PERSATUAN GEOLOGI MALAYSIA
GEOLOGICAL SOCIETY OF MALAYSIA

NATIONAL GEOSCIENCE CONFERENCE 2010

Grand BlueWave Hotel • Shah Alam, Selangor
11 – 12 June 2010

Geoscience for Nation Building

Programme & Abstracts

Co-organiser
Jabatan Mineral & Geosains Malaysia

Collaborators

Institute of Geology Malaysia (IGM)

Universiti Kebangsaan Malaysia (UKM)

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Foreword

Since its establishment in 1967, the Geological Society of Malaysia has been a major contributor to the advancement of knowledge in the geosciences at the national and regional levels. The National Geoscience Conference 2010 (NGC2010) is the 23rd in the annual series of conferences organised by the Society. To foster a closer relationship with the Minerals & Geoscience Department Malaysia (JMG), NGC2010 is co-organised with JMG and will be held back-to-back with JMG's Conference 2010. The Conference is a premier geoscientific event in Malaysia, which is well attended by geoscientists from academia as well as the public and private sectors.

The theme of NGC2010 is *Geoscience for Nation Building*. Geoscience has an important contribution towards the building of a prosperous, safe and sustainable nation. The Earth provides us nearly all the raw materials and energy required for our existence. Research and development of new and innovative techniques has enabled geoscientists to discover these finite resources and manage their extraction in a more sustainable manner. Earth processes are also the source of various geological and climatic hazards that have to be minimised through sound planning to reduce the risk of disasters. Geoscience also provide solutions to pollution of the Earth due to anthropogenic activities.

The scientific programme of NGC2010 consists of 4 keynote, oral and poster presentations. An overwhelming response has been received from various organisations. A total of 92 papers have been accepted for presentation, comprising 48 oral papers and 44 posters. It is expected that the papers will improve our knowledge of geoscience in Malaysia. It is hoped that the presentation will generate fruitful discussion and exchange of ideas among the participants of the Conference.

The NGC2010 Orgainsing Committee gratefully acknowledges all the authors for their contributions, sponsors for their generosity and participants for their support.

Zakaria Mohamad
Organising Chairman

SCHEDULE OF EVENTS

Friday, 11 June 2010		
08:00 – 09:00	Registration	
09:00 – 09:30	Opening Ceremony	
09:30 – 11:00	Poster Session 1 & Tea Break	
11:00 – 11:30	KEYNOTE 1	
11:30 – 12:30	SESSION A1 General & Sedimentology	SESSION B1 Economic Geology
12:30 – 14:30	Lunch / Prayer Break	
14:30 – 15:00	KEYNOTE 2	
15:00 – 17:00	SESSION A2 Engineering Geology	SESSION B2 Economic Geology
17:00 – 17:30	Tea Break	
17:30 – 19:00	Dailogue on the Geologists Act 2008	
19:00 – 22:00	Conference Dinner	
Saturday, 12 June 2010		
09:00 – 09:30	KEYNOTE 3	
09:30 – 10:30	SESSION A3 Geohazards & Geomatics	SESSION B3 Palaeontology / General Geology
10:30 – 11:30	Poster Session 2 & Tea Break	
11:30 – 12:50	SESSION A4 Geomatics & Environmental Geology	SESSION B4 General Geology & Petrology
12:50 – 14:00	Lunch / Prayer Break	
14:00 – 14:30	KEYNOTE 4	
14:30 – 16:10	SESSION A5 Structural Geology	SESSION B5 Geophysics
16:10 – 16:30	Tea Break	
16:30 – 17:30	SESSION A6 Structural Geology	SESSION B6 Geophysics
17:30 – 18:00	Closing Ceremony	

Venue:	Room 1	Room 2

PROGRAMME

DAY 1 – FRIDAY 11 JUNE 2010

08:00 – 09:00	REGISTRATION	
09:00 – 09:10 09:10 – 09:30	**OPENING CEREMONY** Welcoming Address by Prof. Dr. Joy J. Pereira President, Geological Society of Malaysia Opening Address by Y.A.B. Tan Sri Dato' Seri Abdul Khalid bin Ibrahim Chief Minister of Selangor	
09:30 – 11:00	**POSTER SESSION 1** AND TEA BREAK	
11:00 – 11:30	**KEYNOTE 1** **12** Joy Jacqueline Pereira Geoscience in support of climate resilient development	
	TECHNICAL SESSION A1	TECHNICAL SESSION B1
11:30 – 11:50	**PAPER A1** **18** Lee Chai Peng Mass extinctions and global warming: lessons from the past for our present and the future	**PAPER B1** **46** Richard Mani Banda, Alex Unya, Liu Hua & Chen Shick Pei Geology and geochemistry of Bukit Nimong and Selanjan intrusives of West Sarawak, Malaysia - Implications for gold and porphyry copper mineralization
11:50 – 12:10	**PAPER A2** **20** Patrick Gou & Wan Hasiah Abdullah The geochemical fingerprint of the Layang-Layangan Beds, Labuan Island, NW Sabah Basin: Belait or Temburong Formation?	**PAPER B2** **47** Zakaria Endut & Teh Guan Hoe Structural control on quartz veins in the Penjom Gold Mine, in particular at Kalampong Pit
12:10 – 12:30	**PAPER A3** **22** Padmanabhan, E., A.S. Mohd Pauzi, M.S. Masnan, M.A. Mokhtar & M.V. Prasanna Ripple mark styles in the Belait Formation: Implications on depositional history	**PAPER B3** **48** Teh Guan Hoe, Nurul Fatehah & Hazel Hamilson Characterisation of gold mineralisation, Sungai Charah - Cini Timur area, Pahang
12:30 – 14:30	LUNCH / PRAYER BREAK	
14:30 – 15:00	**KEYNOTE 2** **13** Gue See Sew, Wong, Shiao Yun & Cheah, Siew Wai Geotechnical engineering for hillsite development	
	TECHNICAL SESSION A2	TECHNICAL SESSION B2
15:00 – 15:20	**PAPER A4** **23** Tajul Anuar Jamaluddin Ketidaksesuaian kaedah perlindungan cerun – Kajian kes cerun potongan batuan metasedimen terluluhawa tinggi di Malaysia	**PAPER B4** **49** Nurddin, S. M. A. S. M. & Hashim, M Local silica sand deposits and their utilisation in producing cordierite glass-ceramics

15:20 – 15:40	**PAPER A5** **24** Tan Boon Kong The Kuala Lumpur Outer Ring Road: Engineering geology	**PAPER B5** **50** K.K. Cheang Critical mineral characteristics and their applications to the paint industry in the Asia region
15:40 – 16:00	**PAPER A6** **25** Ghani Rafek, A., Goh, T.L., Hariri Ariffin, M., & Baizura Yunus, N. Perbandingan kaedah penentuan kekuatan ricih batuan granit	**PAPER B6** **51** Mat Niza bin Abdul Rahman & Mohd Suhaili Ismail Lime industry in Malaysia
16:00 – 16:20	**PAPER A7** **26** Mohd For Mohd Amin, H.M. Abdul Aziz K.M. Hanifah, Amir Hamzah Mustapha, Edayu Saleh @ Aman Engineering properties of limestone from Pandan Indah, Kuala Lumpur	**PAPER B7** **52** Kamar S. Ariffin, Hayato Kurumi & Akira Imai Rare Earth Elements (REE) resources potential in weathered granitic rocks in Peninsula Malaysia
16:20 – 16:40	**PAPER A8** **27** Ismail Abd Rahim, Sanudin Hj. Tahir & Baba Musta Correlation between Modified Slope Mass Rating (M-SMR) System with lithofacies of the Crocker Formation in Kota Kinabalu, Sabah, Malaysia	**PAPER B8** **53** Sharizan Ibrahim Recovery of gold from gold scrap by hydrometallurgical process
16:40 – 17:00	**PAPER A9** **28** Z. A. Rahman, N. Ahmad, U. Hamzah & W. Z. W. Yaacob Pencirian geoteknik tanah baki granit dan metasedimen tercemar minyak	**PAPER B9** **54** Hamzah Mohamad, Mohd Basril Iswadi Basori & Wan Fuad Wan Hassan An investigation by variable pressure scanning electron microscopes (VPSEM) of primary gold from Selinsing Gold Mine, Pahang, Malaysia
17:00 – 17:30	TEA BREAK	
17:30 – 19:00	**DIALOGUE ON THE GEOLOGISTS ACT (2008)**	
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	TECHNICAL SESSION A3	TECHNICAL SESSION B3
09:30 – 09:50	**PAPER A10** **29** B.K. Lim The need for independent post-survey QC to check the high failure rate of Geohazards Predictions	**PAPER B10** **55** Basir Jasin & Zaiton Harun Early Carboniferous (Tournaisian) Radiolarians from Peninsular Malaysia and their significance
09:50 – 10:10	**PAPER A11** **31** Rodeano Roslee & Tajul Anuar Jamaluddin Kebolehrentanan bencana gelinciran tanah (LHV): Sorotan literatur dan cadangan pendekatan baru untuk pengurusan risiko gelinciran tanah di Malaysia	**PAPER B11** **56** Aye Ko Aung A short note on the discovery of Early Devonian tentaculite-bearing unit from Taunggyi-Taungchun range, Shan State (south), Myanmar
10:10 – 10:30	**PAPER A12** **33** Omar Alkouri & Ros Fatihah Geospatial information system of karst land use evaluation in Kinta Valley, Malaysia	**PAPER B12** **57** Elvaene James, Hamzah Mohamad, Shariff A.K. Omang & Mohd Rozi Umor Singkapan batuan yang tersingkap dari Layang-Layang hingga Laban Rata, Gunung Kinabalu Sabah
10:30 – 11:30	**POSTER SESSION 2** AND TEA BREAK	
	TECHNICAL SESSION A4	TECHNICAL SESSION B4
11:30 – 11:50	**PAPER A13** **34** Mohd Ezwan Bin Dahlan, Mohd Yusop Bin Ramli & Mohd Anuar Bin Ishak Kajian penderiaan jauh kawasan Saratok-Pengajar, Sarawak, Malaysia	**PAPER B13** **58** Kamal Roslan Mohamed Geologi Teluk Kubang Badak, Langkawi, Kedah Darul Aman
11:50 – 12:10	**PAPER A14** **35** Mohamad Abd Manap, Wan Nor Azmin Sulaiman, Mohammad Firuz Ramli, Noraini Surip, & Mohd Armi Abu Samah Application of the Analytical Hierarchy Process (AHP) to groundwater potential mapping in upper part of Langat Basin	**PAPER B14** **59** Dana Badang Geologi dan geomorfologi kepulauan dalam cadangan Geopark Delta Sarawak
12:10 – 12:30	**PAPER A15** **36** Askury Abd Kadir, Angga Pratama Herman, Aminur Rashid Mohd Shariai and Aaron Subash George Physico-chemical behavior of carbonaceous shale at Batu Gajah, Perak: Their problems and mitigation	**PAPER B15** **60** Mohd Rozi Umor, Azman Abd. Ghani & Hamzah Mohamad Geokimia batuan igneus Pulau Pangkor, Lumut, Perak

12:30 – 12:50	**PAPER A16** **37** Enio Kang, M.S., J. Shamshuddin, C.I. Fauziah & M.H.A Husni Occurrence of pyrite in the coastal plains as an evidence for the rise of sea level in the Malay Peninsula during the Holocen	**PAPER B16** **61** Wan Fuad Wan Hassan & Muhamad Hafiz bin Juhari Heavy mineral pattern in stream sediments of Kuala Krai area, Kelantan
12:50 – 14:00	LUNCH / PRAYER BREAK	
14:00 – 14:30	**KEYNOTE 4** **15** H.D. Tjia Earthquake and tsunami threats to the Malaysian shores of the South China Sea	
	TECHNICAL SESSION A5	TECHNICAL SESSION B5
14:30 – 14:50	**PAPER A17** **38** Zuhaini Mohamed & H.D. Tjia Fault patterns in Peninsular Malaysia: Origin and development	**PAPER B17** **62** Haryati Awang & Syahril Amri A.Malek Site investigation using integrated methods of borehole and resistivity imaging for silty soil – A case study
14:50 – 15:10	**PAPER A18** **39** Felix Tongkul & Shariff A.K Omang Active regional fault zones in Sabah, Malaysia	**PAPER B18** **63** Abd Rahim Harun & Abdul Rahim Samsudin Survei graviti untuk kajian morfologi kars di subpermukaan kawasan Lembah Kinta, Perak - Penemuan awal
15:10 – 15:30	**PAPER A19** **40** Zaiton Harun & Basir Jasin Distribution of several thrust faults in Kedah: Implications to the geology of Kedah	**PAPER B19** **64** Ahmad Tajuddin Hj. Ibrahim & Che Noorliza Lat Electrical resistivity imaging to characterize weathered basalt and granite
15:30 – 15:50	**PAPER A20** **41** Mustaffa Kamal Shuib Structural map and multiple deformation episodes of Tanjung Kempit, Endau, Johore	**PAPER B20** **65** Samsudin Hj Taib Electrical resistivity method – An application in site engineering work
15:50 – 16:10	**PAPER A21** **42** Zainal Abidin Jamaluddin, Mazlan Mohamad Zain, Wan Saifulbahri Mohd & Mohd Badzran Mat Taib Kajian geologi struktur kawasan Bukit Tinggi, Bentong, Pahang	**PAPER B21** **66** Nur Islami, Samsudin Hj Taib & Ismail Yusoff High-resolution imaging of the groundwater potentials with geoelectrical resistivity tomography in back fluvial deposit, Machang, Kelantan, Malaysia
16:10 – 16:30	TEA BREAK	
	TECHNICAL SESSION A6	TECHNICAL SESSION B6
16:30 – 16:50	**PAPER A22** **43** Ros Fatihah Muhammad & H.D. Tjia Double impact rings Luat and Bertam, Cenderoh area, Perak	**PAPER B22** **67** Nurul Nabihah Hussin, Che Noorliza Lat & Ahmad Tajuddin Hj. Ibrahim Pemetaan Hidrogeofizik di Pulau Kapas, Terengganu

16:50 – 17:10	**PAPER A23** **44** Jatmika Setiawan & Ibrahim Abdullah Structural geology of Gua Musang Formation in negeri Kelantan	**PAPER B23** **68** Mohammed I. I. Abu-Shariah, Samsudin Hj. Taib, Ismail Yusoff, Ros Fatihah Muhammad & Samsudin Shahid Geophysical techniques for hydrological investigations
17:10 – 17:30	**PAPER A24** **45** Muhd. Barzani Gasim, Mohd. Ekhwan Toriman, Hii Hion Tung & Pan Ia Lun The two seasonals characteristics of Pahang River, Pahang, Malaysia	**PAPER B24** **69** Wan Suriani A Raman & Zuhar Tuan Harith High resolution seismic refraction survey in urban area
17:30 – 18:00	**CLOSING CEREMONY**	

POSTER SESSION 1: 09:30 – 11:00, Friday 11 June 2010

POSTER SESSION 2: 10:30 – 11:30, Saturday 12 June 2010

Notes

ABSTRACTS

Keynote 1

Geoscience in support of climate resilient development

Joy Jacqueline Pereira
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Localised climate projection by the National Hydraulic Research Institute of Malaysia (NAHRIM) indicate a substantial increase in monthly rainfall over the northeast coastal region and a decrease in monthly rainfall in the west coast of Peninsular Malaysia by the year 2050. Simulations of future river flows in several watersheds in the east coast of Peninsular Malaysia indicate increases in hydrologic extremes, i.e. higher high flows and lower low flows when compared with historical levels.

With the onset of climate change, the number of disasters and people affected is anticipated to increase. Climate change is a process that influences all hydrometeorological hazards. Generally, geological hazards are not influenced by climate change. However, landslides and subsidence are to a certain extent influenced by the water table level that is sensitive to rainfall, which is in turn susceptible to climate change. Increases or decreases in water levels of rivers may also have consequences for water quality. Higher and extreme run-offs may result in increased risk of flooding, which in turn heightens the risk of landslide disasters in urban areas. Increased flooding, particularly in areas previously not exposed to the hazards could lead to dispersal of contaminants and toxins into rivers where wastewater treatment plants are overwhelmed. The possibility of circulation of environmentally hazardous substances in surface water where industrial sites and landfills are affected cannot be ignored. The consequences could be disastrous if such risks are not addressed.

In order to achieve sustainable human development, it is necessary to ensure that the planning process includes socio-economic considerations, management of resources and suitability of land, taking into account its potential geohazards and environmental impacts. In addition, the planning process also has to take into account the changing climate and its potential impacts so as to reduce vulnerability and ensure resilience of any proposed socio-economic development project. It would be more cost-effective to take adaptation measures early on, especially for critical infrastructure with long economic life. Current planning of critical infrastructure should take into account adaptation to the impacts of climate change to reduce the risk of disasters.

The issue of climate change and its interplay with the environment is complex, connected and highly variable in spatial and temporal scale. There is also a high level of uncertainty involved. Decision-making in the context of climate change demands an appreciation of the "big picture". The three dimensional spatial and temporal approach of geoscience allows for an appreciation of the "big picture" to address the complex interplay of environmental systems in a changing climate. The use of geoscience expertise, tools and mapping capabilities can contribute to assess the vulnerability of society to catastrophic and insidious hazards, both current and anticipated, in the onset of climate change.

Keynote 2

Geotechnical engineering for hillsite development

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Since the collapse of Tower 1 of Highland Towers on 11th December, 1993 that killed 48 people, both geotechnical engineers and engineering geologists have been put under the limelight. As a result of a shortage of flat or undulating land, housing and infrastructure developments on hilly terrain have become unavoidable. As such, the need for greater understanding of slope management and engineering practices has become more prominent and inputs from engineers and engineering geologist throughout the entire stage of hillsite development has been emphasised.

Improvements in slope engineering and slope management have been noticeable, since the notorious landslide incident in 1993. One of them was the establishment of the Slope Engineering Branch under the Public Works Department (PWD) in 2004, after the rock fall failure at Bukit Lanjan near Kuala Lumpur in 2003 which resulted in a 6 months highway closure. Numerous guidelines on policies for hillsite development were also introduced with more stringent conditions for approval. Furthermore, the introduction of Accredited Checkers in 2007 by BEM for geotechnical designs of hillsite development is also one of the initiatives implemented to improve slope engineering practices and mitigate the risk of landslides.

This keynote outlines the essential elements in slope engineering and management for both soil and rock slopes. The roles and responsibilities of both geotechnical engineers and engineering geologists are also emphasised especially on the importance of design checks and reviews. Furthermore, important considerations for subsurface investigation planning and recommendations on good engineering practices are also discussed. Finally, appropriate systems for construction quality assurance and control (QA/QC) as well as supervision by Design Consultants are recommended together with guidelines on long-term slope maintenance.

Keynote 3

Geoscience for Nation Building: Challenges facing the petroleum E & P sectors

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Our nation's development and prosperity owes much to the petroleum resources under our seas and to the successful management of these resources by our national oil company, PETRONAS. Since its incorporation in 1974, PETRONAS has paid the government about RM336 billion. However, the petroleum exploration and production (E&P) sectors are currently facing challenging times. As recently as July 2008, oil prices hit record highs of over US$147 per barrel. But by December the same year, prices plummeted to below US$40 per barrel amid the worst global recession in decades. E&P industries are certainly facing many challenges. Among the main challenges considered most critical are (i) the high costs (ii) high risk of working in frontier areas, and (iii) inadequate quantity-quality of human capital. Universities, in their effort in trying to support the industry, are also facing a number of challenges. Primarily the challenge that Universities face is trying to meet the demands of the oil industry for skilled graduates. Yet universities are themselves lacking in much needed funding, facilities as utilised within E&P sectors and industry experienced-manpower. Universities need to engage the best brains to teach and should obtain talent worldwide to ensure that the teaching quality is raised. The industry must step forward and work with the universities to attract high-achieving students to petroleum geoscience. The current shortage of geoscientists presents a great opportunity for industry and universities to develop long-term collaboration. Presently UM is embarking further into this with the plan to introduce a new MSc in Petroleum Geoscience (70% research) whereby, as required by MQA, a Board of Study has to be established which is to consist of 5 members from industry and 3 from local higher learning institutions. UM is prepared to expand their facilities and manpower to meet the industry demand to train geoscientists, and is always seeking ways to develop long-term collaboration with industry. We are experiencing many challenges and many more await us.

Keynote 4

Earthquake and tsunami threats to the Malaysian shores of the South China Sea

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The rhombic outline of the South China Sea contains an oceanic portion, a southeastern continental borderland, and the broad continental platform in the west and southwest. Exotic continental blocks occur in the southeast and in the northwest (Fig. 1). Tertiary seafloor spreading that formed the oceanic basin ceased by 15 Ma. This is also demonstrated by the architecture of the Northwest Sabah-Palawan trough as seen on seismic. On the Sabah side of the trough is the leading edge of the Northwest Sabah Overthrust Sheet that comprises Crocker and Trusmadi beds. The NWSOS is overlain by deformed sedimentary sheets produced by gravity sliding on account of active crustal rise of Borneo. Even this gravity tectonics off Sabah has been dormant since the ?early Pliocene or earlier.

(A) Active subduction occurs on the 700 km long east-verging Manila Trench whose earthquakes reach into the order of 7 magnitude. Moderate strength earthquakes in early parts of the 21 century appear limited to regional faults among which are the Tonle Sap (or Mae Ping) end in the Mekong Delta region, the Tubau fault onshore Sarawak, and possibly associated with the Mersing Line, also in Sarawak. Mild earthquakes in Sabah's interior occur in decadal periods. Earthquake-generated tsunami appears limited to tectonic activity of the Manila Trench. Recent simulations indicate that the Sabah and Sarawak coasts could experience tsunami heights of 2 metres within 3.5 to 4 hours of a strong event in the trench (Liu *et al.,* 2007). Arrivals of less than 0.5 m tsunami amplitudes on the east coasts of Peninsular Malaysia are predicted to take more than 6 hours after strong events at the Manila Trench (Ruangrassamee & Saelem, 2009).

Potential, non-tectonically generated tsunamis in the South China Sea comprise (B) large-scale collapse of marine-based volcanic bodies, (C) extensive marine slides, and (D) impacting extraterrestrial bodies.

(B) Active cataclysmic volcanism in the region is exemplified by the 1883 caldera-formation of the Krakatau volcano in Strait Sunda. A kilometre high volcanic island exploded and collapsed into a 250-metre deep caldera. The ensuing tsunami on the coasts of Lampung (South Sumatera) and Banten (West Jawa) reached highs exceeding that of coconut trees and 36 000 lives were lost. The greater effect of that tsunami projected itself into the Indian Ocean. The shallowness of the Sunda Shelf appeared to have substantially reduced the tsunami reach, as Batavia (old Jakarta) only a hundred kilometres away from the caldera recorded sealevels not more than 4 metres higher above normal. Kusumadinata *et al*. (1979) summarised results of historical studies of the Krakatau group. Other active insular volcanoes in the region are in the Babuyan group to the north of Luzon, the Ile de Cendres off the Mekong Delta that erupted in 1923, and the extremely active volcanic Sangir Islands in northern Maluku. Explosive volcanoes commonly develop sector grabens or baranccos (Fig. 2). Large sector grabens will almost instantaneously displace large water volumes.

(C) Off the coasts of Brunei and southwest Sabah, 3D seismic records an extensive submarine slide covering an area of ~5300 km2, average thickness of 240 m, involving a sedimentary volume of 1200 km^3. The slide extends from the land limit of 200-m deep sea floor to the floor of the NW Sabah Trough (McGilvery & Cook 2004). The slide involves the top of the sedimentary sequence and thus indicating a very recent event. In the same region, multiple late Miocene-Pliocene mass movements have earlier been identified by Levell & Kasumajaya (1985). Repeated slumping has been mapped in a 1.5 to 2 km thick sedimentary sequence and is associated with slump scars aligned over a total distance of 150 km along a regional faulted basin edge. The authors attributed the mass movements to either one single event or a series of events over a short time period. Figure 3 is a fragment of a SE - NW regional seismic line that shows about 2 seconds TWT of mass disturbance at the late Miocene-Pliocene level offshore western Sabah. Post-Miocene instability in the region can be attributed to incremental uplift the Sabah land area (Wilford 1968) and regional tilting seaward (Tjia (1983).

(D) In less than a decade of investigation of extraterrestrial signatures in Malaysia, about half a dozen sites with compelling evidence have been established (Fig. 4). Ring-like topography (two associated with subsurface depressions in Langkawi), shock metamorphic effects in quartz associated with circular topography; impact breccia (suevite), silica-melt bodies occurring as isolated bodies in the target host rock, fragments of iron-rich stony meteorite are among the indicators. To date, most of the impact sites have been discovered in the pre-Tertiary basement of Peninsular Malaysia. Diameters are less than 5 km. However the largest multi-ring topography, 65 km across, is contained in the Palaeogene sedimentary sequence of Sabah in the Marak Parak area. The number of impact sites established in such relatively short period of study in the land area of Malaysia suggests many more

impacts of extraterrestrial bodies should have occurred in the greater vastness of the South China Sea region. Impact events are not (yet) predictable, but significant tsunamis generated by meteorites falling into the waters of the South China Sea can be expected to occur.

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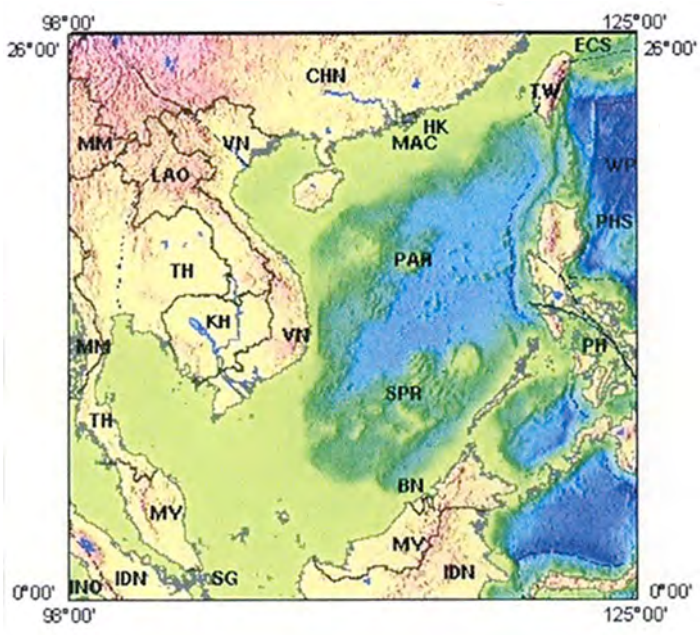

Figure 1: Bathymetry of the South China Sea region. Oceanic depth is in blue. Some of the abbreviations explained: HK Hongkong, MAC Macau, PAR Paracel exotic block, SPR Spratly exotic block, BN Brunei Darussalam, MY Malaysia,, PH Philippines, VN Vietnam.

Figure 2: Barranco or sector graben, a common feature on explosive stratovolcanoes. An extinct or dormant volcano, Gunning Seraya, located in line with active volcanoes in Bali; to its west are the Agung volcano and the Batur caldera. Indonesia. At its widest the Seraya barranco is 2.5 km. Fragment of Bali-Indonesia map by Studio Satumata (2005).

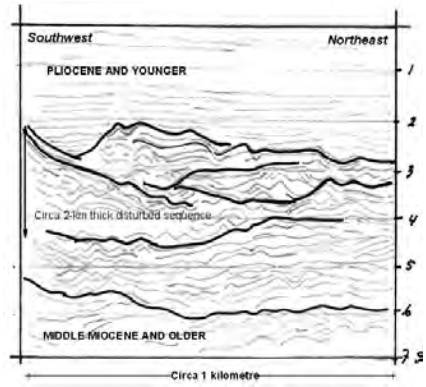

Figure 3: Southwest - Northeast regional geoseismic section offshore and parallel to northwest Sabah shoreline showing late Miocene-Pliocene slump masses about 2 TWT s thick (TWT: two-way-time in seconds; here corresponding to approximately 2.5 km thickness).

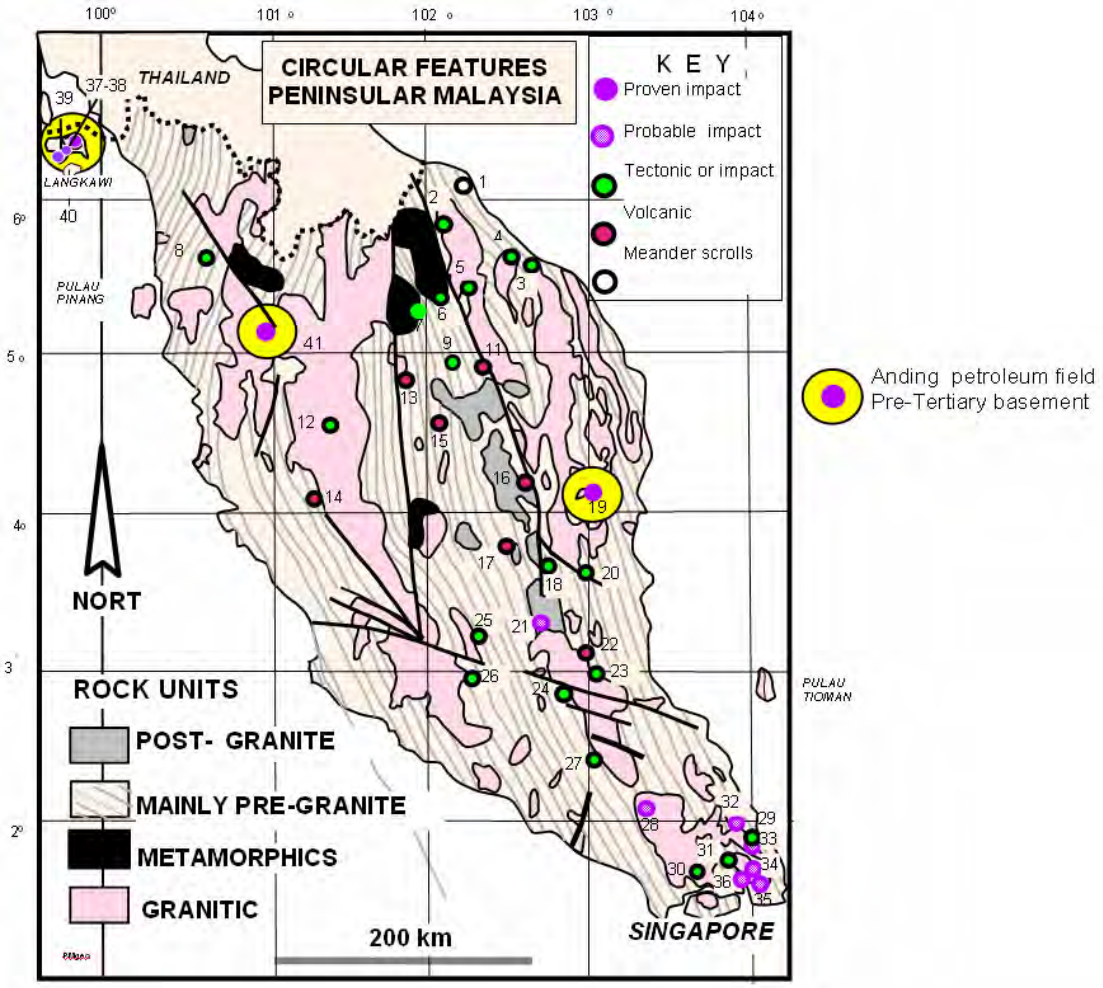

Figure 4: Occurrences of established meteorite impact sites in Peninsular Malaysia. Five ring structures in Langkawi represent one serial impact event. Langkawi serial impact sites (37, 38, 39). Luat-Bertam impact sites (41). Bukit Paloh ring (19). Pre-Tertiary basement of Anding field, offshore Kuala Dungun.

Paper A1

Mass extinctions and global warming: lessons from the past for our present and the future

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A lot has been written of late about global warming or climate change that is linked to anthropogenic activities like burning of fossil fuels and destruction of natural carbon sinks by deforestation. An Intergovermental Panel for Climate Change (IPCC) was set by the United Nations in 1988 to assess the scientific information relevant to human-induced climate change and make recommendations for mitigation and adaptation to cope with its predicted damaging effects. The most significant contributor to global warming was attributed to the rapid rise of greenhouse gases, especially carbon dioxide and methane, generated by anthropogenic activities since the beginning of the industrial evolution. Some detractors deny this and say that it is global warming that is leading to the higher concentrations of greenhouse gases and not the other way round.

Climate modellers came to the fore with powerful computer simulations to create scenarios both local and global on what would be the possible effects for every degree of rise in average global temperature of the Earth. Most climate models stop at 5^{o}C and beyond that we have to peer into the past and get our clues from what can be inferred from looking at life on Earth in those geological periods when global temperatures were higher than that at present (Lynas, 2008).

Five major mass extinctions have been detected in the Phanerozoic record of life in the past. They had been attributed to various causes that could roughly be grouped into either earthbound eg. glaciation, sea level change, volcanism and oceanic current disruption, or extraterrestrial eg. supernova radiations and bolide impacts. These mass extinctions occurred at the end of the Ordovician, Devonian, Permian, Triassic and Cretaceous (Raup & Sepkoski, 1982). Other less severe and more limited mass extinctions were also detected in the geological record such as at the end of the Jurassic and the Paleocene-Eocene boundary.

Global warming associated with greenhouse gases release had not been considered a prominent contributor until more recently. Chief amongst these are the warmer periods in the Earth's past icluding the Cretaceous, the Jurassic and the end-Permian. The longest lasting greenhouse episode occurred during the Cretaceous where global temperatures were on average 10 to 15^{o}C higher and sea-levels were 200 m or more higher than today's reducing the land surface exposed to about 80% of what exist today (Skelton, 2003). Dinosaurs and alligators roamed the palm forests that grew up to Alaska in an ice-free Earth. Massive thicknesses of chalk were deposited in the warm shallow seas that covered much of the drowned land. The earth was sequestering a lot of carbon dioxide in the lush forests and chalky shells of marine plankton in response to the warming Earth. The presence of giant tempestites, however, tells of intense storms that left big hummocks (Ito et al., 2001) on the ocean floor that tells tales of ferocious hurricanes that were most intense when temperatures were highest in the mid-Cretaceous when carbon dioxide and greenhouse temperatures peaked. The pump was primed for the end-Cretaceous mass extinction as few of the ecosystems we know could survive the extreme temperatures for too long. This was mitigated because many of the plants and animals of the Cretaceous world had a long time to adapt to such high temperatures.

While the greenhouse effect was spread out over a long period in the Cretaceous, the better analogue for the rapid rise in global temperature would be the Palaeocene-Eocene thermal Maximum (PETM) event , that like other warming spikes always seem to be associated with deposition of anoxic black shales indicative of "ocean anoxic events' or OAEs (Jenkyns, 2003). A chief suspect of such catastrophic killing of the oceans is the release of methane hydrates (Kerr, 2000) that warm the climate so severely that the oceans cease to turn over properly leading to oceanic desertification. Severe rainstorms and desert sandstorms in a warmer world could also transfer extra amounts of nutients from land to fertilise the oceans leading to worldwide algal blooms that poison the ocean.

The biggest OAE took place in the Jurassic when carbon dioxide concentrations leap to 1,000 ppm in the atmosphere pushing global temperatures to 6^{o}C. It lead to the biggest mass extinction of the Jurassic-Cretaceous period apparently caused by hot volcanic magma intruding into ancient coal seams across thousands of kilometers of southern Africa (Svensen et al., 2005) to release greenhouse gases that accelerated global warming to strip the oceans of oxygen and killing their inhabitants.

The most devastating mass extinction was the end-Permian that wiped out over 95% of species living both on land and in water at that time. Carbon and oxygen isotope studies across the P-T boundary revealed that there was a very rapid warming of no less than six degrees that changed the Permian world from one that was full of life to a nearly lifeless one within about 10,000 years. The discovery of anomalously abundant soil materials washed into marine deposits in Italy (Sephton,2005) and elsewhere together with a signature 'fungal spike' (Visscher et al., 1996) indicated deforestration that left the land bare (Benton, 2003) with proliferation of fungus on rotting vegetation in

the great die-off were caused by desertification as temperatures rose in tandem with carbon dioxide concentrations that reached four times higher than today's (Kidder and Worsley, 2004). It was boosted by a massive injection from the great outpouring of the Siberian flood basalts that also put poisonous sulphur dioxide and nitrous oxides into the atmosphere that came down as acid rain and wiped out many marine organisms drastically affecting the food chain . Oxygen levels dropped to 15% (Weidlich, 2003) killing off many larger land animals while global warming released an estimated 9,000 billion tonnes of methane from unfrozen gas hydrates into the atmosphere. The methane cloud could have been ignited to produce a fuel-air explosive effect (Ryskin, 2003) that nearly destroyed all terrestrial life on Earth. Methane at very high concentrations of 5,000 times background level in the end-Permian together with hydrogen sulphide from rotting organisms, could have destroyed the protective ozone layer allowing deadly UV radiation to bathe the Earth causing harmful mutations (Visscher, 2004). This was followed by a distinct 'coal gap' in the early to mid-Triassic showing that only sparse vegetation survived after the end-Permian extinction. It took 50 million years for the Earth to recover to the level of pre-extinction biodiversity from the disaster.

A sixth mass extinction is occurring at present and attributed to the destructive input from the human race hence its name the Anthropocene Mass Extinction. This extinction was already underway independent of global warming. Our very destructive species has pushed many plants and animals into extinction with our wanton destruction of the organisms and their habitats forcing more and more of them onto the margins of survival so that just moderate climatic changes will be sufficient to push them over the brink. Anthropogenic carbon dioxide release is at least a hundred times faster than the fastest rates of volcanic outgassing in the past. There would not be time for lifeforms to adapt and the tipping point might be just round the corner.

What can be done to put the brakes on anthropogenic global warming and how much time do we have to do it? Lynas (2008) has helpfully summarized the CO2 targets we must achieve for the different degrees of warming we aim for in table form (Table1). The way to do it that he advocates is following Robert Socolow and Steve Pacala's (2004) "knocking in wedges" strategy that proposes that we do more with what we are already doing in the different wedges of fighting greenhouse gases emissions to achieve the targets necessary to give us a fighting chance of putting the brakes on global warming. We can fight but I'm not sure we can win.

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Table 1: Projected temperature rise based on carbon dioxide concentrations and actions needed to achieve the targets (after Lynas, 2008).

Degree change	Actual temperature	Action needed	CO_2 target
One degree	0.1 – I.0°C	Avoidance probably not possible	350 ppm (today's level is 380 ppm)
Two degrees	1.1 – 2.0°C	Peak global emissions by 2015	400 ppm
Threshold for carbon cycle feedback?			
Three degrees	2.1 – 3.0°C	Peak global emissions by 2030	450 ppm
Threshold for Siberian Methane feedback?			
Four degrees	3.1 – 4.0°C	Peak global emissions by 2050	550 ppm
Five degrees	4.1 – 5.0°C	Allow constantly rising emissions	650 ppm
Six degrees	5.1 – 6.0°C	Allow very high emissions	800 ppm

Paper A2

The geochemical fingerprint of the Layang-Layangan Beds, Labuan Island, NW Sabah Basin: Belait or Temburong Formation?

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Labuan Island is located within the NW Sabah Basin of Northwest Borneo and consists of Tertiary sediments. The island itself is one of the many narrow anticlines in the area that are separated by broad synclines, believed to be formed by syn-sedimentary deformation since the Middle Miocene. The axis of the Labuan anticline plunges to the north.

For decades, the Layang-Layangan Beds that underlie the basal conglomerates of the Belait Formation in the northern part of Labuan Island have been a subject of debate. At present, the camp is mainly divided into two. The opinion that the Layang-Layangan Beds are part of the Temburong Formation (see Lee, 1977; Madon, 1994) is mainly based on its position beneath the Lower Miocene Te5 unconformity (after Brondijk, 1962). Others view that they are part of the Belait Formation (see Wilson, 1964; Albaghdady *et al*., 2003). The study by Lee (1977) noted that the lack of fossils in the Layang-Layangan Beds is indicative of Belait Formation. An older study by Liechti *et al*. (1960) puts the Setap Shale instead of Temburong Formation beneath the Belait Formation.

Limited data from a previous geochemical study on the Miocene sediments on Labuan Island (Albaghdady *et al*., 2003) indicate that the Layang-Layangan Beds have more similarities to the Belait Formation instead of the Temburong Formation. This is based on several maturity parameters derived from the GC-MS (gas chromatography-mass spectrometry) analysis of rock extracts.

This study emphasises the geochemical approach used to characterise the Layang-Layangan Beds when conventional sedimentological, stratigraphic and field observation data is inadequate to address the ambiguity between the Temburong and Belait Formations. Saturated hydrocarbon fractions from outcrop rock samples from the Northwest Borneo area, including Labuan Island were analysed using GC-MS in order to produce geochemical fingerprints of the various geological units. Vitrinite reflectance measurements were also made to complement the GC-MS data. Analysis results of the Setap Shale Formation from nearby Klias Peninsula and Lawas were integrated for comparison purposes. Data from the previous geochemical analysis of Labuan samples by Albaghdady *et al*. (2003) were added to the current dataset for a more comprehensive analysis. In total, 29 samples were included covering various lithologies, i.e. shales, mudstones, siltstones, coals, and carbonaceous/coaly sandstones and shales.

Maturity-related geochemical parameters that have minimal influence from the type of source were selected to describe and characterise the Layang-Layangan Beds. Carbon preference indices (CPI), isomerisation ratios of C_{31}- and C_{32}-hopanes, C_{30}-moretane/C_{30}-hopane ratios and vitrinite reflectance (%Ro) plotted onto star diagrams clearly indicate the differences between the Belait and Temburong Formations. This in turn made it more obvious and easier to assign the Layang-Layangan Beds into the Belait Formation, based on these geochemical parameters alone.

In addition to that, it is noted that the Kiamsam Series has a geochemical profile similar to the Setap Shale Formation, although the available data is not complete. This is in agreement with the recent findings of Abdullah *et al*. (2009) that highlighted the similar thermal maturities of the Kiamsam Series and Setap Shale Formation (vitrinite reflectance values are between 0.55 and 0.60%). The Temburong and Setap Shale Formations (including the Kiamsam Series) are quite similar to a certain extent. Only the Temburong Formation samples are within the oil generation window (vitrinite reflectance ranging from 0.68 to 0.80%), while the Belait and Setap Shale Formations are mostly immature (vitrinite reflectance ranging from 0.43 to 0.61%). This is consistent with the isomerisation ratios of the C_{31}- and C_{32}-hopanes.

This study is an example of a simple but successful application of geochemical data to support and aid the identification and classification of geological units in outcrop studies. Such a workflow should be considered when conventional lithostratigraphy methods do not work well, particularly when working in areas where the sediments appear similar in outcrops and depositional facies vary abruptly.

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Paper A3

Ripple mark styles in the Belait Formation: Implications on depositional history

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The Belait Formation comprises alternating sandstones, sand and clays in varying proportions and thickness and is believed to have been deposited as an isolated basin infilling oscillating between littoral and deltaic-paralic type. Ripples are occasionally encountered in this Formation. However, there is a lack of information on the kind of ripples present and the link between the ripples and the associated flow dynamics within the Belait Formation. This information is extremely useful for a better understanding of the formation of these sedimentary basins especially for the oil and gas industry.

Therefore, the main objective of this study was to evaluate the ripple marks occurring in an outcrop belonging to this Formation. The specific objectives were to ascertain the origin of these marks, to estimate the principal flow directions and to link the characteristics of the ripple marks to the flow characteristics.

Approximately 800 measurements of ripples were made at this outcrop along three vertical transects. Ripples are generally asymmetrical in cross section and the ripple indices are inconsistent throughout the outcrop. The ripple indices show temporal and spatial variations within and between strata. The majority of the ripples have sinuous in phase patterns. A few strata at the top of the outcrop exhibit linguoid patterns. Principal flow directions as assessed from the ripples were NE or SE.

All strata have fine sand texture. The quartz grains are subrounded and do not exhibit any preferred orientation. Interstitial spaces are filled with iron-oxyhydroxides. Taking into consideration the mean particle size in each strata, the estimated mean flow velocity in a unidirectional sense would be about 0.3-0.4m/s under laminar flow conditions. Evidently, there has been no appreciable increase in this flow rate as there are no evidences of planar stratification in the field.

The change in the flow direction is non-systematic from a temporal perspective. These changes appear to be linked to the meandering nature of the large channel. The study also shows that the Belait Formation has a complex depositional history at the micro and meso-scales of observation.

Paper A4

Ketidaksesuaian kaedah perlindungan cerun – Kajian kes cerun potongan batuan metasedimen terluluhawa tinggi di Malaysia

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Kebanyakan cerun potongan pada batuan terluluhawa di Malaysia dilindungi dan distabilkan dengan kaedah pepaku tanah (*soil nails*) dan konkrit semburan (*shotcrete* atau *gunite*) serta jaring keluli (*steel mesh*). Kaedah perlindungan cerun sebegini sering digemari oleh pemilik dan jurutera cerun kerana agak mudah dan cepat dibina, walaupun tidak semestinya murah. Namun demikian, pengalaman menunjukkan bahawa struktur perlindungan cerun ini banyak yang gagal, hanya selepas beberapa tahun dipasang. Kegagalan struktur ini antara lainnya berpunca daripada ketidaksesuaian rekabentuknya kerana kurangnya kefahaman tentang kelakuan geomekanik jasad batuan, proses-proses geologi yang berkaitan dan faktor-faktor geologi yang mempengaruhi kestabilan cerun metasedimen yang terluluhawa tinggi.

Di Semenanjung Malaysia, formasi batuan metasedimen lazimnya terdiri daripada batuan syis, filit, sabak dan metakuarzit; berusia sangat tua (Palaeozoik Atas) dan tersebar meluas terutama di Pantai Timur Semenanjung Malaysia serta wujud sebagai pending bumbung di atas jasad batolith Granit Banjaran Utama. Batuan-batuan ini lazimnya berfoliasi, terkekar, terlipat, tersesar dan tericih hebat. Jasad batuan yang sememangnya telah terluluhawa tinggi, jika terdedah ke permukaan akan terurai dan terluluhawa dengan lebih cepat lagi. Penguraian dan penyepaian batuan juga diburukkan lagi oleh faktor pelepasan tegasan (*stress relieve*) apabila bebaban tanah penutup dialihkan seusai kerja-kerja pengorekan dan pemotongan cerun. Kedudukan geomorfologi cerun juga mempengaruhi proses penyepaian jasad batuan ini, terutamanya jika tertakluk kepada pergerakan rayapan. Bahan pembentuk cerun masih boleh terus terluluhawa di belakang lapisan semburan konkrit, hanya dengan kehadiran air yang berpunca daripada resipan dari bahagian atas cerun bukit. Lapisan konkrit itu sendiri, walaupun tegar, bukan jaminan suatu struktur yang tahan lama kerana ia juga terdedah kepada tindakan luluhawa. Dengan rekabentuk sokongan pepaku tanah yang tidak memadai, ditambah pula dengan kelemahan pada sistem saliran cerun, keseluruhan struktur perlindungan cerun boleh gagal secara mengejut kerana peningkatan tekanan air liang dan tegasan ricih cerun.

Kesimpulannya, struktur semburan konkrit dan pepaku tanah tidak boleh dianggap sebagai suatu struktur perlindungan cerun yang muktamad terutama untuk cerun potongan dalam batuan metasedimen terluluhawa tinggi. Cerun potongan pada jasad batuan metasediemn terluluhawa memerlukan struktur perlindungan cerun yang mempunyai ciri-ciri khas. Diantaranya ialah boleh memerangkap bahan-bahan yang tersepai dari muka cerun akibat penguraian jasad yang berterusan. Bersifat sedikit fleksibel dan tidak terlalu tegar (rigid), mampu menanggung beban yang besar dan boleh menyalirkan air secara bebas daripada jasad cerun serta membenarkan tumbuh-tumbuhan hidup secara semulajadi di atas muka cerun. Struktur yang dimaksudkan ini ialah gabungan struktur jaringan keluli (*wire netting*) dan jaringan kabel (*cable netting*) yang diikat ke jasad cerun dengan pepaku tanah atau bolt batuan.

Paper A5

The Kuala Lumpur Outer Ring Road: Engineering geology

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The Kuala Lumpur Outer Ring Road (KLORR) has been planned for easing traffic congestion in the Kuala Lumpur area. Various options for the KLORR route alignment have been looked into. The route studied cuts across the Klang Gates Quartz Ridge in the vicinity of the Klang Gates Dam, and two options for this crossing have been examined, namely: Option 1 (viaduct) versus Option 5 (tunnel). A comparative study of these two options was conducted, and the results of this study are shown in Table 1. Based on the results in Table 1, the viaduct option (Option 1) is selected/recommended.

Additional notes on the geology/engineering geology of the KLORR project include:

i) the northern section of the KLORR project area is underlain almost entirely by Granite. Vein quartz protrudes above the granite in the form of the prominent Klang Gates Quartz Ridge.

ii) the Klang Gates Quartz Ridge represents a strand of the Kuala Lumpur Fault Zone. The faults are inactive.

iii) the geological constraints and geohazards include slope instability/landslide, rockfall, and problems associated with tunnelling and viaduct construction.

Table 1: Comparison of tunnel (Option 5) versus viaduct (Option 1).

FACTOR	TUNNEL	VIADUCT
Slope Instability	minor, at portals only	major, esp. from colluvium
Rockfall	minor, at portals only	major, esp. from quartz ridge
Construction Difficulties	high degree of difficulties, esp. in quartz ridge; progress slow.	less difficult; progress faster
Blasting	required; heavy blasting in quartz ridge	not required
Damage to Dam	possible, from blast vibrations	no blast damages
Reservoir Leak	potential leak from blast-induced fractures (disastrous)	no leak
Environmental Impact	noise/ground vibrations during construction; none after construction	minimal during construction; none after construction
Scenic View	none (long black hole)	scenic view after opening of highway (reservoir & ridge)
Security Concern for Dam	none/minimal (unless someone blows up the tunnel near the dam)	some concern since highway flies over the dam/reservoir
Cost	high, esp. tunnelling in quartz ridge	significantly lower

Paper A6

Perbandingan kaedah penentuan kekuatan ricih batuan granit

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Penentuan kejelekitan dan sudut geseran dalaman bahan batuan lazimnya dilakukan dengan ujian tiga paksi. Sebagai pilihan ujian ricih terus keatas bahan batuan juga dapat menghasilkan nilai kejelekitan dan sudut geseran dalaman. Syor yang dikeluarkan oleh *International Society for Rock Mechanics (*ISRM, 1981), menjelaskan pengaruh tegasan terhadap nilai kekuatan ricih yang diperolehi semasa ujian dijalankan, khususnya pada nilai tegasan normal yang rendah. Dengan mengambilkira perkara-perkara ini dan kemampuan peralatan ricih sedia ada yang hanya dapat membekalkan tegasan normal yang agak rendah, tiga pendekatan digunakan untuk penentuan kekuatan ricih batuan granit. Yang pertama adalah berdasarkan ujian ricih terus di makmal terhadap bahan batuan. Pendekatan kedua dan ketiga adalah berdasarkan syor Goodman, di mana untuk pendekatan kedua nilai purata kekuatan mampatan sepaksi dan kekuatan regangan digunakan untuk membina sampul Mohr-Coulomb, manakala dalam pendekatan ketiga kekuatan mampatan sepaksi dan tiga kali ganda kekuatan regangan digunakan untuk pembinaan sampul Mohr-Coulomb. Ketiga-tiga hasil juga dibandingkan dengan nilai yang dilaporkan dalam literatur, seperti oleh Hoek & Bray (1981) dan Goodman (1989).

Berdasarkan ujian ricih terus di makmal keatas batuan granit segar, nilai purata kejelekitan, C adalah 7.3 MPa dengan sudut geseran dalaman, Φ mempunyai nilai 68.3°. Untuk pendekatan kedua, masing-masing nilai purata adalah C = 15.5 MPa dan Φ = 59.0°, manakala bagi pendekatan ketiga nilai purata tersebut ialah C = 24.0 MPa dengan Φ = 43.2°. Goodman melaporkan nilai C = 55.1 MPa dengan Φ = 47.7 - 51° untuk granit, manakala Hoek & Bray melaporkan nilai C berjulat antara 35 – 55 MPa dengan Φ berjulat antara 35 – 55°. Keputusan dan penilaian ini menunjukkan bawah kekuatan ricih bahan batuan bersifat dwilinear dan tegasan normal berperanan penting dalam penentuannya. Untuk kes sebenar, tegasan normal yang akan tertindak perlu diberi perhatian dalam pemilihan nilai yang sesuai.

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Paper A7

Engineering properties of limestone from Pandan Indah, Kuala Lumpur

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An elevated intersection has been proposed along MRR II at Pandan Indah, Kuala Lumpur. Relevant properties of the *in situ* bedrock are required for the design of this major structure. For this purpose, various types of laboratory test were conducted that include uniaxial compression, Brazilian, point-load and ultrasonic velocity. The tests were conducted on samples collected from 3 locations, Site S1, S2 and S3, at the proposed site. More than 500 fresh (Grade I) rock samples were tested. In the compression test, axial and radial strains of the samples were measured for the determination Young's modulus (E) and Poisson's ratio (υ). Effect of moisture on compressive strength was also investigated by testing saturated samples. The test results show the compressive strength (UCS) of Limestone varies between 14 and 139 MPa. Its tensile strength is between 0.5 to 14 MPa, which is less than 10 % of its UCS. The range of Point-load index strength is between 0.4 and 6 MPa, while its surface compressive strength (based on rebound number R) ranging between 23 and 105 MPa. The rock constant E range between 10 and 88 GPa, and υ between 0.04 and 0.53. Based on the three locations, samples from site S3 seem to exhibit the highest strengths (compressive, point-load and tensile) while samples from site S1 exhibit the lowest strengths. Observation made on samples indicates that the cores from site S1 display small-scale fractures/cracks. These existing fractures may have induced premature failure in some of the samples. In fact these fractures have also contributed to erroneous strain data in a number of tests, consequently resulting in the E and υ value that are lower than expected. There are trends indicating reduction in the samples strength due to saturation, and the range is about 10 to 30% lower than the dry samples. However, for sound and strong rock like limestone this reduction may not necessarily due to moisture content as it could also be contributed by samples variation and accuracy of machine used in the test.

Paper A8

Correlation between Modified Slope Mass Rating (M-SMR) system with lithofacies of the Crocker Formation in Kota Kinabalu, Sabah, Malaysia

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The aim of this paper is to correlate the Modified Slope Mass Rating (M-SMR) classes with the lithofacies of Crocker Formation in the Kota Kinabalu, Sabah area. The rock cut slopes in CPSB Stone Quarry (slope B1 and B3) and Lakang Point (slope LP) in Tamparuli, Tuaran Hospital (slope TH) in Tuaran and Telipok-Sulaman by-pass (slope TS1 east, TS1 west, TS2 east and TS2 west of Telipok) in Telipok were selected for this study. The 'Lithological unit thickness' approach, MRQD method, weighted average of discontinuity set spacing, weighted average of discontinuity condition, normal condition of water flow and discontinuity orientation factor (DOF) method were used to evaluate the unconfined compressive strength, RQD, discontinuity spacing, discontinuity condition, water flow and discontinuity orientation parameters for Modified Slope Mass Rating (M-SMR) system, respectively. The lithological logging mapping and petrographical study were applied in order to determine the facies association for the Crocker Formation. Slope TS1 east, TS2 west and LP representing class II ('low risk' slope), slope B3 and B4 class III ('moderate risk' slope), slope B1, TS1 west and TS2 east class IV ('high risk' slope) and slope TH class VI ('extremely risky' slope) in the study area. The facies types in the study area consist of very thick-bedded sandstone unit (facies B), thick to medium-bedded sandstone unit (facies C), thin-bedded sandstone unit (facies D), thin-bedded siltstone and/or sandstone unit (facies E) and thick-bedded shale unit (facies F). In the study area, the facies unit formed the associations namely channel (slope LP, TS1 east and TS2 west), channel-lobe (Slope B1, B3 and TS2 east), lobe prograding (slope TS1 west) and basin plain (slope TH). The results of analyses shows that the channel facies is represented class II, channel-lobe facies class III and IV, migrating lobe facies class IV and basin plain facies class VI of M-SMR system.

Paper A9

Pengaruh hidrokarbon terhadap cirian geoteknik tanah baki tercemar minyak

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Kemasukan bahan hidrokarbon bersifat cecair ringan tidak larut (LNAPL) seperti minyak pelincir enjin, minyak mentah dan diesel ke ekosistem tanah telah menyebabkan pencemaran yang serius dan sukar dibersihkan. Pencemaran bahan hidrokarbon bukan sahaja mempengaruhi kualiti malah mengubahsuai sifat-sifat geoteknik tanah.

Kajian ini bertujuan untuk melihat kesan pencemaran hidrokarbon ke atas sifat-sifat geoteknik tanah baki basalt dan metasedimen. Penentuan sifat-sifat fizikal tanah yang dikaji meliputi analisis saiz butiran, ujian spesifik graviti serta ujian pembelauan sinar-x (XRD). Manakala sifat geoteknik yang diperhatikan adalah had Atterberg, sifat pemadatan, konduktivi hidraulik dan kekuatan tiga paksi (Ujian Tiga Paksi Tak Tersalir Tak Terkukuh, UU) terhadap sampel yang tidak tercemar dan tercemar dengan bahan pencemar pada ketumpatan yang sama. Sampel-sampel tanah tercemar disediakan dengan mencampurkan bahan hidrokarbon pada kandungan berbeza iaitu 4%, 8%, 12% dan 16% terhadap berat kering. Perbandingan hasil dilakukan di antara sampel tanah tercemar dan tidak tercemar.

Berdasarkan analisis saiz butiran, sampel tanah asalan basalt mengandungi 41% pasir, 51% lodak dan 8% lempung manakala sampel tanah metasedimen terdiri daripada 4% pasir, 43% lodak dan 29% lempung. Hasil analisis XRD pula menunjukkan sampel tanah basalt mengandungi mineral kaolinit, gibsit dan goetit manakala sampel metasedimen hanya mengandungi mineral kuarza dan kaolinit. Nilai spesifik graviti bagi tanah basalt dan metasedimen masing-masing adalah 2.91 dan 2.61. Bagi kedua-dua jenis sampel tanah yang dikaji, penentuan nilai-nilai had Atterberg menunjukkan had cecair, W_L dan had plastik, W_P telah menyusut kesan daripada penambahan kandungan hidrokarbon dalam tanah. Nilai W_L untuk sampel tanah basalt adalah berjulat 66% - 41% manakala untuk sampel tanah metasedimen, julatnya adalah 43%-37%. Sementara nilai W_P untuk sampel basalt adalah di antara 35%-29% manakala nilai W_P bagi sampel tanah metasedimen adalah antara 19%-24%. Pertambahan kandungan hidrokarbon juga menyusutkan nilai-nilai ketumpatan kering maksimum, $\rho_{dry\ max}$ dan kandungan air optimum. Nilai W_{opt} bagi sampel basalt adalah berjulat 23.36% - 16.53% manakala bagi sampel metasedimen adalah berjulat antara 8.4% sehingga 21.9%. Nilai $\rho_{dry\ max}$ bagi kedua-dua sampel pula adalah berjulat 1.6 g/cm^3 - 1.56g/cm^3 bagi sampel basalt manakala 1.58g/cm^3 sehingga 2.0g/cm^3 bagi sampel metasedimen. Ujian tiga paksi pula menunjukkan nilai-nilai kekuatan ricih tanah, C_u yang berjulat 78kPa hingga 24kPa bagi sampel 0%-16% basalt manakala 27kPa hingga 8kPa bagi sampel 0% - 16% metasedimen. Kekuatan ricih tanah tidak bersalir, C_u turut menunjukkan penurunan nilai dengan pertambahan hidrokarbon dalam tanah-tanah yang dikaji. Jelas diperhatikan bahawa kehadiran bahan pencemar hidrokarbon telah menyebabkan sifat-sifat geoteknik tanah yang dikaji berubah berbanding tanah tidak tercemar.

Paper A10

The need for independent post-survey quality control to check the high failure rate of geohazards predictions

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Unanticipated geohazards are the single highest cause of project or drilling failures. Sound project management and decisions can only be made on the basis of reliable and accurate geohazards predictions and risk assessment. Yet interpretation and geohazards prediction skills are seldom considered in the selection of geohazards survey contractor. In any geohazards survey contract, the interpretation of the geophysical data and geohazards prediction receive the least attention and remain the least important factor, despite being the sole cause of any geohazards disaster.

Despite the technological advances in data acquisition and increasing sophistication in data processing and imaging software, interpretation expertise in engineering geohazards surveys continue to be stuck in the "muddy waters" of mystic yesteryears. Reflecting on the past 30 years of experience in the industry, it is clear that modernization has largely bypassed this critical skill in geohazards prediction. The many factors contributing to this stagnation are highlighted in this paper to jolt the industry into realizing this neglect and its dire consequences. Not only has the development of interpretation skills stalled; there seems to be an industry-wide deterioration of geohazards assessment and interpretation capability as well. When fundamentally-flawed interpretation is blindly and repeatedly copied without due geological consideration and lessons learnt from past disasters seem forgotten, it is time to sit up and remedy this untenable situation before things get worse.

The fact that such serious mistakes could routinely slip through top geohazard specialists and contractors, speaks volumes of the interpretation malaise affecting the industry. Some of the more crucial and costly interpretation failures are highlighted to argue for the need for independent quality control (QC) on geohazards assessment and interpretation. The current emphasis on field QC during data acquisition is understandable since data acquisition cost is many times the cost of post-survey interpretation. As the final site survey results can only be as good as the expertise behind the interpretation, it pays to QC the geophysical interpretation, given the number of past failures.

Being a poor cousin to the exploration sector, the lack of experienced interpreters has always been an industry-wide problem as experienced and talented geophysicists seek professional advancement in the more lucrative exploration sector. Under current industry's practice, geophysical contractors bear the sole responsibility of geophysical interpretation. Although all geophysical data acquired technically belong to the Clients or project owners, very seldom were the data requested for quality control purposes.

Besides minimizing human errors and providing experienced guidance, expert QC consultants can readily identify shortcomings in the contractor's interpretation expertise that are normally not apparent during the fast-paced field acquisition phase. Furthermore, interpretation work is normally quoted on lump sum basis; thus making it difficult to quantify the amount of interpretation work or time input. With the constant shortage of experienced geophysicists, post survey QC is a necessity to look after the Clients' interests.

Without post survey QC, the interpretation of site survey data is often reduced to over-simplified charting and meaningless choices of low-moderate to high-moderate risk of gas hazards. Even when favourable site conditions or geological factors were apparent in the site survey data, opportunities to capitalize on them for project benefits were normally ignored; basically because there were no instructions from the Client to do so. Without a knowledgeable QC review, such valuable information might not even surface for due consideration.

By their ambiguous nature, interpretation errors are conveniently attributed to various factors such as limited work scope, resolution, accuracy, penetration etc, rather than technical incompetence. Furthermore, failures to detect potential geohazards or geotechnical problems are not easily recognized as mis-interpretation as they do not necessarily manifest into immediate disasters. Investigation into past major disasters such as the 1990 Barton Blow-out, revealed how an initially flawed interpretation (in the early eighties) was blindly adopted; leading to subsequent mis-interpretation in later surveys (by no less than 3 survey contractors) which further compounded the initial mis-interpretation. If the present authors had not persisted on disputing the flawed survey results, the truth might never have surfaced. Immediately after the blow-out, the Barton-A platform was evacuated and destined for shutdown on the perceived fear of platform instability and imminent collapse due to the "unstable soft sediment within the sub-seabed depositional basin". A QC review of the past surveys' interpretation revealed an appalling series of site survey mis-interpretation and over-turned the impending shutdown of the platform. Now more than 19 years later, the said platform had not failed as initially feared following the blowout. This is one of the many prime examples where costly disasters could have been averted, had the early erroneous interpretation and geological inconsistencies been detected by routine QC on geophysical interpretation.

Even though it was geologically inconsistent to have a large depositional basin at the apex of an outcropping anticline structure, the highly faulted complex structure was nevertheless mistakenly interpreted as such. Although abnormally high circulation losses were reported in all the drilling preceding the fateful blowout, the pre-drill site surveys continued to chart patches of cement on the seafloor as coral outcrops despite evidence to the contrary. The disbelief that drilling cement meant to seal the well-bores could resurface through the pervious faults was proven to be true when ROV recovered cement fragments from the erroneously charted "coral outcrops". The series of interpretation errors epitomize the need for independent expert QC on geophysical interpretation. Sadly the Barton Blowout is not an isolated case.

Paper A11

Kebolehrentanan bencana gelinciran tanah (LHV): Sorotan literatur dan cadangan pendekatan baru untuk pengurusan risiko gelinciran tanah di Malaysia

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Topik berkenaan kebolehrentanan bencana gelinciran tanah (LHV) masih dianggap baru dan kurang mendapat perhatian di kalangan geosaintis dan jurutera di Malaysia. Kebolehrentanan ditakrifkan sebagai darjah kerugian (kerosakan) bagi sesuatu elemen atau elemen-elemen yang berisiko akibat berlakunya fenomena semulajadi yang bertindak balas pada suatu magnitud tertentu (Varnes, 1984). Walaupun terdapat beberapa garis panduan dan polisi berkenaan pembangunan di kawasan berbukit bagi mengatasi gelinciran tanah, namun bilangan gelinciran tanah di seluruh negara yang membawa kepada malapetaka semakin terus meningkat. Kertas penyelidikan ini cuba mengupas dan merumus konsep LHV dengan mengambilkira pendekatan aspek sosio-ekonomi dan sains. Pendekatan baru dalam konsep kebolehrentanan bagi penyelidikan pengurusan risiko bencana gelinciran tanah di Malaysia juga turut diperkenalkan. Untuk merealisasikan matlamat ini, suatu rangka kerja telah direkabentuk untuk menaksirkan kebolehrentanan manusia, fizikal dan persekitaran terhadap bencana gelinciran tanah. Rangka kerja ini dirumuskan secara semi-kuantitatif melalui pembangunan pengkalan data elemen-elemen berisiko (manusia & kewangan) yang berdasarkan kepada maklumat daripada sorotan literatur yang ekstensif dan pencerapan lapangan. Parameter-parameter LHV daripada literatur dianalisis secara statistik untuk menilai kepentingannya supaya dapat diterima dalam model penyelidikan pengurusan risiko gelinciran tanah (LRM) yang praktikal bagi keperluan keadaan tempatan. Antara parameter-parameter yang diambilkira dalam menilai LHV termasuklah status sosial (kecederaan fizikal, kehilangan nyawa dan tempat tinggal), implikasi fizikal (kerosakan harta benda, bangunan, kelengkapan dalaman dan kemudahan infrastruktur) dan gangguan terhadap persekitaran (masa terjejas, operasi harian dan pelbagai). Setiap parameter yang diambilkira dalam penaksiran kebolehrentanan diperuntukkan nilai perkadaran tertentu yang berjulat dari 0 (0% kerugian/kerosakan), 0.25 (1-25% kerugian/kerosakan), 0.50 (26-50% kerugian/kerosakan), 0.75 (51-75% kerugian/kerosakan) hingga 1.00 (75-100% kerugian/kerosakan). Langkah selanjutnya adalah mengira jumlah nilai purata bagi ketiga-tiga jenis kebolehrentanan sosial, fizikal dan persekitaran yang kemudiannya dikelaskan kepada lima kelas darjah kebolehrentanan, iaitu kelas 1 (< 0.20) (kebolehretanan sangat rendah), kelas 2 (0.21-0.40) (kebolehrentanan rendah), kelas 3 (0.41-0.60) (kebolehrentanan sederhana), kelas 4 (0.61-0.80) (kebolehrentanan tinggi) dan kelas 5 (> 0.81) (kebolehrentanan sangat tinggi). Hasil kajian ini mendapati bahawa nilai perkadaran LHV di Malaysia adalah jauh lebih tinggi berbanding dengan negara-negara maju. Hal ini antara lainnya disebabkan oleh kurangnya kesedaran awam, pengetahuan dan pendedahan mengenai gelinciran tanah; serta kekurangan kod-kod bangunan dan ketiadaan penilaian rekabentuk kejuruteraan yang mengambil kira faktor-faktor pencetus bencana (hujan lebat/gempa bumi). Perkiraan perkadaran kebolehrentanan tidak dapat ditentukan secara kuantitatif semata-mata kerana ianya memerlukan data pencerapan lapangan yang disokong oleh data sekunder secara relatif.

Landslide Hazard Vulnerability: Review of literature and a proposed new approach in landslide risk management for Malaysia

Topic on landslide hazard vulnerability (LHV) in Malaysia is relatively new and received little attention from geoscientists and engineers. Vulnerability is defined as the potential degree of loss (damage) to a given element or risk elements resulting from the occurrence of a natural phenomenon of a given magnitude (Varnes, 1984). Although there are some guidelines and policies regarding hillside development to prevent landslide, the number of disastrous landslides is steadily increases nationwide. This research papers try to review and formulate the concept of LHV by taking into account the socio-economic and science aspects. New approach in vulnerability concept for research in landslide risk management in Malaysia is also introduced herein. To achieve this goal, a framework was designed for assessing the human, physical and environmental vulnerabilities to landslide hazard. The framework was formulated semi-quantitatively through the development of database for the risk elements (human & financial) based on informations from the extensive review of literature and field observations. LHV parameters from the literature were analysed statistically to evaluate their significance in developing an acceptable and practical model for landslide risk management (LRM) that will suit best to the local conditions. The parameters include:

social status (physical injury, loss of lives and accommodation), physical implication (property damage, building, internal materials and infrastructural facilities) and interference on environment (affected period, daily operation & diversity). Each considered parameters in the vulnerability assessment is allocated with a certain rating value ranges from 0 (0 % loss/damage), 0.25 (1-25 % loss/damage), 0.50 (26-50 % loss/damage), 0.75 (51-75 % loss/damage) and 1.00 (75-100 % loss/damage). The next step is to count up the total average value for the three types of human, physical and environment vulnerabilities. The value is then classified into five classes of vulnerabilities, namely class 1 (< 0.20) (very low vulnerability), class 2 (0.21-0.40) (low vulnerability), class 3 (0.41-0.60) (medium vulnerability), class 4 (0.61-0.80) (high vulnerability) and class 5 (> 0.81) (very high vulnerability). Results from this study indicate that the rating value for the vulnerability on landslide hazard in Malaysia is generally higher than those of the developed countries. This is mainly due to poor awareness, knowledge and exposure amongst the public, as well as poor building codes and lack of consideration on the hazard triggering factors (intense rainfall and earthquake). It is also noted that the rating of vulnerability cannot be simply determined quantitatively because it requires data from field observations supported by the relative secondary data.

Paper A12

Geospatial information system of karst land use evaluation in Kinta Valley, Malaysia

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Remote sensing and Geographic Information System (GIS) have been proven to be powerful tools for mapping analysis. In contrast, the conventional methods of mapping land use changes are costly and low in accuracy. Remote sensing provides updated information on land use changes. With the spatial and temporal imaging capability of remote sensing, changes in land use due to natural events and human interferences can be monitored using current and archived remotely sensed data. Kinta valley have been deteriorating dramatically as a result of changes that have occurred in the past and continues due to the close relationship between the fast rate of lateral urbanization and extensive dimensional expansion of mining activities (tin and quarrying). The segmentation classification method is based on various scales determined by range of scale parameters, leading to the formation of a hierarchical network of objects. Geospatial technology and Remote Sensing have opened up opportunities for qualitative analyses of landuse changes and can be helpful in managing this sensitive area. The objective of this paper is to highlight the usefulness of Geospatial Information System as a tool to visualize and define the karst degradation changes. It was found that quarry operation has increased from 1991 to 2004 (12.70% - 20.76%) due to human activities. The urban area has been increased from 15.70% to 18.10% during the period from 1991 to 2004 especially in the northern part of the Kinta Valley. New occurrences of sinkhole are detected spatially after tsunami earthquake 26 of December 2004. The results will assist local authorities, urban planners, and citizens to avoid potential hazardous areas by using the occurrences of sinkholes map.

Paper A13

Kajian penderiaan jauh kawasan Saratok-Pengajar, Sarawak

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Pemetaan Geologi kawasan Saratok-Pengajar berskala 1:50,000 merupakan kawasan yang mula-mula dipilih untuk dilaksanakan dalam projek Pemetaan Geologi Negara di Sarawak di bawah Rancangan Malaysia Ke-9. Sebagai langkah awalan bagi memahami kawasan yang akan dikaji, kajian penderiaan jauh ini dilakukan.

Kajian penderiaan jauh dilakukan dengan menggunakan segala bentuk peralatan dan perisian yang tersedia. Ini termasuklah komputer, perisian Erdas Imagine, ArcviewGIS, ArcGIS, imej Landsat7ETM Sri Aman (120/59), imej RADARSDAT Sarawak dan SRTM. Turut didigitalkan adalah peta-peta geologi daripada kajian terdahulu yang melibatkan kawasan yang kini dikaji.

Kajian ini menonjolkan banyak maklumat geosains yang baru. Lima pola pematang berjaya dicirikan yang secara langsung menggambarkan corak perlapisan batuan. Sebanyak 26 garisan sesar dikenalpasti dan dikelompokkan kepada empat corak utama. Gabungan tekstur, tekstur mikro dan bentuk-bentuk muka bumi yang lain membantu pemecahan unit batuan kepada tiga unit.

Penemuan-penemuan yang diperolehi digunapakai secara terus di lapangan melalui paparan arcpad yang disokong oleh peranti GPS. Ia membantu menafsirkan fitur-fitur geologi di lapangan. Penemuan-penemuan ini membantu merubah peta geologi yang lama di kawasan berkenaan. Oleh itu, pengkaji-pengkaji perlu mengguna-pakai teknologi yang tersedia di sekeliling mereka secara optimum.

Paper A14

Application of the Analytical Hierarchy Process (AHP) to groundwater potential mapping in the upper part of Langat Basin

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In Malaysia, groundwater is always being national issues and rises as an alternative source for water supply especially during drought season. Groundwater resources in Malaysia also are being underutilize compared to other nations such as Thailand, China, Austria and Denmark. Conventional approach of groundwater exploration using geological, hydrogeological and geophysical method normally involved high budget and time consuming. Remote sensing technique provides advantage of spatial and spectral data, having access to large coverage and inaccessible areas with regular revisit capability. Meanwhile Geographical Information Systems (GIS) was used to integrate the spatial layers, handling and analysing the large amount of data. The main objective of this paper is to integrate remote sensing, GIS and multi criteria analysis of Analytical Hierarchy Process (AHP) in identifying groundwater potential zones in the Upper part of Langat Basin, Selangor.

The study area covers part of the Upper Langat Basin and located in Hulu Langat district of Selangor state, Malaysia. It is within the latitude 2° 53' north to 3° 15' north and longitude 101° 43' east to 101° 58' east, with an area of around 500 km square. In this study, eight thematic layers of groundwater parameters i.e. lineament, geomorphology, rainfall, lithology, drainage, landuse, slope, and soil were extracted from satellite images and available maps. Remote sensing data of Landsat imagery was interpreted to produce lineaments and geomorphology. DEM (Digital elevation model) was used for lineaments, geomorphology and slope. Meanwhile drainage, landuse, lithology and soil were extracted from ancillary maps data. The assigned weights for groundwater parameters were normalized by using AHP.

The result of predicted map has been classified into four classes of groundwater potential zones: very high, high, moderate and low. Very high groundwater potential constitutes only about 15% of the total area. High potential category has about 17% meanwhile about 33% comprised of moderately groundwater potential. Areas with low potential constitute 34% of the total study area. Actual bore well yield data compiled by the Department of Minerals and Geoscience, Malaysia (JMG) were used for model validation. Accuracy assessment of predicted groundwater potential map with bore well yield was performed using correlation coefficient. The correlation coefficient result is equal to 0.72. It concluded that the output of this integrated approach is cost effective technique in investigating groundwater potential zones in Malaysia. These output can be used for future planning of groundwater exploration and development by related government agencies and private sectors in Malaysia.

Paper A15

Physico-chemical behavior of carbonaceous shale at Batu Gajah, Perak: Their problems and mitigation

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The Paleozoic carbonaceous shale exposed around Batu Gajah is interbedded with sandstone and siltstone, which is sandwiched in between Kinta Limestone over a total thickness estimated to be about 3,000 m. It deposited within deep marine environment indicated by the dissemination of reduction pyrite. The exposures along Seputeh-Batu Gajah (new road) were studied whenever numbers of slope failure occurred along the stretch, as well as stained road surfaces and drains, which is believed trigger by the material properties of black shale. Chemical weathering is the only factor that contributes to the change of chemical and physical properties of the carbonaceous shale. Acid rock drainage (ARD) is one of the environmental problem occurred and it produced by the oxidation of sulphides minerals, such as pyrite and marcasite (FeS_2). Both of these phenomena can affect the physical and chemical properties of the carbonaceous shale. Acid Rock Drainage is found around the world both as a result of naturally occurring processes and activities associated with land disturbance such as highway construction and mining where acid-forming minerals exposed to the air and water. These acidic can cause metal in geologic material to dissolve, which can cause a very serious contamination and damage the environment for the flora and fauna around the area. Acidic soil contributed by pyrite oxidation in carbonaceous shale has a very low pH near 3. An appropriate method need to be implemented in order to treat the acidic soil problem. Due to the high acidity, plants or vegetation are unable to grow. The growth of plants or vegetation is important because the roots of the plant can serve as natural fiber reinforcement and will increase the resistance to slope failures. Pyrite oxidation, also referred to as pyrite disease or pyrite decay, is identified by a sulphuric acid odor, white crystalline powder, yellow sulphide powder, and/or gray to yellowish microcrystalline mass in and out of specimens. One of the important approaches to prevent pyrite oxidation is to create a surface coating on pyrite. In the study conducted, a coating of iron 8–hydroxyquinoline was formed by leaching pyrite with a 0.10M H_2O_2/0.0034 M 8-hydroxyquinoline solution; stability of the coated pyrite was tested under various pH and temperature conditions. It shown the iron 8-hydroxyquinoline coating could significantly suppress further pyrite oxidation by both chemical (H_2O_2) and biological (*Thiobacillus ferrooxidans*). Ammonium gas and ethanolamine thioglycollate treatments neutralize sulphuric acid and remove ferros-sulphate, and are reportedly effective in partly or completely removing oxidation reaction products. Calcium carbonate or limestone powder can also be utilized to treat the ARD, where the exposed black shale covers by calcium carbonate, and then cover back by layer of softwood and hardwood. These mitigation methods suggested can be implemented to enhance the growth of grass and stabilize slopes.

Paper A16

Occurrence of pyrite in the coastal plains as an evidence for the rise of sea level in the Malay Peninsula during the Holocene

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The presence of sandy beach ridges in the Kelantan Plains has been used an indication of the rise of sea level during Holocene. Pyrite is found in some of the sediments in these coastal plains and this pyrite can only be formed in the presence of sea water. A study was conducted in the Kemasin-Semerak Integrated Agricultural Project, Kelantan to explain the formation of pyrite in the area. A survey was carried out to determine the location where pyrite was found in the area. Soil samples were collected according to depth (0-15, 15-30, 30-45, 45-60 cm) and analyzed for chemical and mineralogical properties. After 2 weeks of exposure to the atmosphere, the samples from the depths of 30-45 and 45-60 cm were found to produce yellowish mottles, which were found to be jarosite ($FeK_3(SO_4)_2(OH)_6$). This jarosite must have been formed by the oxidation of pyrite (FeS_2). The presence of this pyrite in the soils is therefore indicative of the presence of sea water in the area, during which the pyrite was formed. It means that this location was once covered by sea water. This is consistent with the report of earlier studies that about 5000 BP the sea level was 3-5 m above the present. So the presence of pyrite a few km away from the present shoreline can be used as further evidence for the rise of sea level in Malaysia during the Holocence.

Paper A17

Fault patterns in Peninsular Malaysia: Origin and development

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Major lineaments shown on satellite images (Figures 1 and 2) of Peninsular Malaysia occur in distinct patterns (Figure 3) that reflect their association with associated, dominant lithologies. In some cases the lineament patterns also indicate sequential development. Radiometric ages of major fault zones indicate that actual tectonic activity in PM ceased by 43-45 Ma, or intra-Eocene. Younger crustal movements have probably continued periodically since then, but only evidence from Quaternary and Recent events of reactivation of existing faults are documented with certainty. As examples are (a) the fault pattern in the Quaternary Kuantan basalt that mimics that in the Carboniferous rocks of the Sungai Lembing area, and (2) the 2008-2009 tremors that are closely associated with the major Bukit Tinggi fault zone in the central Western Belt of the Peninsula. It is very likely that the latter swarm of mild earthquakes had been induced by tectonic events at the plate boundary that surfaces as the Sunda Trench off Sumatera. Repeated GPS readings appear to confirm the interpretation.

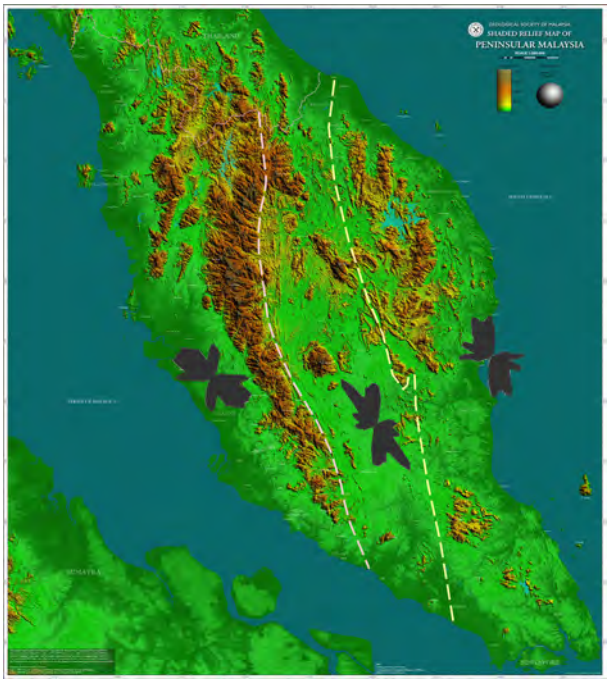

Figure 1: Three-fold division of Peninsular Malaysia : Western Belt, Central Belt and Eastern Belt.

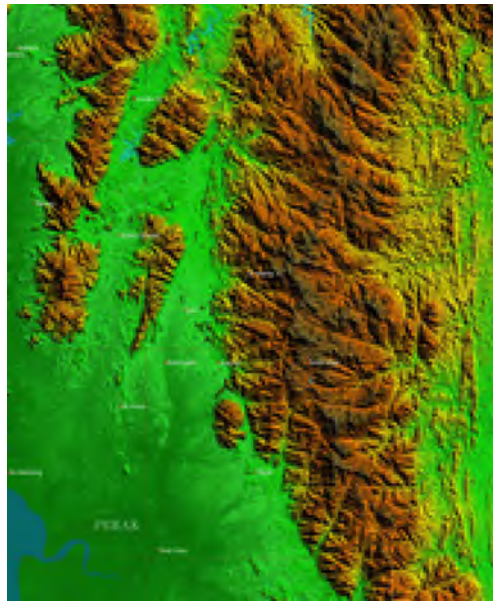

Figure 2: SRTM of part of Peninsular Malaysia displays lineaments.

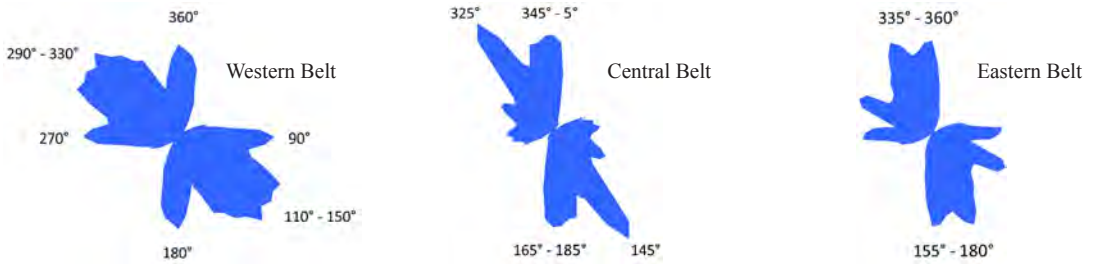

Figure 3: Lineament patterns derived from SRTM. Western Belt (total length = 753.1 km), Central belt (total length = 290.8 km) and Eastern Belt (total length = 515.8 km). Most linemaments are NW-SE in the Western Belt; some showing N-S and E-W orientations. In the Central Belt the dominant ones also show NW-SE; while in the Eastern Belt are mostly N-S.

Paper A18

Active regional fault zones in Sabah, Malaysia

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Recent regional studies using SRTM images supported by preliminary field studies show the presence of two major trends of active fault zones in Sabah (Figure 1). In southeast Sabah several N30E and N70E trending regional active faults occur which have been grouped together as the Tawau-Kunak-Lahad Datu-Temanggong Fault Zone (TKLTFZ). In northeast Sabah similar N30E and N70E trending regional active faults also occur. They have been grouped together as the Ranau-Pitas-Banggi Fault Zone (RPBFZ) and Pensiangan-Telupid-Paitan Fault Zone (PTPFZ). The active faults are interpreted based on the occurrence of linear structures, earthquake epicenters, mud volcanoes and landslide-prone areas. Some of the straight coastlines of Sabah may also be associated with the NW-SE and ENE-WSW trending faults. Field evidence shows both horizontal and vertical movements in these faults. These active faults are thought be related to the on-going NW-SE tectonic compression in Sabah and surrounding areas due to the northward movement of the Australian Plate against Sulawesi-Eastern Sabah.

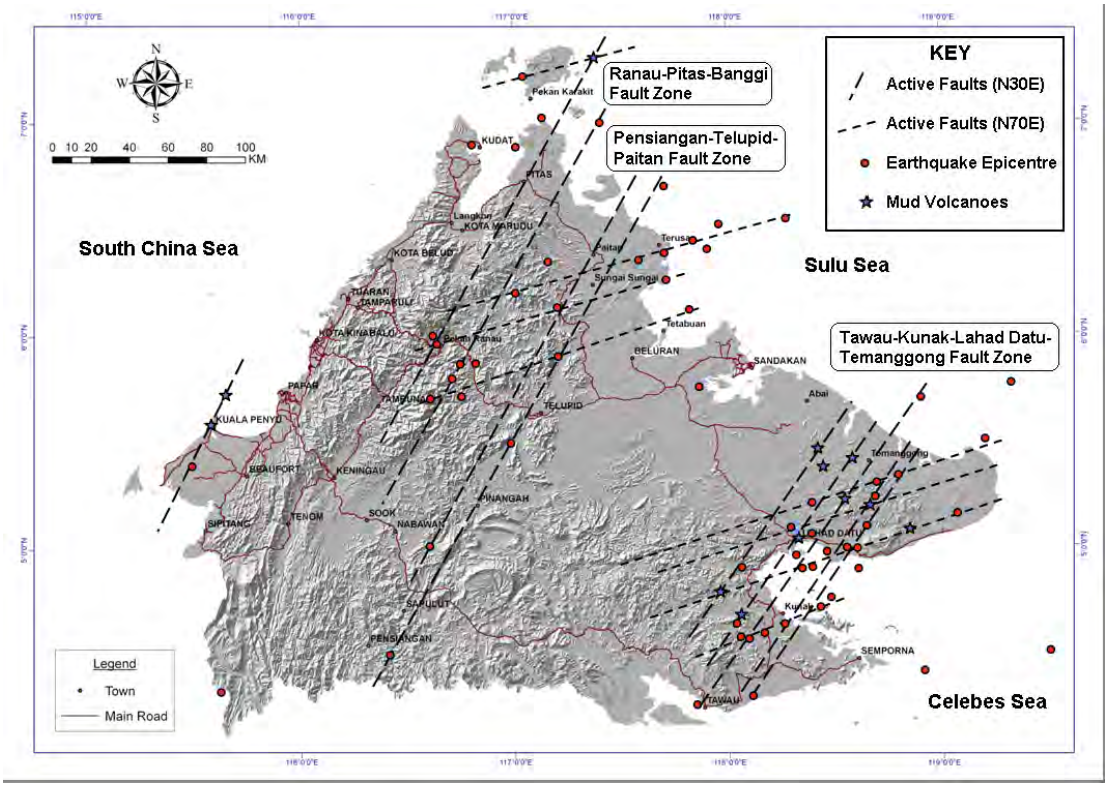

Figure 1: Location of active regional fault zones in Sabah.

Paper A19

Distribution of several thrust faults in Kedah: Implications to the geology of Kedah

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New information on geology of Kedah particularly thrust faults, for the last ten years have been revealed from new exposures due to active earth quarries at many locations in the state. In Kuala Ketil, the chert unit of the Semanggol Formation is thrusted mainly towards north along the ENE to ESE thrust faults. The Bukit Kukus thrust consists of weathered mylonite enclosing blocks of bedded cherts, bedded mudstone, bedded sandstone and mudstone, bedded tuffaceous sandstone and mudstone. The thrust has brought up the Middle Triassic chert sequence on top of the late Late Permian chert. In Pokok Sena area several thrust faults were discovered. At Bukit Jabi about more than one kilometer of green to red slate of the Mahang Formation occupies the NNW strike ridge. The slate strikes NNW to N and dips towards east at western margin of the ridge. About a half kilometer across the ridge the slate dips towards the west. The slate overlies an unmetamorphosed sequence of thick sandstone and mudstone of the upper part of the Kubang Pasu Formation. The thrust fault is a boundary between the two formations is called as Jabi Thrust. Other exposures were also observed at top of the hill in Cheong Chong Kaw Estate, Bukit Meng and Bukit Tunjang. There are cases which the Kubang Pasu Formation lying on top of the slate of the Mahang Formation and separated by fault for example exposure at Bukit Tinggi, Bukit Pelobang, Bukit Gelong. The mylonite width ranges from half a meter e.g. Bukit Tinggi to tenth of meters e.g. Bukit Pelobang. The mylonites strike northwards and dip eastwards. An exposure of 40m height of thrust fault at Kampong Malau, Jitra comprises black mylonite enclosing lensoids and blocks of sandstones, and intercalation of sandstone and mudstone of the Kubang Pasu Formation. The mylonite strikes NNE and dips eastwards. Westwards tectonic transport is deduced from the slickensides on the lensoids surfaces. The present findings reveal that the Mahang Formation is not confined within the south Kedah. The slate occurs at several small hills and low ridges in Pokok Sena area and north Kedah. The Mahang Formation is sandwiched between thrust faults that cutting the Kubang Pasu Formation. This may be the reason the Mahang Formation is in normal position with the Kubang Pasu on the top. but the fault is in between them. The occurrence of northwards thrusts seem to be in consistent with the exception of the Bukit Kukus thrust which striking mainly ENE to ESE.

Paper A20

Structural map and multiple deformation episodes of Tanjung Kempit, Endau, Johor

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Detailed field mapping and structural analysis of Tanjung Kempit, some 5 km east of Endau, east coast of Johore, revealed at least five episodes of deformation affecting the probable Upper Paleozoic Mersing Bed metasediments. The first episode D_0 was a syn-sedimentary deformation event giving rise to mesoscopic extensional growth faults that has never been reported before in the Eastern Belt. The earliest tectonic deformation episode D_1 seems to be the result of an E-W compression, is represented by N to ENE oriented reclined tight to isoclinal folds associated with nearly bedding-parallel cleavages S1, and boudin. The main deformation episode D_2 is represented by N to ENE oriented mesoscopic folds, which are upright, tight to open, and associated with a non-axial planar cleavage S_2 especially well developed along localized strike-parallel dextral shear zones. Small-scale folds are periclinal and arranged in en-echelon arrangement. These kinematic indicators show that D_2 were the result of dextral transpressive deformation. The structures developed during the fourth deformation episode D_3 include the kink-like curvilinear axial traces of F1/F2 folds, NNW striking thick quartz veins and the disposition of the general layering into NW-SE-trending sub vertical kink bands, and S-shaped asymmetric folds. They developed almost exclusively on those parts of the structure where D_2 folding produced steep bedding and planar fabric suggesting sub vertical direction of principal compression likely due to strike-slip movement. The latest episode of deformation D_4 includes NNW-SSE trending sinistral strike-slip faults with subordinate NNE-SSW striking dextral strike-slip faults. D_4 represented brittle structures developed due to by E-W oriented compression. These may imply that the strata may have undergone an initial syn-sedimentary extension prior to a regional E-W compression followed by a transpressive deformation leading to N-S dextral and then later sinistral shearing followed by later brittle strike-slip deformations. The results of this study suggest a multi-episode of deformation involving syn-sedimentary extension, followed by contraction and transpressive history that is more complex than previously proposed for this part of the Eastern Belt.

Paper A21

Kajian geologi struktur kawasan Bukit Tinggi, Bentong, Pahang

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Kawasan Bt. Tinggi terletak di bahagian barat daya negeri Pahang, berhampiran dengan sempadan negeri Selangor. Beberapa gempa bumi berskala kecil telah berlaku di kawasan ini bermula dari 30 November 2007. Berikutan kejadian gempa bumi ini, pihak Jabatan telah mengambil inisiatif menjalankan siasatan geologi bertujuan untuk menentukan struktur geologi tempatan dan rantau, seterusnya mengaitkan kejadian gempa bumi dengan struktur major kawasan. Kawasan kajian disempadani oleh longitud 101° 46.6' T hingga 102° 02.7' T dan latitud 03° 15.2' U hingga 03° 31.5' U. Kawasan Bt. Tinggi didasari oleh batuan granit biotit, diorit, granodiorit, mikrogranodiorit porfiri dan batuan volkanik berkomposisi dari riolit hingga andesit. Sesar-sesar utama yang terdapat di kawasan ini iaitu Sesar Bt. Tinggi yang berada dalam arah baratlaut-tenggara dan Sesar Karak yang berada dalam arah utara serta sesar-sesar yang berada dalam arah utara-timurlaut, timurlaut, barat-baratlaut dan timur-timurlaut. Ditafsirkan sesar mendatar Bt. Tinggi yang berlaku dengan meluas wujud dalam fasa terawal diikuti penyesaran normal dan seterusnya sesar songsang. Sesar-sesar dalam arah barat laut hingga barat-baratlaut yang selari dengan sesar Bt. Tinggi banyak ditemui dilapangan kebanyakannya sebagai sesar mendatar ke kiri, jelas ditunjukkan oleh muka upam pada satah sesar. Sebahagian titik epicenter gempabumi terletak berhampiran atau pada sesar-sesar yang telah dikenalpasti. Titik-titik epicenter ini berada sejajar dengan arah baratlaut-tenggara Zon Sesar Bt. Tinggi dan arah utara Zon Sesar Karak. Kejadian gempa bumi yang telah berlaku ditafsirkan sebagai hasil pelepasan tenaga oleh gerakan pada sesar-sesar utama di kawasan ini iaitu Sesar Bt. Tinggi dan Sesar Karak.

Bt. Tinggi area is located at the southwest Pahang near to the boundary of Pahang-Selangor state. Beginning 30th November 2007, a number of minor earthquakes have rocked this area. In respond to the events, the Department has initiated geological investigation with the aims to determine the regional and local structures; and to correlate between the earthquakes and the major structures of the area. Study area is bounded by longitud 101° 46.6' E to 102° 02.7' E and latitude 03° 15.2' N to 03° 31.5' N. The Bt. Tinggi area underlain by biotite granite, diorite, granodiorite, porphyritic microgranodiorite and volcanic rocks of andesitic to rhyolite composition. Major faults trends in this area include northwest-southeast Bt. Tinggi Fault and northerly Karak Fault, north-northeast, northeast, west-northwest and east-northeast. Widely distributed of Bt. Tinggi strike slip fault interpreted occured in the earliest phase followed by normal faulting and then reverse faults took. Northwest to west-northwest faults trending associated with Bt. Tinggi Fault abundantly observed in the field as left strike slip fault, clearly showing by slickensides on the fault plane. Several of the epicenters are located near or at known faults. The epicenters also suggest alignment with the NW-SE Bt. Tinggi Fault zone and also the northerly Karak Fault zone. Earthquakes in Bt. Tinggi area occurred interpreted as a result of released strain through movement on major faults in this area comprising Bt. Tinggi Fault and Karak Fault.

Paper A22

Double impact rings Luat and Bertam, Cenderoh area, Perak

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In the course of detailed mapping of the Quaternary felsic volcanic ash in the Cenderoh - Kota Tampan area of Perak, our study team found evidence of double impact rings: Luat and Bertam circular features. The diameters are between 3.5 and 4 kilometres and the two rings are partially superimposed. The larger Bertam Ring consists of four concentric topographic expressions. Several years earlier, shocked quartz and other PDFs (planar deformation features) comprising clasts in a breccia at Bukit Bunuh were identified as impact breccia or suevite (Tjia & Mazlan 2003). However, no obvious impact topography was found associated with Bukit Bunuh. Since that paper, follow-up fieldwork has resulted in discovering more localities bearing evidence of extraterrestrial impact features in the general area of Kota Tampan - Cenderoh reservoir. A major discovery consists of fragments of very dense iron-rich rock. These fragments were found scattered over a relatively small area near Kampung Beng and occupy the outer ring of the Bertam ring. The larger fragments measure about 15 cm. All fragments are subangular and most show distinct irregular but relatively planar fracture surfaces. One of the fragments has a broadly pitted surface suggestive of "ablation", similar to those on proven meteorites and interpreted to have formed by partial melting. Early investigation by XRD shows the main composition of these rocks are hematite and magnetite and the presence of kamacite in melt breccia found in the same area is also detected.

Paper A23

Geologi struktur pada Formasi Gua Musang di negeri Kelantan

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Negeri Kelantan adalah salah satu negeri bahagian paling utara daripada Semenanjung Malaysia. Negeri ini bahagian utara bersempadan dengan Thailand, bahagian timur bersempadan dengan Negeri Terengganu dan bahagian selatan bersempadan dengan Negeri Pahang, manakala bahagian barat bersempadan dengan Negeri Perak dan Negeri Kedah. Kertaskerja dimaksudkan untuk menghuraikan secara terperinci pelbagai struktur yang melibatkan berbagai jenis batuan dalam Formasi Gua Musang di seluruh Negeri Kelantan. Secara geologi Negeri Kelantan tersusun daripada litologi Olistortrom Kelantan Barat, Syis Taku dan Formasi Gua Musang. Manakala batuan rejahan berupa granit, diorit porfir, andesit, ignimbrit dan dolerit. Negeri Kelantan secara struktur di bahagian barat disempadani oleh olistostrom Kelantan Barat yang di beberapa lokaliti direjah oleh jasad serpentinit dan bahagian timur disempadani oleh Sesar Lebir. Metodologi yang digunakan dalam penelitian ini ialah ritisan terperinci di sepanjang laluan jalan dan sungai. Manakala analisis yang digunakan iaitu dengan Program Dips dan secara manual. Formasi Gua Musang, merupakan formasi yang paling luas menempati Negeri Kelantan. Lipatan utama yang dijumpai di bahagian tengah dengan paksi lipatan berarah utara selatan hingga utara baratlaut-selatan tenggara. Manakala di bahagian utara paksi terpesong oleh rejahan granit dan diorit porfir membentuk arah paksi timurlaut-baratdaya. Sesar yang melibatkan Formasi Gua Musang berupa sesar dektral berjurus U30-45^{o}T miring ke arah tenggara 60-70^{o}. Sesar sinistral berjurus U330-340^{o}T miring ke arah timurlaut dan baratdaya 60-70^{o}. Sesar songsang berjurus U350^{o}T miring ke arah timut-timur laut dan barat-baratdaya 60-80^{o}T. Di kawasan yang bersempadan dengan rejahan granit dan sesar besar, Formasi Gua Musang menjadi sangat keras dan terlipat-lipat rapat. Rejahan diorit porfir di Kampung Pasir Maya berarah timurlaut-baratdaya telahpun memesongkan arah paksi lipatan utama pada Formasi Gua Musang menjadi selari dengan rejahan. Tegasan utama yang melipatkan dan mensesarkan Formasi Gua Musang berarah antara barat-baratlaut – timur-tenggara hingga timur-timurlaut – barat-baratdaya.

Structural geology of Gua Musang Formation in Kelantan

Kelatan is a northern state of Peninsular Malaysia. The boundary of this state to the north is Thailand, easthern part is Terengganu, southern part is Pahang and westhern part with Perak and Kedah. This paper explains structural variation of all litologi of Gua Musang Formation in Negeri Kelantan. Geologicaly Negeri Kelantan are comprises of west Kelantan Olistostrom, Taku Schist and Gua Musang Formation. Igneus rock in Negeri Kelantan are granite, diorite porphire, andesite, ignimbrite dan dolerite. Structuraly Negeri Kelantan are boundared by olistostrom in the west and Lebir Fault Zone in the east. The method of this study is detailed measurement along the road and river. The analysis by the Dips programme and combination with manual method. Gua Musang Formation is mainly separate in Negeri Kelantan. Main fold of Gua Musang Formation in the middle part towards north-south up to north-northwest – south-southeast. In the northern part of this main fold terned by granite intrusion and diorite pophire towards NE-SW. The main of fault in the Gua Musang Formation are dekstral fault with strike N30-45^{o}E and diping 60-70^{o} to SE and of sinistral fault with strke N330-340^{o}E and diping 60-80^{o} to ENE-WSW. In the area boundared by igneus granit intrusion and near than main fault, Gua Musang Formation formed the compact and strongly folding. Itrusion of diorite pophire towards NE-SW have to terned the main fold of Gua Musang Formatin to follow this intrusion. The main compression who formed the folding and faulting of the Gua Musang Formation towards between WNW-ESE up to ENE-WSW.

Paper A24

The two seasonal characteristics of Pahang River, Pahang, Malaysia

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Pahang River is the longest river in Peninsular Malaysia. Pahang River starts from the confluence of Tembeling River and Jelai River at Kuala Tembeling with length more than 300 km to estuary of Pahang River at Pekan. Rapid development and conversion of forested land into other land uses within the Pahang Basin has an impact to the river ecosystem due to lack of proper and effective management and have led to deterioration and shortage of water quality and water resource. Higher of Soil loss also related to urbanization and agricultural activities were recognized as the cause of water pollution. Two hydrological and water quality samplings have been carried out during the study; first sampling was conducted from 1st to 3rd January 2010 and the second sampling from 22nd to 25th February 2010. At least 15 stations along Pahang River have been chosen to determine hydrology (rainfall, velocity and stream flow) and water quality (WQI parameters) of the river. During first sampling, measurement of the velocity ranged from 0.31 to 0.58 m/s and river flow was ranged from 153.28 to 439.68 m^3/s. For water quality analysis; pH range from 7.2 to 7.6; dissolved oxygen range from 5.24 to 7.28 mg/L, chemical oxygen demand from 20.0 to 69.0 mg/L, biochemical oxygen demand from 0.40 to 0.97 mg/L; total suspended solids from 50.0 to 65.6 mg/L and ammonia nitrogen from 0.19 to 1.16 mg/L. For the second measurement, almost all of parameters were dropped; velocity ranged from 0.22 to 0.48 m/s the river flow from 52.07 to 304.49 m^3/s. For water quality analysis; pH range from 7.2 to 7.5; dissolved oxygen range from 7.51 to 8.65 mg/L, chemical oxygen demand from 5.0 to 17.0 mg/L, biochemical oxygen demand from 0.26 to 1.49 mg/L; total suspended solids from 18.5 to 34.5 mg/L and ammonia nitrogen from 0.03 to 0.21 mg/L. Due to no proper rainfall between sampling period, It can be shown that during the second sampling water level of Pahang River was dropped, this phenomenon is reflected by decrease of velocity, stream flow and water quality level for the most water quality parameters unless for dissolved oxygen.

Paper B1

Geology and geochemistry of Bukit Nimong and Selanjan intrusives of West Sarawak, Malaysia - Implications for gold and porphyry copper mineralization

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Bukit Nimong and Bukit Selanjan areas located in the south central part of West Sarawak are underlain by the dioritic intrusives surrounded by metasandstone of the Silantek Formation. The intrusives are the result of the multi-phase magma intrusions into the Silantek Formation during Miocene, developed simultaneously with other nearby intrusives at Bukit Klambi and Bukit Tiong Laju. These areas were the target for mineral exploration as far back as in the 1700's when the Dutch geologists crossed over to Sarawak from Kalimantan, Indonesia, the former Dutch colony. However, more detailed and systematic geochemical survey was only carried out during 1980s by the Geological Survey Malaysia, mainly collecting stream sediments and panned concentrates at the confluence of 4th or the 3rd order stream (Tan, 1979, Alex Unya *et al*., in press). The results from the analysis of the stream sediments showed some high anomalous values for gold, copper and other metallic minerals.

In more recent years, detailed geological mapping, geochemical and geophysical surveys were carried out in the vicinity of these two hills. Geological mapping results showed that the intrusives in the two areas are multi-phase intermediate to acid intrusive stocks which had thermally metamorphosed the surrounding country rocks belonging to the Silantek Formation. Rock geochemistry study shows that the intrusives in the two areas can be classified as calc-alkaline series in which the weight percentage of CaO = K_2O+Na_2O, and the weight percent of silica are between 56-61% (oversaturated).

The two intrusive stocks are associated with extensive hydrothermal alteration and are believed to have potential for gold and copper mineralization. In Bukit Selanjan area, there are potentials for the existence of gold mineralization zones controlled by two large breccia pipes in the intrusive rocks. The three major breccia zones outcropped in the central part of the southern intrusive body; the largest of one is about 2100 m^2 (70 m×30 m), and the other two breccia outcrops are 600m^2 (30 m×20 m) and 480 m^2 (24 m×20 m) respectively. Two types of breccia pipes that may be associated with gold mineralization can be recognized; high fluidized breccia and low fluidized breccia. The alteration is mainly sillicification, sericitization, chloritization and advanced argillization that may relate to possible gold mineralization.

Extensive stock-works and with sporadic disseminated copper mineralization associated with gold are confined within the intrusive outcrops in the Bukit Nimong area. Evidence of major alterations in Bukit Nimong area includes silicification, potassium metasomatic alteration, sericitization, boititzation and K feldspar development. These are indications of a possible porphyry copper system in the Bukit Nimong area.

Geochemistry results of soil samples from both the Selanjan and Bukit Nimong areas showed anomalous values for copper and gold. Geophysical Induced Polarization survey is planned to be carried out in the two areas with latest technology and high capacity equipment (10kw power supply VIP 10000 IP System) which can penetrate down to five hundred meters. The IP results will guide further exploration works including drilling in the two areas.

Paper B2

Structural control on quartz veins in the Penjom Gold Mine, in particular at Kalampong Pit

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Penjom Gold Mine lies 50 km east of a major terrain boundary, the Raub-Bentong Suture within the central belt of the Malay Peninsular. Regional structure as seen on SRTM DEM shows that Penjom is situated along the NNE trending splay from the main Raub-Bentong Suture as indicated by strike ridge lineaments. The host rock is composed of Late Permian turbiditic sequence (Shafeea Leman *et al*., 2005) comprising of calcareous shale, carbonaceous shale, tufffaceous sandstone and conglomerate. These sequences are intruded by felsite intrusives of tonalitic composition. This intrusive rock is a very important lithological unit that provides chemical and physical contrasts under its structural control.

Veins are important components of most of epigenetic hydrothermal ore system. Understanding their formation and the different styles of quartz veining is the key to unravelling the structural controls on the ore system (Davis, 2005). It is very important to study episodes of veins formation to distinguish features due to the vein formation and superimposed features by later deformation.

Gold mineralisation in the Penjom Gold Mine is dominantly hosted in structurally controlled quartz-carbonate veins that display variable degrees of an overprinting event under ductile-brittle environment. Quartz vein is categorised into two main types, namely as shear veins and extensional quartz veins (Davis, 2005). Shear veins comprise of ribbon to laminated veins developed only in carbonaceous units either as massive or very thin units, parallel to bedding or shearing. These veins are interpreted as occurring during folding and thrusting events involving repeated opening of the bedding and shearing. They are generally hosts to high grade mineralization (Corbett, 1999) although at certain places are not well mineralised. Along the main thrust, these shear veins have been further reactivated as shown by their textural modification during later stage event. Associated with shear veins are several types of extensional veins including sub-vertical extension vein array, breccias and stockwork.

Faults parallel to the Penjom thrust that show both reverse and dextral displacements overprinted the earlier event but only generated extensional veins of the same morphology, mostly at intersections of sediment-intrusive contact or as shallowly dipping veins within the intrusive bodies. This structure may also reactivate earlier shear vein structures. Local NNW faults control significant mineralization at the west wall of Jalis Corridor in the form of shear veins, massive to sheeted extensional veins. A series of North-South trending sinistral, oblique to normal faults intercept the Penjom Thrust and a folded sequence at low angles are not associated with the above style of veins but locally hosted quartz-calcite veins.

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Paper B3

Characterisation of gold mineralisation, Sungai Charah – Cini Timur area, Pahang

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The Sg Charah-Cini Timur area is bounded by longitude 103 02'E to 103 05'E and latitude 3 15'N to 3 18'N, SE of Tasik Chini and about 90km from Kuantan. The area is dominated by Carbo-Permian metasediments of the Mersing Beds which consists of slate, phyllite and quartzite.

Gold is encountered in quartz veins as primary eluvial or colluvial gold on hillslopes or as alluvial gold in adjacent streams and rivers. Jets of water are directed at and around loose material along quartz veins along hillslopes and foothills and gold is recovered by panning or simple mobile palongs. Ore material from certain hillslopes were ground on site in mini grinders and then recovered in mini palongs. Gold was panned from 2 hillslopes in the Cini Timur area whereas in the Sungai Charah area gold was panned from 2 hillslopes and an alluvial mine.

Binocular study show that physically the gold grains in the Cini Timur area are angular to rounded in roundness and prismoidal to discoidal in sphericity with average lengths of 1.17 - 3.64 mm and widths of 1.39 - 2.02 mm. The gold grains recovered in the Sungai Charah area are subrounded to angular in roundness and have subprismodal to subdiscoidal sphericity with average lengths of 0.3-3.0mm and widths of 0.5 - 4.0 mm.

EPMA analyses show that geochemically the gold grains from Cini Timur area have 4 main sets of fineness values of 601.5 - 663.9, 720.1 -744.9, 754.0 - 799.6 and 808.6 - 843.1. The gold grains from Sungai Charah area, however, have 2 main sets of fineness values of 852.2 -883.1 and 900.7 - 932.0.

Paper B4

Local silica sand deposits and their utilisation in producing cordierite glass-ceramics

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Three silica sand deposits (Bintulu, Terengganu and Perak ex-mining land) were used as a raw material in producing cordierite glass-ceramics (MgO-Al_2O_3-SiO_2-TiO_2). The crystallization sequences of MgO-Al_2O_3-SiO_2-TiO_2 system glass were studied by means of differential thermal analysis (DTA), X-ray diffraction (XRD) and field emission scanning electron microscopy (FESEM). The base glass had a composition of 45.00% SiO_2, 24.00% Al_2O_3, 15.00% MgO and 8.50% TiO_2 as the nucleating agent. The procedure for the preparation of the cordierite glass-ceramic material included glass melting, forming, annealing and heat treatment. From the DTA results, the crystallization temperature was found to start around 800ºC~ 900ºC. The XRD analysis of the glass-ceramics indicated that the cordierite phase became more dominant for the Bintulu silica sand compared to the Terengganu and Perak ex-mining land deposits. The coefficient of thermal expansion (CTE) results showed that the Bintulu glass-ceramics had lower thermal expansion compared to the glass-ceramics using Terengganu and Perak ex-mining land deposits. The Vickers micro-hardness result of the Bintulu, Terengganu and ex-mining revealed that increasing the heat-treatment temperature results in a slightly increase of the hardness values. Based on the XRD results, the Bintulu and Terengganu silica sand deposits can be used as SiO_2 source for producing cordierite glass-ceramics without any further chemical upgrading. Here it also clear that the ex-mining silica sand deposit does not have the purity level required to have the same performance as Bintulu and Terengganu deposits without further improvement

Tiga deposit pasir silika (Bintulu, Terengganu dan bekas lombong Perak) telah digunakan sebagai bahan mentah untuk penghasilan kaca-seramik kordierit (MgO-Al_2O_3-SiO_2-TiO_2). Aturan penghabluran sistem kaca (MgO-Al_2O_3-SiO_2-TiO_2) telah dikaji dengan menggunakan alat analisis pembezaan terma (DTA), pembelauan X-ray dan FESEM. Kaca asas mempunyai komposisi 45.00% SiO_2, 24.00% Al_2O_3, 15.00% MgO dan 8.50% TiO_2 sebagai agen penukleusan. Prosedur penyediaan bahan kaca-seramik kordierit termasuk peleburan, pembentukan, penyepuhlindapan dan rawatan haba kaca. Daripada keputusan DTA, suhu penghabluran diadapati bermula sekitar 800ºC~ 900ºC. Analisis XRD kaca-seramik mendapati fasa kordierit menjadi lebih dominan bagi pasir silika Bintulu berbanding dengan deposit Terengganu dan bekas lombong Perak. Keputusan ujian pekali pengembangan haba (CTE) menunjukkan kaca-seramik Bintulu mempunyai pengembangan haba yang rendah berbanding dengan kaca-seramik Terengganu dan bekas lombong Perak. Keputusan ujian micro-kekerasan Vickers Bintulu, Terengganu dan bekas lombong Perak mendedahkan bahawa peningkatan suhu rawatan haba akan sedikit meningkatkan nilai kekerasan. Berdasarkan kepada keputusan –keputusan XRD yang telah didapati, deposit pasir silika Bintulu dan Terengganu mempunyai potensi untuk digunakan sebagai sumber SiO_2 bagi penghasilan kaca-seramik kordierit tanpa melalui proses tambah nilai secara kimia. Kajian ini juga membuktikan bahawa deposit pasir silika bekas lombong tidak mempunyai tahap ketulenan yang diperlukan seperti untuk memiliki prestasi yang serupa deposit Binyulu dan Terengganu tanpa tambah nilai lanjut.

Paper B5

Critical mineral characteristics and their applications to the paint industry in the Asia region

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In general, industrial mineral deposits are often defined by the mineralogy, quantity and quality of what we perceive as suitable for the industry, without sufficient understanding of the final applications. But very often, it is the detailed requirements (specifications) of the end-user, other than the processing capabilities, the price and the logistics, which define whether a deposit is economically viable, and whether it can be used for certain applications or not, such as for the paint industry.

The paint industry is important because it is one of the industries where a large abundance of minerals are used, and where the specifications are normally quite stringent. This industry contributes a value of over US$ 450 million (from 150 million litres) to the Malaysian economy. It is therefore extremely important to focus on the particular requirements of this industry, so that we have a better guide to search for mineral deposits that can fulfill the requirements of this industry.

In the infancy of the paint industry, minerals are commonly used as cheap fillers to reduce the cost of a can of paint. However, in recent times, modern paint formulators can modify both the engineering and aesthetics of these paints or coatings, of which the mineral fillers (now referred to as extenders) are a part.

The extenders are now used as engineering tools, and they play diverse roles in the application and function of the modern coatings.

Some of the more important extenders or mineral groups used by the paint industry in Malaysia, and many countries in Asia, are calcium carbonate, barium sulfate, silica, and the silicates which include talc, clay, feldspar and mica.

However, many more mineral products need to be studied and researched, as the industry is getting better aware of their role in improving the paint properties, as well as in reducing costs by replacing the existing, highly expensive (but similar mineral materials), that are being imported from the US and the EU.

The critical mineral parameters that have to be considered, when formulating different types of paints for certain functions, are as shown below.

a) Physical & chemical characteristics of individual mineral or composites
b) Size of mineral grains achievable, based on grinding capabilities
c) Degree of weathering of the mineral product
d) Presence or absence of impurities in the mineral product; what types, quantity, in what form eg locked or free, and are the processes capable of separating the impurities from the mineral products.
e) Are the mineral products in compliance with environmental & safety regulations eg. are the mining operations sustainable, & is the source rehabilitated after mining.
f) Consistency of the products delivered from supplier (for every batch)

Some examples of the mineral properties that are critical to the paint industry are discussed.

From consideration of the above requirements, it may be necessary to further delineate various sub-zones within a mineral deposit for different applications to the paint industry.

Paper B6

Lime industry in Malaysia

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The lime industry is one of the established mineral-based downstream industries in Malaysia. The term lime is used for an inorganic compound, white in colour with chemical formula CaO or known as calcium oxide. Lime is not a mineral; it is manufactured from limestone or other sources of calcium carbonate ($CaCO_3$) such as coral, chalk or oyster shells. There are two main types of lime produced in Malaysia, namely quicklime or unslaked lime or calcium oxide (CaO) and hydrated lime or slaked lime or calcium hydroxide ($Ca(OH)_2$). In addition, hydraulic lime and putty lime or plaster lime are also being produced to cater for the local market demand.

Lime is used in many important industrial processes including iron and steel manufacture, non-ferrous metal industry, building/construction, food industry, agriculture, soil stabilization, chemical industry and other environmental applications.

There were 19 lime producers throughout the country in 2008; 16 in Peninsular Malaysia and three in Sarawak. Most of the lime producers are using modern kiln to produce lime in bulk quantity, however there are still some producers using the traditional method in calcinations process.

During 2008, Malaysia produced about 21 million tonnes of lime valued at RM105.6 million. During the same period, 0.3 million tonnes of lime worth RM64 million were exported and 0.014 million tonnes valued at RM 7.8 million were imported.

Industri kapur di Malaysia

Industri kapur merupakan salah satu industri hiliran berasaskan mineral yang telah kukuh bertapak di Malaysia. Istilah kapur digunakan untuk sebatian bukan organik, berwarna putih dengan formula kimia CaO atau dikenali sebagai kalsium oksida. Kapur bukan sejenis mineral, ia dihasilkan daripada proses yang dilakukan terhadap batu kapur atau sumber kalsium karbonat ($CaCO_3$) yang lain seperti karang, kapur (chalk) atau cengkerang. Terdapat dua jenis utama kapur yang dikeluarkan di Malaysia, iaitu kapur tohor atau kalsium oksida (CaO) dan kapur tohot terhidrat atau kalsium hidroksida ($Ca(OH)_2$). Selain itu, kapur hidraulik dan kapur putty atau kapur plaster turut dikeluarkan bagi memenuhi permintaan pasaran tempatan.

Kapur digunakan dalam banyak proses industri yang penting termasuk pembuatan besi dan keluli, industri logam bukan berbesi, bangunan/pembinaan, industri makanan, pertanian, penstabilan tanah, industri kimia dan lain-lain kegunaan berkaitan dengan alam sekitar.

Terdapat 19 pengeluar kapur di seluruh negara pada tahun 2008; 16 di Semenanjung Malaysia dan tiga di Sarawak. Kebanyakan pengeluar kapur sudah menggunakan teknologi moden untuk pengeluaran kapur dalam kuantiti yang banyak. Walau bagaimanapun terdapat sebilangan pengusaha yang masih menggunakan kaedah tradisional dalam proses pengkalsinan.

Pada tahun 2008, pengeluaran kapur di Malaysia adalah sebanyak 21 juta tan yang bernilai RM105.6 juta. Pada masa yang sama, Malaysia mengeksport kapur sebanyak 0.3 juta tan kapur bernilai RM64 juta dan mengimport sebanyak 0.014 juta tan kapur bernilai RM7.8 juta.

Paper B7

Rare Earth Elements (REE) resources potential in weathered granitic rocks in Peninsula Malaysia

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In this study, a potentiality for ion-adsorption REE deposits in Malaysia is examined. Since weathered granites are well developed because of a tropic climate with high temperature and high humidity in Malaysia, mineralization of ionadsorption is expected. Fresh and weathered granitic rocks were collected in Malaysia and these samples were analyzed in order to evaluate REE resources potential in Malaysia. Powdered samples were analyzed contents of major and the traces of elements by X-ray Fluorescence Spectrometry (XRF) and Inductively Coupled-Mass Spectrometry (ICP-MS). Though the volatile components such as moisture and carbonate cannot be analyzed by XRF, LOI (Loss on Ignition) allows to measure wt% of volatile components. An average ∑REE content of fresh granites is 267ppm and an average ∑REE content of weathered crusts is 217 ppm. In addition, averages of LREE/HREE and Th+U (ppm) are 13 and 64 ppm. It can be observed that the more REE concentration, the more radioactive elements concentration. At Lumut (Manjong), weathered crusts were developed well and high REE concentrations were observed. The ∑REE content of China ion-adsorption type deposits varies from 500 ppm to 2000 ppm while the highest ∑REE content of Lumut is 763 ppm (+Y 844 ppm).

Paper B8

Recovery of gold from gold scrap by hydrometallurgical process

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A process for the recovery of gold from gold scrap is described. It is based on heating the scrap material along with the mixture of hydrochloric acid, sulphuric acid and sodium nitrate. The gold scrap is completely dissolved only if the silver content in the scrap is below 15%. Recovery of gold is achieved by precipitation with ascorbic acid. The study showed that ascorbic acid is capable to recover gold up to 99.9%. A brief comparison of this dissolution system and aqua regia method is reviewed. The process can be scaled up and is suited to high carat gold.

Satu proses pengembalian semula logam emas daripada skrap emas dilakukan berdasarkan kepada pemanasan bahan skrap emas di dalam campuran asid hidroklorik, asid sulfurik dan sodium nitrat. Skrap emas hanya akan melarut dengan sempurnanya jika kandungan perak di dalam skrap tidak melebihi 15 peratus. Pengembalian semula logam emas dilakukan dengan pemendakan menggunakan asid askorbik. Kajian yang dijalankan menunjukkan bahawa asid askorbik berupaya mengembalikan logam emas sehingga mencapai ke tahap 99.9 peratus. Satu perbandingan ringkas di antara sistem pemelarutan ini dengan kaedah aqua regia telah diulas. Proses ini berupaya digunakan mengikut skala dan sesuai bagi emas yang mempunyai karat yang tinggi.

Paper B9

An investigation by variable pressure scanning electron microscopes (VPSEM) of primary gold from Selinsing Gold Mine, Pahang, Malaysia

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Characterization of primary gold in Selinsing Gold Mine, Pahang has been done using the variable pressure scanning electron microscopes (VPSEM). The VPSEM has been found to be a very useful technique in the characterization of gold samples. VPSEM study shows that the gold samples in the Selinsing Gold Mine, Pahang are associated with other minerals such as arsenopyrite, pyrite, rutile, scheelite, FeAsS ± Pb mineral, iron oxides and a range of trace minerals that include chalcopyrite, tetrahedrite and sphalerite. VPSEM analysis also shows that Au composition ranges from 89.20% to 89.30% with 10.70%-10.80% Ag in the gold samples. The presence of Ag being seen as non-uniform replacement of Au in the gold alloy.

Paper B10

Early Carboniferous (Tournaisian) radiolarians from Peninsular Malaysia and their significance

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Distribution of Early Carboniferous (Tournaisian) radiolarians was widespread. They were reported from Western Europe, southern North America, Australia, Turkey, south China and Southeast Asia. In Peninsular Malaysia, the Early Carboniferous radiolarians were reported from the Kubang Pasu Formation, Late Paleozoic chert sequence from north Perak, the chert block in Langkap and the Kenny Hill Formation. The Kubang Pasu chert is exposed at several earth quarries at Ulu Pauh and Guar Sanai, Perlis, Bukit Inas, Ladang Cheong Chong Kaw, Kampung Belukar, Bukit Panchor, Bukit Kamelong, Bukit Telaga Jatuh, Guar Kepayang, and Bukit Meng, Kedah. Early Carboniferous radiolarian chert was also reported from Late Paleozoic rock sequence exposed at north Perak near the Thai border. High diversity radiolarians were reported from the chert block exposed at Langkap Negeri Sembilan. The radiolarians from the Kubang Pasu were recorded from Ulu Pauh, Bukit Kamelong, Telaga Jatuh, Bukit Binjal and Guar Kepayang. Samples from Bukit Binjal yielded nine species of radiolarians viz. *Stigmosphaerostylus variospina* (Won*), Entactinia unispina* Won, *Entactinia inaquoporosa* Won*, Callela hexatinia* Won*, Callela* cf *parvispinosa, Trianosphaera hebes* Won*, Cubaxonium? Octaedrospongiosum* Won*, Duplexia foremanae* Won and *Duplexia parviperporata* Won. Other localities yielded only two species mainly *Stigmosphaerostylus variospina* (Won) and *Callella* sp. Radiolarite from the Paleozoic rock sequence north Perak yielded twenty radiolarian taxa namely *Albaillella* cf. *perforata* s.l. Won, *Archocyrtium lagabriellei* Gourmelon, *Archocyrtium pulchrum* Braun, *Archocyrtium venustum* Cheng, *Astroentactinia biaciculata* Nazarov, *Astroentactinia digitosa* Braun, *Astroentactinia mirousi* Gourmelon, *Astroentactinia multispinosa* Won, *Astroentactinia stellaesimilis* Won, *Belowea hexaculeata* Won, *Belowea variabilis* Ormiston & Lane, *Ceratoikiscum berggreni* Gourmelon, *Palaeoscenidium cladophorum* Deflandre, *Pylentonema antiqua* Deflandre, *Stigmosphaerostylus brilonensis* (Won), *Stigmosphaerostylus tortispina* (Ormiston & Lane), *Stigmosphaerostylus variospina* (Won), *Stigmosphaerostylus vulgaris* (Won), *Trilonche altasulcata* (Won), and *Triaenosphaera* sp. Thirty radiolarian taxa were identified from the chert block in Langkap i.e. *Albaillella cornuta* Deflandre, *Albaillella deflandrei* Gourmelon, *Albaillella paradoxa* Deflandre, *Albaillella undulata* Deflandre, *Archocyrtium clinoceros* Deflandre, *Archocyrtium ludicrum* Deflandre, *Archocyrtium lagabriellei* Gourmelon, *Archocyrtium pulchrum* Braun, *Archocyrtium strictum* Deflandre, *Archocyrtium* cf. *ferrum* Braun, *Archocyrtium* sp. A, *Archocyrtium* sp. B, *Astroentactinia multispinosa* Won, *Astroentactinia biaciculata* Nazarov, *Belowea* sp. *Callella* cf. *conispinosa* Won, *Callella* sp.*, Callella parvispinosa* Won, *Ceratoikiscum avimexpectans* Deflandre, *Ceratoikiscum berggreni* Gourmelon, *Ceratoiciskum umbraculum* Won, *Ceratoiciskum* sp., *Cerarchocyrtium singulum* Cheng, *Cystisphaeractinium mendax* Deflandre, *Cystisphaeractinium* sp. A, *Cystisphaeractinium* sp. B, *Entactinia digitosa* Braun, *Entactinia vulgaris* Won, *Entactinosphaera palimbola* Foreman, *Huasha* sp, *Polyentactinia polygonia* Foreman, *Pylentonema* sp.*, Robotium* sp., and *Triaenosphaera sicarius* Deflandre. The radiolarians from these localities exhibit different specific diversity which was related to the different type of environments. The relatively shallow water environment is characterized by low diversity and is dominated by *Stigmosphaerostylus variospina* (Won) and *Calella* sp. The deeper water is characterized by high specific diversity and dominated by *Albaillella* association. Early Carboniferous was considered as a part of an ice-house period. During the Tournaisian there was a hypersiliceous event where the radiolarian productivity was very high. The high radiolarian productivity during this time suggests that the water mass was very rich in nutrient and siliceous material. This event was probably related to the upwelling currents which brought nutrient-rich bottom water to the surface. The widespread radiolarian bearing chert can be used as a marker bed for stratigraphic correlation in Peninsular Malaysia.

Paper B11

A short note on the discovery of Early Devonian tentaculite-bearing unit from Taunggyi-Taungchun range, Shan State (south), Myanmar

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The Devonian limestone unit, which contains tentaculites, is reported for the first time from the Taunggyi town area, in Shan State (south). They occur in the narrow outcrop between the Linwe Formation of Silurian age and the Plateau Limestone Group of Permian to Triassic. The unit is stratigraphically measured 10.7m at the Taungchun section. The unit's lower part is dominated by thick-bedded limemudstone with occasional thin beds of fine sandstone. The tentaculites occur in purple, calcareous siltstone of the base of the section. In the upper part of the unit, features thicker and medium bedding and is composed chiefly of light to dark grey limemudstone.

The Taungchun tentaculites are small, 1.5-9mm in length, thin-shelled forms. There are two basic types, ringed and unringed of similar proportion. The Taungchun tentaculites are closely compared with those from the Mahang Formation of Kampong Pahit, Perak, northwest Malaya (Burton 1967a) in size range and shape and proportion of the constituted fauna. The Malaysian ringed tentaculites are also long, as much as 8mm and have wider space (3.6 to 5.8) rings in 1 mm, interspaces are wide and flat, fine longitudinal ribs numbering between 4 and 7 in 0.2 mm. The Malayan ringed tentaculites commonly proved to be closed to Lower Devonian *Nowakia acuaria* it is possible to correlate the beds with lower Emsian (middle part of Early Devonian. The Taungchun tentaculites might have close similarity to *Nowakia acuaria* of the Zebingyi Formation in Pyin Oo Lwin township described by Aye Ko Aung (in prep.) from Early Devonian (Pragian) Khin Zo chaung limestone Member of the Zebingyi Formation (Aye Ko Aung, 2008). The unit is correlatable with the Early Devonian Zebingyi Formation of Pyin Oo Lwin township, Mandalay Division and possible equivalents of the latter in the Shan State (south) are also stated.

Paper B12

Singkapan batuan yang tersingkap dari Layang-Layang hingga Laban Rata, Gunung Kinabalu, Sabah

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Kerjalapangan dari Layang-Layang hingga Labah Rata telah dilakukan di Gunung Kinabalu, Sabah. Singkapan batuan yang tersingkap ini terletak dibahagian tengah Gunung kinabalu. Kajian ini dilakukan bertujuan untuk mengenal jenis-jenis batuan yang terdapat di sepanjang jalan rintisan dari Layang-Layang hingga ke Laban Rata. Selain itu, kajian ini juga bertujuan untuk melihat kaitan antara batuan dilapangan seperti hubungan sempadan antara batuan, kaitan kandung-mengandung dan kaitan terobosan antara batuan. Batuan yang terdapat dilapangan boleh terbahagi kepada enam jenis batuan iaitu granit hornblend berbutir sederhana, granit hornblend berporfirit, serpentinit, batuan Formasi Trusmadi, korok aplit dan korok pegmatit. Namun begitu, dua jenis batuan sahaja yang dominan iaitu granit hornblend berbutir sederhana dan granit hornblend berporfirit. Kaitan antara batuan menunjukkan bahawa batuan granit hornblend berporfirit menerobos kedalam batuan granit hornblend. Ini ditunjukkan oleh sempadan batuan diantara batuan granit hornblend dan granit hornblend berporfirit di bahagian Laban Rata. Berdasarkan kepada saiz butiran kedua-dua batuan di sempadan batuan, didapati pengaturan fenokris feldspar alkali kebanyakkannya adalah selari dengan sempadan batuan. Selain daripada itu, pada tepi batuan granit hornblend berporfirit berdekatan dengan sempadan juga turut mengalami penghabluran semula. Namun fenokris feldspar alkali masih sedikit jelas kelihatan dan sebahagian daripada mineral telah terhablur membentuk mineral yang lebih kecil dan bersaiz butiran halus. Kaitan kandung-mengandung antara batuan menunjukkan bahawa batuan serpentinit dan Formasi Trusmadi terkandung didalam batuan granit hornblend berporfirit. Ini menunjukkan bahawa serpentinit dan batuan Formasi Trusmadi merupakan batuan yang lebih tua daripada batuan granit hornblend berporfirit. Selain itu, di Pondok Rehat Villosa terdapat korok aplit yang menerobos batuan granit hornblend berporfirit. Penerobosan ini menunjukkan bahawa korok aplit mempunyai usia yang lebih muda dari granit hornblend berporfirit.

Paper B13

Geologi Teluk Kubang Badak, Langkawi, Kedah

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Teluk Kubang Badak terletak di bahagian utara Pulau Langkawi dan merupakan kawasan di mana Formasi Machinchang dan Formasi Setul bersempadan. Formasi Machinchang terletak di bahagian barat, merangkumi Pantai Pasir Tengkorak, Tanjung Buta serta Pulau Jemuruk, manakala bahagian timurnya pula terdapat Formasi Setul yang merangkumi Tanjung Sabung, kawasan kuari simen dan juga bukit Gua Pinang.

Jujukan Formasi Machinchang di Pantai Pasir Tengkorak hingga Tanjung Buta memperlihatkan beberapa sekutuan fasies. Sekutuan fasies batu pasir berlapisan silang terdiri daripada himpunan lapisan batu pasir tebal hingga masif dan banyak struktur lapisan silang boleh diperhatikan, termasuk lapisan silang bersaiz mega. Dalam sekutuan fasies ini juga boleh ada lumpur nipis dan kadang-kadang memperlihatkan struktur riak simetri. Satu lagi ialah sekutuan fasies selang lapis batu lumpur, lodak dan batu pasir nipis. Secara umumnya lapisan lumpur lebih tebal daripada lapisan pasir. Antara struktur sedimen yang utama boleh diperhatikan ialah canggaan akibat larian air ke atas yang membentuk struktur api dan kesan beban serta kesan riak simetri. Terdapat juga beberapa kesan hasil daripada korekan organisma dalam lapisan lodak.

Di Pulau Jemuruk terdapat lapisan batu pasir, lodak dan lumpur yang membentuk dua sekutuan fasies yang lain. Sekutuan pertama terdiri daripada perlapisan batu pasir yang sederhana tebal, terdapat struktur laminasi selari serta lapisan silang bersudut rendah dan tiada struktur lapisan silang berskala besar atau bersudut tinggi. Dalam sekutuan fasies ini pernah dilaporkan penemuan serpihan fosil trilobit. Sekutuan fasies kedua terdiri daripada selang lapis batu lumpur dan batu pasir nipis. Dalam sekutuan ini terdapat fosil kesan yang menjalar di atas lapisan.

Sempadan dua formasi ini jelas kelihatan di Tanjung Sabung yang bertentangan dengan Pulau Jemuruk. Di sini boleh diperhatikan lapisan sedimen klastik Formasi Machinchang yang terdiri daripada batu pasir, lodak serta syal terletak di bawah lapisan masif batu kapur Formasi Setul secara selaras. Sebelum jujukan klastik Machinchang berubah kepada batu kapur Setul, terdapat satu zon peralihan setebal beberapa meter di mana batu kapur dan batu klastik saling berlapis nipis. Ini menunjukkan peralihan daripada Machinchang kepada Setul tidak berlaku secara mendadak, tetapi peralihan secara perlahan-lahan.

Batu kapur Formasi Setul yang terdapat di Teluk Kubang Badak berlapisan tebal dan masif. Batu kapur ini telah berubah yang mana sebahagian besarnya telah menjadi marmar. Perubahan batu kapur ke marmar ini disebabkan oleh rejahan granit yang terdapat di Bukit Sawar.

Selain daripada jujukan batuan Paleozoik Formasi Machinchang dan Formasi Setul, di Teluk Kubang Badak juga terdapat satu endapan kuaterner yang terletak di bukit Gua Pinang. Endapan Kuaterner ini terdiri daripada himpunan cengkerang kuno yang tidak diketahui usianya. Himpunan cengkerang kuno yang serupa telah ditemui di beberapa tempat di Langkawi dan ada yang menunjukkan usia hingga 7000 tahun. Endapan cengkerang ini terletak puluhan meter lebih tinggi daripada aras laut sekarang dan merupakan satu petunjuk aras laut masa lampau.

Paper B14

Geologi dan geomorfologi kepulauan dalam cadangan Geopark Delta Sarawak

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Terdapat lapan buah pulau kecil dalam cadangan Geopak Delta Sarawak. Pulau-pulau ini terletak di utara kawasan Bandaraya Kuching dan di Kuala Salak. Gugusan kepulauan terdiri daripada Pulau Satang Besar, Satang Kecil, Sampadi, Tukong Ara dan Tukong Banun terletak 3 hingga 10 km ke utara luar pantai Kuching. Manakala gugusan kepulauan mengandungi Pulau Salak, Kelasah dan Kera terletak di Kuala Salak. Pulau Satang Besar, Sampadi, Satang Kecil, Tukong Ara dan Pulau Kera didominasi oleh Batu Pasir Kayan; Pulau Tukong Banun, Salak dan Kelasah dibentuk oleh batuan Formasi Pedawan yang termetamorf sentuh disebabkan oleh rejahan igneus. Di Pulau Salak terdapat beberapa rejahan igneus yang lebih dominan berbanding di pulau-pulau lain yang membentuk rejahan kecil seperti daik dan sil. Morfologi pantai di kebanyakkan pulau dibentuk oleh hamparan batuan yang mendatar, kadang-kadang dilitupi oleh kelikir di beberapa tempat. Terdapat juga pantai di beberapa pulau yang dibentuk oleh morfologi tebing yang curam. Morfologi pantai perpasir didapati di bahagian selatan Pulau Satang Besar. Pulau Salak menunjukkan morfologi berbeza kerana didominasi oleh perbukitan yang dibentuk oleh beberapa stok igneus. Kewujudan pulau-pulau ini membentuk kepelbagaian landskap yang mencirikan keunikan tersendiri dalam sistem delta Sungai Sarawak.

There are eight small islands within the proposed Sarawak Delta Geopark. These islands are located at the offshore area north of Kuching City area and also at the mouth of Sungai Salak. Islands of Satang Besar, Satang Kecil, Sampadi, Tukong Ara and Tukong Banun located 3 to 10 km to the north of Kuching coastal area. Meanwhile another group of islands namely, Pulau Salak, Kelasah and Kera are located at the Salak river mouth. The Satang Besar, Sampadi, Satang Kecil, Tukong Ara and Kera Islands are composed mainly the Kayan Sandstone; Tukong Banun, Salak and Kelasah Islands are underlain by the contact metamorphosed rock of the Pedawan Formation, which was formed as the result of igneous body intrusion. In Salak Island, there are several igneous occurrence of the intrusive body compared to other islands with only small intrusions such as dyke and sill. The beach in these islands solely made up flat rock pavements, however in places covered with gravel deposit. The islands are also bounded by cliff faces. Sandy beach are observed in the southern part of the Satang Besar Island. Salak Island showed a different morphology of mountain formations underlain by the igneous stocks. These islands had created landscapes that characterize its uniqueness in the Sarawak River delta system.

Paper B15

Geokimia batuan igneus Pulau Pangkor, Lumut, Perak

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Pulau Pengkor terletak di bahagian pantai barat Semenanjung Malaysia. Kajian dilakukan untuk menentukan jenis-jenis batuan igneus dan geokimia batuan igneus yang tersingkap di Pulau Pangkor dan pulau sekitarnya. Sebanyak 40 stesen cerapan dilakukan meliputi 28 stesen di sepanjang rintisan jalan raya dan 12 singkapan meliputi tinjauan menggunakan bot merangkumi pulau-pulau berhampiran. Berdasarkan saiz butiran, warna dan kewujudan batuan, didapati empat jenis batuan boleh dibezakan di lapangan, iaitu granit biotit berbutir kasar berporfir, granit biotit berbutir sederhana, mikrogranit berporfir dan telerang mikrogranit. Daripada 40 sampel yang diambil, sebanyak 8 sampel terpilih telah dianalisis secara XRF untuk mendapat 10 unsur-unsur major dan 20 unsur-unsur surih. Ia menunjukkan julat peratusan SiO_2 antara 75.52 – 80.09 wt%, dengan purata 77.26 wt%. Unsur Al_2O_3 adalah tinggi iaitu berjulat antara 12.58 – 14.59 wt% dengan purata 13.73 wt%. Unsur-unsur TiO_2, MnO dan P_2O_5 menunjukkan nilai yang sangat rendah masing-masing dengan julat dan purata, 0.13 – 0.32 wt% dan 0.22 wt%; 0.01 – 0.04 wt% dan 0.03 wt%; 0.05 – 0.13 wt% dan 0.08 wt%. Unsur MgO adalah tersangat sedikit, iaitu kesemua sampel di bawah had pengesanan kecuali sampel S3(a) yang bernilai 0.05 wt%. Nilai kepekatan K_2O adalah tinggi dengan julat antara 5.11 – 6.33 wt% dan purata 5.53 wt%. Manakal unsur Na_2O dan Fe_2O_3 adalah rendah dengan masing-masing julat dan purata iaitu 0.75 – 1.04 wt% dan 0.89 wt%; 0.79 – 2.17 wt% dan 1.63 wt%. Plotan Gambarajah Harker menunjukkan tren negatif yang baik oleh unsur TiO_2, Al_2O_3, Fe_2O_3 dan MnO. Unsur-unsur CaO, Na_2O, K_2O dan P_2O_5 menunjukkan tren mendatar. Tren ini menunjukkan empat jenis batuan berasal daripada punca magma yang sama. Nilai jumlah alkali adalah tinggi iaitu antara 5.93 – 7.27 wt% menunjukkan batuan dikelaskan sebagai batuan siri alkali. Nilai nisbah A/NK dan A/CNK didapati berjulat antara 3.45 – 7.04 dan 1.46 – 1.58 masing-masing. Ini menunjukkan batuan adalah jenis peralumina dan dikelaskan sebagai granit jenis-S yang berasal daripada kerjaan semula batuan sedia ada.

Paper B16

Heavy mineral pattern in stream sediments of Kuala Krai area, Kelantan

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A study of the heavy minerals in the stream sediments in an area to the south of Kuala Krai, Kelantan was carried out. The lithology of the area consist of Late Paleozoic sedimentary rocks of the Gua Musang Formation being intruded by an igneous complex consisting of acid igneous rocks from diorite to granite. A total of 16 heavy mineral samples were collected by panning. The samples were dried, sieved and later the light minerals were removed by a heavy liquid. The mineral composition of the heavy mineral sample was estimated by point counting under a binocular microscope. Common major minerals such as ilmenite, zircon and magnetite were identified by their physical properties whereas the more uncommon ones such as hornblend and cassiterite were identified by XRD. The heavy mineral fractions were also run through a Frantz Isodynamic Magnetic separator to find out the magnetic resistivity pattern of the individul sample. Each sampel composition was plotted onto an ilmenite-zircon-hornblende triangular diagram. Result of the analyses show the common major minerals present in almost all sampls are ilmenite, zircon and hornblend while minor minerals are magnetite, monazite, xenotime, garnet, pyrite, mica, cassiterite, etc. The magnetic resistivity disitribution patterns show high peaks at the 0.2-0.4 ampere fraction in almost every sample indicating the presence of ilmenite and hornblende while the less magnetic fraction dominated by zircon is less prominent. Hornblende which is ubiquitous in the igneous rocks here is detected in the heavy mineral, and to some degree, can point to the sediment provenance.

Paper B17

Site investigation using integrated methods of borehole and resistivity imaging for silty soil – A case study

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Site investigation (SI) is an essential work that provides preliminary background of the site and information for the design, construction and environmental assessment. The purposes of site investigation are to evaluate the general suitability of the site for the purposed project, to enable an adequate and economical design, to disclose and make provision for difficulties that may arise during construction due to ground and other local condition (Budhu, 2007). In order to gather information of sub-surface, borehole technique is commonly used, where heavy machineries are used to drill shaft at site. The borehole data then recorded until it reaches the hard layer. This type of tedious works may bear a high cost and time consuming. However resistivity imaging is one of the geophysical methods that also can be used to determine the soil layer. Electrical resistivity permits the delineation of the main soil types and, when performed repeatedly over time, also provides information on soil properties. The information collected is usually very useful for civil engineering works (Lian, 2005). In order to obtain the best method in SI that can save time and cost, a case study was carried out in silty soil using borehole drilling and resistivity imaging methods. The results of resistivity profile and borehole data then were compared. Results of engineering properties that were included in the borehole data, i.e. SPT, N-value was correlated with resistivity value. From the result, it was found that SPT, N-value can be estimated by resistivity value. In consideration to time, the resistivity method showed that it can provide data quicker than borehole method.

Paper B18

Survei graviti untuk kajian morfologi kars di subpermukaan kawasan Lembah Kinta, Perak - Penemuan awal

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Satu survei graviti telah dijalankan oleh kumpulan geofizik UKM di Lembah Kinta, Perak pada Jun 2009 dan Februari 2010. Kawasan kajian terletak di antara garis latitud di Selatan 4°18'8.4" hingga ke Utara 4°44'04" dan garis longitud di Barat 100°55'03" hingga ke Timur 101°57'55.8". Kawasan kajian merupakan satu lembah yang di apit oleh Banjaran Titiwangsa di bahagian timur dan Gunung Kledang di bahagian baratnya.

A regional gravity survey had been carried out in Kinta Valley, Perak in June 2009 and February 2010. The study area located between latitude line of 4°18'8.4" N and 4°44'04"N and longitude line of 100°55'03"E and 101°57'55.8"E. The valley situated at the centre between the peninsular main range at the western part and Kledang Hill in the east. A total of 372 gravity stations had been measured using the Scintrex CG-5 gravity meter, with stations interval range between 0.5 – 2 kilometre. The Tiernan-Wallace altimeter was use to determine the height of every stations. The reduction process had been done using the software "Magnetic and Gravity Reduction" (MREDUC), and then been gridded, filtered and analysed using the Oasis Montaj(Geosoft) software.

The gravity survey in Kinta Valley,Perak succesfully delineated the difference lithological boundary in the subsurface due to fault in regionale scale. A total of 20 anomalies due to karstic morphology in the subsurfece such as depressions and pinacles were clearly delineated. From the total horizontal derivative map done for regional and the residual map the gravity survey succesfully delineated many lineament structures due to tectonic activity in the subsurface at depth and shallow part respectively.

Paper B19

Electrical Resistivity Imaging to characterize weathered basalt and granite

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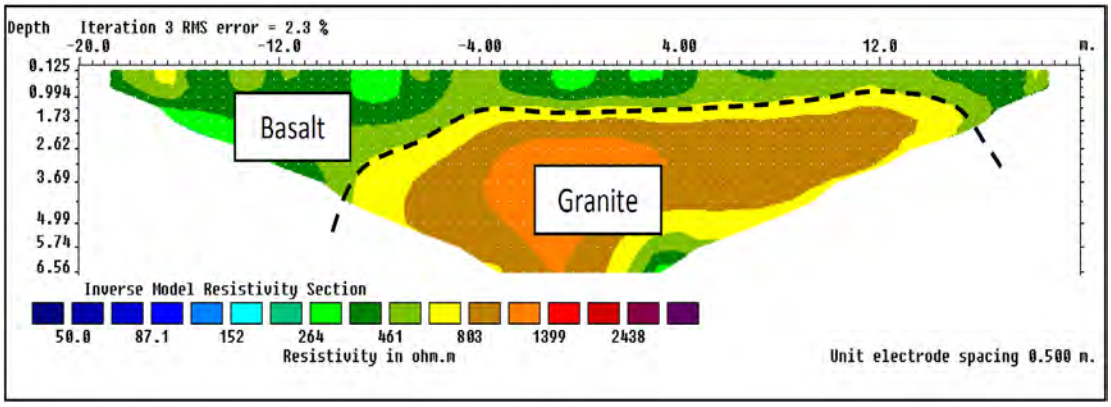
This electrical resistivity imaging project was carried out in the Kuantan, Pahang area where there are abundant exposures of basalt and granite of weathering grades IV (severely weathered) to VI (residual soil). Four profiles, measuring 40 to 80 meters long, were taken at 1 and 2 m spacing, respectively. Grain size analysis was done on the soil samples taken at the sites. The soil samples were further tested for resistivity and moisture content. Electrical resisitivity is said to vary with grain size distribution and water content, and is in turn related to the soil strength.

It was observed that basalt and granite gave different range of readings. The resistivity range for weathered basalt is about 300 to 800 Ωm while for granite, it is between 800 to 4000 Ωm. The range indicates the difference in the amount of weathering the rocks had been through, along with other factors such as amount of moisture available.

Grain size analysis showed that the soils originated from basalt had more finer grain materials than that of granite. As expected, soil resistivity was found to be inversely correlated to soil moisture content; the higher the moisture content, the lower the resistivity. For this test, we start with dried samples, then increased the moisture content until the resistivity reading shows little or no variation. The resistivity-moisture content curves for granitic soils displayed a slower decay covering a larger range of values compared to basalt of similar moisture content. The range of resistivity are 100 to 6000 Ωm for granitic soil and 80 – 1000 Ωm for basaltic soils. The presence of clay and higher percentage of ferromagnesium minerals in basaltic soil contributed to the lower resistivity readings.

This study shows the effectiveness of this method in identifying not only the type of rocks in the subsurface (granite or basalt) but also the varying degrees of weathering within the rocks. The lab results are in tandem with the field results, showing basalt as having lower resistivity values. Dried soil samples give higher resistivity values as compared to the ones obtained in-situ because of the the highly resistive air filling the spaces in between the unconsolidated grains. Resistive zones are associated with higher strength; thus integrating these results with geotechnical information makes this method an invaluable tool in site investigation. This study illustrates that subsurface geology of the area can be studied using this efficient, economical and time-saving method reducing the reliance on invasive and expensive alternatives such as drilling.



Paper B20

Electrical resistivity method – An application in site engineering work

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Electrical resistivity method has been used by many in environmental and engineering site investigation. However, the interpretation of the subsurface resistivity distribution requires prior information. A cases study will be presented where prior information has helped improved knowledge of true subsurface conditions and has aided in appropriate mitigations measures to be carried out.

Paper B21

High-resolution imaging of the groundwater potentials with geoelectrical resistivity tomography in fluvial deposit, Machang, Kelantan, Malaysia

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The first high-resolution images of the groundwater potentials obtained with the geoelectrical resistivity tomography are presented. The geoelectrical resistivity profiling surveys were conducted to determine the characteristics of the subsurface and the groundwater within the aquifer. They made up of twenty one traverse lines of different site location with Wenner configuration. The Machang plain is covered with Quaternary sediments overlying granite bedrock. The drainage system is dendritic with the main river flowing into the South China Sea. The relatively high resistivity contrast between the Quaternary basinal clastic sediments and the pre-Quaternary bedrock opened the way to extract geological information from geoelectrical resistivity explorations. All the high-resolution electrical images show a remarkable resistivity contrast between relatively low resistivity values in the shallow layers and relatively high resistivity zones in the deeper subsurface. The fluvial Machang is one of the more complex components of the Quaternary deposit of the Kelantan Delta. The thickness of Quaternary deposit in the southern and northern part ranges from 5 m to 20 m respectively. The geometry of the pre-Quaternary bedrock, the location and dip of the groundwater potential are imaged. The high-resolution electrical images allow us to trace of the groundwater potential geometry of the basin. The electrical imaging highlights the irregular shape of the basin, which is bordered by Machang Boundary Range and Kelantan River at the east and west side respectively. In longitudinal cross-section, the groundwater potentials appear as a mosaic of good, bad and moderate for an aquifer with resistivity value of 20 – 100 ohm.m, 100 – 200 ohm.m and 200 – 350 ohm.m respectively. Different groundwater potentials or basins are separated by intrabasinal highs of pre-Quaternary bedrock. In transverse cross-section, the basin is an irregular, generally dipping to the northwest. It allows the shallow aquifer flow to the Kelantan River as the ending border of the area at the northwestern side.

Paper B22

Pemetaan hidrogeofizik di Pulau Kapas, Terengganu

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Satu kajian keberintangan telah dilakukan bagi mengenalpasti litologi subpermukaan dan mencirikan air tanah di Pantai Barat, Pulau Kapas, Terengganu. Kawasan ini semakin pesat membangun dengan industri perlancongan. Keperluan untuk air tawar semakin meningkat dan wujud kemungkinan berlaku percemaran air masin.

Pulau Kapas terdiri dari beberapa jenis batuan, iaitu selang-lapis syal dan batu pasir berumur Perm-Karbon, konglomerat Kapas dari usia Trias dan batuan intrusif dari usia Kretas. Kajian ini tertumpu di kawasan barat Pulau Kapas kerana kaedah keberintangan memerlukan kawasan lapang dan permukaan agak lembut dan tidak berbatu agar mudah dimasukkan elektrod. Kawasan pantai berpasir hanya boleh didapati di sini sedangkan di bahagian lain, pemukaannya terdiri dari batuan pejal. Permukaan yang tidak boleh ditusuki elektrod untuk memasukkan elektrod dan mengukur nilai keupayaan menyebabkan kaedah keberintangan tidak boleh dijalankan.

Sebanyak 11 garisan tinjauan dilakukan dengan menggunakan peralatan ABEM SAS 4000. Cerapan dilakukan berdasarkan tatasusunan Wenner SX. Data diproses menggunakan perisian RES2DINV bagi mendapatkan model pengimejan dua dimensi bagi setiap garis tinjauan. Sempadan litologi dan jenis air berlainan dapat ditentukan dari imej ini. Beberapa sampel air permukaan juga diambil dan diuji tahap kemasinan, kekonduksian dan jumlah pepejal terlarut (TDS) dengan menggunakan peralatan Hach SensIon5. Data yang didapati dibanding dengan data keberintangan.

Di sesetengah tempat, zon air masin didapati berada dekat dengan permukaan, lebih kurang pada kedalaman dua meter. Air tawar hadir dalam akuifer terkekang dan tidak terkekang. Zon air payau berada di antara air tawar dan air masin. Tidak semua imej menunjukkan kehadiran ketiga-tiga jenis air tanah. Nilai yang digunakan bagi penentuan jenis air ialah kurang dari 5 ohm.m bagi air masin, julat 5 ke 100 ohm.m untuk air payau dan lebih dari 100 ohm.m untuk air tawar. Data parameter air menunjukkan kehadiran air tawar, air masin dan air payau di permukaan seperti yang didapati di subpermukaan. Seperti yang dijangka, nilai kerintangan berkadar terus dengan nilai TDS dan kemasinan, dan berkadar songsang dengan nilai kekonduksian.

Kajian ini menunjukkan keberkesanan kaedah pengimejan geolektrik dalam menentukan ciri air subpermukaan dalam litologi yang sampir homogen. Kaedah ini agak mudah dilakukan, memerlukan tenaga kerja yang sedikit dan tafsiran imej dua dimensi boleh dilakukan dengan cepat. Pencemaran air masin dari laut boleh dikenalpasti untuk perancangan pembangunan di masa hadapan.

Paper B23

Geophysical techniques for hydrological investigations

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Geophysics in Greek means "physics of earth" (Scheidegger, 1976). Geophysics is the application of physical principles to investigate and study the interior of the earth, from land surface to the inner core, is known as solid earth geophysics (Reynolds, 1997 and Sheriff, 1982). This can be subdivided further into: global geophysics (pure geophysics) and applied geophysics (exploration geophysics or geophysical prospecting). Applied Geophysics is concerned with the investigation of the Earth's crust and subsurface condition, usually with economic exploitation objectives, by making and interpreting measurements of physical properties of the earth. It covers a wide range of application, which includes sub-disciplines: engineering geophysics, environmental geophysics, archaeo-geophysics, hydro-geophysics, and hydrocarbon exploration. The application of geophysical surveys to evaluate the geological and hydrological conditions of underground water studies and prospecting is called hydro-geophysics. Hydro-geophysics utilizes different physical properties of earth materials to study subsurface structures. Major factors that have to be considered in the design of a geophysical survey for hydrogeological application (MaCann & Green, 1996) are as follows depth of penetration into the geological formation, vertical and lateral resolution required for the anticipated targets, and contrast in physical properties between the target and its surroundings. A preliminary stage of the investigation involves a desk study and reconnaissance survey; this is followed by the main stage of detailed field exploration and ground investigation; data review then continues during the groundwater extraction to expose more details of the groundwater quality and conditions. The significance of the research appears considerably in the exploration and studying geological units by mapping their subsurface features and characteristics using geophysical techniques for hydro geological applications for studying subsurface karstic limestone using geophysical techniques at Ipoh, Perak, Malaysia (Abu-Shariah *et al*., 2000; Abu-Shariah, 2002). Therefore, different geophysical techniques were applied in many hydrogeological researches, and satisfactory results were obtained of multi-applications objectives. The geophysical techniques are useful in the assessment and delineation of subsurface structures and features, and provide cost-effective data for this target.

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Paper B24

High resolution seismic refraction survey in urban area

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The seismic refraction survey is of the methods normally used to get the subsurface geology for a particular area. In this paper, the high resolution seismic refraction survey is conducted in urban area. The area chosen in this survey is a 100 m x 200 m square site at Damansara. The objective of the survey is to get the subsurface geology of this area using the refraction method and investigate the bedrock thickness of the area. The classic way of the seismic data collection using hammer and a striker plate is used throughout this survey. The layout spread is designed according to the objectives of this survey and based on the area's condition as well. A total of 98 lines (50 inline and 48 crossline) were collected during the acquisition phase. Some of the data collected is present and discuss in this paper. The challenges during the data collection are mostly noise from the nearby construction area and noise from the surrounding area mostly noise coming from the vehicle at the highway and roads around. One of the most challenging constraints is the coring activity at the same site. The unpredictable weather also plays a major role in this survey. In order to increase the data quality, each shot was stacked more than 30 stacks. The collected data then processed using the IXRefrax software. All lines show a two layer case where the first layer is around 7 m - 16 m in depth, with the average velocity of 523 m/s and the second layer of 1933 m/s. The seismic were then correlated with well data and it shows that the second layers is corresponds to completely weathered and highly weathered layer

Paper P1

Iron mineralisation, south Gunung Jerai, Kedah, implications of genesis

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The Gunung Jerai area consists a series of sedimentary rocks, which have been metamorphosed by granite intrusion, namely, the Cambrian-aged Jerai formation, with a series of exceedingly hard quartzites and much softer schists, which can be correlated to the Machinchang formation, and the Sungai Petani formation which consists of shales of Lower Silurian age. The granite is believed to underlie the sedimentary rocks throughout the Gunung Jerai area. Besides, there are also wide-spread occurrences of pegmatite intrusions and quartz veins throughout the Gunung Jerai area.

The greatest concentrations of iron ore in the south Gunung Jerai area are to be found in the schists and quartzites of the Jerai formation, as well as in the shales of Sungai Petani formation, together with pegmatite intrusions and quartz veins which cut through them. The chief iron minerals found are magnetite, hematite, and goethite. Magnetite occurs chiefly in the form of cross-cutting veinlets or as sporadic disseminations along the bedding planes of the country rocks. Besides, in a number of localities, magnetite is associated with pegmatite intrusions and/or quartz veins. Hematite on the other hand commonly occurs with the magnetite, as a secondary alteration product of magnetite. Hematite of secondary lateritic or residual origin has also been found, formed by the superficial desilication of ferruginous shale. Goethite is mostly secondary in nature, accumulated in the vicinity of primary magnetite and hematite due to weathering and erosion.

Paper P2

Physical and geochemical characterisation of gold mineralisation, Kg Ayer Puteri – Kg Seri pantai area, Mersing, Pahang

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The Kg Ayer Puteri-Kg Seri Pantai area is located 5-8 km south of Mersing town. The area is underlain by metasediments of the Mersing Beds of Carbo-Permian age, consisting of a sequence of thick and thin beds of medium grained quartzite, phyllite and slate. The rocks are tightly folded into tight isoclinal folds striking north-northwest.

Gold in the Kg Ayer Puteri area was panned from the alluvial mine in the vicinity of Sg Lengan Batu. The bedrock in the area is cut by numerous quartz veins. Physically the gold grains at Kg Ayer Puteri have roundness of subrounded to angular and sphericity of prismodal to spherical.

Gold in the Kg Seri Pantai area was panned from two areas, namely offshore placers on the beach and those inland, eluvial and colluvial deposits on slopes fronting the beach. Physically the gold grains at Kg Seri Pantai beach area have good sorting, are subangular to subrounded for roundness and subprismodal to subdiscoidal for sphericity with lengths of 0.5mm to 3mm and widths of 0.5mm to 2mm, whereas those from the inland area are poor sorted, are angular to subangular for roundness and subdiscoidal to discoidal for sphericity with lengths of 1mm to 5mm and widths of 1mm to 4mm.

Geochemically the gold grains from the inland area in Kg Seri Pantai area have 3 main sets of fineness values ranging from 834.6-851.4, 873.8-897.2 and 902.8-917.3, whereas the beach area gold grains have fineness values have 2 main sets of fineness values ranging from ranging from 830.8-845.8 and 871.1-899.5. The gold grains from the Kg Ayer Puteri area have 3 main sets of fineness values that range from 815-825, 847-884 and 902-929.

Paper P3

Potential debris flow study of the Hulu Kelang area

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The susceptibility of debris flow in 62 basins that lay between Taman Tun Razak, Bukit Antarabangsa and Kg. Kemensah in Mukim Hulu Kelang, District of Gombak, Selangor Darul Ehsan, with a total land area of approximately 14 km^2 was investigated. Generally, most basins are within the Class III and IV areas of the construction suitability classification. The basins are characterised by a long stream channel, with some parts being narrow with steep sideslopes. All 62 basins are either partly or minimally disturbed by residential and related infrastructure developments, while the remaining parts are under primary or secondary forest. There are also basins where the developed areas are at both the upper and lower ends of the basin.

The study was carried out in three stages, i.e. data collection and desktop study, field mapping and subsurface investigation (including laboratory tests on soil samples), and data analysing. In the first phase of the study, the topography, geology, landuse and soil maps, aerial photographs, satellite imageries and rainfall data were collected. In the second stage, field data, including characteristics of existing and relict landslides, environmental factors (comprising of geology, physical characteristics of soil, basin morphology, geomorphology, hydrology and land cover) and elements at risk were compiled in the period between October 2009 and February 2010. In the third phase, the data obtained from the second stage were first digitized in the GIS. The results are illustrated on engineering geology maps and detailed cross-sections which provide descriptions through the entire main waterway of each basin based on surface mapping.

Subsequently, information obtained from fieldwork, data derived from GIS analysis (i.e. slope, flow direction), rainfall and soil data that are identified as critical contributing factors for the occurrence of debris flow/landslide will be assigned a weighted value that is expected to be proportionate to the relative contribution to the hazard. Specifically, this process will require that each factor be subdivided into a number of relevant classes, before a weighted value is assigned to each class. All factor maps are then converted to the raster structure in a GIS for the following process, which is overlaying of the weighted factor maps to obtain scores of each terrain unit. The obtained scores will then be classified to produce the landslide/debris flow susceptibility or hazard map. A physical vulnerability map will also be produced by identifying the elements at risk and the potential loss of life and economic losses. A landslide/debris flow risk map will be generated as a product of the hazard and vulnerability maps.

Paper P4

Kajian kestabilan dan pemuliharaan geologi ke atas Permatang Kuarza Genting-Kelang di Ampang, Selangor

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Permatang Kuarza Genting-Kelang merupakan mercu tanda semulajadi yang menjulang di sebelah utara Kuala Lumpur. Ianya seakan membentuk satu sempadan tajam di antara Bandaraya Kuala Lumpur (di bahagian selatan) dan kawasan hutan tropika dan empangan terpelihara (di bahagian utara). Permatang Kuarza Genting-Kelang adalah terbentuk hasil dari pengisian hidrotermal kuarza di sepanjang zon rekahan yang selari dengan Zon Sesar Kuala Lumpur yang berjurus 290^0 - 110^0. Permatang ini dibentuk oleh hampir 99% komposisi kuarza. Disebabkan oleh kedudukannya yang mudah diterokai, telah wujud suatu hubungan antara PKGK dan masyarakat disekitarnya. Ini menjadikannya suatu tapak yang berpotensi untuk dibangunkan secara lestari untuk dinikmati oleh golongan masyarakat yang pelbagai. Satu kajian kejuruteraan geologi yang meliputi bahagian muka dinding selatan permatang yang berkepanjangan 3.2 km keseluruhannya telah dilakukan bagi mengenalpasti kesesuaian tapak untuk dibangunkan sebagai tapak geo-warisan dan geo-pelancongan.

Kajian awal di lapangan melalui penjenisan bentuk fizikal kristal kuarza menunjukkan sebanyak 5 jenis pengkristalan dikenalpasti yang mana berkemungkinan disebabkan oleh fasa-fasa penghabluran yang berbeza. Jenis-jenis kristal kuarza yang dijumpai adalah mengisi ruang-ruang satah retakan yang membentuk telerang-telerang kecil. Sekurang- kurangnya 5 set telerang dijumpai yang mempunyai jurus ke arah NE-SW and SW-NE, E-W, N-S. Kajian unsur minor dan surih telah dijalankan dengan menggunakan kaedah Laser Ablation ICP-MS. Hasil daripada kaedah tersebut menunjukkan kehadiran unsur Mg yang tinggi pada telerang jenis Q5. Telerang Q5 adalah diklasifikasikan mempunyai bentuk yang masif, dengan tiada hablur kristal yang nyata, dan menjurus ke arah yang hampir sama dengan badan utama permatang kuarza. Kandungan Mg yang tinggi pada Q5 boleh ditafsirkan sebagai bawaan unsur daripada badan granitoid berhampiran sesar semasa perejahan hidrotermal dalam fasa pertama.

Kajian kejuruteraan geologi yang memberi fokus di bahagian dinding permatang dan juga cerun koluvium juga dilakukan bagi mengenalpasti potensi kegagalan. Terdapat beberapa set kekar dan sesar yang telah dikenal pasti. Secara umumnya orientasi set-set sesar utama adalah menjurus hampir ke utara. Sesar tersebut yang dicirikan oleh samada batuan breksia ricihan ataupun oleh permukaan lelasan. Saiz bukaan sesar adalah berjulat dari beberapa sentimeter hingga ke beberapa meter. Beberapa set kekar yang bermiring ke arah Utara, Selatan, Timur, TimurLaut dan Barat Daya juga terdapat pada dinding permatang kuarza. Kebanyakkan kekar yang berkemiringan landai adalah dibentuk hasil daripada retakan pelepasan. Retakan-retakan tersebut adalah samada terbuka ataupun tertutup dengan saiz bukaan berjulat dari 0.5cm hingga 5cm. Set-set kekar yang terbentuk kebanyakkanya menghasilkan satah-satah yang tidak stabil. Koluvium juga terdapat di kaki-kaki permatang kuarza yang mana cerun koluvium berkemiringan diantara 30^0 dan 35^0, kecuali yang berhampiran kaki singkapan daik kuarza koluvium yang boleh mencecah 60^0. Berdasarkan data yang diambil di lapangan, julat kemiringan cerun dikategorikan sebagai genting hingga amat genting dan berkeupayaan mengakibatkan susutandarat (“mass wasting”) pada bila-bila masa.

Paper P5

Cannonball concretions of Northern Sabah, Malaysia

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Calcareous sandstone concretions are abundant in the Kudat Formation (Oligocene-Early Miocene) of Northern Sabah. They vary in size from small objects less than 1 cm in diameter to great spherical bodies metre-scale in greatest dimension. The field term cannonball concretion is applied to the larger spherical type. Calcareous sandstone concretion is the product of localized precipitation of mineral matter, mostly carbonate, in the pores of sediment about a nucleus such as organic material or rock fragment. The cannonball concretions occur mainly in the sandstone beds of the Tajau Sandstone Member of the Kudat Formation. They are exposed on cliffs and on shore platforms in coastal areas due to sea erosion. Boulders of dislodged concretions due to sea erosion also litter the coastal areas. Mudstone fragments usually occur as nuclei inside the concretions and they are critical elements in the formation of concretions as they act as nucleation areas. Most of the concretions are spherical, oval or elongated in shape and some are stained or capped with reddish-brown hard iron oxide crust. Sandstone concretions are geological objects with high geoheritage values. They contain a frozen record of the condition of the sediment at the time of deposition. They could provide scientific information on the orientation of past fluid flow in the host rock, local permeability trends, variation in groundwater velocity and the types of geological features that influence flow. They also have high aesthetic, cultural and recreational values. They are under potential threats of destruction due to vandalism, unregulated development, irresponsible specimen collection, inappropriate recreational activities and removal of objects and should be protected. The geoconservation measures include erecting ‘no vandalism’ warning signs, creating awareness and granting legal protection. Geosites with eye-catching sandstone concretions could be developed as geotourism destination. For this purpose, appropriate interpretation and basic infrastructures should be provided. There should be a smart partnership among stakeholders (local community, tourism industry and local authority) to ensure a successful geoconservation and geotourism development through proper planning and management of the site.

Paper P6

Aplikasi GIS dalam penaksiran risiko gelinciran tanah (LRA): Kajian kes bagi kawasan Kota Kinabalu, Sabah, Malaysia

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Aplikasi sistem maklumat geografi (GIS) dalam penaksiran risiko gelinciran tanah (LRA) di Malaysia merupakan suatu bidang sains yang baru diperkenalkan. LRA ditakrifkan sebagai suatu proses membuat cadangan keputusan bagi mengukur tahap tolerabiliti risiko-risiko yang hadir dan memastikan langkah-langkah pengawalan risiko adalah mencukupi, dan sekiranya tidak, langkah-langkah pengawalan risiko alternatif perlu dijustifikasikan ataupun dilaksanakan. Penaksiran risiko merangkumi fasa-fasa analisis risiko dan penilaian risiko (Fell *et al.* 2005). Kertas kerja ini memperkenalkan bidang sains baru yang muncul dari konsep LRA dan mengambil kira potensi peranan GIS. Terdapat beberapa skop bagi mengintegrasikan GIS dengan aspek-aspek LRA. Terma-terma seperti bencana, malapetaka, bahaya, kebolehrentanan, kebolehterancaman, elemen-elemen berisiko, risiko, kegagalan dan sebagainya telah digunakan secara bersilih ganti dan sering bersifat samar dalam penyelidikan LRA. Penyelidikan ini bertujuan untuk membangunkan sebuah model LRA yang komprehensif dengan menggunakan teknik GIS yang bermanfaat kepada pihak-pihak berkepentingan dan selaras dengan keperluan tempatan. Bagi mencapai matlamat ini, pertama, sebuah pengkalan data semi-kuantitatif telah dibangunkan melalui rujukan yang ekstensif, kerja lapangan dan kerja makmal. Ini termasuklah kompilasi data sekunder yang diperolehi daripada literatur, kajian penderiaan jauh, pemetaan geologi kejuruteraan, pencirian parameter-parameter bencana serta ujian-ujian mekanik tanah dan batuan. Kedua, adalah untuk menetapkan kriteria bagi pengenalpastian bencana gelinciran tanah. Sebanyak tujuh parameter yang berkaitan telah diambilkira; i.e. 1) geologi, 2) fitur-fitur geodinamik, 3) keadaan cerun, 4) hidrologi / hidrogeologi, 5) jenis-jenis guna tanah, 6) langkah-langkah penstabilan cerun yang wujud, dan 7) pencirian kejuruteraan tanah dan batuan. Kesemua parameter ini digabungkan dan dianalisis bagi menghasilkan sebuah peta tematik yang dikenali sebagai "Peta Pengenalpastian Bencana Gelinciran Tanah" atau LHIM yang kemudiannya ditindan bersama dengan "Peta Taburan Gelinciran Tanah" (LDM) bagi menjana sebuah "Peta Bencana Gelinciran Tanah" (LHM). LDM dihasilkan berdasarkan kepada kajian lapangan bertujuan untuk menandakan lokasi-lokasi gelinciran tanah di kawasan kajian. Ketiga, survei terhadap kebolehrentanan (fizikal, sosial dan persekitaran) dan kompilasi data sekunder terhadap elemen-elemen berisiko (populasi dan nilai harta benda) dijalankan untuk menghasilkan "Peta Kebolehrentanan Gelinciran Tanah" (LVM), "Peta Populasi" (PM) dan "Peta Nilai Harta Benda" (PVM). Melalui pertindihan LVM dengan PM dan PVM, maka "Peta Konsekuensi Gelinciran Tanah" (LCM) dapat dihasilkan. Akhir sekali, "Peta Risiko Gelinciran Tanah" (LRM) pula dihasilkan melalui pertindihan LHM dan LCM, kerana Risiko (R) = Bencana (H) x Kebolerentanan (V) x Elemen-elemen Berisiko (E). Dalam terma bencana gelinciran tanah, hasil LHM bagi kawasan Kota Kinabalu mencadangkan 18% daripada keseluruhan kawasan dikategorikan sebagai Bencana Sangat Rendah, 26% sebagai Bencana Rendah, 30% sebagai Bencana Sederhana, 15% sebagai Bencana Tinggi dan 11% sebagai Bencana Sangat Tinggi. Manakala dalam terma risiko gelinciran tanah, LRM menunjukkan bahawa 22% daripada kawasan ini adalah dalam zon Berisiko Sangat Rendah, 16% dalam zon Berisiko Rendah, 24% dalam zon Berisiko Sederhana, 18% dalam zon Berisiko Tinggi dan 20% dalam zon Berisiko Sangat Tinggi. Kawasan-kawasan dalam zon bencana rendah tidak bermaksud berisiko rendah terhadap gelinciran tanah, dan begitu juga sebaliknya. Darjah "bencana" merujuk kepada kebarangkalian sesuatu bahaya tertentu (ancaman) berlaku dalam suatu jangka masa tertentu (IUGS, 1997), manakala darjah "risiko" merujuk kepada ukuran kebarangkalian dan kemudaratan suatu kesan yang merugikan kepada kehidupan, kesihatan, harta, dan/atau persekitaran. Secara kuantitatif, Risiko = f (Bencana x Potensi Kehilangan Nyawa). Hal ini umumnya dinyatakan sebagai "Kebarangkalian yang berlaku semasa kejadian akan memberi konsekuensi kepada kejadian yang berikutnya" (IUGS, 1997). Lantaran itu, adalah sangat penting bagi kedua-dua LHM dan LRM dihasilkan apabila menjalankan LRA dalam sesebuah kawasan. Penyelidikan ini juga menunjukkan kemampuan teknik GIS mengendalikan data semi-kuantitatif dalam penyelidikan ruangan (spatial) LRA sebagai peralatan berintegrasi yang hebat. Penyelidikan ini juga diharapkan akan dapat menjadi perintis dan memberi sumbangan yang besar dalam pembangunan penyelidikan LRA di Malaysia.

GIS application in Landslide Risk Assessment (LRA) : Case study for Kota Kinabalu area, Sabah, Malaysia

The application of Geographic Information System (GIS) for landslide risk assessment (LRA) in Malaysia is a relatively new emerging science. LRA is defined as the process of making a decision recommendation on whether existing risks are tolerable and the present risk control measures are adequate, and if not, whether alternative risk control measures are justified or will be implemented. Risk assessment incorporates the risk analysis and risk evaluation phases (Fell *et al.* 2005). This paper introduces the emerging science of LRA concept and examines the potential role of a GIS. There is scope for intergrating a GIS with facets of LRA. Terms including hazard, disaster, danger, vulnerability, susceptibility, elements at risk, risk, failure etc. are often used interchangeably and ambiguously in LRA research. This research aims to develop a model of comprehensive LRA by utilising GIS technique, which can be significantly benefited by stakeholders and suites best to the local conditions. To achieve this goal, first; a semi-quantitative database was developed through extensive desk, field and laboratory studies. This includes compilation of secondary data from the literature, remote sensing studies, engineering geological mapping, characterisation of hazard parameters and, soil and rock testings. Secondly, is to establish criteria for the landslide hazard identification. Seven related main parameters are taken into account; i.e. 1) geology, 2) geodynamic features, 3) slope conditions, 4) hydrology/hydrogeology, 5) types of landuse, 6) existing slope stabilisation measures, and 7) engineering characteristics of soils and rocks. All these parameters are compiled and analysed to produce a thematic map known as "Landslide Hazards Identification Map" or LHIM. The resulted LHIM is then overlaid with "Landslide Distribution Map" (LDM) to generate a "Landslide Hazard Map" (LHM). LDM is produced based on the field studies in order to locate the landslide locations in the study area. Thirdly, survey of vulnerability (physical, social and environmental) and compilation of secondary data for elements at risk (population and properties value) were conducted to produce the "Landslide Vulnerabilities Map" (LVM), "Population Map" (PM) and "Properties Value Map" (PVM). By superimposing the LVM with PM and PVM, the "Landslide Consequences Map" (LCM) is then generated. Finally, the "Landslide Risk Map" (LRM) is produced by superimposing the LHM an LCM, because Risk (R) = Hazards (H) x Vulnerability (V) x Elements at Risk (E). In terms of landslide hazards, the resulted LHM of Kota Kinabalu area suggests that 18% of the area can be categorised as Very Low Hazard, 26% as Low Hazard, 30% as Medium Hazard, 15% as High Hazard and 11% as Very High Hazard. Whereas, in terms of landslide risks, the LRM indicates that 22% of the area is in Very Low Risk zone, 16% in Low Risk zone, 24% in Medium Risk zone, 18% in High Risk zone and 20% in Very High Risk zone. Areas with low degree of landslides hazard does not mean have the low risk to experience landslides, and vice-verca. Degree of "hazards" refers to the probability that a particular danger (threat) occurs within a given period of time (IUGS, 1997), whereas degree of "risks" refers to the measure of the probability and severity of an adverse effect to life, health, property, and/or the environment. Quantitatively, Risk = f (Hazard x Potential Worth of Loss). This is commonly expressed as "Probability of an adverse event times the consequences of that event" (IUGS, 1997). Therefore it is very important for both LHM and LRM to be produced when conducting a LRA in an area. This study also shows the ability of GIS technique in handling semi-quantitative data in spatial LRA research as powerful integrated tools. It is hoped that this research will be pioneering and contribute significantly in the development of LRA research in Malaysia.

Paper P7

Pencirian geomekanik jasad batuan metamorf Formasi Bukit Kenny dengan tumpuan khusus terhadap pencirian geseran satah ketakselanjaran

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Kawasan kajian yang menganjur daripada Putrajaya iaitu di Precint 9 dan Precint 5 hingga ke Shah Alam iaitu di Bandar Saujana Utama dialasi batuan Formasi Bukit Kenny yang terdiri daripada batuan kuarzit, filit dengan kekanta syis amfibolit. Kawasan kajian di Precint 9 merupakan sesuatu tapak di mana terdapat kekanta syis amfibolit dalam kuarzit berbutir halus. Tapak kajian di Precint 5 adalah cerun potongan berhampiran dengan Pusat Konvensyen Antarabagsa Putrajaya (PICC) manakala di bandar Saujana Utama merupa kawasan perumahan yang sedang dalam pembinaan. Pengelasan jasad batuan menggunakan Sistem Pengelasan Geomekanik Bieniawski (1979) yang menggabunkan hasil ujian geomekanik seperti ujian kekuatan beban titik dan kekuatan mampatan sepaksi dengan hasil survei ketakselanjaran untuk pencirian parameter dilaksanakan di ketiga-tiga tapak. Bagi batuan syis yang bergred luluhawa I dan II serta kuarzit yang bergred luluhawa I, ia dikelaskan kepada jasad batuan yang baik iaitu kelas II dengan kejelekitan jasad batuan bernilai 300-400kPa dan sudut geseran jasad batuan bernilai 35°-45°. Bagi batuan syis gred III serta kuarzit yang bergred luluhawa II dan III, ia dikelaskan kepada jasad batuan yang sederhana baik iaitu kelas III dimana kejelekitan jasad batuan ialah 200-300kPa dan sudut geseran adalah 25°-35°. Sudut geseran permukaan satah ketakselanjaran yang digunakan di dalam analisis kinematik adalah dapatan daripada ujian kemiringan yang menggambarkan sudut geseran permukaan ketakselanjaran yang sebenar di lapangan. Bagi batuan syis dengan nilai pekali kekasaran kekar (JRC) 8-10 nilainya adalah 43° dan untuk JRC 10-12 adalah 55°. Bagi batuan kuarzit dengan JRC 4-6 nilainya adalah 59°, 6-8 adalah 42°, 8-10 adalah 59° dan 14-16 adalah 73°. Perkadaran jasad batuan (RMR_{basic}) boleh digunakan untuk memberi nilai kuntitatif dalam pengenalpastian kesesuaian jasad batuan dalam geologi kejuruteraan terutamanya dalam pembinaan dan penentuan tapak cerun potangan batuan yang perlu diberi perhatian khusus untuk penebatan kemungkinan kegagalan secara lebih kuantitatif. Sudut geseran permukaan ketakselanjaran dipengaruhi oleh nilai pekali kekasaran kekar (JRC). Semakin tinggi JRC, semakin tinggi nilai sudut geseran permukaan ketakselanjaran dan semakin sukar untuk kegagalan berlaku. Maka, analisis kinematik seharusnya menggunakan sudut geseran yang sebenar di lapangan kerana ianya adalah lebih jitu berbanding nilai anggaran yang biasa digunakan.

Paper P8

Pengaruh amang terhadap sifat geoteknik tanah baki metasedimen dan basalt

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Amang adalah sisa lombong daripada proses pemisahan fraksi yang bernilai daripada pemprosesan bijih timah.Pencemaran amang terhadap sekitaran menyebabkan hakisan tanah dan fenomena saliran lombong berasid. Kehadiran amang bukan sahaja mencemarkan kualiti air malah turut mempengaruhi sifat-sifat tanah.

Kajian ini bertujuan untuk menentukan kesan pencemaran amang ke atas sifat-sifat geoteknik tanah baki metasedimen di Sungai Lembing dan basalt di Kuantan. Perubahan kekuatan tanah diperhatikan terhadap peratus penambahan amang. Sampel tercemar disediakan dengan mencampurkan amang pada kadar 5%, 10% dan 20% terhadap berat kering tanah. Perbandingan juga dilakukan bagi melihat kesan amang terhadap sifat-sifat geoteknik tanah baki basalt di sekitar Kuantan. Penentuan asas sifat tanah yang dikaji meliputi analisis saiz butiran dan tekstur tanah, ujian spesifik graviti, pembelauan sinar-x (XRD), pH tanah dan kandungan air tanah segar. Manakala analisis geoteknik yang diperhatikan adalah had-had Atterberg, ujian pemadatan, konduktiviti hidraulik dan kekuatan tiga paksi (Ujian Tiga Paksi Tak Tersalir Tak Terkukuh, UU).

Berdasarkan analisis saiz butiran pula telah menunjukkan sampel tanah metasedimen mempunyai nisbah 42.60% lempung, 32.19% lodak dan 25.21% pasir manakala sampel tanah basalt terdiri daripada 21.66% lempung, 41.45% lodak dan 36.89% pasir. Hasil analisis XRD menunjukkan sampel tanah baki metasedimen mengandungi mineral kuarza, kaolinit dan muskovit manakala sampel basalt mengandungi mineral hematit, gibsit dan geotit. Nilai spesifik graviti bagi sampel metasedimen adalah 2.67 manakala sampel basalt adalah 2.73. Nilai pH bagi sampel metasedimen adalah 3.88 manakala sampel basalt adalah 3.49. Kandungan air bagi tanah baki metasedimen adalah 22.2% manakala basalt adalah 33.8%.

Hasil analisis menunjukkan nilai-nilai had-had Atterberg bagi had cecair, W_L dan had plastik , W_p telah menyusut dengan akibat daripada kesan penambahan amang. Julat nilai W_L adalah 50% hingga 55.5% bagi tanah metasedimen dan 48.2% hingga 64.1% bagi tanah basalt. Sementara nilai W_p bagi tanah metasedimen adalah 19.08% hingga 29.57% dan julat 24.17% hingga 34.01% bagi tanah basalt. Pertambahan amang walaubagaimanapun telah menyusutkan nilai-nilai ketumpatan kering, $\rho_{dry\ max}$ dan meningkatkan kandungan air optimum tanah, W_{opt}. Julat nilai bagi $\rho_{dry\ max}$ bagi tanah metasedimen adalah 1.65 gcm^{-3} dan 1.55 gsm^{-3} manakala peningkatan W_{opt} adalah 14.9% ke 18.3%. Sementara itu, julat $\rho_{dry\ max}$ adalah antara 1.69 gcm^{-3} dan 1.52gcm^{-3} tanah basalt dan julat W_{opt} adalah antara julat 15% - 25.36% .Kadar hidraulik konduktiviti meningkat dengan pola penambahan amang pada julat nilai antara 14.49 $cmjam^{-1}$ dan 23.81 $cmjam^{-1}$ bagi tanah metasedimen dan antara 6.85 $cmjam^{-1}$ dan 26.32$cmjam^{-1}$ bagi tanah basalt. Ujian tiga paksi menunjukkan nilai kekuatan ricih tanah,C_u menurun dengan pertambahan peratusan amang dalam tanah. Tanah metasedimen menunjukkan nilai C_u antara julat 646 kPa hingga 312 kPa manakala julat antara 225kPa hingga 49kPa bagi tanah basalt. Kajian ini menunjukkan bahawa sifat-sifat geoteknik telah mengalami perubahan kesan daripada pencemaran amang dalam tanah asalan metasedimen dan basalt.

Paper P9

Analisis pengkuantitatifan gred luluhawa bahan batuan granit dengan ujian tukul Schmidt: Contoh kajian di Malaysia

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Ujian pantulan tukul Schmidt merupakan satu ujian indeks yang diubahsuai daripada ujian in – situ konkrit yang telah tersebar luas penggunaannya dalam bidang mekanik batuan untuk penganggaran kekuatan mampatan sepaksi bahan batuan. Dalam kajian ini, ujian ini digunakan untuk mendapatkan secara kuantitatif kekuatan pantulan batuan dengan gred luluhawa berbeza bagi bahan batuan granit. Lokasi kajian ialah di Kuari Kajang Rock dan Lebuhraya SILK di Kajang, Selangor, D. E., jalan Pos Selim – Kg. Raja, Perak – Pahang, dan Kuari JKR Bukit Penggorak di Kuantan, Pahang. Ujian ini telah dijalankan ke atas 18 cerun batuan melibatkan 3119 bacaan pada dinding cerun dan 4955 bacaan pada sampel batuan di makmal. Berdasarkan aras keyakinan 95%, nilai min bacaan pantulan tukul Schmidt bagi batuan granit segar (Gred I) ialah 54 (±0.16) dengan sisihan piawai 5.33, batuan granit terluluhawa sedikit (Gred II) 37 (±0.21) dengan sisihan piawai 5.54 dan batuan granit terluluhawa sederhana (Gred III) 17 (±0.31) dengan sisihan piawai 4.76. Nilai – nilai ini mewakili penurunan 31.5% atau lebih kurang $^{1}/_{3}$ kekuatan batuan granit sedikit terluluhawa berbanding batuan granit segar serta 68.5% bagi batuan terluluhawa sederhana atau $^{2}/_{3}$ berbanding dengan batuan granit segar. Hasil keputusan ini mewakili kaedah kuantifikasi dalam penggredan tahap luluhawa bahan batuan granit berdasarkan nilai pantulan tukul Schmidt.

The Schmidt Rebound Hammer is an index testing apparatus derived from the non – destructive in–situ testing of concrete that has widespread application in rock mechanics for the estimation of uniaxial compressive strength (UCS) of rock materials. In this study, this test has been employed for the strength quantification of different weathering grades of granitic rock material. The study sites were the Kajang Rock Quarry and SILK Highway in Kajang, Selangor, D.E., Pos Selim – Kg. Raja road, Perak – Pahang, and Bukit Penggorak JKR Quarry in Kuantan, Pahang. The tests were conducted on eighteen slopes consisting of 3119 data on the slope walls and 4955 data on lab samples. Calculated at 95% confidence level, the mean Schmidt Hammer rebound values for fresh granites (Grade I) was 54 (±0.16) with the standard deviation of 5.33, slightly weathered granites (Grade II) was 37 (±0.21) with the standard deviation of 5.54 and moderately weathered granites (Grade III) as 17 (±0.31) with the standard deviation of 4.76. These values represent a 31.5% or about $^{1}/_{3}$ decrease in the rock strength of the slightly weathered granites when compared to fresh granites and 68.5% for moderately weathered granites or $^{2}/_{3}$ with respect to fresh granites. These results represent a means of quantification of granitic rock material weathering grades based on their Schmidt Hammer rebound values.

Paper P10

The effect of soil heterogeneities on the movement of DNAPL using small-scale geotechnical centrifuge

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A mini 0.6 m diameter beam centrifuge has been fabricated at the Universiti Kebangsaan Malaysia in Bangi, Selangor. The centrifuge took almost one year to build. The centrifuge was designed to allow centrifuge testing of soil package for up to 5 kg of weight with maximum rotational speed of 500 RPM and can accelerate for up to 140 in units of times gravity (xg). The dimension of soil package is 10 cm (width) x 28 cm (length) x 19.5 cm (height). This centrifuge is equipped with coloured digital video camera and high speed stroboscope. The recorded of moving images can be stored directly into the computer. Real time video images can also be observed on the LCD monitor installed in the operation room. The centrifuge is controlled using a control box with various buttons and digital displays such as on/off button, RPM controller with digital display. As a safety precaution, the body of the centrifuge is made using double layers 5mm steel with 5cm absorbing membrane as sound barrier. It has a vibration auto switch-off that will automatically stop if the vibration is exceeded the permissible vibration limit. The paper will highlight some early results of the test carried out in this new centrifuge. The test was carried out to investigate the effect of soil heterogeneities on the plume flow pattern of contaminant (DNAPL) in soil. The strong box was filled with different soils to simulate various soil heterogeneities such as horizontal and dipping bedding planes, lenses of clay, saturated-unsaturated zone, and different grain sizes. Tetrachloroethylene (PCE) dyed with Sudan V was introduced as a contaminant on top of the strong box. The test was carried out at different G force, i.e. 20, 40 and 60 g. The behaviour of DNAPL movements in geotechnical centrifuge will be compared with 1-g experiment conducted in a small mini tank in the laboratory.

Paper P11

Microstructural characteristics of some alkali-aggregate reactive granites of Peninsular Malaysia

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In Peninsular Malaysia, granite is the most important source of construction aggregates, accounted for over 75% of the total tonnage of aggregates produced. Granite aggregates is particularly important in the more developed regions of Selangor, Kuala Lumpur, Penang and Johor Bahru, where almost all aggregates are produced from granitic rocks.

Granite aggregates are the preferred material used in concrete in Peninsular Malaysia. They are generally considered as non alkali-aggregate reactive (Chow & Abdul Majid Sahat, 1990; Yeap, 1992). Alkali-aggregate reaction (AAR) is a chemical reaction where alkali cations in solution (Na^+, K^+) react with reactive aggregates in the concrete. Through this reaction, amorphous phases are formed, which imbibes water and swells. It causes expansion, cracking and weakening of the concrete structure and potentially leading to a collapse.

There are three types of AAR, which are associated with the type of alkali-reactive aggregates. Alkali-silica reaction (ASR), which was identified first by Staton (1940) and Staton *et al*. (1942), involves the reaction of disordered forms of silica minerals in aggregates (Hobbs, 1990). Reactive silica aggregates are opal, chalcedony, volcanic glass, cristobalite, tridymite as well as cryptocrystalline, microcrystalline and strained quartz. Alkali-phyllosilicate reaction is believed to be due to the occurrence of swelling phyllosilicate minerals (Gillott *et al*., 1973; Gillott, 1975). Alkali-carbonate reaction (ACR) which has been reported with some dolomitic limestones and carbonates with siliceous or argillaceous components (Swenson & Gillott, 1960; López-Buendía *et al*., 2006) will not be considered in this paper.

Alkali reactive minerals can occur naturally in granite aggregates in several ways. Primary minerals of the granite and associated rocks found in the quarries are generally devoid of reactive minerals, although minor microcrystalline quartz are present in mymerkite in some granites and as individual grains in some fine-grained microgranite and aplite. Granites near the contact with the country rocks often have metasedimentary enclaves, which contain phyllosilicates and microcrystalline quartz. However, in general these enclaves only constitute a very small proportion of the rock material. Granitic rocks can contain reactive secondary minerals such as opal and chalcedony which infill discontinuities. Field studies of granite quarries show that such mineral veins are rare in Peninsular Malaysia. Chalcedony has been observed in only one quarry and it has also reported in Selangor by Yeap (1992). Faulting has generated a diverse variety of deformed granites and caused severe straining and grain size reduction of the quartz grains in the granite (Ng, 1994). The effect of fault deformation on ASR of granites in Peninsular Malaysia has been discussed by Ng & Yeap (2007), and elsewhere (e.g. Kerrick & Hooton, 1992; Wigum, 1995). Lastly, reactive secondary minerals can also form as a result of mineralisation and alteration of granites.

Tests available for the detection of potentially reactive aggregates have been reviewed by Wigum *et al*. (1997). Petrographic examination is a useful and fast method for the identification of potentially deleterious minerals in the aggregates, while the accelerated mortar bar expansion test (ASTM C1260-94) measures the expansion of three mortar bars in immersed in 1N NaOH at 80 °C. Average expansions of more than 0.20% at 16 days after casting are indicative of potentially deleterious expansion, while expansions between 0.10% and 0.20% have marginal behaviour. According to Oberholster & Davies (1986), samples with expansion greater than 0.11% at 12 days is considered as deleterious.

In this study, more than 150 samples of granite and associated rocks were collected from quarries and rock slopes. Thin sections were prepared for petrographic examination. After the petrographic examination, sixteen representative samples collected from granite quarries were subjected to expansion test. Two samples are typical granite that are not deformed and has minimal alteration (sericitisation of plagioclase and chloritisation of biotite). The other twelve samples contain potentially deleterious minerals, all of which experienced marginal to deleterious expansion in the test (0.1% - 0.28%). This study will concentrate on the petrographic microstructures of these alkali-aggregate reactive granites.

Of all the minerals identified in this study, chalcedony is considered as most reactive. Chalcedony infills irregular spaces in the cataclastic granite collected from a quarry in central Selangor. The chalcedony has fibrous habit and forms radiating masses of about 100 μm in diameter, between secondary pyrite and mica grains.

Faulting has resulted in the formation of a wide variety of fault rocks in the granite, ranging from fault gouge and breccias, to cataclasites and mylonites (Ng, 1994). Being incohesive, fault gouge and breccias seldom end up in the production of aggregates. Strained quartz and microcrystalline quartz are the main potentially deleterious mineral in cataclastic and mylonitic granites. Quartz with undulatory extinction is omnipresent in all undeformed and

deformed granite samples. However, not all quartz with undulatory extinction is indicative of deleterious behaviour (West, 1991). It is generally accepted that quartz with undulatory extinction angle larger than 15°, and quartz with deformation bands and lamellae is considered as strained quartz. All quartz clasts in the cataclastic granites are strained, while in the mylonites, relict quartz clasts, which often form ribbon texture also show large undulatory extinction angle, and less frequently, deformation bands and lamellae.

With progressive deformation quartz clasts in the mylonites are polygonised and recrystallised. The formation of polygonal subgrains often progresses inwards from the clast boundaries. The subgrains are equidimensional to weakly elongated, the latter are aligned parallel to the mylonitic foliation. The subgrains are mainly 20 μm to 30 μm in diameter.

Deformation of granites results in grain size reduction. Microcrystalline (<60 μm) quartz occurs in cataclastic and mylonitic granites. In the cataclasites, microcrystalline quartz is produced by abrasive wear, and it is consisting of angular quartz clasts in the matrix. In the mylonites, the microcrystalline quartz is consisting of quartz subgrains and neoblasts, formed as a result of recovery of highly strained quartz. The neoblasts are formed by subgrain rotation mechanism and have similar shape and size as the subgrains. The microcrystalline quartz is often concentrated in quartz-rich bands that form the fabric element of the mylonite.

Microcrystalline quartz is also found in silicified cataclastic granites, which also experienced minor chloritisation and sericitisation. The silicified cataclastic granites contain abundant secondary quartz in the matrix and the quartz also forms veinlets. Although, quartz can occupy up to 75% of the silicified rocks, generally the microcrystalline fraction is only about 25%.

Microcrystalline quartz is also found in strongly sericitised granite, where all the plagioclase has been completely altered to sericite. In some of the sericitised plagioclase, very fine irregularly-shaped quartz grains are observed, probably precipitate from the excess silica produced during the alteration process. One sericitised granite sample shows the largest expansion (0.28%) in the mortar bar test. Due to the high sericite content (~35%), it is unclear whether the expansion is caused by ASR or alkali-phyllosilicate reaction or both.

The microstructural characteristic of some alkali-aggregate reactive granite has been described. Granitic rocks having similar characteristics are potentially alkali reactive and should be verified by accelerated mortar bar test. Although, alkali reactive rocks are present in some quarries in Peninsular Malaysia, generally these rocks will not pose serious problems in the production of concrete aggregates as they constitute only a small proportion of the extracted rocks.

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Paper P12

Study of water quality and heavy metals in soil & water of ex-mining area Bestari Jaya, Peninsular Malaysia

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Tin mining was one of the leading mining industries in Malaysia in 19th century before the world tin crisis in 1985. Most Malaysian tin comes from two states Perak (63%) and Selangor (22%) and is richest in the Kinta, Batang Padang, Bestari Jaya (Batang Berjuntai) and Klang Valley. These mining activities have resulted in about 113,700 hectars of tin tailings throughout the peninsula that created numerous environmental problems such as threat to natural reserves due to landscape changes, damage to natural drainage, pollution and destruction of natural habitats The present study was carried out in old tin mining area Bestari Jaya (Batang Berjuntai old name), Kuala Selangor District in Selangor state. The purpose of this study is to get the ground information about environmental and contamination characteristics and also planning for future work. The mined out catchment covers an area of 323.74 hectars. Initially 92.61 hectors of downstream catchment were investigated which includes two mined out water ponds. These ponds flow downstream to Ayer Hitam River that ultimately ends up with River Selangor, 5 km upstream of Batang Berjunti Water Treatment Plants SSP1 and SSP2 which are major water distributors to federal territory (Kuala Lumpur and Putrajaya) and Selangor state as well. Samples of soil and water were taken separately from fifteen locations of downstream catchment using Global Positioning System. In preliminary studies physio-chemical parameters and concentration of heavy metals Pb^{2+}, Zn^{2+}, Ni^{2+}, Co^{2+}, As^{3+}, Cu^{2+}, Fe^{2+}, Mn^{2+}, Sn^{2+} were anlyzed. The metals were extracted by nitric acid and hydrogen peroxide in a closed vessel microwave digestion system and analysed by using atomic absorption spectroscopy. The method was validated by using standard reference material (NIST SRM 4354, 1643e) and results were compared with interim national water quality standards for Malaysia and found that most of physio-chemical parameters and metals concentration exceeds the permissible limits set by interim national water quality standards for Malaysia. So it is concluded that Bestari Jaya ex-mining catchment has a high pollution potential due to mining activities and Ayer Hitam River, recipient of catchment water is a highly polluted river. Therefore extensive research needs to be carried out in order to evaluate possible environmental risk factors in the area. Different environmental aspects have also discussed in this paper for the future research during this project.

Paper P13

Physical properties of Tasek Bera sediments as indicators of environmental change

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Physical properties of sediments in the open-water areas of Tasek Bera were studied to investigate environmental changes within its catchment area. Five sediment cores extending into the soft sediment and underlying weathered bedrock were collected for investigation of their physical properties; the 1st and 2nd cores collected at the two main sediment entry points, and the rest from the deepest points of open water.

The sediments of the cores can be mostly classified as organic soils or peat with clayey textures in view of their composition, i.e. 93% clay, 5% silt and 2% very fine sand. There is a general increase in bulk density but a general decrease in porosity down the sediment columns. On the basis of the bulk density and porosity, the sediment columns can be separated into two distinct sections that can be correlated with the sampling locations in the open water areas of Tasek Bera. The upper layers of the sediment columns, with the lowest bulk density and highest porosity, are some 18cm thick at the entry points or river mouths (Cores 1 and 2) and some 25cm thick in the deepest part of Tasek Bera. These upper layers are organic-rich clays to peats with a maximum 62% organic content, whilst the porosity in saturated sediments is some 91 to 97%. Maximum bulk densities for these sediments have been determined at 2.06, 1.86, 1.76, 1.75 and 1.45 g/cm^3, for samples from the 1st, 2nd, 5th, 6th and 4th cores, respectively.

Physical properties of sediments in the open water areas of Tasek Bera indicate that environmental changes have occurred within the catchment area. Field observations and a GIS study show that these environmental changes, marked by an increase in organic content in the sediments, are due to the clearing of forested areas and the planting of agricultural crops (FELDA) from the year 1970. The environmental changes are also shown by the dramatic decrease of bulk density and increase of porosity within the sediment columns. From the starting date of environmental change and the thickness of the upper layers, approximate sedimentation rates of 5.0, 4.3, 3.0, 6.3, and 4,7, mm/yr have been obtained for the 1st, 2nd, 4th, 5th, and 6th, core samples respectively.

Paper P14

Characteristic of acid mine drainage and potential remedial method of abandoned tin mine in Sungai Lembing, Pahang

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Acid Mine Drainage (AMD) is one of the most serious water pollution sources that occur due to interaction of water and sulphurous minerals to form a sulphuric acid in water. The study was conducted to characterize and determine the pollution level of the tailings and surface water; to study the influence of the host rock and tailings in the production of AMD; to research the leachability of tailings by weak acidic rainwater and finally to investigate the potential use of limestone in a treatment of AMD. The study involved sample collection and field parameters measurement in the field and followed by laboratory works to test and characterize the tailings and surface water. The location of the study area is a former (abandoned) tin mine located in Sungai Lembing, Pahang. In-situ parameters of surface water such as temperature, pH, conductivity, dissolved oxygen, and total dissolved solid were measured onsite. The pH values of most water samples are ranged from 2.6 to 5.0, which are acidic in nature as a result of AMD processes. Heavy metals analyses of surface water and tailings show that the concentrations of metals in both media are higher and exceeded the environmental standard. Tailings were subjected to column infiltration test using extracting solution made of CH_3CH_2OOH+NaOH at pH 5. The results show that all metals are easily leached out from the tailings just after 20-40 minutes of the testing. Acid – Base accounting reveals that tailings in this former mining area have a high potential to produce acid. The treatment option using limestone (collected from former quarry of Bukit Panching) was conducted in the laboratory using physical tank model. The result of water treatment using limestone shows that limestone is capable to decrease the acidity of water, reduce the electrical conductivity and also decrease the concentration of heavy metals in acid mine water. The study has discovered that AMD processes contribute to low pH and high concentration of heavy metals in surface water. Tailings in this area is regarded as major contributor to AMD and very easily leach out in contact with mild acidic water and also has very high acid generating potential. The study also discovered that limestone is a good neutralizer for acid mine by decreasing the concentration of heavy metals and increasing its pH.

Paper P15

Heavy metals adsorption by residual soils of rhyolite, andesite and basalt from Pahang, Malaysia

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The adsorption tests of heavy metals were carried out on rhyolite residual soil from Lancang, residual andesite from Kuari Kampung Awah and residual basaltic soil from Kuantan, Pahang. Physical and chemical characteristics of the soil that would probably affect the levels of adsorption were firstly characterized. Grain size distribution, Atterberg limits, compaction, permeability, pH, compositions of organic content, capacity exchange cation (CEC) and specific surface area (SSA) were conducted. Physico-chemical properties of soils showed that andesitic soil has high clay content, low pH value, high organic matter content, high capacity exchange cation and high specific surface area. Heavy metals used in the adsorption study were Pb, Cu, Ni, Zn, Co and Cd. The sorption experiment was conducted using two main experiments namely high speed centrifuge mini column test and batch adsorption test. These tests were conducted to study the heavy metals adsorption by different types of soils. Heavy metals were analyzed using Flame Atomic Absorption Spectrophotometer (AAS). The centrifuge mini column data were presented using breakthrough curves. The results showed that andesitic soil has the highest retention capability on heavy metals compared to other residual soils. The equilibrium adsorption data from batch test were fitted to linear, Langmuir and Freundlich isotherm models. All three types of soil were found to adsorb higher amount of Pb compared to other heavy metals with the sorption selectivity of Pb > Cu > Zn > Co > Cd > Ni. Both tests discovered that andesite residual soil adsorbed highest heavy metals compared to rhyolite and basalt with the ranking for sorption as; residual andesite soil > residual basalt soil > residual rhyolite soil. The results of the study demonstrated that the residual amdesite soil has a better potential and a good candidate to be used as an effective, cheap, environmental friendly adsorbent for heavy metals.

Paper P16

Flux of nutrients and heavy metals to Tasik Chini through erosion from Sungai Melai sub-catchment, Chini, Pahang

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This study was conducted to determine the flux of nutrients and heavy metals from Sg. Melai catchments to Lake Chini through erosion. For this purpose several soil physical properties such as particle size, organic content, true and bulk density, clay dispersion coefficient, aggregate stability and soil hydraulic conductivity was determined. Chemical properties determined were pH, electrical conductivity, available nutrients, dissolved nutrients and heavy metals. Indicators of erosion determined in water were total suspended solids, dissolved nutrients and heavy metals. It was found that the texture of the soil in the study area is clay, silty clay, clayey loam and sandy silt loam. Organic matter content is in the range of 3.40 to 9.92%, while the percentage of clay dispersion is between 3.20 to 15.83%. Rainfall erosivity value was 1658.7 Mg mm ha^{-1} h^{-1}. Soil erodibility ranged from 0.06 to 0.26 ton/J and the slope factor, LS range from 7.63 to 18.33. Predicted rate of soil loss was low at 18.93 $tonha^{-1}$ yr^{-1} to very low (0.0028 tan ha^{-1} yr^{-1}). Flow of nutrients and heavy metals into the lake through erosion from Sg. Melai catchment was low based on the low rates of erosion.

Paper P17

Petroleum source potential of Tertiary coals of Western Pinangah, Sabah Malaysia

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The Tanjong Formation which underly the Western Pinangah area is of Upper Miocene age, based on assemblages of both pelagic and calcareous benthonic foraminifera (Collenete, 1965). The majority of foraminiferal samples were collected from the Pinangah River and northern side of the Maliau Basin (Collenete, 1965). An investigation on the coals of the Tanjong Formation in western Pinangah, an area of 45 km^2 in central Sabah, was undertaken to evaluate their petroleum-generating potential. The amount and quality of the organic matter was determined using a SRA (Source Rock Analyzer) run in TPH/TOC (Total Petroleum Hydrocarbon/Total Organic Carbon) mode. The parameters derived from the SRA are equivalent to that produced by Rock-Eval techniques. In total, fourteen coal samples were analyzed. The TOC (Total Organic Carbon) of the coal samples ranges from 51.2 to 72.5 wt%. The Tmax (temperature where the maximum amount of hydrocarbons are artificially generated during pyrolysis) varies from 418°C to 440°C. This is equivalent to a calculated vitrinite reflectance equivalent (VRE) of 0.36 to 0.76% VRE, based on the Tmax-VRE relationship described by Jarvie *et al*. (2001). These low values suggest that the coals are thermally immature to early mature for hydrocarbon generation. The HI (Hydrogen Index) of the coals ranges from 203 to 463 mgHC/gTOC. These values are usually associated with petroleum source rocks that could potentially generate a mixture of oil and gas, or mainly oil. When the HI and Tmax data were plotted in a van Krevelen diagram, most of the data points fall close to the Type II and Type III kerogen line. All of the data above indicate that the Western Pinangah coals are of favorable quality and quantity in terms of petroleum generating potential.

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Paper P18

The Upper Eocene to Upper Oligocene Ransi Conglomerate of the Tatau Formation in the Tatau-Bintulu area, Sarawak

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A recent study in the Tatau-Bintulu area indicates that the Ransi Conglomerate which was originally date as Upper Miocene to Pliocene (Kamaludin Hassan, 2004) is part of the Upper Eocene to Upper Oligocene Tatau Formation. This finding is inconsistent with that of Liechti, et.al (1960) who proposed that is was equivalent to the Middle to Upper Miocene Begrih Formation while Ismail (2000) proposed that it was equivalent to the Upper Miocene to Pliocene Balingian Formation.

This paper discusses the paleo-environment, stratigraphy and its relationship to its adjacent formations. These were used to reconstruct the geological history of the Tatau area. The Ransi Conglomerate is placed at the base of the Tatau formation. It is made up of mostly thick bedded conglomerate and pebbly sandstone interbedded with thin shale horizons. The rounded to sub-rounded conglomerate clasts with mainly soft sandstone clasts and minor shale pebbles in the Pelungau area were up to cobble size while the fine grain conglomerate in Tutong Hill, Tatau Horst and Ransi Hill range from pebble to granule size and are mainly composed of angular to sub-angular clasts of chert, vein quartz pebbles and metamorphic fragments. Most of the sandy beds are quartzitic and light grey in colour but a very thick black carbonaceous horizon was found at the base of the light coloured horizon in the Hormat Pacific Quarry in the northeastern part of the Tatau Horst. Cross bedding is common with the mostly graded-bedded sandstone bed indicating that these are channel sands.

The discovery of significant burrowing in many Ransi Conglomeratesections together with marine microfossils suggest that it was deposited by channels into a shallow marine to lower coastal plain environment. The source of the Ransi Conglomerate was largely from the radiolarian rich chert and metamorphic rock bearing older Rajang Group located to the south as indicated by paleocurrent directions. The present of volcanic clasts suggest active volcanism in the hinterland during the deposition of the Ransi Conglomerate. Some of the volcanic clasts were most probably from the Arip Volcanic and also Bukit Piring subvolcanic exposures located to the southward of the basin.

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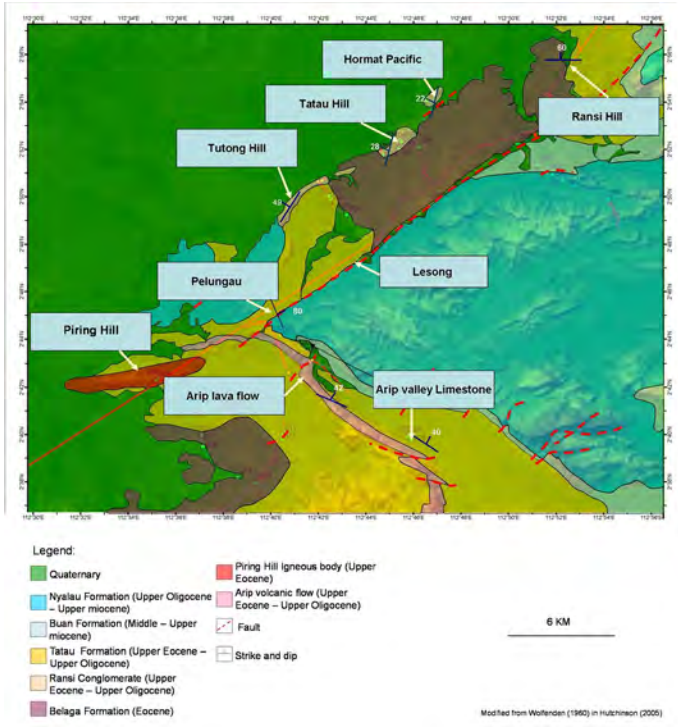

Figure 1: Geological map (modified from Wolfenden, 1960 in Hutchison, 2005)

Paper P19

A GIS -based method to evaluate factors controlling landslides along the East- West Highway (Gerik – Jeli), Malaysia

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The present work aims to utilize remote sensing and GIS to assess the contribution of every predisposing factors on landslides to broaden our knowledge in assigning weights for those factors, in order to construct a potential landslide hazard map along the East West highway (Gerik –Jeli) area.

In order to achieve this, landslide locations map of the study area was prepared from the interpretation of aerial photographs and field surveys, and a spatial database for causative landslide factors was constructed from topographic, geological, soil and precipitation maps. Then, ten thematic maps for the factors that influence landslides occurrences have been produced from spatial data base. The lineaments map was extracted from Landsat 7 ETM+ image. DEM , slope, aspect and elevation thematic maps were calculated from the topographic database. Lithology, fault map, and bedding map were extracted from the geology database . Soil map was produced from laboratory analysis of fifteen soil samples. The rain fall zones map was prepared using data collected from three rain fall stations. These thematic maps were then overlaid with landslide locations map using ArcGIS 9.2 software, and the contribution of each causative factor to landslide was evaluated by calculating the number of pixels forming the scarps fell into the various classes of the maps of the factors. The results obtained from the analysis showed that factors acted differently and for every factor, only some of the classes were considered to have marked importance. It was found that slope ranges from 20º to 40º played a very important role in the concentration of the landslides processes. While from the eight aspect classes the landslides showed highly prevalence toward W, E, NW and SE. In the case of lineaments density, the most dominant landslide frequency was located in the lineament density ranges from 0.505 km/sq km to 1.516 km/sq km. On the other hand, the highest landslide concentration was in the drainage density of 3.505 km/sq km. Comparing the orientation of strata to the slope showed that Landslides occur when the strata has inclination in the same direction with slope direction. In conclusion, it was possible with this method to demonstrate that, for each landslide causative factor considered, only some of the classes had a high influence, whereas others had a less important influence. With the results obtained from this GIS methodology, the weights can be assigned objectively according to the importance of each factor on contributing the landsliding process.

Paper P20

Integrating data from remote sensing and geology for geological investigation in the eastern ends of Wadi Shati iron ore deposit

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Wadi Shatti deposit is a belt of upper-Devonian sedimentary formation including iron ore bearing layers, which extend over about 160 km, in E.NE-W.SW direction, on the northern border of the Murzuk basin, at its western and eastern ends. The iron ore bearing belt is covered by more recent formations which definitively conceal the ore outcrops, French study group (Stero Jexport, 1977). The study area is located in the south west part of the Libya Extend between 27º South and 28º North Latitude and 14º 45´ to 15º45´ East - longitude covering an area of nearly 10,000 sq km. a geological map of this area based on aerial photographs has been produced in 1984 and geological detailed study for the iron ore deposit has been done in 1974.This study examines the use of Remote Sensing (RS) technology in geological to discover any probable extensions of the iron ore deposit; the Landsat Thematic Mapper (ETM+) instruments have provided information relating to specific groups of minerals, specifically the iron oxides and clays. Image processing techniques were applied such as Maximum Likelihood supervised Classification image for bands (7, 3, 1) and band ratio images (3/1, 4/3, and 5/7). XRD and XRF are highly complementary materials analysis methods which when used together greatly improve the accuracy of phase identification and quantitative analysis. Few samples has been collected form the promising new areas, XRD and XRF analysis applied on the collected samples to be compared with the result which been detected from remote sensing study. Small iron ore occurrences are found along the eastern and eastern south end of wadi -shati iron ore belt, these founding of iron deposit bodies may suggest that the iron ore extend under the sand covered area.

Paper P21

Estimation of baseflow index for the upper Langat river catchment, Selangor, Malaysia

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Baseflow, or groundwater runoff, is the flow component contributed to the river by groundwater. The purpose of this study is to estimate the Base Flow Index (BFI) for the upper Langat river catchment. The estimation of the index used the Ineson and Downing base flow separation method that estimated the groundwater discharge below the lower limit of the total hydrograph. The river discharge data recorded at Dengkil from 1960-2008 was used for this study. The estimated value of BFI for the upper Langat river catchment is between 0.50-0.51. The less extensive and thinner quaternary sediment cover in the upper catchment area is believed to limit the surface water and groundwater interaction.

Estimating the Baseflow Index is an important issue in hydrogeologic studies. In most cases, Baseflow Index is estimated by hydrograph separation. In hydrologic terms, hydrograph separation is the process where the storm hydrograph is separated into baseflow components and surface runoff components. Both these compenents are crucial for efficient development and management of groundwater resources.

Although several methods have been used to estimate ground-water discharge from stream flow records, the most commonly used is the estimation by the continues and long term of discharge into the stream. In other words, it requires an extended period of recording to estimate the long-term groundwater discharge. For Malaysian river, less study has been published in Base Flow Index.

The area of Langat river catchment is 1240 km2 and the length of the river is about 200 km. It is underlain by six lithologies which are comprised Hawthornden Schist, Kajang Formation, Kenny Hill Formation, granite, Tekali Quartz Ridge and alluvium (Anis Suhaila, 2007)(Figure 1). The Completed and and consecutive daily mean streamflow records from 1960 – 2008 of a streamflow gauging station in upper Langat river catchment was choosen and the location of the station is also shown in Figure 1.

Ineson & Downing (1964) base flow separation method is approaches to separate base flow component and surface runoff (Figure 2). This method is used because it is more reliable and representing the real situation. The Base Flow Index (BFI) or reliability index, which is long-term ratio of base flow to total stream flow, can be related to the base flow response of a catchment (Nathan & McMahon, 1990).

Table 1 shows that the BFI value is between 0.50 - 0.51 because the location of stream flow gauging station is at the upper part of Langat river catchment. Furthermore, the less extensive and thinner alluvium cover along the river is believed to limit the surface water and groundwater interaction. Both these reason are generally controlled the value of BFI. By using this method, the value of BFI can be determined and this method is reliable to get the value of Base Flow Index. So, more research about this component should be extended to lower catchment of Langat River.

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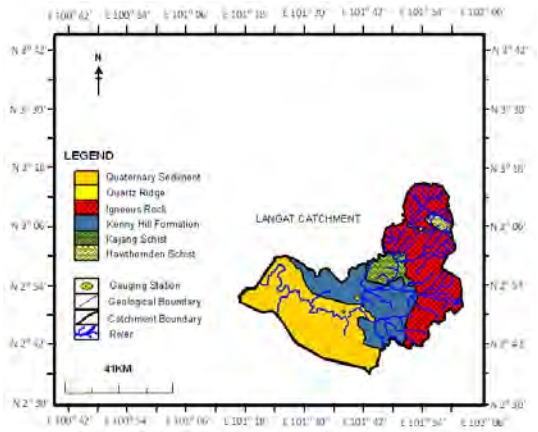

Figure 1: The map of study area and location of the gauging station.

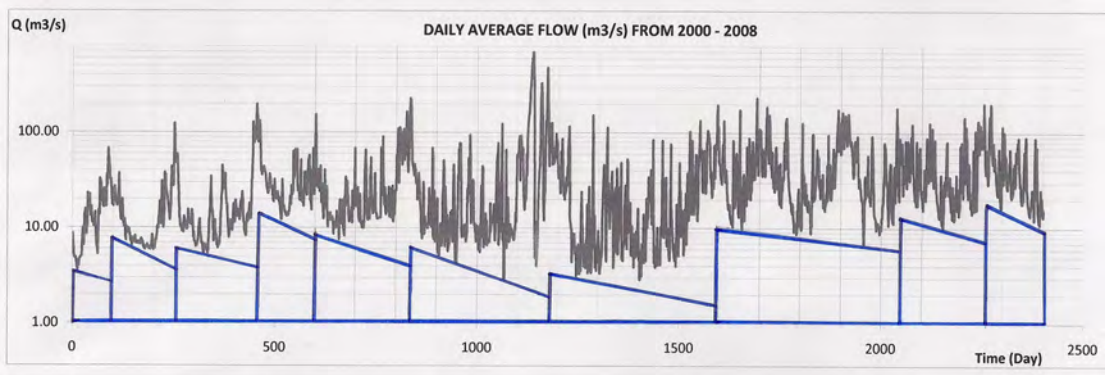

Figure 2: The Base flow separation method.

Table 1: The Base Flow Index

CATCHMENT	STATION NO	LATITUDE	LONGITUDE	AREA (KM^2)	LENGTH (KM)	TIME PERIOD ANALYZED	ANNUAL RAINFALL (mm)	TOTAL STREAMFLOW (m3/year)	BASEFLOW (m3/year)	BASEFLOW INDEX (BFI)	DISCHARGE (m3/s)
Langat	2816441	E101.68343°	N02.85643°	1240	200	1960 - 2008	2375.58	4.00E+11	2.05E+11	0.51	34.7

Paper P22

Quantification of the influence of discontinuities on the compressive strength of Malaysian granite

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Geological discontinuities, weathering grade and compressive strength of rock material play a significant role in influencing the stability of both cut rock slopes as well as underground openings. In the actual scenario, the compressive strength characteristics of the rock material are influenced by both material strength as well as the presence of macro-fracture. This paper presents the results of one important aspect of a systematic research to quantify the mechanical characteristics of granite materials, which are the changes in the compressive strength of fresh as well as slightly weathered granites related to geological discontinuities. The weathering grades of rock material were determined by using Schimdt rebound hammer. The granitic rock samples were tested by uniaxial compressive strength test according to ISRM standard. From the examination on rock 167 samples after the tests, the modes of failures were classified as material failure as well as material and discontinuity failure. Statistical analysis of the results at 95% confidence level showed that the average values of uniaxial compressive strength for fresh as well as slightly weathered for material failure were 113.6 ± 7.0 MPa and 68.9 ± 3.6 MPa respectively. For material and discontinuity failure, the respective average values of uniaxial compressive strength for fresh and slightly weathered were 65.6 ± 4.1 MPa and 43.9 ± 1.3 MPa. The uniaxial compressive tests results exhibited measurable differences, both for the different the weathering grades as well as the failure modes. The results shown that the compressive strength for slightly weathered granite was 2/3 (67%) of the strength of fresh granite. The values of compressive strength for material and discontinuity failure was half (50%) of the strength of material failure.

Paper P23

Some engineering geological and geophysical properties of weathered granitic soils in Fraser Hill, Pahang

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The Bukit Fraser granite exhibits a full range of weathering grades. The variation of engineering geological characteristics and geophysical properties were measured through the weathering profile. The thickness of each grade materials varies from place to place and the weathering profiles are gradational in nature. Most of the profile shows thin residual soil layer. The completely weathered (CW) Grade V is thick, and frequently contains highly weathered (HW) core stones. The highly and moderately weathered materials are commonly thicker and the fresh rock is normally encountered beyond the slightly thin weathered layer. From grain size analysis, the soil range from clay with some gravel and sandy silt to very silty sand. Results show that highly weathered to residual granitic soil in the study area have intermediate plasticity (10 – 15%), low moisture content (12.67 – 26.67%) and higher shear strength (ǿ = 11 - 33˚; c = 24 – 35 kPa). The grain size increases with depth as the weathering grades decreases. An increase in the degree of weathering results in an increase in pore volume and a decrease in relative density. Field observations and geophysical surveys show that the rock has been weathered up to 30 meters depth along the survey lines. Geophysical surveys result also show that the seismic P-wave velocities range from 300 – 800 m/s for top residual soil to completely weathered soil layers, 900 to 1500m/s for compacted saturated soil layer and 1500 – 2500 m/s for highly to moderately weathered rock. The surface electrical resistivity also varies with the increase of weathering grade. Average resistivity changes from 1500 ohm/m for grade VI to 4000 ohm/m for grade IV material. Both seismic velocities and resistivity increase with decrease in the weathering grades. The seismic refraction data are reliable and show consistent results. Seismic velocity was correlated to the properties of geomaterials and depths of bedrock. The variations of the properties of weathered materials show some good correlations with the degree of weathering. The data presented in this paper are important input in geotechnical engineering such as slope stability for highway constructions projects in Malaysia.

Paper P24

Geoelectrical study of Taman Beringin landfill, Kuala Lumpur, Malaysia

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Nowadays, landfills due to their potential effects on groundwater and soil contamination have attracted scientists` attention towards themselves. Heavy rainfall in tropical countries like Malaysia increases ability of waste pile to absorb water and therefore this area is expected to suffer from more pollution problems. This paper discusses the result of the performed measurements of 2D resistivity imaging for exploration of the extent of contaminated leachate plumes and delineation of subsurface profiling as well as proving the potential of this type of geophysical survey technique as an efficient and cost benefit tool for mapping subsurface features. In this study, 2D direct current electrical resistivity method was carried out at a covered and closed landfill called Taman Beringin in Kuala Lumpur. This covered and closed landfill is located in an ex-mine area near Jinjang river. The survey was conducted using SAS 1000 resistivity meter along six 200-m lines using a multi-electrode resistivity meter with 64 electrodes at 5 m intervals. Line L1-L`1 was laid out from southeast to northwest on the top of the landfill. Line L2-L`2 was located along the access road to the top of the landfill. Four lines, L3-L`3, L4-L`4, L5-L`5 and L6-L`6, were laid out at the bottom of the landfill and parallel to Jinjang River. The results obtained from the performed measurements of both wenner and dipole-dipole arrays in this landfill in the period of 5 months. The inversion results of the apparent resistivity data collected from lines L3-L`3, L4-L`4, L5-L`5 and L6-L`6 were combined to simplify the interpretation and better representation of the subsurface structures. The results indicate different leachate zones with low resistivity values (< 10 Ωm) in the profiles of the lines in the landfill. The presence of these zones in the results for different months and changes in their sizes are evidence for the movement of the leachate from the top to the bottom of the investigation site.

Paper P25

The effect of bedding plane orientation towards P-wave velocity of Berea Sandstone at different water saturation degree

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Bedding plane orientation has a significant influence on the sound velocity, specifically P and S wave. Thus, a correlation between sound velocity and bedding plane orientation effect would be highly useful in characterizing rock physics properties. In this study, P and S wave velocity measurement were performed on 9 core plugs, 3 of which were parallel, 3 of which were perpendicular and 3 of which were 45 degrees incline to the bedding plane. Each core was saturated with 80 000 ppm brine water and the velocity measurement were made at different saturation degree until they are completely dry.

From the data retrieved, P wave velocity data distribution for each bedding plane showed different pattern of trend even though they are from the same sedimentary field. This clearly shows that anisotropic effect took place in affecting the P wave velocity value. The results obtained were then modeled using Gassmann's theory and it was found that the measured data did not fit the equation. The P wave velocity data measured were way greater than the estimated value which concludes that the rocks tested in this study were not the same type as Gassmann used before to derive his equation.

By using regression analysis, a strong correlation between wet-rock P wave velocity and dry-rock P wave velocity for different bedding plane was developed. As a result, 3 different equations had successfully been derived to predict the wet-rock P wave velocity from the dry-rock P wave velocity for each bedding planes orientation.

Paper P26

Survei keberintangan geoelektrik dan GPR dalam kajian pencemaran minyak di sekitar Stesen Caltex Kubang Kerian, Kota Bharu, Kelantan

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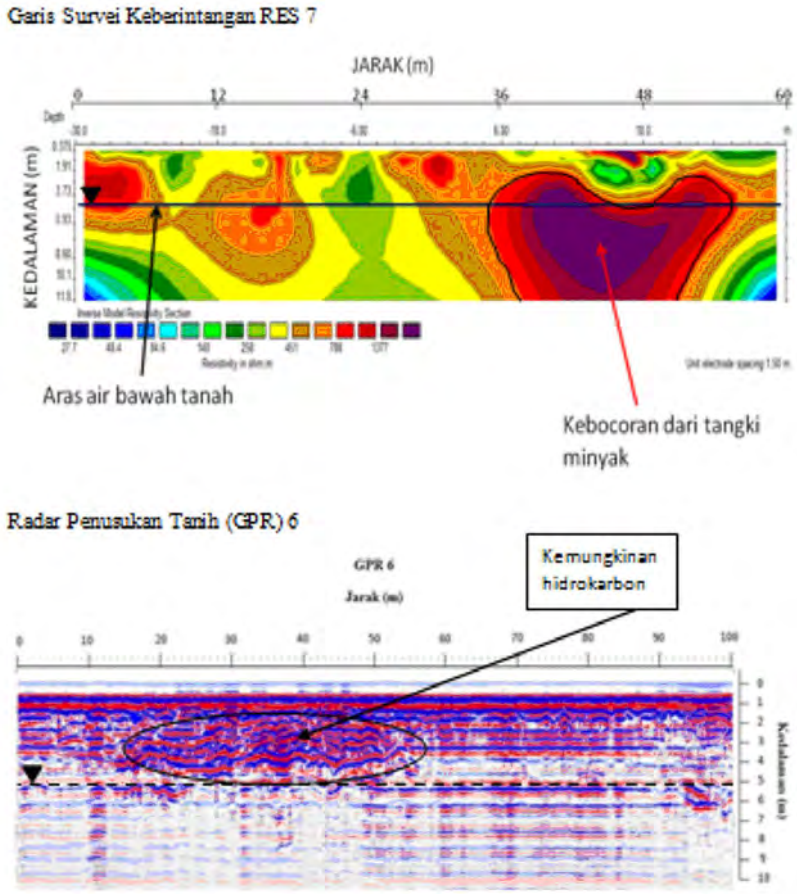
Survei keberintangan geoelektrik telah dilakukan di stesen minyak Caltex Kubang Kerian, Kota Bharu, Kelantan untuk menyiasat pencemaran bawah tanah yang disebabkan kebocoran tangki minyak di sekitar kawasan tersebut. Pengukuran geofizik telah dijalankan di sepanjang empat belas garis survei. Survei keberintangan geoelektrik telah dilakukan dengan teknik Schlumberger sepanjang dari 30 m hingga 60 m dan jarak elektrod di lapangan ialah dari 0.5 hingga 1.5 m. Data lapangan diproses dengan perisian RES2DINV untuk mendapatkan model 2D. Hasil menunjukkan keberintangan pencemaran hirdokarbon ialah antara 200 Ωm hingga 10000 Ωm. Survei radar penusukan tanih (GPR) juga dilakukan pada 8 profil di kawasan kajian. Keratan rentas GPR menunjukkan dengan jelas kehadiran aras air tanah yang berasosiasi dengan longgokan minyak. Zon berkeberintangan tinggi yang berasosiasi dengan zon pasir tidak tepu dan zon pencemaran minyak menunjukkan amplitud pantulan yang tinggi dan berbentuk kacau (chaotic) manakala zon keberintangan rendah yang berada di bawah aras ait tanah menunjukkan pantulan yang kurang jelas kerana faktor serapan gelombang EM yang digunakan. Model songsangan 2D keberintangan geoelektrik dibandingkan dengan model imej GPR pada garis survei yang sama untuk tafsiran yang terperinci. Model keberintangan menunjukkan hasil kajian yang lebih dalam manakala hasil GPR hanya pada aras air tanah sahaja. Oleh itu hasil keberintangan geoelektrik adalah lebih baik dalam kajian pencemaran minyak dalam air tanah. Data keberintangan menegak yang dilakukan dalam lubang auger cetek membuktikan dengan lebih jelas tentang kehadiran minyak pada kedalaman tertentu yang berasosiasi dengan sampel tanah tercemar. Aluvium Kuaterner di lokasi kajian berkomposisi dominan pasir dan sedikit lodak.yang boleh dikelasifikasikan sebagai pasir berlodak. Sampel air yang diambil dari 12 perigi pemantauan dianalisis untuk mendapatkan beberapa sifat fizik air. Nilai kekonduksian elektrik purata ialah 95.52 µs/cm. Manakala pH ialah 5.85, oksigen terlarut 6.37 mg/l, dan TDS ialah 6.135 mg/l. Nilai purata pH sampel tanih adalah sedikit berasid dan sedikit beralkali iaitu antara 4.6 hingga 9.9. Analisis logam berat juga menunjukkan kehadiran logam seperti Cr, Mn, Fe, Ni, Cu, Zn, Cd, dan Pb. Manakala logam toksik seperti As juga didapati dalam sampel tanih dan air. Logam berat ditafsirkan berasal dari minyak yang masuk ke dalam air dan tanih di sekitar.

Rajah 1 menunjukkan perbandingan garis survei keberintangan RES 7 dengan Radar Penusukan Tanih GPR 6. Kedua-dua keratan rentas tersebut diambil pada satu garis survei yang sama. Garis survei ini terletak di bahagian belakang stesen minyak Caltex. Permulaan pada garis survei RES 7 iaitu bahagian kiri rajah adalah bersamaan dengan bahagian kanan keratan rentas Radar Penusukan Tanih GPR 6.

Pada garis survei RES 7 dapat ditafsirkan terdapat kebocoran daripada tangki minyak pada jarak 34 m hingga 56 m berpunca daripada stesen minyak Caltex tersebut. Hal ini disebabkan nilai keberintangan yang tinggi ditunjukkan sekitar 788 Ωm hingga 1377 Ωm. Kebocoran daripada minyak tersebut ditunjukkan dengan warna keberintangan yang tinggi iaitu dari warna merah hingga warna ungu. Kebocoran yang berlaku berada sekitar aras air bawah tanah iaitu 5 m. Keberintangan yang rendah ditunjukkan dengan warna hijau hingga biru dimana menunjukkan kedudukan air bawah tanah.

Pada keratan rentas GPR 6 menunjukkan struktur di bawah permukaan berdasarkan riak pantulan yang ditunjukkan. Keratan rentas GPR 6 menunjukkan terdapat kehadiran longgokan minyak pada aras air bawah tanah. Kehadiran minyak di kesan berdasarkan zon keberintangan yang tinggi dimana ditunjukkan dengan amplitud pantulan yang berbentuk kacau (chaotic). Pada keratan rentas GPR 6 menunjukkan kehadiran longgokan minyak pada jarak 15 m hingga 55 m. Zon keberintangan rendah pula ditunjukkan pada kedudukan dibawah air tanah dimana amplitud pantulan adalah kurang jelas dan lemah disebabkan faktor serapan gelombang EM.

Perbandingan dibuat antara garis survei RES 7 dengan GPR 6 pada laluan yang sama. Daripada perbandingan tersebut memang wujud kehadiran minyak dimana kedudukan yang dikesan berkeberintangan tinggai adalah sama pada kedua-dua keratan rentas tersebut. Oleh yang demikian, pada garis survei tersebut terdapat longgokan minyak pada aras air bawah tanah.



Rajah 1: Perbandingan antara Garis Survei Keberintangan RES 7 dengan Radar Penusukan Tanih GPR 6.

Paper P27

Kajian petrografi dan geokimia batuan igneus di kawasan selatan Pulau Pinang

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Kertas kerja ini menerangkan tentang kajian petrografi dan geokimia di sekitar kawasan selatan Pulau Pinang meliputi Kampung Pasir panjang, Kampung Pulau Bentung, Kampung Genting, Kampung Terang, Kampung Tengah, Kampung Nelayan, Kampung Teluk Kumbar, Kampung Binjal, Batu Maung dan Kampung Teluk Tempoyak Kecil. Terdapat 12 lokaliti cerapan yang dilakukan penelitian dan persampelan. Kajian terbahagi kepada kajian terdahulu, kajian di lapangan dan kajian makmal. Kajian terdahulu mencadangkan Pulau Pinang terdiri daripada 3 jenis batuan granit, iaitu granit biotit dan granit biotit muskovit. Rejahan pluton di Pulau Pinang dikatakan berada pada Trias Atas. Kawasan selatan Pulau Pinang terdiri daripada kedua-dua unit batuan granit biotit dan granit biotit muskovit yang mempunyai butiran sederhana hingga kasar. Kebanyakan batuan tersebut mempunyai aturan megakris K-feldspar. Hasil kajian di lapangan membuktikan terdapat tiga jenis batuan granit di kawasan kajian iaitu granit biotit porfifi, granit biotit muskovit porfiri dan granit biotit muskovit butir sederhana. Batuan granit biotit porfiri mempunyai tekstur porfiri dan dapat dikenali di lapangan dengan kehadiran mineral K-feldspar yang kasar iaitu saiznya yang lebih dari 5 mm. Granit biotit muskovit porfiri dan butir sederhana dapat dikenali di lapangan dengan kehadiran mineral muskovit yang berkeping dan dapat dilihat dengan jelas. Untuk yang mempunyai tekstur porfiri, dapat dilihat fenokris K-feldspar yang bersaiz purata 5.5 mm. Kajian di makmal diwakili oleh kajian petrografi yang dibuat terhadap sampel-sampel yang dipilih. Kajian tersebut membuktikan lagi terdapat 3 unit batuan di kawasan kajian. Hasil kajian XRF menunjukkan SiO_2 iatu kuarza mempunyai purata peratus yang paling tinggi iatu 67.74 % diikuti Al_3O_2 16.11 % dan K_2O sebanyak 6.0 %. Daripada plotan gambarajah Harker yang ditunjukkan oleh ketiga-tiga batuan, dapat disimpulkan bahawa batuan granit di kawasan kajian berasal dari fraksi magma yang sama.

Paper P28

Petrografi dan geokimia batuan granit di bahagian utara Pulau Pinang

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Kertas kerja ini bertujuan untuk mendapatkan maklumat berkenaan petrografi dan geokimia batuan granit di kawasan utara Pulau Pinang. Kajian petrografi ke atas irisan nipis yang dibuat daripada sampel lapangan dapat memperihalkan kandungan mineral utama dan aksesori serta tekstur batuan secara mikroskopik. Berdasarkan kandungan mineral dan tekstur batuan, batuan dikelaskan kepada tiga jenis batuan iaitu granit biotit berbutir kasar, granit berbutir sederhana dan granit biotit porfiri. Kesemua batuan mempunyai peratusan kuarza antara 20% - 40% isipadu batuan. Peratusan mineral feldspar alkali adalah antara 10% - 50% dan peratusan mineral plagioklas pula adalah antara 8% - 50% isipadu batuan. Mineral aksesori yang hadir adalah biotit, apatit dan zirkon. Antara tekstur batuan yang dikenalpasti adalah tekstur poikilit, mikropertit dan pengezonan. Berdasarkan pengelasan batuan igneus mengikut Streckeisen (1976), batuan igneus di lapangan adalah setara dengan batuan granit hingga granodiorit. Kajian geokimia terhadap unsur-unsur major iaitu SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O dan K_2O dan unsur minor iaitu TiO_2 dalam sampel batuan dapat menjelaskan tentang asalan jenis magma dan sejarah pembentukan batuan di kawasan kajian. Set data geokimia yang diperolehi daripada kaedah XRF boleh diolah untuk mengelaskan batuan berdasarkan kandungan kimia, asalan magma dan sekitaran tektonik. Pengelasan asas berdasarkan peratus berat unsur silika, dimana sampel batuan memberikan nilai peratus berat unsur silika iaitu 66% - 72% mengesahkan batuan adalah terdiri daripada kumpulan asid. Plot pada gambarajah Harker memberikan korelasi negatif bagi unsur CaO, Al_2O_3, MgO, Fe_2O_3 dan TiO_2 melawan unsur SiO_2 dan korelasi positif bagi unsur Na_2O melawan SiO_2. Berdasarkan dapatan nilai A/NK dan A/CNK, nilai A/NK lebih daripada satu dan A/CNK kurang daripada satu. Oleh itu batuan dikelaskan kepada jenis metalumina dan granit jenis I. Peratus Na_2O adalah melebihi 3.2 %. Granit jenis I ini juga dibuktikan dengan nilai CIPW Korundum dan Diopsid adalah kurang daripada 1 %. Pengelasan TAS membahagikan batuan kepada granit dan seinit. Sekitaran tektonik pula dicadangkan pada sekitaran orogenik yang mengalami pengangkatan lewat dan semasa berlakunya proses pertembungan kerak.

Paper P29

Kajian petrografi dan geokimia batuan igneus di Teluk Bahang-Balik Pulau, Pulau Pinang

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Kertas kajian ini membincangkan kajian petrografi dan geokimia di kawasan barat di Pulau Pinang meliputi kawasan Teluk Bahang hingga ke Balik Pulau. Terdapat 26 lokaliti cerapan telah dilakukan untuk penelitian dan persampelan. Kajian terdahulu telah mencadangkan granit di Pulau Pinang merejah pada Trias Lewat dan terbahagi kepada 2 pluton, utara dan selatan. Pluton utara terdiri daripada granit biotit berbutir sederhana hingga kasar. Kawasan kajian di barat Pulau Pinang yang terletak di dalam pluton utara terdiri daripada batu granit biotit berbutir sederhana dan kasar. Kajian lapangan telah membuktikan terdapat 1 jenis batuan berwarna kelabu cerah, berbutir halus hingga kasar dan juga yang berporfiri tidak jelas di sesetengah tempat. Batuan granit biotit berbutir kasar terdiri daripada kuarza yang bersaiz purata 8 mm manakala plagioklas dan alkali feldspar bersaiz purata 5 mm. Batuan granit berbutir sederhana pula mempunyai kuarza bersaiz purata 4 mm manakala plagioklas dan alkali feldspar bersaiz purata 3 mm. Terdapat juga batuan granit biotit berbutir halus yang mempunyai saiz butiran kurang daripada 1 mm. Batuan granit berporfiri tidak jelas pula terdiri daripada fenokris K-feldspar yang bersaiz purata 10 mm dan kuarza serta plagioklas sebagai jisim latar. Terdapat 2 hingga 3 set struktur kekar di sesetengah lokaliti. Kajian makmal dilakukan terhadap 25 sampel keratan nipis batuan granit yang terpilih. Kajian tersebut membuktikan terdapat 1 jenis batuan yang mempunyai tekstur yang berlainan di kawasan kajian. Batuan granit biotit bertekstur halus mempunyai mineral bersaiz julat 0.2-1 mm. Batuan yang bertekstur sederhana hingga kasar mempunyai mineral yang bersaiz julat 2-5 mm. Di dalam batuan granit berporfiri tidak jelas pula terdiri daripada fenokris K-feldspar dan plagioklas yang bersaiz purata 2 mm dan kuarza sebagai jisim latar. Hasil analisis XRF menunjukkan unsur major terhadap kesemua jenis batuan mendapati bahawa SiO_2 mempunyai peratusan yang tinggi berbanding unsur major yang lain iaitu 73.20 %. Secara puratanya peratusan unsur major bagi setiap sampel ialah SiO_2=69.35, TiO_2=2.82, Al_2O_3=15.75, Fe_2O_3=2.22, MgO=0.30, CaO=1.06, Na_2O=3.24 dan K_2O=7.02. Batuan di kawasan dikelaskan kepada jenis granit jenis-I dan jenis –S. Oleh itu, hasil analisis geokimia terhadap 7 sampel batuan kawasan kajian mendapati ianya adalah jenis-I bagi sampel L1 dan L2(2) manakala jenis-S bagi 5 sampel yang lain mengikut pengelasan Shand. Berdasarkan gambarajah Harker, didapati bahawa batuan di kawasan kajian terdiri daripada 1 fraksi magma yang sama.

Paper P30

The petrography and geochemical signature of granitic body along the Kajang – Sungai Long Silk Highway, Hulu Langat, Selangor

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The study area is a 4.1km stretch of Kajang Silk Highway, starting from km 16.4 (Kajang Perdana Exchange) towards Sungai Long exit. The moderately undulating hills making up the southern part of the Main Range expose continuous road cuts at five localities (L1 to L5), intermitted by low lying areas barren of outcrops. A total of 50 fresh granitic samples, 10 from each road cuts have been collected for petrographic study and 36 of them have been geochemically analyzed. Field observations have shown that the leucocratic rocks are comprised of coarse-grained biotite granite, medium-grained biotite granite, coarse-grained two-mica granite, and medium-grained two-mica granite. By means of conventional point counting technique for medium-grained rocks and integrated field-microscopic point counting technique for coarse-grained rocks on 41 samples, the granitic rocks of the study area are divisible into three mineralogical classes, in accordance with presently accepted IUGS's scheme. They are quartz-rich granitoid (8 sample, dominating L4 outcrops), granodiorite (25 sample; L1, L2 and L3 outcrops), and granite (8 sample, confined to Loc 5 outcrops). By combining mineralogy and texture, the final nomenclature for the granitic rocks of the study area are (1) Medium-grained quartz-rich biotite granitoid, (2) Medium-grained biotite granite, (3) Medium-grained two-mica granite, (4) Course-grained biotite granodiorite, and (5) Coarse-grained two-mica granodiorite. The average chemical compositions of the 36 samples determined by X-ray fluorescence technique (XRF) are: SiO_2 78.07, TiO_2 0.31, Al_2O_3 14.12, Fe_2O_3 1.39, MnO 0.06 and CaO 1.58, in weight percentage; and As 15, Ba 73, Co 34, Cr 13, Ni 86, Rb 883, Sr 69, V 3, Zn 97 and Zr 166, in µg/g. The studied plutonic body shows rather wide range of SiO_2, i.e. 71.78 – 86.69%, indicating its origin from moderate to highly acidic magma. The rather strong negative correlations shown by SiO_2-TiO_2, SiO_2-Fe_2O_3, SiO_2-MnO and SiO_2-CaO and a positive SiO_2-Al_2O_3 correlation suggest that the five rock types originated from the same parent acidic magma through magmatic evolution, most possibly through fractional crystallization. Some trace elements are depleted as the evolution progresses (e.g. Ba, Rb, Ni), while others have undergone enrichment (e.g. Sr, As).

Paper P31

The petrography and geochemical signature of granitic body at the vicinity of Berjaya Hill Resorts, Bentong, Pahang

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The study area is a 20km stretch of a ring road climbing up to the hill top and descending to the same entry point, connecting places of interest in the popular resorts. Slightly weathered rocks of Bukit Tinggi Granite which form the eastern plank of the Main Range are exposed along the hilly road cuts. Field observations on 37 localities have shown that the leucocratic rocks are comprised of coarse-grained biotite granite (9), strongly porphyritic biotite granite (19) and weakly porphyritic biotite granite (9), with unclear boundaries. All rocks show some degree of deformation from a number of faults in their vicinity. A total of 41 samples have been collected for petrographic study and 34 of them have been geochemically analyzed. By means of conventional point counting technique for equigranular rocks and integrated field-microscopic point counting technique for strongly porphyritic rocks, the granitic rocks of the study area are divisible into three mineralogical classes, in line with the presently accepted IUGS's scheme. They are quartz-rich granitoid (24), granite (14) and alkali feldspar granite (3). By combining mineralogy and texture, the final nomenclature for the granitic rocks of the study area are (1) Coarse-grained biotite granite, (2) Medium-grained porphyritic biotite granite, (3) Fine-grained porphyritic biotite granite, (4) Coarse-grained alkali feldspar biotite granite, (5) Fine-grained alkali feldspar biotite granite, (6) Coarse-grained quartz-rich biotite granitoid, and (7) Medium-grained porphyritic quartz-rich biotite granitoid. The average chemical compositions of 36 samples determined by X-ray fluorescence technique (XRF) are: SiO_2 66.48, TiO_2 0.33, Fe_2O_3 3.37, MnO 0.03, MgO 0.04, CaO 1.27 and P_2O_5 0.08, in weight percentage; and As 18, Ba 147, Co 33, Cr 7, Ni 89, Rb 722, Sr 81, V 20, Zn 85 and Zr 396, in µg/g. The Berjaya Hill plutonic body shows rather narrow range of SiO_2, i.e. 57.78 – 74.01%, indicating its origin from intermediate to typical acidic magma. The rather strong negative correlations shown by SiO_2-TiO_2, SiO_2-Fe_2O_3, SiO_2-MnO and SiO_2-CaO suggest that the seven rock types crystallized from the same parent magma of intermediate-acidic composition through magmatic evolution, most possibly fractional crystallization. Some trace elements are depleted as the evolution progresses (e.g. Ba, Sr, V), while Rb and As have undergone enrichment.

Paper P32

The petrography and geochemical signature of granitic body along the coast of Tanjung Bidara, Masjid Tanah, Melaka

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The study area is a 7.5km coastal area of Tanjung Bidara, Masjid Tanah, Melaka, stretching from Kg. Tanjung Bidara in the north to two kilometers off Tanjung Panchor in the south. In the northern half of the area, the outcrops are dominated by coarse-grained porphyritic biotite granite. Further south the same rock type predominates the coast, with minor occurrences of aplite and tourmaline pegmatite, both in the form of dykes, 0.6 – 1 m thick. Xenoliths of darker rocks are also common, ranging in size from a few cm to 10 cm. 52 samples have been collected for petrographic, as well as geochemical studies. By means of conventional point counting technique and integrated field-microscopic point counting, the main granitic rocks of the study area is granite, based on presently accepted IUGS's scheme, with an affinity towards alkali-feldspar quartz granite. The average chemical compositions of 52 samples determined by X-ray fluorescence technique (XRF) are: SiO_2 67.48, TiO_2 0.42, Fe_2O_3 3.43, MnO 0.05, CaO 1.66, K_2O 5.42 and P_2O_5 0.18, in weight percentage; and As 11, Ba 346, Co 39, Cr 11, Ni 73, Rb 534, Sr 116, V 30, Zn 81 and Zr 304, in µg/g. The studied plutonic body shows rather narrow range of SiO_2, i.e. 64.87 – 71.96%, indicating its origin from crystallization of typical acidic magma. The rather strong negative correlations shown by SiO_2-TiO_2, SiO_2-Fe_2O_3, SiO_2-MnO and SiO_2-CaO and a positive SiO_2-K_2O correlation suggest that the slight compositional variation within the rocks of the studied area is due to magmatic evolution, most possibly by fractional crystallization of the parent acidic magma. The strongly porphyritic nature of the rocks suggests the possible two-stage crystallization, started by the feldspar phenocrysts. Some trace elements are depleted as the evolution progresses (Co, Cr, Sr, V and Zn), while others have undergone enrichment (As, Ba, Rb and Sr).

Paper P33

Deformations in the metasediments and conglomerates of Tanjung Leman, Johor

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Tanjung Leman, which is underlained by multiply deformed Paleozoic Mersing Beds in unconformable contact with the overlying continental Murau Conglomerates provide an opportunity to study the deformation episodes and history for east coast of Johore as well as to understand the nature of the Murau basin. It was determined that the underlying metasediments have undergone two early ductile deformations overprinted by two distinct episodes of brittle-ductile deformation. The earliest northwest–southeast compression (D_1) produced open upright folds with variably developed north-northwest-striking cleavage. Renewed northwest–southeast compression produced second sets of folds with localized strike-parallel shear zones. Interference between folds is well developed. The general structure of the area is the result of the third episode of deformation (D_3). It gives rise to NNW striking shear zones that deformed the first two structures into asymmetric sub-vertical folds. The latest episode of deformation (D_4) includes NNE-SSW trending dextral strike-slip faults with subordinate E-W striking sinistral strike-slip faults. The overlying sub-vertical thick-bedded Murau Conglomerates shows clastic dykes, syn-sedimentary listric growth faults, conjugate normal faults and negative flower structures suggestive of deposition and deformation in a transtensive environment. They are cut by NNE-SSW trending dextral strike-slip faults with subordinate E-W striking sinistral strike-slip faults assigned to the latest episode of deformation (D_4). The deformation provide evidences for early contractional and later dextral transpressional deformation of the Mersing Beds that lead to the development of the Murau basin in a transtensive regime.

Paper P34

Mikrostruktur dan analisis kinematik batuan milonit S-C di Bukit Tinggi, Pahang

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Sebuah kajian mikroskopik mengenai mikrostruktur dan kinematik batuan milonit S-C telah dijalankan di sekitar kawasan Bukit Tinggi, Pahang. Zon Sesar Bukit Tinggi (BTFZ) merupakan salah satu zon sesar utama di semenanjung Malaysia yang melintasi kawasan ini. Zon Sesar Bukit Tinggi merupakan sebuah sesar gelinciran jurus (Shu, 1969; Tjia, 1972; Ng, 1994). Pembentukan beberapa episod sesar di kawasan ini telah menghasilkan pelbagai jenis batuan sesar di antaranya batuan milonit dari jenis S-C. Kawasan kajian dijalankan adalah zon di mana batuan milonit S-C tersingkap paling baik. Kajian mikroskopik batuan milonit S-C ini telah dijalankan dengan menggunakan keratan nipis berarah.

Mineral-mineral utama yang terdapat di dalam milonit S-C ini ialah kuarza, feldspar dan biotit. Mineral kuarza dan biotit menunjukkan sifat yang mulur dengan pembentukan mikrostruktur seperti padaman bergelombang, deformasi jaluran, reben kuarza dan pembentukan sub-butiran bagi kuarza serta lipatan dan penghabluran semula bagi biotit. Sementara mineral-mineral feldspar pula menunjukkan sifat yang rapuh seperti pembentukan retakan mikro dan sedikit mulur seperti pembentukan kembaran mekanikal, *flame perthite* dan penghabluran semula.

Selain itu, penentu kinematik juga dapat dilihat seperti fabrik S-C, foliasi sendeng, porfiroklas mika, porfiroklas feldspar bersayap serta porfiroklas feldspar ofset. Fabrik S-C dibentuk oleh permukaan C yang ditanda oleh neoblas kuarza, mineral opak serta jaluran mineral filosilikat dan serpihan butiran feldspar yang halus. Permukaan S pula dibentuk oleh lensa-lensa kuarza yang menunjukkan orientasi terpilih ke arah ricihan utama iaitu ke arah menganan. Foliasi sendeng pula dibentuk oleh sub-butiran, neoblas dan lensa kuarza yang mengalami pemanjangan ke arah terikan utama. Fabrik yang memanjang ini mengarah masuk ke dalam foliasi C pada sudut yang kecil. Orientasi kesendengan menunjukkan arah terikan menganan. Porfiroklas mika juga terbentuk dengan baik di dalam milonit S-C iaitu selari dengan permukaan S dan condong ke arah ricihan. Permukaan terpanjang mika ini adalah selari dengan permukaan S. Heretan-heretan serpihan mika kecil memanjang ke dalam matrik dan menjulur daripada satu mika ke mika yang lain dan menunjukkan juluran yang lebih tinggi berada di sebelah kanan.

Kebanyakan porfiroklas mantel bersayap yang ditemui pula adalah dari jenis σ_b (Simpson & Schmid, 1983). Porfiroklas dibentuk oleh klas-klas feldspar yang mempunyai bentuk lentikular atau membujur. Butiran halus mantel mengalami deformasi dan membentuk sayap yang terdiri daripada neoblas feldspar, neoblas biotit serta lensa dan neoblas kuarza yang memanjang. Semua porfiroklas bersayap menunjukkan sayap kanan berada pada kedudukan yang lebih tinggi daripada sayap kiri. Porfiroklas feldspar ofset pula mengalami pecahan dan bergerak di sepanjang sesar mikro. Kebanyakan daripada mereka adalah antitetik dimana kedudukan pecahan klas-klas feldspar berada pada sudut yang besar kepada foliasi C. Arah pergerakan relatif sesar mikro ini adalah mengiri iaitu songsang kepada arah pergerakan zon ricihan.

Hasil daripada analisis mikroskopik deformasi mikrostruktur ke atas batuan milonit S-C menunjukkan batuan milonit ini terbentuk pada keadaan rapuh mulur ataupun zon peralihan daripada rapuh ke mulur mengikut konsep model zon sesar yang dicadangkan oleh Sibson (1985). Dianggarkan suhu dimana milonit S-C ini terbentuk adalah 250°C hingga 450°C. Sementara itu, daripada kajian mikroskopik penentu kinematik pula menunjukkan sesar yang menghasilkan milonit S-C mempunyai peralihan menganan.

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Paper P35

Source rock characteristics and basin modelling of the Upper Jurassic Madbi Formation, Masila Basin, Yemen

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The Masila Basin is an important hydrocarbon province in Yemen (Fig.1), however the origin of the hydrocarbons is not fully understood. In this study, we evaluate the Upper Jurassic source rock in the Madbi Formation and assess the results of basin modeling in order to improve our understanding of burial history and hydrocarbon generation. Evaluation of the hydrocarbon source rock potential and oil generation in the central-west of the Masila Basin were based on organic geochemistry (Rock-Eval pyrolysis, TOC and bitumen extraction) and organic petrology studied. Shales in the Upper Jurassic Madbi Formation contain relatively high quantities of organic matter (usually more than 2.0 wt% TOC; Fig.2) and have very good to excellent hydrocarbon potential (Fig.2). The shales predominantly contain algal Type II kerogen with minor Type I kerogen (Fig.3). Thermal maturity of the organic matter is 0.69–0.91% vitrinite reflectance. Thermal and burial history models indicate that the source rock entered the early- mature to mature stage in the Late Cretaceous to Early Tertiary times (Fig.4). Therefore, the hydrocarbon generation from the Madbi source rock occurred in the Late Cretaceous, reaching maximum rates during the Early Tertiary (Fig.4). Cretaceous subsidence had only a minor influence on source rock maturation and organic matter transformation. This source rock has generated commercial volumes of hydrocarbons which migrated into Jurassic and Lower Cretaceous reservoir rocks.

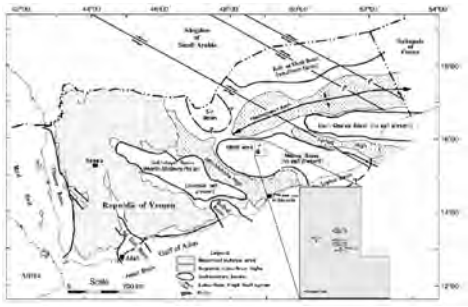

Figure 1: Location map of the study area in the central-west of the Masila Basin, showing locations of the studied wells.

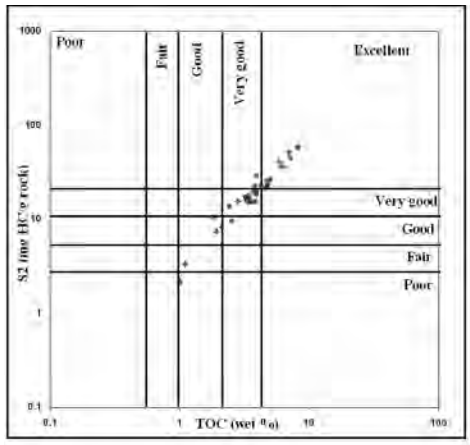

Figure 2: Distribution of shale samples into S2 verses total organic matter (TOC) plot; showing generative source rock potential.

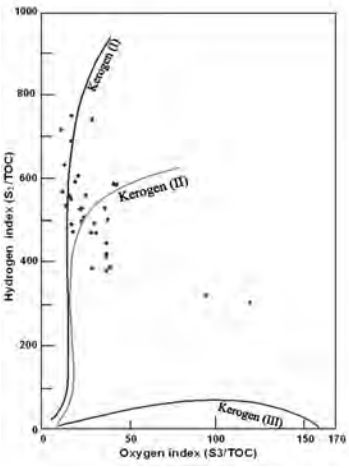

Figure 3: Van Krevelen diagram based on oxygen index (OI) versus hydrogen index (HI), showing the oil prone kerogen type. Most samples plot along Types I and II evolution paths.

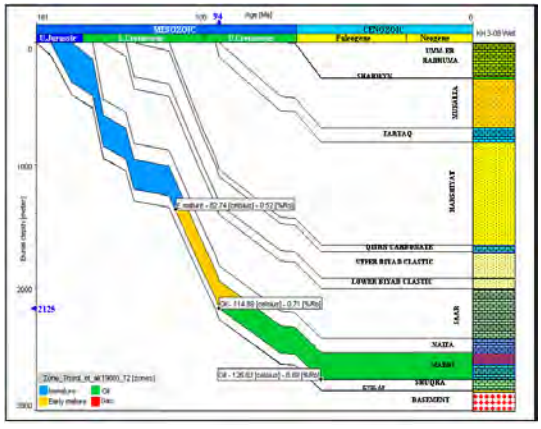

Figure 4: Burial history curves with hydrocarbon zones of Madbi shale in wells KHA 3-08 in the study area.

Paper P36

Spatial-temporal variability of hydrocarbon distribution in the northern sector of the Belait Formation

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Spatial and temporal variability is the subject matter of interest in the Oil and Gas Industry. Recently, Padamanabhan (2010) indicated that the Belait Formation in North-eastern Sarawak showed tremendous spatial and temporal variability. By understanding this variability, improvements may be introduced to understanding reservoirs and its managements.

The Belait Formation in North-eastern Sarawak represents the Middle – Upper Miocene age in the Miri Zone tectonostratigraphic. The Formation comprises alternating sandstone, sand and clays in varying proportions and thickness (Liechti *et al*., 1960; Tate, 2001; Hutchison, 2005). Traditionally the Belait Formation has been accepted as barren. However it has been discovered recently that hydrocarbons can be present in various forms in the Formation. The purpose of this research is to investigate further the occurrence of hydrocarbon and to characterize this aromatic hydrocarbon in the northern sector of the Belait Formation in Sarawak. Four representative samples were selected from an outcrop that had a stratigraphic height of about 100m. These samples were subjected to range of mineralo-chemical analysis and petrographical analysis.

Fourier Transform Infrared spectra confirm the presence of aromatics in addition to free radicals and carboxyl group. This finding is further supported by variations of E_4/E_6 ratios varying from 1.43 - 1.52. The x-ray fluorescence spectrometry indicates a high amount of oxygen, silica and aluminum indicating the presence of minerals such as kaolinite and quartz. Subordinate amounts of iron can be attributed to the presence of hematite or goethite. Powder diffraction data confirms the presence of the above weathered minerals in addition to traces of mineral such as titanium. Surface area estimations revealed that the presence of aromatic hydrocarbons attribute to the substantial increase of surface area. It is concluded that there is a spatial and temporal variability of appreciable sense of the hydrocarbon distribution in the northern sector of the Belait Formation. The presences of the aromatics are probably terrestrial and indicative of kerogen type I to III. However, the ongoing study to confirm the kerogen type is expected to be completed later this year.

Paper 37

Lithofication and fossils of Quaternary carbonate rocks from the Bum-Bum Island, southeast Sabah, Malaysia

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Bum-Bum Island one of many islands distribute along the east coast of Sabah state, East Malaysia, about 1 kilometer east of Semporna Town (Figure 1). This island crop out above the sea level as a result for the fluctuation and changing in sea level during the Quaternary, this fluctuation has effected strongly on the depositional environments of the sedimentary rocks there. The present topography of the area came as a result of period of erosion and volcanic activity during the Pliocene where the volcanic actions has continued and forming a large areas of volcanic rocks and sediment with volcanic detritus were deposited until the Quaternary which distinguished by a recession of sea level changes in most areas as a result of glacial and tectonic movements. A later recession of sea level of 25 to 30 feet in relatively recent times has caused the emergence of extensive old coral reef of the Semporna area and nearby islands .

As initial study total of 25 thin-sections represent the samples have been collected from carbonate rocks out crops around the coast of the island between 2-3 meters above the present day high tide level and the thickness of carbonate beds between 0.5 to 3.0 meters (Figure 2). The aim of this study is to estimate the depositional environment and the effecting of sea level changing during the time of deposition in addition to identify the marine conditions in terms of salinity, paleocurrent energy and organisms diversity. The carbonate sediment classified in to two microfacies; biomicrite and biosparite. These two facies has distinguished according to the bioclast and matrix materials which include green and red algae, bivalves, gastropod and foraminifera in addition to micrite and sparite as matrix materials (Figures 3, 4 and 5). Based on the fossils and texture, the depositional environment has been interpreted to be a shallow marine, lagoon and tidal flat environments, with warm water, normal salinity and low to moderate water current energy.

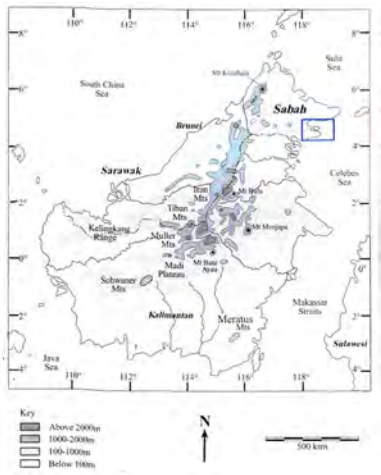

Figure 1: Topographic map of Borneo Island, showing the study area.

Figure 2: one of the carbonate rocks out crops in the Bum-Bum Island.

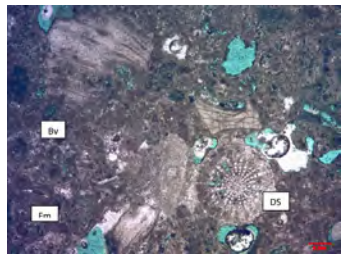

Figure 3: the Dasyclad green algae (DS) with foraminifera and bivalves in micrite matrix.

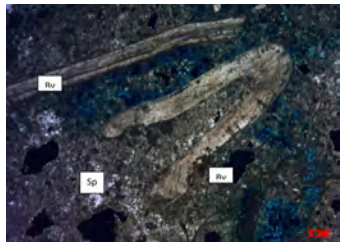

Figure 4: The bivalve shells (Bv) within sparite matrix (Sp).

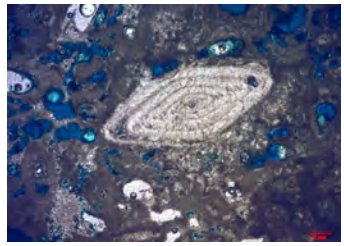

Figure 5: Large benthonic foraminifera within sparite matrix.

Paper P38

Mikrofasies dan diagenesis batu kapur Sungai Kilim dan Sungai Kisap, Formasi Setul di Langkawi, Kedah Darul Aman

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Sungai Kilim dan Sungai Kisap terletak di bahagian timur laut Pulau Langkawi dan terdiri daripada perbukitan batu kapur yang diselangi oleh paya bakau. Batu kapur ini merupakan sebahagian daripada Ahli Batu Kapur Setul Atas dalam Formasi Setul yang berusia Ordovisi Tengah engah hingga Devon Akhir. Proses hakisan terhadap batu kapur yang berterusan telah menghasilkan morfologi karst di sepanjang Sungai Kilim dan Sungai Kisap yang membentuk fitur-fitur seperti stalaktik, gua batu kapur, pulau baki dan dolina. Perlapisan batu kapur yang tersingkap di kawasan ini mempunyai tiga set jurus yang utama iaitu berjurus barat laut-tenggara, barat daya-timur lautdan juga tenggara-barat laut dengan variasi kemiringan berjulat 10°-60°. Batu kapur di kawasan ini berwarna kelabu gelap dan secara umumnya, litologi utama batu kapur yang di temui di kawasan ini terdiri daripada batu kapur berlapis nipis, batu kapur berpelapisan tebal, batu kapur massif, batu kapur hitam, batu kapur berlaminasi dan batu kapur koral. Daripada analisis petrografi yang dilakukan, butiran alokem utama yang membentuk batu kapur ini ialah peloid dan juga butiran kerangka. Butiran kerangka terdiri daripada pecahan cangkang gastropod, bivalvia, brakiopod, ostrakod dan alga. Batu kapur di kawasan ini boleh di bahagikan kepada 5 mikrofasies utama iaitu batu lumpur, batu wak, batu padat, batu butir dan juga dolomit. Batu lumpur dicirikan oleh kehadiran partikel karbonat bersaiz lumpur yang banyak. Ia juga dikenali sebagai mikrit. Mikrit ini membentuk hampir 90% daripada keseluruhan kandungan batuan ini. Batu lumpur karbonat ini mengandungi kandungan alokem yang kurang daripada 10%. Ia merupakan batu yang mempunyai sokongan matrik. Mikrofasies batu lumpur yang wujud terdiri daripada batu lumpur karbonat dan juga batu lumpur bioklas. Batu wak dicirikan oleh kehadiran alokem yang agak tinggi berbanding batu lumpur karbonat. Ia mempunyai kandungan alokem yang lebih daripada 10% dan kebiasaanya butiran alokem ini tidak bersentuhan antara satu sama lain. Selain daripada itu, ia juga masih terbentuk hasil daripada sokongan matrik. Dapat diperhatikan matrik yang berwarna agak gelap mengisi ruang-ruang kosong antara butiran alokem. Mikrofasies batu wak yang wujud terdiri daripada batu wak kristalin dan batu wak berdolomit. Batu padat pula dicirikan oleh kandungan butiran alokem yang tinggi sekitar 60%. Walau bagaimanapun, ia masih mengandungi kandungan matrik sekitar 30%. Apa yang membezakan batu padat dengan batu wak ialah batu ini mempunyai sokongan butiran dan mempunyai kurang kandungan marik. Butiran-butiran alokemnya bersentuhan antara satu sama lain. Terdapat sedikit kalsit spar sekitar 10%. Batu padat mengandungi tiga pecahan mikrofasies iaitu batu padat berpeloid, batu padat berdolomit dan juga batu padat berbioklas. Batu butir (rajah 4.12) dicirikan oleh kandungan matriknya yang sangat sedikit, dan kebiasaanya tidak langsung mengandungi matrik. Batu ini mempunyai sokongan butiran. Ruang-ruang kosong antara butiran diisi oleh simen kalsit spar yang kelihatan bewarna putih. Kandungan butiran alokem adalah sekitar 65% daripada jumlah kaseluruhan, manakala kalsit spar sebanyak 30% dan sedikit mikrit sekitar 5%. Batu butir berbeza dengan batu padat adalah dari segi jisim latarnya. Butiran alokem dalam batu butir diikat oleh kalsit spar manakala batu padat diikat oleh lumpur karbonat. Mikrofasies batu butir yang terdapat di kawasan ini merupakan batu butir bioklas. Dolomit merupakan batuan yang terbentuk daripada diagenesis batu kapur melalui proses pendolomitan. Mineral dolomit berbeza dari segi bentuknya dengan mineral kalsit. Hablur mineral dolomit berbentuk rombus. Batu dolomit yang mempunyai kandungan mineral dolomit dominan adalah sebanyak 90% hingga 100%. Namun terdapat juga mineral kalsit dalam sampel dolomit. Mikrofasies dolomit yang terbentuk terdiri daripada dolomit biasa, dolomit berkapur dan juga dolomikrit. Proses diagenesis yg berlaku terdiri daripada penyimenan, pemikritan, pendolomitan, pemadatan, pelarutan dan neomorfisma . Sungai Kilim dan Sungai Kisap ditafsirkan terenap di sekitaran laut cetek bertenaga rendah yang menumpu di sekitaran lagun hingga beting. Sekitaran diagenesis penyimenan dan neomorfisma mencadangkan sekitaran freatik air tawar, pemikritan mencadangkan sekitaran freatik air masin, pendolomitan mencadangkan berlakunya di zon percampuran, pelarutan di sekitaran freatik air tawar manakala pemadatan terbentuk akibat penimbusan dalam.

Paper P39

Detailed mapping of volcanic ash distribution in Lenggong and Kuala Kangsar areas

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Volcanic ash that is associated with 74k year old Toba eruption in Lenggong and Kuala Kangsar has been mapped in detail. Layers of fresh and reworked deposits of ash have been discovered with thickness up to more than 4 m mostly, in the valley area. Ash is more common at low elevation which is in vicinity of Perak River banks and on gentle slopes of palm oil estate. No occurrence has been found in high elevation possibly due to it has been eroded by wind and water, mixed with sand and clay and ultimately dispersed into river. The highest occurrence has been observed at 176 m from sea level and the lowest is at 58 m. The occurrences of reworked material under a few layers of fresh deposits could indicate a possibility that the tephra layers are originated from more than one source eruption. The objective of this study is to determine the extension of volcanic ash dispersal from Sumatra's Late Pleistocene eruptions in these areas. Recent studies suggested that Toba ash has even been found in bore logs from South China Sea apart from the previous discoveries in the west in Hindi Ocean and as far as the Arctic. These deposits have been subjected to long history of weathering and reworking since their fall. The distribution is heavily influenced by topographic that cannot be assumed to affect ash depth uniformly across the study area. We have used ArcGIS to refine this study and demonstrate the relationship of topographic of these areas with the distribution of volcanic ash.

Paper P40

Vertebrate fossils from Badak Cave C, Lenggong, Perak in Peninsular Malaysia

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Badak Cave C (N 05° 08' 984" and E 100° 59 101") is one of several caves in a small limestone hill given the same name (Gua Badak), in the Lenggong Valley, Perak. The cave is located in an elongated limestone mogote hill about 5km north of Lenggong town in an area of above-ground limestone caves where rich archaeological material has been found including the famous Perak Man skeleton (10,000 y.b.p). The cave is elongated north-south and extends about 50m with two distinct narrow northeast-southwest branches. Its entrance is locatedat 12 m above ground level.

Abundant vertebrate fossils are found in remnants of alluvial sediments attached to the walls and floor of the cave that has been excavated by guano diggers. Most of the materials are disarticulated teeth and bone fragments found embedded in isolated clusters in several parts of the cave within the sediments. No complete skeletons have been found. Seven clusters of fossil were found in three different levels of chambers (lower, intermediate, and upper level chambers). Most of the fossils were recovered from the intermediate level chamber except for one cluster from the upper level chamber and another from the lower level chamber.

The fossils contain a highly diversified fauna ranging from large carnivores and herbivores to small fossils like bats. The material found includes: common wild pig (*Sus scrofa),* bear (Ursidae- gen.et sp. indet.), macaque (*Macaca* sp. indet*.),* primates (non-human hominoid), ?domestic dog (*Canis familiaris*), Southern serow (*Capricornis sumatraensis*), red muntjac (*Muntiacus muntjak*), sambar deer (*Cervus unicolor*), Asian tapir (*Tapirus indicus*), rhinocerotidae (gen. et sp. indet.), bovidae (gen. et sp. indet.), Asiatic brush-tailed porcupine (*Atherurus macrourus*), Malayan porcupine (*Hystrix brachyura*), and unidentifiable fragmented bones.

The fossils appeared to have been washed in by a prehistoric flood or brought in by other animals with gnaw marks by porcupine animals found on the roots of one pig tooth collected from this cave.

The fossil assemblage is suggestive of a Middle Pleistocene age that is supported by preliminary uranium-series dating done on the flowstones encasing the fossils. This date would be confirmed by red thermoluminescene dating of the sediments currently being attempted at Macquarie University, Australia by Dr. Kira Westaway.

Paper P41

Thermal maturity assessment of Tertiary coal-bearing sequence of the West Middle Block of the Pinangah Coal Field, Sabah, Malaysia

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The coal-bearing sandstone and shale sequence of the Early to Middle Miocene Tanjong Formation in the West Middle Block of the Pinangah Coal Field, central Sabah, was evaluated to determine thermal maturity based on vitrinite reflectance and n-alkane distributions. The Tanjong Formation was described by Collenette (1965) as a thick succession of sandstone, mudstone and siltstone with lenses of conglomerate in the Pensiangan and Upper Kinabatangan Rivers in central of Sabah. The depositional environment of the Tanjong Formation is interpreted as brackish water (Collenette, 1965), based on limited biostratigraphy data. Thirteen coal and four carbonaceous shale outcrops along river banks were described and sampled. Most coals were classified as bright coals which are characterized by alternating lustrous and dull bands of black coal. Petrographic analyses of the coals were performed under reflected white light and UV light excitation at 50x objective magnification. Coal petrology or microscopy involves the study of maceral or organic components visible in transparent thin sections or polished blocks or fragmented coal particles (Stach, 1975). The coals are dominated by vitrinite with common occurrence of liptinite macerals. Vitrinite reflectance measurements carried out on the coals under oil immersion record values between 0.45 and 0.55%Ro. Based on vitrinite reflectance, the coals are ranked as sub-bituminous B-A and high volatile bituminous C, and are considered thermally immature to early mature for petroleum generation, as oil generation typically commence at about 0.60%. The thermal immaturity of the coal samples is supported by the high CPI (carbon preference index) values. This is further confirmed by the distinct odd to even predominance (OEP) in the gas chromatograms of saturated hydrocarbon fractions.

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Paper P42

Kewujudan bivalvia Alatochonchidae di dalam batu kapur Bukit Biwah, Tasik Kenyir Terengganu

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Batu kapur Bukit Biwah telah banyak dikaji dari aspek sedimentologi dan paleontologinya. Namun demikian baru-baru ini satu spesies bivalvia daripada famili Alatochonchidae didapati wujud di dalam lapisan bahagian bawah jujukan batu kapur di Bukit Biwah Terengganu. Fosil ini wujud sebagai serpihan kerangka yang bersaiz mega tertabur di dalam sedimen kapur yang berbutir halus. Wujud bersama taburan kerangka bivalia ini ialah fusulina dan karang. Di Malaysia setakat ini fosil yang sama pernah dilaporkan dari lapisan H.S Lee di Ipoh. Species bivalvia ini masih tidak diketahui namun demikian ia mungkin sama dengan fosil dari Ipoh tersebut. Organisma ini merupakan hidupan laut cetek tropika dan setakat ini pernah dilaporkan ditemui dibeberapa tempat di dunia dari Yugoslavia, Turki, Algeria, Afghanistan, Malaysia dan Jepun. Kewujudan fosil ini yang sangat langka memberikan nilai saintifik yang sangat tinggi dan menjadikan salah satu sumber geowarisan yang bernilai sangat tinggi di Tasik Kenyir.

Paper P43

Penemuan radiolaria berusia Perm dari kawasan sekitar Pos Belau, Ulu Kelantan

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Satu singkapan batuan rijang telah ditemui di sebelah timur dan barat cerun potongan jalan raya di kilometer 38, lebuhraya Gua Musang-Cameron Highland berhampiran Pos Belau pada kedudukan 4°45.056′ utara dan 101°45.358′ timur. Batuan rijang ini memperlihatkan satah-satah perlapisan yang jelas dari bahagian bawah hingga atas teres potongan cerun. Lima log batuan telah dibina dan sebanyak 65 sampel batuan rijang telah diambil dari singkapan sebelah timur. Berdasarkan kajian lapangan, tiga fasies litologi telah dikenalpasti iaitu fasies selanglapis batu pasir dengan batu lumpur sama tebal, fasies selanglapis rijang dengan batu lumpur dominan dan fasies rijang. Fasies selanglapis batu pasir dengan batu lumpur terletak di bahagian paling bawah jujukan batuan. Batu pasir dan batu lumpur ini mempunyai ketebalan 15 cm hingga 25 cm. Dalam fasies selanglapis rijang dengan batu lumpur dominan, lapisan rijang mempunyai ketebalan antara 10 cm hingga 70 cm, manakala batu lumpur berketebalan 10cm hingga 40cm. Fasies rijang pula dicirikan oleh rijang berfosil radiolaria, berwarna kelabu kemerahan, berperlapisan setebal antara 0.5 cm hingga 20 cm. Analisis mikropaleontologi daripada 11 sampel yang dipilih telah menghasilkan beberapa spesies fosil termasuklah *Pseudoalbaillella lomentaria* Ishiga dan Imoto, *Pseudoalbaillella sakmarensis* Kozur, *Pseudoalbaillella scalprata* Holdsworth dan Jones m. *scalprata* Ishiga, *Pseudoalbaillella* sp., *Pseudoalbaillella* sp. *aff. Ps. longicornis* Ishiga dan Imoto, *Nazarovella phlogides* Wang sp. nov., *Latentibifistula* sp., *Latentifistula* sp. aff. L. *crux* Nazarov dan Ormiston, *Entactinia cf. itsukaichiensis* Sashida dan Tonishi, *Stigmosphaerostylus cf. pycnoclada* Nazarov dan Ormiston, *Stigmosphaerostylus* sp.cf. *S.* itsukaichiensis Sashida dan Tonishi, *Quinqueremis robusta* Nazarov dan Ormiston, *Copicyntra* sp., *Tetraspongodiscus stauracantus* Feng n. sp., *Latentibifistula* aff. *asperspongios*a Sashida dan Tonishi, *Ruzhencevispongus* sp., *Ruzhencevispongus uralicus* Kozur dan Mostler, *Palaeolithocyclia pilata* Feng n. sp., *Palaeolithocyclia platta* Feng n. sp., dan *Spongosphaeradiscus shaiwaensis* Wang. Himpunan fosil ini secara umumnya mencadangkan usia Perm kepada batuan rijang di kawasan kajian.

Paper P44

Pemetaan dan analisis lineamen menggunakan imej PCA SPOT 5 di bahagian utara Maran, Pahang

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Lineamen ialah fitur lurus ringkas atau komposit pada permukaan yang boleh dipetakan. Analisis komponen utama atau PCA adalah kaedah analisis pembolehubah multi yang bertujuan memperkecilkan dimensi pembolehubah asal sehingga memperolehi pembolehubah baru (komponen utama) yang saling tidak berkorelasi serta menyimpan sebahagian besar informasi yang terkandung dalam pembolehubah asal. Objektif kajian ini dijalankan adalah untuk memetakan lineamen daripada imej PCA SPOT 5 dan membuat analisis serta korelasi sesar antara peta lineamen yang terhasil dengan peta geologi. Kajian ini menggunakan imej SPOT 5 bagi kawasan seluas 2400 km² yang terletak di bahagian utara Maran, Pahang. Secara umumnya, kawasan kajian terdiri daripada batuan sedimen Paleozoik Atas (Lapisan Seri Jaya), Mesozoik (Formasi Semantan dan Kumpulan Tembeling) dan rejahan granitoid. Sebelum pengekstrakan lineamen dilakukan, imej SPOT 5 diproses secara digit terlebih dahulu yang merangkumi pembetulan geometri, pembetulan radiometri, penonjolan kontras dan penurasan berarah serta tidak berarah bagi meningkatkan mutu imej. Kajian ini telah menggunakan kaedah PCA dalam penghasilan imej PCA 1 SPOT 5, penurasan imej mengikut empat arah utama, penggabungan hasil turasan imej mengikut arah dengan menggunakan konsep PCA dan padanan dilakukan antara peta lineamen akhir yang dihasilkan daripada kajian ini dengan peta geologi terdahulu untuk mendapatkan peratusan padanan. Hasil kajian menunjukkan imej PCA 1 SPOT 5 mengandungi 76.16 % maklumat dan sebanyak 889 lineamen dengan jumlah panjang 2350 km dipetakan daripada imej PCA 1. Daripada kajian ini turut didapati arah utama linemen di kawasan kajian adalah BL-TG dan kajian ini berjaya memetakan 11 lineamen major yang mungkin merupakan sesar yang belum dipetakan dan juga telah melanjutkan panjang 1 sesar yang terdapat dalam peta sesar yang diterbitkan.. Selain itu, kajian ini turut memperlihatkan korelasi yang baik antara peta lineamen akhir yang dihasilkan dengan peta sesar yang diterbitkan kerana analisis menunjukkan terdapat 60.69 % padanan antara peta lineamen akhir yang dihasilkan dengan peta sesar yang diterbitkan.

Lineament mapping and analysis using PCA SPOT 5 image at northern Maran, Pahang

Lineament is a simple or composite straight feature on the earth surface that can be mapped. Principal component analysis (PCA) is a method of analysis on multi variable to minimize the dimension of original variables to obtain a new variable (main component) that is not correlated among each other and contains most information as compared to the original variable. The objective of this research is to map and analysis lineaments from PCA SPOT 5 image and to do fault analysis and correlation between final lineament map that is produced and published fault map. This research uses SPOT 5 image with area of 2400 km² that is located at northern Maran, Pahang. Generally, the study area consists of Upper Paleozoic sediments (Seri Jaya Bed), Mesozoic (Semantan Formation and Tembeling Formation) and granitoid intrusive. Before the extraction of lineament, SPOT 5 image is processed digitally which includes geometric correction, radiometric correction, contrast enhancement and has gone through directional filtering and non directional filtering to increase the quality of image. Methods that is used in this research include the application of PCA method in producing PCA 1 SPOT 5 image, filtering of produced image in four main directions, combining of filtered images according to the direction of filter by using the concept of PCA and matching method is used to find out the percentage of matching between final lineament map and published fault map. Result from this research shows PCA 1 SPOT 5 image contains 76.16 % information and 889 lineaments with a total length of 2350 km is mapped from PCA 1 image. Besides, the main direction of lineament at Northern Maran that is obtained from this research is in NW-SE direction and this research manages to map 11 major lineaments besides elongate 1 lineament that is mapped in the published fault map. The result also shows there is 60.69% of matching between final lineament map and published fault map which shows high correlation between the final lineament map and published fault map.

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