orange-colored brines are often called as the 'Blood of the Naga.'

characterize an environment where only few species can survive;

2. A layer of groundwater, low in oxygen and rich in Fe^{2+}; this level is in pressure communication with the marine realm;
3. A shallow layer of very freshwater, the immediate filtrate from rainfall.

It is to be noted that the term artesian is used when groundwater rises in a well above the level where it was initially encountered (Lutgens and Tarbuck, 2006). This in turn can occur when either the aquifer is exposed to the surface at one end or aquitards are present on either side of the aquifer to prevent the water from escaping. In the study area, pressure-confining layers are formed by claystone layers within the Lambir and Tukau formations. However, the described artesian effect is not only caused by stratigraphy, but equally due to incision by river systems, resulting in elongated remnants of plateau that separate the shoreline from the (low-lying) hinterlands. The Fe-laden aquifers belong to these semi-isolated incised plateaus, and respond with an artesian flow-out, as soon as pressure builds up within the aquifer due to the rising tide

Where permeable sandstone is found in a crestal position, podsolization occurs. As shown in Figure 2, the sand in the uppermost meters is often thoroughly bleached. Fe^{2+} sulfides in near-surface black clay-stone beds are oxidized, with iron oxides, and smaller clay particles (coherent clay layers resist better) are being mobilized and removed. The iron could migrate to deeper aquifer levels in a process that is poorly understood in this locality, or be leached out onto surrounding areas, not excluding coastal areas.

Qualitative observations from 2005 onwards showed that at a given time of the day, brown slicks were seen appearing on the Kampong Sewajaya lake, which is located ca. 7 m above sea level. In the last year (2007/2008), a systematic check indicated that the appearance of the Fe-rich slick coincided with the onset of high tide, and was fluctuating with changes in tide-levels everyday. It can be concluded that there is no other known process that could cause this shifting pattern, apart from seasonal fluctuations and rainfall etc.

Observations have shown that the Fe^{2+} rich water layer is hydraulically linked to the fluctuations in seawater levels. Artesian spring activity is seen coinciding with the high tide. As shown in Figure 3, ferric slurry forms every day on the surface of a fishpond on the southern side of the Siwak Jaya plateau. As high tide approaches, tiny platelets of shiny or orange-colored iron oxide precipitates appear on the lake's surface.

Figure 4A: Massive artesian outpouring of oxidized Fe^{3+} precipitate-rich groundwater, as documented here near to the Tusan cliffs, Headlands II area.

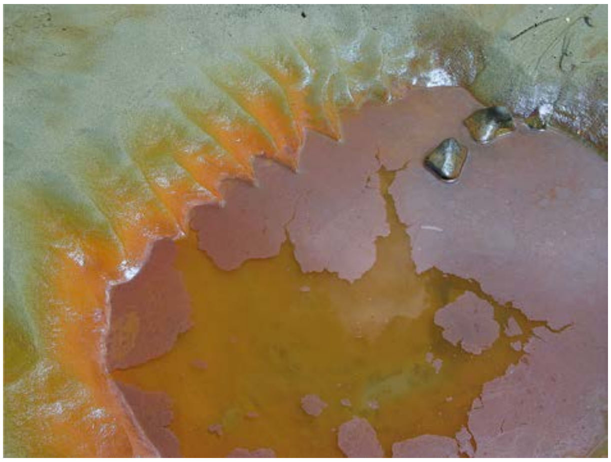

Figure 4B: puddles of artesian orange-colored Fe^{3+} coated groundwater and sediment, inter-tidal zone, near Tanjung Batu.

Simple weight measurements (Fe-slurry water in comparison to clean tap water) indicate that the Fe^{3+} oxide content is in the order of 6 g/liter. If allowed to dry, the voluminous orange precipitate forms a very thin coating of yellow-orange on any substratum, be it sand, wood, stone or even plastic bottles.

In the lake, the orange precipitate floats on the surface. After an hour or two, a gradual color change from orange to dark green is observed, possibly indicating a sudden algal bloom. Fresh orange-coated water is devoid of any smell; the greenish algal derivate, however, emits a strong organic smell (if left to decay in a sample bottle). Three hours later, the layer sinks to the pond's bottom and the surface is clear again. Potentially, this process (extrusion of iron-rich fluids, algal bloom, deposition) could lead to the formation of source rock, although further evidence is required to support this hypothesis. Variations in the color of the slurry indicate compositional changes that could range from metallic bonds to chelated forms.

Massive outpourings of stained groundwater also occur along the coastline, within or above the intertidal zone (Figures 4A & 4B). These waters mix with the incoming tide. Interestingly, the outflow of Fe^{2+} rich

Figure 5A: Layered iron mineral carpets, precipitated recently from iron-rich run-offs in the Tusan/Tanjong Batu area. Iron oxide carpets are typical for the supra-tidal realm, where little or no sediment reworking occurs.

Figure 5B: Small cove near Headland II that shelters pebbles - likely formed from the cave-roof material, or washed in from the vicinity. The brown composite layer is formed by pebbles that are glued together by ferric oxides, precipitating from groundwater seeps in the cave's rear part. Nodular iron-oxide stained conglomerates form in inter-tidal caves: Nuclei are commonly sandstone pebbles originating from the cave's sandstone walls, whilst the iron oxide coatings are reworked precipitates originating from subterraneous iron-laden springs.

fluids is nearly completely independent from precipitation events.

Clear artesian water, however, belongs to the shallowest aquifer, appearing shortly after strong rainfall. No iron-rich deposits originate from these springs.

Contemporaneous Deposits

Iron deposits are either layered (Figure 5A), or concentric-nodular (Figure 5B). Layered deposits are characteristic for the supra-tidal realm, where there is little reworking, and the iron oxides can precipitate quietly and form layered carpets.

Nodular accretions and stained conglomerates, however, are formed in inter-tidal subterraneous caves. The coastline between the Tusan and Peliau beaches

Figure 6: Fe-stained sandstone pebbles and ophiomorpha burrows as seen in the Tanjong Lobang outcrop in Miri, Sarawak. This outcrop (Miri Fm) is of Late Miocene age.

offers a large number of such caves showing a complete sequence of processes: deposition of iron-oxide precipitation; hardening as layers and coatings. Given the rapid contemporaneous erosion of the coastline, such caves are quickly eroded and iron-stained pebbles and broken-up iron-oxide layers are scattered along the beach by long-shore currents for several hundreds of meters, if not kilometers.

Fossil Deposits

The question remains as to how recent Fe-migration and Fe-deposits can be related to similar-looking features of Late Miocene age, found in deposits of the Miri and Lambir formations. These sediments have formed in coastal to shallow-marine settings, and the paucity of fossils (mainly ophiomorpha, occasionally bivalves, absence of echinodermata) suggests a deviation from a steno-haline environment (Figure 6). Interestingly, the sandstone facies of the Miri formation are very rich in Fe-coated sand pebbles, and ophiomorpha burrows are filled by iron oxides. These suggest early diagenetic iron coating, as documented in the recent sediments. Lee and Taib (2006) concluded that the process of fossilization involving replacement by Fe should be very rapid in order to preserve corals as fossils. Similar situations are encountered in the study area where Fe-coating or replacement of fossils appears to occur within 12 months.

CONCLUSIONS

The evidence provided in this paper is supportive of a strong tidal influence on the dynamics of aquifers, and iron mobility in coastal areas. Re-deposition of the Fe in oxidized form could be in combination with other metallic cations, anions or even in chelated forms with organics. The reduction of Fe^{3+} forms to Fe^{2+} forms and subsequent mobility in aquifers, and iron deposits (coated pebbles, filled burrows) could have characterized the facies signature of coastal Miocene rocks, as it does in present-day sediments – possibly serving as a distinct facies indicator. Equally, the above-described processes might be potentially related to the development of source rocks in coastal offshore deposits.

ACKNOWLEDGEMENTS

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MALAM JURUTERA 2008

24 OCTOBER 2008, DEPARTMENT OF GEOLOGY, UNIVERSITY OF MALAYA

REPORT

"Malam Jurutera 2008" featured 2 speakers, namely Sdr. Lee Eng Choy from Emaskiara and Sdr. Chow Chee Meng from G & P.

Sdr. Lee spoke on the electro-kinetic consolidation of soft clay, discussing the theory, processes, instrumentations and actual local case studies on marine clay.

Sdr. Chow discussed challenges in near-shore piling works using the Penang Bridge as example, including some details on geology and soil profiles.

As usual, the talks were followed by various questions and discussions from the floor.

Tan Boon Kong,
Chairman, Working Group on Engineering Geology, Hydrogeology and Environmental Geology

CERAMAH TEKNIK TECHNICAL TALK

FINDING TSUNAMI SOURCE REGIONS IN EASTERN INDONESIA: INTEGRATING GEOSCIENCE AND DISASTER MITIGATION

Ron Harris

Professor of Structural Geology and Tectonics,
Bringham Young University, Provo, Utah, U.S.A.

9 December 2008
Department of Geology, University of Malaya

The technical talk on the above subject was arranged at short notice due to communication problems with Prof. Dr. Harris in the field in Kisar, Indonesia. Nevertheless it attracted an enthusiastic audience of about 20 persons especially geophysicists interested in earthquakes and tsunamis. The talk was delivered at the Department of Geology, University of Malaya on 9.12.08. An abstract of the talk is given below.

Abstract: The ongoing earthquake storm in western Indonesia is not a surprise to those who know the history of mega earthquakes in tsunami in SE Asia. By compiling Dutch records and conducting field studies, we have recently discovered that a similar cluster of events occurred in eastern Indoensia also, along mega thrust faults that are likely near the end of their earthquake cycle. This cycle may also be shortened by stress contagion from the large events over the past few years along the Sunda Arc, which is transitional with the Banda Arc of eastern Indonesia. This talk showed evidence from historical records as far back as 1600 combined with integrated field studies of potential tsunami source regions throughout eastern Indonesia.

Prof. Harris also talked about support for 'In Harms Way', the non-profit organization he has set up to reduce the impact of natural hazards in SE Asia. He was able to visit many communities in heavily populated areas of Indonesia that are at considerable risk. For example, the Padang region of Sumatra is directly offshore from the only major segment of the Sumatra thrust system that has not yet ruptured during the recent earthquake storm. The last time this segment broke was in 1833, which means that it is overdue even more than adjacent segments that have produced mag. 8 earthquakes caused tsunami. There is also a stress contagion effect from these other events on the Padang segment. They fully expect a major event (perhaps as large as a magnitude 9.0) on the Padang segment within the next few years. Indonesian officials say that they have warned government leaders in the region. However, those in harms way are not informed as documented by one of their teams that visited the region this year. They propose to meet with communities in harms way there, including Promuka (scouts in the region). The focus of their efforts will be directed towards education and posting warning signs along the coastline. They will also assist in constructing and practicing an evacuation plan.

Another project they are planning is disaster prevention education in Eastern Indonesia. They have translated and inspected historical records of geological events that were dutifully compiled by the Dutch in the 'Spice Islands' as far back as 1600, These records describe in detail a series of major earthquakes and tsunami in the region that have a recurrence interval of around 150 years. For the past 180 years nothing has happened in the region anything like what occurred in the early 1600's and again in the late 1700's when earthquakes and tsunami destroyed many cities and coastal communities. Now ten times more people live in harms way of these hazards.

They were able to access some islands in this region this year and had tremendous success in "Siap dan waspata" (readiness and awareness) education. No one knew what to do when the ground starts shaking. The most receptive and effective group are the scouts (Promuka) who carried the message home and to school. They also took upon themselves the task of posting warning signs along the beaches.

These two projects bridge the large gap that currently exists between those forecasting geohazards and those affected by them. Never, in the history of the world have we better understood how to prevent natural disasters. At the same time, never have more people been in harms way. Please let him know if you or your company is interested in contributing to their efforts. Please visit: inharmswayhelp.org for more information about the non-profit organization.

Lee Chai Peng

THE MOUNT KINABALU GRANITE OF NORTH BORNEO: RESULT AND CAUSE OF OROGENIC DEFORMATION

Rober Hall

18 December 2008
Department of Geology, University of Malaya

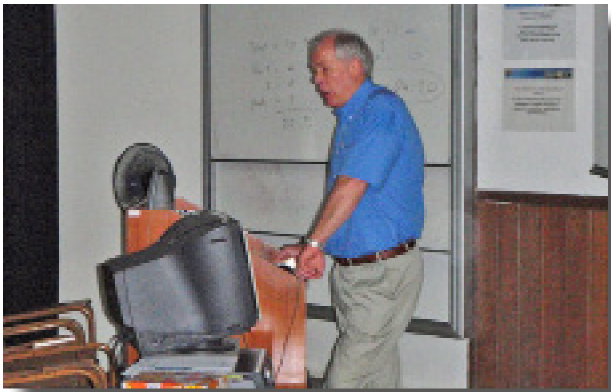
Prof. Dr. Robert Hall is Professor of Geology and Director of the SE Asia Research Group at Royal Holloway University of London. His talk entitled "The Mount Kinabalu granite of North Borneo result and cause of orogenic deformation" was well attended by about 40 geoscientists from the industry and academic. The talk is a joint project by Robert Hall, Michael Cottam and Christian Sperber from SE Asia Research Group, Department of Earth Sciences, Royal Holloway, University of London and Richard Armstrong from PRISE, Research School of Earth Sciences, The Australian National University. The abstract of the talk is given below:

Abstract: Mount Kinabalu is a granite body in north Borneo that intrudes rocks deformed in the Early Miocene Sabah Orogeny following subduction of the South China continental margin beneath the north Borneo margin. It is the highest mountain in SE Asia at 4100m and ice action during Pleistocene glaciations has resulted in excellent exposure of the summit area. It has an unusual position at the end of the mountain range and rises dramatically above the nearby peaks of the Crocker Ranges 2000 m below. The granite has previously been interpreted as a compositionally zoned, steeply sided pluton with a central biotite granodiorite, surrounded by hornblende granite and a marginal porphyritic facies. New zircon U-Pb SHRIMP ages record emplacement and crystallization. Zircon fission track data and apatite (U-Th)/He dates record the development and exhumation of the orogen. The age data with field, petrological and geochemical observations suggest a new interpretation of Kinabalu's structure, emplacement history and links to regional tectonics.

U-Pb SHRIMP analyses of growth zones in zircon record crystallisation of the granite between 7.85 and 7.22 Ma. Age data support models relating the Kinabalu granite to deep crustal anatexis not subduction. Inherited zircon ages suggest melting of deep crust, including South China continental crust and arc basement rocks. SHRIMP dating also provides insight into rates of magmatic processes. The entire pluton was emplaced and crystallised within a period of less than 700,000 years, with at least four pulses of magmatism, each lasting about 100,000 yrs. Zircon fission track data record post-crystallisation cooling but abundant dislocations make apatite fission track data unreliable. Apatite (U-Th)/He ages have a broadly concentric pattern. The thermochronological data indicate cooling of the granite was a response to growth of topography and rapid exhumation of the orogen.

We interpret all these data to indicate that Kinabalu has a sheet-like character with the oldest biotite granite near the summit. The porphyritic facies represents the last and deepest major intrusive pulse. There was significant topographic expression by around 6 Ma with subsequent NE-SW trending extensional faulting on the south side of the body. The unusual tectonic setting of Kinabalu suggests links between granite formation, exhumation, offshore sedimentation and deformation, and the mantle. After Early Miocene collision and emergence much of Sabah subsided and shallow water sediments were deposited over most of the area. Probable Late Miocene emergence of most of Sabah was associated with a change in character of magmatism in South Sabah as well as melting of the deep crust beneath Kinabalu. We suggest the granite is the product of collision-related crust and lithospheric thickening in the Sabah orogeny, but is now itself driving fold and thrust deformation offshore after rapid uplift and exhumation following loss of a deep lithospheric root.

Photographs of Mount Kinabalu curtesy of Prof Dr. Robert Hall.



CHAIRMAN'S LECTURE No. 13

NATIONAL SLOPE SAFETY SYSTEM – AN APPROACH

ABD RASID JAAPAR

17 December 2008, Department of Geology, University of Malaya

Sdr Abd Rashid Jaapar delivered the 13th Chairman's Lecture entitled "National Slope Safety System – An Approach" to an audience of 20 persons. Abd Rasid Jaapar is the Project Manager, Asian Geos Sdn Bhd. He graduated with BSc (Hons) in geology from UKM in 1992. He completed his MSc (Dist) in engineering geology from HKU in 2006 where he won the Halcrow Prize for mark of distinction and overall best student. The same lecture was delivered to the group of consultants and committee members for the National Slope Master Plan led by Kumpulan Ikram Sdn Bhd. The lecture touched on the systematic approach on how to develop a Slope Safety System based on risk management practices. Slope Safety System is a system where any occurrence of slope failure can be considered as a defect to the system.

KEAHLIAN MEMBERSHIP

Ahli Seumur Hidup (Life Member)

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Ahli Penuh (Full Member)

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2. Daphne Yap Yen Yee, No. K/P: 850918-13-5082
3. Alaa M. Baky, Egyptian berkerja di Indonesia
4. Anies Helmy Djamil, No. Paspot: A228791
5. Zul Azmar Aziz, No. K/P: 750222-09-5037

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8. Nurul Baizura Mohd Yunus, No. K/P: 850610-01-5412, UKM
9. Khairul Anuar Alang, No. K/P: 860504-38-7545, University of Malaya
10. Goh Thian Lai, No. K/P: 710526-06-5033, UKM
11. Samy Ismail Mohmed, No. Paspot: 1790773, UPM

PERTUKARAN ALAMAT CHANGE OF ADDRESS

1. Ng Tong San, 22, Jalan Bungor 8, Kaw 6, Bandar Botanic, 41200 Klang
2. Jasmi Abd Talib, Geoscience & Petroleum Engineering Department, Universiti Teknologi Petronas, Bandar Seri Iskandar, 31750 Tronoh
3. Salva R. Seeni, P.O. Box 47, FD Dept (FDD18, RAA), Qatar Petroleum, Doha, Qatar
4. Zahari Lambak, Guthrie Industries Malaysia Sdn.Bhd., Melalap Estate, P.O. Box 205, 89908 Tenom, Sabah
5. Ng Chak Ngoon, Tan Kail Tin, Kong Chi Liang and Marie Tungka, Subsurface Engineering Sdn. Bhd., No. 13, Jalan Anggerik Mokara 31/57, Seksyen 31, Kota Kemuning, 40460 Shah Alam
6. Arul Mani Shanti, Faculty of Civil & Environmental Engineering, Skempton Building, Imperial College London, South Kensington, London SW7 2AZ, U.K

ADDRESS WANTED

1. Radios Hendrartijanto, formely of PT. INCO Tbk-SOROWAKO

Eleventh Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia

Istana Hotel, Kuala Lumpur, Malaysia • 8 – 10 June 2009

GEOSEA 2009

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The Geological Society of Malaysia is organising the Eleventh Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia (GEOSEA 2009) in Kuala Lumpur on 8 – 10 June 2009 to mark the conclusion of the United Nations International Year of Planet Earth, 2007-2009. The Congress offers an excellent opportunity to exchange scientific and technical information and advancement in geoscience, mineral and energy resources among geoscientists. The GEOSEA Congress is a premier geoscientific event in the region and has been well attended by the geoscientific community world-wide. In addition to countries in Southeast Asia, GEOSEA 2009 is expanded to include participation from East Asia, to establish a new era of regional collaboration among geological institutions.

The technical program of GEOSEA 2009 consists four keynote papers and more than 60 technical papers on geoscience and related aspects of the GEOSEA core region of Southeast Asia as well as East Asia. Other related activities include six side events and a post-congress geological fieldtrip. Please refer to the final circular for details on the programme and list of papers (http://geology.um.edu.my/gsmpublic/geosea/geosea_2009.pdf).

Make a note in your diary and join us in Kuala Lumpur for GEOSEA 2009.

For further information and GEOSEA 2009 circular, please contact:

The Organising Committee, GEOSEA 2009
c/o: Minerals and Geoscience Department Malaysia
20th Floor, Tabung Haji Building, Jalan Tun Razak,
50658 Kuala Lumpur, MALAYSIA
Tel: +603-21611033 Fax: +603-21611036
E-mail: geosea2009@jmg.gov.my

UPCOMING EVENTS

December 10-12, 2008: Geo-Chiangmai, focusing on new developments in soil & rock engineering, engineering geology & environmental geotechnique, Chiangmai, Thailand. Contact: GT08-Conference Secretariat, CI-PREMIER P/L, 150 Orchard Road #07-14, Orchard Plaza, Singapore 238841. Tel: +65 6733 2922; Fax: +65 6235 3530; email: cipremie@singnet.com.sg)

December 16-17, 2008: Towards Excellence in Science and Technology: 25 Years of Scientific and Technological Progress with COSTAM, Kuala Lumpur Convention Centre, Kuala Lumpur, Malaysia. Contact: COSTAM Secretariat, c/o Pro-Secretariat Management Services S/B, C3A-10, 4th Floor, Lift No. 5, Damansara Intan, No. 1, Jalan SS20/27, 47400 Petaling Jaya, Selangor. Tel: 603 71182062/4; Fax: 603 71182063; email: secretariat@costam.org.my; website: www.costam.org.my

January 5-30, 2009: Computer Assisted Training in Mineral Resources Development. Sponsorship: UNESCO, Division of Ecological & Earth Sciences. Contact: Ecole Nationale Superieure des Mines de Paris, Centre de Geosciences, 35, rue Saint Honore, F 77305 Fontainebleau cedex, France. Tel: 33164694904; Fax: 33164694711; email: claim@geosciences.ensmp.fr

February, 16-21, 2009: International symposium on efficient groundwater – Thailand 2009 (IGS – TH 2009). Contact: Somkid Buapeng, Chairman, International Groundwater Symposium Thailand 2009, 49 Soi 30 Rama VI Road, Phayathai, Bangkok, 10400 Thailand. Tel: +6622993965-6; Fax: + 6622993926; email: igsth2009secretariat@dgr.go.th

February 22-26, 2009: ASEG 09 Brighter Deeper Greener – Geophysics in a Changing Environment, Adelaide, Australia. Contact: email: aeeg09@sapro.com.au; website: www.sapro.com.au/ASEG/home.htm

February 23-26, 2009: International Conference on Implementing Environmental Water Allocations (IEWA), Port Elizabeth, South Africa. Contact: www.wrc.org.za/events_sa.htm#EWA

February 24-27, 2009: 14th Asia Oil Week: Asia Upstream, Orchard Hotel, Singapore. Contact: Global Pacific & Partners, Laan Copes van Cattenburch 60A, 2585 GC, The Hague, The Netherlands. Tel: +31 70 324 6154; Fax: +31 70 324 1741; email: babette@glopac.com or Amanda@glopac.com or gayle@glopac.com

March 2-3, 2009: Petroleum Geology Conference & Exhibition 2009, Kuala Lumpur Convention Centre, Kuala Lumpur, Malaysia. Contact: Organising Chairman, PGCE 2009, Geological Society of Malaysia, c/o Dept. of Geology, University of Malaya, 50603 Kuala Lumpur. Tel: 603 79577016; Fax: 603 79563900; email: geologi@po.jaring.my; website: www.pgcem.com

March 2-6, 2009: Basic Petroleum Geology. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

March 3-4, 2009: 1st Regional Conference on Geo-Disaster Mitigation in ASEAN: Waste Management Regional Conference 2009: Toward Sustainable in GeoEnvironment, GeoHazard and Waste Management, Kuala Lumpur, Malaysia. Contact: The Secretariat, Organising Committee of 1st Regional Conference on Geo-environmental, Geohazard and Waste Management, Engineering and Technology Research Platform, EITD, Engineering Campus, 14300 Nibong Tebal, Penang, Malaysia. Tel: 604 5942148; Fax: 603 5941037; email: hariy@eng.usm.my; wmrc2009@eng.usm.my; kamarshshariffin@gmail.com; website: http://eitd.eng.usm.my/geoenv2009.htm; http://mineral.eng.usm.my/geoenv2009.htm

March 16-20, 2009: Compressional and Transpressional Structural Styles, Houston, USA. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

March 17-20, 2009: Workshop on water recycling via aquifers, Adelaide, Australia. Contact: email: peter.dillon@csiro.au

March 23-27, 2009: AVO, Inversion and Attributes: Principles and Application, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

March 16-20, 2009: Basic Geophysics, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

March 30-April 3, 2009: Basic Drilling Technology, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

April 19-24, 2009: EGU General Assembly 2009, Vienna, Austria. Session NH11.2: Modelling and simulation of dangerous phenomena and innovative techniques for hazard evaluation, mapping, mitigation. Session NH4.14/HS 11.6: Landslide forecasting. Contact: G. Iovine, Tel: +39 0984 835 521; Fax: +39 0984 835 319; email: g.iovine@irpi.cnr.it . Website: www.meetings.copernicus.org/egu2009

May 4-8, 2009: Mapping Subsurface Structures. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

May 5-7, 2009: 33rd IPA Convention and Exhibition, Jakarta Convention Center. Contact: Indonesian Petroleum Association, Indonesia Stock Exchange Building, Tower !!, 20th Floor, Suite 2001, Jl. Jendral Sudirman Kav. 52-53, Jakarta 12190, Indonesia. Tel: +62 (021) 515 5959; Fax: +62 (021) 5140 2545/6; email: tpc@ipa.or.id; website: www.ipa.or.id/33rd-convention/index.asp

May 11-15, 2009: Structural Styles in Petroleum Exploration. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

May 11-15, 2009: Seismic Acquisition Field Techniques – Theory and Practice, London, UK. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

May 13-14, 2009: 3rd International Workshop and Conference on Earth Resources Technology: Stepping towards Sustainable Mining, Metallurgical, and Petroleum Technology Development. Contact: Dr. Tetsuro Yoneda (email: yonet@eng.hokudai.ac.jp) or Dr. Tsutomu Sato (email: tomsato@eng.hokudai.ac.jp); address: Laboratory of Environmental Geology, A6-16, Graduate School of Engineering, Hokkaido University, Kita 13, Nishi 8, Kita-ku, Sapporo 060-8628, Japan. Tel/Fax: (+81) 11 706 6305

June 1-12, 2009: Exploration and Production Process Basics: Understanding the Petroleum Industry Value Cycle. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

June 8-10, 2009: Eleventh Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia, (GEOSEA 2009), Istana Hotel, Kuala Lumpur, Malaysia. Contact: The Organising Committee, GEOSEA 2009, c/o Minerals and Geoscience Department Malaysia, 20th Floor, Tabung Haji Building, Jalan Tun Razak, 50658 Kuala Lumpur. Tel: 603 21611033; 603 21611036; email: geosea2009@jmg.gov.my

June 15-19, 2009: Petroleum Project Management: Principles and Practices. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

June 29-July 3, 2009: Operations Geology, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

July 13-17, 2009: Development Geology, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

July 13-17, 2009: 18th IMACS World Congress MODSIM 09, Cairns, Australia: Session G3: Modelling and Simulation of Dangerous Phenomena, and Innovative Techniques for Hazard Evaluation. Contact: G. Iovine, Tel: +39 0984 835 521; Fax: +39 0984 835 319; email: g.iovine@irpi.cnr.it . Website: www.mssanz.org.au/modsim09/

July 20-24, 2009: Introduction to Seismic Stratigraphy: A Basin Scale Regional Exploration Workshop, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

July 27-31, 2009: Basic Petroleum Engineering Practices, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

July 27-31, 2009: Advanced Seismic Stratigraphy: A Sequence-Wavelet Analysis Exploration-Exploitation Workshop, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

July 27-31, 2009: Basic Reservoir Engineering, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

August 3-7, 2009: Seismic Imaging of Subsurface Geology, London, UK. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

August 3-7, 2009: Well Log Interpretation, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

August 3-14, 2009: Applied Reservoir Engineering, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

August 10-14, 2009: Shaly Sand Petrophysics, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

August 11-15, 2009: AOGS 6th Annual General Meeting, Singapore. Session IWG01: Modelling and simulation of dangerous phenomena and innovative techniques for hazard evaluation, mapping, mitigation. Contact: G. Iovine, Tel: +39 0984 835 521; Fax: +39 0984 835 319; email: g.iovine@irpi.cnr.it . Website: www.asiaoceania.org/aogs2009

August 17-21, 2009: Sandstone Reservoirs. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

September 7-12, 2009: Sustainable development and management of groundwater resources of hard rock terrains – Joint IAH/IAHS International Convention combing 37th IAH Congress and 8th IAHS Scientific Assembly, Hyderabad, India. Contact: email: iahs@ensmp.fr or w.struckmeier@hgr.de

September 9-11, 2009: VII Forum GEOITALIA 2009, Rimini, Italia. Session B4: Innovative approaches for landslide hazard evaluation and risk mitigation. Session B7: Landslide forecasting. Contact: G. Iovine, Tel: +39 0984 835 521; Fax: +39 0984 835 319; email: g.iovine@irpi.cnr.it.

September 14-18, 2009: Carbonate Reservoirs. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

September 28 –October 2, 2009: Introduction to Offshore Oil and Gas Systems. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

September 28-October 2, 2009: Petroleum Geochemistry: Tools for Effective Exploration and Development. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

October 5-9, 2009: Turbidite Sandstones, London, UK. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

October 5-9, 2009: Structural and Stratigraphic Interpretation of Dipmeters and Borehole-Imaging Logs, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

October 19-23, 2009: Seismic Interpretation, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

October 19-23, 2009: Coring and Core Analysis, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

November 2-4, 2009: Capillarity in Rocks, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

November 9-13, 2009: Basic Petroleum Geology. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

November 9-13, 2009: Wireline Formation Testing and Interpretation, Kuala Lumpur, Malaysia. Contact: Petroskills, P.O. Box 35448, Tulsa, Ok 74153-0448. Tel: +1 918 828 2500; Fax: 918 828 2580; email: training@petroskills.com/ap-enquiries@petroskills.com

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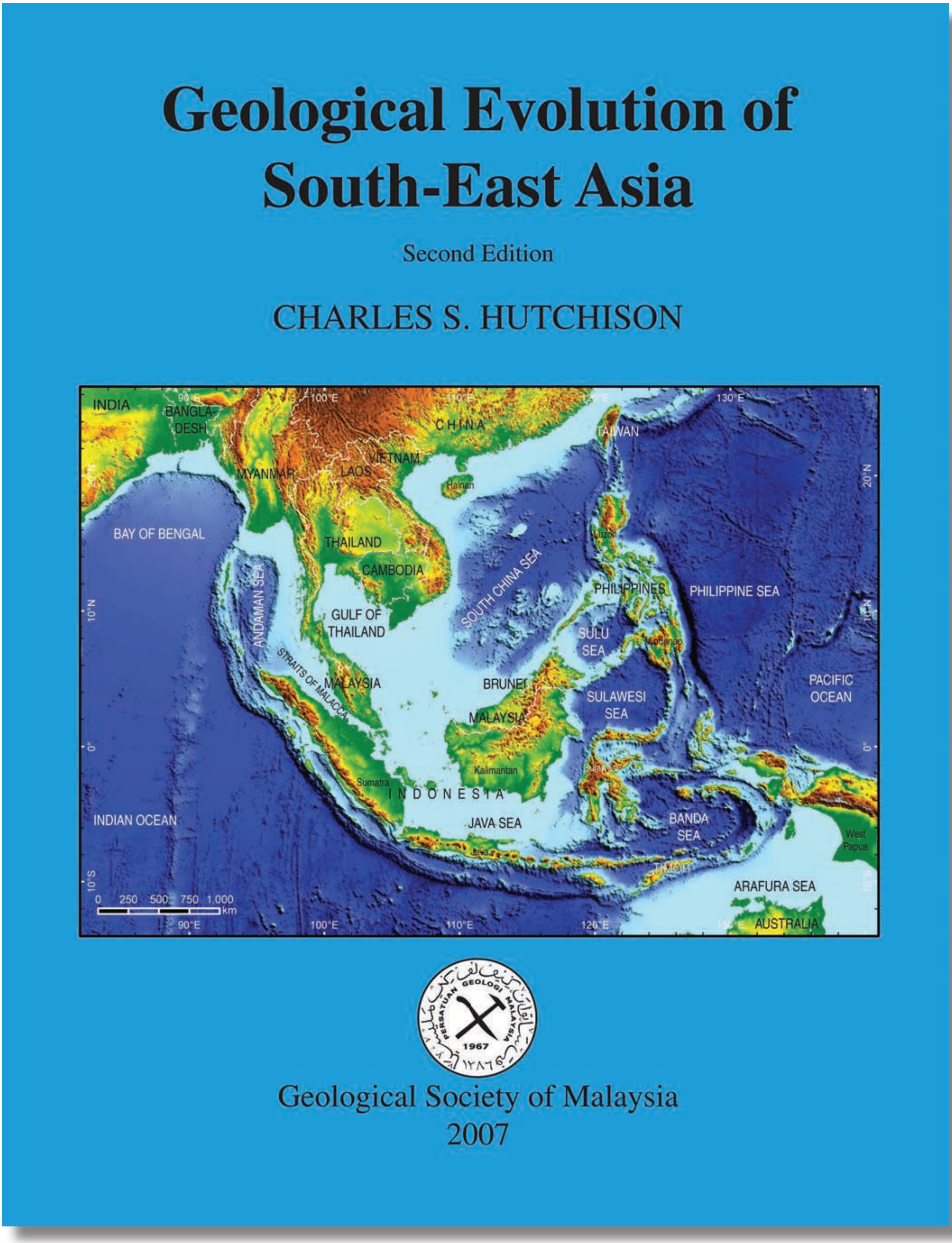
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