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About the Society

The Society was founded in 1967 with the aim of promoting the advancement of earth sciences particularly in Malaysia and the Southeast Asian region.

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

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Some early recollections of geology at the University of Malaya: I, Singapore days

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By the time I arrived in Singapore in the middle of 1957, the geology department was already over a year old. It had been established because of the requirement that civil engineering students must have the principles of geology included in their syllabus. Professor Charles S. Pichamuthu (Fig. 1) had been appointed to the first chair from his home in Bangalore and he had the foresight to insist that, in addition to servicing the engineering faculty, geology be fully established as a department in its own right within the science faculty.

Initially occupying temporary space in the main science faculty buildings of the Bukit Timah Road campus, the department was transferred to a two-storey colonial-style house within Dalvey Estate (Fig. 2), on a bluff overlooking the Nassim road entrance to the campus. It had an uninterrupted view down a well-trimmed grassy slope towards Raffles residential college. The house had its own garden, meticulously maintained by the peon Mr. K. Krishnan, who had previously worked in the nearby botanical gardens. He had been sent by the Japanese army of occupation to work on the 'death railway' in Thailand, and upon return after the war had never been able to trace his wife and family.

I was working as an oil company geologist in Trinidad when the offer of an assistant lectureship came with a request from the registrar Mr. Lewis that my services were urgently needed. Urgency in those days meant travel by first class sea. So I sailed on the s.s. *Reina del Mar* from Port of Spain to Plymouth. After a few weeks in Scotland, I sailed from Southampton on the magnificent P & O s.s. *Canton* to Singapore. The Suez Canal was closed, so the voyage took a wonderful 5 weeks via Cape Town. It may be hard to believe, but my salary at the university was actually an improvement on what I had been earning in the oil industry, and certainly the university conditions of service were considerably more favourable. Half salary was paid during travel.

Upon arrival early one morning at Keppel Harbour, Professor Pichamuthu, Anthony Henry, who was the secretary, and Tengku Ismail,

Figure 1. Charles S. Pichamuthu, the inaugural professor of geology at the University of Malaya.

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who was the laboratory assistant, met me. Tengku and his family lived in an out-house adjacent to the department.

Pichamuthu was not tall and of rather frail stature, bespectacled and always well dressed. He usually wore a tie, long-sleeved shirt and well pressed starched long trousers. He was always of distinguished appearance. Academically he had an immaculate reputation, was the world's foremost authority on charnockites, held a D.Sc. and Ph.D. from Glasgow University and was a fellow of the Royal Society of Edinburgh. I did not have a Ph.D. in those early days and was somewhat overawed by his academic status. I carefully maintained the gap between us by always addressing him as 'sir', which I thought to be the most appropriate address. He always, somewhat condescendingly addressed me as 'my dear Charles'; but we had a good friendly relationship and occasionally he invited me to tea with his wife and son in the nearby Dalvey Road flats. Pichamuthu walked daily from the flats along a shaded footpath, with steps up the final approach to the department garden.

A wooden staircase spiralled up from the entrance to what had been the main upstairs lounge area, now the general office, run very efficiently by Anthony Henry. It jutted out over the garden, forming a porch over the entrance driveway. Its side and front walls were of wooden louvers and hinged windows, held open during the day by brass hooks, closed only at night and to keep any heavy rain out. The front entrance led directly to the left into the museum. My very first addition to it was to have made a five-sided rotatable wooden prism, standing over 6 feet tall — the geological column that stands today in the geology department museum in Pantai Valley (Fig. 3). Tengku Ismail and I found a company in North Bridge Road that made billboards for cinemas. Details on all five faces were meticulously scribed in paint. The design was modified after a similar column to be found in the geological museum in London.

Lecturing in the upstairs room, with its window wide open onto the garden, had its problems. One afternoon my class and I had to rapidly vacate as a swarm of bees came in through the window. They eventually built their nest on the window frame. The lecture room and my adjacent staff room could not be used for 3 days, while staff from the estate office devised a scheme to safely remove them.

My staff room was unproductive for private research. I invariably fell asleep at my desk in the afternoon heat and humidity. I moved my

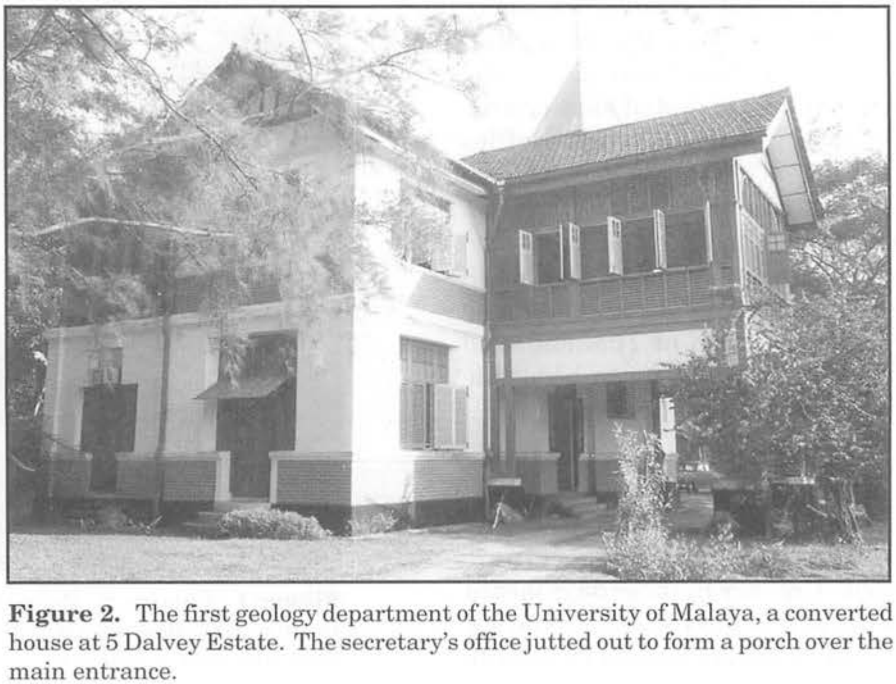


Figure 2. The first geology department of the University of Malaya, a converted house at 5 Dalvey Estate. The secretary's office jutted out to form a porch over the main entrance.

Swift microscope into the nearby small photographic darkroom, and used it as a private laboratory. There was no objection since I was also in charge of departmental photography.

During his first year, Pichamuthu had very efficiently equipped the department with a good stock of teaching aids. There was a complete rock and mineral collection from Wards in USA, housed in locally constructed and imported display and storage cabinets. There was a reasonable selection of fossils, real and plaster casts from Dr. Krantz in Germany, a wonderful collection of wooden crystal models from Alminrock in India, and an amazing solid wood model of the biaxial indicatrix which could be dismantled to show the circular sections. Most of these are still in the department. There were several Leitz, Zeiss and Swift research and teaching microscopes and a complete set of Cargill immersion liquids. Some field equipment had been obtained from Gregory Bottley. The professor's pride and joy was a Leitz panphot, used for photomicrography and drawing. It came with its own desk and drawers full of a comprehensive range of eyepieces and objectives. It had a clockwork-driven carbon rod electric arc for bright illumination. Its transformer produced so much heat, that one day it began to burn a hole through the wooden floor. Thereafter we insulated it from the floor. Frequent visitors to the department were Mr. Toukof of Schmidt Scientific and several staff from Motiwalla, who supplied all the stationery. They also printed Wulff and Schmidt nets for my crystallography classes. The rock preparation room had been well set up for sawing and grinding, and Tengku Ismail became quite proficient at making thin sections. With Tengku's help, I designed and made a wall-mounted rotating Wulff net for class work.

Professor Pichamuthu introduced me to a most valuable collection of Singapore rocks collected by Mrs. F.E.S. Alexander, which she had bequeathed to the department upon her departure for Nigeria. Mrs. Alexander was a qualified geologist, married to a lecturer in the physics department. Her collection, map and accompanying field notes offered me the ideal introduction to the local geology. After cataloguing the collection, I began my own research into the norite and granite of the island. There was also a P.W.D. publication on the igneous rocks by Mr. Hollis-Bee, but it was of lesser quality.

Mrs. Alexander was fascinated by the intense tropical weathering of Singapore rock outcrops. She described and collected samples showing the immense variety of tropical weathering phenomena, including liesegang

Figure 3. The geological column first stood in the museum at 5 Dalvey estate, before being transferred to the present Pantai Valley campus.

patterns and secondary quartz crystals, which resembled 'false teeth'. In an attempt to find out how fast the weathering process took, she buried several fresh granite specimens in the swamps of the Jurong area, near Tuas. Sad to relate, two years later, she recorded that she was unable to rediscover her buried specimens. Another curiosity in her collection was a small tektite, which she claimed fell out of the sky onto the deck of a ship as she sailed one evening along the Straits of Malacca. How this came about is a mystery for there are no modern falls of tektites; but it is recorded in her notebook.

One morning I was summoned to Pichamuthu's office to meet Harold Service, the retiring director of the Geological Survey of Malaya, who was about to embark on his return sea journey to his home in New Zealand. J.B. Alexander succeeded him and the geological survey had moved its headquarters from Batu Gajah to Scrivenor Lane, off Tiger Lane in Ipoh. Harold Service desired to purchase a new German camera, and Pichamuthu introduced me as the photography expert who knew the dealers and could obtain a good discount. I had been put in charge of photography in the department and was in the process of training Tengku Ismail how to run the darkroom. I took the director for lunch at the Dalvey road mess, then onto Ruby and Amateur Photo in North Bridge Road, where he made his purchase. He invited me to join his farewell dinner that evening in Raffles hotel, where I met Clive Jones and Keith Burton, Mrs. Service and Mrs. Burton.

Wolverton Mess was the social centre of the university (Fig. 4). It was there that I first met the great Cyril Northcote Parkinson. He was professor of history, but made his international reputation when his best-selling *Parkinson's Law* was published. I remember seeing him in the bookshop near Collyer Quay autographing copies of his newly published book. His *Law* was based on his Singapore experience, especially of careful observation of the university administration. Soon after its publication, he was invited to a lecture tour of the U.S.A. and never returned. He made enough money to retire thereafter to the Channel Islands.

I belonged to a group of lecturers that met often in Wolverton Mess and frequented the numerous watering holes of Singapore. The others were Tony Berry (zoology), David Bassett (history) and Bernard Brown (law). Some of our favourite places were the *Seventh Storey*, the *Tanglin Inn*, the *Coconut Grove*, and *Bugis Street*. Bugis Street was the most famous, but

Figure 4. Wolverton mess at the end of Nassim road, adjacent to the entrance to the campus. This strange looking 'Hansel and Gretel' building offered accommodation to unmarried academic staff and was the social centre of the university.

was completely fraudulent. The beer was adulterated with Chinese tea, and the street girls were all transvestites. But they offered good entertainment to watch. Tony Price (English) was the local expert. The Coconut Grove was a really delightful place. It was a house and garden, containing coconut trees, situated just round the corner from Cold Storage, off Orchard Road and affectionately known as *Bill Bailey's Place.* It was owned and run by Bill Bailey and his wife, reputed to be of Barnum and Bailey circus fame. It had a homely atmosphere, and drinking guests provided their own entertainment at the piano. The Place is sadly long since gone and replaced by the concrete jungle of modern Singapore.

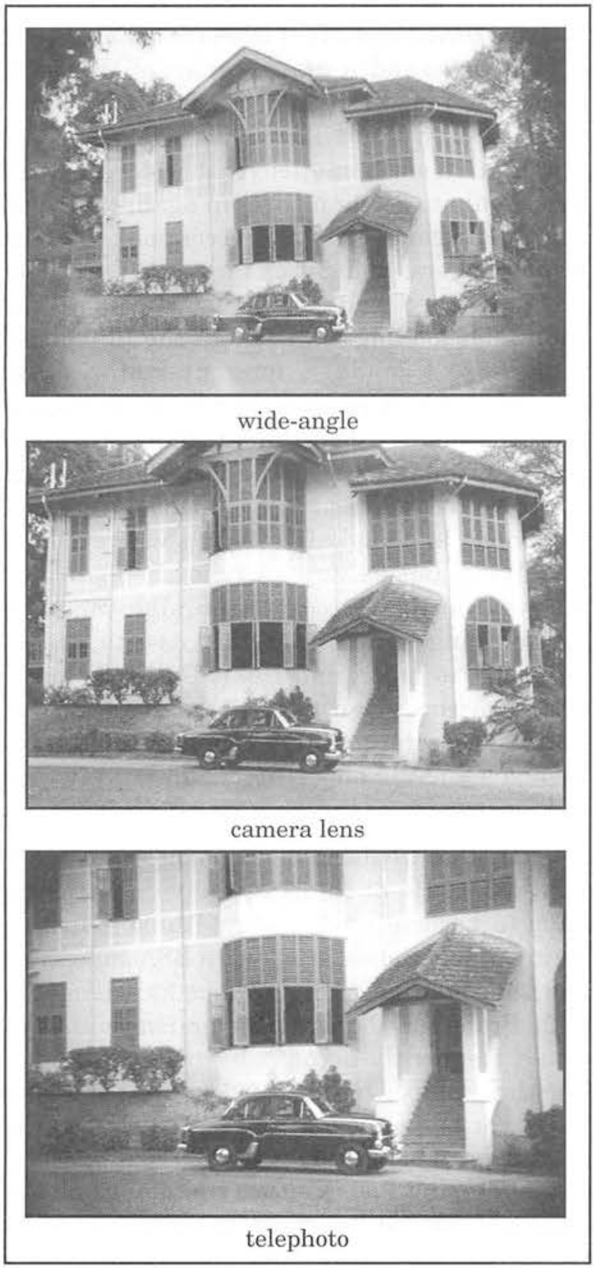


Figure 5. The Dalvey road mess where I stayed in Singapore.

Dalvey road mess, where I had a room (Figs. 5 and 6), gave me an excellent opportunity to make friends from a wide spectrum of academics. Staff who lived there from time to time were: Len Young (history), Mike Swift (Malay studies), Ivan Polunin (medical), Roger Smart (maths), Dennis Keene (english), Mary Turnbull (history), George Low (engineering), Dai Davis (law) and Jean Robertson (medical). David Marshall, the eminent lawyer and former Chief Minister, frequently attended university functions and eventually married Jean. Ivan Polunin made films on wild life of international repute. Both Len and Mary ended up at the university of Hong Kong, while George and I ended up in Kuala Lumpur. Tim Whitmore (forestry) frequently came to the mess for lunch before he transferred to Kepong.

Professor Pichamuthu ran the department autocratically and did not pass information to his staff. Thus it was one morning, as Tengku and I entered the thin-sectioning room (formerly the kitchen), we found to our surprise a young stocky slightly-balding Chinese man, wearing a white lab coat, already there making a thin section. Tengku mistook him for a businessman. We struck up a conversation with him, only to find that this was J.H. (Tony) Leow, the newest addition to the academic staff. He was a Singaporean, qualified in mineralogy and

Figure 6. The author in his 5 Dalvey Road Estate room. The days of the slide rule.

petrology from the University of Western Australia. A few weeks later there was another similar event, when an unknown Tamil Indian was seen wandering in the department. He turned out to be Sambe Gouda, the next addition from India. Sambe, senior to both Tony and myself, was a palaeontologist. Tony and I made a pact — my research, which I had already begun, was to be on the igneous rocks of the island, while he took the sedimentary part. We were not concerned with what Gouda did, and Pichamuthu, always too busy with his Mysore charnockites, showed no research interest in Singapore or Malayan geology. Pichamuthu had written a newspaper article concluding that Malaya and Singapore had no petroleum potential. But, of course, we knew nothing of the offshore in those days.

During a visit to Raffles Museum, I talked to the curator about the exact locality of the large monoliths of granite containing norite xenoliths, which were stored in the garden behind the building. He explained that they were from Monk's Hill, a site completely demolished for building, and that he was anxious to get rid of them. I immediately offered them a new home adorning the front garden of the geology department. Pichamuthu readily agreed and we had the university lorry transport them. They were later transferred with the department to Pantai Valley, where they can be seen today.

Sambe Gouda had to have been the world's worst driver. He bought a small Ford Escort and somehow obtained a driving licence. Several times either Tony or I received a telephone call from Sambe telling us that he had run off the road and needed help. None of his accidents were serious, but his car accumulated a large number of dents. We also had calls to come and change a tyre for him, for he was also not mechanically inclined.

Keith Burton became a frequent visitor to the department. He was stationed at the Johore Bharu district office of the geological survey. He was actively mapping south Johore and preparing a memoir on its geology. He was a good source of information on the geology of the Peninsula and on the Linden Hill gabbro of Johore and of Pulau Ubin. After studying some of his thin sections, I told him that eucrite would be the most appropriate term for the Johore rocks and I also brought him to see the norite quarries of Singapore. I suspect that Keith was separated from his English wife by this time and was married to a Malay lady from Kelantan, by whom he later had a son. To show his disapproval, the director delayed Keith's promotion and allowed Clive Jones to step over him into the position of principal geologist.

I had several visits from David Slater, who was the survey geologist posted to Kota Bharu. David and I had been classmates both at high school and at the university of Aberdeen. I was able to get a room for him in the Dalvey Road mess, where I lived. On one occasion I saw him off on home leave at the Singapore docks, only to see him turn up again one week later. The cargo ship had accommodation for 10 passengers, had got as far as Penang, only to be diverted back again to Singapore for additional loading. On one of the university vacations, I made a long up-country car excursion, accompanied by two good friends from the history department, Mary Turnbull and Len Young, and his fiancée Cathy Wong. We travelled as far as Kota Bharu. We found the house in Pengkalan Chepa where David was living, but he was away in the field. On the way north we took the mining company narrow gauge trains from the coast to Sungei Lembing tin mine, and Bukit Besi iron mine, where we were given overnight accommodation by the Australian mining company. This trip also gave me the opportunity to have my first look at aspects of the East Coast geology.

Another frequent visitor to the department was Robert Ho of the geography department, later to become professor in Kuala Lumpur. He invariably wore shorts, rode a BSA motorcycle and smoked a lot. He developed a friendship with Professor Pichamuthu and myself, and would frequently accompany us in the field. The three of us went for a weekend to Mersing in my car and stayed at the resthouse. It was my first introduction to the structural complexity of the Mersing Beds, but we could not find the volcanic rocks, although we searched along the main road to Endau. This was my first claim for mileage allowance, but I asked Pichamuthu to submit it because he could claim a more attractive rate than I could.

The government mileage claim scheme was complicated; the rates changed across state borders. Kelantan and Terengganu, which had few sealed roads and many ferry crossings, attracted the highest rates. Pahang was next, and the West Coast states, including Singapore, were lowest. The rates also depended on car engine size and salary of the employee.

Although student numbers were low, I have only a limited recollection of their names. I remember Jaafar bin Ahmad, Helene Lin, Ignatius Wong, Law Wei Min and Lim Yew Hock (Fig. 7). Apart from the latter, they all transferred to Kuala Lumpur and finished their degrees.

Later, accompanied by Tony Leow and Sambe Gouda, we took our students on a one-day field excursion to those same Mersing outcrops and taught them how to make structural measurements on folded rocks, and how to make use of graded bedding (Fig. 8).

I made several Sunday visits with my non-geological friends Len Rayner, who worked for George Kent, and Mary Turnbull to the Kota Tinggi waterfall at a granite-metasediment contact, which was still an emergency 'hot' area and under night time curfew. The nearby tin-iron mine of Pelepah Kanan had a thick overlying gozzan containing spectacular large pyritohedra, pseudomorphed by martite, and the underlying vein system contained good cassiterite crystals. We also frequently visited the top of Gunong Pulai. On the way up there were good waterfall outcrops of rhyolitic tuff. Other Sunday visits to the Kota Tinggi area were made accompanying the zoology group, notably Tony Berry, Johnny and Ann Johnson.

I had planned, with the help of Wilford of the geological survey in Kuching, a student field trip to Sarawak. We had even made a booking on the Straits Steamship 'Rajah Brooke'. But it unfortunately fell through because not every student could obtain a passport on time. Wilford later sent us a collection of Sarawak ore minerals.

Instead a 10-day field excursion was made to the East Coast mines of Sungei Lembing and Bukit Besi, where I had agreed to give a talk to the Australian mining geologists. Unfortunately we arrived one day late, a common experience because of the exasperating delays at the numerous river ferry crossings (Fig. 9). Sometimes it was impossible to progress to the head of the traffic queues because of the priority system, which favoured ambulances, police and VIP's. Fortunately unplanned overnight stops were always possible at the numerous rest houses. We encountered the additional hazard of flooding between Rompin and Temerloh and had to detour via Kuala Lumpur. We had been advised that, if we became cut off by flooded roads, that a return journey was usually possible from Tumpat by loading the minibus on the train. The monsoon floods rarely affected the railway line via Kuala Lipis. The mines at Sungei Lembing (tin) and Bukit Besi (iron) were each accessed from the coast by a two-hour journey on the company narrow gauge railway lines. The mine at Sungei Lembing had obtained a special duty free concession from the Pahang government. There was a bonded warehouse and beer was cheap. The staff drank only from large bottles!

Another fieldtrip was made to Kedah, Perlis and Penang (Fig. 10). On this trip the minibus became bogged down while negotiating the track up the southern slope of Kedah Peak to the historic Hindu temple (Fig. 11), which was in the process of being restored by a French archaeology expert from Angkor Wat, in collaboration with Alistair Lamb from the history department.

Sambe Gouda and Pichamuthu were obviously close friends and had known each other before their Singapore days. However, the friendship was not to last. Pichamuthu departed on home leave to India and left Gouda in charge of the department with specific instructions to convert the downstairs back room into an air-conditioned microscope laboratory for students. Tony and I were, of course, not told about this, and during the absence of Pichamuthu, Gouda converted the room into his own air-conditioned office. Pichamuthu was furious when he returned and never spoke to Gouda again thereafter. I was selected by both of them to be the go-between — a sort of interpreter. "Tell him to move out of that room as soon as possible", Pichamuthu

Figure 7. Three of the first senior students in the mineralogy/petrology lab. Helene Lin, Lim Yew Hock and Law Wei Min.

Figure 8. The first field excursion to Mersing. Sambe Gouda with hat-in-hand and the author wearing a hat. Identified students are Helene Lin in foreground and Jaafar Ahmad and Law Wei Min at top of picture, sitting on Mersing Beds.

Figure 9. A field trip to the mines and outcrops of the East Coast. Negotiating one of the numerous ferries.

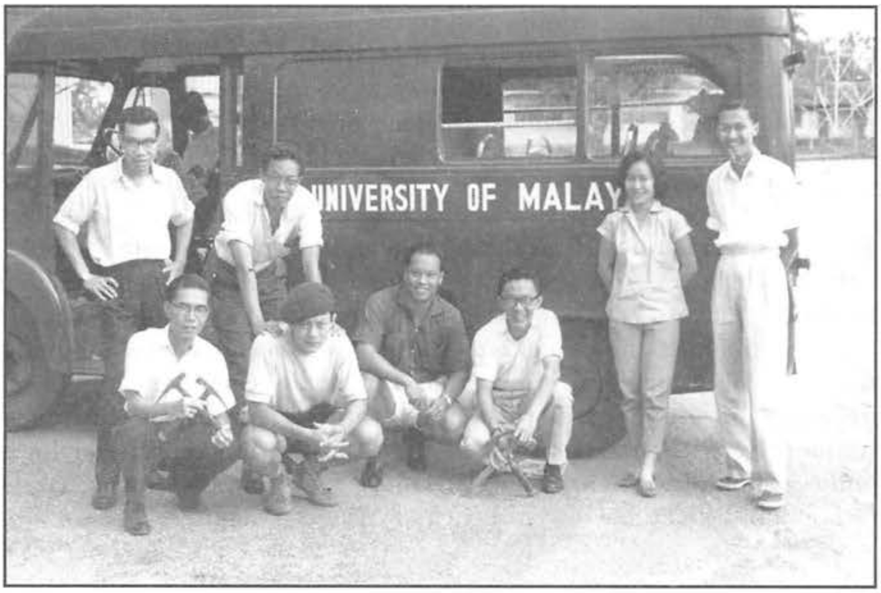


Figure 10. A field trip to Penang and the north. Tony Leow in centre. To his left Law Wei Min. Helene Lin and Ignatius Wong at far right. Lim Yew Hock and Jaafar Ahmad at far left.

Figure 11. Stuck on the way up Kedah Peak. The author levering-up the minibus, while Helene Lin supervised.

would instruct me. He never brought himself to mention the name Gouda, but I always knew to whom the "him" referred. I would get an appropriate reply to convey to the professor. I did not ask for this job, but seemed to have been automatically selected.

The rules of service were extremely liberal. Staff could be absent for every long vacation, required to return only two weeks before the beginning of term. The constitution was firmly based on that of Oxford University and the terms bore such names as Michaelmas and Trinity. Transport by first class P&O sea voyage (or equivalent) to the staff member's designated 'home' was given every second long vacation and sabbatical leave of a whole academic year after two such home leaves, with similar fare for staff member and family paid to the place of study. 'Home' was not the place from which you were appointed, but the country of your nationality. Local staff obviously had no benefit from 'home leave', but were equally entitled to sabbatical leave.

I converted my first home leave fare entitlement in February 1959 to a round-the-world air ticket, with side trips; a common practice amongst the expatriate staff. It was the days of propeller aircraft and the non-pressurized super constellation stopped frequently, with meals provided at airports and occasionally at nearby hotels. On the way to London, I had a few days in each of Athens, Rome, Zurich and Paris. On the return journey I travelled extensively in North America, visiting most of the well-known universities in search of a place and scholarship to study for my Ph.D. The most memorable was a visit to Yale, where Horace Winchell made me feel extremely welcome. He had previously played host to Professor Pichamuthu. I then went across the Pacific to Hawaii and Wake Island, with stopovers in Tokyo and HongKong, where I stayed in the university flat of Ian McLean, who had transferred from Singapore to the physics department. Upon return to Singapore, the staff turned in to the bursar the unused portion of the liberal travel voucher. Those were good days!

It was the morning after the 1959 victory celebration of the P.A.P. party at the general election. I was along the coast at Changi, accompanied by Tengku Ismail in the university landrover. Although there were no true outcrops, the upper beach had several large granite core boulders, and we were busy hammering them and trying to collect a hand-specimen. Of all people, who should walk down to the beach from the government bungalow than Lee Kwan Yew and his wife? He had been there with his colleagues for an all night celebration. He complained that we were trespassing on private property. After explaining that we were innocently studying geology, his attitude changed and we shook hands. I was never to meet him again.

Manuscript received 5 April 1999

PERTEMUAN PERSATUAN
Meetings of the Society

Ceramah Teknik (Technical Talk)

Understanding slope movements and the failure process

ANDREW MALONE

Laporan (Report)

Prof. Andrew Malone gave an illuminating talk on "Understanding slope movements and the failure process" on 10th May 1999 at the Department of Geology, University of Malaya. The talk was based on numerous case histories of slope movements and failures investigated by the Geotechnical Engineering office (GEO) of Hongkong. It is particularly interesting since the approach to the investigations/studies incorporated both geological and geotechnical studies. An abstract of the talk is attached below.

Some 80 "members" attended the talk, with a vast majority being members of IEM (geotechnical engineers). A lively and prolonged discussion session followed the presentation.

Abstrak (Abstract)

This presentation will summarise the results of recent research into slope movements and the process of failure of cuttings in saprolitic materials formed by the tropical weathering of igneous rocks.

Evidence will be presented of slope movements and failure in twenty-three Hong Kong case histories. All cases relate to hillside cuttings. Landslides occurred in 22 cases. In one case movements were detected at an early stage and the failure process was brought to a halt before main failure occurred.

The landslides are separated into two groups, based on their geometry and the velocity of movement at main failure: steep-shallow landslides and deep landslides.

The steep-shallow landslides move extremely rapidly at main failure and travel many metres or tens of metres until arrested. In contrast, the deep landslides generally move slowly at main failure, displacing by 1 to 3 metres at most before coming to rest. Movement of the deep landslides may be reactivated by severe rainfall conditions. Whereas the deep landslides show evidence of movement before main failure, the steep-shallow landslides generally do not.

The differing velocity of movement of the two types of landslide may be explained in terms of the mechanical properties of the materials within the rupture zone. Pre-main failure movement of the deep slow-moving landslides may be the result of progressive development of the rupture zone within the saprolite mass. In contrast, it appears that rupture initiates in the steep-shallow landslides just before the main failure occurs. Hence, in theory, the latter landslides will be energetic but the former will not.

In describing slope movements the presentation will follow the classification of stages of slope movement suggested by Leroueil *et al.* (1996). Use of this new classification system is recommended for studies of landslides in tropically weathered soils and rocks.

The presentation will conclude with a discussion of the implications of the findings for slope design.

Tan Boon Kong
Chairman
Working Group on
Engineering Geology & Hydrogeology

Footnote: Professor Malone teaches in the Departments of Earth Sciences and Civil Engineering of the University of Hong Kong, where he is responsible for a new MSc programme in Applied Geosciences. He also works for the World Bank as an adviser on landslides. Previously he was the head of the Geotechnical Engineering Office in Hong Kong. He graduated in Civil Engineering from Leeds University in 1964 and was awarded a Ph.D. from Imperial College in Engineering Geology in 1969. He was invested with the Bronze Bauhinia Star in the 1998 Honours List of the Hong Kong Special Administrative Region of the Peoples Republic of China.

The uses of surface area data obtained on reservoir core samples

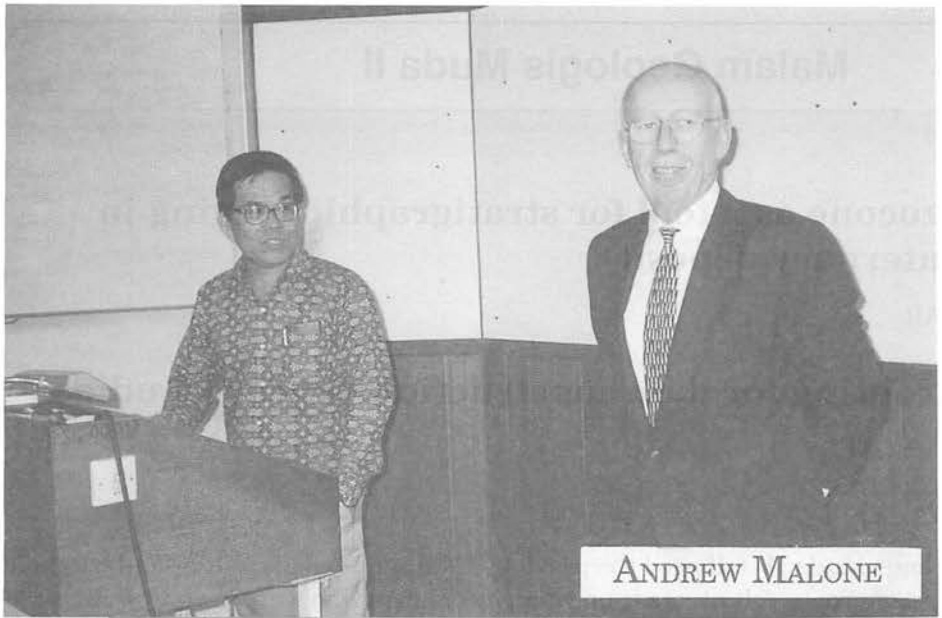
ROBERT EAST

Laporan (Report)

Robert East of Core Laboratories Indonesia gave the above talk between 12.00 noon to 1.00 pm on 20th May 1999 at Petronas Twin Towers Level 41, Conference Room. Robert graduated from the University of London in 1974. He has worked in the petroleum industry since then in Asia, Australia and the Middle East in various capacities but the majority of his time has been spent in the core analysis lab business. He is currently the Sales Manager for Core Laboratories in Indonesia.

In his talk, Robert emphasized that surface area measurements performed on reservoir core samples can provide important characterisation data. Surface area controls or partially controls permeability, irreducible water saturation and excess conductivity. At this time surface area is rarely measured during routine core analysis, which is perhaps unfortunate given the potential uses of the data.

Surface area is shown to correlate well with permeability and irreducible water saturation. Surface area data generated from cuttings may allow the geoscientist to obtain permeability/ irreducible water saturation data from uncored wells based on formation specific correlations. The relationship between surface area and cation exchange capacity allows surface area data to be used as a core based shaliness parameter, particularly when measured CEC data is available to calculate surface charge density. A limited data set also appears to show a useful and theoretically justifiable relationship between surface area and the clean sand (shale corrected) 'm' cementation exponent.



ANDREW MALONE

Malam Geologis Muda II

A review: Piezocone as a tool for stratigraphic logging in Malaysian Quaternary deposit

ABD. RASID JAAPAR

Drilling and grouting for dam construction — case studies

NIK ADLIN NIK YUSOFF

Laporan (Report)

The "Malam Geologis Muda II" followed the previous "Malam Geologis Muda" and was held on 16th June, 1999 in response to volunteers from young geologists who were keen to share their experiences with members of the Society. Although three speakers were scheduled for the evening, one unfortunately did not show up, perhaps due to last-minute commitment at work(?).

Anyway, the two speakers for the evening gave some interesting case studies on the use of the piezocone in identifying soil types and soil profiling in the soft soil deposits (by Mr. Abd. Rasid Jaapar of Soil Centralab S/B); and some experience on grouting works for damsites (by Mr. Nik Adlin Nik Yusoff of Carita S/B).

Both speakers, by the way, are ex-graduates of UKM, and again judging from the materials that they have presented, both have done well in their professional careers. Once again, SYABAS!

Tan Boon Kong
Chairman
Working Group on Engineering Geology & Hydrogeology

1999 AAPG Distinguished Lecture — 4-D analysis of extensional fault systems in rift basins

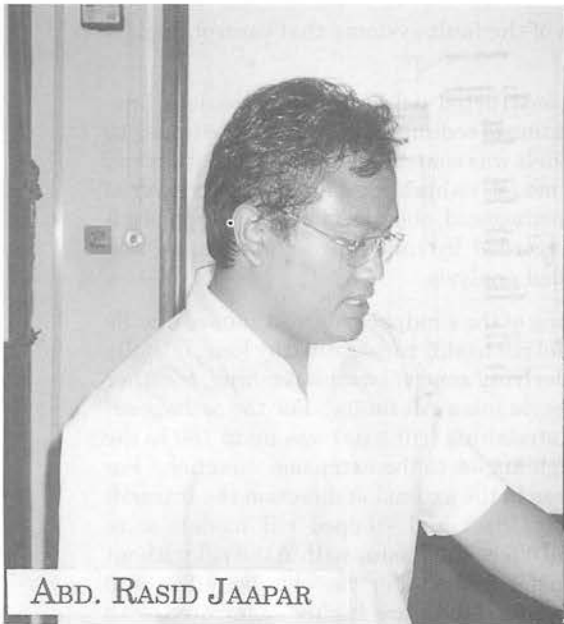
KEN MCCLAY

Laporan (Report)

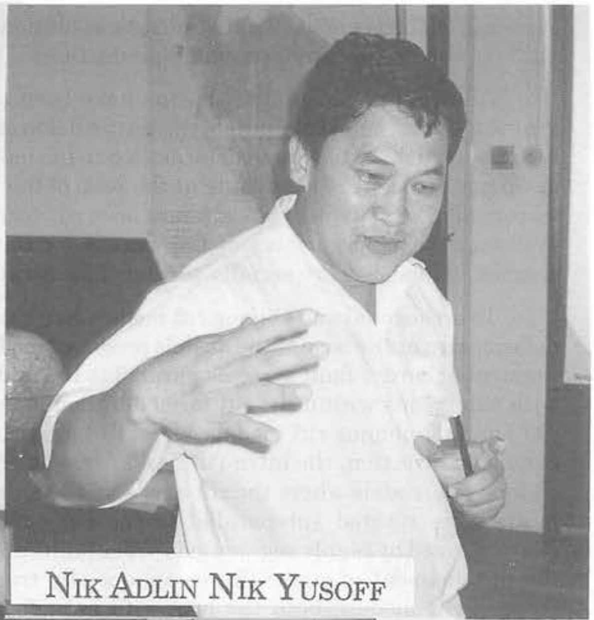
Ken McClay, Acro Professor of Structural Geology, Royal Holloway, University of London, U.K., gave the above lecture on 17th June 1999, at the Geology Department, University of Malaya.

Abstrak (Abstract)

The 4-D evolution of extensional fault systems in sedimentary basins, and in particular rift systems, has been investigated using scaled sandbox analogue models. Sandbox models have proved to be a powerful and graphic tool in developing an understanding of the 4-D geometric and kinematic evolution of extensional fault systems. The model results have been compared with natural examples of fault systems at both outcrop and seismic scales. Many rift basins and passive margins contain major hydrocarbon accumulations and an under-



ABD. RASID JAAPAR



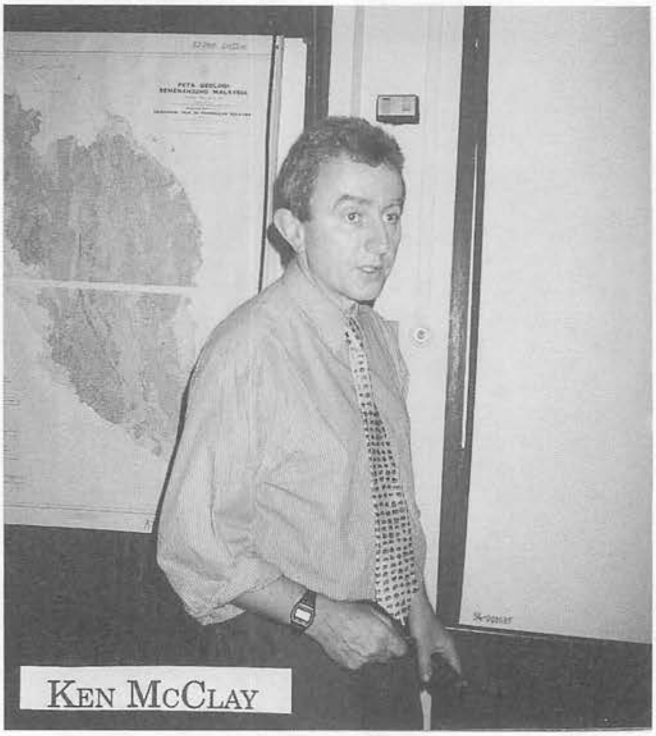
NIK ADLIN NIK YUSOFF

standing of the geometric and kinematic evolution of the fault systems that control them is vital for successful exploration and production.

Analogue models of rift basins have been constructed using dry, cohesionless fine-grained, quartz sand to simulate the brittle deformation of sedimentary rocks in the upper 10 km of the crust. Extensional deformation in the models was controlled by the orientation and geometry of a zone of stretching at the base of the model, either a rubber sheet or a layer of viscous silicone polymer. Models have been run for orthogonal, oblique, offset and stepped rift systems. The top surfaces of the models were recorded by time-lapse photography and completed models were serially sectioned for detailed analysis.

In orthogonal and oblique rift models stretching of the sandpack above a zone of ductile deformation at the base of the models produced model rift basins constrained by long, initially segmented border fault systems parallel to the underlying zone of basal stretching, together with sub-basins within the rift formed by domino-style intra-rift faults. For the orthogonal (90") and for oblique rift models where the zone of stretching (rift axis) was up to 150 to the extension direction, the intra-rift faults were at high angles to the extension direction. For oblique rift models where the rift axis was 450 or less to the extension direction the intrarift faults were rotated sub-parallel to the rift axis. Offset and stepped rift models were characterized by highly segmented border faults and offset sub-basins within the rift without the development of strike-slip or oblique-slip transfer faults. For the oblique, offset and stepped rift models, both the intra-rift and rift border faults are highly segmented with individual offsets of like-dipping, dominostyle, extensional faults forming characteristic relay ramp structures. Offset, oppositely dipping extensional faults from interlocking fault arrays-transfer zones. Along-strike displacement transfer within the rift between segmented and offset sub-basins is accommodated by "soft-linked" accommodation zones characterized by interlocking arrays of conjugate extensional fault systems. The results of these analogue model studies have permitted the construction of 4-D evolutionary extensional fault models that can be applied to natural fault systems in sedimentary basins.

The results of the analogue models are compared and contrasted with natural examples of extensional fault systems from the Gulf of Suez and Red Sea, Egypt, from the Gulf of Aden, Yemen, from the North Sea, Indonesia and Australia. These natural extensional fault systems show geometries, segmentation and offset structures that are extremely similar to those developed in the analogue models.



KEN McCLAY

Persidangan Tahunan Geologi 1999

29 & 30 Mei 1999, Desaru, Johor

Laporan

Persidangan Tahuan Geologi 1999, telah diadakan pada 29 dan 30 Mei 1999, di Golden Beach Desaru Hotel, Desaru, Kota Tinggi Johor. Ini adalah julung-julung kalinya persidangan ini diadakan di negeri Johor Darul Ta'zim. Penyertaan amat menggalakkan dan diluar jangkaan, walaupun lokasi persidangan beratus batu jauhnya dari Kuala Lumpur. Seramai 157 orang peserta telah mengambil bahagian.

Para peserta yang mengikuti Kerjalapangan Pra-Persidangan telah mula sampai ke hotel seawal petang Khamis 27 Mei 1999. Dan kerjalapangan Pra-Persidangan ke Tg. Balau dan Tg. Lompat telah diadakan pada Jumaat 28 Mei 1999. Kerjalapangan ini telah dihadiri oleh 17 orang peserta termasuk dua orang jurupandu iaitu Pengerusi Persidangan sendiri dan En. Mustaffa Kamal Shuib.

Para peserta mula berduyun-duyun tiba (kebanyakannya dari Kuala Lumpur) pada petang Jumaat 28 Mei 1999, serentak dengan kepulangan para peserta Kerlapangan Pra-Persidangan yang basah kuyup ditimpa hujan sewaktu di Tg. Lompat. Kemeriahan dan suasana ceria di lobi hotel mula dirasakan apabila para peserta dapat bertemu dengan rakan-rakan lama dan ahli-ahli keluarga pada petang itu. Pada sebelah malamnya, para peserta diraikan dengan majlis "barbeque" yang disumbangkan oleh Malaysia Mining Corporation (MMC). Kemeriahan suasana makan malam itu disaksikan sendiri oleh wakil MMC — En. Raj Kumar, yang hadir bersama dengan keluarganya. Selepas makan malam, para peserta kebanyakannya mengambil kesempatan berbual-bual dan bertukar-tukar fikiran di lobi hotel dengan rakan-rakan sejawat, terutamanya rakan-rakan yang telah lama tidak bertemu.

Majlis Perasmian telah disempurnakan dengan rasminya kira-kira jam 9.20 pagi 29 Mei oleh wakil kepada Y.A.B. Menteri Besar Johor, iaitu Y.B. Dr. Chua Soi Lek, Pengerusi Jawatankauasa Hal Ehwal Pengguna dan Alam Sekitar Negeri Johor. Seramai kira-kira 75 orang peserta termasuk tetamu-tetamu jemputan telah menghadiri upacara perasmian. Walaupun Y.A.B. Menteri Besar Johor, Dato' Abdul Ghani Othman tidak dapat hadir ke Majlis Perasmian ini, beliau telah bertmurah hati menaja Majlis Makan Malam Persidangan pada malam Sabtu 29 Mei 1999. Kepada beliau, Persatuan ingin merakamkan ucapan terima kasih yang tak terhingga.

Persidangan kali ini telah berjaya menghasilkan sebanyak 51 buah kertas kerja (termasuk 4 kertas ucaptama) dan 14 buah poster. Ini merupakan suatu rekod bagi Persidangan Tahunan Geologi anjuran Persatuan Geologi Malaysia, dan ini telah memaksa persidangan dilakukan dalam 2 sessi tunggal dan 4 sessi serentak di dalam dua dewan berasingan. Sessi pertama merupakan sessi khas anjuran Kumpulan Kerja Struktur dan Tektonik, yang bertemakan "Tektonik Jalur Timur Semenanjung Malaysia".

Dalam Persidangan kali ini juga menyaksikan pembentangan kertas kerja yang amat menggalakkan daripada ahli pelajar. Seramai 15 ahli pelajar telah menyumbangkan kertas kerja dan juga poster. Hampir kesemua topik bidang geologi telah dibentangkan, namun begitu topik yang paling popular ialah Geologi Kejuruteraan dan Geofizik Gunaan. Dr. Azman Abdul

Ghani dari Universiti Malaya, mencipta rekod sebagai "Juara Poster" kerana telah membentangkan sebanyak 7 buah poster dalam persidangan ini. Dr. Abdul Hadi Abd Rahman dan Prof. Madya Dr. Teh Guan Hoe pula berkongsi "Juara Kertas Kerja", kerana masing-masing telah membentangkan 3 buah kertas kerja. Sdr. Mustaffa Abdullah dari MARA Kuantan pula mencipta sejarah baru bagi Persidangan Tahunan Geologi, apabila bersusah payah membawa komputer peribadinya dari Pahang untuk persembahan "poster" dalam bentuk tayangan komputer secara langsung mengenai "Internet as a tool for geoscience education". Semuga banyak lagi idea-idea kreatif akan dibentangkan oleh ahli-ahli persatuan di masa-masa akan datang.

Aktiviti pasca Persidangan, iaitu memancing bersama Nelayan Tg. Balau, yang dijadualkan pada malam Ahad terpaksa dibatalkan kerana tiada sambutan. Ini disebabkan oleh hampir kesemua peserta ingin pulang ke tempat masing-masing kerana hari Isnin berikutnya merupakan hari berkerja dan anak-anak mula bersekolah. Hampir semua peserta telah meningggalkan Desaru pada petang Ahad itu juga.

Secara ringkasnya, Persidangan kali ini telah berjalan dengan lancar dan penuh berhasil. "Kegawatan ekonomi" dan tempat persidangan yang jauh dari ibu kota ternyata tidak menghalang ahli-ahli persatuan untuk terus aktif dan inovatif dalam menghasilkan kertas-kertas penyelidikan. Semuga semangat yang ditunjukkan di dalam Persidangan Tahunan Geologi 1999 ini terus membara sehingga ke persidangan-persidangan yang berikutnya.

Laporan Kerjalapangan Pra-Persidangan Tg. Balau dan Tg. Lompat 28 Mei 1999

Kerjalapangan Pra-Persidangan Tahunan Geologi 1999 telah diadakan di Tg. Balau dan Tg. Lompat, Desaru Kota Tinggi Johor pada 28 Mei 1999. Pengerusi Penganjur dan En. Mustaffa Kamal Shuib, Jabatan Geologi Universiti Malaya telah menjadi jurupandu untuk kejalapangan yang disertai oleh 17 orang perserta yang terdiri daripada ahli dan ahli pelajar Persatuan Geologi Malaysia.

Para perserta telah mula berhimpun di dataran Golden Beach Desaru Hotel Desaru sejak pukul 8.00 pagi, dan berangkat menuju ke Tg. Balau pada tepat jam 8.30 pagi. Oleh kerana ramai yang masih belum bersarapan, maka kami mengambil keputusan untuk bersarapan di Gerai Pak Anjang, di tepi pantai Tg. Balau. Kira-kira jam 9.15 pagi, suatu taklimat ringkas telah diberikan oleh jurupandu kerjalapangan dan buku panduan lapangan [Mustaffa Kamal Shuib dan Tajul Anuar Jamaluddin, 1999. *Multiple deformations of the Upper Palaeozoic Mersing Beds of the Desaru Area (Tg. Balau dan Tg. Lompat), Johor — a field guide book.* Pre-Conference Fieldtrip, 28th May, Ann. Geol. Conf. 1999, Desaru Johor, 36p.] turut diedarkan kepada semua peserta.

Kerjalapangan dimulakan kira-kira jam 9.30 pagi. Oleh kerana air laut masih pasang dan kebanyakan singkapan masih tenggelam, maka lokasi yang dituju hanya terhad kepada lokasi-lokasi yang berada di daratan. Sebanyak 14 lokasi telah dilawati di Tg. Balau, dan lawatan berakhir kira-kira jam 1.00 tengahari. Para peserta nyata bergitu tertarik dengan kepelbagaian struktur tektonik, seperti lipatan, ira kerdutan, lipatan terlipat semula, boudin, zon ricih, lipatan tersilang ira dan lain-lain serta enapan batuan pantai Kuarterneri yang menindih secara tak-selaras batuan tercangga Palaeozoik Atas tersebut. Banyak soalan telah dikemukakan kepada jurupandu, terutama berkenaan aspek memahami fasa canggaan dan proses pembentukan struktur pada batuan metasedimen tersebut. Ahli-ahli pelajar tidak melepaskan peluang untuk bertanyakan cara-cara menggunakan kompas dan cara mengambil bacaan struktur. Oleh kerana struktur-struktur yang begitu menarik lagi klasik, ada di antara perserta yang mencadangkan agar gambar-gambar struktur klasik ini dijadikan "Atlas struktur geologi Malaysia". Ada juga yang memberi komen agar buku panduan yang diberikan itu ditulis dengan bahasa yang lebih mudah agar ia boleh dimanafaatkan oleh masyarakat umum.

Sewaktu kerjalapangan di Tg. Balau, suatu kemalangan kecil telah berlaku di mana seorang ahli pelajar wanita telah terpijak paku sehingga menembusi kasutnya lalu mencederakan tapak kaki beliau. Ini menggambarkan betapa pantai kita masih terbiar dan dicemari dengan sampah-sarap dan benda-benda tajam. Sekali gus mengingatkan penganjur agar sentiasa membawa alat pertolongan cemas walaupun berkunjung ditempat yang disangka tiada bahaya. Selepas makan tengahari, di gerai yang sama di Tg. Balau, pelajar ini telah dibawa ke klinik di Bandar Penawar untuk mendapatkan rawatan.

Selepas makan tengahari, para peserta dibawa pula ke Tg. Lompat, kira-kira 5 km ke selatan Tg. Balau. Sesampainya kami di Tg. Lompat pada kira-kira jam 2.30 p.m., hujan turun dengan lebatnya. Setelah menunggu kira-kira jam 2.40 petang di bawah pokok, namun tiada tanda-tanda yang hujan akan reda. Oleh itu, kami meneruskan lawatan ke 4 lokasi terpilih sahaja walaupun dalam keadaan basah kuyup. Semangat ingin tahu yang ditunjukkan oleh para peserta kerjalapangan begitu tinggi sekali dan wajar diucapkan tahniah dan syabas.

Oleh kerana hujan terus turun dengan lebatnya, maka kami mengakhiri kerjalapangan Pra-Persidangan ini pada kira-kira jam 3.40 p.m. Jauh lebih awal dari yang dijangkakan. Para-peserta diangkut dengan kenderaan balik ke hotel dalam basah kuyup dan kedinginan.

Kesimpulannya, kerjalapangan Pra-Persidangan ini telah berjalan dengan jayanya walaupun terdapat suatu kemalangan kecil dan hujan lebat disebelah petangnya di Tg. Lompat. Para peserta mengakui tentang keunikan struktur-struktur canggaan berganda yang tersingkap dengan baik dan jelas di Tg. Balau dan Tg. Lompat. Rata-rata para peserta bersetuju dengan peganjur kerjalapangan agar kawasan dipulihara dan diwartakan sebagai "Taman Warisan Geologi" untuk dimanfaatkan oleh semua warga geologis dan masyarakat umum.

Tajul Anuar Jamaluddin
Pengerusi Penganjur

Persidangan Tahunan Geologi 1999

29 & 30 Mei 1999, Desaru, Johor

Ucapan Pengerusi Penganjur

Yang dimuliakan
Tuan Pengerusi Majlis
Prof. Madya Dr. Syed Sheikh AlMashoor

Y.B. Dr. Chua Soi Lek
Pengerusi JK Alam Sekitar & Hal Ehwal Pengguna Negeri Johor
(Wakil Y.A.B. Menteri Besar Johor)

Yang Berbahagia Prof. Dr. Ibrahim Komoo
Presiden Persatuan Geologi Malaysia

Yang Berbahagia En. Zubir Yahya
Pengurus Besar Kejora

Yang Berbahagia En. Chen Shick Pei
Ketua Pengarah Jabatan Penyiasatan Kajibumi Malaysia

Dato'- Dato'
Tuan-Tuan dan Puan-Puan Sekelian

Assalamualaikum warahmatullah hiwabarokatuh; & Salam Sejahtera

Bersyukur kita kehadrat Ilahi, kerana di pagi yang indah ini kita dapat sama-sama berhimpun untuk menghadiri Majlis Perasmian Persidangan Tahunan Geologi 1999, di Golden Beach Desaru Hotel, Desaru ini. Setinggi-tinggi penghargaan dan terima kasih saya ucapkan khusus kepada Y.B. Dr. Chua Soi Lek, Wakil YAB Menteri Besar Johor, kerana sudi datang seawal pagi di hari cuti umum (Wesak) begini untuk menyempurnakan Majlis Perasmian Persidangan.

Telah menjadi semacam suatu tradisi bagi Persatuan Geologi Malaysia untuk mengadakan Persidangan Tahunan Geologi pada hampir setiap tahun sejak ianya ditubuhkan pada tahun 1967, kecuali jika pada tahun itu Persatuan Geologi Malaysia (PGM) menganjurkan persidangan yang lebih besar seperti GEOSEA, umpamanya GEOSEA 1988.

Objektif utama Persidangan ini adalah sebagai suatu "forum" bagi para geologis tempatan dan luar negara untuk membentangkan dan membincangkan hasil-hasil penyelidikan atau penemuan- terbaharu mereka, dengan harapan akan dapat mempertingkatkan dan mengemaskini pengetahuan tentang geologi Malaysia dan rantau Asia Tenggara secara amnya. Diharapkan Persidangan kali ini akan dapat mencapai objektif yang dimaksudkan ini.

Seperti pada tahun-tahun sebelumnya, Persidangan pada tahun ini diharapkan dapat mengumpulkan sekurang-kurangnya 30 buah kertas kerja. Tetapi saya merasa amat gembira apabila mendapati sambutan diluar dugaan. Sebanyak 51 buah kertas kerja lisan dan 15 buah poster telah berjaya dikumpul untuk Persidangan Tahun ini. Setahu saya, sejak saya mula menyertai Persidangan Tahunan Geologi pada 1987 diUKM; jumlah ini merupakan suatu rekod baru bagi Persidangan Tahuan Geologi Persatuan. Nampaknya, walaupun dalam keadaan kegawatan ekonomi dan lokasi Persidangan yang beratus batu jauhnya dari KL, tuan-tuan/ puan-puan masih begitu produktif dan bersemangat untuk menjayakan Persidangan kali ini. Syabas dan tahniah saya ucapkan.

Saya pernah ditanya oleh teman-teman geologis, tak ketinggalan juga Pengurus Hotel ini En. Haziz Hassan: "*Mengapa Persidangan Geologi ini dibuat di Desaru*? Mungkin tuan-tuan yang berada di dalam Dewan ini juga tertanya-tanya soalan yang serupa. Saya dan PGM mempunyai beberapa sebab; Pertamanya: kerana memang PGM belum pernah mengadakan Persidangan Tahunannya di Johor. Negeri Johor ini pun tidak kurang juga penting dan menarik dari segi geologinya. Kedua; kerana berhampiran Desaru ini terdapat beberapa buah Tanjung yang mempunyai singkapan batuan yang begitu menarik lagi klasik strukturnya. Sebab itu jugalah, sudah 4 tahun berturut-turut saya membawa Pelajar-pelajar Jabatan Geologi UM ke sini untuk melakukan kerjalapangan geologi struktur.

Batuan yang terdapat di Tanjung Balau, Tg. Lompat dan Tg. Siang memang unik dan menarik. Ia merupakan suatau khazanah semulajadi yang amat berharga dan bernilai saintifik tinggi. Amat sesuai dijadikan "makmal lapangan" yang unggul untuk pengajaran dan pembelajaran geologi. Malah jika diusahakan, ia boleh dijadikan suatu tarikan pelancong dan monumen kebanggaan negara. Jika di UK, misalnya, mereka boleh berbangga dengan "Classical Geology Sites" seperti "Rhosconlyn Anticline" di Holyhead Island Anglesey, Wales; atau "Moine Thrust Zone" di Southern Upland Scotland, maka kita juga boleh berbangga dengan "Struktur Canggaan Berganda" di Tg. Balau. Menjadi harapan saya agar peserta yang hadir ke persidangan ini mengambil peluang untuk mengenali dan menghargai khazanah semulajadi bumi Malaysia yang tersingkap tak berapa jauh dari tempat persidangan kita ini.

Melalui kesempatan ini, saya ingin merakamkan ucapan ribuan terima kasih kepada Ahli Jawatan Kuasa Persidangan, terutamanya Prof Madya Dr. Teh Guan Hoe dan ahli-ahli jawatankauasa teknikalnya yang berkerja keras demi menjayakan Pesidangan ini. Terima kasih yang tak terhingga juga kepada Pn. Anna Lee, yang membuatkan suasana kerja sentiasa meriah dan memastikan persediaan Persidangan berjalan lancar. Kepada Prof Ibrahim Komoo Presiden Persatuan, yang juga merupakan bekas "pesyarah/penyelia" saya semasa menuntut di UKM, dan kesemua ahli Majlis Persatuan; yang memberikan kepercayaan penuh kepada saya untuk menganjurkan sebuah persidangan yang amat besar lagi bermakna ini — terima kasih setingi-tingginya di atas segala nasihat dan buah fikiran.

Dari segi bantuan kewangan pula, saya mesti merakamkan setingi-tinggi penghargaan kepada Pejabat Menteri Besar Johor dan Pernas Chrrter Management yang bermurah hati menaja majlis barbeque dan makan malam. Semasa berlangsungnya persidangan ini, kami juga amat mengalu-alukan sekiranya masih ada yang sudi menghulurkan sumbangan dan derma, kerana Persatuan kami ini bukan lah sebuah organisasi komersial. Aktivitinya banyak bergantung kepada sumbangan derma, selain kutipan yuran keahlian.

Semuga bersama kita menjayakan Persidangan dua hari ini dengan penuh ceria dan bermakna. Sekian, terima kasih.

Dr. Tajul Anuar Jamaluddin
Pengerusi Penganjur
Persidangan Tahunan Geologi 1999

Persidangan Tahunan Geologi 1999

29 & 30 Mei 1999, Desaru, Johor

Ucapan Y.A.B. Menteri Besar Johor di Majlis Perasmian Persidangan Tahunan Geologi 1999

Yang Mulia Tuan Pengerusi Majlis,

Yang Berbahagia Prof. Dr. Ibrahim Komoo, Presiden Persatuan Geologi Malaysia,

Yang Berbahagia, Dr. Tajul Anuar Jamaluddin, Pengerusi Jlkuasa Penganjur Persidangan,

Yang Berbahagia, En. Zubir Yahya, Pengurus Besar Kejora ,

Ahli-Ahli Yang Berhormat,

Tuan-tuan dan puan-puan serta hadirin yang dihormati sekelian.

Saya dimaklumkan bahawa Persatuan Geologi Malaysia pada tahun ini meneruskan tradisinya membawa Persidangan Tahunannya ke negeri-negeri di seluruh Malaysia, dan inilah pertama kalinya Persidangan ini diadakan di Johor. Selamat datang ke negeri Johor Darul Takzim kepada para peserta Persidangan; yang saya dimaklumkan, terdiri daripada geosaintis dari Universiti-Universiti Tempatan, Jabatan-Jabatan Kerajaan, Badan-Badan Berkanun dan Sektor Swasta di Malaysia.

Saya percaya suasana alam sekitar yang indah, nyaman dan tenteram di Desaru ini akan membantu tuan-tuan dan puan-puan melahirkan idea-idea bernas bukan sahaja untuk meningkatkan mutu akademik dan profession geosains, malah seterusnya memberi sumbangan yang bermakna dalam bidang masing-masing ke arah pembangunan dan kemakmuran negara.

Saya juga difahamkan, negeri Johor ini tidak kurang penting dari segi geologi dan sumber buminya. Walaupun negeri Johor tidak semewah negeri Perak dan Selangor dari segi penghasilan bijih timahnya, atau negeri Terengganu dengan emas dan petroleumnya, begitu juga Pahang dengan bijih timah, emas dan sebagainya. Namun tidak dapat dinafikan, pembangunan dan ekonomi negeri Johor turut mendapat manafaat yang besar dari sumber-sumber bahan bumi seperti **mineral-mineral lempung bebola (ball clay), kaolin, pasir silika, bijih besi** dan **bauksit**, serta tidak kurang juga **air** yang dibekalkan kepada negara jiran Singapura. Kewujudan batuan-batuan yang bermutu tinggi seperti **granit**, juga turut menyumbang kepada ekonomi negeri melalui industri pengkuarian dan pembekalan agregrat bahan binaan. Negeri Johor mempunyai banyak sumber batuan **granit** dan **gabbro** yang juga sesuai dijadikan batu dimensi. Bagaimanapun ini memerlukan kajian susulan yang terperinci. Saya percaya, bahan-bahan bumi yang diusahakan di negeri Johor ini adalah hasil penerokaan dan kajian tuan-tuan yang berada di dewan ini. Dan saya berharap, tuan-tuan dan puan-puan akan terus mempergiatkan usaha mengkaji dan menerokai sumber bumi di Johor ini khususnya, dan sekaligus membantu kami mewujudkan suasana pembangunan yang mampan tanpa menjejaskan kualiti alam sekitar.

Tuan-tuan dan Puan-puan;

Suatu ketika dahulu warga geosaintis lazimnya dikaitkan dengan aktiviti-aktiviti penerokaan dan perlombongan sumber bahan bumi seperti bijih, emas dan petroleum. Kemudian, sejajar dengan pembangunan pesat infrastruktur negara, para geologis turut memainkan peranan penting dalam kerja-kerja kejuruteraan, berganding bahu dengan jurutera, untuk membina rangkaian lebuhraya-lebuhraya, bangunan-bangunan pencakar langit, empangan-empangan hidroelektrik, lapangan terbang, sehinggalah kepada pembukaan kawasan-kawasan perumahan di lereng-lereng bukit.

Pembangunan yang sebegini memang diperlukan dan memberikan sumbangan yang besar kepada negara dalam mengorak langkah mencapai Wawasan 2020. Tetapi ia juga ada meninggalkan beberapa "**impak negatif**". Di antaranya ialah "**kemerosotan kualiti alam sekitar**" dan meningkatnya kejadian-kejadian bencana "**cetusan-manusia**" (**man-induced hazard**). Contohnya, masalah banjir lumpur, banjir kilat, kejadian tanah runtuh dan sebagainya. Baru-baru ini kita dikejutkan oleh kejadian tanah runtuh di Bukit Antarabangsa Hulu Kelang Selangor, walaupun tragedi Highland Tower 6 tahun lepas, di kawasan yang sama, masih segar dalam ingatan. Kesemua kesan atau impak negatif ini tentunya mempunyai kaitan langsung dengan sekitaran fizikal, khususnya proses-proses alam yang bertindak di permukaan bumi.

Saya yakin, tentu banyak sumbangan yang boleh dijalankan oleh pakar-pakar geologi untuk meminimumkan impak negatif ini, agar pembangunan dan kemajuan negara dapat terus berjalan dengan sempurna. Tuan-tuan sebagai pakar tentang kejadian bumi dan proses-proses yang berlaku di permukaannya, tentu dapat memainkan peranan yang lebih aktif dalam menasihati kerajaan dan pihak swasta tentang cara-cara dan kaedah-kaedah yang paling sesuai membangunkan negara tanpa menjejas kualiti alam sekitar dan keselamatan nyawa serta harta benda.

Dengan meningkatnya kesedaran tentang penjagaan kualiti alam sekitar dan penggunaan sumber yang optimum, saya yakin skop peranan tuan-tuan kini menjadi lebih luas dan penting. Input daripada tuan-tuan sangat diperlukan dalam membantu menangani masalah-masalah seperti yang disebutkan tadi. Oleh itu saya ingin menyeru agar ahli geologi tempatan perlu lebih sensitif terhadap "keperluan-keperluan" dan teknologi baru untuk memastikan sokongan yang berterusan kepadam pengembangan aktiviti industri dan pembangunan negara.

Saya difahamkan juga, ahli-ahli geologi profesional tempatan telahpun menubuhkan **Institut Geologi Malaysia** dan telah mencadangkan kepada kerajaan untuk mewujudkan "**Akta Ahli Geologi**" sebagaimana yang diamalkan oleh pertubuhan-pertubuhan geosains di negara-negara maju. Saya berharap usaha tuan-tuan ini segera terlaksana. Ini kerana sebagai sebuah badan professional, amat penting bagi ahli-ahlinya menjaga reputasi profesionalisma masing-masing, supaya hanya geologis yang benar-benar berkelayakan melibatkan diri dalam manangani masalah dan kerja-kerja yang membabitkan sekitaran fizikal bumi dan kandungannya.

Tuan-tuan dan Puan-puan;

Dalam keghairahan membangunkan negara, seharusnya kita tidak lupa akan kepentingan menjaga dan memelihara unsur-unsur geologi semulajadi yang penting dan menarik kerana ini adalah sebahagian daripada khazanah antikuiti negara. Saya dimaklumkan bahawa kini terdapat di kalangan tuan-tuan, melalui satu lagi sub-bidang geologi yang baru berkembang di Malaysia, ia itu "**Geopelancungan**" atau "**Geotourism**"; untuk mengenalpasti kawasan-kawasan bermaklumat saintifik tinggi dan menarik agar dipelihara sebagai "Taman Warisan Geologi" untuk dijadikan tarikan pelancong dan "**monumen semulajadi**" kebanggaan negara.

Saya merasa gembira kerana diberitahu bahawa salah sebuah lokasi yang dimaksudkan itu berada tidak jauh dari tempat Persidangan ini, iaitu di Tanjung Balau dan Tanjung Lompat.

Saya dimaklumkan, di sana terdapat banyak struktur batuan yang menarik dan bernilai saintifik tinggi yang amat wajar dipelihara agar boleh dijadikan tarikan pelancong dan dimanafaatkan oleh kita dan generasi akan datang. Persatuan Geologi Malaysia kini sedang menjalinkan kerjasama erat dengan KEJORA untuk mewujudkan "**Taman Warisan Geologi Tg. Balau**". Saya amat mengalukan-alukan usaha ini. Harapan saya, negeri Johor khususnya di Johor Tenggara ini nanti, bukan sahaja dikenali atau dikunjungi kerana keindahan pantainya tetapi juga dikenali dan dikunjungi kerana "Warisan Geologi" nya yang istimewa. Saya berharap usaha ini akan menjadi kenyataan tidak lama lagi.

Akhir kata, sekali lagi saya mengucapkan berbanyak terima kasih di atas jemputan dan penghormatan yang diberikan kepada saya untuk bersama-sama tuan-tuan dan puan-puan pada pagi ini.

Saya dengan ini mengisytiharkan **Persidangan Tahunan Geologi 1999**, dibuka dengan rasminya.

Terima kasih dan Selamat Bersidang.

Persidangan Tahunan Geologi 1999

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Persidangan Tahunan Geologi 1999

Persidangan Tahunan Geologi 1999

29 & 30 Mei 1999, Desaru, Johor

Programme

FRIDAY 28 May 1999

0830–1200 : **Pre-Conference Fieldtrip to Tg. Balau**

1200–1445 : ***Lunch Break/Friday Prayer at Bandar Penawar***

1500–1730 : **Pre-Conference Fieldtrip to Tg. Lompat**

2000–2300 : ***Ice-breaker Dinner. Host: Malaysia Mining Corporation Bhd.***

SATURDAY 29 May 1999

0800–0830 : Late Registration

Opening Ceremony

0830–0845 : **Welcoming Address by Dr. Tajul Anuar Jamaluddin, Organising Chairman of GSM Annual Geological Conference '99**

0845–0900 : **Address by Prof. Ibrahim Komoo, President, Geological Society of Malaysia**

0900–0930 : **Opening Address by YAB Dato' Abdul Ghani Othman, Menteri Besar Johor Darul Takzim, read by Dr. Chua Soi Lek, State Environment & Consumer Affairs Committee Chairman**

0930–1000 : ***Tea Break***

1000–1030 : **Keynote I — Ibrahim Komoo** *(UKM – Lestari)*
Geologi Pemuliharaan: peranan ahli geosains tempatan

Technical Session I
(Special Session on The Eastern Belt Tectonics)

1030–1050 : **Mohd Shafeea Leman, Kamal Roslan Mohamed, Ibrahim Abdullah, Che Aziz Ali, Uyop Said & Ahmad Jantan** *(UKM)*
The age of Bukit Keluang Formation and its significance towards tectonic development of the Eastern Belt of Peninsular Malaysia

1050–1110 : **Mustaffa Kamal Shuib & Abdul Hadi Abd Rahman** *(UM)*
The tectonic evolution of Peninsular Malaysia based on a five-fold stratigraphic and tectonic subdivision

1110–1130 : **Lee Chai Peng** *(UM)*
Volcaniclastic conglomerates of central Pahang

1130–1150 : **Mustaffa Kamal Shuib, Tajul Anuar Jamaluddin, Zuraimi Ahmad & Jamin Jamil** *(UM)*
Structural history of the Upper Palaeozoic Mersing Beds of the Kuala Sedili area, Johor: evidences for dextral transpression

1150–1210 : **Tajul Anuar Jamaluddin & Mustaffa Kamal Shuib** *(UM)*
Multiple phase deformational structures in the Tg. Balau, Tg. Lompat and Tg. Siang areas, Desaru, Johor, Peninsular Malaysia

1210–1230 : **Felix Tongkul** *(UMS)*
Intrinsic geological resources for ecotourism development: a case study of an ancient oceanic crust in Tandek, Sabah

1230–1400 : ***Lunch Break***

1400–1430 : **Keynote II — Chen Shick Pei** *(Geological Survey)*
Challenges in implementing the minerals and geoscience programmes in the new millennium

Technical Session II — Parallel Session
(Palaeontology/Sedimentology)

1430–1450 : **Basir Jasin** *(UKM)*
Geological significance of radiolarian chert in Sabah

1450–1510 : **Abdul Hadi Abd. Rahman & Azlina Habibullah** *(UM)*
Facies, textural characteristics and depositional model for the Tertiary boulder beds of Batu Arang, Selangor

1510–1530 : **Azmi Mohd. Yakzan** *(PETRONAS)*
Palynomorphs from an intermontane basin, Thailand: a significant finding on *Florshuetzia* tp. pollen

1530–1550 : **Ibrahim Amnan** *(Geol. Surv. Mal)* **& Henri Fontaine** *(France)*
Carboniferous of Malaysia: a synthesis

1550–1610 : **Mohd Shafeea Leman** *(UKM)* & **Masatoshi Sone** *(Deakin University)*
Permian brachiopod from Bera Formation (West Malaysia) and their paleobiogeographic significance

1610–1630 : ***Tea Break/Poster Session***

1630–1650 : **Abdul Hadi Abd. Rahman** *(UM)*
Ancient floodplain deposits from the Jura-Cretaceous alluvial complex near Bandar Muadzam Shah, Pahang: facies characteristics and climatic significance

1650–1710 : **Uyop Said & Shahfuddin Mustaffa** *(UKM)*
A palynomorph assemblage from Bukit Mambai, Labis, Johor

1710–1730 : **Lee Beng Huat, Umar Hamzah, Ahmad Jantan, Ibrahim Abdullah & Che Aziz Ali** *(UKM)*
Seismic mapping of Pahang Quaternary sediments, Pekan, Pahang

2000 : ***Conference Dinner. Host: Menteri Besar Johor Darul Takzim***

Technical Session III — Parallel Session
(Geochemistry/Economic Geology/Mineralogy/Petrology)

1430–1450 : **Teh, G.H. & Anisalimahwati Sulaiman** *(UM)*
Geochemistry and characterisation of alluvial gold from Jeli and Sokor areas, Kelantan

1450–1510 : **Azman Abdul Ghani** *(UM)*
Contrasting chemical characteristics of granite and syenite from Perhentian Islands, Peninsular Malaysia

1510–1530 : **Tai Tang Oh & Tan Boon Kong** *(UKM)*
Perbandingan sifat fiziko-kimia tanah syis grafit dan tanah syis kuarza -mika kawasan sekitar Kota Melaka, Melaka

1530–1550 : **Tan Boon Kong** *(UKM)*
Physico-chemical properties of soils from South Johor

1550–1610 : **Zamila Abd. Rahman & Tan Boon Kong** *(UKM)*
Sifat fiziko-kimia alluvium tua sepanjang Lebuhraya Johor Baru-Pasir Gudang, Johor

1610–1630 : ***Tea Break/Poster Session***

1630–1650 : **G.H. Teh** *(UM)*
Geological and related applications on the EPMA (Electronprobe Microanalyzer)

1650–1710 : **Wan Fuad Wan Hassan & Syafrina Md Daud** *(UKM)*
Rare-earth and trace element patterns of Langkawi granites

1710–1730 : **Alphonsus Sim Cheng Yang & Tan Boon Kong** *(UKM)*
Perbandingan sifat fiziko-kimia tanah granit dan tanah gabbro sepanjang Lebuhraya Linkedua, Johor

SUNDAY 30 May 1999

0830–0900 : **Keynote III — John Kuna Raj** *(UM)*
Stability of slope cuts in metamorphic bedrock areas of Peninsular Malaysia

TECHNICAL SESSION IV — PARALLEL SESSION
(Engineering Geology/Geophysics/Environmental Geology)

0900–0920 : **Abdul Rahim Samsudin, Tan Chu Ai, Bashilah Baharudin & Mohd Tadza Abdul Rahman** *(UKM)*
The use of geoelectrical imaging to study groundwater pollution at Gemencheh waste disposal site, Negeri Sembilan

0920–0940 : **Goh Swee Heng** *(UKM)*
Geochemical exploration for stream sediments and water quality determination in Sungai Pahang basin, Pahang Darul Makmur

0940–1000 : **Vun, B.O. & Yeap, E.B.** *(UM)*
Engineering geology of Cyberjaya, Selangor Darul Ehsan

1000–1020 : ***Tea Break/Poster Session***

1020–1040 : **Mohd Tadza Abdul Rahman, Daud Mohamad, Abdul Rahim Samsudin & Tan Teong Hing** *(MINT)*
Sebaran bahan pencemaran dalam sistem air tanah di tapak sisa domestik Gemenceh, Negeri Sembilan, Malaysia

1040–1100 : **Jasmi Abd. Talib & Azlikamil Napiah** *(MACRES)*
Landslide hazard zonation mapping using remote sensing and GIS techniques

1100–1120 : **Tajul Anuar Jamaluddin & Mustaffa Kamal Shuib** *(UM)*
Geological assessment of the cut slope failures in highly weathered igneous rocks at the Senai Toll Plaza of the Malaysia-Singapore Second Crossing Expressway, Johor, Malaysia

1120–1140 : **Cheong, K.W & Yeap, E.B.** *(UM)*
The geology, petrography and index properties of limestone and granite aggregates for the construction industry in Central Selangor-Federal Territory

1140–1200 : **Qalam Azad Rosle & G.H. Teh** *(UM)*
Primary geological features in relation to cut slope instability — a case study from Pengkalan Hulu (Keroh), Hulu Perak

1200–1220 : **Mohd. For Mohd. Amin and Azman Kassim** *(UTM)*
Description and classification of filled joint in granite — an approach

1220–1240 : **Tan Siang Fei & Tajul Anuar Jamaluddin** *(UM)*
Geologi kejuruteraan kawasan Taman Bukit Utama, Ulu Kelang-Ampang

1240–1300 : **Khairul Anuar Mohd Nayan, Abdul Rahim Samsudin, Abdul Ghani Rafek, Umar Hamzah, Megat Iskanar Megat Ismail & Mohd Zamzuri Zain** *(UKM)*
An integration of geophysical and geotechnical methods in the assessment of slope stability at Kamsis G, UKM

1300–1400 : ***Lunch Break***

Technical Session V — Parallel Session

(Structural Geology/Stratigraphy/Remote-Sensing/Geophysics)

0900–0920 : **Zaiton Harun** *(UKM)*
Faults in the Lower Detrital Member at Teluk China Mati, Pulau Tanjung Dendang

0920–0940 : **Juhari Mat Akhir & Yong Hoy Leong** *(UKM)*
Geomorphological mapping: a case study in southern parts of Langkawi Islands

0940–1000 : **Ibrahim Abdullah, Che Aziz Ali & Kamal Roslan Mohamed** *(UKM)*
Tafsiran struktur Pulau Langgun, Langkawi

1000–1020 : ***Tea Break/Poster Session***

1020–1040 : **Abdul Hadi Abd. Rahman & Mustaffa Kamal Shuib** *(UM)*
Facies architecture, stratigraphic evolution and tectonic history of the Miocene alluvial fan of Batu Arang

1040–1100 : **Abd. Nassir** *(UKM)*
Application of P & SH waves for rock anisotropy studies: Genting Highlands case study

1100–1120 : **Juhari Mat Akhir & Wong Siew Fung** *(UKM)*
Digital processing of LANDSAT TM data for geological applications: an example from the Langkawi Islands

1120–1140 : **Ros Fatihah Muhammad & Yeap E.B.** *(UM)*
The origin and characteristics of notches in the limestone hills in Peninsular Malaysia

1140–1200 : **Abdul Ghani Rafek, Rahman Yaccup, Abdul Rahim Samsudin, Khairul Anuar Mohd. Nayan & Umar Hamzah** *(UKM)*
Rakaman seismos dalam lubang gerudi bagi penyiasatan tanah runtuh: kajian kes tapak stesen pemancar gelombang mikro, Jalan Temerloh-Mentakab, Pahang

1200–1220 : **Mohammed Ismael Abu Shariah, Abdul Rahim Samsudin, Umar Hamzah & Abdul Ghani Rafek** *(UKM)*
High-resolution seismic reflection and geoelectrical resistivity imaging at school teachers' quarters, Pengkalan, Pegoh, Ipoh, Malaysia

1220–1240 : **Che Noorliza Lat** *(UM)*
Relating earthquake clustering to faults and lineaments

1240–1300 : ***Poster Session***

1300–1400 : ***Lunch Break***

SUNDAY 30th May 1999

1400–1430 : **Keynote IV — Khoo, T.T.** *(UM)*
Coastal geomorphology of the Strait of Malacca during the past millennium

Technical Session VI

(Geotourism/hydrogeology)

1430–1450 : **Joy J. Pereira & Ibrahim Komoo** *(UKM)*
Geoindicators for sustainable urban management

1450–1510 : **Majeed M. Faisal & Edward Voo Lok Zan** *(UMS)*
Evaluation of groundwater Tuaran, Sabah, Malaysia

1510–1530 : **Presentation of tokens to Posters Presenters**

1530–1550 : ***Closing Ceremony***

1550–1610 : ***Tea***

Posters

1. **Abdul Hadi Abd. Rahman** *(UM)*
Ciri-ciri dan asal-usul permukaan ketakselarasan di dalam lapisan boulder (Miosen) Batu Arang, Selangor

2. **Ahmad Shamsul Kamal Zakaria & Azman Abd. Ghani** *(UM)*
Geologi am dan kajian tekstur batuan di kompleks igneus, Pulau Susu Dara, Besut: Implikasi terhadap perletakan magma

3. **Amer Mohamed Ibrahim, Wan Hasiah Abdullah & Azhar Hj. Hussin** *(UM)*
Organic geochemistry of selected Upper Palaeozoic Kuantan Group sediments of East Pahang, Eastern Belt, Peninsular Malaysia

4. **Azlan Mohamad, A. Tajuddin Ibrahim & Azman Abd. Ghani** *(UM)*
Beberapa aspek kaitan lapangan dan petrografi batuan granitik Bukit Labohan, Kerteh, Terengganu

5. **Azman Abd. Ghani** *(UM)*
Chemical characteristics of some of the granitic bodies from the Terengganu area

6. **Azman Abd. Ghani** *(UM)*
Chemistry of muscovite from the Kuala Lumpur granites, Peninsular Malaysia

7. **Azman Abd. Ghani** *(UM)*
Mantle feldspar from the Noring granite, North Peninsular Malaysia: petrography & chemistry

8. **Azman Abd. Ghani** *(UM)*
Systematic classification of the granitic rocks from the western province, Peninsular Malaysia

9. **Che Aziz Ali & Ahmad Jantan** *(UKM)*
Sedimentation in the tropical, mesotidal, wave dominated Pahang River delta complex

10. **Kamal Roslan Mohamed & Watin Malun** *(UKM)*
Pemetaan sedimen dasar Sungai Pahang, Pekan–Tanjung Agas, Pahang

11. **Mursyidah A. Hamid & Azman A. Ghani** *(UM)*
Kajian terperinci tekstur batuan granit di kawasan Damansara-Sri Hartamas, Kuala Lumpur

12. **Mustafa Abdullah** *(MARA)*
The internet: a valuable tool for geoscience education and promotion

13. **Samsuddin Hj Taib** *(UM)*
Magnetic signature over part of Pahang and Johor

14. **Tajul Anuar Jamaluddin, Mustaffa Kamal Shuib & Abdul Hadi Abd. Rahman** *(UM)*
The occurrence of Tertiary boulder beds between km 22.6 and km 24.5 of the Malaysia-Singapore Second Crossing Expressway, Kangkar Pulai, Johor, Malaysia

Persidangan Tahunan Geologi 1999

29 & 30 Mei 1999, Desaru, Johor

Abstracts of Papers

Keynote Paper I

Geologi Pemuliharaan: peranan ahli geosains tempatan

IBRAHIM KOMOO
Institut Alam Sekitar & Pembangunan (LESTARI)
Universiti Kebangsaan Malaysia

Apa itu Geologi Pemuliharaan?

Pemuliharaan sumber geologi merupakan aktiviti pemuliharaan yang telah lama dilakukan di peringkat antarabangsa. Gagasan aktiviti ini terdorong dari sifat **reaktif** keperluan memulihara sumber geologi unggul, khususnya sumber landskap luarbiasa. Biasanya, tapak telah dikenali oleh masyarakat umum dan telah menjadi kawasan rekreasi sekian lamanya. Di Amerika Syarikat, sumber geologi unggul dipulihara melalui mekanisme pengurusan *National Park System.* Sejumlah Taman Negara dan Monumen Geologi diisytiharkan sebagai kawasan pemuliharaan di bawah rangkaian Taman dan Monumen Kebangsaan. Di United Kingdom, pendekatan pemuliharaan sumber geologi dilakukan melalui pertubuhan kebangsaan *Nature Conservancy.* Sumber geologi unggul diisytihar sebagai *Geological and Geomorphological Sites of Special Scientific Interest* (SSSI) dan *Regionally Important Geological Sites* (RIGS). Di peringkat antarabangsa, United Nations melalui UNESCO telah memperkenalkan konsep *World Heritage Sites* (WHS) dan mengsyor setiap negara memohon tapak bernilai warisan tabii (biologi dan geologi) terunggul disenaraikan dalam WHS ini.

Geologi Pemuliharaan merupakan pembangunan gagasan baru dalam geologi gunaan yang terdorong dari sifat **proaktif** membangun sumber geologi (geotapak) untuk keperluan pemuliharaan. Geologi Pemuliharaan, seperti sub-bidang geologi gunaan lain (Geologi Ekonomi, Geologi Petroleum atau Geologi Kejuruteraan), menjalankan penyelidikan secara bersistem untuk membangunkan sejumlah sumber geologi unggul untuk keperluan pemuliharaan. Sumber geologi bernilai saintifik, rekreasi atau estetik unggul di peringkat tempatan, negeri atau negara diperkenalkan sebagai Sumber Warisan Geologi (SWG).

Hambatan Geologi Pemuliharaan

Gagasan Geologi Pemuliharaan sukar digerakkan kerana menghadapi dua hambatan utama. Pertama, masyarakat awam mempunyai kesedaran yang amat rendah mengenai sumber geologi unggul dan keperluan pemuliharaannya. Sejumlah sumber geologi mengandungi nilai **intrinsik tinggi**. Ia menyimpan rekod sejarah Bumi iaitu asalmula dan peristiwa penting mengenai proses pembentukan planet Bumi dan evolusi hidupan yang menghuninya. Sumber geologi unggul merupakan **tapak** atau **artifak** bernilai warisan kepada masyarakat awam, khususnya sebagai Khazanah Negara, dan sumber rekreasi, pendidikan dan penyelidikan.

Kedua, peranan tradisi ahli geosains ialah untuk meneroka sumber bumi untuk keperluan ekonomi dan kesejahteraan masyarakat. Geologi Ekonomi dan Geologi Petroleum berkembang kerana perlunya kajian yang bersistem untuk eksploitasi sumber geologi bernilai ekonomi dan sebagai sumber tenaga. Geologi Pemuliharaan mempunyai paradigma yang menyimpang dari peranan ahli geosains tradisi seperti yang dinyatakan terdahulu. Pembangunan gagasan Geologi Pemuliharaan berteraskan konsep utilisasi sumber geologi secara tanpa musnah. Penyimpangan paradigma pendekatan penggunaan sumber geologi ini merupakan hambatan asas yang perlu diatasi segera jika Geologi Pemuliharaan ingin dikembangkan.

Peranan Ahli Geosains Tempatan

Sejumlah sumber geologi unggul di kebanyakan negara lain telah terpulihara. Di Malaysia belum ada satupun sumber ini terpulihara atas sifatnya sebagai warisan geologi. Apakah kita tidak memiliki SWG? Atau, ahli geosains tempatan masih belum memainkan peranannya dalam konteks ini?

Untuk memastikan sejumlah sumber geologi unggul negara terpulihara, masyarakat geosains tempatan perlu menyokong gagasan Geologi Pemuliharaan ini. Dan dalam mengupas hambatan utama di atas, adalah didapati kedua-duanya berpunca dari sikap dan pegangan ahli geosains tempatan sendiri.

Kesedaran awam mengenai pengetahuan geosains atau sumber geologi unggul amat terbatas kerana maklumat untuk awam mengenai perkara ini adalah sangat terhad. Kebanyakan ahli geosains lebih berminat menulis laporan dan penerbitan atau berseminar untuk komuniti geosains. Pengetahuan geologi seakan maklumat ekslusif khas untuk ahli geologi sahaja. Pelajar dan masyarakat awam lebih terdedah kepada maklumat geosains mengenai negara luar berbanding negara sendiri. Seolah-olahnya Malaysia tidak memiliki sumber geologi unggul!

Hambatan paling kritikal ialah merubah paradigma ahli geosains supaya Geologi Pemuliharan dilihat sebagai penyangga pengembangan ilmu Sains Bumi bagi mencapai kesejahteraan masyarakat. Justeru, Geologi Ekonomi, Geologi Petroleum dan Geologi Pemuliharaan perlu dilihat sebagai bergerak sejajar untuk menampung keperluan manusia. Dalam kes Geologi Pemuliharaan, tumpuan diberikan kepada sumber geologi unggul yang bernilai warisan. Pembangunan sumber melibatkan usaha pemuliharaan dan aktiviti ekopelancongan. Konflik antara subbidang geologi gunaan ini perlu diselesaikan dalam konteks keperluan jangka panjang dan berteraskan konsep pembangunan mampan.

Kejayaan memulihara sumber geologi terletak pada iltizam ahli geosains tempatan untuk membangun kesedaran awam dan menyokong gagasan pemuliharan sumber warisan geologi negara.

The age of Bukit Keluang Formation and its significance towards tectonic development of the Eastern Belt of Peninsular Malaysia

MOHD SHAFEEA LEMAN, KAMAL ROSLAN MOHAMED, IBRAHIM ABDULLAH,
CHE AZIZ ALI, UYOP SAID & AHMAD JANTAN

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Three hills of conglomerate and associated continental rocks, namely the Bukit Keluang, Bukit Bubus and Bukit Dendong formed rather spectacular monuments on top of the vast coastal plain, south of Kuala Besut in the northernmost part of Terengganu. These island-like hills have created histories themselves as to their age affinity and the implicated tectonic history of the area. This rock unit was named the Bukit Keluang Formation by Kamal Roslan Mohamed & Ibrahim Abdullah (1993, 1994). Though no one have questioned their continental origin, the age of this rock formation has been widely speculated based merely on lithological correlation with other rocks of the same origin, e.g. Carboniferous-Permian (MacDonald, 1968), late Triassic-Jurassic (Koopmans, 1968; Gobbett, 1973), and Jurassic-Cretaceous (Kamal Roslan Mohamed and Ibrahim Abdullah, 1993, 1994). Fontaine and Khoo (1988) noted the presence of a rugose coral (i.e. Paleozoic age) from Bukit Keluang, but without the exact location or lithology of the fossil-bearing bed. Apart from that note, this formation was thought to be a fossil barren formation until our recent discovery of several fossiliferous horizons containing various Permian flora and fauna.

Regional north-south Terengganu faults: Besut, Kampung Buluh and Ping-Teris

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Three major, roughly north-striking fault zones in Terengganu outcrop as multiple, each tens to hundreds of metres wide intervals of mylonite and phyllonite among unfaulted or less faulted rock sequences. Drag features and subhorizontal fault striations establish that these regional fractures: Besut fault zone, Kampung Buluh fault belt, and Ping-Teris fault zone are strike-slip faults. Lateral displacements on the first two mentioned had been left lateral, while the Ping-Teris fault zone moved in right-lateral sense. The amounts of displacement are not known. Along their strikes, the three fault zones appear to continue as the wide belt of north to north-northwest striking faults in the north-western end of the Malay basin. Total traceable map-lengths of the fault zones reach 300 km each. In the basin, these faults transect upper Miocene and older rocks, but onshore Terengganu the three fault zones are only known to be of post-granitoid age, that is post-Carnian. There is no evidence that the onshore faults were active during the Cenozoic. There is indication along the Ping-Teris fault zone that its pre-Tertiary slip sense was right-lateral, while during the Cenozoic its subsea extension in the Malay basin moved left-laterally

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The tectonic evolution of Peninsular Malaysia based on a five-fold stratigraphic and tectonic subdivision

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The generally accepted and widely used threefold division of the Malay Peninsula is a geographic and spatial one. Despite its usefulness in giving a general picture of the geology of the Malay Peninsula, it does not reveal the real geology, which involves stratigraphic development, tectonic history and magmatism through time.

A new five-fold stratigraphic and tectonic subdivision of the peninsula through geologic time, which involved the recognition of five major unconformities, has been proposed at the April's Dynamic Stratigraphy & Tectonics of Peninsular Malaysia Seminar. The identified unconformities are the Middle-Upper Devonian Unconformity, the Variscan (Upper Permian) Unconformity, the Indosinian (Upper Triassic) Unconformity, the Middle Cretaceous Unconformity and the Pliocene-Pleistocene Unconformity and erosional surface.

These unconformities and their time-equivalent conformities are the bounding discontinuities to mega-sequences of sedimentary rocks, igneous rocks and other minor unconformities. The mega-sequences are informally named as:

1. The Setul mega-sequence (Cambrian to Devonian);
2. The Singa mega-sequence (Upper Devonian to Permian);
3. The Semanggol-Semantan mega-sequence (Triassic);
4. The Tembeling mega-sequence (Upper Triassic to Cretaceous) age and;
5. The Tertiary Batu Arang mega-sequence.

The basin architecture for each mega-sequence is as follows:

1. The Setul mega-sequence — the presence of shallow deltaic sediments in the west grading into platform sediments and eventually deep basinal sediments to the east suggest a continental margin setting;

2. The Singa mega-sequence — the presence of shallow marine near-shore sediments to the west and eastern sides of the basin together with the presence of deep water sediments along the central part of the basin suggest deposition within a rift basin setting;
3. The Semanggol-Semantan mega-sequence — a five province facies distribution is recognised that represents sedimentation along dextral strike-slip controlled basins. They are from west to east, a stable carbonate platform facies, grading into a fault bounded deep-shallow basinal province, a continental facies province along The Bentong-Raub Zone, a shallow to deep volcaniclastic fault bounded facies in the Central Basin and a continental deposit province along the East Coast;
4. The Tembeling mega-sequence — they are composed of continental alluvial fan and red beds sequence deposited in many small intermontane basins probably associated with dextral strike-slip fault movements;
5. The Batu Arang mega-sequence — they are continental sediments deposited in isolated strike-slip pull-apart basins.

Volcaniclastic conglomerates of central Pahang

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Sporadic outcrops of pebble to boulder conglomerates are exposed in several roadcuts in central Pahang. These conglomerates are characterized by very well rounded clasts of acid to intermediate volcanics in addition to smaller quantities of other rock types such as sandstones, quartzites and chert.

The volcanic clasts seem to be from sources similar to volcanic rocks exposed in the vicinity of Jerantut. The coarsest conglomerate is exposed just at the eastern edge of Jerantut town and consists almost entirely of well rounded volcanic boulders averaging 30 cm and ranging up to more than 1 m across. A weathered outcrop of volcaniclastic pebbly conglomerate is found at Km 6.8 Jalan Gelanggi 1-2 about 20 km west of Jerantut showing a general westward transport direction if the source is the same for both of them. A third outcrop is located at Kg. Dato Sharif near Kuala Kerau at 21.2 km north of the junction from Mentakab to Jerantut. This outcrop is important as it exposes the unconformable contact between the Triassic Semantan Formation and the volcaniclastic conglomerate above it. The clasts are well rounded and range commonly between 5 to 15 cm across and up to 65 cm in size. A fourth outcrop of thick conglomeratic beds containing similar volcanic clasts which are pebble to cobble sized but in smaller proportion compared to sandstone and quartzite clasts is located at Taman Setia Jasa near Kg. Awah, about 30 km SSE of Jerantut, 10.3 km from the Pahang River on the main trunk road to Kuantan. Most of the clasts are between 2 to 15 cm in size and the largest clast was 45 cm across. The volcanic clasts are all weathered to clay and in some beds created the false appearance of the isolated more resistant quartzite clasts floating in a clayey matrix. The conglomeratic beds here are interbedded with whitish feldspathic muddy sandstones and a few beds of black carbonaceous mudstones. The source of the volcanic clasts in this outcrop was probably the agglomerates exposed at the JKR quarry near Kg. Awah or its equivalents.

These conglomerates have never been dated by fossils. The conglomerates in Jerantut and Kota Gelanggi had been placed in the Lanis Conglomerate of Late Jurassic to Early Cretaceous age while that at Taman Setia Jasa has been correlated to the Murau Conglomerate of suggested Triassic age in the Tembeling Group. There is a possibility that these assignments are wrong as there is no fossil evidence. The unconformable contact with the Semantan Formation at Kg. Dato Shariff points to a Late Triassic or younger age.

A somewhat paradoxical aspect of these conglomerates is their textural maturity as evidenced by the well rounded clasts coupled with their mineralogical immaturity as evidenced by the presence of unstable feldspars and volcanics. Under normal circumstances mechanical processes in breaking up the clasts must have been dominant to provide the rounding of the volcanic clasts and yet chemical weathering must have been inhibited in the environment of deposition. Since chemical weathering is inhibited only in dry or low temperature environments and mechanical weathering needs water, this may lead to an erroneous interpretation that the climate was quite cold in order to produce fresh well rounded volcaniclastic conglomerates at the time of deposition. This paradox can be resolved by examining the likely pyroclastic sources exposed at Taman Perwira Jerantut Fasa 2, just about 2 km west of Jerantut on the road to Benta and another outcrop at Kg. Sg. Badak about 9.3 km from Jerantut along the same road. There is clear evidence at both the outcrops that the volcanic clasts were already well-rounded even before being freed from the parent outcrop and transported to be deposited in the conglomerates! The rounding could be accomplished by explosive volcanic processes where the blocks were tumbled about in a highly fluid magma in the volcanic vent knocking into each other and rapidly having their sharp corners worn off as the clasts were transported upward during the eruption. These rounded clasts were freed by selective weathering of the volcanic matrix which proceeded in a spheroidal fashion as was observed in a weathered horizon in the Taman Perwira quarry. This also explains how such well rounded conglomerates can be deposited so near to the source of the clasts. A long transport history is therefore not needed to explain the sedimentary anomaly observed in the volcaniclastic conglomerates of central Pahang.

Structural history of the Upper Palaeozoic Mersing beds of the Kuala Sedili area, Johor: evidences for dextral transpression

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The complex array of structures found in the Kuala Sedili Area make it a critical area for the understanding of the structural and deformational history of the Eastern Belt. The Upper Palaeozoic Mersing Beds of the Kuala Sedili Area show evidence for 3 successive fold episodes.

The first generation folds (F_1) varies from broad to tight and isoclinal folds with fold axes generally gently plunging to the NNW or sub-horizontal. Their axial surfaces ranging from steep to gently dipping and commonly associated with bedding parallel cleavage (S_1). Transposition of layering during D_1 produce a high-strain zone characterize by minor en-echelon doubly plunging folds associated with dextral slip surfaces parallel to F_1 axes.

The second generation folds (F_2) varies from steeply plunging Z-asymmetrical folds to gently doubly-plunging periclinal folds. They are commonly closely associated with NNW strike-slip dextral shear zones. Well-developed crenulation cleavages (S_2) in the pelitic beds commonly transected the folds.

The third deformation event (D_3) was relatively mild and represented by subvertical kink bands and chevron folds, commonly associated with both minor NW sinistral and SW dextral strike-slip faults. Both the kink bands and chevron folds orientations are generally sub-perpendicular to the general structural strike.

In places, the association of upright to recumbent folds with thrust faults and the occurrences of high-strain zone of dextral shear suggest that the D_1 deformation were derived from intense NE-SW compression with significant dextral strike-slip component (i.e. dextral transpressive). A number of evidence suggests that the D_2 deformation was dextral transpressive. These include 1) the predominance of F_2 Z-asymmetrical folds, 2) steeply dipping dextral shear zones, which bound the zones of intense F_2 folding. 3) Asymmetric pinch-and-swell structure as well as asymmetric boundinages, 4) dextral shear bands, 5) Right-stepping, en-echelon, cleavage-transected periclinal folds. 6) Non-coaxial superposition of en-echelon folds. Dextral transpressive deformation of D_2 produced zones of high flattening strain and NNW-striking dextral brittle-ductile shear zones.

The association of steeply plunging F_3 folds with NW-SE sinistral and NE-SW dextral faults probably indicates that the D_3 deformation was the result of an E-W shortening resulting from a NW-trending sinistral strike-slip deformation.

The timing of deformation is difficult to constrain due to lack of palaeontological data. However, from regional correlation, it can be speculated that the D_1 structures would have been resulted from strong dextral transpressional deformation as early as Mid-Permian, while the D_2 transpressional deformation could occur as late as Late Triassic. The D_3 strike-slip deformation could possible be a post-Cretaceous feature.

Many workers have reported multiple deformation in the Eastern Belt rocks. The earliest deformations were generally assumed to be compressive. The recognition of dextral transpressive deformations here during D_1 and D_2 implies that the deformations were non-coaxial and rotational in character. It suggests that the initial closure of the Permo-carboniferous basin involved a progressive ENE-WSW shortening with a significant component of strike-parallel dextral strike-slip movement that continued into the Late-Triassic Indosinian Orogeny.

Multiple phase deformational structures in the Tg. Balau, Tg. Lompat and Tg. Siang areas, Desaru Johor, Peninsular Malaysia

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The well exposed metasedimentary rock of probable Permo-Carboniferous age (e.g. Tjia 1987, 1989; Chakraborty & Metcalfe 1984), along the coastlines of Tg. Balau, Tg. Lompat and Tg. Siang, clearly recorded evidences for multiple phase deformation. Although complexly deformed, the existence of various interesting and classical examples of geological structures (Tajul Anuar Jamaluddin, 1996), rendered these areas vital in the understanding of the deformation history of this part (if not the entire) of the Eastern Belt of Peninsular Malaysia.

From the structural superposition and geometrical relationships, at least three phases of deformation (D_1, D_2, and D_3) can be distinguished. D_1 structures, although rarely encountered, are commonly represented by closed to isoclinal folds (F_1), associated with slaty and schistose cleavage (S_1) which are axial planar to the folds (F_1). S_1 cleavages also are usually parallel to the bedding planes (S_0).

D_2 structures are predominant in the study area and their general strike is NNW-SSE. D_2 deformation is represented by various kind of folds (F_2) ranging from closed to isoclinal, upright to recumbent folds which commonly show Z-asymmetrical shape. S_2 cleavage is commonly found in zonal or discrete crenulation cleavage. D_2 is also characterised by *en-echelon* periclinal folds or cleavage-transected folds, suggestive of dextral transpressive deformation. The D_2 pervasive shear zones are characteristically zones of sub-vertical, semi-ductile to ductile shear zones with dextral sense of shear striking NNW – parallel to the present sandy beach coastlines amongst the interrupted capes along the coast of southeastern Johor.

D_3 deformation is relatively mild and being represented by steeply plunging single or conjugate kink bands, chevron folds and localised subvertical warping. They are sub-perpendicular to the general strike of the D_1 and D_2 structures. F_3 folds are commonly associated with minor strike slip faults.

Timing of deformation is difficult to constraint due to lack of palaeontological information. However, from regional correlation (Mustaffa Kamal Shuib *et al., this volume*), D_1 deformation was probably commenced as early as mid Permian. While the D_2 transpressional deformation probably occurred in Late Triassic and its structural association may be best explained by invoking model of positive flower structure. D_3 is more localised in character and probably represents strike-slip deformation of Post-Cretaceous.

Organic geochemistry of selected Upper Palaeozoic Kuantan Group sediments of East Pahang, Eastern Belt, Peninsular Malaysia

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A total of six outcrop samples comprising of four shales, a coaly shale and a limestone from the Upper Palaeozoic Kuantan Group collected from three different localities in East Pahang were analysed by means of organic petrological and geochemical methods. The purpose of this study was to discuss the use of biomarkers (or geochemical fossils) in assessing type of organic matter, maturity and depositional environments. The saturated hydrocarbons of these sediments were analysed using gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS). The petrographic study was performed using a photometry microscope in reflected white light and blue light excitation.

The mean vitrinite reflectance (%R_0) for all the samples studied is in the range of 1.08%–1.13%, indicating that these sediments have reached a high level of thermal maturity (late oil-window maturation range). Both the 22S/22S+22R C_{32} hopane and 20S/20S+20R C_{29} sterane ratios had reached equilibrium, thus supporting the vitrinite reflectance data. This high maturity suggests the sediments have previously been buried to considerable depth, prior to being uplifted to their present position.

The GC fingerprints of the shales and coaly shale display a smooth high end-member distribution of n-alkanes extending beyond nC_{30}. A relatively lower abundance of n-alkanes is displayed by the limestone sample. Most of the samples show evidence of slight biodegradation as suggested by the presence of unresolved complex compounds and the loss of some of the lower molecular weight n-alkanes. The strong predominance of high molecular weight n-alkanes in the shales/coaly shale of the Charu and Sagor formations suggest significant input of higher land plant organic matter into these sediments. The distinction between the shales and the coaly shale samples is mainly based on petrographic observation and TOC (total organic carbon) content. The Panching limestone sample is dominated by nC_{17}–nC_{19} alkanes suggesting significant contributions of algal-derived organic matter. The lack of higher land plant-derived organic matter within the Panching limestone sample is evident from the low concentration of higher molecular weight n-alkanes compared to the Charu and Sagor sediments. The high Pr/Ph and Pr/nC_{17} ratios in the Charu and Sagor samples compared to the Panching limestone sample are likely to be associated with the source of the organic matter (i.e. higher land plant material) and is not indicative of the extent of anoxicity/oxicity of the depositional condition. No distinct variation is observed for the Ts/Tm ratio (generally considered to be associated with higher land-plant organic matter) among the samples studied suggesting this ratio may not be indicative of source input but are strongly influenced by the high thermal maturity attained by all of these samples. The high abundance of C_{24} tetracyclic terpanes could be associated with either higher land-plant, algae or microbial sources. The presence of significant marine influence is suggested by the high abundance of tricyclic terpanes in all of the samples studied.

Based on this study, although differences between the sediments within a particular formation could not be made, distinction can be made between the dominant type of organic matter that is present in the shales/ coaly shale compared to the limestone. The Charu and Sagor formations seems to have received substantial amount of land-derived organic matter that has been transported into the marine depositional setting, while the Panching Limestone is dominated by algal-derived organic matter and lacks higher plant material. Although high maturity, the samples are still within the oil-window range, suggesting these samples have not been too severely effected by thermal metamorphism or active tectonic activities of the Eastern Belt of Peninsular Malaysia.

Keynote Paper II
Challenges in implementing the minerals and geoscience programmes in the new millennium

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From the basic activity of geological mapping and mineral investigations initiated in 1903, the Geological Survey Department Malaysia (GSD) has been progressively expanding its scope, since the early 1970s, to encompass other aspects of geoscience in tandem with development in the country. Today, the primary activities of GSD include regional geological mapping, marine geology, mineral exploration, engineering geology, hydrogeology, environmental geology, and various laboratory services. These activities are undertaken to facilitate the mobilization of the country's mineral resources for national development and to address certain aspects of socio-economic programmes as well as to serve the needs of the private sector.

Presently there is an on-going exercise to merge GSD with the Mines Department into a new entity to be named the Department of Minerals and Geoscience. Even after the merger, minerals and geoscience will remain as one of the core activities of this new department. These activities, which are expected to be concentrated in the states, will be more client-oriented, with emphasis being stressed on the provision of quality information and services to the State Government, other Government agencies, the industries and individuals.

In the coming years, the use of IT as an enabling tool for data collation, analysis, storage, retrieval, and dissemination of information will be intensified. This strategic approach will entail the continued maintenance and updating of geoscience and mineral databases which would be linked through an efficient network system to facilitate quick decision-making, and the use of the information by the stakeholders and clients. The department also expects to see an increasing dependence on outsourcing to realise the objectives of some of its activities. In no small measure, this move is expected to stimulate the growth of the private sector in the fields of minerals and geoscience. To live up to these expectations, the department will continuously strive to increase its level of expertise in the minerals and geoscience disciplines to enable it to contribute more effectively to the country's planned R&D activities, industrial development strategies and socio-economic thrusts as outlined in the aspirations of Vision 2020.

Geological significance of radiolarian chert in Sabah

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Radiolarian cherts are found associated with ophiolitic rocks in the Chert Spillite Formation and as blocks within the chaotic deposits. The ophiolitic chert association is found as isolated outcrops mainly in Banggi Island, Kudat, Taritipan, Telupid, Segama Valley and Pulau Timbun Mata. The chert sequence consists of thinly bedded chert interbeds with siliceous shale. The sequence overlies the pillow lava, basalt, spilite serpentinite and peridotite. The chert blocks are found in the Wariu, Ayer, Kuamut and Garinono Complexes. The complexes are composed of blocks of tuffaceous sedimentary rocks, bedded mudstone, sandstone, chert, limestone, and volcanic rocks. These chaotic deposits are considered to have diapiric origins (Mc Manus and Tate, 1986).

Several radiolarian assemblages were identified from the ophiolitic chert association in the Kudat (Basir Jasin and Sanudin Tahir, 1988), Mandurian (Basir Jasin and Sanatulsalwa Hasan, 1992), and Telupid areas (Basir Jasin, 1992). The age of the chert was thought to be Valanginian to Barremian, Early Cretaceous (Leong, 1977; Basir Jasin, 1991). Aitchison (1994) retrieved some Radiolaria from the chert block in the Ayer Complex. He indicates that the age of the chert is pre Albian, Early Cretaceous.

Recently, several chert samples were collected from a chert block in the Wariu Complex and the ophiolitic chert association in Kudat. The chert yielded very well-preserved radiolarian faunas. Several taxa of radiolarians were identified from the chert of the ophiolitic chert association in Kudat. The assemblage consists of:-

Pseudodictyomitra carpatica (Lozyniak)
Ultrnapora praespinifera Pessagno
Thanarla brouweri (Tan)
Triactoma tithonianum Rust
Sethocapsa asseni (Tan)
Dictyomitra communis (Squinabol)
Acaeniotyle umbilicata (Rust)
Xitus spicularius (Aliev)
Archaeodictyomitra lacrimula (Foreman)
Pseudoeucyrtis hanni (Tan)
Thanarla pacifica Nakaseko & Nishimura
Wrengellium puga (Schaaf)
Sethocapsa orca Foreman
Pantenellium squinaboli (Tan) and
Podobursa typica (Rust)

This assemblage indicates that the age of the chert ranges from Barremian to Aptian, Early Cretaceous.

The Radiolaria from the chert block of the Wariu Complex consists of:-

Dictyomitra gracilis (Squinabol)
Pseudoaulophacus sculptus (Squinabol)
Triactoma cellulosa Foreman
Xitus spicularius (Aliev)
Ultranapora praespinifera Pessagno
Orbiculiforma maxima Pessagno
Stichomitra communis Squinabol
Scadiocapsa speciosa (Squinabol)
Acanthocircus multidentatus (Squinabol)
Acanthocircus levis Donofrio & Mostler
Thanarla conica (Squinabol)
Triactoma paronai (Squinabol)

The assemblage indicates the age of Aptian to Cenomanian.

The aim of this paper is to review and revise the age of radiolarian assemblages based on the up to date information and to use geochemical data for environmental interpretation.

Facies, textural characteristics and depositional model for the Tertiary boulder beds of Batu Arang, Selangor

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The Tertiary Boulder Beds exposed at a hill-cut west of Batu Arang town can be distinctly divided into three units — a Red Conglomeratic Unit at the bottom, an intermediate zone of flat bedded, pebbly and gray coloured siltstone and mudstone and a Gray Conglomerate Unit at the top. An interbasinal angular unconformity separates the Red Conglomeratic Unit and the flat-bedded sandstones from the overlying Gray Conglomerate Unit. Facies and textural characteristics of the different units suggest that each unit have been deposited by different, temporally separated depositional regimes within a basin governed by fault-related movements.

The Red Conglomeratic Unit comprise a multi-stacked upward-fining cycles of red, well-rounded and sorted orthoconglomerate at the base, overlain by subordinate lenses of sand, silt and mud at the top of each cycles. These cycles are not laterally uniform but instead display terminations and diffused interfingering of sub-facies. Gravelly scour-fills, mudstone-pebbly conglomerate interbedding and normal and reverse-graded lenses are not uncommon. The maximum size for clasts of this unit ranges from 45 cm to 55 cm. Clast imbrication is common. The lenses of the petromict conglomerate comprises clasts of quartzite, sandstone, chert, vein quartz, phyllite and schist, with sandstone being the dominant clast-type. The presence of syn-depositional structures like listric faults, conjugate normal faults and wedge-shaped tensional fissures within this unit suggest that tectonic activities has influenced the sedimentary pattern within the basin. The Red Conglomeratic Unit is interpreted as a subaerially water-laid, alluvial fan deposit.

The flat-bedded, gray-coloured pebbly sandstone and siltstone overlies the distinct palaeosol horizon of the Red Conglomeratic Unit. The contact is conformable or para-conformable. The deposition of these flat-bedded layers indicate a marked change in the depositional regime operating within the environment. The gray colouration of the beds indicate that deposition occurred subaqueously in a reduced environment. This unit is interpreted to be upper flow-regime flat bed.

The Gray Conglomerate Unit is a dark gray conglomeratic unit which exhibit 'paraconglomeratic texture'. This poorly-rounded and poorly-sorted unit contains a lot of outsize, angular and elongated clasts, and is supported by sand and pebbles. Its pertomict composition includes clasts of sandstone, quartzite, schist, phyllite, vein quartz and shale. Maximum clasts sizes exceeded 1 m. This unit is interpreted to be a debris flow deposit, deposited into a subaqueous environment.

The facies characteristics and stratigraphic relationships of the different units of the Boulder Beds of Batu Arang reflect the intimate interplay between depositional processes and tectonism in the stratigraphic development of the succession.

Palynomorphs from an intermontane basin, Thailand: a significant finding on *Florschuetzia* tp. pollen

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Thirty (30) samples from a 45 m-long core drilled in Sa Kae Ngam Coalfield, Nong Ya Plong Basin, Thailand, were analysed for their palynomorph content. The core penetrated Lower Miocene lacustrine sediments which consist of a 10 m thick mudstone with siltstone and sandstone interbeds. The mudstone is overlain by a 6 m thick bituminous coal which is in turn overlain by a thick succession of mudstone with occasional thin layers of carbonaceous material. All samples contained rich assemblages of palynomorphs believed to have been derived from aquatic and hydrophytic plants, and dryland vegetation.

In this paper, the results of palynological analysis on the coal and the underlying mudstone units are presented. Palynomorph assemblages in the lower part of the mudstone unit are dominated by *Alnipollenites verus* and bisaccate pollen together with pteridophyte spores. The upper part of the mudstone unit, which is immediately underlying the coal bed, yielded abundant bisaccate pollen and the freshwater algae, *Pediastrum* spp. and *Botryococcus braunii*, together with common pollen bearing a close morphological resemblance to the genus *Florschuetzia* and related lythraceous taxa. Two samples analysed from the coal bed yielded reduced abundance of *Pediastrum* spp. but increased representations of *A. verus* and lythraceous/*Florschuetzia* pollen together with hinterland bisaccate pollen.

Sediments from the lower part of the mudstone unit are thought to represent deposition in an *Alnus* and fern-dominated swamp which was surrounded by mountains with Pine and Spruce forests. The swamp was probably transformed into an open lake which was fringed by mostly lythraceous and, to a lesser extent, *Sonneratia*-related plants. Pine and Spruce forests formed the dominant vegetation in the surrounding hinterland and mountains. With time, as the lake level lowered, a similar hinterland and mountain vegetation persisted. However, in the lowland area, an *Alnus* and lythraceous/*Sonneratia*- dominated swamp could have developed. This kind of swampy condition is suited to the accumulation of peat which accounts for the thick bituminous coal deposit. The deposition of the mudstone and peat is thought to occur under a cool climatic condition, probably comparable to an upper montane climate in terms of present day vegetation.

Data from this study illustrates for the first time that the modern mangrove genus *Sonneratia* may have been derived from a freshwater swamp precursor. The morphology of *Florschuetzia* tp. and related lythraceous pollen recovered from the mudstone and coal units compares well with that of *Florschuetzia trilobata* and the brackish water species, *F. levipoli* and *F. meridionalis*.

Carboniferous of Malaysia: a synthesis

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A comprehensive study on the Carboniferous of Malaysia was recently done in an attempt to produce a Carboniferous biozonation for both local and regional biostratigraphical correlation in Malaysia. This project is considered as a part of the geological correlation programme in Southeast Asian region, which was initiated by the CCOP (Coordinating Committee for Coastal and Offshore Geoscience Programmes in East and Southeast Asia) headquartered in Bangkok, Thailand. The work has involved an extensive compilation of the existing geological and palaeontological data gathered from the published reports together with some new data recently collected from the field work. As a result, the authors realised that those data are still insufficient for the production of a good biozonation for Malaysian biostratigraphy. Some data are found to be conflicting to each other that might arise due the problem in fossil identification in the past. In some cases, the situation is worsened by the occurrence of discontinuous rock exposures in study areas together with very poorly preserved fossils that has forced the workers to make a geological correlation solely based on lithological correlation. These problems usually lead to the misinterpretation of the local geology and the result may inconsistent with the regional geology in surrounding areas. It is also noted that almost one hundred published study on the Carboniferous of Malaysia has been done in the past that contributed to a better understanding on the geology, biostratigraphy and palaeogeography of the Carboniferous rocks in Malaysia.

The Carboniferous of Malaysia may be summerised and geographically divided into four distinct zones, which differ in their sediments and their fossils. The divisions from the east to the west are as follows:

1. Eastern region, the area extending from south Thailand to Sarawak covering Terengganu State and greater parts of Kelantan and Pahang States; characterised by shallow marine and continental sediments.
2. A narrow elongated area corresponding to the Bentong-Raub suture zone displaying deep marine sedimentation.
3. The Kinta Valley, with limestone deposited in a relatively shallow marine environment.
4. The northwestern part of Peninsular Malaysia, the area where Late Carboniferous-Early Permian sediments are interpreted as glacial-marine deposits by many authors.

The presence of Carboniferous rocks is more widespread in Peninsular Malaysia than in East Malaysia. Its presence was first documented in Kuantan area, Pahang in the year 1920 by J.B. Scrivenor when he introduced a note "on Carboniferous corals from Kuantan" prepared by S. Smith. More studies on the Carboniferous rocks in Kuantan and from other parts of Peninsular Malaysia has progressed rapidly after the year 1920 until recent years. More information on the Carboniferous of West Malaysia has been developed especially by the discoveries of diagnostic Carboniferous fossils.

In East Malaysia (Sarawak and Sabah), Carboniferous rocks have been found only in Terbat area in Sarawak. The rocks is well known as 'Terbat Formation', a name introduced by N.S. Haile in 1954.

For the purpose of presentation in this paper, the Carboniferous is divided into three parts they are:

i. Lower Carboniferous (Tournaisian, Visean, Serpukhovian)
ii. Middle Carboniferous (Bashkirian, Moscovian)
iii. Upper Carboniferous (Kasimovian, Gshelian)

The Lower Carboniferous corresponds to the Mississippian of United States whereas the Middle and the Upper Carboniferous are together equivalent to the Pennsylvanian.

Permian brachiopod from Bera Formation (West Malaysia) and their paleogeographic significance

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The sedimentary sequence in between Tasik Bera and Bukit Bertangga was considered by MacDonald (1970) as part of the Lipis Group, while Cook & Suntharalingam (1970) considered it as part of the Gemas (or Tenang) bed. Cook & Suntharalingam (1970) noted on the occurrences of early Middle Permian fusulinid from the Gemas bed in Bera area, though the Gemas Formation was described by Foo (1970) for the Triassic sediments in the area around Gemas town and the area east of it which include Bera area. With more Permian fossils discovered and sufficient differences recognised between the Permian rock unit in the Bera area and the Triassic rocks, Mohd Shafeea Leman, *et al.* (1999, in press) had proposed a new name for this rock unit. The Bera Formation was described by Mohd Shafeea Leman *et al.* (1999, in press) for the Permian rocks outcropped in the area east of Tasik Bera, Pahang Darul Makmur.

Ancient floodplain deposits within the Jura-Cretaceous alluvial complex near Bandar Muadzam Shah, Pahang: facies characteristics and climatic significance

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The Jura-Cretaceous alluvial complex near Bandar Muadzam Shah exposes at least seven upward-fining cycles of sandstone-siltstone-mudstone succession with minor conglomerate. The sedimentary characteristics of the succession suggests that these are deposits of relatively sinuous alluvial channels. Detail stratigraphic logging have led to the recognition of three different types of floodplain deposits interbedded within the succession.

The first type of floodplain deposit occur at the lower levels of the succession as the capping layers overlying basal sandstones in Cycle 1, 2 and 3. The fine-grained deposit comprise dark gray to dark reddish-maroon massive mudstone punctuated with rusty-coloured, oxidised, lateritic palaeosol layers. The irregular palaeosol layers ranges in thickness between 10 to 30 cm. In Cycle 1 and 2, this deposit is also interbedded with inclined, thin layers of fine-grained sandstone which overlies the basal sandstone. Very little traces of former vegetation, either in the form of coal or rootlets horizon are present. Only a few scattered pieces of coalified wood fragments were observed at the base of Cycle 3.

The massive, unlaminated mudstones were probably deposited by floodwaters in areas of the floodplain that were normally subaerially exposed. Evidence of subaerial emergence is evidenced by the presence of the rusty coloured pedogenic layers. This floodplain facies reflect the dominance of a relatively dry climate with seasonal heavy rainfall and flooding.

Cycle 4 and 5 is dominated by flat-bedded, sheet-like green siltstone, both underlained by basal fine- to medium-grained sandstone. The total thickness of the two cycles exceeds 15 m. Individual sand sheets are 0.3–2.0 m thick, but amalgamation of beds are common. This unit is noted for the total absence of interbedded mudstone. No primary sedimentary structures is evident; the most conspicuous feature here are the highly spherical "dinasour egg" concretions protruding from the beds.

Sheets sandstones and siltstones have been interpreted as the product of flash floods depositing sand and silt under upper flow-regime plane bed conditions. The green colour reflect reducing environment of deposition. The lack of mudstone facies indicate a temporally long, sustained flooding event with minimum traction current to winnow away the finer grained mud to more distal parts of the floodplain. This facies indicates that a fairly wet climate prevail throughout during its deposition.

The third type of floodplain deposit dominate the whole of Cycle 7. This unit comprises repeated, small-scale coarsening-upward successions of laminated fine-grained sandstone, siltstone and mudstone. Very small scale ripples are also present in the sand and silt layers. Syndepositional loading and micro-slumping structures are also common.

Interlamination of mud, silt, and very fine-grained sand is common in overbank areas, and represents deposition from suspension and from weak traction currents. This facies was probably deposited in a poorly-drained alluvial backswamps.

The contasting climatic indicators exhibited by the different floodplain deposits probably indicate the difference in climatic regimes operating within the basin and its fluvial source area.

A palynomorph assemblage from Bukit Mambai, Labis, Johor

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A well-exposed rock sequence at Bukit Mambai in the north of Labis was previously mapped as Jurassic-Cretaceous in age. The rock sequence dips in the north-west direction, and it comprises predominantly of fine to medium-grained sandstone, siltstone and shale. Several layers of the rock sequence are very rich in organic materials of dark grey to black in colour, and some of them can be found as parallel laminations in fine-grained sandstone layers. It is interpreted that, the rock sequence was deposited in a fluvial environment as indicated by the presence of commonly associated sedimentary structures of cross-bedding and ripple marks.

Out of twenty-eight samples which were systematically collected and processed for palynological study, seven samples yield some identifiable of fairly well-preserved palynomorphs. The remaining samples, however, are very rich in palynodebris and contain poorly-preserved palynomorphs of either badly corroded or are unable to be identified due to their opacity. After a considerable effort has been given during the sample preparation by applying several different oxidation times and or using different oxidising agents in order to yield correctly oxidised palynomorphs to be studied under a light microscope, most of the poorly-preserved specimens are ignored. Despite a majority of the samples examined contain poorly-preserved palynomorphs, this study is able to identify a palynomorph assemblage which can be utilised in interpreting the age of the rock sequence and the most probable climatic condition during which the sediments were deposited.

The present palynomorph assemblage comprises of *Classopollis* spp. and *Ephedripites* sp. as the most dominant constituents together with the less dominant ones such as *Cycadopites* sp., *Cyathidites* sp., *Todisporites minor* Couper, *Balmeisporites holodictyus* Cookson and Dettmann, *Klukisporites scaberis* Cookson and Dettmann, *Cicatricosisporites* sp. and *Dictyophyllidites* sp. Based on their size range and the nature of the tetrad mark, the commonly observed genus of *Classopollis* is assignable to three different species, namely *C.* cf. *classoides* (Pflug) Dettmann, *C. torosus* (Reissinger) Balme and *C.* cf. *vignollensis* Reyre, Kieser and Pujol. For example, *C.* cf. *classoides* can be distinguished from *C. torosus* by being larger in size and having a typical triangular shape of aperture, whilst the latter is normally smaller in size as well as its aperture with a distinct trilete-like structure in the middle. The genus of *Ephedripites* is also commonly found in the present samples and it can be recognised by its elliptical outline with a distinct spirally-arranged ridge-like ornamentation on the exine. Due to their scarcity, the other genera of *Cycadopites*, *Cyathidites*, *Cicatricosisporites* and *Dictyophyllidites* are not assigned to their respective species, but nevertheless, they show a close resemblance to the previously recorded genera from other areas. Some species can be recognised with certainty based on their typical ornamentation. *Balmeisporites holodictyus* is recognised by its reticulate pattern of ornamentation with some elevated muri at the equator. In comparison, this species shows some similarities to *Klukisporites scaberis*. However, the latter is ornamented by verrucae which do not exceed its equatorial outline. Only a single specimen of *Cicatricosisporites* sp. is observed in the present samples, and therefore, at this stage, it is not assigned to any particular species of this genus until more specimens acquired.

Based on the dominance of *Classopollis* spp. and *Ephedripites* sp., the rock sequence at Bukit Mambai is interpreted to be late Early Cretaceous in age. Although the former genus is also a common constituent in the older palynomorph assemblage, but the presence of the latter genus which is confined to the late Early Cretaceous supports the proposed age of the studied rock sequence. The abundance of *C.* cf. *classoides* in the present palynomorph assemblage is also recorded in Neocomian's assemblage but the younger assemblage is distinguished by the absence of other common species such as *Cicatricosisporites australis* and *Alisporites grandis*. Furthermore, the proposed age is also supported by the presence of *Balmeisporites holodictyus* which appeared for the first time in Aptian. The dominance of *Classopollis* spp. in the present samples indicates that the climate during which the sediments were deposited was warm and dry. As a result of the present palynological study, it enables a more specific age to be proposed for the rock sequence which was previously mapped as only Jurassic-Cretaceous in age.

Seismic mapping of Pahang Quaternery sediments, Pekan, Pahang

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For the past 70 years, reflection seismic is the most common geophysical technique applied for underground structure imaging in petroleum exploration as this technique could depict the real underground geological structures. With some modifications, the technique could be applied for shallow underground structures studies such as the Quaternary sediment study around the Pekan area, Pahang. Shallow seismic reflection exploration begins with the data acquisition technique. Optimum window technique is the most common technique being applied to determine the most suitable field data acquisition parameters. Seismic wave is generated by the hammer source or dynamite explosion. Reflection seismic signals are detected by geophone array with natural frequency 14 Hz and 100 Hz and recorded by 24 channels ABEM Terraloc seismograph. With the raw field data in hand, the first thing to do is editing and increase the signal to noise ratio. After that, the raw field data will be sorted and gathered following the common depth point (CDP) sequence. This CDP gathered sequence data will go through some processes like static correction, velocity analysis, stacking, diconvolution and migration to produce the seismic reflection section. The section afterwards has to be fitted with borehole data and combined with other data to conclude the overall geological interpretation. In general, the Holocene sediment is marine and covered the top 35 m under the surface but this information could not show in the seismic reflection section. The high amplitude, frequency and parallel reflections are recorded from depths 35 m to 200 m and represented the Pleistocene fluvial deposit. Parts of the parallel reflections were displaced by normal high angle listric fault. Granite bedrock is overlaid by Pleistocene sediments.

Geochemistry and characterisation of alluvial gold from the Jeli and Sokor areas, Kelantan

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The geochemical and characterisation study was concentrated in 2 main areas where alluvial gold samples from Sungai Tadoh and Sungai Pergau, situated in Jeli, were collected together with alluvial gold samples from Sungai Tui, Sungai Sokor and Sungai Ketubong in Sokor, Kelantan.

The main purpose of the study is the characterisation of the gold deposits from these 2 areas with emphasis on their physical and chemical characteristics. The physical characteristics covered include morphology, shape and grain size. Whereas, the chemical characteristics include types of inclusions and the quantity of gold and silver in the gold grains from EPMA and microscopic studies.

The morphology and shapes of the gold grains of the study area as a whole ranges from subrounded to rounded, and therefore strongly suggest that the gold samples are alluvial gold in character except for the gold samples from Sg. Ketubong which are sub-angular. This is because the gold particles collected at Sungai Ketubong are very near the area of the mineralized gold veins. The sphericity of the samples collected in the Jeli area is classified as prismoidal, which is the dominating sphericity in this area, and this differs from the samples in the Sokor area which have sphericity that ranges from subdiscoidal to discoidal.

Gold grain size studies show that the samples from Sokor are fine grained which range from 0.1–0.3 mm for the lengths and the widths of the samples collected from Sg. Tui and Sg. Sokor as a whole, whereas the grain size of the samples from Jeli are bigger with an average length of 0.7 mm for samples from Sg. Pergau. For samples from Sg. Tadoh, the average particle size is 0.8 mm long and 0.4 mm wide. As a whole, the samples from the Jeli area comprise grain sizes that are larger when compared to the samples from Sokor area.

EPMA studies show that the geochemistry of the gold grains are different for the 2 main areas. In the Jeli area, the 3 areas sampled in Sg. Pergau show average fineness values of 941.435, 922.624 and 911.224 respectively, while the 2 areas in Sg. Tadoh average 916.015 and 943.912 respectively.

In the Sokor area, the fineness values are less than 900.000 and the average fineness values show a larger spread, the 2 areas in Sg. Tui average 810.069 and 892.330 respectively, whereas the 2 areas in Sg. Sokor average 849.088.

Contrasting chemical characteristics of granite and syenite from Perhentian islands, Peninsular Malaysia

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The Perhentian intrusion is a reversely zoned complex exposed over several islands off the east coast of Peninsular Malaysia. The intrusion is made up of Perhentian Kecil Syenite rimmed by more evolved Perhentian Granite. The former consists of a variety of igneous rocks ranging in composition from syenitic to monzonitic and even gabbroic rocks whereas syenogranite dominated the latter pluton. Field relationships of the rocks suggest that the Perhentian granite is younger than the Perhentian Kecil syenite. Both plutons show different trends in the Q-A-P classification, thus the Perhentian Kecil syenite samples show a similar trend to the rocks from the alkaline province whereas the Perhentian granite samples plot in the field of granitoid formed by crustal fusion. The essential minerals in Perhentian Kecil syenite are K-feldspar, plagioclase, hornblende, pyroxene, quartz, biotite, sphene, epidote, apatite, zircon and magnetite whereas K-feldspar, plagioclase, quartz, biotite, hornblende, allanite, zircon, epidote and opaque phase make up the Perhentian granite. As in the field and petrographic characteristics, geochemistry of both plutons also show a different behaviour. The differences are:

1. Perhentian Kecil syenite trend evolved towards the nepheline normative whereas the Perhentian granite rocks seems to evolved towards the quartz normative on a TAS diagram.
2. Both pluton show a different ACNK trend with SiO_2, thus the ACNK trend of the syenitic rocks increase whereas those from the granitic rock are decrease with increasing SiO_2.
3. Plots of CaO and (Na_2O vs K_2O) vs SiO_2 emphasise the alkali calcic character of the syenitic rocks i.e. alkali-lime index of 54.5, as well as very different character, in alkali term, of the Perhentian granite pluton in which the CaO and (Na_2O + K_2O) curves do not intersect. This is due to the lower CaO and higher (Na_2O + K_2O) contents of the granitic rocks which are constant over the SiO_2 ranges (71–75%).
4. In rocks from the Perhentian Kecil syenite, Ba, Ce, La, Rb, Th increase and Sc, V, Sr, Pb, Y, Zn and possibly Zr decrease with increasing SiO_2. Trace elements in the Perhentian granite show some odd trends, thus Ce, Co, La, Nd, Pb, Th, Rb and Y neither increase nor decrease but produced a steeply vertical trends which is difficult to explain by simple fractional crystallisation.
5. Rocks from Perhentian Kecil syenite have high Sr and Ba compared to the Perhentian granite. All the Perhentian granite rocks plot below the line Ba/Sr = 1 and can be considered as low Ba-Sr granite.
6. The Perhentian Kecil Syenite has very high Sr/Y ratio compared to the Perhentian granite.
7. The Perhentian granite has low total REE (106–382) compared to the Perhentian Kecil syenite (224–450). The granite also has more restricted La_N/Lu_N ratios (0.96–58.8) compared to the syenitic rock which has more wider La_N/Lu_N ratios (30.7–218.5).

Field, petrology and geochemical study of the Perhentian rocks indicate that both Perhentian granite and Perhentian Kecil syenite are made up of individual batches of melt.

Perbandingan sifat fiziko-kimia tanah syis grafit dan tanah syis kuarza-mika kawasan sekitaran Kota Melaka, Melaka

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Sejumlah 23 sampel tanah syis grafit (GS) dan 13 sampel tanah syis kuarza-mika (QS) yang mewakili bahan tanah pelbagai gred luluhawa (meliputi gred IV, V dan VI) telah dipungut di kawasan sekitar Kota Melaka dan dibawa pulang ke makmal untuk diuji beberapa sifat fizikal dan kimia kedua-dua tanah tersebut. Tujuan utama kertas ini ialah untuk melapor, membincang dan membandingkan hasil ujian-ujian makmal fizikal dan kimia yang perolehi bagi dua jenis tanah baki tersebut yang mempunyai taburan meluas di kawasan kajian. Untuk kemudahan perbincangan, hasil analisis makmal bagi kesemua 23 dan 13 sampel tanah GS dan QS masing-masing, tidak akan dibezakan dari segi gred luluhawa. Secara umum, sifat-sifat fizikal yang telah diuji adalah selaras dengan cadangan-cadangan U.S. Department of the Army (1970) dan merangkumi: kandungan air tabii (W_O); ketumpatan relatif (G_S); taburan saiz butiran (G, S, M dan C); had-had Atterberg (LL dan PL) dan sifat-sifat pemadatan (g_{dmak} dan W_{opt}). Aspek kimia tanah yang dikaji pula ialah kimia air liang tanah di mana sampel-sampel air liang disediakan dengan menggunakan kaedah "Pengekstrakan Tepu" seperti mana yang dicadangkan oleh Geotechnical Research Centre (1985) dan merangkumi: pH; kekonduksian dan kepekatan kation (Na^+, K^+, Ca^{2+} dan Mg^{2+}) serta anion larut (SO_4^{2-} dan Cl^-).

Hasil yang diperolehi telah diringkaskan dalam Jadual 1 dan 2. Secara umum, boleh diperhatikan bahawa wujud perbezaan-perbezaan yang kecil ke jelas bagi sifat fiziko-kimia kedua-dua tanah GS dan QS itu. Rata-rata, walaupun fraksi halus (khususnya fraksi lodak) merupakan fraksi yang paling dominan bagi kedua-dua tanah tersebut, tanah QS mempunyai fraksi pasir yang lebih signifikan (3.6–38.0%) jika dibandingkan dengan tanah GS (2.0–28.6%). Perbezaan kecil dalam tekstur kedua-dua tanah tersebut turut dicerminkan oleh parameter-parameter fizikal yang lain seperti kandungan air tabii dan sifat keplastikan di mana tanah GS mempamerkan nilai-nilai W_O di samping nilai-nilai LL dan PL yang secara relatif lebih tinggi berbanding tanah QS, selaras dengan tekstur tanahnya yang lebih halus. Selain itu, nilai-nilai g_{dmak} bagi tanah GS rata-rata lebih rendah (1.33–1.62 g/cm^3) berbanding tanah QS (1.39–1.76 g/cm^3) dan ini dikaitkan dengan penggredan saiz butiran tanah GS yang umumnya lebih bersifat segaya. Secara perbandingan, nilai-nilai G_S kedua-dua tanah tersebut tidak menampakkan apa-apa perbezaan yang ketara. Fraksi halus kedua-dua tanah tersebut boleh dikelaskan dalam kelas CL-ML dan ML ke MH iaitu masing-masing merujuk kepada lempung ke lodak yang berkeplastikan rendah dan lodak berkeplastikan rendah ke tinggi. Sesetenganh sampel tanah GS mungkin lebih sesuai dikelaskan dalam kelas OL (lodak organik berkeplastikan rendah) kerana kandungan bahan berkarbon (grafit) yang tinggi bagi sampel-sampel berikut.

Kandungan bahan bermika (lazimnya muskovit) yang hadir dengan agak melimpah dalam kedua-dua tanah GS dan QS (yang berkurangan dengan peningkatan darjah perluluhawaan) mengenakan pengaruh yang genting ke atas sifat-sifat fizikalnya secara umum. Antara kesan-kesan yang dapat diperhatikan ialah nilai-nilai keplastikan yang secara relatif agak rendah; plot-plot pada carta aktiviti yang "bercanggah" dengan plot-plot pada carta keplastikan dan nilai-nilai g_{dmak} yang rendah (kebanyakan nilai kurang daripada 1.60 g/cm^3), menggambarkan keadaan ketumpatan kering maksimum yang "terpendam". Di samping itu, kehadiran bahan berkarbon yang agak melimpah dalam tanah GS turut mengenakan pengaruh tambahan ke atas sifat-sifat fizikalnya di mana kesan yang paling ketara ialah peratusan fraksi lodak tanahnya yang luar biasa tinggi (mencapai 97.8%).

Secara umum, air liang tanah GS nampaknya lebih berasid (nilai pH mencapai 4.5) berbanding air liang tanah QS. Kekonduksian air liang tanah GS rata-rata lebih tinggi berbanding air liang tanah QS. Kelimpahan relatif kation larut tanah GS adalah seperti berikut: $Na^+ >> K^+ > Ca^{2+} > Mg^{2+}$. Kelimpahan relatif kation larut tanah QS pula mengikut urutan berikut: $Na^+ >> Ca^{2+} > K^+ > Mg^{2+}$. Yang menariknya, walaupun kelimpahan relatif kation larut kedua-dua tanah tersebut sedikit berbeza, air liang tanah GS dan QS itu kedua-duanya dicirikan dengan kedominanan kation larut Na^+. Ini mempunyai implikasi yang ketara terhadap potensi penyerakan kedua-dua tanah tersebut. Rata-rata, nilai-nilai nisbah penjerapan natrium (SAR) dan nisbah jumlah kation monovalen terhadap jumlah kation dwivalen $((Na^+ + K^+)/(Ca^{2+} + Mg^{2+}))$ yang lazimnya tinggi mencadangkan bahawa kedua-dua tanah GS dan QS bersifat dispersif. Ini turut disokong oleh plot-plot pada carta potensi penyerakan tanah berdasarkan parameter peratus kandungan natrium melawan jumlah kation Na^+, K^+, Ca^{2+} dan Mg^{2+} dalam air liang (Sherard *et al.*, 1976). Selain itu, air liang tanah GS mempamerkan kepekatan anion larut SO_4^{2-} yang jauh lebih tinggi (mencapai 130 bpj) berbanding tanah QS (1.0–13.5 bpj) manakala kepekatan anion larut Cl^- air liang tanah QS rata-rata lebih tinggi berbanding tanah GS. Kelimpahan anion larut SO_4^{2-} dalam air liang tanah GS dikaitkan dengan hasilan-hasilan sekunder luluhawa kimia mineral logam sulfida khususnya pirit yang hadir dalam batuan induknya iaitu asid sulfurik (H_2SO_4) dan jarosit ($KFe_2(SO_4)_2(OH)_6$) yang turut menyumbang kepada keasidan air liang tanah GS yang lebih ketara berbanding tanah QS. Berdasarkan keputusan ini, tanah GS mempunyai potensi untuk menghasilkan saliran asid.

Kesimpulan daripada kajian ini menunjukkan sekali lagi bahawa tanah baki yang berasal daripada batuan induk yang berlainan (dalam kes ini syis grafit dan syis kuarza-mika) akan mempamerkan perbezaan-perbezaan dalam sifat-sifat fiziko-kimianya. Parameter litologi yang memainkan peranan utama ialah komposisi dan tekstur batuan asal. Faktor darjah perluluhawaan yang mengawal perkembangan profil luluhawa yang terbentuk, turut mempengaruhi sifat fiziko-kimia kedua-dua tanah tersebut namun, perbincangan mengenainya adalah di luar skop kertas ini.

Physico-chemical properties of soils from South Johor

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Some 70 soil samples from South Johor were analysed for their physico-chemical properties. The types of soils studied comprise residual soils of basalt, granite, gabbro, shale and Old Alluvium. The results of the study show that the physical properties can be correlated with the lithology or soil types, for example particle size which is coarser for granitic soils (sandy in nature) compared with gabbro soils (more fine-grained, i.e. comprising silts and clays). The compaction properties of the soils are also influenced by grain size, for example the Old Alluvium which is coarse-grained and well-graded produce maximum dry densities which are high compared to the gabbro soils which are fine-grained. The gabbro soils also show the highest plasticities in view of the high clay contents.

The pore fluids chemistry shows low ionic contents for all the soil types studied. Na^+ is the predominant soluble cation. The pH values obtained are < 7, indicating the acidity of the pore fluids for all the soil types studies.

Sifat fiziko-kimia tanah aluvium tua sepanjang Lebuhraya Johor Baharu-Pasir Gudang, Johor

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Kajian ini dilakukan untuk menentukan sifat fiziko-kimia dan mineralogi lempung tanah Aluvium Tua di sepanjang lebuhraya Johor Baharu-Pasir Gudang, Johor. Burton (1964) telah membuat kajian di kawasan Johor dan Singapura yang khusus menyentuh kewujudan Aluvium Tua. Beliau mendapati bahawa kebanyakan dari Aluvium Tua membentuk bukit-bukit rendah, membulat dan bercerun sangat landai. Ketinggian bukit-bukit biasanya jarang melebihi 70m dari paras laut. Ia telah menyentuh secara terperinci mengenai ciri-ciri Aluvium Tua. Burton (1973) juga telah menerbitkan hasil kajian geologinya meliputi kawasan Kulai hingga Johor Baharu, syit peta 130, Johor Baharu dimana beliau telah membahagikan enapan permukaan kepada Aluvium Tua dan Muda dan juga menyatakan usia sedimen ini adalah Pleistosen Awal berdasarkan perubahan aras laut semasa Pleistosen.

Sampel adalah sebanyak 20 sampel dengan 10 lokaliti penyampelan, 10 sampel untuk tanah 10 sampel Aluvium Tua bersaiz butiran halus (OAH) dan 10 sampel Aluvium Tua bersaiz butiran kasar (OAK). Ujian makmal dijalankan adalah untuk mencari sifat-sifat fizik seperti peratusan kandungan air, ketumpatan relatif, analisis taburan saiz butiran, had-had Atterberg dan pemadatan. Sifat-sifat kimia pula ditentukan dengan ujian kimia air liang iaitu menentukan pH, konduktiviti, kepekatan kation monovalen Na^+ dan K^+, kepekatan kation dwivalen Mg^{2+} dan Ca^{2+}, kepekatan anion Cl^- dan SO_4^{2-}. Seterus dari sifat-sifat kimia ini maka sifat penyerakan tanah dapat ditentukan. Pengenalan mineralogi lempung di tentukan dengan kaedah pembelauan sinar-X. Mineral-mineral dikenal pasti dengan corak belauan sinar-X.

Hasil dari ujikaji yang dilakukan telah diringkaskan pada jadual 1 untuk rujukan penggunaan simbol sifat-sifat yang dikaji serta unitnya. Peratusan kandungan air OAK(3%–15%) adalah lebih rendah berbanding OAH (8%–24%). Ini menunjukkan tanah Aluvium Tua OAH mempunyai keupayaan menyimpan air berbanding OAK. Ini ada kemungkinan kehadiran fraksi lempung yang tinggi di dalam OAH. Nilai Gs pula menunjukkan OAH (2.54–2.66) mempunyai julat nilai yang lebih tinggi dari OAK (2.52–2.63). Ini kemungkinan kehadiran fraksi lempung dalam OAH dimana Gs mineral lempung adalah tinggi dan juga kehadiran mineral berasosiasi dengan lempung iaitu oksida besi. Pengelasan saiz butiran menunjukkan sampel OAK mempunyai fraksi G yang paling dominan iaitu sekitar 22%–76% dan sampel OAH mempunyai fraksi S yang paling dominan iaitu sekitar 19%–81%. Hasil dari kajian ini, pengelasan dapat dibuat dimana fraksi kasar tanah OAK adalah kelikir berpasir, GP-GW manakala fraksi kasar OAH adalah pasir berlodak, SM. Dari ujikaji had-had Atterberg, fraksi halus sampel OAH boleh dikelaskan CL-ML dengan nilai-nilai LL, 30%–60%, menunjukkan penjerapan air yang rendah dan nilai-nilai terletak di antara garis U dan garis A. Perbandingan(rajah 1.4) di antara parameter pemadatan tanah Aluvium Tua menunjukkan OAK mempunyai nilai Ddmax yang lebih tinggi, 1.62 g/cm^3–1.69 g/cm^3 dan nilai Wopt yang lebih rendah 13.54%–15.70% dari OAH, Ddmax sekitar 1.45 g/cm^3–1.55 g/cm^3 dan Wopt 14.95%–20.10%.

Dari ekstrak air liang hanya sampel OAH sahaja yang dikaji kerana untuk menghasilkan ekstrak air liang sampel memerlukan bahagian fraksi lodak dan lempung yang tinggi. Nilai pH adalah berasid sehingga mencapai nilai 4.31. Hasil kajian Shamsudin (1986) yang mengatakan pH enapan aluvium memang berasid dengan pH < 5.5. Konduktiviti diukur menunjukkan sampel memberikan nilai sehingga 1.0 mS/cm. Secara keseluruhannya kepekatan kation monovalen K^+ dan Na^+ pada sampel-sampel adalah rendah iaitu di bawah 40 bpj. Kepekatan kation dwivalen Mg^{2+} pula ditunjukkan oleh sampel memberikan nilai iaitu sekitar 0 bpj–4.2 bpj dan bagi kation dwivalen Ca^{2+} memberikan julat nilai sekitar 0.2 bpj–6.1 bpj. Kepekatan anion Cl^- di dapati berdasarkan keseluruhan sampel adalah rendah iaitu sekitar 10 bpj–40 bpj dan kepekatan SO_4^{2-} yang tinggi iaitu sehingga 100 bpj dan 2 sampel dari 10 sampel diuji menunjukkan kepekatan yang sangat tinggi iaitu sehingga 500 bpj memberikan kemungkinan pencemaran di lapangan telah berlaku dari sisa kilang kimia berdasarkan lokaliti penyampelan adalah di kawasan perindustrian. Berdasarkan dengan kepekatan kation-

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

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

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

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

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Jadual 1. Ringkasan sifat-sifat fiziko-kimia tanah Aluvium Tua sepanjang lebuhraya Johor Baharu-Pasir Gudang, Johor.

SIFAT FIZIKO-KIMIA		Julat Nilai	
		OAH	OAK
Sifat-Sifat Fizik	Kandungan air, Wo (%)	7.73–24.36	2.7–15.45
	Ketumpatan relatif, Gs	2.54–2.66	2.52–2.63
	Had- had Atterberg		
	Had cecair, LL (%)	30–84	
	Had keplastikan, PL (%)	18–38	
	Indeks keplastikan, PI (%)	7–46	
	Analisis Taburan Saiz Butiran		
	Fraksi kelikir, G (%)	0–13	22–76
	Fraksi pasir, S (%)	19–81	22–75
	Fraksi lodak, M (%)	14–64	1–56
	Fraksi lempung, C (%)	4–36	1–36
	Pemadatan		
	Ketumpatan kering maksimum, Ddmax (g/cm^3)	1.45–1.55	1.62–1.69
	Kandungan air optimum, Wopt (%)	14.95–20.10	13.54–15.70
		Julat Nilai	
		OAH	
Sifat-Sifat Kimia	pH	4.31–6.45	
	Konduktiviti (mS/cm)	0.035–1.04	
	Kation Na^+ (bpj)	6.3–39.3	
	Kation K^+ (bpj)	2–38.4	
	Kation Mg^{2+} (bpj)	0–4.12	
	Kation Ca^{2+} (bpj)	0.28–6.20	
	Anion Cl^- (bpj)	9–38.5	
	Anion SO^{2-}_4 (bpj)	2.25–515.63	
	SAR	1.04–5.29	
	Kation Mono/Dwivalen	3.09–40	

kation, parameter dapat diterbitkan untuk menerangkan sifat penyerakan tanah iaitu nisbah jerapan natrium (SAR) dan nisbah kation monovalen terhadap dwivalen. Kebanyakan nilai SAR > 2 yang secara umumnya berjulat dari 1.0–6.0. Hasil dari plot graf penyerakan (rajah 2.5) Sherard et at (1979), keseluruhan sampel berada di zon C iaitu zon perantaraan. Ada juga beberapa sampel yang jatuh di zon A, zon tanah terserak. Nisbah kation monovalen terhadap dwivalen memberikan julat sekitar 3–40. Nilai-nilai ini menunjukkan bahawa kation monovalen adalah lebih dominasi dari kation dwivalen, maka menurut Mitchell (1976) yang dipetik dari Tan (1995) nilai-nilai ini menunjukkan keupayaan penyerakan tanah yang tinggi.

Secara umumnya mineralogi lempung bagi tanah Aluvium Tua adalah mineral kaolinit yang didapati secara dominan diikuti oleh ilit iaitu secara sederhana hingga jarang dan juga mineral geotit yang didapati jarang.

Sifat penyerakan tanah biasanya bergantung kepada kepekatan ion-ion di dalam tanah bertindakbalas dengan mineral lempung yang telah dinyatakan sebelum ini akan lebih cenderung jika kehadiran mineral smektit wujud di dalam sampel yang dikaji. Kehadiran mineral kaolinit akan mengurangkan kecenderungan ini kerana mineral ini mempunyai struktur kekisi tetap dan keupayaan menjerap air atau ion adalah rendah. Pemisahan antara lapisan tidak berlaku seperti mineral smektit di mana penjerapan air atau ion berlaku di permukaan luar dan bucu-bucu zarah.

Akhir sekali penulis ingin mencadangkan agar kajian seterusnya dapat dilakukan di kawasan perindustrian Pasir Gudang mengenai punca dan kesan pencemaran akan mempengaruhi sifat kimia air liang dan kecenderungan tanah tersebut untuk terserak.

Geological and related applications on the EPMA (Electronprobe Microanalyzer)

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A wide variety of materials, geological and related, have been received from research groups and the industry, for analysis with the EPMA (electronprobe microanalyzer), at the Geology Department, University of Malaya.

The EPMA at the Geology Department, University of Malaya, is a fully automated multi-tasking system with full integration of 4 WDS spectrometers with 12 analysing crystals and an EDS spectrometer for analyses and X-ray mapping of most elements in the Periodic Table down to Be.

The EPMA is able to give precise analysis of spots less than 10 microns and through X-ray maps show the distribution of elements in materials like circuit boards, concrete, steel, circuit breakers, air-filters, doorknob, discs, needles, circuit contacts, terminals, gold grains, mineral grains, paints, clays, new material coatings, contaminants and others.

Software is available to assign different colours to different elements while their intensities can be varied to enhance specific concentration related to certain minerals or features.

Equipped with an idea of the mineral composition and elemental distribution, decisions can then be made with confidence on steps to undertake to rectify the problems or improve the standard and quality of materials used.

Rare-earth and trace element patterns of Langkawi granites

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Eleven samples of the Langkawi granites have been collected and analysed for their REE and trace elements. Examinations of the REE patterns show that they have the usual 'bird-wing' shape with weak to moderately strong negative Eu anomalies. This pattern is similar to the West-coast S-type granites and is different from the I-type granites of the East coast. Based on the Eu anomalies, granites of Penerak, Pulau Bumbon and Pulau Tuba seem to have moderately strong negative Eu anomalies, whereas those of Gunung Raya batholith have weak negative Eu anomalies. Rb:Sr ratios also show similar differences with Rr:Sr ratios in Penerak, Pulau Bumbon, and Pulau Tuba granites being much higher than those of Gunung Raya. Pulau

Daya Bunting granite seems to have affinity to that of Gunung Raya rather than of Pulau Tuba. A possible source material for the Langkawi granite is the Cambrian sediments of the Machincang formation.

Perbandingan sifat fiziko-kimia tanah granit dan tanah gabro sepanjang Lebuhraya Linkedua, Johor

ALPHONSUS SIM & TAN BOON KONG

Jabatan Geologi
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43600 Bangi

Sebanyak 15 sampel tanah baki granit dan 7 sampel tanah baki gabro telah diambil di sepanjang lebuhraya Linkedua dan dikaji serta dibandingkan sifat fiziko-kimianya. Sifat fizikal yang telah dikaji merangkumi kandungan air semulajadi, spesifik graviti, taburan saiz butiran, had-had Atterberg dan parameter pemampatan yang merangkumi kandungan air optimum dan ketumpatan kering maksimum. Sifat-sifat kimia pula merangkumi sifat kimia air liang tanah termasuk nilai pH, kekonduksian, konsentrasi kation terlarut (Na^+, K^+, Ca^{2+}, Mg^{2+}) dan konsentrasi anion terlarut (SO_4^{2-}, Cl^-).

Kandungan air semulajadi, W_0 %

Nilai kandungan air semulajadi tanah granit adalah agak tidak sekata iaitu antara 10% hingga 33.94% dengan majoritinya kurang daripada 30%.

Kandungan air semulajadi tanah gabro pula secara umumnya tinggi, antara 24.33% hingga 55.54%, dengan kebanyakkan sampel menunjukkan kandungan lebih daripada 30%. Nilai yang tinggi adalah disebabkan tanah gabro yang bercorak lempung yang berupaya menjerap air.

Spesifik graviti G_s

Nilai spesifik graviti bagi tanah granit berjulat daripada 2.17 hingga 3.26 dengan kebanyakkan dalam lingkungan 2.65–2.75. Kebanyakkan nilai G_s memperlihatkan nilai yang hampir dengan nilai kuarza iaitu 2.6 yang merupakan mineral utama dalam granit.

Nilai spesifik graviti bagi tanah gabro pula tidak banyak berbeza dengan tanah granit iaitu antara 2.55–2.77, kebanyakannya menunjukkan nilai melebihi 2.6.

Taburan saiz butiran

Bagi tanah granit, julat saiznya adalah meluas, dari saiz kelikir hingga saiz lempung. Namun, saiz yang dominan adalah saiz pasir dan lodak. Julat saiz kelikir (G) adalah antara 0%–25.25%, saiz pasir (S) antara 13.85%–44.69%, saiz lodak (M) antara 18.6%–59.37% dan saiz lempung (C) antara 0%–44.7%.

Taburan butiran tanah gabro pula lebih sempit dan lebih menumpu ke saiz halus dengan saiz lodak dominan. Secara terperinci, saiz kelikir (G) berjulat 0%–2.81%, saiz pasir (S) 4.92%–27.42%, saiz lodak (M) 38.32%–68.20% dan saiz lempung (C) 23.36%–42.34%.

Had-had Atterberg

Had cecair (LL) bagi tanah granit secara umum adalah sederhana rendah dan berjulat LL = 34%–72% dengan kebanyakkan nilai kurang daripada 50% manakala had plastiknya (PL) berjulat antara 8%–39%.

Had cecair (LL) bagi tanah gabro pula adalah tinggi, lebih tinggi daripada tanah granit, berjulat 56%–85% dengan semua nilai lebih daripada 50% manakala had plastiknya (PL) antara 18%–81%. Had cecair yang begitu tinggi boleh dikaitkan dengan penjerapan air yang tinggi oleh partikel lempung.

Pengelasan bahan tanah

Bagi tanah granit, fraksi halusnya dikelaskan sebagai CL-ML iaitu lempung yang berkeplastikan rendah hingga lodak yang berkeplastikan rendah. Ada juga sesetengah sampel termasuk dalam kelas MH iaitu lodak yang berkeplastikan tinggi. Tanah gabro dikelaskan sebagai MH-CH iaitu lodak berkeplastikan tinggi hingga lempung berkeplastikan tinggi.

Parameter pemadatan

Rajah pemadatan bagi tanah granit dan tanah gabro ditunjukkan dalam Rajah 3.8 dan 3.9. Secara umumnya, ketumpatan kering maksimum tanah granit adalah lebih tinggi jika dibandingkan dengan tanah gabro dengan julat bagi tanah granit ialah 1.11 g/cm^3 hingga 1.73 g/cm^3 dengan majoriti bernilai lebih daripada 1.40 g/cm^3 dan julat bagi tanah gabro antara 0.98 g/cm^3 hingga 1.40 g/cm^3 dengan kebanyakkan bernilai kurang daripada 1.20 g/cm^3. Nilai ketumpatan kering maksimum yang lebih tinggi mungkin disebabkan kandungan air optimum yang lebih rendah iaitu antara 7% hingga 46% dengan kebanyakan sampel memberikan nilai kurang daripada 25% jika dibandingkan dengan tanah gabro yang memberikan nilai kandungan air optimum antara 19% hingga 44% dengan kebanyakan bernilai lebih daripada 25%.

pH

Secara umumnya nilai pH bagi tanah granit dan gabro adalah berasid rendah dan agak serupa dengan tanah granit menunjukkan julat antara 6.15 hingga 6.63 manakala tanah gabro menunjukkan julat 6.07 hingga 6.36.

Kekonduksian elektrik (Konduktiviti)

Secara umumnya, nilai kekonduksian yang diberikan oleh kedua-dua jenis tanah adalah rendah. Daripada rajah itu dapat diperhatikan bahawa nilai purata kekonduksian bagi tanah granit lebih tinggi daripada tanah gabro. Julat nilai kekonduksian bagi setiap jenis tanah adalah seperti berikut:

Tanah Granit	:	0.089–0.284 mS/cm
Tanah Gabro	:	0.074–0.161 mS/cm

Konsentrasi kation terlarut

Secara umumnya jumlah kation terlarut utama dalam semua jenis tanah adalah rendah. Bandingan antara tanah menunjukkan jumlah kation terlarut dalam tanah gabro adalah lebih rendah daripada tanah granit.

Ringkasan jumlah kandungan kation jenis tanah adalah seperti berikut:

Tanah granit	:	7.45–22.44 ppm (kebanyakkan > 10 ppm)
Tanah gabro	:	6.49–15.74 ppm (kebanyakkan < 10 ppm)

Konsentrasi anion terlarut (SO_4^{2-}, Cl^-)

Daripada hasil analisis konsentrasi anion, didapati secara keseluruhannya kandungan anion adalah lebih tinggi daripada jumlah kandungan kation dan konsentrasi ion Cl^- didapati lebih tinggi daripada ion SO_4^{2-} dalam hampir kesemua sampel.

Jumlah konsentrasi anion bagi jenis tanah granit dan tanah gabro adalah hampir serupa dan tidak menunjukkan perbezaan yang jelas.

Keynote Paper III
Stability of slope cuts in metamorphic bedrock areas of Peninsular Malaysia

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Low to medium grade regionally metamorphosed rocks of the greenschist facies are the predominant metamorphic bedrock of Peninsular Malaysia and include almost all its' Lower and Upper Palaeozoic rocks. Lower Palaeozoic strata mostly occur as medium grade regionally metamorphosed rocks and consist of mica and quartz-mica schists, marbles, graphitic schists, quartzites and amphibole schists. Upper Palaeozoic strata constitute low grade regionally metamorphosed rocks and mainly occur as quartzites and phyllites interbedded with argillites, slates, meta-siltstones and meta-volcanics. Although a variety of metamorphic rocks is found, only three groups are of importance in discussions on slope stability due to their wide-spread occurrence, i.e. Mica Schists, Interbedded Quartzites and Phyllites, and Marbles.

In areas of mica schists (including quartz-mica and graphitic schists), weathering profiles show variable morphological features that are influenced by not only their topographic settings, but also by the structural planes, textural, chemical, and mineralogical variations, inherent in the bedrock mass. Two broad morphological zones can be differentiated; an upper Zone I of completely weathered bedrock, and a lower Zone II of in situ, moderately to highly weathered bedrock. In some rare cases, a bottom Zone III of slightly weathered to unweathered bedrock can also be seen. Zone I is up to about 5 m thick and consists of soft to very stiff, silty to sandy clays, often containing lateritic concretions. Zone II is up to 30 m and more thick and consists of alternating bands of variously coloured, stiff to hard, silts and sandy silts that show distinct relict bedrock textures and structures.

In low-lying to undulating terrain over mica schists, low cuts (< 5 m high) expose morphological Zone I materials and are usually stable, though steep ones (> 60° overall cut angle) can be affected by earth falls and shallow slips. These small failures occur during rainfall, long after the end of construction, and are preceded by the development of tension, and desiccation, cracks. High cuts (> 5 m high) expose materials of morphological Zones I and II and are usually stable, though at steep cuts (> 50° overall cut angles), the Zone I materials can be affected by small earth falls and shallow slips, and the Zone II materials by wedge failures, slab and block slides. In low-lying to undulating terrain, when groundwater tables are intersected by the slope cuts, slumps and compound slides can occur under undrained and drained conditions.

In hilly to mountainous terrain over mica schists, low cuts (< 5 m high) expose morphological Zone I materials and are usually stable, though steep ones (> 60° overall cut angle) can be affected by earth falls and shallow slips. High cuts (> 5 m high) expose materials of morphological Zones I and II and are also usually stable, though at steep cuts (> 50° overall cut angle), the Zone I materials can be affected by small earth falls and shallow slips, and the Zone II materials by wedge failures, slab and block slides. The small failures involving Zone II materials occur during periods of rainfall and result from sliding along favorably orientated, relict structural discontinuity planes, particularly foliation. Large compound slides can also sometimes affect the high cuts, particularly during or following, periods of continuous rainfall when a rise in groundwater tables can lead to sliding that is controlled in part by relict foliation. 'Softening' of Zone II materials with time and exposure can also gradually lead to disaggregation (air slaking) of slope materials and result in small debris falls. In areas where the slightly weathered to unweathered bedrock of Zone III is exposed at steep cuts (> 60° bench face angles), small to large, block and slab slides, as well as wedge failures can occur, often during rainfall, as a result of sliding along day-lighting, structural discontinuity planes, particularly foliation.

In areas of interbedded quartzites and phyllites, weathering profiles show extremely variable morphological features that are influenced by not only their topographic settings, but also by the structural planes, textural and mineralogical variations, inherent in the heterogenous bedrock mass. Two broad morphological zones can be differentiated; an upper Zone I of completely weathered bedrock, and a lower Zone II of in situ, moderately to highly weathered bedrock. In some rare cases, a bottom Zone III of slightly weathered to unweathered bedrock can also be seen. Zone I is up to about 5 m thick and consists of soft to very stiff, silty to sandy clays, and dense clayey sands, often containing lateritic concretions. Zone II is up to 30 m and more thick and consists of alternating bands of variously coloured, stiff to hard, clays, silts and sandy silts, and dense to very dense, sands and silty sands, that show distinct relict bedrock textures and structures.

In low-lying to undulating terrain over interbedded quartzites and phyllites, low cuts (< 5 m high) expose morphological Zone I materials and are normally stable, though steep ones (> 60° overall cut angle) can be affected by earth falls and shallow slips. These small failures occur during rainfall, long after the end of construction, and are preceded by development of tension, and desiccation, cracks. Higher cuts (> 5 m high) expose materials of morphological Zones I and II and are usually stable, though at steep cuts (> 60° overall cut angle), the Zone I materials can be affected by small earth falls and shallow slips, and the Zone II materials by wedge failures, slab and block slides. In low-lying to undulating terrain, where groundwater tables are intersected by cuts, slumps are likely to occur under undrained and drained conditions.

In hilly to mountainous terrain over interbedded quartzites and phyllites, low cuts (< 5 m high) only expose morphological Zone I materials and are usually stable, though steep cuts (> 60° overall cut angle) can be affected by earth falls and shallow slips. Higher cuts (> 5 m high) expose materials of morphological Zones I and II and are often stable, though at steep ones (> 50° overall cut angles), the Zone I materials can be affected by small earth falls and shallow slips, and the Zone II materials by wedge failures, slab and block slides. The small failures involving Zone II materials occur during periods of rainfall and result from sliding along favorably orientated, relict structural discontinuity planes, particularly bedding. Large compound slides can also sometimes affect the higher cuts, particularly during or following, periods of continuous rainfall when a rise in groundwater tables leads to sliding that is controlled in part by relict bedding planes. 'Softening' of the Zone II materials with time and exposure can also gradually lead to their disaggregation (air slaking) of slope materials and result in small debris falls. In areas where the slightly weathered to unweathered bedrock of Zone III is exposed at steep cuts (> 60° bench face angles), small to large, block and slab slides, as well as wedge failures can occur, often during rainfall, as a result of sliding along day-lighting, structural discontinuity planes.

In areas of marble bedrock, weathering profiles are extremely thin and often absent, due to the removal by solution of almost all the weathering products. Bedrock outcrops are found both at the surface in the form of steep-sided, isolated hills and at depth in the form of a subsurface karst covered by a thick layer of alluvium. These bedrock outcrops show very variable, external and internal features, including the development of pitted, rilled and scalloped surfaces, as well as the development of solution hollows, notches, caves and tunnels of variable sizes. Slope cuts of any height in marble bedrock are primarily dependent upon the orientations, and surficial features, of its' inherent structural discontinuity planes, particularly joint and fault planes. At cuts of moderate to steep angles (> 50° overall cut angle), day-lighting discontinuity planes can result in small to large, block and slab slides, as well as wedge failures.

It is concluded that the stability of slope cuts in metamorphic bedrock areas of Peninsular Malaysia is dependent upon several factors; the most important one being the structural discontinuity planes inherent in unweathered bedrock, and indistinctly to distinctly, preserved as relict structures in their weathering profiles. The overall, and individual bench, angles of slope cuts is also important in influencing their stability, whilst the topographic setting determines the influence of groundwater tables. Climatic conditions, as rainfall duration and intensity, also influence the stability of the cuts.

The use of geoelectrical imaging to study groundwater pollution at Gemenceh waste disposal site, Negeri Sembilan

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Geoelectrical imaging method is now frequently used for environmental pollution studies. The method basically maps the distribution of the resistivity of subsurface materials. Ground water that has been contaminated by leachate frequently has a significantly lower resistivity value. The geoelectrical imaging technique was used in this study to help delineating contaminated ground water at a domestic waste disposal site of Gemenceh, Negeri Sembilan. The quality and contaminated zone of the underground water was determined based on the measured geoelectrical resistivity value of subsurface materials. Two dimensional resistivity profiles and subsurface geological information from both bore hole as well as seismic refraction data were used to interpret the extension and direction of the contaminant flow within the underground water system in the area being studied.

The contaminated zone of the ground water aquifer gives relatively low resistivity value of less than 10.0 ohm-m compared to that of the uncontaminated groundwater which resistivity value ranges from 10 to 100 ohm-m. The geoelectrical resistivity and chemical analysis of the water samples indicate that the underground water aquifer in all bore hole except SP8 and SP12 have been contaminated by the leachate. In comparison, the ground water sample from bore hole SP4 is highly contaminated. However the ground water contamination in this area appears to be confined within the vicinity of the dumping ground. The resistivity profiles suggest a flow of contaminant towards north east which follows the regional trend of ground water flow of the area.

The seismic refraction result gives three subsurface layered material. The first or top layer has low velocity (< 500 m/s) which corresponds to unconsolidated soil of silty sand to sandy silt. Whereas the second or intermediate layer has an average seismic velocity of greater than 1,600 m/s which is interpreted to be the water saturated aquifer layer. The third layer shows relatively high velocity (> 2,500 m/s) which represents the weathered material of the granite bedrock.

Geochemical exploration for stream sediments and water quality determination in Sungai Pahang basin, Pahang Darul Makmur

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The study area is located in the Sungai Pahang Basin and its immediate surroundings, bounded by latitude 101°30'E to 103°30'E and longitude 3°00'N to 4°45'N. The scope of study includes geochemical exploration using stream sediments, and determination of water quality of the entire stretch of Sungai Pahang as well as groundwater quality around Pekan. For geochemical exploration, 291 stream sediment samples were collected for Sn, Pb, Cu, Zn, Fe, Mn, Ni, Cd, Cr and Au analysis. A total of 26 anomalous areas have been detected. The distribution of the anomaly patterns show that there are indications of Au, Sn, Fe-Mn and Pd-Cu-Zn mineralization. Au and Sn mineralization is located in the western part of the study area near to the Bentong-Raub Suture, and the Fe-Mn and Pb-Cu-Zn mineralization occur in the center and eastern part of the study area. Correlation analysis indicates that Cd, Fe, Mn, Pb, Cu and Zn are associated with each other. F test also indicates that the distribution of Fe and Mn in this area are wide, however distribution of Pb, Cr and Ni are limited. A total of 291 samples of stream water samples have been collected from the entire stretch of Sungai Pahang and its major tributaries. The parameters tested include physical, chemical and biological parameters. From water quality classification, most of the Sungai Pahang and its tributaries can be classified as Class II water except for tributaries viz. Sungai Luit, Sungai Jempul, Sungai Tekam, Sungai Bentong and Sungai Chenderoh, all of which fall in Class III, water. Results of this study indicate that the river is contaminated not only from human activities but also from natural resources viz. rock types. A total of 47 groundwater samples have been collected from twelve boreholes around Pekan for various physical and chemical tests. Groundwater analyses show that there is some salt water intrusion around the Kuala Pahang and Kampung Bentan areas. The quality of the groundwater in other boreholes shows normal groundwater quality, which can be utilized for domestic purposes.

Engineering geology of Cyberjaya, Selangor Darul Ehsan

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Cyberjaya, encompassing an area of 100 km^2 and located on the NE of the Dengkil District is being developed as the IT centre for the Multimedia Super Corridor (MSC). The construction of the infrastructure is almost complete while presently the University of Telecommunication and several other private venture IT facilities are being built. The development is expected to be accelerated in the near future. The government has expressed the intention of developing Cyberjaya as a zero defect city. It is thus very important that as much geotechnical information as possible be gathered to make this zero defect city a reality.

All exposed rocks in the Cyberjaya area are affected by tropical weathering and shows Grades of III, IV, V and VI. Soil, rock and complex soil-rock mass failures were observed in 9 out of the 28 cut slopes in Cyberjaya. Soil slope failures include earth fall, slump and planar failure. Many slopes were also affected by rill and gully erosion. Rock mass failure observed include wedge and planar slide. Complex soil-rock mass failures take the form of slump and affects only cut slopes in the Kenny Hill Formation. The schist of the Hawthornden Formation though affected by weathering (Grade IV) is still a moderately strong rock. The Kenny Hill Formation rocks show lesser strength and are regarded as weak rocks. Flat and rolling areas underlain by residual soil of the Kenny Hill and Hawthornden Schist are geotechically sound for infrastructure development and construction of buildings and other facilities. Large tracts of alluvium between the residual soil areas in Cyberjaya required special consideration as they contain peaty soils and clays which are geotechnically not sound. The far western part of Cyberjaya is underlain by bedrock of mainly buried karstic marble with minor schist and granite. This far western part of Cyberjaya had been used and is presently being mined for alluvial tin. The very thick alluvial sediments and tailings (> 40 m) which may trap slime layers and the buried karstic limestone bedrock required special investigation technique if it is to be used for any development.

In order to achieve the expressed intention of constructing a zero defect city, the geological and geotechnical aspect of Cyberjaya must be given utmost consideration.

Distribution of pollutants in groundwater system at Gemencheh landfill site in Negeri Sembilan, Malaysia

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The landfill site Gemencheh, Negri Sembilan covers an area of 15 acres and is situated about 150 km south of the Malaysian Institute for Nuclear Technology Research (MINT). Ever since its operation in 1981, an estimated 39, 780 metric ton and as high as 1–2 metre of domestic waste has been disposed to the site. This landfill is divided into two sections, the North East area covers the old dumping site whereas the South West represents the new dumping area. The open system domestic waste disposal on the land surface is employed at this site. The Gemencheh landfill site is basically a granitoid covered with residual soil resulted from weathered granitoid process. In general, the residual soil consists of sandy silt or sandy clay or silty sand. Ground water flow in this site is influenced by the recharge areas coming from the North West, the South West and South East directions. Since the refuse has the potential to deteriorate the ground water system, the study of pollutants distribution in landfill area was performed using the integrated nuclear, geophysics and hydrochemical techniques. These techniques have been able to determine the species, the flow velocity, flow direction and the distribution of pollutants in ground water system. From the study, the flow velocity is between 0.1–8.0 metres per day. The variation in flow velocity is depending upon the media involved whether the layer is sandy clay, sandy silt or silty sand. Besides this, the flow velocity is also influenced by the recharge. The flow direction of the pollutants does not follow the regional direction that is to the East but rather to the North East direction. The determination of the chloride, sulfate, nitrate and electrical conductivity shows that the migration of pollutants is localised and confined to the landfill site only.

Landslide hazard zonation mapping using remote sensing and GIS techniques

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The aim of this study is to enhance the effectiveness of using remotely sensed data and GIS techniques for slope instability studies with emphasis on the landslide cases. This study will result in the assessment and prediction of current and future instability areas, which can be used by planners and decision-makers in the country. The chosen study area is Cameron Highlands as the most unpleasant issues in this area are the casualties and damages caused by frequent occurrences of landslides became important headlines.

The main task for the analysis preparation is the preparation of the demarcation of the landslide area either interpreted from satellite imagery or aerial photographs into the map. This landslide distribution map is prepared with each of the polygon is assigned with its unique code. Others map like lithology, geomorphology, structural geology with emphasis for the lineaments and faults, distance map, slope and aspect map also been

created either generated or extracted from the existing ancillary data. The result of slope instability study by using the Information Value Method, one of the modeling method used has given the indication of the most relevant causative factors influencing the landslides occurrences in this area. The very high risk area covers 164,600 m^2, mostly emphasizing several main road slopes and part of the market gardening area in Bertam Valley and some sloping areas in Tanah Rata and surroundings.

Geological assessment of the cut slope failures in highly weathered igneous rocks at the Senai Toll Plaza of the Malaysia-Singapore Second Crossing Expressway, Johor, Malaysia

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During the wet season in mid April 1997, a major slope failure has occurred in a slope cut near the Senai Toll Plaza of the Malaysia-Singapore Second Crossing Expressway. The failure can be described as a deep sliding (Varnes, 1978; Ibrahim Komoo, 1986) in a zone of highly weathered rocks (grade IV) to residual soil (Grade VI), although the failure mechanism took place in the form of double wedge controlled by relict structural discontinuities.

Detailed geological mapping was carried out to identify the geological factors that might cause the failure. Field evidences indicate that the failure is structural-controlled, and thus discontinuity survey was thoroughly carried out on every berm slopes including the failure scarps to identify the attitude and influence of discontinuities towards the slope instability. The conventional discontinuity survey (e.g. Geotechnical Control Office Hong Kong, 1984; Ibrahim Komoo & Ibrahim Abdullah, 1983) could not be conducted because the slope surface is almost entirely turfed and the outcrops are too limited as well as intensely weathered. Thus, the study has to be carefully done in a "walk-over" survey over almost the entire slope surface to detect the presence of any form of relict discontinuities. The mapping was also extended to the areas around the failed section to identify environmental factors that might contribute towards the slope failure.

Results of the kinematics stability analysis on the discontinuity data clearly indicate that the elements of instability already existed in the slope mass due to the presence of unfavourably daylighting intersecting sets of discontinuity. The sliding planes were developed along the relict fault zone, relict joints and also along a highly weathered aplite (kaolinite) dyke. There are signs that surface runoff flow towards the failed sections. Man-made topographic depressions found in the oil palm estate above the slope were responsible for temporary water ponding, which encourage water infiltration. Infiltration rate was also accelerated by the widespread occurrences of shrinkage cracks in the clayey soil surfaces, which are interconnecting with the relict discontinuities within the slope. Water also infiltrated into the slope through the cracks on the concrete berm drains and water spillage from the clogged up drains.

In conclusion, the slope failure is primarily caused by the presence of relict structural discontinuities. Water was identified as the main triggering factor. An almost continuous daily rainfall prior to failure has led to increasing flow of surface runoff and rate of infiltration. This subsequently led to saturation and drastic decrease of shear strength parameters of the materials and discontinuity planes. It is suggested that stability assessments of slope cuts in highly weathered rocks need to take into consideration not only the material strength parameters, but also most importantly relict discontinuities and local climatic conditions and other surrounding factors. The constructed slope should also be constantly and continuously monitored, especially during the rainy seasons.

The geology, petrography and index properties of limestone and granite aggregates for the construction industry in Central Selangor-Federal Territory

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The remarkable growth in the K.L., and P.J. for the past 15 years and the recent setting up of Putra Jaya and Cyberjaya within the central Selangor region has resulted in the increase in the use of construction aggregates. The coarse aggregate needs of the Federal Territory and the Central Selangor region is presently supplied by about 35 natural rock aggregate quarries. It is estimated that about 25 million tonnes of natural rock aggregates are produced by these quarries per year worth no less then RM250 million. There is still some shortages of the aggregate in the Central Selangor-Federal Territory area due to seasonal demand.

In the Federal Territory and the Central Selangor region, granite (28 quarries), limestone (2) of the Kuala Lumpur Limestone and sandstone (1) of the Kenny Hill Formation had been used for the purpose of producing natural rock aggregates for the construction industry. The quartzite and the chloritoid schist of the Dinding Schist can potentially be used for the production of natural rock aggregates also. The rocks in the Federal Territory and the Central Selangor area had been affected by faulting and shearing to a varying degree. These often become channel ways for solutions which caused the alteration and subsequent weathering of the rocks.

Three quarries in this region were mapped to demarcate the different rock types, the weathering grades and the affects of the faulting and alteration. Samples were collected according on the rock types and the effects of these factors. The index aggregate properties of these samples were tested according the British Standard or ASTM procedures. For each sample, detailed petrographic examination was carried out.

The fresh and unaffected granite and marble make very good natural rock aggregates which come well within the limits set by the Jabatan Kerja Raya. Rocks which are affected by weathering, faulting, shearing and alteration were found to show poorer index properties and some are even below the limits regarded as suitable for various construction purposes. Field and petrographic examination can be used to distinguish rocks with poor index aggregate properties from those which are good for the production of natural rocks aggregates for the construction industry in the Federal Territory and Central Selangor.

Primary geological features in relation to cut slope instability — a case study in Pengkalan Hulu (Keroh), Hulu Perak

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The case study of primary geological features in relation to cut slope instability was carried out in an area which is located about 35 km north of Grik along the Kg. Lalang-Kg. Air Panas highway, between kilometer 9.5–9.0 from Keroh near the Felda Nenering village.

Geologically the study area is underlain by two formations, namely, Kroh Formation and the continental deposits of the Nenering Tertiary Beds, the former acting as the basement unit for the latter, separated by a plane of angular unconformity. The Kroh Formation consists of four main facies, that is the Argillaceous Facies, Arenaceous Facies, Siliceous Facies and Calcareous Facies whereas the Nenering Tertiary Beds consist of a braided river pattern of channel fill alluvial-fluviatile deposits.

A massive landslide occurred in June 1996 involving weathered to completely weathered material of the

overlying Nenering Tertiary Beds where a combination of slump and flow movements brought down a huge volume of earth from one side of the road, on to the tarmac and on to the other side, totally blocking the road. The slump occurred on a pre-existing failure plane that is the plane of unconformity above the fresh grade I–II limestones of the calcareous facies of the Kroh Formation. The slump has exposed the higher level of the limestone bedrock underlying the area besides the already exposed outcrop along the road stretch.

Description and classification of filled joint in granite — an approach

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The weathering degree of joint blocks and its infilling affects the deformational behaviour of filled joint. To appreciate its behaviour and level of criticality to an engineering construction, filled joint should be described and classified according to its weathering degree. This paper proposes the procedures for classifying filled joint in the field. Based on weathering classification of weathered rock, the suggested method is suitable for filled joint resulting from differential weathering of joints in granite.

A systematic field classification scheme is one of the most practical methods for obtaining initial data pertaining to geological materials and structures which are difficult to sample.

Like weathered rock masses, filled joints are formed by weathering process. Therefore, one feasible method to classify them in the field is through weathering classification of their major components namely, joint blocks and infilling. The weathering classification of rock material and rock mass can be used to classify filled joint into various weathering grades. The joint-block system undergoes at least four weathering stages before joint aperture could be filled with residual soils. When infill consists of layers of material, the most weathered layer controls the joint behaviour. Therefore, it is essential to acknowledge its presence irrespective of the weathering grade of the joint-block system.

The geological and mechanical characteristics of certain components of filled joint can be assessed in the field and laboratory. These include crushability, particle grading and weathering grade of the infill, and strength of the joint surfaces. If the assessed characteristics can be numerically graded according to their degree of significance in controlling joint behaviour, they may be used as basis for a comprehensive classification. A research is now being undertaken (RMC/UTM Vot 71319) to study this possibility.

Geologi kejuruteraan kawasan Taman Bukit Utama, Ulu Kelang-Ampang

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Kawasan kajian merupakan kawasan perumahan baru iaitu Taman Bukit Utama di Bukit Antarabangsa dan mempunyai keluasan kira-kira 4.0 km^2. Litologinya terdiri daripada granit biotit berporfiritik (Unit 1), granit 2-mika berporfiritik (Unit 2) dan granit kuarza-feldspar-tourmalin (Unit 3) yang berusia Trias. Telerang biasanya hadir dalam bentuk daik atau intrusi kecil yang menerobos ketiga-tiga unit, diikuti oleh Unit 3 yang merejah Unit 1 dan 2. Pada keseluruhannya, jasad granit di kawasan ini tericih dan terkekar dengan hebat.

Cerun di Taman Bukit Utama pada keseluruhannya boleh dikelaskan sebagai cerun batuan yang dipotong oleh sekurang-kurangnya tiga set kekar yang berbagai orientasi. Set kekar dominan di kawasan tersebut berjurus 110-120/290-300 dengan kemiringan 74°-90°. Bahan pengisi utama dalam kekar ialah mineral lempung, telerang kuarza dan telerang tourmalin. Manakala kekasaran permukaan kekar adalah beralun dan/ atau bertangga. Kesan aliran air atau mata air boleh diperhatikan pada cerun potongan. Ini menandakan bahawa paras air tanah adalah tinggi. Batuan di kawasan kajian telah terluluhawa dengan hebat dan keenam-enam gred luluhawa boleh ditemui pada singkapan. Langkah penstabilan cerun yang dilakukan pada lapisan tanah bergred VI dan V ialah tutupan rumput.

Pada umumnya cerun-cerun potongan ini curam dan mungkin boleh menimbulkan masalah kestabilan cerun. Penilaian kestabilan cerun telah dilakukan berdasarkan orientasi dan ciri set ketakselanjaran. Daripada kajian lapangan, beberapa contoh kegagalan satah dan kegagalan baji boleh diperhatikan. Analisis kinematik data-data ketakselanjaran menunjukkan bahawa cerun batuan di kawasan kajian berpotensi untuk gagal dalam bentuk kegagalan satah, kegagalan baji dan kegagalan terbalikan. Kombinasi set-set kekar yang padat pada beberapa cerun memungkinkan kegagalan lingkaran (cerun batuan) dan kegagalan gelongsoran (cerun tanah) pada gred VI.

Kesimpulannya, masalah kestabilan cerun bukan sahaja bergantung pada kehadiran satah-satah ketakselanjaran, malahan juga bergantung pada faktor-faktor lain seperti darjah peluluhawaan bahan, pengaruh iklim, tindakan larian air permukaan dan air bawah tanah. Faktor-faktor sampingan lain termasuk langkah penstabilan cerun yang kurang memuaskan, kelemahan pada rekabentuk cerun dan penyelenggaraan cerun yang tidak sempurna. Contohnya pembuangan sisa-sisa dan sampah-sarap domestik menghalang sistem saliran air dan perparitan daripada mengalirkan air yang berlebihan.

An integration of geophysical and geotechnical methods in the assessment of slope stability at Kamsis G, UKM

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A study was undertaken to investigate the possible cause of slope failure at Kamsis G, UKM that had occurred on 20th October 1997 after a period of heavy rainfall. The failed section of the slope was part of a fill ground that was constructed about a year before the failure had occurred. An integration of geophysical and geotechnical methods was selected comprising several *in situ*, laboratory and slope stability analysis in order to deduce the possible failure mechanism. Geophysical tests encompassing P and S wave seismic refraction and the electrical resistivity imaging were conducted to cover extensive areas of the site. Both P and S wave seismic refraction have shown a first layer of distinct low velocities to depths of 1 to 6 m at various locations of the site which can be correlated to the fill material. The electrical resistivity imaging has also revealed an extensive high resistivity area of the site that has reinforced the result from the seismic refraction on the fill material. Geotechnical site investigations encompassing boreholes, Mazier sampling, standard penetration testing, stand pipe piezometer and sand cone density test were conducted covering both the fill and the original ground. Mazier samples from various depths of the borehole has shown that the top portion of the fill is of loose material which is further supported by low standard penetration values (SPT) and low *in situ* density obtained from the sand cone test. Occasional measurements from the piezometer have shown that there is no water recorded during the day without rainfall. Laboratory test that includes basic sieve analysis and Atterberg limits has classified the fill material to be sandy silt of low plasticity. Drained shear box test from both the vertical and horizontal orientation of the undisturbed samples have shown that the fill material is of low cohesion values of 9.5 to 61.7 kN/m^2 with a friction angle of 23 to 40 degrees. The *in situ* density an the shear strength parameters are then used in a slope stability analysis using the computer program SLOPE/W that

employs various limit equilibrium methods. Almost all the limit equilibrium methods used have revealed the anticipated slip failure planes to be almost consistent with each other. Further analysis using the finite element program SIGMA/W based on linear elastic material has shown the possible displacement, stress and the strain distributions of the slope profile based on assumed elastic properties of the soil.

Faults in the Lower Detrital Member at Teluk China Mati, Pulau Tanjung Dendang

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Pulau Tanjung Dendang is situated at northeast of the Langkawi main island. It is an elongated island which is aligned in almost north- south direction. The whole island comprises the Setul Formation of Ordovician to Lower Devonian age. One third of the island (the northern part) consists of the Middle Ordovician dark grey limestone. The limestone is thickly bedded and fossiliferous. Two thirds of the island (the southern part) comprises the Upper Ordovician or possibly Silurian limestone. The limestone is dark grey and thickly bedded. Fossil has never been found from this part of the island. The Lower Detrital Member is in between the limestones. The Lower Detrital Member is exposed in Teluk China Mati, a small bay facing east. The exposed Lower Detrital Member consists of bedded dark grey mudstone and chert. Fault boundary was observed between the Middle Ordovician limestone on top of the Lower Detriotal Member. The boundary between the Upper Ordovician limestone and the Lower Detrital Member has been interpreted to be thrust fault (Jones, 1981)

The bedded mudstone and chert are complexly folded and faulted. The folds vary from gentle open fold to tight isoclinal inclined fold. Sense of displacement on faults is determined by fault drag and offset layer. Fault planes are commonly filled with fault breccia and thin mylonites.

There are three groups of fold orientations. The first group is folds plunging to north northeast and south southwest. The second group is folds plunging to northwest and to southeast. The third is a small group of folds plunging to north. Two major sectors of fault orientation have been identified. The relationship between the faults and the folds will be discussed later.

Geomorphological mapping: a case study in the southern parts of the Langkawi Islands

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This study involves the geomorphological mapping in the southern parts of the Langkawi Islands which include Pulau Dayang Bungting, Pulau Tuba and Pulau Singa Besar. Geologically the area consists of the Setul Formation which is compose of mainly limestone with minor sandstone and shale (Detrital Members), the Singa Formation which is consists of mainly mudstone and shale with minor sandstone, the Chuping Formation which is compose of limestone and granitic rocks. In addition, approximately 30% of the study area is covered with unconsolidated Quaternary sediments.

The classification of the geomorphological units and subunits is mainly based on the degree of steepness and morphogenesis of the landform respectively as suggested by van Zuidam (1985) through aerial photographic interpretation. Geomorphological units are classified into flat to gently sloping terrain, moderately sloping terrain and extremely steep terrain according to its degree of steepness. The dominant subunits in Pulau Dayang Bunting is of karstic origin that include karst hills and mountains, star karst zones, conical karst zones, tower karst hills, sinkhole, karst alluvial plains and karst marginal plains. Non-karstic subunits include denudational hills, denudational mountains, sandy beaches and fluviol-marine backswamp. The geomorphological subunits in Pulau Tuba consist of denudational hills, talus, fluviol-marine backswamp, sandy beaches, marine terraces, tidal flats, karstic denudational slopes, tower karst hills and sinkhole. The geomorphological subunits of Pulau Singa Besar consist of denudation hills, denudation valleys, sand beaches, fluviol-marrine backswamps and tower karst hills. This study produces a 1:20,000 scale geomorphological map of the study area.

Tafsiran struktur Pulau Langgun Langkawi

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Peta geologi Pulau Langgun yang pernah diterbitkan yang terdiri daripad Formasi setul menggambarkan keadaan struktur yang agak mudah terutama dalam batu kapur. Jones (1966) menunjukkan taburah arah jurus dan kemiringan batuan yang terdapat di sini. Seterusnya Kimura dan Jones (1967) menunjukkan batuan Formasi setul di bahagian timurlaut Pulau Langkawi terlipat mudah dengan arah paksi mengarah ke barat-baratlaut. Jones (1981) menunjukkan batuan gersik di Teluk mempelam mengalami terlipat mudah.

Fotograf udara pulau ini pula menunjukkan terdapat beberapa lineamen yang agak jelas.Arah lineamen agak berbagai anrata arah baratlaut hingga timur laut. Cerapan lapangan menunjukkan batu kapur di pulau ini mempunyai arah jurus yang berubah-ubah. Purubahan arah jurus agak ketara pada bahagaian yang menghampiri satah atau zon sesar. Secara umum lapisan di sini berjurus sekitar baratlaut miring ke arah timurlaut sebesar antara 25 hingga 40 darjah. Kerencaman struktur boleh diperhatikan dibahagaian utara pulau ini dengan jurus pada arah hampir utara-selatan miring samaada ke timur atau ke barat sebesar antara 30 hingga 80 darjah. Umumnya kemiringan lapisan di sektor ini adalah lebih curam membentuk satu sinklin dan satu antiklin bersaiz agak besar dengan panjang gelombang sekitar 1 kilometer, menunjam ke arah utara.Sempadan timur dan barat zon ini ditadai dengan satah sesar sesar. Sesar di bahagian barat jelas merupakan sesar songsang, manakala sesar di sempadan timur tidak dapat ditentukan jenisnya dilapangan. Satu Satu lipatan rebah bersaiz sederhana dengan panjang gelombang sebesar puluhan meter dapat diperhatikan pada baghagian selatan pulau ini dengan arah paksi menunjam ke arah baratlaut. Di sini juga diperhatikan terdapat satu sesar songsang yang berjurus ke baratlaut, miring ke timutlaut.

Cerapan ini jelas menunjukkan arah paksi lipatan dalam batu kapur formasi setul tidak semudah yang digambarkan sebelum ini. Di sini terdapat arah paksi lipatan yang berbeza daripada yang gambarkan dalam peta terdahulu bagi kawasan berdekatan Ternyata sesar terutamanya sesar songsang yang terdapat di sini memainkan peranan bagi mengawal struktur di Pulau Langgun ini.

Keadaan struktur dalam Ahli Gersik Formasi Setul di Teluk Mempelam juga mengambarkan keadaan yang cukup rencam dengan arah paksi lipatan yang perbagai dan dikawal oleh struktur sesar. Tafsiran tentang terdapat satah ketakselarasan yang memisahkan batuan Paleozoik bawah daripada Paleozoik atas sangat meragukan. Sempadan antara kedua-dua kumpulan batuan tersebut searah dengan arah sesar yang terdapat di sini.

Facies architecture, stratigraphic evolution and tectonic history of the Miocene alluvial fan of Batu Arang

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Three lines of evidence suggest that basin development of the Tertiary Batu Arang Basin, at least during the deposition of the Boulder Beds (Miocene to Pliestocene), were controlled by the development of contemporaneous fault system, with deposition exceeding subsidence.

Evidence 1: The facies organisation of the Boulder Beds shows that distal, subaerially deposited and oxidised, orthconglomeratic, stream flow alluvial plain facies is overlained by proximal, subaqueously deposited and reduced debris flow, dark gray paraconglomeratic facies. This may indicate a basinward movement of the source area.

Evidence 2: The red orthoconglomeratic unit is separated from the overlying gray paraconglomeratic unit by an intrabasinal angular unconformity which overlies a distinct palaeosol horizon. This suggest that Red Conglomeratic Unit and the Gray Conglomerate Unit are deposited in distinctly different, temporally separated basins.

Evidence 3: The structural styles exhibited by the Red Conglomeratic Unit and the Gray Conglomeratic Unit are distinctly different. The red conglomeratic layers show wavy or undulating beds and also localised warping, while the upper gray conglomerate layers are almost flat bedded. This suggests that different tectonic regimes operated before, during and after the deposition of these units.

These evidences suggest that the Boulder Beds were deposited in a tectonically active basin.

Application of *P* & *SH*-waves for rock anisotropy studies: Genting Highlands case study

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Seismic refraction surveys utilizing *P & SH-waves* were carried out over an abandoned quarry at Genting Highlands in order to study the anisotropy of the bedrock of that site. Shear (S) and Compression (P) acoustic velocities of the subsurface refractor have shown significant variations in spatial distribution of velocity measurements. These variations in velocity values were compiled and then qualitatively correlated with surface fracture surveys conducted during the course of acquiring field data.

Seismic *P & SH-wave* velocity values obtained from in situ measurements have been used for calculating the Anisotropy factor, Slowness factor & Poisson's ratio. The petrophysical parameters computed are then contoured and used for identifying the orientation of fracture zones along the subsurface refractor.

Field Data Acquisition and Processing

Seismic Refraction method is a geophysical tool widely used for routine engineering site investigations (Redpath, 1973) whereby the subsurface structure of the surveying area is inferred from interpretation of the seismic field data gathered from surface measurements. The *SH*-refraction method has found increasing use for seismic anisotropy studies since the velocity derived from such surveys are direction dependent (Danbom and Domenico, 1987).

The survey site is located in an abandoned quarry at Genting highlands, Pahang State, and the survey lines were set up on the floor of the quarry. The lithology of the site is made up mainly of two layers. The top layer consists of aggregate of rhyolite mixed with clayey silty coarse sand while the second layer or bedrock is made up of rhyolite.

The objective of this study is to delineate the topography of the rhyolite bedrock, determine petrophysical parameters of the bedrock (refractor layer) and to identify the orientation of the fractures on the rhyolite bedrock. Surface fractures surveys are also involved in this study, and mapped in details along outcrops exposed in the site.

Seismic Refraction surveys utilizing *P & SH-waves* are carried out on Overlapping Radial Patterns. The Azimuths between survey lines are kept small in order to secure good coverage for the spatial distribution of the Shear wave Velocity as well as the P-wave velocity that are derived from the survey lines.

Field data collected from those surveys are then interpreted using the Generalized Reciprocal Method (Palmer, 1980). The first arrivals of refracted signals are digitally picked (Hatherly, 1980) during processing the data for further accuracy of arrival time measuring and thus decrease the difference in reciprocal time estimated between the off-end shots. The *P-wave* components in the opposite polarity field data records gathered from the Shear wave surveys have been reduced by computer processing before picking first arrivals of the *SH*-refracted signals. The *P-wave* seismic refraction section for line-1 where the topography of the refractor, which is rhyolite bedrock, have been fairly delineated.

Conclusion

The anisotropy of acoustic velocity, measured horizontally along several azimuths within narrow angles between refraction survey lines, provides high quality data that can be used for fracture density studies. Petrophysical parameters derived from the acoustic velocities of *P & SH*-waves assist in locating the trend of fractures.

Digital processing of LANDSAT TM data for geological applications: an example from the Langkawi Islands

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Satellite data such as LANDSAT MSS, LANDSAT TM, SPOT and RADAR are commonly used in helping geological mapping and interpretation in areas with less or no vegetation, soil and surface material cover. However, in tropical area like Malaysia with a combination of dense vegetation and thick soil cover, the value and potential of using satellite data is greatly reduced, therefore the used of such data in geological mapping and interpretation is said generally to be very difficult to produce useably result. Notwithstanding, the vegetation anomalous and the geomorphologic appearance which are usually related to the rock types, quite frequently could be seen or detected in satellite images and therefore could be use to delineate certain lithologic units. With this regard, this study is carried out in order to see whether the LANDSAT TM image characteristics of the Langkawi Islands could be used to recognise, differentiate and correlate with rock types in the area. The island was selected because it has been mapped in detail geologically.

The Langkawi Islands consists of four rock formations. The oldest, known as Machinchang Formation consists of mainly quartzite and subordinate flagstone. This formation is conformably overlain by the Setul Formation which is compose of mainly limestone with minor sandstone and shale. The Singa Formation which is consists of mainly mudstone and shale with minor sandstone unconformably overlain the Machinchang and Setul Formations. The youngest rock formation is known as Chuping Formation consists of limestone (dolomitic), conformably overlain the Singa Formation. In addition to these formations, granite and alluvium are also widespread in the islands.

The satellite data was digitally processed with the objective of producing more interpretable images. The processing techniques involved include geometric correction, atmospheric correction, contrast enhancement, colour display in colour composite, principle component analysis (PCA), ratioing and filtering. The characteristics of every image produced were carefully observed and inspected directly from the computer monitor to obtain any relationship with the lithology of the area. As a result, a few processed images show distinct and good image characteristics which could be used to compare and relate with the lithologic units of the area. In order to test the capability of the satellite image in exhibiting the geological information of the area, the image characteristics of these digitally processed LANDSAT TM images were compared to the published geological map.

It was found that the best amongst the image product in exhibiting the good correlation with the geological information of the Langkawi Islands is provided by the band ratio colour composite combination of bands TM2/1-7/1-4/2, followed by the principle component colour composite PC432 and band colour composite TM452 displayed in red, green and blue respectively. Geological lineaments are best displayed on black and white image in TM band 4. The best non-directional filter in displaying lineaments for the area is filter with convolution matrix :

0	-1	0
-1	5	-1
0	-1	0

whereas for directional filters, the best convolution matrix for each particular direction are as follow:

-1	-1	-1	-1	0	1	-1	-1	0	0	-1	-1
0	0	0	-1	0	1	-1	0	1	1	0	-1
1	1	1	-1	0	1	0	1	1	1	1	0
east-west			north-south			northeast-southwest			northwest-southeast		

The result from this study show that it is clear the characteristics of remote sensing data, in this case the LANDSAT TM images, are well correlated with most geological information in the study area, and therefore have a great potential to be used in general geological mapping in tropical zone like Malaysia particularly the area which is largely still covered by natural vegetation and less disturbed by the development.

The origin and characteristics of notches in the limestone hills in Peninsular Malaysia

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Massive limestone hills occurring in the tropics usually take the form of steep sided hills known as the tower karst. In the Kinta Valley, the tower karst is regarded as the mature type consisting of isolated small to large mogote hills rising above an alluvial plain which is largely underlain by the Kinta Valley Limestone. The mogote hills are largely found at the eastern to north-eastern part of the Kinta Valley for an area measuring 30 km long and 5 km wide. A number of mogote hills (Kanthan area) also occur in the north-western part of the Valley. The mogote hills in the Kinta Valley is observed to continue vertically downwards till the platform levels of the buried karst which underlie most parts of the Kinta Valley underlain by the limestone.

Notches are horizontal solution grooves of varying depths common found cutting into the foot of the mogote hills coinciding with or above the local swamp levels. Typically the Kinta Valley notches are the multiple level type. The tallest recognizable notch is about 14 m from the present alluvial plain level or about 23 m from the platform level of the subsurface or buried karst. From the 23 m to the 13.5 m level above the major platform level, the notches are the horizontally grooved or scalloped type with the height of the scalloped grooves ranging from a few cm to 50 cm. Below the 13.5 m level to the level of the present ground surface (and swamp level or about 7 m above the platform level) the notches are the multiple level horizontal roof type. The deepest horizontal roof notch is determined to be 7 m cutting horizontally into the foot of the mogote hill of Gunung Rapat. The vertical height of this deep notch is 2 m.

It is believed that no marine processes had played any role in the formation of these notches. The notches were formed as the result of the freshwater groundwater or swamp cut and the shape and horizontal depth of the notches were related to the conditions and the recession of the levels of the groundwater or swamp water levels.

It is believed that the notches were dissolved into or etched on the vertical to subvertical surface of the mogote hill which were platformed as the result of an earlier transgressive solution phase. After the main platform of the buried karst were formed, the platform surface were subjected to periods of dryer climatic conditions. The precipitation was sufficient to allow mainly vertical solution resulting in the formation of rounded pinnacles and dolines under some alluvial/ soil cover. These resulted in the reworking and the formation of the tin-bearing old alluvium. During about Late or Middle Pleistocene and coinciding with the eustatic rise in the sea level in the Sundaland region, a wetter condition existed. The formation of the Transitional Unit part of the alluvium took place during this time. The Transitional Unit Alluvium is composed of massive non-bedded "granite wash" indicating sporadic mass flow transport and sedimentation. It is believed that the granite wash was quickly eroded during periods of seasonal flood which deposited the Transitional Unit Alluvium en masse in part as colluvial deposits. The Transitional Unit is thickest near the siliceous highlands and become thinner at the lower parts of the valley. However, it is believed that at the Gunung Rapat area the deposition of the Transitional Unit reached a level of at least 23.5 m above the present ground level. The Transitional Unit at that time had covered up the foot of the vertical and subvertical mogote hills such as Gunung Rapat.

This level of deposition was temporary as this was above the stable base erosional level prevalent at that time. The coming of the more wet condition resulting from further rise in the eustatic sea level, the Transitional Unit Alluvium become saturated. The groundwater level had probably reached a level of 23.5 m above the present ground level and had started etching into side of the mogote hill. Meanwhile, the temporary depositional surface was denuded as the result of erosion and formation of river system in the Kinta Valley. The result of such solution and etching had caused the formation of the horizontal scalloped notches from 23.5 m to the 13.5 m level. Below this level, the climate must have become very wet and swampy condition was formed around the mogote hills. The solution now is believed to be faster and the vertical denudation rates had become slower. The resultant solution consist of the flat roof notches which were found at between the 13.5 m to the 7 m (or 4.5 m to -2 m relative to the present ground level) above the major platform level. This period of notching under swamp condition is believed to mark the onset of the Holocene.

Rakaman seismos dalam lubang gerudi bagi penyiasatan tanah runtuh: kajian kes tapak stesen pemancar gelombang mikro, Jalan Temerloh-Mentakab, Pahang

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Kejadian tanah runtuh lazimnya berkaitan dengan kewujudan satah lemah dalam jasad bumi. Satah tersebut merupakan satah sepanjang mana gelongsoran tanah berlaku dan selepas kejadian tanah runtuh satah ini memisahkan bahan bumi terganggu danpada bahan bumi yang tidak mengalami kegagalan. Penentuan kedudukan satah kegagalan memainkan peranan penting dalam penyiasatan tanah runtuh dan melaksanakan langkah pemuliharaan dan pencegahan.

Kertas kerja ini membentangkan hasil survei seismos dalam lubang gerudi bagi kedua-dua gelombang primer, P, dan sekundar, S, untuk mengesan kedudukan satah kegagalan sesuatu tanah runtuh di bukit pemancar gelombang mikro, km 7, jalan Temerloh-Mentakab. Hasil rakaman scismos lubang gerudi dikorelasikan dengan hasil ujian penusukan piawai (standard penetration test, SPT).

Pengirian halaju dalam lubang gerudi adalah dengan menentukan halaju sela (interval velocity) pada kedalaman berbeza dalam sesuatu lubang gerudi. Skema pengiraan halaju ditunjukkan dalam gambarajah 1. Hasil survei seismos dalam lubang gerudi bagi tiga lubang gerudi, iaitu MZ 1, MZ 2 dan MZ 3 ditunjuk dalam gambarajah 2. Rakaman dalam lubang gerudi ditanda sebagai "Gelombang P (DHL)" bagi rakaman gelombang P, iaitu Vp, dan "Gelombang S (DHL)" bagi gelombang S, iaitu Vs. Disamping hasil rakaman Vp dan Vs, hasil survei seismos biasan di permukaan bagi lokasi ini juga ditunjuk sebagai "Gelombang P (Biasan)". Hasil ujian penusukan piawai, SPT, ditunjuk dalam gambarajah 3. Kedudukan lubang gerudi DB/3 adalah 4.5 m daripada MZ 2 pada ketinggian yang sama di lereng bukit, manakala kedudukan DB/4 adalah 8.Om daripada MZ 1, juga pada ketinggian yang sama di lereng bukit.

Hasil survei scismos dalam lubang gerudi menunjukan taburan nilai halaju bagi kedua-dua Vp dan Vs yang dapat dikaitkan dengan kehadiran satah lemah. Keadaan ini dapat diperhatikan dengan jelas bagi MZ 2 dan MZ 1, manakala bagi MZ 3 perubahan adalah kurang jelas. Bagi MZ 1, satu peningkatan halaju kedua-dua Vp dan Vs dapat diperhatikan pada kedalaman -3.8 m, diikuti olch penyusutan nilai dan peningkatan semula pada -5.8 m. Penyusutan dan peningkatan nilai yang ketiga diperhatikan pada kedalanian -13.0 m. Setiap penyusutan dan peningkatan nilai ditafsirkan sebagai kehadiran sesuatu satah yang lemah; kemungkinan besar sesuatu satah kegagalan. Keadaan yang serupa dapat juga diperhatikan dalam MZ 2. Bagi MZ 3, hanya pada kedalaman -7.8 m perubahan yang serupa diperhatikan.

Korelasi hasil rakaman halaju Vp dan Vs dengan nilai SPT menunjukan tren yang selari. Perbandingan MZ 1 dan DB/4 menunjukkan tiga kedalaman yang hampir sama (+10%) di mana terdapat perubahan halaju seismos dan nilai SPT. Keadaan yang scrupa dapat diperhatikan bagi MZ 2 dan DB/3. Tetapi dalam kes ini, satah lemah yang terdalam tidak dapat dikesan oleh rakaman scismos kerana tidak sampai pada kedalaman tersebut.

Penyiasatan menunjukkan keberkesanan rakaman scismos lubang gerudi untuk mengesan kedudukan satah-satah lemah dalam satu kawasan tanah runtuh. Hasilnya disahkan dengan korelasi nilai-nilai Vp dan Vs dengan nilai penusukan piawai, SPT.

High resolution seismic reflection and geoelectrical resistivity imaging at School Teachers' Quarters Pengkalan, Pegoh, Ipoh, Malaysia

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The geotechnical engineering applications are normally interested in small scale features of shallow depth which may range from a few meters to hundreds of meters. Seismic reflection and geoelectrical resistivity imaging techniques were employed to investigate the shallow features of buried karstic limestone of Kinta Valley limestone formation because the sinkholes and cavities are quite common in this formation. The techniques were conducted along three traverse lines to evaluate the subsurface ground conditions for construction work of the school teachers' quarters blocks. The site is located at Pengkalan, Pegoh in Ipoh district of Perak. The limestone bedrock topography have complex phenomena and highly relief subsurface topography due to the presence of karstic features. These features arise considerable difficulties in both the design and construction of the foundations, such as: foundation stability, settlement, and subsidence during the construction in this site. These geotechnical problems arise whenever foundations are established on the surface of the limestone bedrock or within the overburden soils.

The common depth point (CDP) shallow seismic reflection sections of the traverses lines show clearly the displacement system within the bedrock and poor reflection data. This displacement system is usually associated with sinkholes or slow subsidence in the site caused by chemical dissolution. The poor reflection data quality in the CDP sections were interpreted as voids of cavity zone.

The two dimensional resistivity inverse models of the traverses lines shows the low resistivity anomalies. These anomalies are interpreted to represent swallow holes and cavity zone. The cavities are usually filled up with water.

Interpretation based on the combination of seismic reflection and electrical resistivity imaging survey have been a successful and satisfactory way to identify the location of the surface depression and subsurface conditions.

Relating earthquake clustering to faults and lineaments

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A study was done in the Garfield Hills, Nevada, an area with moderate seismicity characterized by short-lived, randomly distributed clusters. This area experienced a magnitude 5.0 earthquake on September 19, 1989. The earthquake, along with its aftershocks, represented an opportunity to study the phenomena of clustering and correlate that to the geological structures, namely the mapped faults and lineaments obtained from satellite imagery data. The area lies between WNW-trending faults to the north and the NNE-trending faults to the west.

The data used was from the University of Nevada-Reno Seismological Laboratory for the years 1852 to 1989 with the signals from mine blasting removed. In addition field records were taken using a portable seismograph system. The events were re-picked and relocated using several methods to achieved a more accurate data set. The focal depths were concentrated between 3 to 16 km. The seismicity did correlate with some mapped faults and lineaments. The NE-NW trends of the fault planes from earthquake focal mechanism solutions were consistent with the fault trends in this area.

Keynote Paper IV
Coastal geomorphology of the Strait of Malacca area during the past millennium

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The study of coastal geomorphological developments of the Strait of Malacca during the past millennium may give important pointers to possible shoreline development during the next millennium. For this study in addition to the usual tools like field observations and mapping, historical and navigational records are invaluable sources of evidence. For dating of young events such as occurring during the past 1,000 years the usual radiometric carbon 14 method may be at its limits of suitability but dating can be obtained from ceramic sherds if they occur and the sherds are also suitable for thermoluminescence dating.

Evidence from field mapping of ceramic-bearing raised beach deposits, available data from offshore geophysical survey, archaeological and historical records and radiometric carbon 14 dating has been used in Khoo (1996) to reconstruct the geomorphological evolution of the Merbok estuary area in Kedah. At the beginning of this millennium the area had a lagoon with an elongate bay mouth bar and several islets. The port city of early Kedah was sited on the beach of this lagoon. This configuration can be identified as one of the stages of an emergent coast and this stage appeared to be relatively stable for a 1,000 years or more. A dramatic fall in sea level of perhaps 2-3 m occurred within a span of perhaps 100 years from about 1300 to 1400. The shallowing of the bay led to the fall in importance of the port city in the entrepot trade between East and West but this was compensated by an increase in agricultural land area. Other port cities on the opposite side of the Malacca Strait such as Kota Kandis, Jambi and Palembang in Sumatra too suffered the same predicament as early Kedah during the same period and these former port cities are now stranded far inland. This event appears to be widespread throughout the Strait area. I shall call this 1300-1400 regressive episode as the **Merong Event** as an eye-witness account of this event has been given in no less than 15 passages in the *Hikayat Merong Mahawangsa*, also known as the *Kedah Annals* to western scholars.

After the Merong Event, from Martaban to Malacca there are geomorphological features of emergent shoreline at different stages of development, the final of which is the straightening of the coastline like the Merbok area. The present shoreline of the Takuapa area on the west coast of the Thai peninsula for example is at a stage before final straightening. In Eredia's 1,613 map of Malacca there was a well developed tombolo, an emergent coast structure, south of the city. The tombolo has since been destroyed by the more explicable activities of man. Another geomorphological legacy of the Merong Event is the wide Merbok estuary with its short drainage basin. The estuary is the only remnant of the lagoon which existed before the Merong Event. Such estuary has been called the **Merbok–type** in Khoo (1996). Another Merbok-type estuary is the present Dinding estuary with its wide mouth and short drainage basin. It was possibly the remnant of a former lagoon.

The post Merong Event geomorphological configuration of the Pangkor area has been described by Arab, Dutch and British navigators from ~ 1511 to 1822. Of special significance is in the *Kitab al-Minhaj* by Sulaiman (~ 1511) there are records in 3 folios of the area. It was recorded that in the Dingding (as spelled in the early records) area there are two large, long, barren islands and facing them is the island of Tankur Lau (also spelled as Bankur Lau in the work). In Folio 67 both large islands are referred to as the Dingding islands. Bankur Lau is obviously the present Pangkor Laut near the much larger Pangkor island. The missing island of the Dingding has merged with the mainland forming the headland opposite the present Pangkor island. This merger was probably caused by increase in sedimentation contributed in part by human activities such as tin mining and agriculture among other possible factors. This merger probably happened before 1660 and after ~1511 as Nieuhoff in his *Collection of Voyages and Travels* in 1660 published in 1745 mentioned only one island of Dingding. The change in name from Dingding to Pangkor occurred sometime before 1822 as Crawfurd (1828) wrote in 1822 that the Dingding in maritime charts should more correctly be Pangkor and Dingding referred to the mainland opposite Pangkor.

The present Bukit Jugra which is some 6 km from the coast was formerly known as Parcellar in Portuguese maps such as Eredia (1613). Nieuhoff in 1660 recorded that the cape of Barcelai is a high mountain near a point of the land. Earlier Peter Floris (a.k.a. Pieter van Elbing) in his 1611-1615 journal recorded that Pulo Parselar was a high mountain standing on a low point of ground and appeared to be an island from afar but it was firm land. This is the latest record to my knowledge of the hill being referred to as an island (pulau or pulo by Floris). The hill has been referred to as an island in all earlier Arab records such as Fulo Pasalar (Sidi Ali Selebi in the *Muhit*, 1553) and Pulau Basalar (Sulaiman in *Kitab al Minhaj*, ~1511; Sulaiman in *Umdat al Mahriyah*, ~ 1511). In Admiral Zhenghe's *Wu Pei Chih* navigation charts of the early 15th century the place is called Mi Hua Su (Cotton Island). It would appear that the island merged with the mainland sometime post Merong Event, after 1553 but before the beginning of the 17th century, a timing somewhat similar to the merging of one of the Dingding islands with the mainland mentioned above. Increased sedimentation coupled with a small fall in sea level may have been some of the reasons.

Most interestingly in the *Kitab al Minhaj* of Sulaiman (~1511) Folio 77 it is mentioned that the islands of Pulau Sanbilan (Pulau Sembilan near Pangkor) were at the northern head of a bay just as Pulau Basalar were at the southern head of the same bay. This would imply that the coastline of the part of Selangor between Sabak Bernam and Bukit Jugra was a bay concave to the east and the further implication that the coastline had accreted westward at a relatively rapid rate to the situation as obtain today. Indeed the coastal stretch between these two points are covered by young marine sediments. The development of mud flats and mud islands such as the Ketam-Carey group mark the forefront of the accretion boundary. Increased erosion of the hinterland and sedimentation perhaps aided by slight fall of sea level could eventuate the system. The same kind of coastal development with a coast festooned by mud islands and mud flats especially exposed at low tide occur on the Sumatran coast and the shoreline is building eastward toward the peninsula.

The role of human activities in changing the coastal geomorphology is textbook knowledge. A rather unique human activity changing the coastal geomorphology occurred at Pulau Upeh, near Malacca and Teluk Pelandok, near Cape Rachado. At these two places I have found evidence of extensive laterite cutting with remnant rectangular cavities still to be seen on laterite bedrock. The Upeh site was worked by the Portuguese throughout their occupation of Malacca from 1511 to 1641 as mentioned in records such as Cardon (1934). The laterite cutting at Teluk Pelandok has been mentioned in Khoo (1997) and the occurrences of ceramics dating from the mid 18th century near the site suggest that possibly the Dutch worked on the site to obtain laterite blocks for structures such as the St John Fort and repairs to the Portuguese fort existing then. The extensive laterite cutting at these two sites had caused the sea to denude further inland. To some extent the present bay at Teluk Pelandok is not a naturally formed bay but partly caused by taking away of voluminous lateritic material. The headlands with their naturally occurring outcrops of laterite, which could not be cut, were left as small islets way out from the present coastline.

At the Teluk Pelandok locality is a bed of ferricreted (iron oxide cemented) beach deposit with well cemented pebbles of quartz, laterite, wood fragments (a sample even with 2 copper nails), glass and about 10 pieces of ceramic sherds. Among the ceramic sherds are pieces similar to those found in the environ of the mid 18th century Dutch fort at Kuala Linggi and a piece of Chinese ceramic with sapphire-blue glaze appears to date from the mid 18th century as well. The development of this ferricreted beach deposit would require at least a slightly lower sea level after the mid 18th century and subsequent rise in sea level has exposed the by now ferricreted beach deposit. The lowering can be no more than 50 cm and there is no evidence to date the time of the subsequent rise, here called the **Pelandok Event,** more precisely. But the significance of the ferricreted beach deposit is that it shows that a minor fall and rise of sea level occurred.

From the limited data available it will be tempting to make a prognosis of the coastal geomorphology of the Malacca Strait area into the next millennium. It would be necessary to understand the reasons for the events and developments which occurred during the last millennium to forecast the *feng-shui* of the area in the next millennium. The Merong Event with its rapid fall in sea level, the post Merong progressive build-out of the coastal zone westward from the peninsula and eastward from Sumatra and the Pelandok Event suggest to me a cycle of uplift for the peninsula and the adjacent Sumatra which began with the Merong Event and subsided by the Pelandok Event. During the initial phase of an orogenic uplift the initial phase is rapid followed by a longer phase of slower uplift. The Merong Event marked the initial phase of uplift which witnessed a rapid fall in sea level. The longer period of post Merong uplift provided for the increase in sedimentation to the coastal areas where the geomorphology of the accretion boundary at various stages of development can still be seen. The mud flats and mud islands of Ketam-Carey in Selangor and Port Weld-Trong in Perak represent a stage before final straightening of the coastline like the coastal area of Muar-Kesang in Johor. If the cycle has been terminated by the advent of the Pelandok Event then we may witness stability of the coastline and maybe the onset of erosion as a result of the cessation of uplift, however, small. A more dreaded *if* will be the Pelandok Event heralded the beginning of a longer cycle of erosion of the coastline after the cessation of uplift. If the uplift cycle has not been completed, with the Pelandok Event being a minor reversal, then the island clusters such as Ketam-Carey will merge with the mainland. There will then be continued build-out onto the Malacca Strait from both the peninsula and Sumatra considerably narrowing the

Strait. Further research will be able to gather in more golden threads of evidence which can be woven to evolve a prognosis with an accuracy, detail and beauty as exquisite as the *kain songket.*

Geoindicators for sustainable urban management

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Geoindicators are high-resolution measures of short-term surface and near-surface processes and phenomena that are significant for environmental monitoring and assessment. They can be used to track changes in fluvial, coastal, highland and other terrestrial areas where urban centres are located. They provide a framework for recognizing and assessing abiotic landscape changes that are important to environmental planning and management. A checklist of 27 earth system processes and phenomena that are significant for environmental sustainability and ecosystem integrity has already been identified (Berger and Iams 1996). However, these have yet to be adapted and tested for tropical terrain where the nature and rate of earth processes are different.

Malaysia, through the Economic Planning Unit of the Prime Minister's Department is in the process of developing a Sustainable Development Indicators (SDI) framework for national reporting. The framework that is being planned will utilize the Pressure-State-Response approach (Mohd Nordin 1998). Sectoral initiatives on indicators in the country include the Malaysian Urban Indicators Programme (MURNINET) lead by the Town and Country Planning Department of Peninsular Malaysia and the Healthy Cities Programme established of the Ministry of Health Malaysia (Zainuddin 1998). Both these initiatives will eventually fit into the overall framework of the SDI.

The SDI framework, MURNINET and the Healthy Cities Programme emphasises aspects that are relevant to the human habitat, where cities are defined in political and geographical terms. The ecological reality is that cities are mere nodes of consumption in a much larger ecosystem. Thus, the use and availability of non-renewable material resources required to support the urban population and economy for the present and future generations are not taken into account in the sectoral initiatives. Another aspect that is missing from these initiatives is the category of "extreme natural events" which is made worse by human activities, particularly in urban areas. Such events, which relate to surficial and sub-surface earth processes and phenomena, include landslides, subsidence, storms, floods, rivers and coastal erosion as well as groundwater salination. Examples of geoindicators proposed for landslides are movement of surficial rock formations and critical slope angles, which require measurement of slope stability, mapping, monitoring using benchmarks and historical record. Sea level changes, rainfall and changes in river levels are examples of geoindicators for flooding while negative vertical movements has been proposed as a geoindicator for subsidence There is a need to identify appropriate geoindicators for geohazard occurrences in the tropical setting and define thresholds in changes that lead to such events.

In order to fill in the gaps and establish a holistic approach to the national indicator programmes, the Institute for Environment and Development (LESTARI) and the Geological Survey Department Malaysia has embarked on a project to establish a menu of geoindicators to assess abiotic landscape changes that are significant for urban planning and management. It is anticipated that the results of this project will benefit urban planners, policy and decision-makers by providing information that illustrate the trends and status of environmental sustainability, and evaluate the success of existing policies in ensuring urban sustainability, particularly with regard to earth material consumption and hazard occurrences. The project will also identify tangible and measurable targets to shape future urban policies, strategies and guidelines to achieve urban sustainability.

Intrinsic geological resources for ecotourism development: a case study of an ancient oceanic crust in Tandek, Sabah

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The intrinsic geological resources which embodies the formation of a particular rock or landscape not only adds value to existing ecotourism sites but open up new sites. This case study of an ancient oceanic crust along Baliojong River in Tandek describes the intrinsic values attached to it. The oceanic crust, comprising of pillow lava and chert is one of the oldest rocks in Sabah. It provides not only information on the early geological evolution of Sabah and surrounding areas, but also potentially generate models for the formations and occurrence of industrial minerals associated with it. Since such sites of high quality (well-exposed and easily accessible) could not be found easily in other parts of Sabah or even the whole of Southeast Asia, it is recommended that this site be gazetted as a heritage site for the present and future generation. To pay not only for its conservation but generate economic revenue for local communities it may be possible to utilise its intrinsic value for ecotourism development.

Evaluation of groundwater Tuaran, Sabah, Malaysia

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The population growth in Malaysia has resulted in an increase in water demand and greater contamination of water. Tuaran is located along the western coast of Sabah, Malaysia. The tropical climate provides abundant rain (> 2000 mm annually) but the presently available potable water is hardly sufficient to cover the need of the populations. The area will face a water shortage problem that will necessitate the development of all possible sources. A detailed study of geology, hydrology and ground water chemistry should be done in order to establish the water resource condition of the study area. This area was chosen because this sector is subjected most to pollution due to its proximity to the coastal area. Chemical and physical composition of ground water samples collected from various stations throughout the study area was determined to be able to describe the background ion concentration and to identify the major hydrochemical processes that control the ground water chemistry. Results of the investigation indicate that the ground water of Tuaran has evolved chemically through water - rock interaction. The geologic setting of the study area has a major impact on the physical and chemical characteristics of ground water. Ground water quality of Tuaran depends upon the duration of contact with its environment. An environmental management programme should be strictly implemented in the study area to prevent any ground water pollution.

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Abstracts of Posters

Ciri-ciri dan asal-usul permukaan ketakselarasan di dalam lapisan Boulder (Miosen) Batu Arang, Selangor

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Lapisan Boulder (Miosen) yang tersingkap di Batu Arang boleh dibahagikan kepada tiga unit utama, iaitu: i) unit ortokonglomerat fasies kipas lanar berwarna merah dibahagian bawah sekali; ii) lapisan-lapisan rata batulodak dan batupasir berpebel berwarna kelabu gelap dibahagian tengah; dan iii) unit parakonglomerat fasies aliran debri berwarna kelabu gelap dibahagian atas sekali. Unit ortokonglomerat merah mempamerkan ciri-ciri pengoksidaan awal semasa pengenapan dikawasan subudara, manakala lapisan-lapisan rata batulodak dan batupasir, dan juga unit parakonglomerat kelabu gelap menunjukkan bukti-bukti pengenapan didalam penurunan.

Permukaan ketakselarasan yang wujud didalam Lapisan Boulder ini memisahkan lapisan-lapisan rata batupasir berpebel kelabu dibawahnya dari unit parakonglomerat kelabu gelap diatasnya disesetengah bahagian, manakala dibahagian yang lain satah ini mempertemukan unit ortokonglomerat merah dengan unit parakonglomerat kelabu gelap.

Hubungan diantara unit ortokonglomerat merah dan lapisan-lapisan rata parakonglomerat kelabu adalah selaras atau secara ketakselarasan separa. Ini menunjukkan bahawa kenaikan muka air awal telah mengakibatkan pengenapan lapisan-lapisan rata batulodak dan batupasir berpebel, kemungkinannya oleh regim aliran atasan. Pertemuan diantara lapisan-lapisan rata batupasir dengan unit parakonglomerat kelabu dikaburi oleh pewarnaan yang serupa. Satah ketakselaran ditadai oleh perubahan saiz klas yang mendadak dan ketara. Keadaan ini menunjukkan bahawa perlunggukan unit parakonglomerat kelabu melalui aliran debri berlaku didalam keadaan akuas.

Dibahagian yang mana ketakselarasan ini mempertemukan ortokonglomerat merah dengan parakonglomerat kelabu, satah ini dipamerkan oleh suatu permukaan terhakis diatas lapisan paleosol merah. Satah sempadan yang tajam ini ditimbuni oleh konglomerat petromik berwarna kelabu gelap yang tidak mempamerkan apa-apa perlapisan yang jelas. Keadaan ini menunjukkan bahawa kenaikan muka air berlaku serentak dengan pengenapan unit parakonglomerat kelabu.

Ciri-ciri dan hubungkait yang ditunjukkan oleh unit-unit litologi yang berbeza dan satah ketakselarasan boleh diperjelaskan oleh turutan peristiwa yang berikut: 1) pengenapan ortokonglomerat dan pasir yang berkaitan oleh aliran air yang kuat dan laju yang membentuk kipas lanar dalam keadaan subudara; 2) pengoksidaan dan proses pedogenesis menghasilkan warna merah dan membentuk lapisan paleosol dibahagian atas kompleks kipas lanar; 3) kenaikan paras muka air menghasilkan keadaan penurunan dan pemendakan lapisan-lapisan rata batulodak dan batupasir berpebel; 4) gerakan tektonik yang mungkin menghasilkan sesar baru, mendedahkan pecahan-pecahan batuan baru. Paras air muka mungkin naik semakin tinggi dan membanjiri sebahagian besar lembangan kipas lanar. Hujan yang lebat mungkin boleh dikaitkan dengan pembentukan aliran debri yang akhirnya menghasilkan unit parakonglomerat kelabu gelap.

Geologi am dan kajian tekstur batuan di Kompleks Igneus, Pulau Susu Dara, Besut: implikasi terhadap perletakan magma

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Kawasan kompleks Igneus yang dikaji terletak di bahagian timurlaut Pulau Susu Dara, Besut Terengganu. Walaupun kompleks ini hanya mempunyai keluasan kira-kira 100 meter persegi, terdapat tidak kurang dari 3 jenis batuan igneus yang telah menerobos batuan metasedimen yang membentuk sebahagian besar pulau Susu Dara. Jenis batuan igneus yang terdapat di sini (mengikut turutan umur dari tua-muda) ialah batuan granit porfiri, diorit porfiri, mikrogranit, daik dolerit dan telerang kuarza. Kajian tekstur batuan granit porfiri dan diorit porfiri mencadangkan kedua-kedua magma batuan ini menerobos ke dalam satu retakan yang sempit. Tekstur porfiritik yang ditunjukkan oleh kedua-dua batuan ini mencadangkan bahawa magmanya telah menghablur pada sesuatu kedalaman sebelum melalui retakan tersebut. Hasil kajian ini mencadangkan bahawa retakan ini mungkin mewakili sesar lama yang telah sedia wujud sebelum penerobosan kedua-dua magma ini.

Beberapa aspek kaitan lapangan dan petrografi batuan granitik Bukit Labohan, Kerteh, Terengganu

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Kawasan kajian terletak kira-kira 50 km ke utara bandar Chukai, Kemaman dan merangkumi kawasan seluas kira-kira 3 km^2. Batuan yang terdapat di sini ialah batuan igneus, batuan metasedimen dan enapan kolovium. Kajian ini bertujuan untuk memetakan secara terperinci batuan granitik yang terdapat di kawasan Bukit Labohan dan kawasan sekitarnya. Hasil pemetaan menunjukkan bahawa pluton ini terdiri daripada 2 jenis batuan granitik iaitu batuan granit hornblend biotit dan granit biotit merah jambu. Terdapat juga intrusi minor seperti daik dolerit, batuan diorit kuarza dan inklusi seperti rangkuman mafik mikrogranular (mafic microgranular enclaves).

Kedua-dua batuan granit hornblend biotit dan granit biotit merah jambu membentuk pluton penzonan terbalik (reverse zoning pluton) iaitu granit hornblend biotit membentuk teras pluton dan dikelilingi oleh granit biotit merah jambu. Sentuhan antara granit hornblend biotit dan granit biotit merah jambu tidak dijumpai kerana singkapan yang terhad. Kedua-dua batuan mempunyai kandungan mineralogi yang hampir sama kecuali granit hornblend biotit yang dicirikan oleh kehadiran mineral hornblend. Kedua-dua batuan ini diterobos oleh daik dolerit.

Analisa geokimia unsur-unsur major untuk batuan granit hornblend biotit, granit biotit merah jambu, daik dolerit dan rangkuman mafik mikrogranular menunjukkan, (1) kedua-dua batuan granit hornblend biotit dan granit biotit merah jambu adalah berasal daripada magma yang sama dan (2) daik dolerit dan sebahagian daripada rangkuman mafik mikrogranular mungkin berasal dari magma induk yang berlainan dari batuan granit hos.

Chemical characteristics some of the granitic bodies from Terengganu area

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The present study involve some of the granitic rocks from the Eastern granitic belt which is located in the Terengganu area (Map 1). Four granitic bodies will be considered : they are Maras Jong pluton, Jerong batholith, Perhentian granite pluton, and Kapal batholith. *The Maras Jong pluton* is the most easterly granitic pluton in the Eastern Belt of mainland Terengganu. The rock is coarse grained and consists of plagioclase, K-feldspar, quartz, biotite, apatite, tourmaline, opaque phases, muscovite, sericite, chlorite and epidote. *The Jerong batholith* located immediately to the south of the Maras Jong pluton. The batholith is a rather small but complex body having a compositional range from gabbro to granite. It consists of several plutons such as Tanggol, Wakaf and Kenanga granites. They consists of plagioclase, K-feldspar, quartz, hornblende, biotite, pyroxene, olivine, apatite, opaque phase and sphene. *The Perhentian granite* is located in the Perhentian island off Terengganu area. They consists of plagioclase, K-feldspar, quartz, hornblende, biotite, allanite, epidote, apatite, opaque phase and sphene. *Kapal batholith* is one of the largest granitic bodies in the Eastern Belt. The batholith consists of several smaller granitic plutons such as Saok granodiorite, Chengal granite and Kesing granite. The batholith is a composite body ranging from diorite to monzogranite in composition and dominated by granodiorite. They consists of plagioclase, K-feldspar, quartz, hornblende, biotite, pyroxene, apatite, opaque phase and sphene.

The range of SiO_2 in each granitic body is: Maras Jong (65.67–76.34%), Jerong (66.7–76.9), Perhentian (70.9–75.4%) and Kapal (63.03–76%). This shows that the range of SiO_2 values from each granitic bodies, especially the Maras Jong, Jerong and Kapal overlap. In general, the plots show clear trends of decreasing Al_2O_3, TiO_2, $Fe_{(tot)}$, MgO, CaO, P_2O_5 and MnO and K_2O increase with increasing SiO_2. Two samples from Kapal batholith show exceptionally high MgO, CaO and low Na_2O. Differences between the four granites probably is best illustrated on a P_2O_5 vs SiO_2 diagram. Thus, two trends can be differentiated in this diagram, Maras Jong samples form a separate trend to those of other three granites. This is a result from a higher P_2O_5 content of the Maras Jong granite compared to the other three granites at a given SiO_2 concentration. For example granites with 65% SiO_2 from the Maras Jong have 0.24% P_2O_5 compared to the rock from Kapal granite which only has 0.16% P_2O_5 at a same SiO_2 contents. This probably indicates that this samples may represent a separate pulse from the rest of the Kapal granite samples. All granites are high K calc alkali. They also have high total alkali content where ($Na_2O + K_2O$: 5.9 to 9.8) and are mildly metaluminous to peraluminous (ACNK values : Maras Jong = 1.01–1.27; Jerong = 0.98–1.05; Perhentian = 0.92–1.03 and Kapal = 0.89–1.07). Both Ce and La in Kapal and Jerong granites plot in two trends respectively, one decreases and the other increases with SiO_2. This may indicate that these granites consist of several separate granitic pulses. The Kapal granite also shows significantly low Nb compared to the other three granites whereas the Maras Jong granite has low Ce, Y and La. All granites have low Sr and V and high La compared to the rocks from elsewhere (e.g. Cordillera Blanca batholith, Peru). All the granitic rocks evolved towards high Y concentration and low Sr/Y ratios similar to the mantle wedge derived magma.

LIL elements and TiO_2 vs Zr plots of all the granites indicate that K-feldspar, biotite plagioclase, zircon, biotite, hornblende and sphene play an important role in determining the variation during fractionation process. The geochemistry of the granites show that each granitic body has a specific character and probably is made up of individual batches of melt.

Chemistry of muscovite from the Kuala Lumpur granite, Peninsular Malaysia

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This work presents a new muscovite analyses from the Kuala Lumpur granite. The biotites has been analysed from three different samples namely equigranular normal biotite-muscovite granite (NBMG), deformed muscovite granite (DBMG) and porphyritic biotite-muscovite granite (PBMG).

Bivariate plots of the major elements versus Mg/Mg+Fe values for these muscovites show that the muscovite from the DBMG has high Si, Fe, Mn and K compared to muscovite from NBMG and PBMG. Muscovites from the NBMG has high Al(pfu) content and those from the PBMG is slightly higher in Na(pfu) compared to the other facies. Muscovites from the NBMG also have higher Mg/Mg + Fe ratio compared to muscovites from the other two facies. The major difference of the muscovites from the three samples are the TiO_2 contents. Thus, muscovites from the PBMG have the lowest TiO_2 content (0 to 0.028%; mean: 0.04%) and those from the NBMG have the highest TiO_2 content (0.29 to 0.65%; mean: 0.53%). The DBMG muscovites have intermediate TiO_2 content (0.02–0.67%; mean: 0.46%). All muscovites samples from the DBMG and PBMG plot in the secondary muscovite field of Miller *et al.* (1981) those from the NBMG plot in the primary muscovite field. Muscovites from the NBMG have high BaO and low P_2O_5 contents compared to those from the other two samples.

The variation diagrams of Si(pfu) with respects to Al(pfu), Fe(pfu), Mg(pfu) and Na(pfu) show remarkable differences between the chemical composition of muscovite from the different facies. Muscovite from the DBMG has the widest range of Si(pfu) content compared to the other facies. Clear trend of decreasing Al and Na and increasing of Mg and Fe with increasing SiO_2 shown by the muscovite from the DBMG. The decreasing Na content in muscovite may be related to the decrease of formation temperature and the variation of Fe, Mg and Al with Si can be related to solid solution between the end members muscovite and caledonite.

Mantle feldspar from the Noring granite, north Peninsular Malaysia: petrography and chemistry

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The Noring pluton formed the Stong complex with other two granite plutons i.e. Kenerong microgranite and Berengkat tonalite and is located closed to the Central Belt of the Peninsular Malaysia. Mantle feldspar found in the Noring granite, have been investigated in terms of their petrography and geochemistry. The size of the texture ranges from several mm to 3 cm. The thickness of the plagioclase rim varies from 1 mm to 10 mm. The K-feldspar core also varies in size, from 2 mm to 2 cm across.

Petrographically the mantle feldspar consists of whitish plagioclase rim mantled the pinkish K-feldspar core. The K-feldspar core consists of a single crystal or several crystals usually showing simple twinning. Occasionally, it contains euhedral hornblende, magnetite and biotite inclusion. Small irregular outline plagioclase inclusions occur in the K-feldspar core being most abundant near the contact with plagioclase rim. The texture suggests that the K-feldspar core replacing and enclosing relicts of plagioclase rim. Plagioclase rim is generally composed of numerous euhedral to subhedral plagioclases with the size usually less than 1 mm. In places the plagioclase rim consists of a single crystal about 2 mm thick. Despite well developed euhedral growth zones, many of the crystals have ahhedral irregular inner margin indicating continued growth to late stage. Common growth zones are normal and oscillatory types. Fine mymerkite intergrowth sometimes occur along the K-feldspar core and plagioclase rim contacts indicating late stage intergrowth. Twinning according to albite, polysynthetic and Carlsbad-albite law are common. Hornblende, biotite and sphene can be seen associated with plagioclase at the margin of the texture.

Geohemistry of the plagioclases in the Noring granite shows that the those from the mantle feldspar have restricted composition compared to the individual plagioclase. In term of An %, the former ranges from An_{38} to An_{44} compared to An_{28} to An_{50} of the latter. This may suggests that the plagioclase rim probably precipitated from a different magma type to the Noring magma possibly of andesitic in composition. Variations in melt composition as a consequence of magma mixing and/or mingling can produce the mantled feldspar. The K-feldspar that has crystallised in the Noring magma act as a substrates for the growth of plagioclase, producing the mantles texture. The aggregates of individuals crystals that have floated together in the magma attached to the K-feldspar as in synneusis model of Vance (1969). Once this nucleation takes place there is relatively straight forward process of crystal growth yielding the mantled texture (Hibbard, 1981). Other evidences that may support the magma mixing process in the Noring rocks are (i) occurrence of small rounded mafic inclusion (hornblende ± biotite) usually 1 to 2 mm in size and (ii) discontinuous nature of plagioclase zoning and irregular shapes of the cores.

Systematic classification of the granitic rocks from western province, Peninsular Malaysia

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The Western Province granite is a huge mountain range along the western side of Peninsular Malaysia. The granites were emplaced into Upper to Lower Paleozoic formations which include phyllite and marble. These granites are generally coarse to very coarse grained, equigranular or porphyritic biotite muscovite granite. Mineralogical classification indicates that these granites are monzogranite to syenogranite with subordinate granodiorite. They are metaluminous (ACNK = 0.92) to peraluminous (ACNK = 1.18) and share many common characteristics to the continental collision ('S') type. Although the granites in many aspects, are comparable to the 'S' type granites of the Lachlan Fold Belt, they also have some differences. This include the ACNK value in which the trend (with increasing SiO_2) is reverse to those observed in the 'S' type granite of the Lachlan Fold Belt. The behaviour of P in the Western province magmas also contrast to the behaviour of P in the S type magma. The main implication from the systematic classification of the Main Range granites is that the magma derived from melting of the crustal material of metasedimentary origin.

Sedimentation in the tropical, mesotidal, wave dominated Pahang River delta complex

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The sedimentary development of a delta complex involves an interplay between wave, tide, longshore current and river processes. Although several models have been proposed and provided a coherent framework for deltaic sedimentary studies, they still await testing from a variety of environmental setting. Pahang river delta complex is another unique delta. The delta situated in a humid tropical climate with high rainfall

intensity throughout the year is subjected to a strong wave during the monsoon season.

The aim of this paper is to document patterns of sedimentation and characteristics of sedimentary environments that present in the delta complex.

The Pahang river delta complex is located in the east coast of Malay Peninsula. The main river which is the Pahang river is debauching water and mainly coarse-grained sediment eastward into the South China Sea. The delta is unique in the sense that it is developing in a monsoonal tropical setting where the river discharge is continuous and high, a medium ranges tides (~ 2 m) and seasonally strong winds and storms. The storms and winds produce high wave amplitudes that strike in the coast obliquely from the northeast and significantly affect the development of the delta. The Pahang delta complex shows a series of geomorphological and sedimentary changes that include considerable reworking and obliteration of certain facies and marked partial imbrication of fluvial, lagoonal and wave deposits. These changes are due to hydrodynamic conditions such as the interaction between longshore drift, stream flows and storm wave.

The sediments on the delta plain comprising continental and marine deposits of poorly consolidated clastic sand, clays and gravelly sands. These sediments form a 1-30 m high coastal plain bounded by outcrops of older rock formations in its western, northern and southern margin that originally formed a funnel-shaped depression and embayment. The lower Pahang river valley is barred seawards by a series of beach ridge-strandplain deposits standing 1-2 meter above the present mean sea-level. These series of beachridge-strandplain deposits were brought about by the late Pleistocene and Holocene sea-level fluctuations. These fluctuation have resulted in the erosion and deposition of various coastal plain deposits. Remnants of paleobeaches/shorelines can be seen outcropping some kilometers landward of the present day shoreline and at different elevations attesting to the time that they were deposited (The, 1982; Bosch, 1988; Tjia, 1992). The present proper Pahang River delta is probably the result of progradational of different lobes in response to the stabilasation of the relative sea-level around 2,000 years ago.

By studying the delta we can increase our knowledge and hopefully use it as an analogs for the deltaic system in the older deposits.

Pemetaan sedimen dasar Sungai Pahang, Pekan-Tanjung Agas, Pahang

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Satu kajian secara menyeluruh telah dan sedang dilakukan di kawasan Delta Pahang. Tujuan kajian ini adalah untuk melihat dan menentukan proses-proses pengendapan yang telah/sedang berlaku dan fasies yang terhasil, serta mengsyorkan framework stratigrafi yang sesuai untuk lembangan Delta Pahang. Untuk mencapai tujuan ini, fasies sedimen yang terdapat dipermukaan (daratan, sungai dan lautan) telah dipetakan, dan data bawah permukaan (subsurface) telah diperolehi melalui lubang gerudi dan dengan kaedah geofizik (seismik).

Untuk membantu tafsiran sekitaran pengendapan sedimen (berusia Kuaterner) yang terdapat di bawah permukaan, satu aktiviti pemetaan sedimen dasar sungai Pahang telah dilakukan. Tujuannya adalah untuk membuat perbandingan fasies muara (dalam sungai) yang sedang terbentuk dengan fasies yang diperolehi daripada lubang gerudi, yang tidak diketahui kaedah pembentukannya.

Morfologi utama yang ada dalam sungai ini ialah beting pasir, alur dan pulau. Beting dan alur dapat ditentukan melalui pemetaan kedalaman air sungai. Di permukaan beting pasir boleh diperhatikan struktur sedimen jenis permakaan rata ('plane beds') dengan foresetnya di bahagian hujung hilir. Riak arus bersaiz kecil boleh diperhatikan tertabur bertompok-tompok di atas permukaan rata ini.

Pemetaan sedimen dasar ini dilakukan dengan mengambil sedimen dasar sungai menggunakan "grab sampler". Lokaliti di mana sampel diambil dapat ditentukan dengan menggunakan alat GPS jenis Magellan model 15005. Setelah diuji, didapati GPS ini mempunyai ralat beberapa meter sahaja. Selain daripada mengambil sampel sedimen, kedalaman air juga diukur. Sampel yang diambil telah dilakukan beberapa analisis, antaranya ialah analisis saiz butiran (ayak dan hidrometer), analisis komposisi butiran, analisis jenis mineral lempung, serta analisis polen, foraminifera dan ostrakod. Kemasinan air sungai juga ditentukan.

Satu peta taburan sedimen dasar Sungai Pahang daripada Pekan hingga Tanjung Agas telah dibuat. Didapati jenis sedimen yang paling dominan yang tertabur di sini ialah sedimen bersaiz pasir sederhana. Hampir keseluruhan beting pasir yang ada terdiri daripada sedimen bersaiz pasir sederhana. Sedimen halus (lodak dan lumpur) cuma terdapat di kawasan yang terlindung. Tidak ada satupun sampel yang diambil yang mengandungi sedimen bersaiz kelikir. Dari segi komposisi, butiran kuarza (monohablur dan polihablur), feldspar dan pecahan batuan (batuan igneus dan sedimen) merupakan komposisi utama yang membentuk sedimen di sini. Selain itu terdapat juga lempung jenis kaolinit, illit dan montmorilonit. Hasil daripada analisis yang dijalankan, didapati terdapatnya foraminifera, ostrakod serta polen dalam sedimen muara sungai. Foraminifera boleh ditemui kerana air masin memasuki sungai semasa air laut pasang. Taburan mineral lempung tidak dipengaruhi oleh kemasinan air. Percampuran mineral lempung ini mungkin disebabkan adanya pengaruh angkutan oleh arus sungai dan juga arus air pasang.

Kesimpulan yang boleh diperolehi daripada kajian ini ialah, sedimen yang berbentuk di sekitaran muara Sungai Pahang terdiri daripada fasies atau sedimen bersaiz pasir sederhana. Foraminifera, ostrakod serta polen boleh wujud dalam fasies ini, kerana pengaruh sungai dan pengaruh lautan masih memainkan peranan yang penting.

Kajian terperinci tekstur batuan granit di kawasan Damansara-Sri Hartamas, Kuala Lumpur

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Kajian terperinci tekstur batuan granit dikawasan Damansara-Sri-Hartamas telah dilakukan terhadap dua jenis batuan iaitu batuan granit tak porfiritik dan batuan granit porfiritik. Hasil kajian lapangan, petrografi dan analisa geokimia mencadangkan kedua-dua batuan ini berasal daripada magma yang sama. Tujuan kajian ini ialah menggunakan petrografi batuan porfiritik untuk mengetahui (1) turutan penghabluran magma batuan granit di kawasan kajian dan (2) untuk mengkaji secara terperinci evolusi tekstur batuan di kawasan kajian. Hasil kajian menunjukkan magma batuan granit di kawasan ini menghablur dalam tiga fasa iaitu (1) Fasa penghabluran mineral awal seperti mineral apatit, biotit awal, plagioklas awal dan fenokris K-feldspar, (2) Fasa pembentukan kerangka kerja (framework) hablur yang terdiri daripada feldspar alkali, kuarza, plagioklas dan biotit dan (3) Fasa penghabluran mineral pada liang-liang terhad seperti kuarza lewat.

The Internet: a valuable tool for geoscience education and promotion

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The Internet can be a valuable tool for geoscience education and promotion. There is already an immense amount of geologic information available on the Internet today. With a little time and effort we can access this information for our (or our students') use. We can even add to that information by imparting our own knowledge or expertise on our own websites.

Geologic information on the Internet comes from a variety of sources. The most reliable sources are from universities and scientific organizations. Many university lecturers now provide course outlines along with other materials online. A good place to begin a search for these is at the World lecture Hall (http://www.utexas.edu/world/lecture/index.html). This site has a limited number of courses in its data base because in order to be listed a request must be made by the course instructor. A more complete listing of courses can be found at For First Time Readers (http://www.uh.edu/~jbutler/anon/use.html) which is a site maintained by John C. Butler at the University of Houston. Butler has collected a list of more than 600 course resources that appear online (Butler, 1998). In order to be considered a course resource, the materials posted must take advantage of the interactive nature of the Internet.

Besides universities, many scientific organizations also maintain websites with geoscience information. The Society's website (http://www.geocities.com/CapeCanaveral/Lab/4838) has information about the Society as well as a good introduction to the rocks of Malaysia based on the Society's Common Rocks of Malaysia poster. Another useful service that can be provided at this type of website is answering questions submitted by the public. Several websites presently offer this type of service. These include the United States Geological Survey's "ask-a-geologist" site (http://walrus.wr.usgs.gov/docs/ask-a-ge.html) and Scientific American's website "ask-the-expert" (there are a variety of "experts," the geology one is http://www.sciam.com/askexpert/geology). Finally there is the Geological Society of America's Partners in Education Program which includes an email partners program to answer geoscience questions (http://www.geosociety.org).

Using the Internet to disseminate geoscience information can be a powerful tool. With a little ingenuity (along with a bit of time) all of us can successfully use the Internet to improve geoscience education and awareness. This can be done by developing original educational resources to post on the Internet (some simple examples will be presented), by volunteering to be an "expert" to answer questions online, or by helping others to access information presently available online. This is particularly important in Malaysia now with the introduction of the Smart School concept.

Magnetic signature over part of Pahang and Johor

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The aeromagnetic anomaly over part of Peninsular Malaysia has been available since 1965 (Agocs, 1965). The analysis of the aeromagnetic data has been based mainly on localized anomalies and areas, and not much modeling has been done. The main purpose was to determine the granite contact in order to locate areas of mineralization such as tin and sulphide mineralization. The geological interpretation that has been carried out has been aided by land traverses, however, has been hampered largely by accessibility at that time, lack of outcrop, thick weathering and the country was in a state of Emergency. Since then the data have not been utilized much.

With the availability of efficient computing facility and the present amount of geological information a relook into the magnetic signatures in the country is necessary. The much-improved accessibility and computing facilities allow a more through interpretation, analysis and modeling to be carried out. In addition there are many land magnetic survey that has been carried out by individuals which could aid in the interpretation. Additional land magnetic survey has also been plan. This presentation is an initial work carried out on the magnetic signatures. The magnetic data used is from the published aeromagnetic map by Agocs (1965, Area 4 and Area 5). Some land magnetic data has also been acquired within the area. The geological information is largely from published maps (e.g. Directorate of National Mapping, Malaysia, 1985) and other publications. Field sampling and susceptibility measurements have been started.

The magnetic data analyzed is near the southern part of the Peninsular Malaysia. It stretches from the west coast in Johor (Batu Pahat-Muar) to the east coast in Pahang (Pekan) and in Johor (south of Mersing). Beside the localized analysis and interpretation, the data which stretches from the west coast to the east coast has been selected to enable a study of the magnetic changes across the major north-south structure in Peninsular Malaysia.

In analyzing magnetic anomalies, difficulty arises from the fact that the source of the magnetic anomalies is dipole in nature. This give rise to directed or vectors quantities and the resulting magnetic field has a south to north direction. Whilst the source has it own magnetic field and direction, this field is superimposed on the earth magnetic field. The source magnetic field may be in the same or different direction to the earth magnetic field but normally the induced source field has direction similar to that of the earth field. The measured magnetic anomaly is thus largely a resultant of the induced source field and the earth magnetic field.

The consequence of the dipole nature of the source body is that a magnetic anomaly comprises of a pair of maximum (positive) and minimum (negative) values when traversing in a south to north profile. The relative position of the positive-negative peak pair is important in analyzing magnetic anomaly. As Malaysia is located south of the magnetic equator the direction of magnetization (magnetic inclination) is a few degrees upwards. The anomaly thus has its positive peak to the north side while the negative peak to the south side. Superimposing a few magnetic anomalies gives rise to a complicated anomaly. The interpretation of the magnetic signatures is based on the above assumption and limitations.

The aeromagnetic anomaly across from the west coast to the east coast in this region can be divided into three main areas.

1. The areas where there are obvious relatively long wavelength anomalies and these are mainly at the west coast,
2. The area of comparatively magnetically quite zone and is mainly along the east coast and
3. The area of magnetically active zone dominated by medium to short wavelength anomalies which lies mainly between the area of long wavelength anomaly zone and the magnetically quite zone.

Comparison to the geology indicates that the long wavelength anomalies are often associated to large igneous bodies. This is true of the long wavelength anomaly in Bandar Maharani and Batu Pahat at the west coast. The short to medium wavelength anomalies does not show an obvious relationship to the geology. They occur over both the sedimentary rock interbeded with the volcanics and the granites. Obvious correlation to the basalt body can be made in places such as in Segamat. The magnetically quite zone, mainly at the east coast, occurs over both the granites and sedimentary rocks.

Hutchison (1975) tectonic subdivision divides the area into the Main Range Granite Belt and the Eastern Granite Belt. The area of long wavelength anomaly is within the Main range Granite Belt while the rest is in the Eastern Granite Belt. However, the Eastern Granite Belt has a magnetically active zone and a magnetically quite zone along the coast. This could be related to the tin bearing granite along the east coast of Johor and the non tin bearing granite of the more inland areas.

Within the magnetically active zone the medium to short wavelength magnetic anomalies generally have a northwest to southeast trend and east-west trend. This trend is similar to that of the smaller scale faulting trend. In the magnetically quite zone along the east coast, the small-scale faults trend mainly in a north-southerly and east-westerly direction.

This initial observation shows that the magnetic signature has a lot unused information. A more thorough study is being carried out to analyze and interpret the magnetic anomaly. The Geological Survey Malaysia hopefully makes digital data available. This would facilitate the analysis. The result hopefully would add into the understanding of the geological setting locally and regionally.

The occurrence of Tertiary boulder beds between km 22.6 and km 24.5 of the Malaysia-Singapore Second Crossing Expressway, Kangkar Pulai, Johor, Malaysia

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The stretch between km 24.5 and km 22.6 of the Malaysia-Singapore Second Crossing Expressway is cut across a probable Tertiary rocks consisting predominantly of semi-consolidated boulder beds and sandstone with minor intercalation of mudstone.

The Boulder Beds comprise essentially of pebble to boulder, matrix-supported, polymictic conglomerate with poorly defined bedding. The clasts of various lithology, predominantly metasandstone, granite biotite, granodiorite, adamellite, quartz veins, volcanic and volcaniclastics, are generally subangular to well rounded, very crudely sorted and poorly graded. The sandstone, often with better defined bedding, are generally coarse-grained and poorly-sorted, and occasionally contain pebbles of granite, metasandstone, volcanic and volcaniclastics. The fining upward pattern, poorly graded and erosive base conglomerate, matrix supported, and the sandstone with trough cross-bedding, parallel lamination and common with channelised beds, probably indicates that depositional take place mainly in a fluviatile environment with the sediment supply mainly come from the surrounding country rocks.

The Boulder Beds are gently dipping c. 12-25° variably to the N, NE and SE, suggesting either due gentle, broad folding or deposition upon irregular basinal topography. However, with the common occurrences of joints, a dextral fault associated with narrow shear zone, and a reverse fault clearly indicated that these are tectonic. These mild tectonic features are characteristically common in other Tertiary Boulder Beds encountered in Batu Arang Selangor, Felda Lawin Perak and the Nenering, Keroh, Perak.

Shallow gas risk in the Central North Sea

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Shallow gas occurs due to the migration of gas up the geological section to a depth of less than 1,000 m and its subsequent entrapment within certain horizons or features. The source of this gas is thought to be from deep hydrocarbon burial. The shallow gas becomes a risk to exploration companies if attempt to drill through it to the underlying hydrocarbon; this is when a blow out could occur. Drilling procedures at this stage do not often contain a blow out preventer therefore could lead to a large gas kick.

Shallow gas surveys are therefore necessary to predict the presence and depth of any such anomalies using data such as seismic and well logs. The main risk in this area is attributed to three horizons. These horizons lie within a package of late Tertiary/Quaternary sediments.

Horizon 1 represents a medium/high gas risk in the southeast of the area and low gas risk in the northwestern part. It is thought that this could be controlled by careful drilling methods and is unlikely to cause uncontrolled blowouts.

Horizon 2 is only present in a limited area over the centre of the basin, but represents a high risk in this region and obviously low in the rest. These high gas zones are associated with large volumes entrapped within mounded features that are characteristics of this region. However, they are not in uniform distribution and could be avoided if shown accurately by 3D seismic.

Horizon 3 has a varying gas risk, with a large area which is of medium/high overlapping the perimeter of the central part of the basin. The medium gas risk runs in a band around this and the rest of the area is low (in the north east region mainly). The gas risk associate with this horizon is shown by the chaotic behaviour over the basin.

As these risks have been identified safety procedures can thus be taken to reduce risk to operation or life.

BERITA-BERITA PERSATUAN
News of the Society

PETUKARAN ALAMAT (Change of Address)

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

1. Osama A.M. Abu-Libda
   21 Jalan Perdana 2/2B, Taman Puchong Perdana, 47100 Puchong, Selangor Darul Ehsan, Malaysia
2. Mirza Arshad Beg
   P.O. Box 47, QGPC, Doha, Qatar
3. Siti Hafidzah S. Ismail
   45, Jalan PU6/6, Taman Puchong Utama, 47100 Puchong.
4. Teoh Lay Hock
   160 SS2/16, 47300 Petaling Jaya, Selangor
5. Wan Anuar bin Hj Ibrahim
   1398 Jalan Mawar 24, Taman Permint Jaya, Chendering, 21080 Kuala Terengganu.

PERTAMBAHAN BAHARU PERPUSTAKAAN
(New Library Additions)

The Society has received the following publications:

1. Palaeontological abstracts, vol. 14, no. 1, 1999 & vol. 13, no. 4, 1998.
2. Acta Micropalaeontologica Sinica, vol. 15, no. 4, 1998.
3. AAPG Explorer, May 1999.
4. Annales Academiae Scientiarum Fennicae no. 160, 1999.
5. American Museum Novitates, nos. 3263, 3264, 3265 & 3267, 1999.
6. Institute of Geoscience, The University of Tsukuba, Annual Report no. 24, 1998.
7. Proceedings of the SOPAC 27th session, 1998.
8. National Science Museum Monographs no. 14, 1998.
9. Berliner Geowissenschaftliche Abhandlungen, Band 198, 1998.
10. Journal of Shijiazhuang, Univ. of Economcis, vol. 21, no. 6, 1998; vol. 22, no. 1, 1999.
11. Acta Geoscientia Sinica, vol. 20, no. 1, 1999.
12. Annual Report: Chinese Academy of Geological Sciences, 1997.
13. Geoscience Journal, vol. 3, no. 1, 1999.
14. Episodes, vol. 22, no. 1, 1999.
15. Monthly statistics on mining industry in Malaysia, Jan & March 1999.
16. Earth Science Frontiers, vol. 5, no. 4, 1998 & vol. 5; suppl. 1998.
17. Geoscience, vol. 12, no. 4, 1998.
18. Geological Survey of Japan, Bulletin vol. 49, nos. 8–12, 1998 & vol. 50, nos. 1–2, 1999.
19. Humans & Nature, no. 9, 1998.
20. Nature & Human Activities, no. 3, 1998.
21. Catalogue of collections in the Museum of nature & human activities, Ityogo, no. 2, 1997.
22. AAPG Bulletin vol. 83/2, 83/3, & 83/4, 1999.
23. American Museum Novitates, nos. 3249, 3251, 3252 & 3253, 1998.
24. Oklahoma Geology Notes, vol. 58, nos. 4–6, 1998.
25. Acta Micropalaeontologica Sinica, vol. 16, no. 1, 1999.
26. Acta Palaeontologica Sinica, vol. 38, no. 1, 1999 & vol. 37, no. 4, 1998.
27. U.S. Geological Survey, Prof. Paper: 1998: nos. 1552-D, 1560. 1999: no. 1598.
28. U.S. Geological Survey, Circular: 1997: no. 1148.

BERITA-BERITA LAIN
Other News

Local News

Malaysia set to be petroleum sufficient

Oil Producer Malaysia will attain self-sufficiency in petroleum products this year once two major projects are completed, industry experts said on Wednesday.

"When everything is up then we should be self-sufficient, but the product mix won't be exactly right," a source at national oil company Petronas said.

Malaysia would reduce its petrol and fuel oil imports dramatically when the second Malacca refinery and Shell Refining Co's long residue catalytic cracker (LRCC) are commissioned in the next few months.

The country would become a serious exporter of transportation fuels such as diesel and jet fuel.

Oil traders said Malaysian imports, mostly sourced from Singapore — about 200,000 tonnes of petrol and 100,000 tonnes of fuel oil per month — would be cut by more than half.

Experts estimated that Malaysia consumed around 450,000 barrels per day (bpd) of petroleum products.

They said refining capacity would be bolstered by 150,000 bpd to 520,000 bpd when the two projects came onstream.

"It's good news for the Malaysian economy because it means the costs of running the whole business is lower. Importing crude oil rather than product is cheaper," said Merrill Lynch energy analyst James Brown.

The country's second oil refinery in Malacca, a 100,000-bpd unit, has already begun trial production and is expected to be commissioned next month.

The refinery is 45% owned by Petronas, 40% Conoco and 15% Statoil.

Oil traders said that the refiner had already begun selling unfinished petrol, diesel and jet fuel on a tender basis with some of these resold into the Malaysian market.

The sophisticated billion-dollar refinery is able to produce high quality oil products such as diesel, which meets stringent US specifications.

The Shell LRCC, built at a cost of RM1.4 bil, would raise production capacity at the Port Dickson refinery by 50,000 bpd to 155,000 bpd.

"The complex will produce an improved yield of high value products, thereby improving the company's margins and reducing Malaysia's margins and reducing Malaysia's reliance on imports of these high value products," Shell said earlier.

Oil traders said majors such as Mobil, BP Amoco and Caltex, which do not have a refining presence in Malaysia, were likely companies who would continue to import part of their petrol needs to meet domestic sales.

The Petronas source said that fuel oil imports would in the long term be eliminated as power generators switch from oil-fired to gas-fired combined-cycle plants.

"Right now about 80% of all power plants in Malaysia use gas. All the new plants use gas and Tenaga is converting existing plants to gas," he said.

Tenaga Nasional Bhd. is the main power provider in Malaysia.

Star, 7.5.1999

More highland projects to require EIA

A move to reduce by half the hectarage for highland projects that require an Environmental Impact Assessment is under way to allow more stringent enforcement and to avoid landslides.

Under present regulations development of hilly areas 50 ha or more require an EIA to be done.

The proposed amendment of the Environmental Quality (Prescribed activities) (Environmental Impact Assessment Order 1987 of the Environmental Quality Act, seeks to reduce the area to 25 ha.

Science, Technology and Environment Minister Datuk Law Hieng Ding said today with the amendments, more land area would be covered under EIA and *"we hope more stringent enforcement can be carried out and try to avoid and minimise unpleasant incidents"*.

Speaking to reporters after opening the Green Productivity workshop, he said: *"We have to look at the regulations from every angle and detailed studies would be carried out. We hope to table the amendment as soon as possible."*

The most recent incident was multiple landslides last week in Bukit Antarabangsa, resulting in residents being forced to evacuate from condominiums and bungalows in Taman Hill View.

Sixty landslides also occurred in Fraser's Hill and along the Gap-Kuala Lipis road early last month, resulting in a 40-hour traffic halt.

The natural drainage of hills has been disrupted by ill-planned development encroachment, illegal land clearing and indiscriminate agricultural activities.

The last major incident was last February when 17 people were killed and two injured following a landslide which buried four squatter houses under tonnes of mud and debris in Kampung Gelam in Sandakan, Sabah.

Law said the decision to amend the regulations was made following rampant development on hilly areas and after suggestions from non-government organisations.

The EIA regulations encompass 21 activities such as agriculture (500 ha or more), airport construction, drainage and irrigation (200 ha or more), fisheries, logging (500 ha or more), housing (50 ha or more), ports, ex-mining pools and ex-dumpsites.

NST, 19.5.1999

Go-ahead for amendment to Environment Quality Act

The Cabinet today gave the go-ahead for the Environmental Quality Act to be amended to check the rapid development of hilly areas and ensure stricter enforcement is carried out.

Science, Technology and Environment Minister Datuk Law Hieng Ding said the Department of Environment had been directed to immediately look into the drafting of the amendments to the Environmental Quality (Prescribed Impact Assessment) Order 1987 of the Act.

He said the amendments — including a proposal to reduce by half the hectarage for housing projects which require an Environmental Impact Assessment — would give the DOE more clout on environment matters as a bigger number of development projects would come under its purview.

Under present regulations, only development of areas 50 ha or more are subject to EIAs.

Among the other proposals are reducing the size of logging areas that require an EIA and making EIAs mandatory for hillside projects with a gradient of between 30 and 40 degrees.

On concerns raised about development on highlands, Law said it was wrong to suggest that no activity be allowed in such areas.

"They can be developed but one has to look, among others, at the soil structure, sensitivity of the area and then build according to nature," he said before chairing his weekly post-Cabinet meeting.

Law said the Cabinet, however, did not discuss the proposal that the Federal Government be given the responsibility on all environment matters.

He said what was more important was ensuring that State governments work closely with Federal authorities on such matters.

Asked whether the size of projects that

required an EIA could be further reduced, he said it would cause developers to incur additional cost, besides the possibility of projects being delayed.

He said the decision to reduce the hectarage was made as some developers had in the past "abused" the regulations by dividing their projects into smaller areas to escape the EIA requirement.

"We decided on the 50 ha requirement earlier as we felt that projects of this size that would more likely cause environmental problems."

NST, 20.5.1999

Kelantan, Emission Control in gold mining project

Kelantan yesterday entered into a joint gold mining project with Emission Control (M) Sdn. Bhd. in Sungai Galas, Gua Musang, which involves estimated reserves worth more than RM500 million.

Seven sites covering 537 hectares between Kampung Limau Kasturi and Gua Musang town along a 50 km stretch of the river have been identified as containing gold ore in the form of gold flakes and nuggets amounting to 16 tonnes and valued at US$144 million (RM547.2 million).

The State Government stands to earn a 10 per cent royalty from the net gold content of the project.

Kelstone Sdn. Bhd., the State Economic Development Corporation's subsidiary, will hold 30 per cent equity while the remaining 70 per cent will be held by Emission Control.

The project will be carried out once the mining certificate is issued by the State Government. It is expected to take off before year end.

Emission Control chief executive officer John Ranko Lozo said the company would pump in an initial RM5 million. It expected to see returns within the first year of mining.

"We should see a one-third earning from the initial estimate of US$144 worth of gold reserves."

He said the State Government had agreed to lease out the mining areas for 10 years but the company intended to extract the gold at a faster rate.

"The company has a long-term plan to invest in the gold mining project in Kelantan," he told reporters after the signing of the joint venture agreement between Kelstone and Emission Control in Kota Baru.

State Trade, Industry, Entrepreneur Development and Human Resource Committee chairman Ahmad Yakub and Emission Control president Sumiyoshi Omure signed the agreement, witnessed by Menteri Besar Datuk Nik Abdul Aziz Nik Mat yesterday.

Ranko Lozo said the project, first identified in 1986, had been stalled until the company negotiated a new deal with Kelstone in March last year and set up a full structure of the agreement to revive the project.

"The State Government gave its first consent to the project in Sept 23, last year," he said.

"Exploration work which followed later had found a large amount of gold deposits in the area."

He said although the company was given a 10-year lease to mine gold, it intended to extract the ore at a faster rate in half the lease period.

He added that the project would also create employment for the people and that it expected to employ a 100 per cent local workforce.

NST, 21.5.1999

Malayan Cement expects difficult year

Malayan Cement Bhd. expects the current financial year ending Dec 31, 1999, to be a difficult one unless there is sustainable growth in the cement industry.

"We're starting to put in three months of positive growth behind us now although it is a gradual increase in the volume," said managing director Alistair R. Cox when speaking to reporters after the company's annual general meeting in Kuala Lumpur yesterday.

"I feel that we will see volumes coming back a little more strongly at the end of this year."

"We're seeing more enquiries now compared with six months ago although (the enquiries) may not necessarily be translated into contracts," he said.

After several years of uninterrupted growth, cement demand in Peninsular Malaysia recorded a decline of 38 per cent to 9.7 million tonnes last year (from 15.6 million tonnes in 1997 and 13.3 million tonnes in 1996).

On the financial prospects this year, Cox said: *"Given the downturn in the market and price pressures as well as volatility, it will be a difficult year and will be worse than 1998."*

For the financial year ended Dec 31, 1998, the company achieved a pretax profit of RM83.5 million — a decline of 51.5 per cent over the previous year.

Cox said the company had changed from being a net importer last year to being an exporter, mostly to Southeast Asia.

Malayan Cement's subsidiary, Associated Pan Malaysia Cement Sdn. Bhd., has been exporting "reasonable tonnages" to niche markets like Tahiti.

"We'll be taking more than a million tonnes into the international market," Cox said.

Being in the Blue Circle network has benefited the company in that it allowed it market access to secure significant export tonnages.

Malayan Cement is a member of the Blue Circle Group which is one of the world's leading building materials companies with operations in the UK, the US, Canada, Chile and Africa.

Cox said although most of the current worldwide excess of cement was sourced in Southeast Asia, the prices had not been attractive.

The company also has to face stiff competition from countries like Thailand, China, Indonesia and Korea.

Its 65 per cent equity interest in Kedah Cement Holdings Bhd., which was acquired last October from Bolton Bhd. and Hicom Holdings Bhd., will provide the company with a stronger position in the Malaysian cement industry as the combined market share is 50 per cent.

The completion of the proposed acquisition is expected to be within the next couple of weeks.

NST, 27.5.1999

Prehistoric geological sites found in Johor

The Geological Society of Malaysia has identified two prehistoric sites in Johor, dating back 300 million years, with unique and distinctive rock formations.

The rocks at the sites are much older than those of the Permian period which began 275 million years.

The sites are at Tanjung Balau and Tanjung Lompat, east of Kota Tinggi in Johor. The land belongs to the Johor Tenggara Development Authority (Kejora).

Both the sites are barely five kilometres apart and are easily accessible by four-wheel drive vehicles.

State Environment and Consumer Affairs Committee chairman Dr. Chua Soi Lek said the State Government was keen to turn the sites into a geological monument.

"The sites will also be gazetted under the National Parks (Johor) Corporation Enactment 1989 to facilitate research and to protect them from rock poachers."

"We will consider funding further studies before turning it into a geo-tourism park to attract geologists worldwide," he said.

The study team, led by Dr. Tajul Anuar Jamaluddin, had made a preliminary finding during its geological study which began last year.

Dr. Chua said the team would continue the study to ascertain the actual size of the rock formations.

To create more awareness among the public, Dr. Chua said a section of the Fishermen's Museum in Tanjung Balau would be used to exhibit certain rock formations.

He said the rock formation at the sites were unique as each layer had distinctive markings of its age at different geological periods.

NST, 30.5.1999

Geologists find rare rock formations in Johor

Studies conducted by the Geological Society of Malaysia on rock formations in Tanjung Balau and Tanjung Lompat showed that they were at least 280 million years old.

"The rock formations in Tanjung Balau and Tanjung Lompat are very rare and we have yet to come across similar ones in other parts of the country," said the Society's Dr. Tajul Anuar Jamaluddin.

Dr. Tajul Anuar, who heads a project to turn the two areas into geological parks, said the state government should preserve these sites as a national heritage.

He said the rock formations showed signs of environmental changes that have taken place over millions of years.

Dr. Tajul Anuar said Tanjung Balau and Tanjung Lompat were, therefore, ideal field laboratories for geology students, while tourists would appreciate the rock formations.

The rock formations, he said, lie over a 5 km stretch between Tanjung Balau and Tanjung Lompat and measures must be taken to protect them from visitors.

He said geo-parks would not only benefit geology students but also promote geo-tourism in Johor.

Dr. Tajul Anuar added that this was the first time the Society had been involved in such a project and hoped to complete its study in a year's time.

Meanwhile, state Environment and Consumer Affairs Committee chairman Dr. Chua Soi Lek said the state government fully supported the project and would gazette the sites as national parks.

Star, 31.5.1999

Malaysia's gas output to grow steadily

Most of the past years' forecasts on Asian gas demand are now considered obsolete as the Asian "economic flue" has depressed economic growth and reduced the projected levels of energy and gas demand, the Pacific Economic Co-operation Council said.

As such, last year the Asia Pacific Energy Research Centre came up with new forecast figures.

It has forecast that Malaysia's natural gas production will increase by five billion cubic metres to 30 bcm by 2000 from 25 bcm in 1995.

Reports prepared by the PECC stated that Malaysia's production of natural gas is expected to grow steadily and estimated to nearly reach 40 bcm in 2005 and 50 bcm in 2010.

Unlike countries like Japan, South Korea and Singapore, Malaysia is expected to produce its own natural gas as it has much natural resources.

The most important factor which encourages the demand for natural gas in Asia is the electricity generation sector.

The combined cycle power generation method has been responsible for much of the natural gas growth in East Asia, PECC said.

Power generation using a conventional steam boiler is limited to a 36 per cent thermal efficiency while combined cycle units can exceed even 50 per cent.

The combined cycle units operate on gas, liquified petroleum gas, naphtha or distillate, but not residual fuel oil, thus restricting the ability of oil to compete in this attractive market.

NST, 3.6.1999

Spratlys claim based on EEZ

Malaysia's claims over several islands and reefs in the disputed Spratly Islands is based on the Exclusive Economic Zone policy, which states that a nation's territory extends 200 nautical miles from its coastline.

Malaysia is claiming three islands and four rock groups in the Spratlys, which has more than 100 islets, coral reefs and shoals, scattered in the South China Sea.

Disputes over the islands — which are also claimed in all or part by Vietnam, Philippines, Taiwan, Brunei and China — revolve around overlapping territorial claims, particularly where potential gas and old reserves are said to be available.

Malaysia claimed its first island in 1979, indicating that it is in the country's continental shelf.

In 1992, Asean and China signed a declaration on the South China Sea, which stipulated that all claimants would agree to put aside their territorial claims on the islands and jointly develop the area.

Star, 26.6.1999

KALENDAR (CALENDAR)

1999

July 11–14
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (International Regional Conference), Istanbul, Turkey. (Contact: AAPG Conventions Dept., P.O. Box 979, Tulsa, OK 74101-0979, USA. Tel: 1 918 560 2679; Fax: 1 918 560 2684)

July 12–14
ICHNOFABRICS IN PETROLEUM GEOLOGY (International Meeting), Aberdeen, Scotland. (Contact: Stuart G. Buck, Mark J.F. Lawrence, Z&S Geology Ltd., Campus 2, Aberdeen Science and Technology Park, Balgo wnie Drive, Bridge of Don, Aberdeen, AB22 8GU, UK. Tel: +44 122 48 22 555; Fax: +44 122 48 23 777; E-mail: stuart.buck@zands.com *or* mark.lawrence@zands.com *or* Nigel H. Trewin, Department of Geology & Petroleum Geology, Meston Building, King's College, University of Aberdeen, Aberdeen, AB24 3UE, UK. Tel: +44 122 42 73 448; Fax: +44 122 42 72 785; E-mail: n.trewin@geol.abdn.co.uk)

July 12–15
THE BATHURST MEETING, Cambridge, UK. (Contact: Dr. J.A.D. Dickson, Dept. of Earth Sciences, University of Cambridge, Downing St, Cambridge, CB2 3EQ, UK. Tel: +44 1223 333400; Fax: +44 1223 333450; E-mail: jaddl@esc.cam.ac.uk)

July 12–16
NATIONAL SPELEOLOGICAL SOCIETY (Convention), Filer, Idaho, USA. (Contact: David W. Kesner, P.O. Box 1334, Boise, Idaho, USA 83701. Tel: +1 208 939 0979; E-mail: drdave@micron.net)

July 15–20
ICHNOFABRICS (5th International Workshop and Field Seminar), Manchester, U.K. (Contact: John Pollard, Department of Earth Sciences, University of Manchester, Manchester, M13 9PL, UK. Tel: +44 161 27 53 817; Fax: +44 161 27 53 947; E-mail: john.pollard@man.ac.uk)

July 19–30
INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS, Birmingham, UK. (Contact: IUGG99, School of Earth Sciences, University of Birmingham, Edghaston, Birmingham B15 2TT, UK. Fax: 44 121 414 4942; E-mail: IUGG99@bham.ac.uk)

July 19–30
INTERNATIONAL ASSOCIATION OF HYDROLOGICAL SCIENCES (International Meeting), Birmingham, UK. (Contact: IUGG99, School of Earth Sciences, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK. Fax: 44 121 414 4942; E-mail: IUGG99@bham.ac.uk)

July 22–25
EUROPEAN PALEONTOLOGICAL ASSOCIATION WORKSHOP, Lisboa, Portugal. (Contact: CEPUNL, Quinta da Torre, P-2825 Monte de Caparica, Portugal. Tel: 351 1 2948573; Fax: 351 1 2948556; E-mail: cepunl@mail.fct.unl.pt; Website: http://www.si.fct.unl.pt/~w3cepunl)

August 3–12
INTERNATIONAL UNION FOR QUATERNARY RESEARCH (INQUA) (15th Congress), "The Environmental Background to Hominid Evolution in Africa", Durban, South Africa. (Contact: Dr. D. Margaret Avery, INQUA XV CONGRESS, P.O. Box 61, South Africa Museum, Capetown 8000, South Africa. Tel: +27 21 243 330; Fax: +27 21 246 716; E-mail: mavery@samuseum.ac.za; WWW: http://inqua.geoscience.org.za)

August 4–12
AFRICA, CRADLE OF HUMANKIND DURING THE QUATERNARY (XV INQUA Congress), Durban, South Africa. (Contact: Prof. T.C. Partridge, Climatology Research Center, University of Witwatersrand, 13 Cluny Rd., Forest Town, Johannesburg 2193, South Africa. Tel: +27 11 646 3324; Fax: +27 11 486 1689; E-mail: 141tcp@cosmos.wits.ac.za)

August 6–11
INTERNATIONAL ASSOCIATION OF MATHEMATICAL GEOLOGISTS (Annual International Conference) and IUGS Commission on Fossil Fuels, Trondheim, Norway. (Contact: IAMG í99, c/o Stephen Lippard, Department of Geology and Mineral Resources Engineering, 7034 Trondheim, Norway. Tel: +47-73 594828; Fax: 47-73 594814; E-mail: iamg99@geo.ntnu.no)

August 9–12
SOIL DYNAMICS AND EARTHQUAKE ENGINEERING (SDEE '99) (9th International Conference), Bergen, Norway. (Contact: K. Atakan, SDEE '99 LOC, Institute of Solid Earth Physics, University of Bergen, Allegaten 41, 5007 Bergen, Norway. Tel: +47-55 583420; Fax: +47-55 589669; E-mail: sdee99@ifjf.uib.no; Website: http://www.ifjf.uib.no/seismo/sdee99.html; abstract deadline: January 31, 1999)

August 14–25
CARBONIFEROUS-PERMIAN (XIV International Congress), Calgary, Alberta, Canada. (Contact: Dr. Charles Henderson, Associate Professor, Department of Geology and Geophysics, The University of Calgary, N.W. Calgary, Alberta, Canada T2N 1N4. Tel: 403 220 6170; Fax: 403 285 0074; E-mail: henderson@geo.ucalgary.ca)

August 22–25
SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS (SGA) (5th Biennial Meeting) and International Association on the Genesis of Mineral Deposits (IAGOD, 10th Quadrennial Meeting) (Joint Meeting), "Mineral Deposits: Processes to Processing," London, UK. Imperial College Natural History Museum. (Contact: Dr. Chris Stanley, Department of Mineralogy, Natural History Museum, Cromwell Road, London, SW7 5BD, UK. Tel: +44 171 938 9361; Fax: +44 171 938 9268; E-mail: cjs@nhm.ac.uk)

August 22–27
GOLDSCHMIDT CONFERENCE (9th Annual, International), Cambridge, Massachusetts, USA. (Contact: Stein B. Jacobsen, Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA 02138, USA. Tel: +1-617 495 5233; Fax: +1-617 496 4387; E-mail: goldschmidt@eps.harvard.edu; Website: http://cass.jsc.nasa.gov/meetings/gold99/)

August 24–26
SEDIMENTOLOGY (19th Regional European Meeting), Copenhagen, Denmark. (Contact: Conventum Congress Service, Carit Etlarsvij 3, DK-1814, Frederiksberg C, Denmark. Tel: +45 31 31 08 47; Fax: +45 31 31 63 99; or Lars B Clemmensen, Geological Institute, Oster Voldgade 10, DK-1350, Copenhagen K, Denmark. Tel: +45 35 32 24 49; E-mail: larsc@geo.geol.ku.dk)

September
THE CONTINENTAL PERMIAN OF THE SOUTHERN ALPS AND SARDINIA (ITALY): Regional reports and general correlations (International Field Conference), Brescia, Italy. (Contact: Prof. G. Cassinis, Dipartimento di Scienze della Terra, Universita di Pavia, Via Ferrata, 1, I-27100 Pavia, Italy. Tel: 39 382 505834; Fax: 39 382 505890; E-mail: cassinis@ipv36.unipv.it)

September
INTERNATIONAL ASSOCIATION OF HYDROGEOLOGISTS (29th Congress), Bratislava, Slovakia. (Contact: Prof. L. Melioris, Comenius University, Mylinska Dolina, 84215 Bratislava, Slovakia. Tel/Fax: +42 7 725 446; E-mail: podzvody@fns.uniba.sk)

September
INTERNATIONAL SOCIETY OF ROCK MECHANICS (9th International Congress), Paris, France. (Contact: Dr. S. Gentier, Secrétaire Général du CFMR, BRGM/DR/GGP, Avenue Claude Guillemin, B.P. 6009, F-45060 Orléans Cedex 2, France. Tel: +33 2 38 64 38 77; Fax: +33 2 38 64 30 62)

September 6–9
BIOGEOIMAGES 99 (International Conference sponsored by SEPM, Association de Paleontologie Francaise, and others), Dijon, France. (Contact: BGI 99, Biogeosciences-Dijon, UMR 5561 CNRS, 6 blvd Gabriel, 21000 Dijon, France. E-mail: BGI99@u-bourgogne.fr; Website: http://www.u-bourgogne.fr/BIOGEOSCIENCE/BGI99.htm)

September 6–10
INTERNATIONAL ASSOCIATION OF HYDROGEOLOGISTS "Hydrogeology and Land Use Management" (29th Congress), Bratislava, Slovakia. (Contact: Marian Fendek, Geological Survey of Slovak Republic, Mylinska Dolina 1, 81704 Bratislava, Slovakia. Tel: +421-7 3705355; Fax: +421-7 371940; E-mail: IAHCONG@GSSR.SK)

September 6–12
MINING AND THE ENVIRONMENT II (International Meeting), Sudbury, Ontario, Canada. (Contact: Sudbury '99, Centre in Mining and Mineral Exploration Research (CIMMER), Laurentian University, Sudbury, Ontario, P3E 2C6, Canada. Tel: +705 673 6572; Fax: +705 673 6508; E-mail: cmosher@nickel.laurentian.ca *or* bevans@nickel.laurentian.ca)

September 12–15
OIL & GAS IN THE 21ST CENTURY — DAWN OF THE THIRD AGE (AAPG International Conference and Exhibition), Birmingham, UK. (Contact: AAPG Convention Dept., P.O. Box 979, Tulsa, OK 74101-0979, USA. Tel: 1 918 560 2679; Fax: 1 918 560 2684; E-mail: convene@aapg.org; Website: www.aapg.org)

September 16–17
NON-VOLCANIC RIFTING OF CONTINENTAL MARGINS: A COMPARISON OF EVIDENCE FROM LAND AND SEA (International Conference of Geological Society of London), London, United Kingdom. (Contact: R.B. Whitmarsh, Challenger Division, Southampton Oceanography Centre, European Way, Southampton U.K. SO14 3ZH; Fax: +44 1703 596554; E-mail: bob.whitmarsh@soc.soton.ac.uk; Website: http://www.soest.hawaii.edu/margins/; abstract deadline: April 16, 1999)

September 19–24
ABRAHAM GOTTLOB WERNER (1749–1817) AND HIS TIMES, Freiberg, Germany. Organized by TU Bergakademie Freiberg and the International Commission on the History of Geological Sciences (INHIGEO). (Contact: Dr. Peter Schmidt. Tel: +49 (0) 3731 39-3235; Fax: +49 (0) 3731 39-3289; E-mail: pschmidt@ub.tu-freiberg.de *or* Prof. Dr. Helmuth Albrecht. Tel: +49 (0) 3731 39-3406; Fax: +49 (0) 3731 39-3406; E-mail: halbrecht@vwl.tu-freiberg.de)

September 26 – October 2
VII INTERNATIONAL SYMPOSIUM ON MESOZOIC TERRESTRIAL ECOSYSTEMS, Buenos Aires, Argentina. (Contact: Georgina Del Fueyo, Avda. Angel Gallardo 470, 1405 Buenos Aires, República Argentina. Tel/Fax: 54-1 983-4151; E-mail: imposio@musbr.org.secyt.gov.ar)

September 26 – October 6
FIFTH INTERNATIONAL CONGRESS ON RUDISTS, Erlangen, Germany (with post-conference excursion to the Alps). (Contact: Prof. Dr. Richard Höfling, Institut für Paläontologie, Universität Erlangen-Nürnberg, Loewenichstrasse 28, D-91054 Erlangen, Germany. Tel: +49 9131-85 22 710; Fax: +49 9131-85 22 690; E-mail: richie@pal.pal.uni-erlangen.de)

September 27–30
PALEOCEANOLOGY OF REEFS AND CARBONATE PLATFORMS: MIOCENE TO MODERN (International Meeting), Aix-en-Provence, France. (Contact: Gilbert F. Camoin, Cerege BP 80, F-13545, Aix-en-Provence, cedex-4, France. Tel: +33 4 42 97 15 49; E-mail: camoin@cerege.fr)

October 3–6
VII INTERNATIONAL CONGRESS ON PACIFIC NEOGENE STRATIGRAPHY, Mexico City, Mexico. (Contact: Prof. A. Molina-Cruz, Inst. Cien, Mar. y Limnol., UNAM, Ap. Post 70-305, Ciudad Universitaria, Mexoco D.F. 04510. Tel: 52-5-6225816; Fax: 52-5-6160748; E-mail: amolina@mar.icymyl.unam.mx)

October 13–17
FOSSIL ALGAE (7th International Symposium), Nanjing, China. (Contact: Mu Xi-nan, Nanjing Institute of Geology and Palaeontology, Academia Sinica, 39 East Beijing Road, Nanjing 210008, China. Fax: +86-25 335 7026); E-mail: algae@pub.jlonline.com)

October 25–28
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; WWW: http://www.geosociety.org/meetings/index.htm)

October 30 – November 4
SOIL SCIENCE SOCIETY OF AMERICA (Annual Meeting), Salt Lake City, Utah, USA. (Contact: SSSA, 677 So, Segoe Rd., Madison, WI 53711, USA. Tel: 1 608 273 8090; Fax: 1 608 273 2021; E-mail: rbarnes@agronomy.org)

November 7–10
ENVIRONMENTAL HYDROLOGY AND HYDROGEOLOGY (4th USA/CIS Joint Conference), San Francisco, California, USA. (Contact: American Institute of Hydrogeology, 2499 Rice Street, Suite 135, St. Paul, Minnesota 55113-3724, USA. Tel: +1 651 484 8169; Fax: +1 651 484 8357; E-mail: AIHydro@aol.com; Website: http://www.aihydro.org; abstracts deadline: February 28, 1999)

December 5–8
ADVANCED RESERVOIR CHARACTERIZATION FOR THE TWENTY-FIRST CENTURY (Research Conference sponsored by Gulf Coast Section of Society of Economic Paleontologists and Mineralogists Foundation), Houston, Texas. (Contact: GCSSEPM Foundation, 165 Pinehurst Rd., West Hartland, Conn. 06091-0065, USA. Tel: 800/ 436-1424; Fax: 860/738-3542; E-mail; gcssepm@mail.snet.net; WWW:http:// www.gcssepm.org)

2000

January 24–28
OCEAN SCIENCES (Meeting sponsored by AGU), San Antonio, Texas, 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@kosmos.agu.org; Website: http:// www.agu.org)

March 6–9
SOCIETY FOR MINING, METALLURGY, AND EXPLORATION (Annual Meeting), Salt Lake City, Utah, USA. (Contact: SME, 8307 Shaffer Parkway, P.O. Box 625002, Littleton, CO 80162-5002, USA. Tel: 1 303 973 9550; E-mail: smenet@aol.com)

March 8–9
THE NATURE AND TECTONIC SIGNIFICANCE OF FAULT ZONE WEAKENING (International Research Meeting, sponsored by UK Tectonic Studies Group), London, UK. (Contact: R.E. Holdsworth, Department of Geological Sciences, University of Durham, Durham DH1 3LE, UK. Fax: +44 0191 374 2510; E-mail: R.E. Holdsworth@durham.ac.uk; Website: http:// www.dur.ac.uk/~dgllms/reh.htm; abstract deadline: 30 September 1999)

April 6–9
NATIONAL EARTH SCIENCE TEACHERS ASSOCIATION (Annual Meeting), Orlando, Florida, USA. (Contact: NESTA, 2000 Florida Ave., N.W., Washington, D.C. 20009, USA. Tel: +1 202 462 6910; Fax: +1 202 328 0566; E-mail: fireton@kosmos.agu.org)

April 16–19
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (Annual Meeting), New Orleans, Louisiana, USA. (Contact: AAPG Conventions Department, P.O. Box 979, 1444 S. Boulder Ave., Tulsa, OK 74101-0979, USA. Tel: +1 918 560 2679; Fax: +1 918 560 2684; E-mail: dkeim@aapg.org)

May 7–11
SALT SYMPOSIUM, The Hague, The Netherlands. (Contact: Secretariat Organizing Committee, 8th World Salt Symposium, P.O. Box 25, 7550 GC Hengelo Ov, The Netherlands. Tel: 31 74 244 3908; Fax: 31 74 2443272; E-mail: Salt.2000@inter.NL.net)

May 15–18
GEOLOGY AND ORE DEPOSITS 2000: THE GREAT BASIN AND BEYOND (Conference), Reno-Spark, Nevada, USA. (Contact: Geological Society of Nevada, P.O. Box 12021, Reno, Nevada 89510, USA. Tel: +1-702 323 3500; Fax: +1-702 323 3599; E-mail: gsnsymp@nbmg.unr.edu; Website: http://www.seismo.unr.edu/GSN)

May 23–25
TRACERS AND MODELLING IN CONTAMINANT HYDROLOGY (International Conference), Liege, Belgium. (Contact: TraM'2000, LGIH, University of Liege, B19 Sart-Tilman, 40000 Liege, Belgium. Tel: +32 4 366 2216; Fax: +32 4 366 2817; E-mail: adassarg@lgih.ulg.ac.be)

June 24–30
INTERNATIONAL PALYNOLOGICAL CONGRESS (10th), Nanjing, China. (Contact: Secretary of the Organizing Committee for 10th International Palynological Conference, Nanjing Institute of Geology and Palaeontology, Academis Sinica, 39 East Beijing Road, nanjing 210008, China. Website: http://members.spree.com/sip/spore/index.htm)

July 16–22
APPLIED MINERALOGY — ICAM 2000 (6th International Congress), Gottingen & Hannover, Germany. (Contact: ICAM 2000 Office, P.O. Bx 510153, D-30631 Hannover, GERMANY. Tel: +49-511 643 2298; Fax: +49-511 643 3685; E-mail: ICAM2000@bgr.de; Website: www.bgr.de/ICAM2000; abstract deadline: September 1, 1999)

July 18–23
INTERNATIONAL ASSOCIATION OF VOLCANOLOGY AND CHEMISTRY OF THE EARTH INTERIOR (IAVCEI) GENERAL ASSEMBLY 2000, Bandung, Indonesia. (Contact: Secretariat, Volcanological Survey of Indonesia, Jalan Diponegoro 57, Bandung 40122, Indonesia. Tel: +62-22 772606; Fax: +62-22 702761; E-mail: iavcei@vsi.dpe.go.id; Website: http://www.vsi.dpe.go.id/iavcei.html; abstract deadline: February 29, 2000)

July 31 - August 4
JOINT WORLD CONGRESS ON GROUNDWATER, Forteleza, Brazil. (Contact: ABAS, Ceara Chapter, Avienda Santos Dumont, 7700 Papicu, Fortaleza, CEP 60 150-163, Brazil. Tel: +55 85 265 1288; Fax: +55 85 265 2212)

August 6–17
31ST INTERNATIONAL GEOLOGICAL CONGRESS, Geology and Sustainable Development: Challenges for the Third Millennium, Rio de Janeiro, Brazil. (Contact: 31st IGC Secretariat Bureau, Av. Pasteur, 404-ANEXO 31 IGC, Urca, Rio de Janeiro RJ, CEP 22.290-240 Brazil. Tel: +55 21 295 5847; Fax: +55 21 295 8094; E-mail: 3ligc@cristal.cprm.gov.br; Website: www.3ligc.org. To request current Circular, send e-mail to mailto:address@3ligc.org)

September 3–8
GOLDSCHMIDT 2000 (International Conference), Oxford, UK. (Contact: P. Beattie, Cambridge Publications, Publications House, P.O. Box 27, Cambridge UK CB1 4GL. Tel: +44-1223 333438; Fax: +44-1223 333438; E-mail: Gold2000@campublic.co.uk; Website: http://www.campublic.co.uk/science/conference/Gold2000/)

October
INTERNATIONAL MILLENNIUM CONGRESS ON GEOENGINEERING, Melbourne, Australia. (More information soon)

October 15–18 (Provisional)
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (International Meeting), Bali, Indonesia. (Contact: AAPG Conventions Dept., P.O. Box 979, Tulsa, OK 74101-0979, USA. Tel: 1 918 560 2679; Fax: 1 918 560 2684)

October 23–27
INTERNATIONAL ASSOCIATION OF HYDROGEOLOGISTS (30th Annual Meeting), Cape Town, South Africa.

November 13–16
GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Reno, Nevada, 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; WWW: http://www.geosociety.org/meetings/index.htm)

November 19–24
GEOTECHNICAL AND GEOLOGICAL ENGINEERING — GEOENG 2000 (International Conference), Melbourne, Australia. (Contact: GeoEng2000, ICMS Pty. Ltd., 84 Queensbridge Street, Southbank, Vic 3006, Australia. Tel: +61 3 9682 0244; Fax: +61 3 9682 0288); E-mail: geoeng2000@icms.com.au; Website: http://civil-www.eng.monash.edu.au/discipl/mgg/geo2000.htm)

2001

March 22–25
NATIONAL EARTH SCIENCE TEACHERS ASSOCIATION (Annual Meeting), St. Louis, Missouri, USA. (Contact: NESTA, 2000 Florida Ave., N.W., Washington, D.C. 20009, USA. Tel: +1 202 462 6910; Fax: +1 202 328 0566; E-mail: fireton@kosmos.agu.org)

April 8–11
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (Annual Meeting), Denver, Colorado, USA. (Contact: AAPG Conventions Department, P.O. Box 979, 1444 S. Boulder Ave., Tulsa, OK 74101-0979, USA. Tel: +1 918 560 2679; Fax: +1 918 560 2684; E-mail: dkeim@aapg.org)

August 23–28
INTERNATIONAL CONFERENCE ON GEOMORPHOLOGY (5th), Tokyo, Japan. (Contact: Prof. K. Kashiwaya, Dept. of Earth Sciences, Kanazawa University, Kanazawa, 920-1192 Japan. E-mail: kashi@kenroku.kanazawa-u.ac.jp)

November 5–8
GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Boston, Massachusetts, 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; WWW: http://www.geosociety.org/meetings/index.htm)

2002

March 10–13
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (Annual Meeting), Houston, Texas, USA. (Contact: AAPG Conventions Department, P.O. Box 979, 1444 S. Boulder Ave., Tulsa, OK 74101-0979, USA. Tel: +1 918 560 2679; Fax: +1 918 560 2684; E-mail: dkeim@aapg.org)

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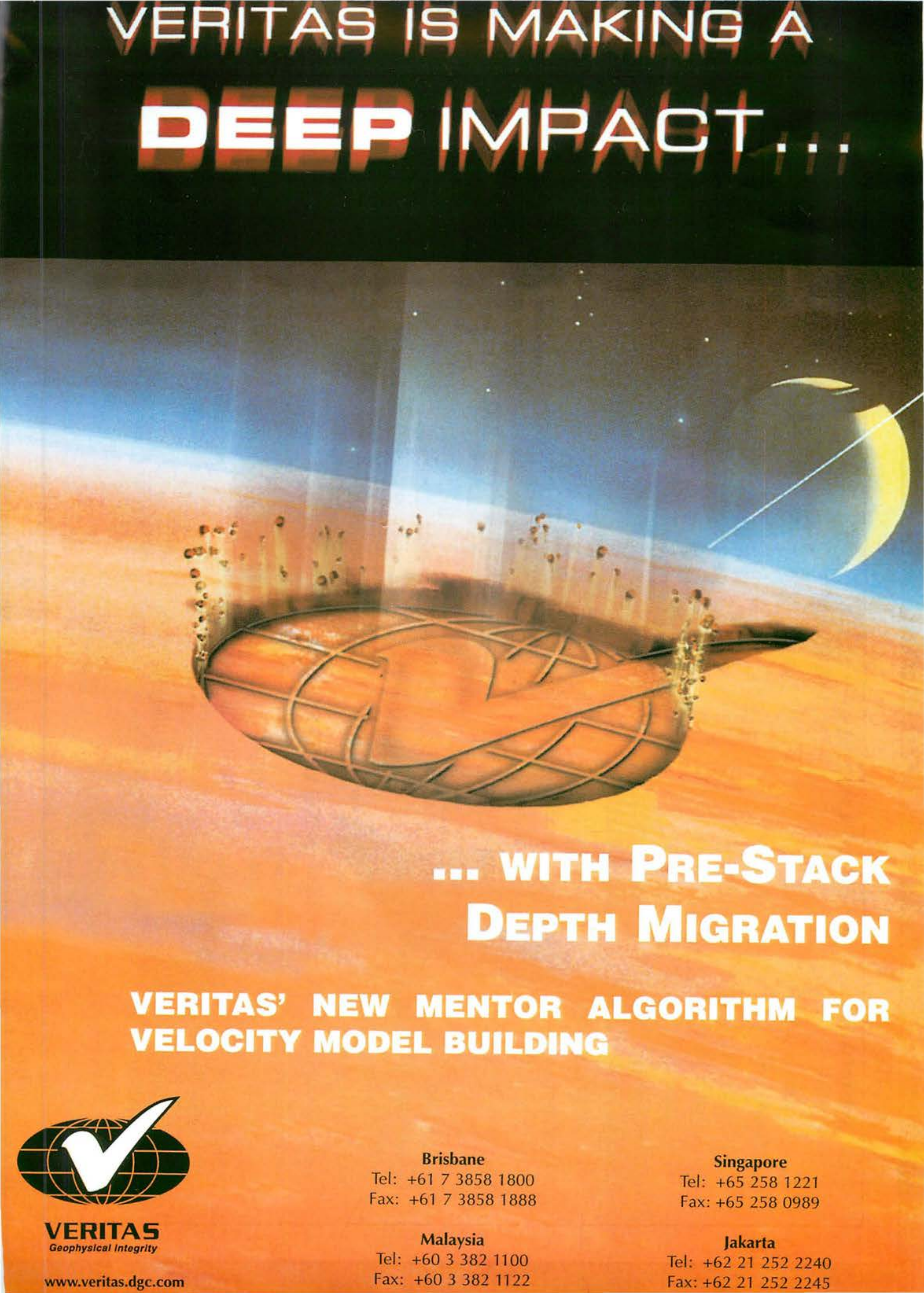
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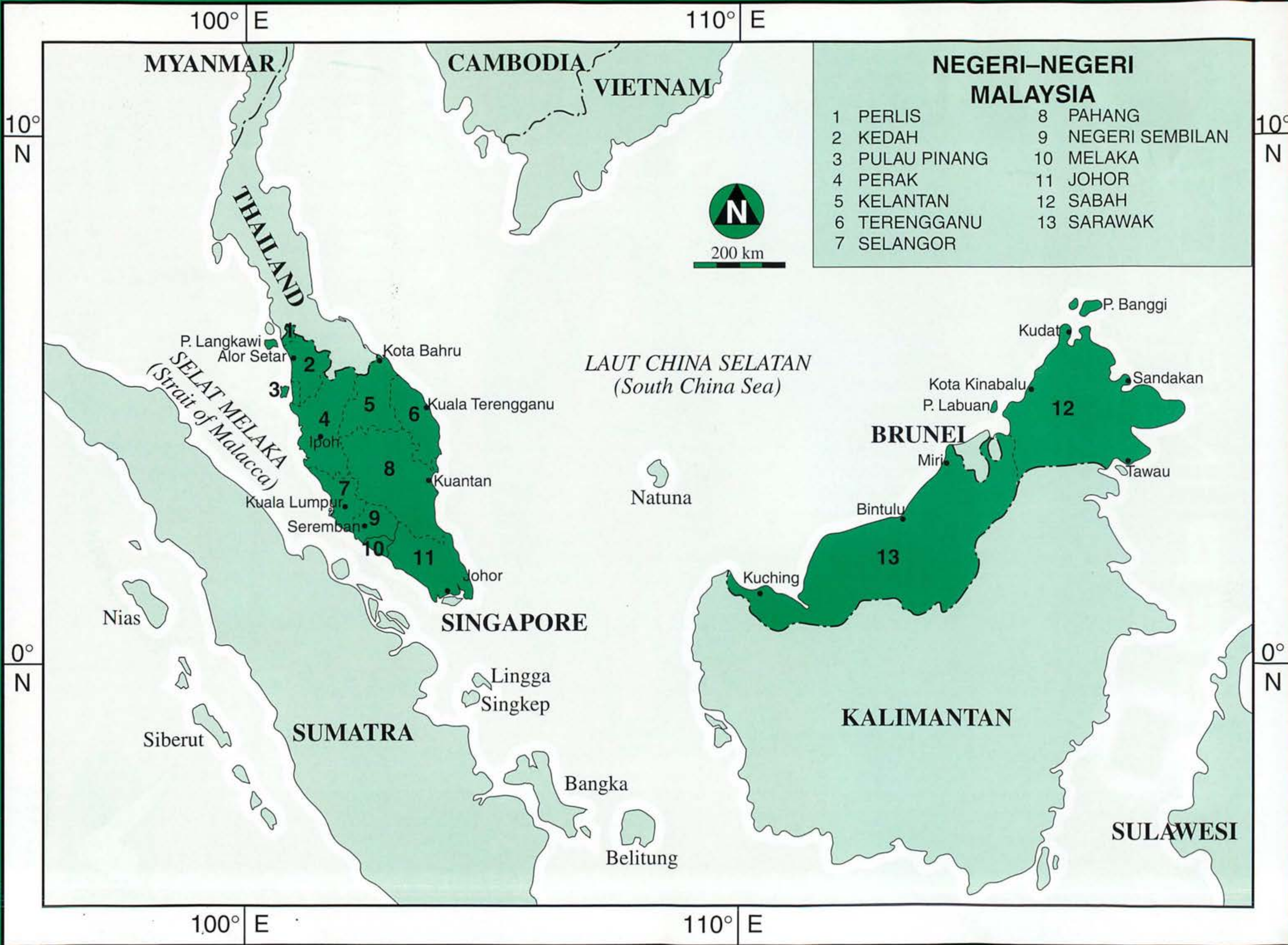
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