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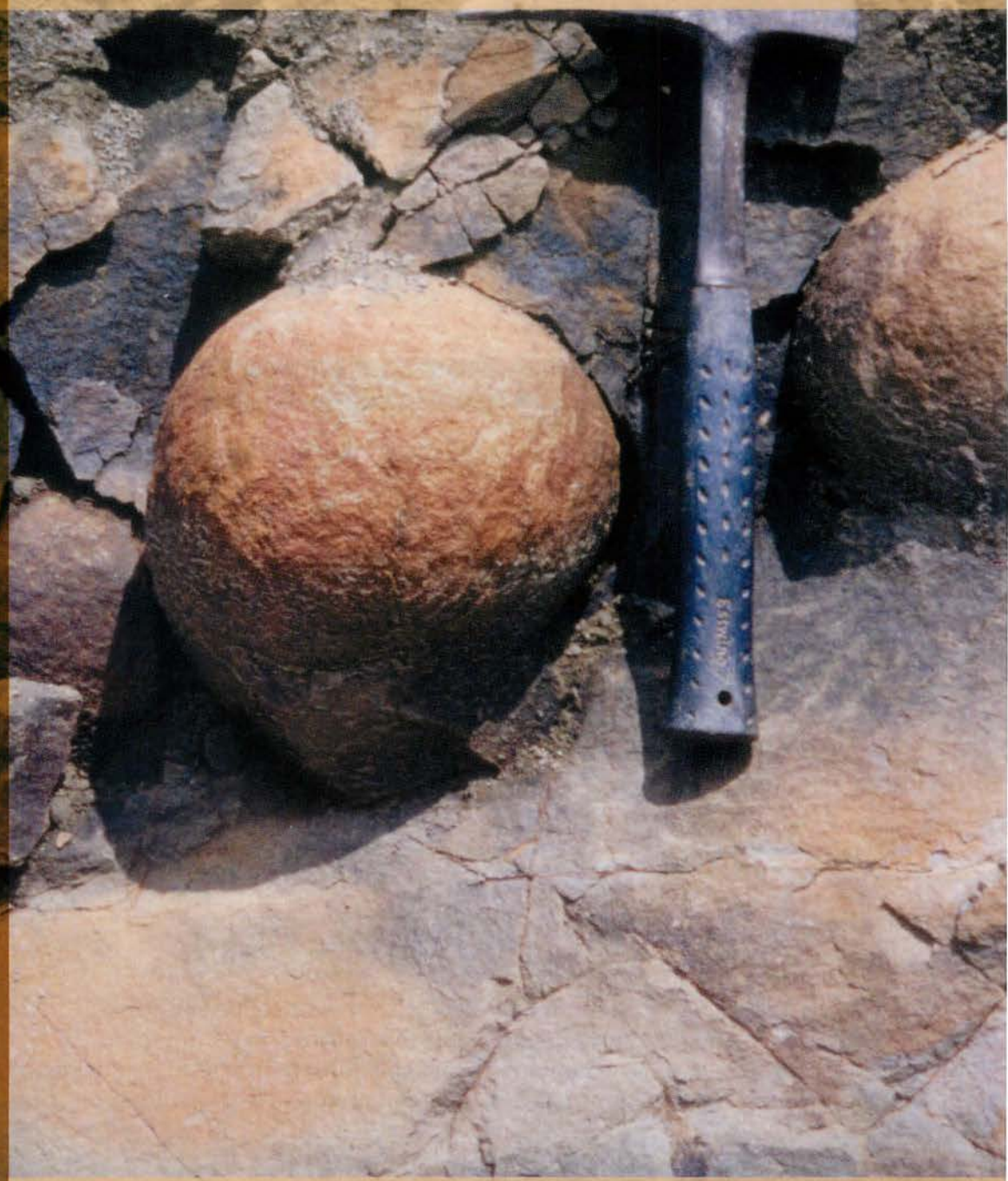
PERSATUAN GEOLOGI MALAYSIA

WARTA GEOLOGI

NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MALAYSIA



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Geological Society of Malaysia

About the Society

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The Society has a membership of about 600 earth scientists interested in Malaysia and other Southeast Asian regions. The membership is worldwide in distribution.

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CATATAN GEOLOGI
GEOLOGICAL NOTES

Characterization of ambient dust from a quarry district in Malaysia

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Abstract: Ambient dust particles from the Labu-Nilai-Pajam quarry district of Peninsular Malaysia was studied in a period before the construction of Malaysia's Kuala Lumpur International Airport (KLIA). The dust particles are composed of ten minerals. The dust-fall particles have been characterized by SEM-EDX analyses, which also calculate silicate, non-silicate contents and a silicate to non-silicate ratio (Si:nSi). The Si:nSi value indicates the distance of the dust sampling sites from quarries, with a high ratio suggesting the presence of dust resulting from quarrying activity.

Abstrak: Zarah-zarah debu terapung ke udara persekitaran perlombongan batu di Labu-Nilai-Pajam, Semananjung Malaysia telah di kaji pada satu masa sebelum pembinaan tapak kapalterbang KLIA di Malaysia. Debu tersebut mengandungi sepuluh mineral. Jatuhan zarahan debu tersebut dikaji dan dicirikan dengan analisa SEM-EDX, dimana kandungan silicate, kandungan bukan silicate, dan nisbah silicate:bukan silicate (Si:nSi) juga dikira. Nisbah tersebut menunjuk jarak penyampelan debu dengan lokasi lombong batu dan nilai tinggi nisbah bererti jatuhan debu mungkin berpunca daripada aktiviti perlombongan.

INTRODUCTION

The rock mass located in the Labu-Nilai-Pajam district of Negeri Sembilan state, Peninsular Malaysia, supplied the major portion of granite and aggregates used in the construction of Malaysia's Kuala Lumpur International Airport (KLIA), which was opened in June, 1998. The building of the hub for airlines required the use of an enormous quantity of these materials, and the runway itself was estimated to have consumed 1.2 million tons of aggregates (Yeap, 1994). The proximity of the Labu-Nilai-Pajam triangle to the construction site, which is only about 30 km away, rendered this triangle the principal supplier of building material. In 1990 (when quarrying commenced), the triangle was largely suburban, with four small townships. These are located on land below the quarry sites, which are located between 76 and 229 m above sea level on the slopes of the Galla Hills. The highest peak is 613 m. The seven quarries (Ng *et al.*, 1995), each of which was only about 0.8–

Keywords: Ambient dust, automated microanalysis, mineral, rock aggregates
* Corresponding author

6.0 km from the towns, produced large volumes of dust due to the urgency of the builders to complete the airport on schedule and associated heavy transport activities.

This study details the ambient dust types emanating from the quarries during a peak month, i.e. October, 1994. The study involved sampling and characterization of particles in terms of the chemical composition by using an automated micro-analyzer.

MATERIALS AND METHODS

Study area

The study area is located in a drainage basin on western side of the Main Range of Peninsular Malaysia. The seven quarries were fully operational. Three were located at the northern end of the Galla Forest Reserve and four on the western slope of the Galla Hills. Granitic rocks, which are typically megacrystic and which consist of potassium-feldspar megacrysts (set in the ground mass of quartz, plagioclase K-feldspar and minor amounts of muscovite, biotite and tourmaline) underlie the district's eastern part whereas the western part is underlain by lower Paleozoic meta-sedimentary rocks that consist of quartz-mica schist, quartz-graphite schist and quartzite (Fig. 1). The district is on the leeward of the prevailing winds and the air temperature for October 1994 was 25–34°C. The rainfall was about 249 mm. The dust-fall rate varied from 0.0474 g $m^{-2}d^{-1}$ to 0.431 g $m^{-2}d^{-1}$ (Ng *et al.*, 1995).

Collection of dust samples

The dust samples were sampled by using two methods. For the first method, the gauge was modified (Ng *et al.*, 1995; Ng, 2001) from a reported procedure that used the dust-fall gauge No. ASTM D 1739:39 (ASTM, 1989). Twenty gauges were placed at twenty monitoring stations (Stations 1–20; Fig. 1). Each gauge was placed 2 m from the ground, and all were placed in open spaces, free from obstruction. Copper sulphate was placed in the gauges to prevent fungal and algal growth.

For the second method, four dust samples were scooped at random from the stockpiles of two quarries, a haul-road to the quarries (at the western slope of the Galla Hills), and a laterite road to an oil-palm estate.

Automated microanalysis

The dust samples were prepared for automated microanalysis on an electron probe micro-analyzer (Superprobe JEOL 733). The analyses were carried out at the Royal School of Mines, Imperial College of Science, Technology and Medicine, London, UK. From each sample, a small quantity (approximately 90 mg) was soaked in 1–2 ml of 95% ethanol. The particles were briefly agitated in de-ioned water to break up the lumps, and the suspension was filtered through 20 μm mesh cloth. The particles that were filtered through the cloth (<20 μm particle fraction) were sprayed evenly on a 0.4 μm polycarbonate membrane filter. Six membrane filters were mounted on a glass slide, which was coated with conductive carbon paint for subsequent analysis.

The automated micro-analyzer consisted of a scanning electron microscope (SEM) combined with an energy-dispersive X-ray detector (EDX) (Watt and Johnson, 1987). The operating conditions of the SEM-EDX were set: an accelerating voltage of 25 kV, beam current of 2 nA°, and magnifications at 40X and 400X. X-ray counts were set at 6.81 gain, 20 range and 1 process time. The X-ray information was recorded with a beryllium window detector operating together with a Link Analytical Automation AN10000 system, which was equipped with a DIGISCAN-FDC feature detection and characterization program. The DIGISCAN-FDC counted the net X-ray intensities for the twenty-one elements including Na, Mg, Al, Si, P, S, Cl, Cd, K, Ca, Sb, Ti, Ba, Mn, Fe, Ni, Cu, Zn, Pb, As and Mo. The waveforms plotted for each element were expressed as the percentage of X-ray counts after corrections for background radiation and spectrum peak overlap. The raw data were analyzed by the MIDAS package (Watt, 1990), which interpreted the microscopy images in terms of the number of particles and their elemental composition. The information and statistics were classified and expressed into histograms and scatter diagrams (Johnson *et al.*, 1993).

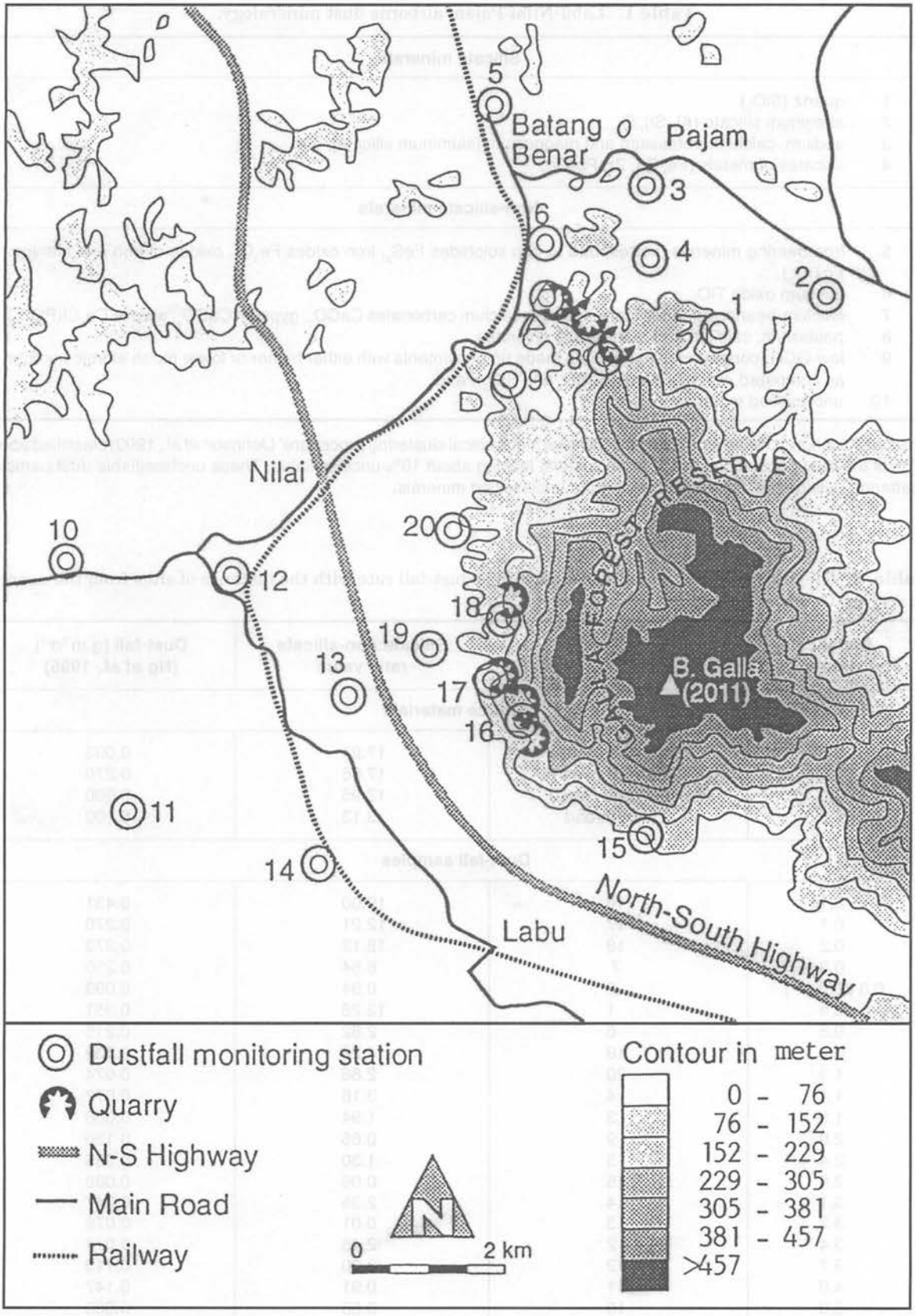

Figure 1. Labu-Nilai-Pajam district, Malaysia showing the location of dust-fall monitoring sites and quarries.

Table 1. Labu-Nilai-Pajam airborne dust mineralogy.

Silicate minerals
1. quartz (SiO_2)
2. aluminum silicate $(Al, Si)_r.O_{2r}$
3. sodium, calcium, potassium and magnesium [aluminum silicate], and
4. silicates of metals (Fe, Zn, Zr, Pb-Cr)
Non-silicate minerals
5. iron-bearing minerals (correspond to iron sulphides FeS_2, iron oxides Fe_3O_4, oxides of iron and titanium $FeTiO_3$)
6. titanium oxide TiO_2
7. calcium-bearing minerals [correspond to calcium carbonates $CaCO_3$, gypsum $CaSO_4$, apatite $Ca_5Cl(PO_4)_3$]
8. potassium, calcium and magnesium chlorides
9. low-GCR (corresponds to minerals made up of elements with either higher or lower mean atomic number as compared with standards $BaSO_4$ and SiO_2), and
10. unclassified minerals.

The classification scheme employing the 'divisive hierarchical clustering procedure' (Johnson *et al.*, 1993) classified about 90% of the dust populations which form clusters, leaving about 10% unclassifiable. These unclassifiable dust particles scattering outside the clusters correspond to unclassified minerals.

Table 2. The decreased Si:nSi values and average dust-fall rate with the distance of sites from the nearest quarry for October, 1994.

Distance (km)	Site	Silicate:non-silicate ratio value	Dust-fall (g $m^{-2}d^{-1}$) (Ng *et al.*, 1995)
Source materials			
0.0	Quarry A (north)	17.94	0.093
0.0	Quarry B (west)	17.66	0.270
0.0	Haul-road (west)	12.95	0.300
4.0	Laterite road	3.13	0.100
Dust-fall samples			
0.1	16	19.00	0.431
0.1	17	12.21	0.270
0.2	18	18.12	0.373
0.3	7	6.84	0.250
0.3 (229 m*)	8	0.94	0.093
0.5	1	13.28	0.351
0.8	6	2.82	0.215
0.9	19	4.26	0.138
1.3	20	2.86	0.074
1.4	4	3.16	0.077
1.9	3	1.94	0.060
2.0	9	0.65	0.130
2.4	5	1.30	0.085
2.5	15	0.06	0.088
3.1	14	2.35	0.047
3.2	13	0.01	0.076
3.4	2	2.45	0.074
3.7	12	3.00	0.113
4.9	11	0.91	0.147
6.0	10	0.65	0.080

* height (m) above sea level.

RESULTS AND DISCUSSION

The ambient dust emanating from the quarrying areas that supplied the granite for the construction of KLIA during the peak activity period comprise ten dominant minerals (Read, 1984; Pye, 1987) that are classified according to their silicate and non-silicate contents (Table 1). The information then yielded the ratio of silicate mineral to non-silicate mineral, which is a dimensionless number. As with previous studies on open-cast mining (Merefield *et al.*, 1994; Merefield *et al.*, 1995a) that made use of the clay (represented by kaolinite) to non-clay (represented by quartz) ratio to indicate the contribution of fugitive dust, the present study has furnished the analogous silicate:non-silicate ratio (Si:nSi), a parameter that relates the contribution of dust with the distance from the quarry from which the dust originated. Typically high values (2.82 to 19.0) were found for the on-site (stations that were 0.1–1.4 km from the nearest quarry) dust-fall samples. Lower ratio values (0.01 to 3.0) were found for off-site (stations that were 1.9–6.0 km from the nearest quarry) and above-site (>229 m above sea level) samples (Table 2). The elevated Si:nSi values are linked with quarry-derived dust; on the other hand, low values relate to ambient and background dust only. Such spatial variations in the Si:nSi ratio were not evident from the sampling sites on higher and heavily-vegetated slopes; a low ratio of 0.94 was obtained for Station 8 (which was 0.2 km from the nearest quarry but was at 229 m and would therefore be higher than the quarry).

Figure 2 summarizes the variations of the eight principal mineral classes at the twenty sampling stations (see experimental, method 1). The sites are arranged in increasing distance from the nearest quarry. The aluminum silicate and presumably aluminosilicate minerals generally constituted more than 50% of the principal minerals at the ten on-site samples but the iron-bearing and low-GCR (low gross count rate of X-rays) minerals constituted less than 10%. The aluminum silicate minerals did

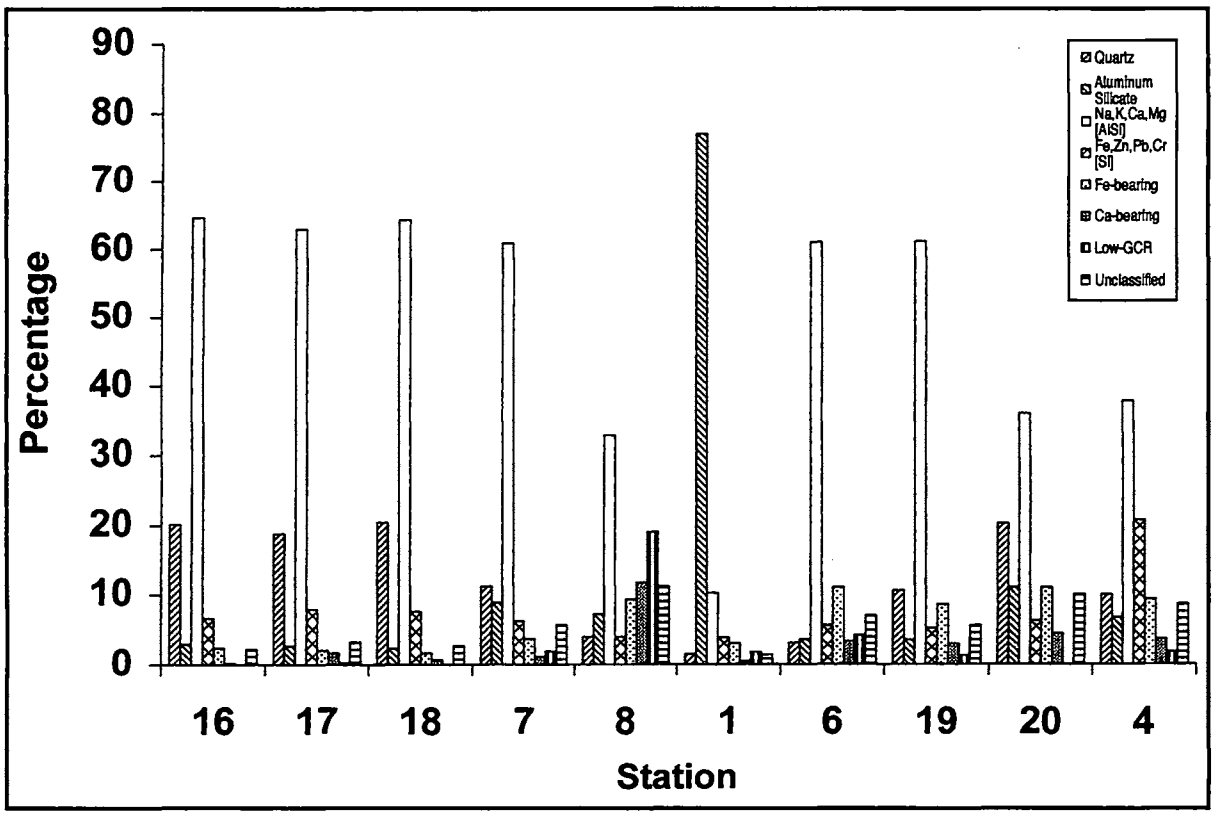

Figure 2a. The proportions of 8 principal minerals in dust-fall samples at 10 stations (at 0.1–1.4 km from nearest quarry), Labu-Nilai-Pajam, Malaysia.

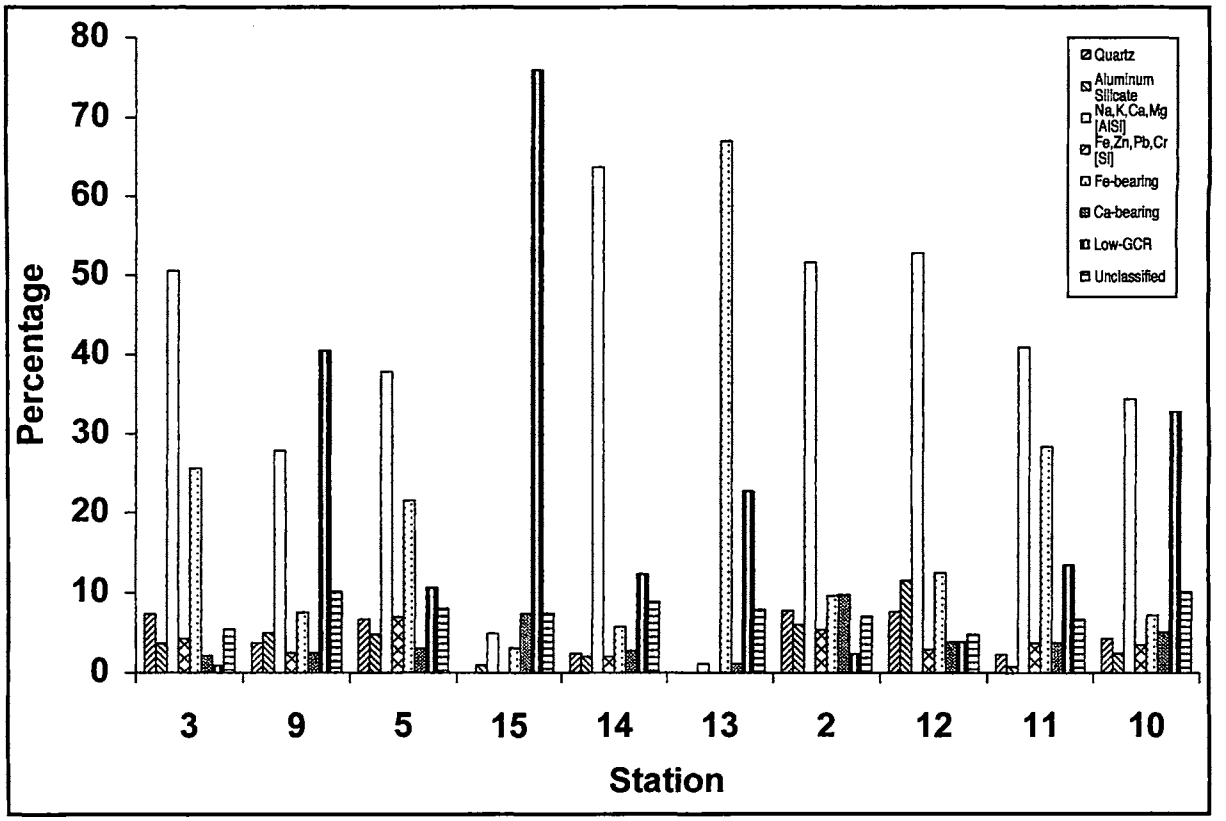

Figure 2b. The proportions of 8 principal minerals in dust-fall samples at 10 stations (at 1.9–6.0 km), at the study area.

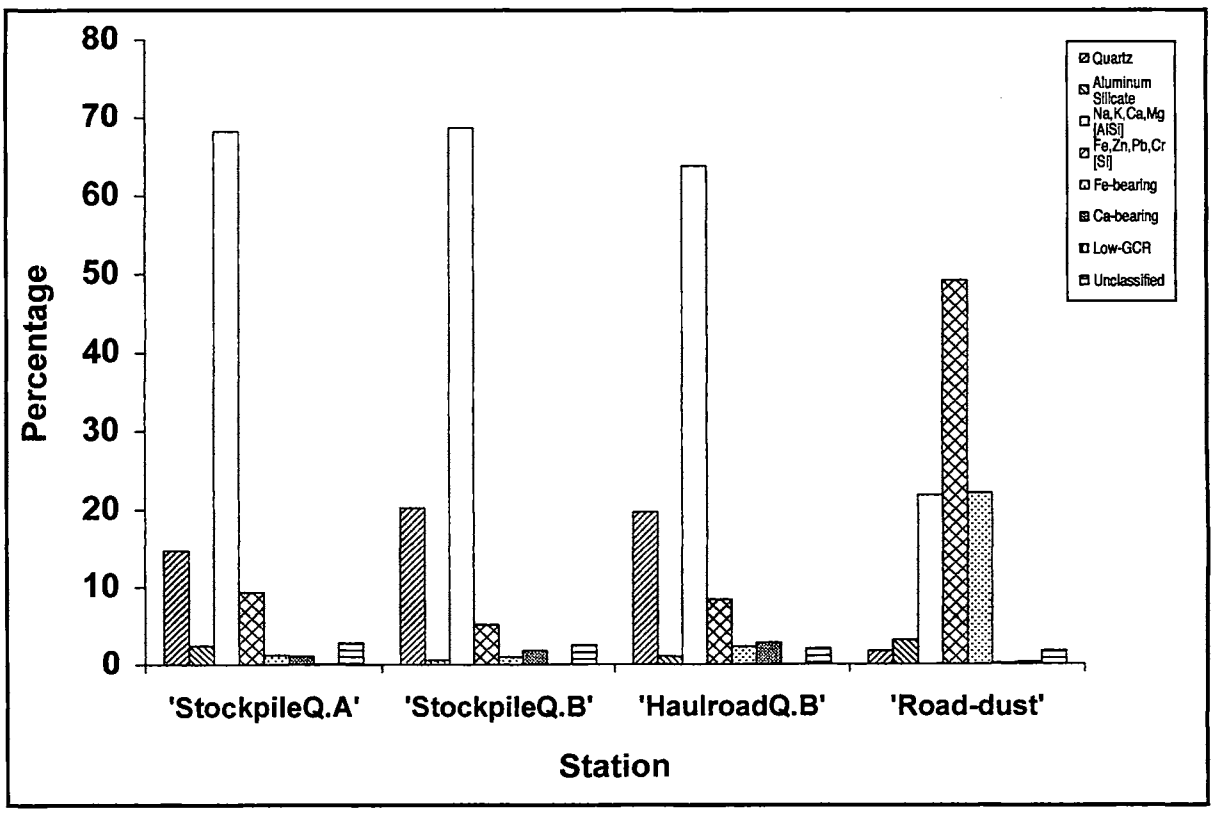

Figure 2c. The proportions of 8 principal minerals in source materials from stockpile, haul-road and laterite road dust within study area.

not exceed 12% but if the sum of aluminum silicates and aluminosilicates of Na, Ca, K and Mg are considered, the four off-site samples (only 40% of off-site samples) would exceed 50%. With the exception of Stations 2 and 12, the iron-bearing and low-GCR minerals totaled 20% to 90% of the principal minerals at other eight off-site samples (Fig. 2 cont.) The iron-bearing and low-GCR minerals are significantly high in dust-fall at Stations 10, 11,13 and 15 (Si:nSi values are less than 1) sampled along motorways and roads. At these places, dust was resuspended by passing vehicles. The number of trucks and vehicles carrying rocks would cause wind-driven dust emission. Low-GCR minerals were more abundant near buildings, human settlements and along main road. Similar site-specific indications by characteristic minerals and trends based on kaolinite and quartz have been reported in studies on open-cast mining (Merefield *et al.*, 1995a).

The mineral contents and Si:nSi ratio of the second sampling method (Fig. 2 cont.) are essentially similar to the contents and distribution patterns provided by the dust-fall samples collected by the first method. Such similarity suggests that the source materials of the dust-fall samples would have originated from the spoil heaps, haul-roads and aggregate stockpiles that constituted a significant portion of the samples. This similarity is also evident from the scatter diagrams (Fig. 3) of a representative dust-fall sample at Station 18 (3494 particles analyzed) and of stockpile and haul-road samples (4,000 particles).

The Si:nSi values are consistently high for stockpile and haul-road samples (13.00 to 18.00). The high values parallel the values of Stations 16, 17, 18, 1 and 7 (Table 2). The aluminosilicates of the Na, K, Ca and Mg as well as quartz ($Si0_2$) components in combination constituted 85–90% of the eight principal minerals, and there is an increase over ambient levels of silicates. The value for the off-site unpaved laterite road dust (Si:nSi = 3.13) compares well with the value from the dust-fall samples at Station 12 (Si:nSi = 3.00) in mineral contents, which is enriched with high ferro-magnesium silicates and iron non-silicates (pyrite, oxides and ilmenite). The relatively high incidence of iron-bearing minerals against background was noted in road dust elsewhere (Farmer, 1993). The off-site mineralogy confirms the collected dust has the same composition as the soil from where it came.

The most abundant minerals in stockpile and haul-road dust are silicates as would be expected for any on-site mineralogy. The presence and variation of the rock-forming silicates is in line with the study area's geological setting and mineralogical composition of granitic rocks (Ng, 2001). An X-ray powder diffraction analysis (XRD) revealed the relatively high abundance of silicate minerals (quartz, plagioclase and K-feldspar) in the dust at quarries and adjacent sites. Not unexpectedly, the rate of dust-fall was high near the quarries and it decreased with distance: 0.32 g $m^{-2}d^{-1}$ for sites less than 2.5 km to 0.04–0.15 g $m^{-2}d^{-}$

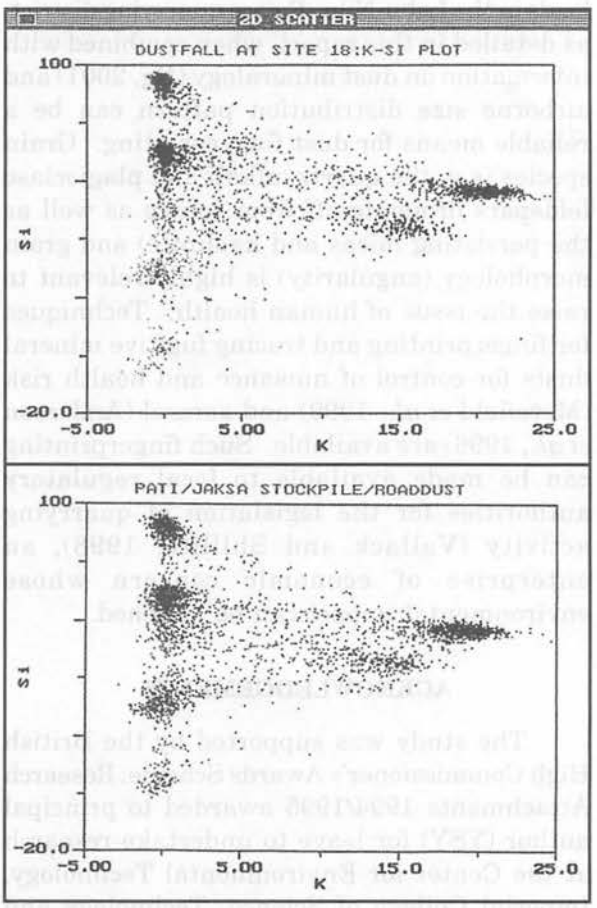

Figure 3. Scatter diagrams of dust particles from dust-fall sampled at Station 18 and source materials from stockpile and haul-road dust samples.

[1] for sites between 3–6 km (Table 2) This result signifies a release of wind-driven quarry-derived materials. Dust from quarrying activity originates from either point or non-point sources. The point sources are crushing and screening plants, drilling machines and stockpiling points; the non-point sources are blasting, haul-roads, stockpiles or overburden dumps, and wind-driven circulatory flow over barren areas. The extent of dispersion of fugitive emissions of granite dusts from point sources would appropriately considered to have impacts detected up to 2 km away, as contrast to 1 km for mineral dust. On a PM_{10} health study in the United Kingdom, coal particles from open-cast coal mining were found up to 1 km from sources (Merefield *et al.*, 1995b; Pless-Mulloli *et al.*, 2000). The airborne size distribution as a function of distance from the quarry site might be interesting to elucidate this dispersal pattern (Ng, 2001).

Particle characterization on ambient dust loads in the Labu-Nilai-Pajam quarrying district, as detailed in this report, when combined with information on dust mineralogy (Ng, 2001) and airborne size distribution pattern can be a reliable means for dust fingerprinting. Grain species (e.g. the quartz, alkali and plagioclase feldspars dropping off from source as well as the persisting micas and kaolinite) and grain morphology (angularity) is highly relevant to raise the issue of human health. Techniques for fingerprinting and tracing fugitive mineral dusts for control of nuisance and health risk (Merefield *et al.*, 1999) and aerosol (Anderson *et al.*, 1996) are available. Such fingerprinting can be made available to local regulatory authorities for the legislation of quarrying activity (Vallack and Shillito, 1998), an enterprise of economic concern whose environmental impact can be lessened.

ACKNOWLEDGEMENTS

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Manuscript received 30 May 2003

PERTEMUAN PERSATUAN
MEETINGS OF THE SOCIETY

Ceramah Teknik (Technical Talk)

Turbidite sandstone reservoirs: depositional models and exploration experience

HOWARD D. JOHNSON

Laporan (Report)

Prof. Howard D. Johnson, Custodian Geology, PETRONAS Carigali, gave the above talk on 17th September 2003 at 5.30 pm at Geology Department, University of Malaya.

Abstrak (Abstract)

Our knowledge of turbidite reservoirs has increased enormously over the past 10 years or so, mainly as a consequence of the success of deep water petroleum exploration and the rapid global expansion in exploring this last major frontier area. This presentation will review the development of depositional models of deep water systems and illustrate how these have been used to improve prediction of turbidite reservoirs in the subsurface, at both the basin and field scales. Examples off subsurface turbidite reservoirs from around the world will be illustrated, including 3D seismic images of the wide range of deep water reservoir bodies. Finally, a case history of the Tertiary of the North Sea basin will be presented to illustrate how different processes influence turbidite sandstone reservoirs, including tectonics, eustasy, basin topography, sediment supply and depositional processes.

MALAM JURUTERA/Engineers Nite 2003
(Slope Engineering)
25 September, 2003
Geology Department
University of Malaya
Report

A case study of a landslide in Johore

EDDIE NG, T.S.

How do we learn from failures and prevent recurrence in slope engineering? — some case studies

LIEW, S.S.

Geological aspects in site investigations for slope stabilisation design

NEOH, C.A.

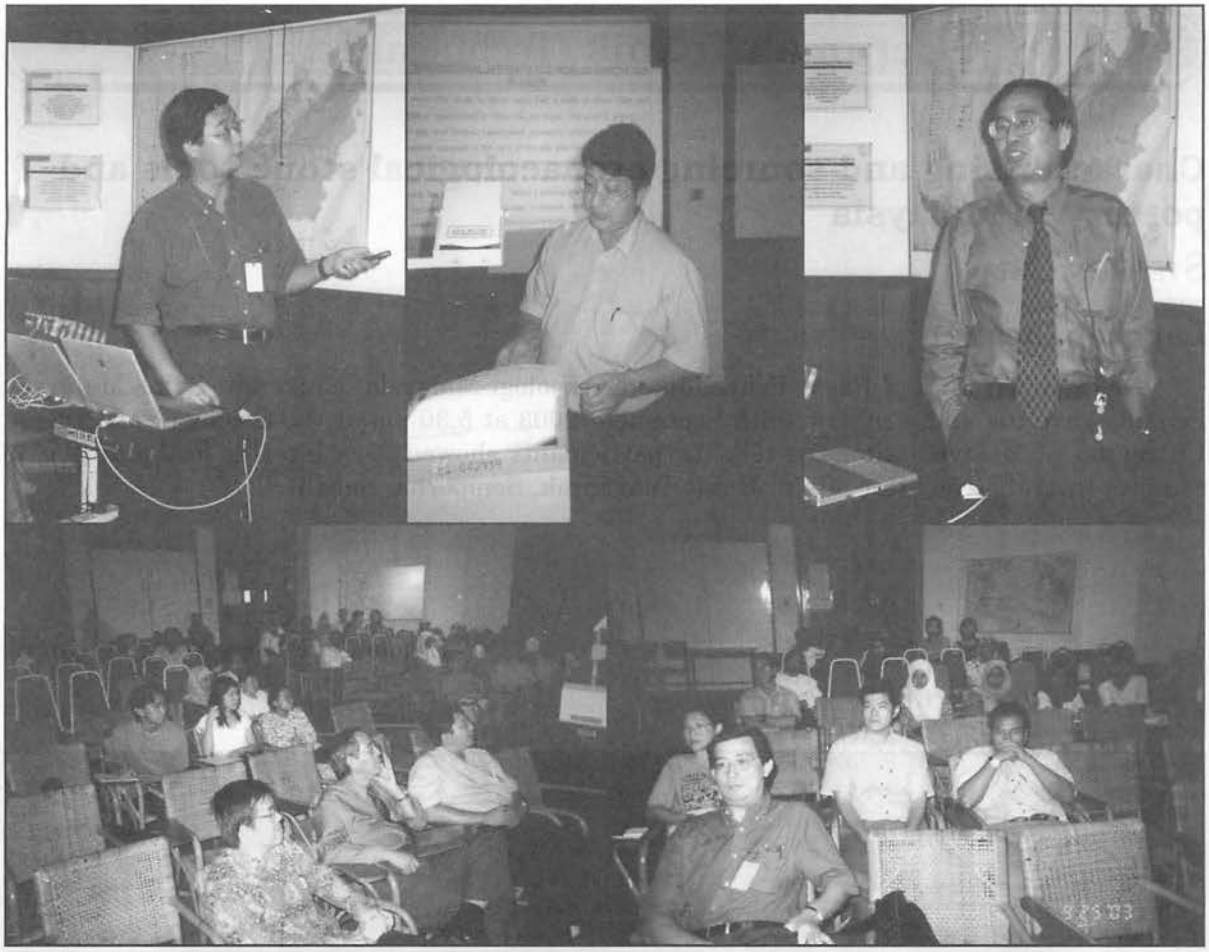
Laporan (Report)

Three consultant engineers presented talks on various aspects of slope engineering and slope failures to members of the Society on Thursday 25th September 2003, at the Department of Geology, University of Malaya.

Ir. Eddie Ng, T.S. gave a case study of a massive slope failure involving residual soils of gabbro in southern Johore. The failure planes are bilinear and controlled by relict joints. Remediation works via an observational approach include rockfill toe with compacted backfill, and subsoil horizontal drains.

Ir. Liew, S.S. presented two case studies of slope failures, one in northern Peninsular Malaysia, and the other in southern Johor. The first case involved materials of shale, mudstone and sandstone of weathering grades III to V, and the failure involved soil nailed slope as well. Analysis using limiting equilibrium method gave factor of safety close to unity. Analysis using the finite element method showed development of a shear band propagating to full slip surface. The second case involved residual soils of gabbro. Inclinometers used successfully detected the multiple, rotational slip planes. Shear strength parameters, both peak and residual, from laboratory tests, back analyses using limiting equilibrium and finite element methods, are in good agreements.

Ir. Neoh, C.A. gave a comprehensive account of the investigations, analysis and design of slope remediation works, including geological features or adversities relevant to such works. Numerous case histories were shown via a series of colour slides. Materials prone to failures, e.g. the graphitic schist soils, were highlighted. The possibility of lighting as one of the causes of rock slope failure/rockfall was mentioned, to the amusement of the audience.



As usual in this series of Malam Jurutera talks, active discussions followed each presentation, and the event must have been very educational for all present.

Tan Boon Kong
Chairman
Working Group on Engineering Geology & Hydrogeology
26th September 2003

Ceramah Teknik (Technical Talk)

Characterising and sourcing archaeological stone tools and pottery in Malaysia

STEPHEN CHIA

Laporan (Report)

Dr. Stephen Chia of Pusat Penyelidikan Arkeologi Malaysia, Universiti Sains Malaysia, Penang, gave the above talk on 26th September 2003 at 5.30 pm at the Geology Department, University of Malaya. After the talk the participants showed keen interest in the display of samples from the Neolithic site at Bukit Tengkorak, Semporna, Sabah.

G.H. Teh
Chairman
Economic Geology Working Group

Ceramah Teknik (Technical Talk)

Age and correlation of the Permian-Triassic boundary and mass extinction in China

IAN METCALFE

Laporan (Report)

Prof. Ian Metcalfe of the Research & International Division, University of New England, Armidale, Australia gave the above talk on 29th September 2003 at 5.30 pm at the Geology Department, University of Malaya.

Abstrak (Abstract)

This paper presents results of a seven year project aimed to provide biostratigraphically controlled robust multi-method radio-isotopic ages for the Permian-Triassic boundary, end Permian Mass Extinction, and vital new tie points for the Permian-Triassic geological time scale. Integrated high-resolution geochronometry, biostratigraphy chemostratigraphy and magnetostratigraphy was undertaken to determine synchroneity/diachroneity and time-duration of mass extinction and biotic recovery in the sea and on land. Provision of constraints on proposed catastrophic causes of the greatest punctuation in the history of life on earth was also a principal aim of the project. We have conducted work on the International Global Stratotype Section and Point (GSSP) for the base of the Triassic (Permian-Triassic/Palaeozoic-Mesozoic boundary) at Meishan, (Zhejiang Province, China), on the ancillary P-T boundary section at Shangsi, Sichuan Province, on terrestrial sequences at Dalongkou and Lucaogou, Xinjiang Province, and on non-marine to marginal marine sections in Yunnan and Guizhou Provinces, China.

Our studies have confirmed that the first appearance of the conodont microfossil species *Hindeodus parvus* (Kozur & Pjatakova), used to define the base of the Triassic, is synchronous in all studied marine/paralic sections in China (Nicoll *et al.*, 2002).

Definitive ages for the GSSP defined Permian-Triassic boundary (253 Ma) and main Permian-Triassic Mass Extinction (at around 254 Ma) have been established (Mundil *et al.*, 2001; Metcalfe *et al.*, 2001; Mundil and Metcalfe, 2002).

Our radio-isotopic age data indicate that the final stage of the Permian (Changxingian) is considerably longer than previously thought — as long as 5 Myr.

The claimed <165,000y short duration for the negative carbon isotope excursion at the P-T boundary (Bowring *et al.*, 1998) cannot be confirmed by our data. In fact, according to our new findings the duration of the carbon excursion might have lasted as much as 1–2 Myr (Mundil *et al.*, 2001).

Our isotopic dating confirms the temporal coincidence of the main P-T Mass Extinction with the Siberian Traps massive volcanic eruptions indicating a causative link (if a systematic bias between Ar/Ar and U/Pb isotopic systems is taken into account, see below). In view of these findings, a very short single catastrophic cause (such as an extra-terrestrial bolide impact) as suggested by recent publications, for the P-T Mass extinction has to be reconsidered.

The project work in China has confirmed the systematic bias between the U-Pb and Ar-Ar isotopic decay systems with Ar-Ar ages being 1–2% younger than U-Pb ages, which translates to 2.5 to 5 Myr for ages around 250 Ma. This is most likely due to a miscalibration of the 40K decay constant and has important fundamental implications for isotopic dating in general.

Work on palynological microfossils and on carbon isotopes of organic matter have confirmed that the so-called "fungal spike" at the P-T boundary, suggested to be caused by saprophytic metabolisation of dead vegetation following extinction, is in fact algal in nature, occurs at multiple horizons, and extends over a period of 10 million years (Foster *et al.*, 2002).

Palaeomagnetic data consistently shows a reverse to normal polarity change just below the P-T boundary, coincident with the P-T Mass Extinction. The upper Permian Changxingian and at least part of the Wuchiapingian stages belong to the Illawarra mixed interval (Glen *et al.*, 2002).

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SEMINAR ON GEOPHYSICS 2003

Effective Utilization of Geophysical Techniques in Site Investigation

Department of Geology
University of Malaya
Kuala Lumpur

11th October 2003

Jointly organised by
Department of Geology
University of Malaya

Collaborators
Geology Programme, Universiti Kebangsaan Malaysia
Geophysics Programme, Universiti Sains Malaysia

REPORT

The Seminar on Geophysics 2003 was hosted by the Geology Department, University of Malaya on 11th October 2003. This annual seminar of the Society's Geophysics Working Group targets the promotion of the development and application of geophysical methods particularly used on land for engineering purposes. The seminar this year went by the theme *"Effective Utilization of Geophysical Techniques in Site Investigation"*. A good response of 11 oral papers and 1 poster were presented.

The seminar was declared open by Assoc. Prof. Mohd Ali Hasan, Head of Geology Department, University of Malaya after the address by Prof. Dr. Abdul Rahim Samsudin, Chairman Geophysics Working Group and the Welcoming Address by Dr. Samsudin Hj. Taib, Organising Chairman of Seminar on Geophysics 2003.

A good turnout of about 80 participants testified the importance of geophysical techniques in site investigations among geologists, engineers and the academia.

The President, Prof. Madya Dr. Ghani Rafek, in closing the seminar congratulated the Organising Chairman, Dr. Samsudin Hj. Taib, for organising a very successful seminar.

SEMINAR ON GEOPHYSICS 2003

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Effective Utilization of Geophysical Techniques in Site Investigation

Department of Geology
University of Malaya
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PROGRAMME

0830 – 0900	:	Registration/Arrival of Participants and Guests
0900 – 0910	:	Welcoming Address by Dr. Samsudin Hj Taib, Organising Chairman of Seminar on Geophysics 2003
0910 – 0920	:	Address by Prof. Dr. Abdul Rahim Samsudin Chairman Geophysical Working Group GSM
0920 – 0930	:	Opening Address by Assoc. Prof. Mohamad Ali Hasan Head of Department, Department of Geology
0930 – 1000	:	John Kuna Raj (UM) *Geology in site investigations*
1000 – 1030	:	Abdul Rahim Samsudin (UKM) *Evaluating geophysical methods for geotechnical site investigations*
1030 – 1100	:	Tea Break/Exhibition
1100 – 1120	:	Loke Meng Heng and Zuhar Zahir Tuan Harith (USM) *Site investigation using 2D and 3D electrical imaging surveys*
1120 – 1140	:	Abdul Kahar Embi (JMG) *Gegaran dan gelombang seismik pada jarak dekat dan jauh dari aktiviti letupan kuari di Malaysia*
1140 – 1200	:	Harith, Z.Z.T., Iskandar S.A.R. and Rosli B.S. (USM) *The application of Ground Penetrating Radar (GPR) in mapping buried utilities*
1200 – 1220	:	B.K. Lim (Hydrocom Geophysical Sdn. Bhd.) *An integrated approach to resolving shallow marine structures and seabed sediments*
1220 – 1240	:	Samsudin Hj. Taib (UM) *Microgravity: an example on its application as a site investigation tool*
1240 – 1250	:	Rubiah Abdul Rahim (Electro Magnetic Detection Service Sdn. Bhd.) **Poster:** *The use of electromagnetic techniques in detecting and mapping of underground utilities*
1250 – 0215	:	Lunch/Prayer Break/Exhibition
0215 – 0235	:	Khairul Anuar Mohd. Nayan (UKM) *Civil engineering applications of the Spectral Analysis of Surface Wave (SASW) method*

0235 – 0255	:	Abdul Rahim Samsudin, Suharsono, Abdul Ghani Rafek (UKM) *An alternative analysis of surface waves data for site characterization*
0255 – 0315	:	Devendran, A. (HydroQuest Sdn. Bhd.), Rosli Saad, Zuhar Zahir Tuan Harith and Mohd. Nawawi (USM) *Geophysical input for geotechnical site investigation over reclaimed land, mangrove swamp and marine environment*
0315 – 0335	:	Samsudin Hj. Taib and Mustaffa Kamal Shuib (UM) *Seismic refraction method and its use in quarry site investigation: case history*
0335 – 0345	:	Closing Ceremony by Assoc. Prof. Dr. Abdul Ghani Rafek, President of Geological Society of Malaysia
0345 – 0430	:	Tea Break/Exhibition

SEMINAR ON GEOPHYSICS 2003

Effective Utilization of Geophysical Techniques in Site Investigation

Department of Geology
University of Malaya
Kuala Lumpur

11th October 2003

Abstracts of Papers & Poster

Geology in site investigations

J.K. Raj

Department of Geology
University of Malaya

Site investigations provide information on the environment and ground conditions at proposed locations of engineering structures in order to allow their safe and economic design. Several methods are employed in site investigation and include not only desk-top studies involving the interpretation of available information, but also field surveys and explorations with a variety of equipment. Geological field mapping serves as one method of site investigation and allows determination of the surface and subsurface distribution of earth materials within an area. Geology also plays an extremely important role in all other methods of site investigation, for the training, taught skills and acquired experience of geologists allows them to not only predict the environment and ground conditions at proposed locations for investigations, but also interpolate between, and extrapolate from, the known ground conditions at one or more sites.

Site investigations using 2D and 3D electrical imaging surveys

Loke Meng Heng and Zuhar Zahir Tuan Harith

Pusat Pengajian Sains Fizik
Universiti Sains Malaysia
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Many engineering and environmental survey sites have a complex geology that present a special challenge to geophysical techniques. Among the new techniques available to geophysicists are 2D and 3D electrical imaging surveys. These surveys provide a picture of the subsurface resistivity that is related to the geological targets sought. It can be used in areas that are noisy or have low resistivity where seismic and GPR surveys cannot be used. Examples of its use include detection of cavities in limestone areas, boulders, pipes, groundwater contamination and archaeological surveys. The 2D imaging technique is currently used in most

surveys, particularly in areas with moderately complex geology. 3D surveys are useful in very complex areas. The electrical imaging method can give even more accurate results when used with other geophysical techniques; such as seismic, GPR and microgravity. This reduces the ambiguity in the survey results and provides a more effective use of geophysical surveys in engineering and environmental investigations.

Kebanyakan tapak kajian kejuruteraan dan alam sekitar mempunyai geologi yang kompleks yang memberikan cabaran khas bagi teknik-teknik geofizik. Antara teknik-teknik baru yang boleh digunakan oleh ahli geofizik ialah tinjauan-tinjauan pengimejahan kerintangan 2D dan 3D. Tinjauan-tinjauan ini memberikan gambaran bawah-tanah yang berkait dengan sasaran geologi yang dicarikan. Ia boleh digunakan dalam kawasan yang bising atau kawasan yang mempunyai kerintangan rendah di mana tinjauan seismik dan GPR tidak boleh digunakan. Contoh kegunaannya termasuk pengesanan rongga dalam kawasan batukapur, batu tongkol, paip, kecemaran airtanah dan tinjauan arkeologi. Pada masa ini, teknik pengimejahan 2D digunakan dalam kebanyakan tinjauan, terutamanya di kawasan-kawasan dengan geologi yang sederhana kompleks. Tinjauan 3D memang berguna dalam kawasan yang sangat kompleks. Kaedah pengimejahan elektrik boleh memberi keputusan yang lebih tepat bila digunakan dengan kaedah geofizik lain; seperti seismik, GPR dan mikrograviti. Ini mengurangkan ketakpastian dalam hasil-hasil tinjauan dan memberikan kegunaan tinjauan geofizik yang lebih efektif dalam kajian-kajian kejuruteraan dan alam sekitar.

Gegaran dan gelombang seismik pada jarak dekat dan jauh dari aktiviti letupan kuari di Malaysia

ABDUL KAHAR EMBI

Pusat Penyelidikan Mineral
Jabatan Mineral dan Geosains Malaysia

Terdapat lebih dari dua ratus buah kuari yang aktif di Malaysia yang mengeluarkan dua belas jenis batu. Secara amnya bentuk operasi mereka boleh dikelaskan kepada lima jenis. Kaedah menggerudi dan meletup merupakan kaedah yang murah dan banyak digunakan. Teknik letupan menghasilkan kesan sampingan terutama gegaran yang akan merembat ke persekitaran. Pembangunan yang pesat disekitar kuari memerlukan kawalan terhadap gegaran yang dihasilkan. Perkaitan antara jenis kuari, bahan letupan dan gegaran telah dijalankan keatas beberapa kuari mengikut jenis. Perbandingan jarak-sekil pada jarak dekat dan jauh mengikut jenis dibincangkan dalam kertas ini.

The application of Ground Penetrating Radar (GPR) in mapping buried utilities

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Ground Penetrating Radar (GPR) telah lama digunakan dalam pelbagai bidang. Aplikasi kaedah ini semakin berkembang sejajar dengan penemuan kaedah-kaedah baru dan permintaan bagi tinjauan yang besar. Projek ini memfokuskan kepada pengesanan bahan-bahan yang ditanam di bawah permukaan bumi seperti paip dan kabel dan menghasilkan imej 3 dimensi bagi objek-objek tersebut. Dua kawasan tinjauan yang telah dipilih ialah tapak Konvokesyen, Universiti Sains Malaysia dan kilang Intel PG12, Bayan lepas, Pulau Pinang. Data-data diambil dengan mengggunakan peralatan GPR RAMAC dengan antena 250MHz. Selepas data diproses dengan menggunakan penuras seperti penuras DC dan AGC Gain, kesemua paip dan kabel yang

GEOLOGICAL MAP OF BORNEO

Persatuan Geologi Malaysia
Geological Society of Malaysia

Compiled by
Robert B. Tate
Year 2002

Scale 1:1,500,000
0 50 100 150
km

LEGEND

- Q — Quaternary Holocene coastal and river alluvium etc.
- Q — Quaternary-Holocene High-level alluvium
- Nv — Pliocene or younger basalt - East Sabah
- N(v)d — Middle to Late Miocene volcanics - East Sabah
- Np — Pliocene sediments
- Npv — Neogene acid/basic volcanic lavas & tuffs
- Nm/b — Miocene andesite/basalt plugs, dykes & lavas
- Nmi — Miocene tuffaceous lavas
- Nm(B) — Miocene Broken Formation (mélange)
- Nm — Miocene sediments
- Ml — Melinau Limestone (Eocene - Oligocene)
- Nmg — Miocene alkaline granite
- Nmv — Miocene volcanics
- Po — Oligocene sediments
- Pox — Oligocene deepwater sediments
- Pe — Eocene sediments
- Pp — Paleogene sediments
- Pgv — Paleogene volcanics
- Px — Paleogene deepwater sediments
- mélange undeformed
- mélange - sheared
- limestone
- fault
- structural trend lines
- Kus — Cretaceous ultrabasic rocks - harzburgite, serpentinite etc.
- Ks — Cretaceous deepwater sediments
- Kpx — Cretaceous-Paleogene deepwater sediments
- Cs — Cretaceous "crystalline basement" (E. Sabah)
- Ku4 — Upper Cretaceous granite - granite, diorite
- Ku3 — Upper Cretaceous ultrabasic rocks - gabbro, mtnor diorite
- Ku2 — Upper Cretaceous volcanics - dacite to basalt lava, breccia, tuff etc.
- Ku1 — Upper Cretaceous granite - granite, quartz monzonite, alkali granite
- Kl4 — Lower Cretaceous volcanics - andesite lava, breccia, tuff etc.
- Kl3 — Lower Cretaceous granite - granite
- Kl2 — Lower Cretaceous granite - granodiorite, granite, tonalite
- Kl1 — Lower Cretaceous granite - tonalite, granodiorite, locally foliated
- K — Cretaceous sediments
- JK — Jurassic - Cretaceous sediments
- JKm — Jurassic - Cretaceous metamorphic rocks
  Glaucophane schist, metabasalt schist, garnet amphibolite etc. (Mamalus Mts.)
- JKx — Jurassic - Cretaceous deepwater sediments
- Js — Jurassic deepwater sediments
- Jx — Jurassic sediments
- TrJ — Triassic - Jurassic sediments
- Trv — Triassic volcanics
- Trg — Triassic granite
- PTr — Permo-Trias metamorphics
- CP — Carbo-Permian sediments
- PzM — Pre-Carboniferous Pre-Tertiary Metamorphics

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EAST MALAYSIA
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Explanation of Legend

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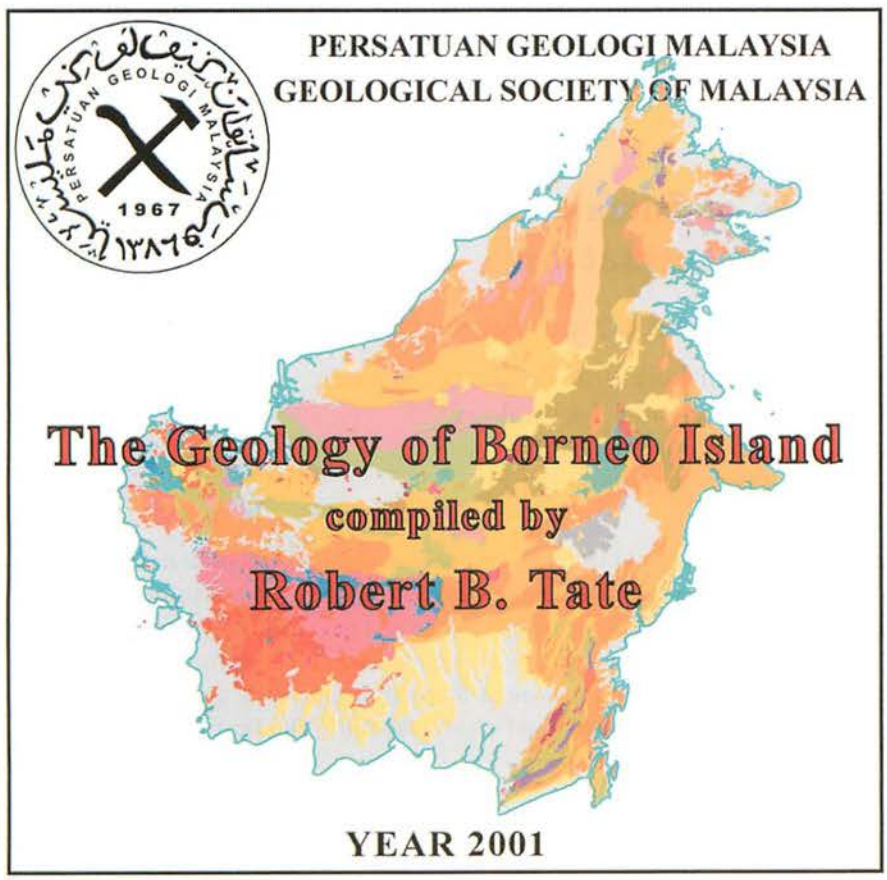

The Geology of Borneo Island

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tertanam di bawah permukaan bumi ditemui. Kedalaman objek-objek tersebut juga dapat dikenalpasti. Kelebaran objek-objek tersebut agak sukar untuk dikenalpasti, tetapi ahli geofizik yang berpengalaman dapat meramal kelebaran objek tersebut dengan baik.

Ground Penetration Radar (GPR) has since long been used in various fields. But its range of applications is growing bigger with the emergence of new techniques and requests for larger investigations. This Project focuses on detection of buried utilities such as pipes, and cables and producing 3 dimensional images of those utilities. Two test sites had been chosen as the study field, which were Tapak Konvokesyen, Universiti Sains Malaysia, and Intel PG12, Bayan Lepas, Pulau Pinang. Data was collected using RAMAC GPR 250MHz shielded antenna. After preprocessing using filter such as DC Filter and AGC Gain, all the pipes and wire beneath the ground were detected. The depth of the object can also be obtained. Determination of the object width was quite difficult, however experience geophysicists are able to predict with confidant.

Microgravity: an example on its application as a site investigation tool

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A gravity survey has been conducted in a residential area where subsurface mass movements has been noted. These movements have been observed through structures like roads, drain and floor and wall of houses within the site which are displaced vertically and some horizontally. The mass movement appears to be concentrated in an area to the west and middle of the site. Subsidence measurements confirms presence of the vertical movement. One of the potential cause of subsidence in limestone area such this site is due to the presence of cavity. A gravity survey has been carried out to determine this. The gravity anomaly obtained from the gravity measurements and the subsequent modelling indicate that this subsiding area occurs over a subsurface limestone ridge. It suggest cavity may not be the cause of the subsidence instead the movement may be all above the limestone bedrock.

An alternative analysis of surface waves data for site characterization

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The spectral analysis of surface waves (SASW) is an *in situ* non-destructive testing method. It has been developed and used for many years in the fields of geotechnical engineering and site characterization. It is typically used in evaluation of elastic moduli and layer thickness of soils, rocks and pavements. This method consists of wave generation, measurement and processing of dispersive Rayleigh waves. The stiffness profile of soil media or pavement systems are determined by fitting measured dispersion data with an adjustable theoretical model of the material that depends on layer thickness and elastic moduli. The best-fit stiffness

profile is usually formed with optimization techniques. This paper presents an alternative analysis of the Rayleigh waves. This alternative analysis comprises four main steps (1) determine the range of frequencies based on the best coherence value, (2) determine the dominant frequency and wave cycle for wavelength (LR) calculations, (3) calculate the attenuation coefficient for each geophones spacing and plot it versus phase velocity (VR) to produce an exponential equation, and (4) calculate the shear wave velocity from the derived exponential equation. The alternative analysis was tested at three sites i.e. Kamsis H UKM, Bangi, Bandar Sri Putra and Sri Damansara. The analysis has successfully produced an empirical exponential curve for each site. For Bandar Sri Damansara site the exponential equation obtained is ±=0.0084*e-0.0014Vs, for Bandar Sri Putra ±=0.0094*e-0.0015Vs and for site at KamsisH UKM ±=0.0035*e-0.0007Vs. The final profile of Vs versus depth obtained for each site is compared with those of the SASW inversion analysis and Standard Penetration Test data from borehole.

Geophysical input for geotechnical site investigation over reclaimed land, mangrove swamp and marine environment

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Seismic reflection and refraction techniques were used to map Quaternary sediments as a fast and inexpensive method to complement borehole and cone penetrometer tests. On this site although thin layers and velocity inversion layers are expected, the seismic refraction method gave useful information to the engineers such as unsaturated layers, near saturated layers and consolidated layers interpreted from velocity computations. The seismic reflection survey on the other hand was able to identify clearly silty clay layers and silty sand layers. The survey also managed to identify settlement of the original ground due to the load of the reclaimed sand. The above information combined with the borehole and CPT results gave in depth understanding of the underlying geology of the survey area. As a comparison two resistivity profiles were also surveyed using the 2D resistivity imaging technique.

Seismic refraction method and its use in quarry site investigation: case history

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Seismic refraction method is commonly used in site investigation for large project such as highways and dams. In small scale development such as in the site investigation for potential quarry site, water tank or reservoir and small housing development, the geophysical or seismic surveys are seldom used. They are used

only when problem exist. In potential granite quarry site, core boulders are often prominent. When using borehole for investigation, these core boulders need to be cored through otherwise a pseudo bedrock may be inferred. The seismic refraction can be used to determined the true bedrock depth. The boring will be necessary for obtaining the bedrock samples to test the rock quality. Beside this the seismic refraction is rapid and more mobile, where the area is large and terrain is rugged. Example from two quarry site are used to emphasise the importance of seismic refraction survey in quarry site investigation.

The use of electromagnetic techniques in detecting and mapping of underground utilities

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Information is the most important ingredient in any undertaking. It permits planning an afternoon's work or a multi million enterprise. When it comes to public works within or sometimes beyond the public right of way, buried utility information proves to be a big problem. The difficulty of obtaining information about buried utility lines is that very little is visible. Drawings, plans or information can sometimes be obtained from relevant parties but many times they are inaccurate, faulty or incomplete. A suitable technique has to be used to obtain the information from underground and a number of techniques are available: such as ultrasonic, IR Imaging, Dowsing, GPR, and electro magnetic detectors.

Compared to the other techniques, electromagnetic detection method is proven to be the most efficient and cost effective way to locate hidden or buried utilities. In EMDS we employ the effectiveness of those methods to detect and map the underground utilities.

Electro Magnetic Detection Service (EMDS), as the name says it, employs various techniques concerning electromagnetic waves, coupled with in-depth knowledge of utility systems to locate pinpoint and correlate these "lost" utilities as logically and as accurately as possible. Thus producing precise and informative maps of underground utilities.

Civil engineering application of the Spectral Analysis of Surface Wave (SAWSW) method

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Civil engineering works covers a wide spectrum of applications that include projects that are small and huge in scale. The applications from a single wave form have never been so successful and widely applied in Civil engineering as the Spectral Analysis of Surface Wave. Its ability to define the dynamics properties of materials for both profiling and imaging has been rapidly utilized to address engineering structures of a few millimetres of depths to bedrock as deep as 50 meters has been widely reported. The direct involvement of

civil engineers themselves in this method of geophysical test has been more intensive than the other geophysical methods. Their applications include evaluation of pavement, testing of concrete structures, assessment of fill materials and evaluations and design in geotechnical engineering. SASW is more practical in the field as the source is reasonably simple as compared to the other geophysical methods. In this paper specific applications of the SASW method in civil engineering are highlighted so that both engineers and geophysicist are able to appreciate their potential applications.

An integrated approach to resolving shallow marine structures and seabed sediments

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Geophysical techniques have been routinely used as reconnaissance tools in the site investigations for marine engineering construction and pre-drilling hazards site surveys. In all these surveys, it is crucial to predict shallow gas hazards from less significant biogenic accumulations or peat occurrences, soft organic or peaty substratum from hard sub cropping formations, stiff/hard over consolidated clays from the very soft to soft recent clay deposition or palaeochannels from circular slip faults. In the modern, large scale construction processes, the survey findings on the critical site conditions are often relayed to the design and planning centres for the route designs, planning and costing, prefabrications of parts and materials, structures, pipeline coating or cable armouring even as the survey progresses. Hence it becomes increasingly important to process and interpret the geophysical data reliably onboard the survey vessels as costly decisions are made on the basis of these pre-engineering surveys. Potential problems or hazards identified or taken into consideration can save millions of dollars in construction costs while unidentified problems actually manifest into costly delays during the construction stage. While many of the site surveys had been largely successful in routine charting and mapping work, there had been notable failures and several undocumented mis-interpretations when more geologically complex situations warranted the need for more specialised investigative skills. The weak link in almost all of these mishaps can be traced to the quality of interpretation or reporting of the survey.

A company can spend hundreds of thousands of ringgit for an advanced seismic system and yet the quality of the survey is only as good as the final interpretation of the seismic data. While the survey techniques and instruments have improved significantly over the years, the same cannot be said for the interpretation processes and techniques. Despite the advances in computer technology, we have yet to see any interpretation techniques that truly harness the power of computer-aided interpretation. Computerised-aided drafting and word processing programmes only add cosmetic not fundamental changes to final presentation of the results. Even though the seismic data are now recorded or backed up on tapes and disks, the major part of the interpretation is still carried out using the hard paper printouts. Although the interpretation is the most critical part of the survey, it is also the most neglected component part of the chain. Why? Because the worth of the survey is based on the number of acquisition data channels, equipment sophistication, speed and everything else except the quality of the interpretation work.

Until we make a paradigm shift, the quality of interpretation will continue to lack behind; unable to take advantage of the technological advances of the 21st century. This paper discusses an integrated approach which had been quite useful in resolving some of the more difficult problems encountered in the pre-construction engineering surveys. The technical points are highlighted here for academic purposes only. No malicious intended. Specific details have been left out intentionally to avoid any legal complications.

Evaluating the application of geophysical methods for geotechnical site investigations

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Engineering geophysical techniques measure specific physical parameters and are routinely applied to geotechnical-related problems. The engineer responsible for site investigation should ensure that geophysical technique(s) employed provide cost effective information about physical properties of interest at the required levels of spatial resolution and target definition.

To successfully apply any geophysical technology a clear understanding of the techniques' limitations and manipulations of recorded data is essential. Experience has shown that dependence on any one particular technique results in data limitations often unacceptable to clients. It is for this reason that a broad spectrum of inspection techniques is essential to ensure supply of expected deliverables. This allows for the generation of multiple data streams enabling cross correlation resulting in increased levels of confidence in the final assessments.

To ensure success of the geophysical surveys, the engineer designing or responsible for the geophysical investigation should raise several pertinent questions, and select methodologies based on the responses. Questions could include:

i. What are the physical properties of interest?
ii. Which geophysical methods measure the physical properties of interest?
iii. Which techniques will likely provide the required spatial resolution and target definition ?
iv. Which geophysical tools will perform well in the study area?
v. Which techniques are most cost-effective?
vi. Which techniques will provide complementary data?
vii. What non-geophysical data are required to constrain the interpretation of the acquired geophysical control?
viii. Is the overall program cost-effective?

Some information about commonly employed geophysical methods and a generalized approach for evaluating their application for a specific geoengineering related problem are discussed. This paper has tried to raise and summarize pertinent related issues, in an effort to assist the engineer involved in designing geophysical surveys, and inform the engineer charged with decision responsibilities.

Ceramah Teknik (Technical Talk)

Art Boucot's Talks

Laporan (Report)

Prof. Art Boucot from Oregon State University gave two talks to the members of our society during his visit to Malaysia. His first talk on *"Phanerozoic global climatic zones and paleogeographic changes through time"* was delivered to GSM members in the Klang Valley at the Department of Geology Lecture Hall in the University of Malaya on 21.10.2003. His second talk on *"Some thoughts about the Shan-Thai Terrane"* was given at the Department of Mineral and Geoscience in Ipoh the next day. The abstracts of his two talks are given below.

Phanerozoic global climatic zones and paleogeographic changes through time

ART BOUCOT

Abstrak (Abstract)

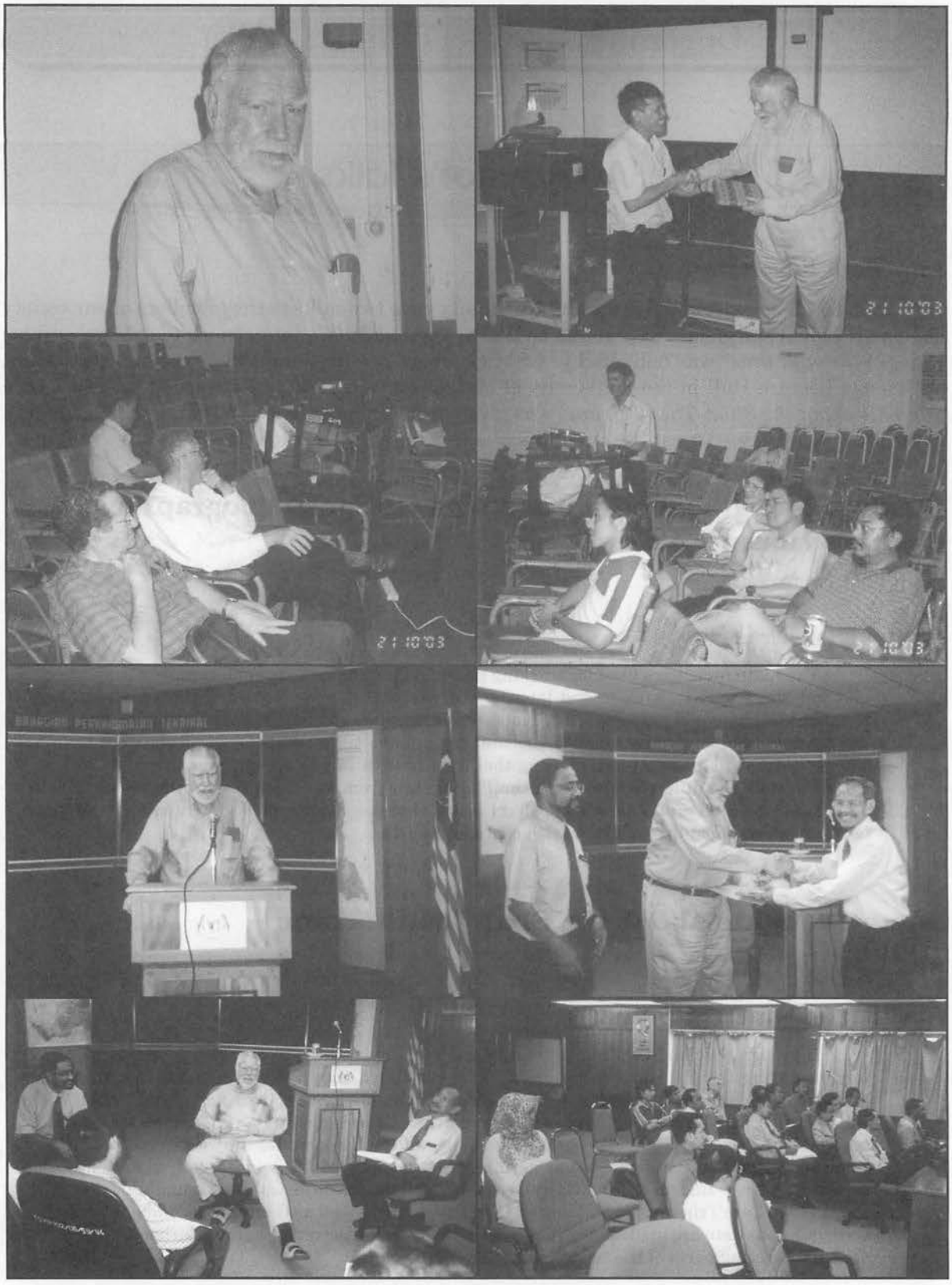
The main indicators used for tracking paleoclimatic changes through time are: warm and wet climate- coal, bauxite and laterite; cool and wet climate- coal and tillites; warm temperate climate- kaolinite (&coal & evaporate), crocodiles, palms & mangroves; warm and dry climates- evaporate and calcrete; cool and dry climate- tillite, dropstone and glendonite. Using the above indicators and plotting their occurrences in paleogeographic maps of the world through the different periods in the Phanerozoic from the Cambrian to the present, allows one to interpret and track paleoclimatic changes as the paleogeography of the landmasses changed through time with continental drift.

Some thoughts about the Shah-Thai terrane

ART BOUCOT

Abstrak (Abstract)

Biogeographic and lithological information bearing on the integrity of the Shan-Thai terrain during the Paleozoic is reviewed. It is concluded that there is compelling Early Permian data (the widespread, so-called pebbly mudstones), Silurian-Devonian data (the widespread Early Devonian "tentaculitid" mudstones featuring abundant dacryoconariids, the widespread earlier Llandovery graptolitic shales and mudstones plus the widespread later Silurian carbonate-rich strata), and permissive Ordovician data (widespread, abundant carbonate facies). Information for Early Carboniferous (carbonate facies) and Lopingian (Late Permian) to Late Triassic, for Middle and Late Devonian, as well as Cambrian is ambiguous. Carboniferous data are inadequate. The possibility of a later Devonian-earlier Carboniferous orogeny affecting parts of the terrane is considered.



MALAM PENCEMARAN (Pollution Nite)

23 October, 2003

Geology Department
University of Malaya

Report

The Malam Pencemaran saw 3 speakers dealing with case studies of hydrocarbon vapour pollution and solid waste managements. Though the audience was a bit thin, i.e. ~ a dozen participants only, there were very lively discussions after each presentation.

Abstracts of the presentations are given below.

Tan Boon Kong
Chairman
Working Group on Engineering Geology & Hydrogeology
27th October 2003

MALAM PENCEMARAN (Pollution Nite)
23 October, 2003
Geology Department
University of Malaya
Abstracts of Papers

Solid waste management in the Philippines: a small island experience

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The Philippines is a country of 85 million people and encompasses 7,107 islands of which only about 2,000 are currently inhabited. The Province of Romblon consists of 20 islands located approximately 275 kilometers (km) southeast of Manila. The Municipality of Odiongan is located on the west coast of Tablas Island, the largest island in the Province of Romblon. Tablas Island comprises a total area of 66,046 hectares (ha), slightly smaller than Singapore, with Odiongan encompassing a total area of 13,603 ha. Odiongan has a residential population of approximately 40,000 spread amongst 25 villages. Average annual income per capita is approximately US$500.

Solid waste in small island communities is managed primarily through open dumping and open burning. However, the municipal government of Odiongan (Municipality) is implementing an ecological solid waste management program aimed at managing solid waste using systems that are sustainable, environmentally sound, and economically viable. From 1995 to 2001, solid waste was disposed through open dumping at a site originally slated for use as a public cemetery. In 1997, the Municipality formally adopted a program to manage solid wastes through recycling, composting, and landfilling, and obtained a 4.4-ha property with the intention of constructing new solid waste processing center. A development plan was prepared for the composting and landfill operations at the new center. The plan for the landfill operation included the design of a leachate collection and removal system (LCRS), a leachate treatment system, fill sequence plans, and a final cover design. A closure plan for the open dump was also prepared.

The development plan was presented to village and municipal councils, as well as neighbouring church congregations for their endorsement and approval. The Municipality conducted simple baseline groundwater monitoring and soil testing, solid waste community surveys, and visited other active waste management operations in other parts of the Philippines. The development plan and other supporting documents were submitted to the Philippine Department of Environment and Natural Resources in order to obtain an operating permit. An operating permit was granted in May 2001 and construction of the first phase was completed in July 2001. Landfill operations at the new center officially commenced in November 2001. Composting operations began in 2002. Construction of the landfill and composting operations were funded by Philippine government institutions.

Assessing the significance of subsurface hydrocarbon vapour migration into a building with an earthen basement: a case study

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The move toward a more structured approach to assessing contaminated sites has led to a growing interest in the U.S. and other developed countries on the potential risks posed by the migration of chemical vapours from subsurface contamination into enclosed spaces located above it. Vapours accumulating in inhabited enclosed spaces pose two levels of concern. First, vapours may be present in the enclosed space at high enough levels to present immediate flammability and/or health risks. The second and more common scenario involves lower concentrations and the concern is more on long-term health risks to the inhabitants. For this second class of sites, time is available to adequately address the problem on a more site-specific basis.

A site-specific approach was used to assess the significance of subsurface hydrocarbon vapour migration into a building with an earthen basement located above a light non-aqueous phase liquid (LNAPL) plume originating from a nearby former gas station in Green River, Utah. The role of mathematical fate and transport modelling in assessing the significance of this pathway is highlighted. Specifically, the use of a popular screening-level model developed by Johnson and Ettinger (1991) for modelling the migration of subsurface hydrocarbon vapours into the building is discussed in the context of the risk assessment. The model relates the steady-state indoor air concentration of a volatile compound to its steady-state soil gas concentration at some depth in the subsurface. The original model algorithm couples vapour diffusion through the vadose zone, vapour diffusion and convection through cracks or small openings in a foundation slab and mixing of vapours inside a building. Model input requirements include distance between the contaminant source and building, chemical properties, soil properties and building properties.

Site-specific soil gas concentrations intended to be protective of the long-term health of the workers inside the building were developed for a range of petroleum constituents, including benzene, toluene, ethybenzene and xylenes (collectively, BTEX), methyl tert-butyl ether (MTBE), naphthalene, and Total Petroleum Hydrocarbons (TPH), using risk assessment methods

recommended by the U.S. Environmental Protection Agency (USEPA) and Utah Department of Environmental Quality (UDEQ). As an initial evaluation of the potential health risks to indoor workers, the calculated soil gas concentrations were compared to measured soil gas concentrations obtained from nearby soil vapour monitoring wells. Based on this preliminary assessment, benzene and hydrocarbons in the C_4-C_{10} range were identified as the primary constituents of health concern. A qualitative evaluation of soil gas concentration profiles obtained from the soil vapour monitoring wells indicated that aerobic biodegradation of the hydrocarbons vapours may be occurring at shallow depths in the vadose zone although this may not be the case beneath the building. Vapour attenuation due to biodegradation was not considered in the mathematical modelling. Lastly, some recommendations for refining the assessment of the pathway are provided, including the collection soil gas samples beneath the building and monitoring of indoor air quality.

Reference

JOHNSON, P.C. AND ETTINGER, R.A., 1991. Heuristic model for predicting the intrusion rate of contaminant vapours into buildings. *Environmental Science and Technology, 25(8),* 1445–1452.

Compacted clay liner in sanitary landfill sites

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Universiti Kebangsaan Malaysia
Bangi, Selangor

Landfill is regarded as Best Practicable of Environmental Option (BPEO) in disposing off solid waste and residues from incinerators. All waste disposal methods give negative impacts to the environment, and we have the option to choose one with lesser impacts. There are two perennial problems regarding landfills; leachate and methane gas. Leachate is very harmful and can contaminate soil and groundwater system underneath the landfill sites. In order to control this problem, sanitary (secured) landfills have utilised several types of liner materials such as compacted natural clay (soil) liner, benthonite clay, asphalt, geomembrane and geosynthetic clay liner. The main purpose of using these materials is to prevent the migration of polluted leachate into the surrounding area. Natural soil has several benefits compared to other liner materials, i.e. it acts physically by retarding leachate flow and chemically by sorption processes to attenuate the contaminants. The physical properties of soils are important in relation to their capability to be compacted to attain a minimum requirement of hydraulic conductivity of $1x10^{-9}$ m/sec.

Meanwhile, the chemical properties of soils are capable of controlling the attenuation of contaminants via various chemical processes namely ionic exchange, precipitation, complexation, and adsorption mechanisms. Soils with high clay contents (>10%) are capable of compacting to densities and permeabilities consistent with the function as a liner. Clay contents influence plasticity, natural moisture content and permeability of the soils. It also greatly affects several chemical parameters of the soils such as the cation exchange capacity (CEC) and specific surface area (SSA). Soils with high pH, high carbonate, organic, and amorphous oxides/hydroxides contents and high CEC-SSA values are favourable for liner materials and to a great extent control the natural attenuation of soils on pollutants.

In Malaysia, there are currently two secured landfill sites that have utilized compacted clay/soil as part of their landfill liner system. The landfill site in Waste Management Centre Bukit Nenas in Negeri Sembilan uses a meter-thick of compacted weathered granitic soil as part

of their liner. This *state-of-the-art* landfill is currently used to receive slags and ashes produced from the burning of toxic wastes (scheduled wastes) in their incinerator. This center has become the only place to receive toxic chemical wastes from factories in Peninsular Malaysia. Another example of sanitary landfills is Air Hitam Sanitary Landfill in Selangor, which is managed by Worldwide Landfills Sdn. Bhd. It utilizes weathered metasediment from Kenny Hill Formation as compacted clay liner. It is only used for disposal of domestic waste (municipal solid waste) from seven councils within the Klang Valley.

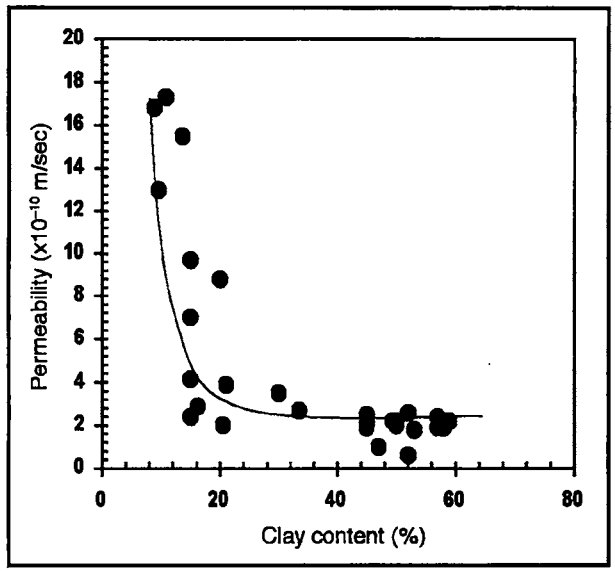

Figure 1. The relationship between permeability and clay content for all soil samples used in this study.

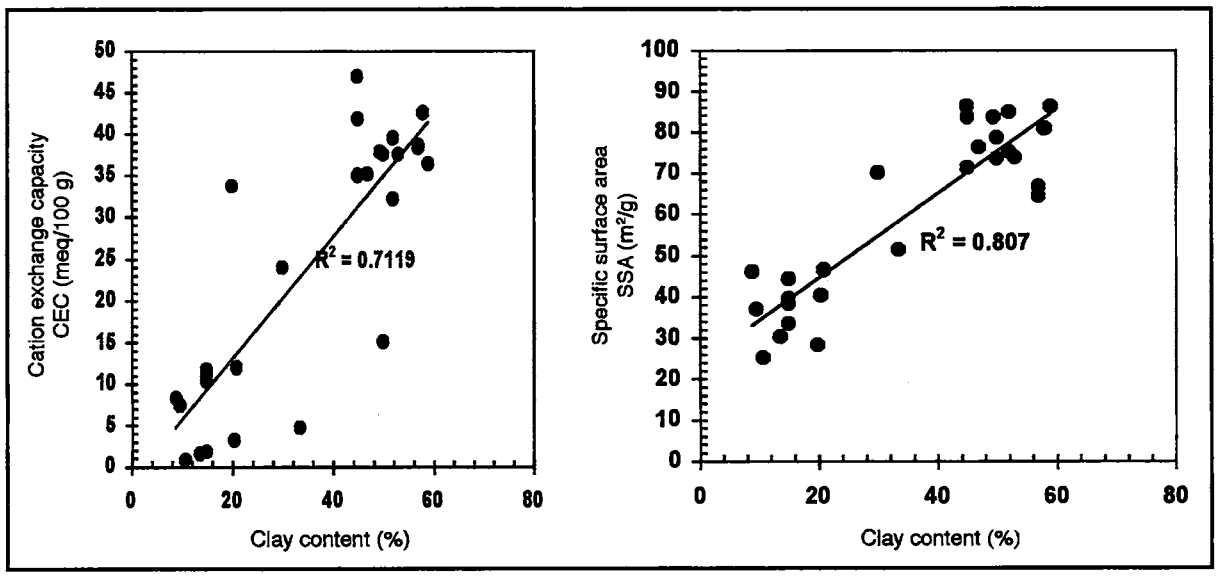

Figure 2. Linear correlation between the clay content with cation exchange capacity (CEC) and specific surface area (SSA).

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PERSATUAN GEOLOGI MALAYSIA
GEOLOGICAL SOCIETY OF MALAYSIA

ANNUAL GEOLOGICAL CONFERENCE 2003

Hilton Hotel
Kuching, Sarawak
24 – 26 May 2003

Editors: G.H. Teh, Alex Unya Ambun, Askury Abd. Kadir & T.F. Ng

Collaborators:
- Minerals and Geoscience Department Malaysia
- Universiti Kebangsaan Malaysia
- University of Malaya
- Universiti Sains Malaysia
- Universiti Malaysia Sarawak
- Institute of Geology Malaysia

Bulletin of the Geological Society of Malaysia

MAY 2003 *Special Conference Issue* No. 46

BERITA-BERITA PERSATUAN
NEWS OF THE SOCIETY

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2. Zaidin b. Satimin
   Environmental Science, 18, Jalan Tago 11, Tago Industrial Park, 52200 Kuala Lumpur.
3. Lee Choon Lian
   SSP Professional Services, 2D-01-01, Block D, Sri Penaga Apt., Jalan Wawasan 4/12, 47100 Pusat Bandar Puchong.

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PETUKARAN ALAMAT (Change of Address)

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3. Daniel Lewis
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4. Norzita Mat
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6. Ahmed Mardzukie bin Hassan
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7. Ahmad Rosli Othman
   Jabatan Mineral Dan Geosains Negeri Kelantan, Tingkat 3, Wisma Persekutuan, Jalan Bayam, 15658 Kota Bharu, Kelantan D. Naim.

PERTAMBAHAN BAHARU PERPUSTAKAAN (New Library Additions)

The Society has received the following publications:

1. SOPAC News, No. 2003 (1&2), 2003.
2. Geoscience Journal, vol. 7, no. 2, 2003
3. AAPG Bulletin 87, no. 4, 9 & 10 2003.
4. Monthly statistics on Mining Industry in Malaysia, May 2003.
5. AAPG Explorer, June & September, 2003.
6. Journal of Science of the Hiroshima University, vol. 11, no. 2, 2003.
7. Development in Sarawak: an aerial persective.
8. Episodes, vol. 26, no. 3, 2003.
9. Overview of trends in Canadian mineral exploration, 2002.
10. Oklahoma Geology notes, vol. 62, nos. 3 & 4, 2002.
11. Geological Survey of Japan, Bulletin no. 53, no. 11/12, 2002 & no. 54, nos. 1/2 & 3/4, 2003.
12. USGS Professional Paper, no. 1630 (2001).

WORKING GROUP CHAIRMAN

The Council is looking to interested members to fill the Chairmanship of the following Working Groups:

1. Stratigraphy/Sedimentology
2. Economic Geology
3. Petroleum Geology
4. Young Geoscientist

The responsibility of the Chairman of a Working Group is to organise activities for the benefit of members of the Working Group in particular and the Society in general.

BERITA-BERITA LAIN
OTHER NEWS

2003 SEAPEX Exploration Conference and Farmout Forum, Singapore

The 13th SEAPEX Conference was held in the Orchard Hotel, Singapore from 15th to 17th September, 2003. The bi-annual conference was scheduled to be held in April but was postponed until September due to the SARS outbreak when most delegates were forbidden from travelling to SARS –infected countries. The event attracted 280 delegates attended from 23 countries. The larger than expected attendance was due to presentations from five governmental organizations offering offshore acreage for exploration, namely, Australia, Indonesia, Malaysia, Philippines and Vietnam. Ali Md. Shariff from PETRONAS presented an update on Malaysia's exploration scene and likely acreage on offer although precise details were not given here. Ed Manalac, a retired industry explorer who has now joined the Philippines Government as Under-Secretary for Energy, presented the Philippines acreage located in areas offshore Palawan. Contract terms have been made exceptionally attractive to attract potential investors; there is no royalty and with a 60/40 split, tax is deducted from the Government portion. Delegates were positively drooling over these conditions, especially when they knew bids are already open until January and sign-up expected in March-April 2004. Clearly, the Philippines Government wants to do business now. In contrast, PetroVietnam gave details of upcoming acreage but does not intend to invite bids until 2005! The 4th MIGAS Bidding Round in Indonesia was presented by Edy Hermantora. Marita Bradshaw presented acreage release offshore South Australia. Clearly, exploration opportunities in Natuna, East Java, South Sulu and Timor Seas as well as Southwest Arufura and North Palawan excite interest and the coming year should see new drilling in those areas.

The technical papers on petroleum geology commenced on Day 2 with a series of five presentations in a "cross section" from the Wichian Buri Field in Thailand to the Hai Thach gas field in the Nam Con Son basin, offshore Vietnam. Unocal Thailand then described their attempts in prospecting for extensions to the old onshore depleted Erawan Field and gave a fascinating example of small-scale seismic exploration comprising a survey team of a road vibrator/compactor and a six team crew! The method, developed in Thailand, delivers superb seismic sections to 2 seconds penetration — perfect for shallow, onshore fields; the secret of course is in the processing of the data to eliminate, for example, the buffalo thumping and frog croaking in the paddy fields!! Interest then focused on Indonesian Kalimantan with Unocal presenting the frontier deepwater exploration offshore Kutei where more than 200 deepwater wells have been drilled. Farmout presentations included acreage in Palawan, onshore New Zealand and Vietnam.

Day 3 commenced with presentations on oil-prone petroleum systems in Australia and the Perth Basin gas prospects. The advent of 4D seismic allows 3D seismic to be run again across acreage previously surveyed, allowing changes in impedance to be measured. BP China presented an interesting example for 4D results across the Yacheng Gas Field in the South China Sea clearly showing the depletion of gas reserves on comparative seismic sections. It is important that the boat sails the same direction along traces as in the first survey otherwise unexpected results can occur. This is the first time 4D seismic has been done in East Asia and has proved useful if estimating the life of a field. The final paper translated the audience to the arctic wastes of the Sakhalin Peninsula

with a fascinating overview of the offshore acreage there. The main problem seems to be not the icy meteorology but the protracted negotiating contract process.

A CDRom and hardcopy of the abstracts for all papers presented was included in the conference literature and a further CDRom containing all the papers in full will be sent to all delegates and members with the next issue of SEAPEX Press.

SEAPEX celebrates 30 years this year and, although at one stage becoming near extinct during that time, now seems to be riding a wave of satisfactory optimism with active membership, a bi-monthly in-house, full color magazine for members giving the latest oil exploration news in the region and chapter groups in Jakarta, Kuala Lumpur and Bangkok. A week-long field trip to the Khorat Plateau is planned for the coming November. The 13th Conference was a great success and there was a substantial amount of geology presented rather than 'technical' geophysics and provided manifold sustenance for office-bound explorers.

Robert Tate

KALENDAR (CALENDAR)

2003

November 2–5

GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Seattle, Washington, USA. (Contact: GSA Meetings Dept., P.O. Box 9140, Boulder, CO 80301-9140, USA. Tel: +1 303 447 2020; Fax: +1 303 447 1133; E-mail: meetings@geosociety.org; Website: http://www.geosociety.org/meeting/index.htm)

December 8–12

AMERICAN GEOPHYSICAL UNION (Fall Meeting), San Francisco, California, USA. (Contact: San Francisco, California, USA. (Contact: AGU Meetings Department, 2000 Florida Avenue, NW, Washington, DC 20009 USA. Tel: +1 202 462 6900; Fax: +1 202 328 0566; E-mail: meetinginfo@agu.org; Website: http://www.agu.org/meetings)

2004

January 14–16

ASIAN MARINE GEOLOGY (5th International Conference), Bangkok, Thailand. (Contact: Thanawat Jarupongsakul, Department of Geology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand. Fax: +(662) 2185464-5; E-mail: thanawat@sc.chula.ac.th)

March 27 – April 4

NATIONAL EARTH SCIENCE TEACHERS ASSOCIATION (Annual Meeting), Atlanta, Georgia, USA. (Contact: NESTA, 2000 Florida Ave., N.W., Washington, D.C. 20009, USA. Tel: +1-202 462 69 10; Fax: +1-202 328 0566; E-mail: fireton@kosmos.agu.org)

April 18–21

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS AND SOCIETY FOR SEDIMENTARY GEOLOGY (SEPM) (Joint Annual Meeting and Exhibition), Dallas, Texas, USA. (Contact: AAPG Conventions Dept., P.O. Box 979, Tulsa, OK 74119, USA. Tel: +1-918 560 2679; Fax: 1-918 560 2684; E-mail: convene@aapg.org; Website: www.aapg.org)

May 17–21

AMERICAN GEOPHYSICAL UNION AND CANADIAN GEOPHYSICAL UNION (Joint Meeting), Montreal, Canada. (Contact: AGU Meetings Department, 2000 Florida Avenue, NW, Washington, DC 20009 USA. Tel: +1 202 462 6900; Fax: +1 202 328 0566; E-mail: meetinginfo@agu.org; Website: http://www.agu.org/meetings)

June 27 – July 2

WATER-ROCK INTERACTION (11th International Symposium), Saratoga Springs, New York, USA. (Contact: Dr. Susan Brantley, Secretary General, Dept. of Geosciences, The Pennsylvania State University, 239 Deike Building, University Park PA 16802, USA. Tel: +1-814 863 1739; Fax: +1-814 863 8724; Website: www.outreach.psu.edu/C&I/WRI/)

July 4–9

INTERNATIONAL PALYNOLOGICAL CONGRESS (11th), Granada, Spain. (Contact: Technical Secretary. E-mail: eurocongres@eurocongres.es; Website: www.ugr.es/~bioveg/)

August 20–28

INTERNATIONAL GEOLOGICAL CONGRESS (32nd), "The Renaissance of Geology", Florence, Italy. (Contact: Ms. Chiara Manetti, Universitàdegli Studi di Firenze, Dipartimento di Scienze della Terra, Via La Pira, 4, 50121 Firenze, Italy. Tel/Fax: +39-055 238 2146; E-mail: cmanetti@geo.unifi.it; To request the First Circular, send e-mail to: 32igc@32igc.org or visit the Congress Website: www.32igc.org)

August 27 – September 4

VLADIVOSTOK-2004 INTERIM IAGOD CONFERENCE (Metallogeny of the Pacific Northwest: Tectonics, Magmatism & Metallogeny of Active Continental Margins), Vladivostok, Khabararovsk, Magadan, Russian Far East, Russia. (Contact: Russian National IAGOD Group, Federal Far East Geological

Institute, Far Eastern Branch of Russian Academy of Sciences, 159, Prospekt 100-letiya, Vladivostok, 690022, Russia. Tel: 7(4232)31-87-50; Fax: 7(4232)31-78-47; E-mail: iagodconf@fegi.ru or fegi@online.marine.su; Website: http://www.fegi.ru/IAGOD/index.htm)

September 11–19

TECTONICS, MAGMATISM AND METALLOGENY OF ACTIVE CONTINENTAL MARGINS (Interim International Conference on Metallogeny of the Pacific Northwest), Vladivostok, Russia. Sponsored by the Russian Academy of Sciences and The Society of Economic Geologists. (Contact: Far East Geological Institute, Far Eastern Branch of Russian Academy of Sciences, 159, Prospekt 100-letiya, Vladivostok, 690022 Russia. Tel: +7(4232)31-87-50; Fax: +7(4232)31-78-47; E-mail: iagodconf@fegi.ru or fegi@online.marine.su; Website: http://www.fegi./ru/IAGOD/)

September 15–17

SEDIMENTOLOGY (23rd Annual Meeting of the International Association of Sedimentology), Coimbra, Portugal. (Contact: Rui Pena dos Reis, uiversidade de Coimbra, Dpto. Ciências da Terra, Largo Marquês de Pombal, 3014 Coimbra, Portugal; E-mail: penareis@ci.uc.pt)

October 10–15

SOCIETY OF EXPLORATION GEOPHYSICISTS (74th Annual Meeting and International Exposition), Denver, Colorado, USA. (Contact: Debbi Hyer, 8801 S. Yale, Tulsa, OK 74137, USA. Tel: (+1-918) 497 5500; E-mail: dhyer@seg.org; Website: meeting.seg.org)

November 7–10

GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Denver, Colorado, USA. (Contact: GSA Meetings Dept., P.O. Box 9140, Boulder, CO 80301-9140, USA. Tel: +1 303 447 2020; Fax: +1 303 447 1133; E-mail: meetings@geosociety.org; Website: http://www.geosociety.org/meetings/index.htm)

December 13–17

AMERICAN GEOPHYSICAL UNION (Fall Meeting), San Francisco, California, USA. (Contact: AGU Meetings Department, 2000 Florida Avenue, NW, Washington, DC 20009 USA; Tel: +1 202 462 6900; Fax: +1 202 328 0566; E-mail: meetinginfo@agu.org; Website: http://www/agu.org/meetings).

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