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GEOLOGICAL SOCIETY
OF MALAYSIA

DIKELUARKAN DWIBULANAN
ISSUED BIMONTHLY

PERSATUAN GEOLOGI MALAYSIA

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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.

The Darvel Bay ophiolite complex, SE Sabah, Malaysia – preliminary interpretations

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Abstract: The Darvel Bay ophiolite complex consists of a ultramafic unit, a gabbro unit and a volcanic-sedimentary unit. The complex is bounded by mélanges to the north and south and is overlain by Neogene and Quaternary sedimentary sequences. The ultramafic unit is made up of mantle peridotite and ultramafic cumulate. No tectonic fabric is found within the peridotite body. The gabbro unit includes gabbroic rocks, amphibolites and plagiogranites, while the volcanic-sedimentary unit consists of massive basaltic lavas and radiolarian cherts. Blocks of pillow lava basalts and bedded Early Cretaceous radiolarian cherts, regarded as belonging to the volcanic-sedimentary unit of the complex, occur within the adjacent Early Middle Miocene mélanges.

The Darvel Bay ophiolite complex is interpreted as a part of the oceanic crust segment which lay between the Sundaland craton and the Philippines archipelago and was obducted onto Sabah during the Late Paleogene to Neogene times, probably related to the opening of the South China Sea and Sulu Sea.

INTRODUCTION

The Darvel Bay ophiolite complex (DBOC) consists of ultramafic rocks, gabbros, amphibolites, dyke rocks, basaltic rocks and plagiogranites. The complex is surrounded by mélanges and overlain by Neogene and Quaternary sediments. In the Darvel Bay area (Fig. 1), the sequence of the ophiolite is from a ultramafic unit (mantle peridotite through ultramafic cumulate) into gabbro and dyke units and finally into a volcanic-sedimentary unit. No sheeted dyke complex was found. The ultramafic unit consists of largely serpentinized peridotites, dunites and pyroxenites. The gabbro unit is represented by layered and massive gabbros, amphibolites and plagiogranites. Amphibolites which are associated within the gabbro unit are considered to be formed by metamorphism of gabbros in a transform fault

regime. However, pebbles of garnet-amphibolites found in Sungai Pungulupi (Tungku region) probably represent the metamorphic sole. Plagiogranites, also associated with the gabbro unit, are considered to represent the end product of differentiation within the ophiolite sequences. Volcanic rocks comprise massive basalt with minor layered basalt, metatuffs and volcanic breccia. Massive basalt is sometimes associated with red bedded radiolarian cherts of Early Cretaceous age.

OPHIOLITE SEQUENCE AND PETROGRAPHIC SUMMARY

In the Darvel Bay region the ophiolite sequence is from an ultramafic unit (mantle peridotite through ultramafic cumulate) into gabbro and dyke units, and finally into a volcanic-

sedimentary unit (Fig. 2). Amphibolites and plagiogranites are associated with the gabbroic unit. Bedded radiolarian cherts are sometimes associated with the basaltic rocks. Garnet-amphibolites occurring as loose blocks and/or pebbles in the Tungku area, probably represent the sub-ophiolite metamorphic sole.

Ultramafic unit

Mantle Peridotite: Peridotite, is represented by serpentinized harzburgite and forms the largest outcrop in the study area.

The harzburgite shows an idiomorphic granular texture and consists of olivine, orthopyroxene, clinopyroxene, serpentine and opaque minerals. No tectonite fabrics were seen within the peridotite body, this is probably due to the high degree of serpentinization of the rocks. Amphibole-serpentinite mainly after peridotite (harzburgite) occurs near the margin of the peridotite body. The formation of serpentinites, with variable amounts of talc, amphibole, chlorite, magnetite, iddingsite and sphene, suggest extensive low-temperature metamorphism and hydrothermal alteration.

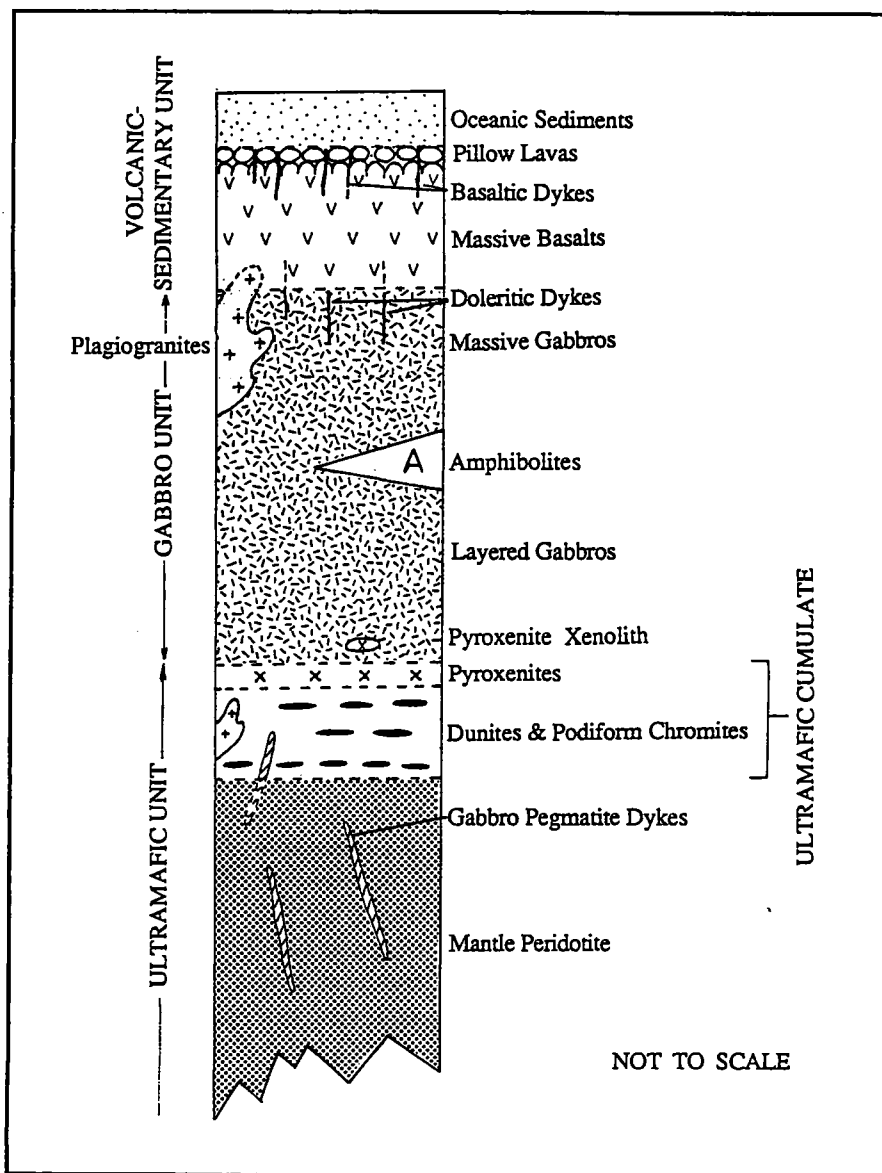


Figure 2. The Darvel Bay Ophiolite Sequence.

Ultramafic Cumulate: It consists of layered dunite (with podiform chromites) and cumulate pyroxenite.

Gabbro unit

The gabbro unit includes layered gabbros, massive gabbros, amphibolites and plagiogranites.

Gabbroic Rocks: The gabbros are idiomorphic to hypidiomorphic granular texture and composed essentially of plagioclase, pyroxene, hornblende and opaques. Nearly all the gabbros show the effects of ocean-floor metamorphism and cataclasis. Where metamorphism was more intense, metagabbros show significant degrees of recrystallization, serpentinization, and alteration of pyroxene to chlorite, hornblende, and/or fibrous uralite. The interstices are frequently replaced by chlorite, epidote, antigorite, talc and/or amphibole. Plagioclase is often cloudy and sodium enriched or saussuritized.

Amphibolites: These rocks contain mainly of hornblende and plagioclase which represent a deformed and metamorphosed gabbro in a transcurrent fault regime in the vicinity of an active spreading ridge.

Plagiogranites: These rocks include hornblende diorites, granodiorites and biotite granites. The rocks are considered to represent the end products of differentiation within the ophiolite sequences.

Dyke unit

No sheeted dyke complex has been observed. However, at least three types of dykes are recognised: (a) gabbro-pegmatite dykes, found in the ultramafic unit; (b) doleritic dykes, cutting the layered and massive gabbros; and (c) basaltic dykes, associated with the basaltic pillow lavas.

Volcanic-Sedimentary unit

Volcanic rocks: Massive basaltic lavas show amygdaloidal, intersertal and subophitic textures. Fresh basalts contain euhedral to subhedral plagioclase and relatively smaller euhedral to subhedral augite phenocrysts. Minor olivine phenocrysts are usually altered to

pseudomorphic chlorite, serpentine, or iddingsite. The groundmass is composed of plagioclase microlites, granular augite, altered olivine and opaque minerals (ilmenite and magnetite). A number of basalts have been metamorphosed to greenschist grade and contain sodium-enriched plagioclase and uralitized augite phenocrysts with intersertal chlorite, epidote, amphibole, and minor carbonate, sphene, mica, talc, clinozoisite, smectite, and opaque minerals.

Basaltic pillow lavas found in the mélange outcrop contains microphenocrysts of plagioclase, pyroxene, olivine and opaque minerals.

Sedimentary rocks: The sedimentary rocks comprise bedded reddish-brown radiolarian cherts, greenish-white bedded cherts and thin layers of red shale.

Sub-Ophiolite Metamorphic sole

Garnet-amphibolites were found along the Sungai Pungulupi in Tungku area, approximately 50 miles east of the study area. It occurs as loose blocks and/or pebbles. The rocks show porphyroblastic and gneissic textures, with some mylonitic texture also visible. Foliation is defined by alternating layers of plagioclase, green-brown amphibole and light green pyroxene.

GEOCHEMISTRY

Alkalis vs. SiO₂ diagram (Fig. 3)

Analysis of Darvel Bay ophiolite samples plotted on the alkalis versus SiO₂ diagram indicates that the alkali content for the samples increase in proportion to the SiO₂ content. Most of the samples fall in the subalkaline/tholeiite field except for the pillow lavas which occur as blocks in the mélange outcrop. From this diagram, the volcanic rocks can be divided into five rock types: alkali basalt, basalt, basaltic andesite, andesite and trachyandesite.

AFM diagram (Fig. 4)

In AFM diagram most of the samples fall within the calc-alkaline field, except for some volcanic and gabbro samples which belong to the tholeiite suite. The Darvel Bay ophiolite

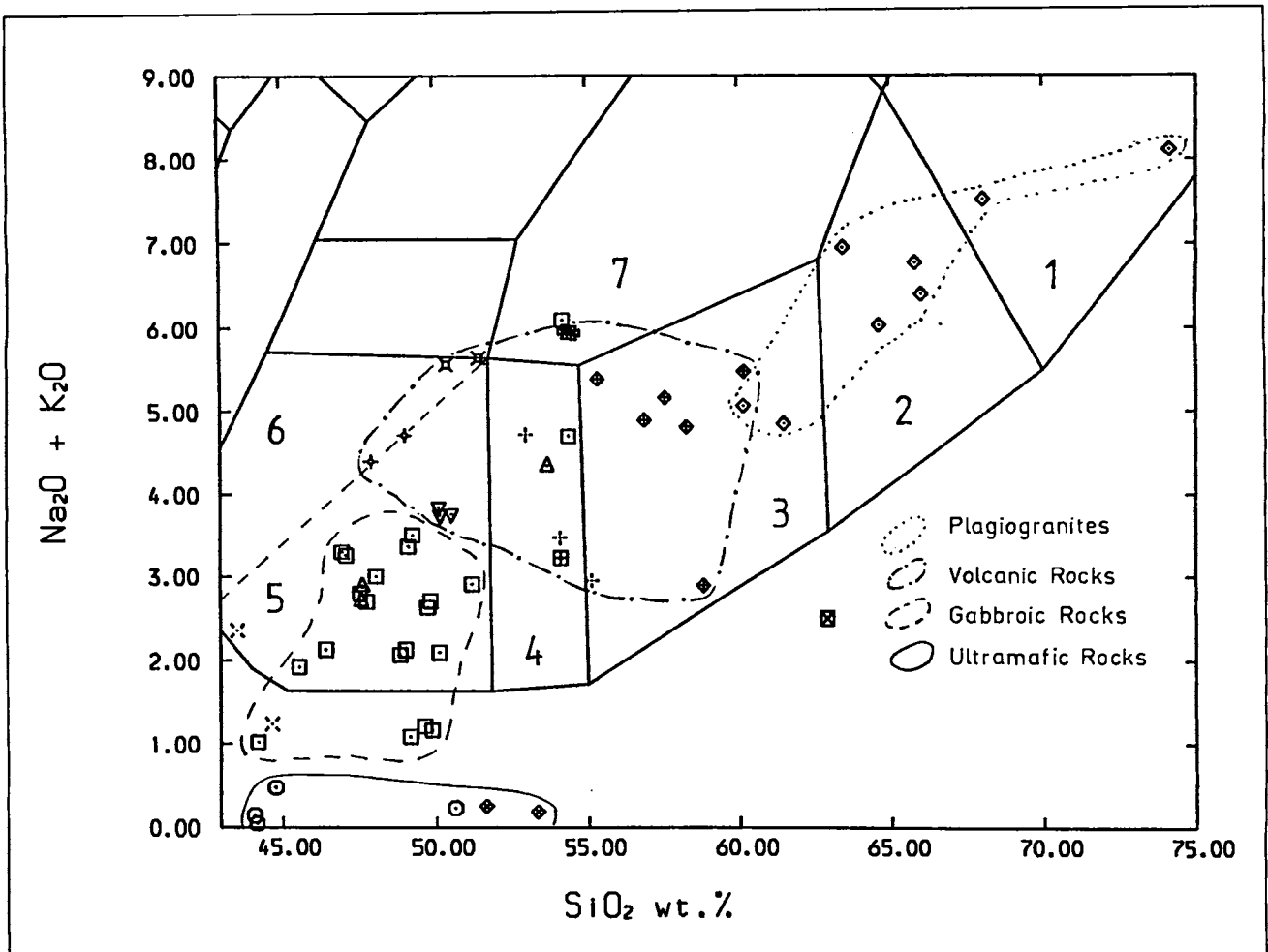


Figure 3. Alkali versus SiO_2 diagram for Darvel Bay Samples. 1- Rhyolite/Granite, 2- Dacite/Granodiorite, 3- Andesite/Diorite, 4- Basaltic andesite/Diorite, 5- Tholeiite basalt/Gabbro, 6- Alkali basalt/Gabbro and 7- Trachyandesite/Monzonite. Fields from MacKenzie *et al* (1982).

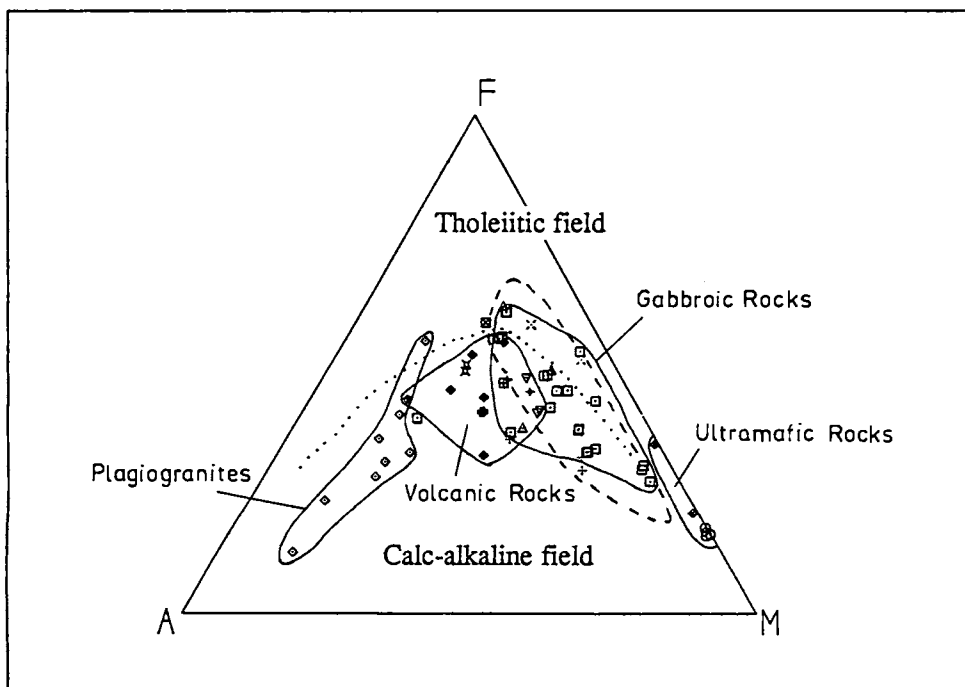


Figure 4. AFM diagram for Darvel Bay samples. Dashed line encloses the field of oceanic gabbros (from Kirst 1970, in Honnorez *et al.*, 1984). Dotted line is approximately boundary between tholeiite and calc-alkaline fields.

rocks show a correlation between alkali content and F/M ratio, where the F/M ratio decreases, the alkali content (sodium mainly) of rocks increases upward from ultramafic rocks through gabbros and volcanic rocks into plagiogranites. The AFM diagram also indicates that most of the gabbros plot in the field of oceanic gabbros.

have marked positive anomalies in Se, Nb, Th and Pb. Typical curve of arc basalts have marked positive anomalies in Pb, Rb, Th and Sr (hydrophile elements), and a strong negative NB anomaly (sample SgPgP).

STRUCTURE

Spider diagram (Fig. 5)

Incompatible-elements abundances normalized to 'chondrite' (Sun, 1980) of some volcanic rocks from DBOC are presented in Figure 5. The concave downwards curve for N-type mid-ocean ridge basalts (N-MORB) reflects their derivation by large degrees of melting of depleted mantle (sample SGB2). The characteristic curves of an alkali basalt (sample KSP2) show depletion in potassium (K) and

Layering is developed in the ultramafic and volcanic rocks. Foliations and mineral lineations always occur in the metagabbros and amphibolites. A major fold defined by different orientations of the dip of the foliation occurs in the Pulau Bohayan. The fold has a vergence to the north and plunges at low to moderate angles to the southeast. Microfolds which have a similar orientation to the major fold support this evidence. Two thrusting events occurred in the study area (Fig. 1). The first is

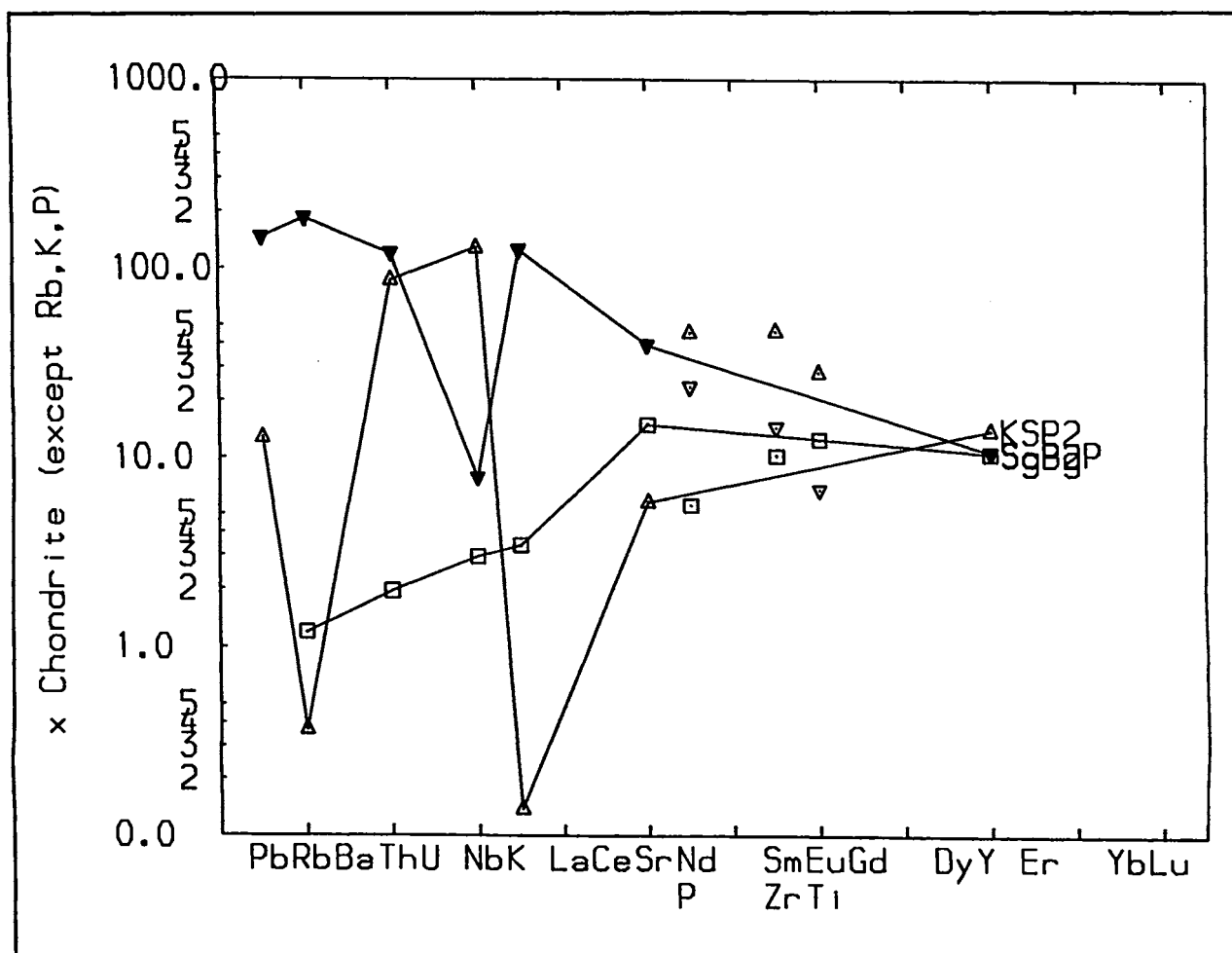


Figure 5. Spider diagram for Darvel Bay volcanic rocks. Samples KSP2- Alkali basalts (\triangle), SgB2-MORB (\square) and SgPgP- Arc basalts (∇).

to the north and followed by a second, back-thrusting, to the south. Minor folds which have a vergence to the south and plunge at low angles to the east occur in the tuffaceous mica schists, as evidence for the second thrusting.

TECTONICS

Tectonomagmatic setting

The tectonomagmatic setting for the Darvel Bay ophiolite has been determined based on the immobile trace elements geochemistry of the volcanic rocks (Fig. 6). Diagram indicates that most of the samples fall in the ocean-floor basalts field and the others in the calc-alkali basalts (Arc Basalts) and within the plate basalts fields. Therefore, the Darvel Bay ophiolite may represent part of a major or small ocean basin and associated with later volcanic activity.

Tectonic evolution

The tectonic evolution of the Darvel Bay region can be related to the opening of the South China Sea and the Sulu Sea. The opening of the South China Sea during Oligocene to Middle Miocene causes southeast or southwards subduction of the oceanic crust in front of the microcontinental crust (Reed Bank and Dangerous Grounds Blocks) beneath the Cagayan arc (Taylor & Hayes, 1983). This event caused intraoceanic thrusting, thrusting and obduction of the oceanic crust in front of the arc to the north or northwest. The opening of the Sulu Sea during the Middle-Late Miocene separated the Cagayan arc to the north and south (Rangin, 1989). Incomplete closing of the Sulu Sea during Late Miocene caused the new oceanic crust to be subducted beneath the Sulu arc (older arc), followed by obduction and

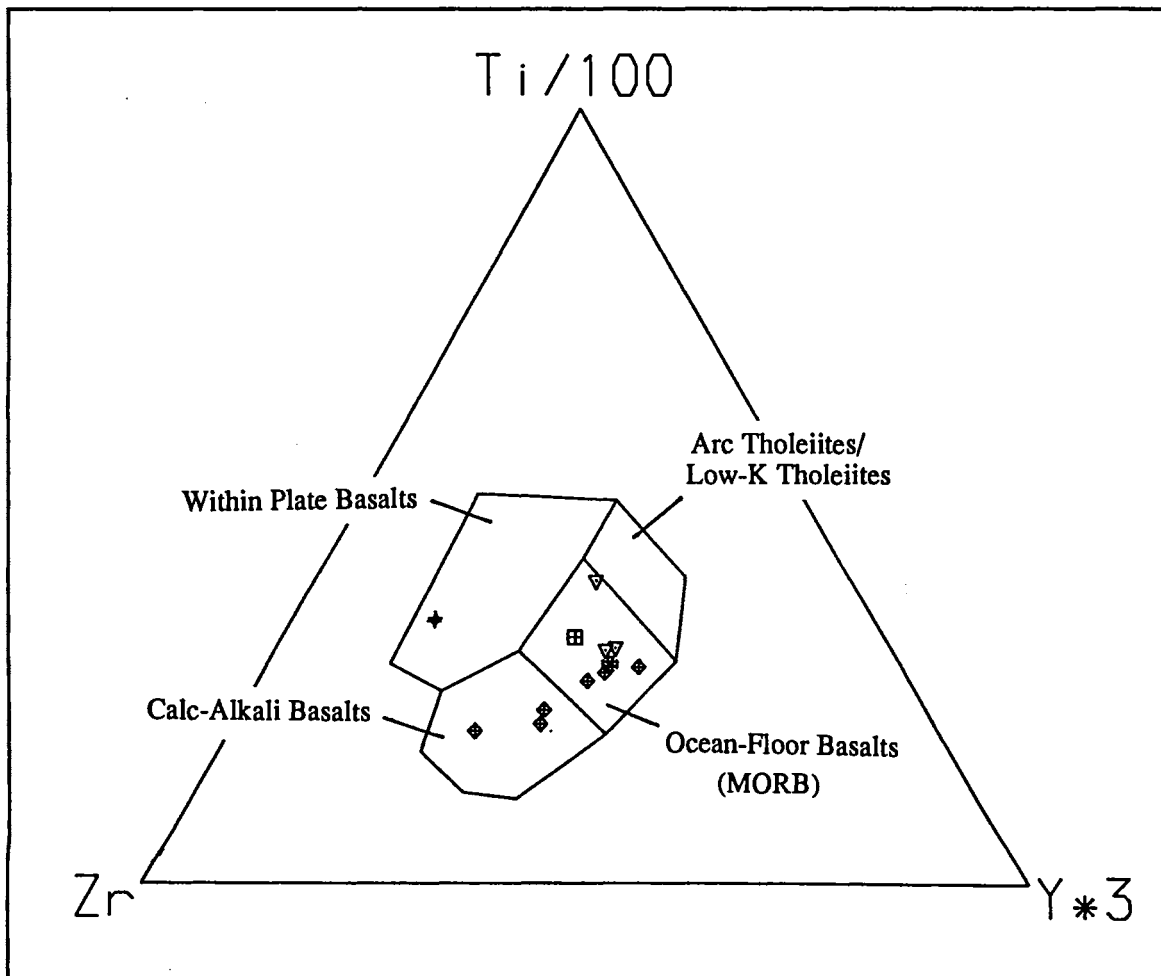


Figure 6. Ti-Y-Zr diagram for Darvel Bay volcanic rocks. Fields from Pearce & Cann (1973). Basalts (∇), Andesites (\diamond), Alkali Basalts (+), Basaltic-andesites (\square) and Trachyandesites (\ast).

back-thrusting to the south. Later, a new arc (Pliocene to Quaternary) formed, superimposed on the older arc.

CONCLUSIONS

The rocks preserved in the study area represent a fragment of an oceanic lithosphere named the Darvel Bay ophiolite complex (DBOC). It is clearly defined by a south to north sequence of peridotite - ultramafic cumulate - gabbroic - dyke rocks - basaltic rocks - cherts. The amphibolites associated with the gabbroic rocks are considered to have been formed by the deformation and metamorphism of the gabbroic ophiolite component in a subvertical shear zone related to the transform fault movement. The basaltic rocks of the area are typical of mid-ocean ridge, arc and within plate types. The structural styles and tectonic events of the complex is related to the opening of the South China Sea and Sulu Sea.

REFERENCES

- HONNOREZ, J., MEVEL, C. & MONTIGNY, R., 1984. Occurrence and significance of gneissic amphibolites in the Vema fracture zone, equatorial Mid-Atlantic Ridge. In: Gass, I.G., Lippard, S.J. & Shelton, A.W. (eds.). *Ophiolites and Oceanic Lithosphere*. Geo. Soc. London Spec. Publ., 13, 121-131.
- MACKENZIE, W.S., DONALDSON, C.H. & GUILFORD, C., 1982. *Atlas of igneous rocks and their textures*. Longman Group Limited, John Wiley & Sons, Inc.
- PEARCE, J.A. & CANN, J.R., 1973. Tectonic setting of basic volcanic rocks determined using trace element analysis. *Earth Planet. Sci. Lett.*, 19, 290-300.
- RANGIN, C., 1989. The Sulu Sea, back-arc basin setting within a Neogene collision zone. *Tectonophysics*, 161, 119-141.
- SUN, S.-s., 1980. Lead isotopic study of young volcanic rocks from mid-ocean ridges, ocean islands and island arcs. *Phil. Trans. R. Soc. London*, A297, 409-446.
- TAYLOR, B. & HAYES, D.E., 1983. Origin and history of the South China Sea basin. In: The tectonic and geologic evolution of southeast Asian seas and island, part 2, American Geophysical Union Geophysical, *Monograph*, 27, 23-56.

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PERTEMUAN PERSATUAN Meetings of the Society

Annual Geological Conference '92 — Laporan (Report)

The Annual Geological Conference 1992 was held on the 9th & 10th May 1992 at the Merlin Inn Resort, Kuantan. The Conference, the 7th in the series, was well attended by nearly a 100 participants.

The Conference was declared open by YAB Tan Sri Mohamad Khalil Yaakob, the Menteri Besar of Pahang Darul Makmur. A total of 39 papers were presented including 2 posters. In addition there was a display of entries to the Society's Fascinating Malaysia Photographic Competition.

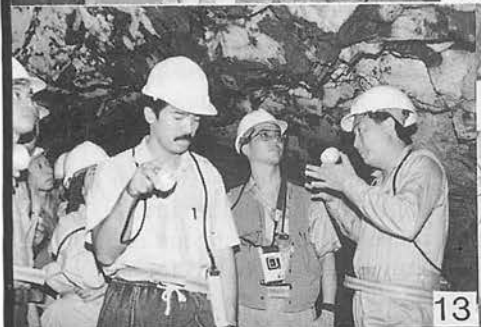
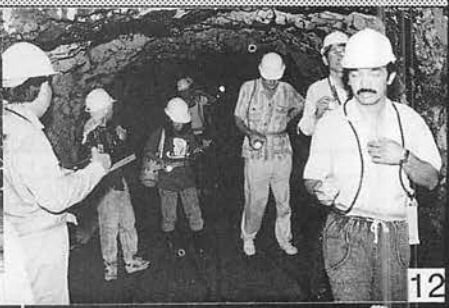
Prompted by the good response to the Pre- and Post-Conference Fieldtrips in Kuching last year, the 2 Pre-Conference Fieldtrips (Mineralization Sg. Lembing & Tasik Cini and Stratigraphy of Kuantan area) and the Post-Conference Fieldtrip (Kuantan-K.L. Transect) were again well participated. Our appreciation to Dr. Azhar Hj. Hussin for the successful fieldtrips and also to Mr. Sia Hock Kiang, Managing Director of Sg. Lembing Tin Mines Sdn. Bhd. for his painstaking organisation of the visit to the former PCCL underground mine and providing lunch for all fieldtrip participants.

We have once again the donors to thank for making the Annual Geological Conference 1992 so pleasant and enjoyable. Malaysia Mining Corporation Bhd. (MMC) again hosted the Conference Dinner while Mamut Copper Mining Sdn. Bhd. hosted the ice-breaker barbecue to provide the right atmosphere to start off the Conference. In addition, we appreciate the kind and worthy financial contributions from Sierra Geophysics, Syarikat Sebangun Sdn. Bhd., SGS (Malsysia) Sdn. Bhd., Perlombongan Sg. Senut and Jaya Enterprises.

G.H. Teh



Annual Geological Conference 1992



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Annual Geological Conference 1992



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Annual Geological Conference 1992



Annual Geological Conference 1992

Pre-Conference Fieldtrips

1. Fieldtrip leader Azhar Hj. Hussin briefing the participants at Bukit Sawar.
2. A closer look at the outcrop at Bukit Sawar.
3. At Tg. Geliga, looking at rocks of the Kuantan Group.
- 4-5. A surprise breakfast at Sg. Lembing Mines.
- 6-7. Managing Director, Mr. Sia Hok Kiang, with the briefing at the Mines Office.
8. A token of appreciation from the Society to Mr. Sia from M.K. Choo.
- 9-10. Mr. Sia briefing participants at the pilot mill.
11. All dressed up and ready for underground.
- 12-13. Mr. Sia elaborating on the mineralisation in the adit.
14. The familiar mini train in the adit.
- 15-17. Participants taking a closer look at the tin mineralisation.
18. Everyone out and happy after the underground visit.
- 19-23. Lunch at the Sg. Lembing Mines Office premises.
24. A token of the Society's appreciation for the fine lunch to Mr. Sia from C.H. Yeap.
- 25-28. Fieldtrip leader G.H. Teh showing the volcanogenic massive sulphide mineralisation at the former Tanchi Mine, Tasik Cini.
- 29-30. G.H. Teh elaborating on the barite deposit at Bukit Ketaya.

Ice-Breaker Barbecue - Hosted by Mamut Copper Mining Bhd.

- 31-32. Participants serving themselves.
33. The main table.
- 34-35. Time for food and discussions.
36. GSM President presenting Mr. Keith Chan of Mamut Copper Mining Bhd. with a token of appreciation.

Opening Ceremony

37. At the registration desk.
38. YAB Menteri Besar Pahang being greeted on arrival.
39. Master of Ceremony, Hamzah Mohamad, starts of the Opening Ceremony.
40. The Organising Chairman with his Welcoming Address.
41. GSM President, Ahmad Said, with his Speech.
42. YAB Tan Sri Mohamad Khalil Yaakob, Menteri Besar Pahang with the Opening Address.
43. A momento for the Guest-of-Honour.
- 44-45. The large turn-out at the Opening Ceremony.
46. YAB Menteri Besar Pahang greeting the participants.
- 47-49. A cup of tea and snacks before the Technical Session.

Technical Sessions

50. K.R. Chakraborty kicks off the Technical Sessions with his Keynote Paper.
51. Anizan Isahak on soils from Johor.
52. G.H. Teh asks a question.
53. Mohamad Ali Hasan on Sg. Buloh Forest Reserve.
54. Sidibe Yaya with the rocks of the Kuantan area.
55. Nuraiteng Tee Abdullah being congratulated by Session Chairman C.S. Hutchison.
56. Mazlan Madon with his paper.
57. Lim Chun Hui on the Lambir Formation.
58. Clive Foss on airborne gravity data.
59. Abd. Rahim Samsudin with his paper.

60. Uyop Said on the Melinau Limestone.
61. Raja Abd. Halim Raja Muda receiving a momento from Session Chairman, M.K. Choo.
62. Askury Abd. Kadir on the ultrabasic and basic rock of Ranau.
63. Joy Periera receiving has momento from Session Chairman, David Wong.
64. Justine Jok Jau on new observations in the Lupar Valley.
65. Session Chairman, N.S. Haile, presenting Juhari Mat Akhir with a momento.
66. Kamal Roslan Mohamed on the Kodiang Limestone.
67. Chieng Yih Yaw with his paper.
68. Nasri poses a question.
69. H.D. Tjia on the Titiwangsa granitoid.

Annual Conference Dinner - Hosted by MMC

- 70-74. The tables at the dinner.
75. Participants trying out the cultural dance.
76. NgTham Fatt receives his cheque from the President for the Society's Photo Competition.
77. Askury Abd. Kadir gets a prize too.
78. Joy Periera receiving her cheque for the Second Prize.
79. Fauzi Zanudin, MMC's representative, with a Speech.

Technical Sessions (cont'd)

80. Sierra Geophysics' display at the Conference.
- 81-82. Mohamad Ali Hasan elaborating on his Poster Displays.
- 83-85. Lunch time.
86. Fascinating Malaysian Geology - entries to the Society's Photo Competition.
87. Siti Faridah Yusup receiving a momento from Session Chairman, Ahmad Tajuddin.
88. Mohd. Shafeea Leman on the Nyalau Formation.
89. Askury Abd. Kadir with a comment.
90. Lee Chai Peng on circular basins.
91. Azhar Hj. Hussin getting his momento from Session Chairman, Zaiton Harun.
92. J.K. Raj with his presentation.
93. Tan Boon Kong being congratulated by Session Chairman, Ahmad Tajuddin.
94. Syed Sheikh Almashoor on the Bentong Suture.
95. A question from the floor.
96. Sazali Yaacob receiving a momento from Session Chairman, Idris Mohamad.
97. Zaiton Harun presenting Basir Jasin's paper.
98. Leong Lap Sau commenting on P-wave velocity variation.
99. Robert B. Tate on the Temburong Formation.
100. The Organising Chairman with the Closing Remarks.

Post Conference Fieldtrip - Kuantan-Kuala Lumpur Transect

101. Fieldtrip leader Azhar Hussin showing the Upper Paleozoic rocks.
102. That is the Lepar Fault Zone.
103. A close examination of the redbeds.
104. Azhar enlightening the participants on the redbeds.
- 105-106. Here is the bedding of the outcrop at Bukit Jaya.
107. Looking at the redbeds near Maran.
- 108-109. Looking at the internal structures of the turbidite sequence at Temerloh.

**Speech by the Organising Chairman, Dr. Teh Guan Hoe,
at the Opening Ceremony, Annual Geological Conference '92,
9th & 10th May 1992,
Merlin Inn Resort, Kuantan, Pahang Darul Makmur**

Tuan Pengerusi Majlis,
YAB Tan Sri Mohamad Khalil Yaakob,
Menteri Besar Pahang Darul Makmur,
Encik Ahmad Said,
Presiden Persatuan Geologi Malaysia,
Para Jemputan Khas,
Tuan-tuan dan Puan-puan hadirin sekalian,

Bagi pihak Persatuan Geologi Malaysia terlebih dahulu saya mengucapkan ribuan terima kasih kepada YAB Tan Sri Mohamad Khalil Yaakob, Menteri Besar Pahang Darul Makmur kerana sudi menghadiri diri untuk menyampaikan ucapan perasmian, seterusnya merasmikan Persidangan Tahunan Geologi sembilan puluh dua ini.

Honoured Guests,
Ladies & Gentlemen,

On behalf of the Geological Society of Malaysia I like to extend our sincere appreciation to you all for your kind presence at this opening ceremony of the Annual Geological Conference 1992.

We are indeed honoured to have with us this morning YAB Tan Sri Mohamad Khalik Yaakob, Menteri Besar Pahang Darul Makmur who will present the Opening Address and officially declare open our 7th Annual Geological Conference.

I would like to take this opportunity to thank the many people who have helped in some way or another in the organisation of this Conference; members of the Organizing Committee, the generous donors & hosts of the lunches & dinners, the authors of papers and my many helpers, and last but not least, all of you for your kind presence, interest and support for the Conference.

Thank you.

**Welcoming Address by President, Geological Society of Malaysia
at the Annual Geological Conference '92,
9th & 10th May 1992,
Merlin Inn Resort, Kuantan, Pahang Darul Makmur**

Tuan Pengerusi Majlis,
Y.A.B. Tan Sri Mohamad Khalil Yaakob,
Menteri Besar Pahang Darul Makmur,
Dr. Teh Guan Hoe,
Pengerusi, Jawatankuasa pengelola,
Dato-Dato,
Tuan-Tuan dan Puan-Puan hadirin sekalian,

Assalamualaikum dan Selamat Pagi.

Bagi pihak Persatuan Geologi Malaysia terlebih dahulu saya mengucapkan setinggi-tinggi ucapan terima kasih kepada Y.A.B. Tan Sri Mohamad Khalil Yaakob, Menteri Besar Pahang Darul Makmur, di atas kesudian beliau menerima undangan kami untuk menyampaikan ucapan perasmian, seterusnya merasmikan Persidangan Geologi Tahunan kali ke-tujuh ini. Kehadiran beliau merupakan satu perhatian dan ganjaran besar kepada Persatuan ini. Tidak ketinggalan juga saya mengucapkan selamat datang kepada para jemputan khas, puan-puan dan tuan-tuan, para peserta sekalian

Ladies and Gentlemen,

On behalf of the Geological Society of Malaysia, I take great pleasure in welcoming our distinguished guests and participants to the opening of the Society's 7th Annual Geological Conference.

We are indeed very honoured to have Y.A.B. Tan Sri Mohamad Khalil Yaakob, Menteri Besar of Pahang Darul Makmur present here today to grace this occasion, which is a significant event for us.

This year's conference is the 7th Annual Conference to be organized by the Society and is one of the 2 major events organized by the Geological Society, the other being the Annual Petroleum Geology Seminar which is now in its 15th year of running. As most of you are aware last year's conference was held in Kuching. That conference was extremely successful with 146 participants. This year's conference is also very significant as this is the first one to be held on the east coast and allows participants not only to enjoy the beautiful beaches but also a chance to participate in the fieldtrips to study local geology.

This Annual Geological Conference has always been very well attended by a good cross-section of geologists from the Geological Survey Department, the local universities and the private sector including mining, oil and service companies. This conference always has provided interesting discussions on regional and local geology and we are very pleased that this year we have attracted a total of 41 technical papers. The papers will occupy a very full 2-day programme. I would like to thank all the numerous authors for all their hard preparations for this meeting.

Also, in conjunction with the conference, 3 geological fieldtrips have been planned for conference participants, two one-day fieldtrips in the Sg. Lembing-Tasik Cini and Kuantan areas which were held yesterday and another 1 fieldtrips to be held after the conference, being a 1-day drive from Kuantan to Kuala Lumpur to study regional geology.

We would like to extend our gratitude to the fieldtrip leaders and all those involved in

organizing the 3 trips, all of which have had a tremendous response. We are certain the fieldtrips will be very beneficial to all participants not only giving them a deeper insight of local geology but also an opportunity to see places of interest and local culture.

Ladies and Gentlemen,

The Geological Society of Malaysia is indeed very proud to have successfully organized a significant number of conferences, seminars, workshops, fieldtrips and technical talks over the past years.

The Society is also currently preparing for two (2) major international conferences to be hosted by the Society in 1992 and 1994, i.e. the GSM-Circum Pacific Energy and Mineral Resources Symposium on Tectonic Framework and Energy Resources of the Western Margin of the Pacific Basin to be held in Kuala Lumpur in November 1992. Preparations for this are advancing well and you can be assured of a high quality programme. The AAPG International Conference to be held in August 1994 will be another major effort for the Society. The Society is sure that these conferences will be a great success especially with your continued support.

Ladies and Gentlemen,

The Society has always strived very hard to advance geological sciences in this country, as can be seen in its regular publication of technical bulletins and newsletters. To-date the Society has produced 29 Technical Bulletins which are recognised both regionally and internationally for the high standard of technical papers. We are also indeed very happy that the Society membership is growing, now standing at 545 members.

The Society currently also enjoy a good financial standing thanks to support for various organization and companies involved in the geoscience industry in Malaysia especially in the petroleum and mineral sector. The Society always striving to utilize these funds for advancement of geological sciences through subsidies of fieldtrips, conferences for members and loans and book prizes for students.

For last's year 25th anniversary, the Society organized a Photographic Competition on Geology. More than 75 entries of high quality were received from enthusiastic geologists and it is planned to publish most of these in a special volume.

Ladies and Gentlemen,

The Society would like to record its appreciations to the Organizing Committee led by Dr. Teh Guan Hoe, who not only successfully organized last years conference in Kuching but also previous conferences in Ipoh, Fraser's Hill and Cameron Highlands. The organizing Committee has again done a wonderful job this year.

Our thanks also go to Mr. Keith Chan Foo Kee and Mamut Copper Mining who hosted last nights barbecue, Sg. Lembing Tin who kindly hosted lunch during the fieldtrip yesterday and also Malaysia Mining Corporation who will be hosting tonight's dinner. MMC has traditionally hosted the Conference Dinner for all the past conferences and we are indeed grateful to MMC for their continued support of the Society's activities. Our thanks also go to the following organizations for their support: Sierra Geophysics, Jaya Enterprise, SGS Malaysia, Perbadanan Kemajuan Negeri Pahang and Perlombongan Sg. Senat.

Ladies and Gentlemen,

On a concluding note, I would like to thank all our distinguished guests especially Y.A.B. Menteri Besar and all participants for all their support and kind attendance this morning.

Dengan ini saya dengan hormatnya menjemput Y.A.B. Tan Sri Mohamad Khalil Yaakob, Menteri Besar Pahang Darul Makmur menyampaikan ucapan pembukaan beliau seterusnya merasmikan Persidangan ini. Dipersilakan.

**Opening Address by Y.A.B. Tan Sri Mohamad Khalil Yaakob,
Menteri Besar Pahang Darul Makmur
of the Annual Geological Conference 1992
on 9th May 1992 at Merlin Inn Resort, Kuantan.**

Tuan Pengerusi Majlis,
Encik Ahmad Said,
Presiden Persatuan Geologi Malaysia
Dr. Teh Guan Hoe,
Pengerusi Jawatankuasa Pengelola Persidangan,
Encik Fateh Chand,
Timbalan Ketua Pengarah Jabatan Penyasatan Kajibumi,
Dato'-Dato', Tuan-Tuan dan Puan-Puan sekalian,

I am indeed honoured to be given the opportunity to address this distinguished gathering of geoscientists representing the universities, government, quasi-government bodies and the private sector, especially those in the minerals, energy and geotechnical industries.

Being Chairman in the Pahang State Ministry of Resources Planning, I feel very happy to be with this crowd this morning. I am certainly not wrong to say that I am addressing today, an important group of professionals who are directly involved in the search for and the exploration of the country's rich resources of oil, gas, groundwater, coal, rocks and minerals, and assist in the construction of dams, tunnels and the country's vast network of roads and highways. Many of our urban and economic centres are indeed related to the development of the mineral industry: tin in the Klang and Kinta Valleys had stimulated the growth of Kuala Lumpur and Ipoh respectively into major cities in Peninsular Malaysia, whereas oil and gas have led to the development of Miri, Bintulu and Kerteh, Raub and Bau grew because of gold. Geoscientists can therefore be proud of the fact that they have contributed significantly towards economic development and technological advancement of our country.

In fact, with the hard work put in by all the geoscientists, our country now has a comprehensive mineral data base that will provide the necessary information to attract local and foreign companies to invest in the mineral industry.

The Geological Survey Department has reported that significant progress has been made on the formulation of the mineral development policy and legislation to attract foreign investments and at the same time to safeguard the country's interest. To help the country diversify its largely tin-dependent mining industry, the Geological Survey has maintained a high level of exploration for precious metals, like gold and silver and base metals like copper, lead and zinc.

In line with the two-pronged mineral diversification strategy, and the emphasis on the exploitation of industrial minerals, priority is given to carry out systematic exploration and evaluation of our ball clay, bentonitic clay, dimension stone, kaolin, silica sand, limestone and granite resources.

Pahang is quite well endowed with mineral resources. There has been prospecting and mining in varying degrees for tin, iron, manganese and barite. Gold is also an important revenue earner for Pahang. With the proposed opening up of more gold mines, and the introduction of new gold extraction technology, and the increase participation in gold exploration by the Geological Survey and other private companies, it is anticipated that gold production will definitely increase in the future. Good quality groundwater as an alternate source of water supply has also been discovered in Nenasi, Kuala Rompin and Pulau Tioman by the Geological Survey.

It is very significant that this conference is being held in Pahang, since the State has a long history of geological exploration and mineral development activities dating well back into the last century when gold was mined in the Raub area and the tin deposit at Sungai Lembing was the largest underground lode tin mine in the world. The search for petroleum has also recommenced offshore Pahang. We are pleased that PETRONAS is successful in encouraging exploration again in the offshore Pahang areas. There are encouraging signs of oil and gas present in the Penyau Basin offshore Pahang and this is being actively pursued by PETRONAS and its production-sharing contractors. I am sure that a lot of secrets still lay hidden in the rocks and beneath our land and it is entirely up to the geologists to uncover and tap these hidden wealth.

It is the desire and the intention of the Pahang State Government to promote the development of the mineral resources. Development of these resources will help to diversify the state's economy, more revenue will be generated by the sale of the mineral commodities and saving of foreign exchange can result from import substitution. The mineral deposits, when developed, will also bring with them the associated job opportunities for our people, hastening the infrastructural development which can lead to the opening up to the rural area.

In order to safeguard the interests of geologists in the country, I have been informed that the Institute of Geologists has already been established. The draft Geologist Act is also ready and the Institute will take it up with the relevant government authorities for approval. I am sure the Geologist Act will help regulate the activities of the geoscientists to ensure that proper professional services are provided to members of the public.

Ladies and Gentlemen,

Geology covers a wide range of disciplines. Besides its indispensable role in the search for valuable minerals, geological data have also increasingly become important for land-use planning and development. In some developed nations, laws have been enforced to ensure the compulsory use of geologic parameters for foundation design, waste disposals and groundwater extraction. In Pahang, the need of geologic input for urban planning is not difficult to visualise as most of our urban centres are located in the so-called geologically hazardous areas such as the coastal deltas or river floodplains and in large flood prone areas underlain by soft sediments. Therefore it is essential to have sufficient geological data to ensure proper planning for successful execution of engineering works. With the setting up of the Institute of Geologists and the enforcement of the Geologists' Act, I hope you will have a proper avenue and mandate to work more closely with the planners and engineers to plan and build our society to the best harmony with the environment.

With that I wish you all happy deliberations in your Conference and I have the pleasure now to declare the 7th Annual Geological Conference officially open.

Sekian, terima kasih.

PERSIDANGAN TAHUNAN GEOLOGI 1992

ANNUAL GEOLOGICAL CONFERENCE 1992

Merlin Inn Resort, Kuantan, Pahang Darul Makmur
9th & 10th May 1992

PROGRAMME

FRIDAY, 8th May, 1992

- 07:30 : PRE-CONFERENCE FIELDTRIPS
1. Mineralization Sg. Lembing & Tasik Cini (Leader: Dr. G.H. Teh)
 2. Stratigraphy of Kuantan area (Leader: Dr. Azhar Hj. Hussin)
- 11:30 : LUNCH AT SUNGAI LEMBING TIN SDN. BHD.
- 19:30 : 'ICE BREAKER' BARBEQUE — HOSTED BY MAMUT COPPER MINING SDN. BHD.

POSTER SESSION

MOHAMAD ALI HASAN & ZAKARIA MARZUKI
Groundwater pollution in the Klang Valley

MOHAMAD ALI HASAN
Subsidence history and future subsidence in the Batu Arang area, Selangor Darul Ehsan — some further thoughts

SATURDAY, 9th May, 1992

OPENING CEREMONY

- 07:45 : Late Registration
- 08:20 : Arrival of invited guests
- 08:35 : Arrival of YAB Menteri Besar, Pahang Darul Makmur
- 08:35 : Welcoming Address by Chairman, Organising Committee
- 08:40 : Speech by President, Geological Society of Malaysia
- 08:50 : Opening Address by YAB Tan Sri Mohamad Khalil Yaakob, Menteri Besar Pahang Darul Makmur
- 90:00 : COFFEE BREAK

SESSION I

Session Chairman : Prof. C.S. Hutchison

- 09:30 : KEYNOTE PAPER
K.R. CHAKRABORTY
Generation of granitic magmas in Malay Peninsula — mechanism of crustal melting
- 10:00 : **ANIZAN ISAHAK**
The clay mineralogy of some soils from Johor, Malaysia

- 10:20 : **NURAITENG TEE ABDULLAH**
Cyclic stromatolitic sequences in the Setul Limestone, Bukit Bintang, Perlis
- 10:40 : **MOHD. SHAFEEA LEMAN**
Upper Permian brachiopods from Merapoh area, Northwest Pahang

SESSION II

Session Chairman : Mr. Jimmy K.K. Khoo

- 11:00 : **MOHAMAD ALI HASAN**
A preliminary appraisal on the waste disposal management system in Malaysia — geological and hydrogeological perspectives
- 11:20 : **LIM CHUN HUI & MOHD SHAFEEA LEMAN**
The occurrence of Lambir Formation in Ulu Bok Syncline, North Sarawak
- 11:40 : **AZHAR HAJI HUSSIN**
Stratigraphy and structure of the Late Paleozoic Bt. Jaya metasediments, Pahang Darul Makmur — paleogeographic and tectonic implications
- 12:00 : **ABD. RAHIM SAMSUDIN & UMAR HAMZAH**
Seismic sub-bottom profiling and borehole analysis of Pantai Kundor, Melaka
- 12:20 : **H.D. TJIA & SYED SHEIKH ALMASHOOR**
The Bentong Suture in Ulu Kelantan
- 12:40 : **LUNCH**

SESSION III

Session Chairman : Mr. David Wong

- 14:00 : **K.R. CHAKRABORTY**
Primary composite-texture granite of the Main Range Province, Peninsular Malaysia — origin and implications
- 14:20 : **SIDIBE YAYA T., AHMAD JANTAN & TAN TEONG HING**
Comparative geochemistry of the sedimentary and metasedimentary clastic rocks of the Kuantan area, Pahang
- 14:40 : **CLIVE A. FOSS**
Modelling of airborne gravity data
- 15:00 : **JOY J. PEREIRA, E.B. YEAP & T.F. NG**
Application of soil geochemistry to the detection of Sb-Au mineralization in the Buffalo Reef area, Kuala Medang, Pahang
- 15:20 : **TAN BOON KONG**
Engineering properties of granitic soils and rocks of Penang Island
- 15:40 : **COFFEE BREAK**

SESSION IV

Session Chairman : Prof. N.S. Haile

- 16:10 : **MAZLAN B. HJ. MADON**
Diagenesis and porosity reduction during burial of upper Miocene sandstones, Jerneh-3 well, Malay Basin

- 16:30 : RUBEN RAJ SUSAI, KAMARUDIN SAMUDING & KAMARUDIN ZAKARIA
Penafsiran data satelit dan geofizik di Sungai Aring, Ulu Kelantan, Kelantan Darul Naim
- 16:50 : NURAITENG TEE ABDULLAH
The genesis and occurrence of mottled limestone in the Miocene Subis Limestone, Sarawak
- 17:10 : JUHARI MAT AKHIR
Peprosesan data satelit secara digit untuk pemetaan litologi di Baratlaut Semenanjung Malaysia — satu penilaian (*Digital processing of satellite data for lithological mapping in Northwest Peninsular Malaysia — an evaluation*)
- 17:30 : MOHAMAD ALI HASAN
The Malaysian standard of mineral water
- 19:30 : DINNER - HOSTED BY MALAYSIA MINING CORPORATION BHD.

SUNDAY, 10th May 1992**SESSION V**

Session Chairman : Dr. Idris Mohamad

- 08:10 : JUSTINE JOK JAU
Petrography of coal from the Merit-Pila coalfield, Sarawak
- 08:30 : RAJA ABD. HALIM RAJA MUDA & MOHD SHAFEEA LEMAN
Sedimentary environment of the Nyalau Formation at Bukit Ancharang, Batu Niah, Sarawak
- 08:50 : MOHAMAD ALI HASAN
Geological considerations of an environmental impact assessment (EIA) — the case of Sungai Buloh Forest Reserve, Selangor Darul Ehsan
- 09:10 : KAMAL ROSLAN MOHAMED, BASIR JASIN & CHE AZIZ ALI
Lithofasies Batu Kapur Kodiang, Kedah
- 09:30 : CHIENG YIH YAW
Some findings in the Batu Gading area, middle Baram, Sarawak
- 09:50 : BASIR JASIN
The Sabah Complex — a lithodemic unit (a new name for the Chert-Spilitite Formation and its ultramafic association)
- 10:10 : COFFEE BREAK

SESSION VI

Session Chairman : Puan Zaiton Harun

- 10:40 : ASKURY ABD. KADIR, ZULKIPLI CHE KASIM & PAULIUS GODWIN
Petrogenesis of ultrabasic to basic rocks in the Ranau Area, Sabah
- 11:00 : AZHAR HAJI HUSSIN
Sedimentary facies of the middle Triassic Semantan Formation and their significance
- 11:20 : H.D. TJIA
Kinematic analysis of striated fractures in Titiwangsa granitoid, Karak Highway (Selangor side)
- 11:40 : LEE CHAI PENG & SEN SIONG CHOO
Circular basin development in the Tangkulap-Kuamut area of Sabah

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- 12:00 : **UYOP SAID & KAMAL ROSLAN MOHAMED**
Aspek sedimentologi dan paleontologi Batu Kapur Melinau di Taman Negara Gunung Mulu, Sarawak (Sedimentological and paleontological aspects of Melinau Limestone from Gunung Mulu National Park, Sarawak)
- 12:20 : **ROBERT B. TATE**
The sedimentology and tectonics of the Temburong Formation —single-phase deformation of Early Tertiary deltaic sequences in NW Borneo
- 12:40 : **LUNCH**

SESSION VII

Session Chairman : Mr. M.K. Choo

- 14:00 : **J.K. RAJ**
The Holocene history of the West Coast of Peninsular Malaysia
- 14:20 : **SYED SHEIKH ALMASHOOR & H.D. TJIA**
Significance of a reverse fault in the Bentong Suture, Ulu Kelantan
- 14:40 : **SAZALI YAAKOB, YEAP EE BENG & HASHIM ABDUL RAZAK**
Potential alkali-silica reaction in some Malaysian rock aggregates and their test results
- 15:00 : **L.S. LEONG, K.H. HO, K.Y. LEE & C.C. YEW**
P-wave velocity variation in water-saturated sand from shallow seismic refraction
- 15:20 : **G.H. TEH**
The Nenering Tertiary sedimentary basin, Keroh (Hulu Perak), Perak
- 15:40 : **COFFEE BREAK**

SESSION VIII

Session Chairman : Dr. Ahmad Tajuddin Ibrahim

- 16:10 : **AZHAR HAJI HUSSIN**
Diagenesis and chertification of the Carboniferous Pancing Limestone, Pahang Darul Makmur
- 16:30 : **TAN BOON KONG**
Investigations for the Tawau Dam, Sabah
- 16:50 : **SITI FARIDAH YUSUP, E.B. YEAP & J.J. PEREIRA**
Mineralogy, bulk composition and trace heavy metal content of some tailing slime in the Kinta Valley
- 17:10 : **RICHARD MANI BANDA & JUSTINE JOK JAU**
Geological observations along new roadcuts in the Lupar Valley, Sarawak, and its possible implication on the current concept of the geology of Lupar Valley
- 17:30 : **CLOSING REMARKS**

MONDAY, 11th May, 1992

- 07:30 : **POST-CONFERENCE FIELDTRIP**
Kuantan-Kuala Lumpur transect (Leader: Dr. Azhar Hj. Hussin)

PERSIDANGAN TAHUNAN GEOLOGI 1992
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Groundwater pollution in the Klang Valley

MOHAMAD ALI HASAN & ZAKARIA MARZUKI

Department of Geology

University of Malaya, 59100 Kuala Lumpur

The Klang Valley or the Klang River Basin, being the most populated area in Malaysia, has a catchment area of 1,288.4 km² and occupies the central parts of Selangor state together with the Federal Territory of Kuala Lumpur. There are two major tributaries, namely Sungai Gombak and Sungai Batu in the upper basin. These tributaries merge before joining the Klang River in the city centre. The lower stretch of the Klang River which follows a rather meandering course flows downstream of the city centre. The annual mean rainfall in the Valley for the period from 1976 to 1985 is estimated to be 2,250 mm ranging from 2,700 mm in the upstream mountainous area to 1,850 mm along the main Klang River. The mean annual evaporation amount is estimated at around 1,070 mm. The geology of the study area consists of the following: Hawthornden Formation, Kuala Lumpur Limestone, Kajang Formation, Kenny Hill Formation, granite and its differentiates and alluvium.

Based on the above information, the hydrogeologic potentials of the various geological formations of the study area was studied. At the same time on the basis of existing well and borehole records as well as previous reports, the groundwater quality of the study area is also ascertained. An obvious question that comes to mind is to whether the groundwater is polluted or not. The poster then will suggest recommendations on how to safeguard the future groundwater quality of the area.

**Subsidence history and future subsidence in the Batu Arang area, Selangor Darul Ehsan —
 some further thoughts**

MOHAMAD ALI HASAN

Department of Geology

University of Malaya, 59100 Kuala Lumpur

Coal mining has been carried out in the Batu Arang area for some 45 years, from 1915 to 1960, with both surface and underground workings. The coal was mined from two main seams; the Upper Seam (some 15 m thick) and the Lower Seam (about 8 m thick). These seams, which are stratigraphically some 65 m apart, are interbedded with shales, clays, siltstones and sandstones of a Late Oligocene to Miocene age that have been termed the "Coal Measures". These gently dipping sedimentary rocks outcrop in the form of a plunging syncline and is also unconformably overlying meta-sedimentary rocks of mainly quartzites and phyllites of an Upper Palaeozoic age. The "Coal Measures" are at the same time unconformably overlain by a probable Pleistocene sequence of boulders, pebbles and sub-angular fragments of quartzite in a sandy to gravelly matrix that have been termed the

"Boulder Beds". The strata of the "Coal Measures" are cut by a few normal faults and contain closely spaced (usually 2 to 5 cm apart) joints that are mostly developed perpendicular to bedding. Laboratory determined uniaxial compressive strengths of coal samples range from about 0.5 to 10 MPa; these strengths being mainly influenced by sample size.

Mapping of past and present features of ground surface subsidence, including depressions and sinkholes (pits), as well as their effects on man-made structures, shows that their development is closely related to the underground coal workings. The depressions have developed as a result of the gradual down-warping (or convergence) of overburden into underground openings, whilst the sinkholes have formed where the caved overburden material has been able to move laterally into adjacent openings.

The most recently occurring depressions and sinkholes are developed over the shallower, earliest underground coal workings, as well as those made during the Second World War, and in a few cases over post-War workings. Depressions and sinkholes developed in earlier times also show a similar relationship and this is to be expected in view of the limited roof support and stowage in these workings. In a few cases, depressions and sinkholes have developed over bricked or timbered underground workings.

Several factors are responsible for the development of the depressions and sinkholes, though the most important one has been the decrease (with time) of the strengths of the coal seams and overburden materials respectively. In view of this temporal relationship, it is concluded that several sites in the area will continue to be affected by the development of depressions and sinkholes.

In this presentation, some further and after thoughts from the earlier reports are highlighted with suggestions on various alternative remedial measures to rehabilitate or conserve the immediate affected premises.

Generation of granitic magmas in Malay Peninsula — mechanism of crustal melting

K.R. CHAKRABORTY
Department of Geology
University of Malaya, 59100 Kuala Lumpur

Granite magmatism in Malay Peninsula is largely the result of anatectic processes in the continental crust. An important and as yet unresolved question pertaining to this is the mechanism(s) primarily responsible for raising the temperature or lowering the solidus or both, to initiate crustal anatexis.

It is generally held that granite magmatism in the central and eastern belts was due to the influx of subduction-related basic magmas and fluids into the crust, whereas in the western belt the primary factor was the internal heating of the tectonically thickened crust consequent upon continental collision. It is unlikely, however, that these mechanisms were responsible for inducing crustal anatexis in Malay Peninsula in view of the fact that reappraisals of various lines of geological evidence have failed to support subduction-collision tectonic models.

Mafic rocks associated with the granitoids in the central and eastern belts are volumetrically very subordinate, and also there is no evidence to suggest that large volumes of mafic rocks remain hidden within the crust. Consequently advective heat transfer through mafic magmas could not have played a significant role in initiating anatexis in these belts. It is more likely that most of the heat needed for anatexis in these belts was transferred by conduction from an upwelling asthenosphere beneath a thinning continental lithosphere. Bimodal magmatism and the earlier age of the mafic rocks relative to the granites are consistent with this mechanism.

Absence of basic magmatism is conspicuous in the western belt and hence subcrustal heat source as an important factor can be discounted. A striking feature of the western belt (Main Range) granites is their high concentration of radiogenic elements implying a source region enriched in these elements. High heat production in the source region coupled with heat retention due to thermal conductivity contrast between the source region and sediment cover, might have been sufficient to raise the temperature of the source region to the solidus. This seems to be the most appropriate mechanism for granite magmatism in the western belt. A contribution from deep crustal metamorphic processes is likely but remains speculative.

The clay mineralogy of some soils from Johor, Malaysia

ANIZAN ISAHAK

Department of Geology

Universiti Kebangsaan Malaysia, 43600 Bangi

The clay mineralogy of surficial materials from major geomorphic units in southeast Johore, Malaysia has been investigated. These geomorphic units consist of granitic, metavolcanic and metasedimentary residual terrains, Older Alluvium terrain and Holocene alluvium terrain. The mineralogy of the granitic and the metavolcanic residual terrains tend to be similar. Kaolinite, goethite, hematite and gibbsite are the dominant clay size minerals in the weathered zones of these terrains. Kaolinite, illite and goethite are the main clay size mineral in the weathered zones of the metasedimentary terrains. The mineralogy of the Older alluvium is predominantly kaolinite and goethite. The mineralogy of the Holocene alluvial tends to be similar to that of the granitic and volcanic residual terrains. These results show that there is a major influence of sedimentary environment and/or age on the clay mineralogy of these geomorphic units.

The properties of kaolinites and goethites have also been investigated in detail. From the XRD traces, kaolinite properties pertaining to crystallinity and unit cell parameters has been determined. Generally, the kaolinites consist of a high proportion of highly disordered kaolinites especially of the type with a monoclinic character (C3-kaolinite), with a small portion of low defect kaolinite or none at all. Low asymmetry indices measured on the basal peaks suggest an absence of halloysite or its presence in very small quantity. The results on the basal spacings, asymmetry indices and width of half heights suggest that the kaolinite crystals are small. These observations were corroborated by scanning and transmission electron microscopy. A general trend relating kaolinite crystallinity index and basal spacing to parent material and hydromorphy was observed. Goethites were investigated for their Al-substitution, mean crystallite dimensions and specific surface area. The Al-substitution ranges from 6-37 mole %. The mean crystallite dimensions perpendicular to (111) ranges from 9.9-

16.2 nm. The mean crystallite dimension perpendicular to (110) ranges from 12.8-18.5 nm. The results indicate that the goethites are generally small in size and highly substituted, indicating a free leaching environment of formation. The kaolinite and goethite properties of these soils were found to be typical of kaolinites and goethites found elsewhere in highly weathered terrains of the tropics.

Oxygen-18 isotope content of kaolinite and gibbsite in several bauxitic concretions from southeast Johore has also been investigated. The results of this study suggest that the bauxites were formed during a glacial period probably in the Pleistocene.

Cyclic stromatolitic sequences in the Setul Limestone, Bukit Bintang, Perlis

NURAITENG TEE ABDULLAH
Department of Geology
University of Malaya, 59100 Kuala Lumpur

The Setul Limestone in the Keng Giap Quarry is composed of 2 cycles of thickly bedded dolostone. The characteristic feature of each cycle is the occurrence of laterally extensive domal stromatolites. This is overlain by a horizon rich in breccia and intraclasts, followed by thick beds of crinoidal sediments. This succession from tidal flat to shelfal sediments indicates the inundation of the former by transgressing seas. A total of 2 transgressive cycles has been observed in this quarry.

Upper Permian brachiopods from Merapoh area, Northwest Pahang

MOHD. SHAFEEA LEMAN
Department of Geology
Universiti Kebangsaan Malaysia, 43600 Bangi

Several localities of Upper Permian brachiopod dominated shelly fauna have been discovered from Merapoh area in Northwest Pahang. The fauna consists of pedunculate and spinosed brachiopods commonly associated with other benthic elements such as binate bivalves, gastropods, fenestrate or stony bryozoans, solitary rugose corals and trilobites and shows very little evidence of transportation. The brachiopod assemblages in general belong to the Upper Permian Leptodus Shale fauna, but details on the faunal assemblages may vary from one locality to another.

A preliminary appraisal on the waste disposal management system in Malaysia — geological and hydrogeological perspectives

MOHAMAD ALI HASAN
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The management and control of any type of waste disposal system will touch on several issues especially if the requirements for the protection of human health and environment are to be met. The three main sets of issues, among others, are (i) safe protection requirements corresponding to the nature of the wastes that are being managed, (ii) the available disposal technology, and (iii) government policy, regulations and conformance requirements. Landfills, wasted land-farms (open space), containment (former mining pools), and underground injection (abandoned) wells are some of the types of waste repositories; with landfills being the most common type of waste disposal. At the present time most waste disposal systems do not take prior consideration of the sources of the waste as well as the manner in which the waste should be handled. Therefore, many of the problems involved are 'buried' in the issues concerning the availability of proper specifications and general technical information only (say for example the geological and hydrogeological considerations relating to disposal criteria, assessment and standards).

In this presentation, an appraisal of the waste disposal management system in Malaysia (taking the Klang Valley as an example) will be highlighted. At the same time the paper will also touch upon the following themes:

- i) Existing types of wastes and collection services
- ii) Characteristics of wastes studied so far
- iii) Evaluation of existing disposal system
- iv) Assessment on the effectiveness of the existing legislation and regulations
- v) Geological and hydrogeological perspectives of the existing disposal sites
- vi) Alternatives and strategy for better waste disposal management system in Malaysia
- vi) Conclusion and suggestions

The occurrence of Lambir Formation in Ulu Bok Syncline, North Sarawak

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The Ulu Bok Syncline in North Sarawak has been mapped to be occupied by the Belait Formation by previous geologists through aerial photograph studies and geological mapping. Current geological mapping shows that the term *Belait Formation* is not suitable for the rocks in this syncline. The lithologic sequence in this syncline revealed the characteristics of the *Lambir Formation* instead. These two formations can be differentiated by the occurrences of calcareous lithofacies, siderite concretions and fossils. The presence of calcareous lithofacies, siderite concretions, abundant and diversified faunas in the Ulu Bok Syncline indicate that the sequence belongs to the Lambir Formation, whereas all these criteria could hardly be found in the Belait Formation.

Stratigraphy and structure of the Late Paleozoic Bt. Jaya metasediments, Pahang Darul Makmur — paleogeographic and tectonic implications

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The late Paleozoic Bt. Jaya metasediments are composed of a lower sandstone-shale unit (estimated thickness is 100 m) which passes upwards gradually and conformably into a predominantly shale unit (estimated thickness exceeds 300 m). *Schwagerina* fusulinids found in the upper unit date its sedimentation in the Early Permian times.

The sandstones in the lower unit are quartz wacke which are generally sheet sandbodies exhibiting poor internal grading. Several channel sandbodies are also present. Features generally attributed to wave or tide origin are not found in these metasediments. Within the lower unit, several slump sheets whose thicknesses vary from a few centimeters to a few ten of meters are found. There is a complete range of deformation style which affected these slumped beds: preserving the original sequence in the coherent type, partially preserving the sequence in the semi-coherent type and totally disrupting the sequence in the incoherent type. This deformational style together with the truncated tops of the slump sheets and welded contacts between them suggest soft sediment deformation penecontemporaneous with sedimentation. The depositional environment for this unit is a submarine slope below the wave base. The orientation of the paleoslope, determined from the direction of the overturning of the slump folds, strike broadly north-south and dip to the east.

In the upper shale unit, several beds of pebbly mudstone are found. Clasts in these beds are mainly older metasediments mixed with reworked shallow water fauna like molluscs, foraminiferas brachiopods and echinoids. Land plants are abundant in some beds. This unit is interpreted as a basinal deposit with some resedimented beds.

The vertical stratigraphic change from slope to basinal environments suggest the deepening of the basin in the Early Permian times and a cut in the supply of coarse clastics. The immediate post-Early Permian event affecting these metasediments was the intrusion of intermediate dykes followed by regional folding and metamorphism.

Seismic sub-bottom profiling and borehole analysis of Pantai Kundor, Melaka

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A total of twenty boring logs were studied in conjunction with four seismic sub-bottom profiling data. Most of the boreholes drilled at depth ranging from 12 to 40 meters were located close to the seismic profiles. By comparing the borehole with the seismic data, empirical relationship between the character of the seismic records and the corresponding lithology was established. Seismic data were analysed using a velocity of 1600 m/sec to convert the two-way travel times into depth. Four distinct lithological units were recognized and classified into units A, B, C and D. The uppermost unit, unit D, representing soft clay with some coarse sand is characterized by strong horizontal stratification on seismic profiles. Unit C which is made up of medium to coarse sand with some clay and shell fragments is recognized by a chaotic reflection pattern in seismic data. Unit B is represented by dense silty sand with numerous mica flakes and is interpreted as weathered granite. The lowermost unit, unit A, comprises of lowly weathered to fresh coarsed grained granite or bedrock and shows a domed reflection pattern on seismic sections. Using these empirical relationship, all the four seismic profiles were interpreted and analysed.

The Bentong Suture in Ulu Kelantan

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A newly constructed dirt road between Pulai, Ulu Kelantan, and Kampung Raja, Cameron Highlands, crosses the Bentong Suture which here is at least 18 km wide. The eastern border zone of the suture consists of bedded chert containing an internal low-angle thrust and is separated from olistostrome to its west along a vertical fault. The western border zone comprises an igneous injection complex – several hundred metres wide – into the schist-phyllite component of the suture. This injection complex is the eastern fringe of the Titiwangsa granitoid masses. Rocks within the suture are thick packets of parallel to subparallel stratified olistostrome (types: with tuffaceous mudstone matrix, with tuffaceous phyllite matrix, and with phyllite matrix), thoroughly weathered massive mudstone, well-bedded chert, phyllite, phyllite-schist and a serpentinite lens. The olistostromal packets contain bedding-parallel mylonite zones. The general strike is NW-SE; dips are moderately steep to vertical; dip inclinations are towards NE. Reverse faults and low-angle thrusts also indicate SW-vergence. Along two stretches of the road traversing the suture, low-angle thrusting towards south represent a younger tectonic activity.

The various rock types of the suture seem to occur as seven or more tectonic units. From west to east (or from a stratigraphically lower to higher levels) a complete tectonic unit is composed of a systematic sequence of schist and phyllite, olistostrome with or without massive mudstone interval, and bedded chert. The recurring rock

sequence in each tectonic unit suggests that the units are stacked rock assemblages or form imbricated structure, presumably as result of collision between the continental lithospheric plate in the east with a continental crustal sliver to the west of the suture. The tectonic units proper were probably crustal and supracrustal rocks occupying a maritime – very likely oceanic – environment between the colliding lithospheric masses. The presence of serpentinite and dominance of volcanic material suggest that the particular maritime environment consisted of an island arc.

Primary composite-texture granite of the Main Range Province, Peninsular Malaysia — origin and implications

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Granitoids of the Main Range Province of Peninsular Malaysia display a variety of textures. Most of the textural variations occur due to an interplay of various factors that include (i) fluctuation in physical conditions, (ii) fluid relocation, (iii) deformation of crystal-melt system, (iv) subsolidus recrystallization and (v) post-crystallization deformation.

This note is addressed to a particular textural variant termed here as "primary composite texture" (PCT). Rocks with this texture appear to be an intimate mixture of coarser granite and microgranite in varying proportions where coarser granite seems to have crystallized earlier and subsequently infiltrated by the microgranite. PCT-granite should not be confused with recrystallized protoclastic/cataclastic granite.

The origin of PCT is not very clear and amenable to alternative interpretations. It is possible that the host coarse granite was invaded by pressure-quenched residual liquid. But this mode of origin of PCT cannot be reconciled easily with several field, petrographic and chemical observations such as (i) occurrence of microcline in the microgranitic portions or PCT, and (ii) presence of aplitic dykes, representing residual liquid, with sharp contacts in PCT-granite and other granites. It is proposed that influx of water, possibly of meteoric origin, into relatively dry hot granite caused localised partial fusion and remobilization of the earlier granite. Crystallization of this remobilized mass gave rise to PCT-granite. This is consistent with the features mentioned earlier.

The proposed remelting of granite does not imply a second thermal event. This is because no reheating is necessary as the relatively dry solidus would have higher temperature than the wet solidus (or even higher than the wet liquidus depending on the "dryness" of the earlier granite). The subsolvus mineralogy of the microgranitic portion of the PCT-granite suggests a minimum pressure of crystallization of about 2.5 kb P_{H_2O} . In presence of the other volatiles this limit would be still lower as the wet solidus would shift towards lower temperature.

Comparative geochemistry of the sedimentary and metasedimentary clastic rocks of the Kuantan area, Pahang

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In Northeast Pahang and South Terengganu, the Kuantan Group and Taweh Bed rocks are redefined in terms of stratigraphic nomenclature. The Kuantan Group consists of 3 formations, viz: Charu Formation, Panching Limestone, and Sagor Formation.

Charu Formation which is the oldest sequence (Lower Carboniferous), is subdivided into 3 units with a status of member for each, i.e. Kolek Member, Cheneh Member, and Lepar Member. The Cheneh Member is synonyme of Sg. Perlis Bed. In the Berkelah area, the lower and metamorphosed part of the Lepar Member is assigned a status of bed, i.e. the Berkelah Bed.

The Taweh Bed is upgraded to the status of formation, and is considered as part of the Tembeling Group.

The stratigraphic classification is supported by statistical geochemical data interpretation. Factor Analysis, as a statistical technique, is used to discriminate the various rock units based on their geochemical variables such as major elements concentrations. In the method, a large number of correlable variables (concentrations) are reduced into a small number of uncorrelable variables (factors). The elements which characterise the factors are selected.

Charu Formation is characterised by the predominance of K_2O , Al_2O_3 , and Fe_2O_3 in the shales of the Kolek Member, by the feldspathic and MgO rich mudstones of the Berkelah Bed, and by P_2O_5 and Mg-Ca rich mudstones of the Lepar Hilir section.

Sagor Formation is dominated by potassic shales and arkoses, both of which are poor in Fe_2O_3 and Al_2O_3 .

Taweh Formation is composed of shales rich in SiO_2 , and sandstones rich in ferromagnesian elements.

Modelling of airborne gravity data

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ARK Geophysics S.E. Asia

The collection of gravity data from aircraft is a method now being used in the oil exploration of frontier onshore areas for which access from the ground is difficult. The major objectives of these surveys is to locate sedimentary basins and to give some indication of their structure. The method relies on being able to recover the true gravity variation from measurements which contain much larger accelerations, and in doing this the output from the gravity meter has to be heavily filtered before profiles and maps can be produced which are suitable for geological interpretation. Modelling of the results of such surveys may be undertaken, but corresponding filters

must be applied to the model data for a valid comparison. The cascade of filters typically applied to airborne gravity data is applied to model data computed for some simple geometric shapes, and it is shown that the effect of these filters is very similar to an upward continuation. The best-fitting upward continuation heights are derived for a range of models, and models are also used to illustrate the resolution of the airborne gravity data in comparison to what can be achieved with ground measurements.

Application of soil geochemistry to the detection of Sb-Au mineralization in the Buffalo Reef area, Kuala Medang, Pahang

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Surface and underground prospecting for gold mineralization carried out during the early 1930's in the Buffalo Reef area uncovered N-S trending lenses composed of quartz and stibnite, located in metamorphosed argillaceous sediments. Since then, extensive surface and some underground mining activities have been carried out for Au and Sb. A spur and ridge soil geochemical survey was carried out in areas that have not been disturbed by such activities. The survey lines were oriented approximately E-W, perpendicular to the regional structure and reported lodes in the area and samples were collected at an interval of 10 m. The minus 80 mesh fraction of the samples were analyzed for antimony and arsenic. The results which were then plotted on a map, indicated the presence of a significant zone of soil anomaly with a N-S trend. A trenching programme across this zone was then embarked upon and this revealed the presence of a prominent gossanized gold-stibnite-quartz style of mineralization.

Engineering properties of granitic soils and rocks of Penang Island

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The granitic rocks of Penang Island can be divided into two types, namely, Type I (Sg. Ara) and Type II (Bt. Bendera), based on the differences in age, mineralogy and texture of the rocks. These two types of granites and the soils derived from them exhibit soil mechanics, soil chemistry and rock mechanics properties which are rather different. Among the apparent differences: granitic soil I possesses high dispersion potential, while the dispersion potential for granitic soil II is low. Granite Type II shows strength/hardness which are higher compared to Granite Type I. Nevertheless, there are also some similarities in the properties mentioned between the two types of granites.

Diagenesis and porosity reduction during burial of upper Miocene sandstones, Jerneh-3 well, Malay Basin

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The average porosity of reservoir sandstones in the Jerneh-3 well, central Malay Basin, decreases with increasing depth, from 31% at 1,270 m to 23% at 1,940 m. Because all the sandstones are fine grained, well to moderately sorted, and mineralogically similar, the observed loss of porosity has been interpreted to be due to burial diagenesis.

Petrographic studies indicate that the reduction in porosity is mainly the result of mechanical compaction during burial down to about 1,200 m, followed by the precipitation of authigenic quartz and kaolinite at greater depths. Cementation was influenced by diagenetic reactions which may have occurred simultaneously within the adjacent shales, namely: (1) the transformation of smectite to illite, and (2) the maturation of kerogen. The silica which formed the authigenic quartz was partly derived from smectite transformation in the adjacent shales, while CO₂ released by maturing kerogen resulted in acidic pore waters which dissolve detrital K-feldspar in the sandstones and precipitate authigenic quartz and kaolinite. Dissolved K-feldspar also provided silica for quartz cementation.

The diagenetic features in the Jerneh-3 sandstones are comparable to those reported from sandstones in the neighbouring Pattani Basin which may have had a similar burial history.

Penafsiran data satelit dan geofizik di Sungai Aring, Ulu Kelantan, Kelantan Darul Naim

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Penafsiran data satelit dan geofizik telah dijalankan di kawasan Sungai Aring, Ulu Kelantan. Penafsiran ditumpukan kepada sempadan formasi dan juga struktur-struktur mega. Imej satelit yang digunakan ialah Landsat TM yang terdiri dari komposit warna palsu (False Colour Composite) dan juga imej tunggal. Landsat TM ini dapat menolong dalam menentukan sempadan litologi dan juga sesar major di kawasan kajian. Survei geofizik yang digunakan ialah kaedah magnet. Keamatan kemagnetan telah diukur di beberapa rentisan jalan balak yang melintasi Formasi Aring dan juga Formasi Telong. Dari pemplotan graf, didapati kenaikan keamatan jelas antara Formasi Aring dan Formasi Telong dan juga sesar major. Keadaan ini boleh dikaitkan dengan zon batuan terretak yang boleh diasosiasikan dengan sesar mendatar utama yang terdapat di kawasan kajian.

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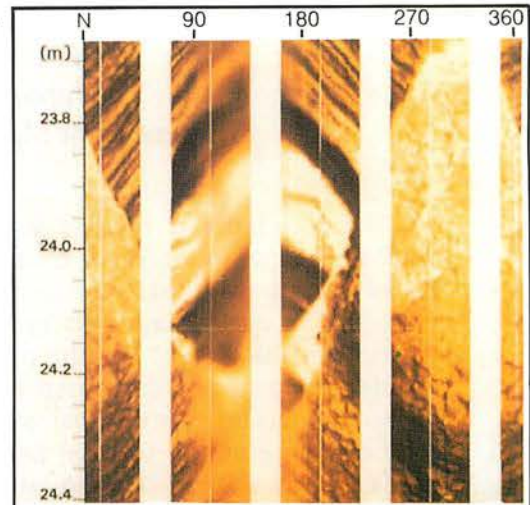
Fullbore Micro Imager*

Formation imaging using microelectrical arrays has benefited the oil industry since its introduction in the mid-80s. The FMI*, Fullbore Formation MicroImager tool, is the latest-generation electrical imaging device. It belongs to the family of imaging services provided by the MAXIS 500* system with its digital telemetry capability.

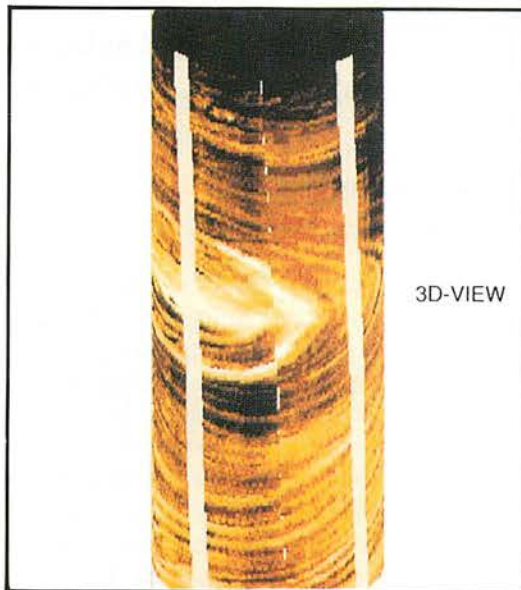
The FMI log, in conductive muds, provides electrical images almost insensitive to borehole conditions and offers quantitative information, in particular for analysis of fractures.

The FMI tool combines high-resolution measurements with almost fullbore coverage in standard diameter boreholes, thus assuring that virtually no features are missed along the borehole wall. Fully processed images and dip data are provided in real time on the MAXIS 500 imaging system.

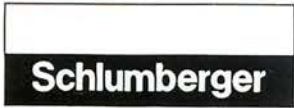
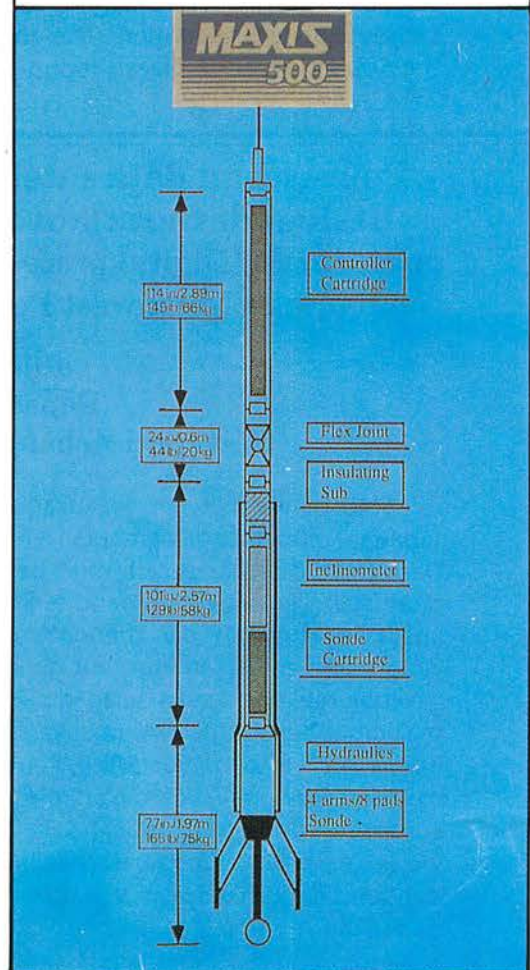
The tool's multiple logging modes allow wellsite customization of results to satisfy client needs without compromising efficiency.



Fault without associated drag



"Bullseye" structure



The genesis and occurrence of mottled limestone in the Miocene Subis Limestone, Sarawak

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The occurrence of mottled limestone in the Subis Limestone is restricted to the coral-algal facies found in the Garagok Quarry. Mottles are defined by their dark grey colour in contrast to the cream-coloured limestone that enclosed them. The formation of mottles is partly controlled by the lithology. This can be seen by some mottles having essentially mimicked the forms of fossils or some selective fabric of the rock. Mottles are generally composed of fossiliferous micrite that contains a significantly higher proportion of microspar and/or sparry cement. The types of cement in the mottles is interpreted to have been formed partly in marine waters and partly in phreatic fresh-waters. This indicates that the development of mottles in the Subis Limestone was an early diagenetic event and that their formation is the result of selective fresh-water leaching of partly cemented marine sediments and their subsequent recementation. The absence of mottles in the flank and basal facies of the Subis Limestone gives support to this interpretation.

Peprosesan data satelit secara digit untuk pemetaan litologi di Barat laut Semenanjung Malaysia — satu penilaian (Digital processing of satellite data for lithological mapping in Northwest Peninsular Malaysia — an evaluation)

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Satu penilaian telah dilakukan terhadap 4-jalur data Landsat berbilang spektrum sebagai sumber bagi pemetaan litologi di kawasan barat laut Semenanjung Malaysia. Data telah diproses secara digit bertujuan untuk menghasilkan imej yang baik untuk ditafsirkan. Proses-proses yang terlibat termasuk penisbahan, analisa komponen utama, analisa diskriminen, dan menggabungkan imej sebagai komposit warna. Beberapa imej yang memperlihatkan fitur-fitur geologi yang berguna dan/atau menonjolkan maklumat geologi kawasan kajian telah dipilih dan dibuat perbandingan daripada segi jumlah maklumat litologi mereka. Imej yang paling tinggi maklumat litologinya ialah komposit-warna MSS nisbah-jalur 5/6-4/7-4/6 yang dipaparkan sebagai biru, hijau dan merah masing-masingnya. Ini diikuti oleh imej kombinasi komponen utama PC3-2-1 dan komposit warna MSS jalur 4-5-7. Tafsiran litologi dilakukan menggunakan imej-imej ini secara visual. Di kawasan kajian, maklumat tekstur lebih berpranan berbanding dengan maklumat spektral untuk menafsirkan litologi dan banyak unit batuan yang ditafsirkan memperlihatkan persekaitan yang baik dengan batuan yang telah dipetakan.

An assessment has been carried out of the use of 4-band Landsat multispectral scanner data as an input to lithological mapping in northwest Peninsular Malaysia. The data were digitally processed with the objective of producing more interpretable images. The processes include ratioing, principal component analysis, discriminant

analysis, and combining of images as colour composites. A few selected images, which show useful geologic features and/or enhance the geologic information of the study area were chosen and then compared in terms of their lithological information content. The single most informative image product is given by the band-ratio colour-composite of MSS bands 5/6-4/7-4/6 displayed in blue, green and red respectively. This followed by the principal component PC3-2-1 combination and the MSS bands 4-5-7 colour composite. Lithological interpretation of these images was undertaken by visual interpretation. In the area, textural information is more important than spectral information for lithological interpretation and many image units correlate well with major mapped rocks.

The Malaysian standard of mineral water

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Malaysia has a good potential to launch its own brand of mineral water as it is readily available virtually in every state. The main problem is to locate the right amount and the right quality for commercial exploitation. Spring water that has been channelled from upstream (mountainous areas) for use in rural areas and Orang Asli settlements could be bottled and marketed as mineral water. It is unadulterated and relatively free of pollution compared to water from underground and hot springs, which if they are unpolluted could also be another excellent source of mineral water.

To date there are at least 112 brands of imported and local mineral water available for public consumption in Malaysia. These mineral waters are being sold in sparkling (carbonated) and non-sparkling (non-carbonated) forms, and contain mineral supplements considered good for the body. Analysis of 57 samples of both imported and local "made in Malaysia" mineral water, together with water from potential sources in Peninsular Malaysia, that can be commercially exploited, revealed interesting findings. The indications were that local spring water is comparable in terms of quality to imported mineral water from France (considered the undisputed leader in the mineral water business). It can also be shown that water from unpolluted and "clean" local hot springs, is arguably superior to the mineral water bottled in Indonesia, Thailand and Singapore which has found their way into the Malaysian market. However, some "made in Malaysia" mineral water are found to be not up to the mark and come from uncertain sources.

In line with the government's interest to seriously consider commercially exploiting its own mineral water and in view of its drive to woo foreign tourists, as well as based on the writer's involvement and experience in the drafting of the procedures and standards of mineral water for Malaysia, this presentation will touch upon the following themes:

- i) A critical evaluation on the perception and definition of mineral water, and its characteristics;
- ii) The reasons why mineral water attracted the attention of the Malaysian public;
- iii) The concept of mineral water standard for Malaysia;

- iv) Some comments on the published Malaysian regulation (standard?) of mineral water;
- v) Some further comments on the Malaysian standard of mineral water (i.e. comparison to CODEX, European, Australian standards, among others);
- v) Conclusion and suggestions.

Through the above presentation, it is hoped that the public at large will be more aware and conscious of the 'real' mineral water. Others who are responsible for the industry, will take the necessary steps and controls so as not only to uphold the good name of the mineral industry, but also preserve the image of Malaysia.

Petrography of coal from the Merit-Pila coalfield, Sarawak

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The coal deposits of the Merit-Pila area are hosted by the Nyalau Formation of Miocene age which occurs as an outlier overlying the early Tertiary Belaga Formation; two coal bearing zones have been identified, namely, the Lower and Upper Coal Zones.

At least 35 coal seams have been identified in these two coal zones, their thickness ranging from a few centimetres to several metres. For the Lower Coal Zone in the Merit block, 5 seams in the area are considered as major seams with economic potentials including 4 seams in the Tebulan block. 4 major seams are found in the Upper Coal Zone, and these are located in the Merit-South block.

Macropetrographically, the seams are composed of clean coal, shaly coal, coaly shale and shale bands. There are no significant differences in the organic composition and the overall micropetrographic appearance is very uniform.

Vitrinite is the major constituent; liptinite does not exceed 14 vol. % and inertinite is not more than 4 vol. %. The random vitrinite reflectance ranges from 0.30 to 0.44%.

Based on petrographic analyses, the coal rank is sub-bituminous B. Laterally the seams are consistent in their petrographic properties. However, there is a slight difference in properties vertically between the seams at the lower part and the upper part of the Lower Coal Zone. A slight difference in properties is also observed between coals of the two zones.

Sedimentary environment of the Nyalau Formation at Bukit Ancharang, Batu Niah, Sarawak

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Bukit Ancharang is a strike ridge situated to the southwest of Gunung Subis, surrounded by low topography. This hill is made up of rocks of the Nyalau Formation, consisting of thick sandy mudstones interbedded with minor siltstones. Apart from a few trace fossils, sedimentary structures are very difficult to be observed because of the high intensity of fractures in this locality. The interpretation of the sedimentary environment is therefore, much dependent upon the types of macrofossils and microfossils including foraminifera, pollen and sedimentary particles as well as the lithologic log of the rock sequence. From the above data, it can be established that the Bukit Ancharang was deposited in a partly open lagoonal environment with little tidal current influence.

Geological considerations of an environmental impact assessment (EIA) — the case of Sungai Buloh Forest Reserve, Selangor Darul Ehsan

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A preliminary Environmental Impact Assessment (EIA) together with a supplementary report for the development of 3,900 acres of Forest Reserve at Sungai Buloh into a modern self-contained development area comprising residential, commercial, institutional and industrial zones (hereafter referred as "SBFRD") have been prepared and forwarded by PKNS for public and expert reviewing. The writer, appointed by the Department of Environment, had the opportunity to comment and put forward suggestions before it was approved or otherwise by the Department of Environment, Ministry of Science, Technology and Environment, Malaysia.

In this brief presentation, the author will highlight the various geological inputs pertaining to the EIA, according to the following themes:

- i) EIA and its role in the development projects
- ii) Some pertinent environmental inputs of the Sungai Buloh Forest Reserve, Selangor Darul Ehsan - mechanisms, comments and environmental considerations
- iii) Geological considerations of an EIA of the proposed SBFRD
- iv) Alternatives and mitigation measures
- v) Conclusion and suggestions

It is anticipated that more geological inputs will be taken into consideration in any development (EIA) projects and in this context the Sg. Buloh case study is thought to be able to make some meaningful contributions.

Lithofasies Batu Kapur Kodiang, Kedah

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Batu Kapur Kodiang tertabur di beberapa buah bukit di sekitar pekan Kodiang, Kedah dan juga di Gunung Keriang, dekat Alor Star. Di Kodiang, formasi ini boleh ditemui di Bukit Hantu, Bukit Kecil, Bukit Kalong, Bukit Kodiang, Bukit Mulong dan Bukit Kepelu. Kajian terhadap litofasies-litofasies yang ada dan jujukannya telah dilakukan. Litofasies-litofasies ini dan korelasi untuk keseluruhan singkapan Batu Kapur Kodiang akan dibincangkan.

Some findings in the Batu Gading area, Middle Baram, Sarawak

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The limestones studied are at the Batu Gading, Bukit Besungai East, and Bukit Besungai North quarries.

Field observations showed distinct truncated vertical beds of the Temala Member of the Kelalan Formation overlain by a basal conglomerate-bearing limestone and separated from an apparently conformable bed of the limestone over the Temala Member by a reverse fault. Sheared shales intruding into the sandstones of the Temala Member near to the base of the limestone contain small *Nummulites* which may indicate an Eocene age for the Temala Member. The base of the limestone was stated to be Upper Eocene (Tb). Coral and algal clasts were found in the middle part of the limestone.

The Batu Gading limestone is divided into a lower micritic limestone (Tb) which consists of *Asterocyclina*, *Discocyclina*, *Pellatispira* and algal-rhodoliths; and an upper limestone breccia predominated by algal-foraminiferal and Eocene reworked clasts. Reworked *Discocyclina* and *Asterocyclina*; and *Lepidocyclina* are present in the matrix. A vertical fissure observed in the Eocene (Tb) limestone was filled and overlaid by mudstone. Coral-algal patches grew on the mudstone. Bedded limestones which succeeded the massive to poorly-bedded limestones of both the Batu Gading and Bukit Bersungai North contain reworked foraminifers and hardgrounds maybe present at their respective bases.

The Sabah Complex — a lithodemic unit (a new name for the Chert-Spilite Formation and its ultramafic association)

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The Chert-Spillite Formation has been used as a formal lithostratigraphic unit for a long time. The naming of this formation has resulted in some confusion. Geological investigation of several new outcrops provides new information. Here, I would like to propose Sabah Complex as a lithodemic unit to replace the Chert-Spilite Formation. This complex is not only to replace the Chert-Spilite Formation but to include its ultramafic association. The Sabah Complex is composed of peridotite, serpentinite, basalt, spilite, pillow lava and chert sequence. The occurrence of radiolaria in the chert enable more precise age determination. The age of the chert is Early Cretaceous. The mafic-ultramafic volcanic rocks must be older than Early Cretaceous, most probably Jurassic.

Formasi Rijang-Spilit telah lama digunakan sebagai unit litostratigrafi formal. Penamaan formasi ini sangatlah mengelirukan. Kajian geologi singkapan baru formasi tersebut telah menghasilkan banyak maklumat penting. Di sini dicadangkan Kompleks Sabah sebagai satu unit litodem menggantikan Formasi Rijang-Spilit. Kompleks Sabah ini bukan sahaja menggantikan nama formasi tersebut tetapi merangkumi batuan ultramafik yang berasosiasi dengannya. Kompleks Sabah terdiri daripada batuan peridotit, serpentinit, basalt, spilit, lava bantal dan jujukan rijang. Kewujudan radiolaria dalam rijang membolehkan penentuan usia batuan itu dengan lebih tepat. Usia jujukan rijang ialah Kapur Awal. Batuan volkano mafik-ultramafik dianggap berusia lebih tua daripada Kapur Awal kemungkinannya Jura.

Petrochemistry of basic to ultrabasic rocks in the Ranau Area, Sabah

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The basic to ultrabasic rocks occur over an area of 50 km² in the northeastern part of Ranau area. These rocks are related to the igneous activities of the Late-Cretaceous Chert-Spilite Formation. The ultrabasic rocks comprise mainly peridotite (harzburgite and lherzolite) with subordinate pyroxenite (olivine websterite, orthopyroxenite and olivine clinopyroxenite), while the basic rocks are mainly gabbro and quartz gabbro with some norite, tonalite and anorthosite. In general, the ultrabasic rocks are dark in colour or melanocratic, while the gabbroic rocks are mostly leucocratic in nature. On the whole, the ultrabasic rocks show some degrees of serpentinization: antigorite

and bastite were found to infill fractures and joints; and were also often found to replace olivine and pyroxene in the host rocks. These ultrabasic and basic rocks have a wide SiO_2 compositional range of 37.8 to 59.5%, high MgO of 18.7% and low total alkali ($\text{Na}_2\text{O} + \text{K}_2\text{O}$) of 2.11%. From the petrogenetic point of view, these rocks were probably derived by magmatic differentiation of primitive basic magma of tholeiitic composition formed in the upper mantle. This magma was evolved from peridotites through pyroxenite into gabbroic rocks. The genetic relationship of these rocks and the magmatic differentiation were evidenced by the continuity of the variation diagrams. The rocks here and the style of formation are comparable to the layered basic intrusives of the Stillwater Complex in Montana.

Sedimentary facies of the middle Triassic Semantan Formation and their significance

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The middle Triassic Semantan Formation and its lithostratigraphic correlatives, composed of coarse to fine grained volcanogenic sandstones and minor conglomerates interbedded with black shales, occur extensively within the Central Belt of the Malay Peninsula. However good exposures are limited to new road cuts and earth quarries, in particular in the region between Karak and Temerloh.

The coarser clastics exhibit a wide variety of sedimentary structures from lenticular and wavy beds, through graded bedding, sheet and channel sand body, slumps and mass flow deposits. Environmental interpretations of these features suggest that the Semantan Basin had steep-sided margins with limited shallow wave-influenced environments. Sedimentation were predominantly by sediment gravity flows of the volcanogenic clasts into a semi-enclosed basins via submarine channels or by collapse of its margins. This interpretation is supported by the variable and opposing directions determined for paleocurrents and paleoslope study.

Thick sequences of conglomerates are found in the vicinity of Karak, Raub, Mentakab and Jerantut. In Karak and Raub, other clasts of older metasediments and limestones are found together with clasts of volcanic origin. These areas possibly represent the western margin of the Semantan Basin. The clasts in the conglomerates exposed in Mentakab and Jerantut are predominantly volcanics with lesser amount of limestones. These are probably erosional products of volcanoes and the limestones, that grew near their top of these volcanoes, within the Semantan Basin.

Kinematic analysis of striated fractures in Titiwangsa granitoid, Karak Highway (Selangor side)

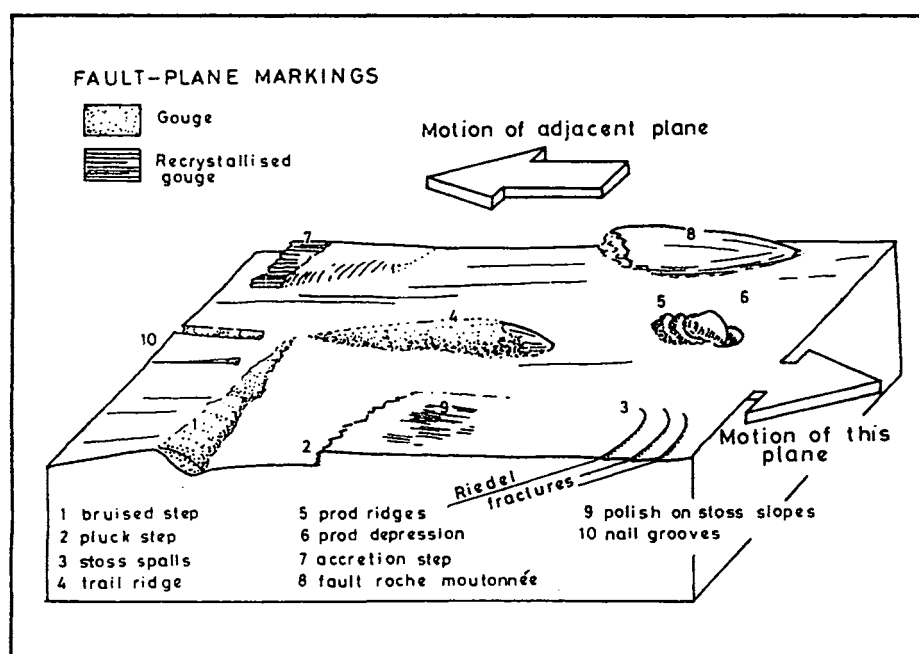
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Reliable fault-sense indicators: bruised steps, pluck steps, accretionary steps, stoss spalls, trail ridges, fault roche moutonnees, prod depressions and prod ridges (Figure 1) establish the nature of motion on slickensided fracture planes in the Titiwangsa granitoid that outcrop in Selangor along the Karak Highway. In certain instances subsidiary structures: *en echelon* tension gashes and drag features, and fault separations provide additional information on the sense of fault motion.

Right lateral and left lateral fault motion took place most frequently along NNE-NE and along ENE-E trending, steeply inclined to vertical fractures, respectively. This movement pattern is consistent with lateral compression within the 33 to 48 degrees sector, which is about 20 degrees at variance with the regional compression direction of Peninsular Malaysia, but is compatible with the vergence of the Genting Thrust Belt. Therefore, contemporaneity of thrusting and lateral fault motion on these particular fractures is indicated.

Among those studied, a comparatively small number of vertical fractures indicates lateral motion in response to compression that acted normal to that in the established sector. It appears that the NW-SE compression resulted from relaxation of the NE-SW stress. Superimposed striae and other fault markings on a number of fracture planes represent isostatic adjustments through gravity faulting.

Fig: 1



Circular basin development in the Tangkulap – Kuamut area of Sabah

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The Bangan Basin south of Tangkulap in the interior of Sabah is a large faulted circular basin of concentric ridges of thick, shallow marine, Middle Miocene sandstones belonging to the Tanjong Formation. East of it around Kuamut is the Tangkong Basin which is filled with clay-rich sediments of equivalent age deposited in a deeper marine environment. Between these two Tanjong Formation basins are the sediments of the Kuamut Formation which consist of large and small blocks of rocks derived from the Chert-Spilite, Kulapis and Tanjong Formations embedded chaotically in a scaly clay matrix.

The older blocks in the Kuamut Formation (i.e. Chert-Spilite and Kulapis) were probably deposited first as submarine land slide or slump deposits within a rift valley that extends to the Cagayan Ridge and subsequently were squeezed up together with broken bits of the Tanjong Formation at the edge of the Bangan Basin in mud diapirs when the basin sank progressively as a giant load structure.

Exposures of the Upper Eocene Kulapis Formation on the northern margin of the Bangan Basin as well as in the clayey portion of the Tanjong Formation in the Tangkong Basin show a progressive decrease in structural disturbance away from the margins of the Bangan Basin.

Aspek sedimentologi dan paleontologi Batu Kapur Melinau di Taman Negara Gunung Mulu, Sarawak (Sedimentological and paleontological aspects of Melinau Limestone from Gunung Mulu National Park, Sarawak)

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Kajian irisan nipis Batu Kapur Melinau dapat menentukan beberapa fasies batu kapur dan mengenalpasti kandungan fosil di dalamnya. Berdasarkan kepada kajian petrografi, Batu Kapur Melinau boleh dibahagikan kepada beberapa mikrofases iaitu batu bebat, batu butir, batu padat, batu wak, batu kapur terhablur semula dan batu lodak berkapur. Beberapa spesies foraminifera, alga dan karang juga telah dikenalpasti daripada kajian ini. Daripada mikrofases dari kandungan fosil yang dikenalpasti dapat ditafsirkan bahawa Batu Kapur Melinau telah terbentuk di sekitaran laut cetek dan berusia Eosen Akhir hingga Miosen.

Several limestone facies and their fossil content were identified from the Melinau Limestone. Based on the petrographical study, the limestone can be divided into several microfacies, namely boundstone, grainstone, packstone, wackestone,

recrystallised limestone and calcareous siltstone. Several species of foraminifera, together with algae and coral, were also identified from this study. The limestone microfacies and their fossil assemblages show that the Melinau Limestone was deposited in a shallow marine environment during Late Eocene to Miocene time.

The sedimentology and tectonics of the Temburong Formation —single-phase deformation of Early Tertiary deltaic sequences in NW Borneo

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The sedimentology and tectonic deformation of the Temburong Formation in East Brunei are described. Original sedimentary structures are still preserved, particularly in the arenaceous sediments and paleo-environmental indicators, suggesting deposition mostly in a shallow water, subsaline, lower alluvial floodplain environment. The style of deformation varies according to lithology and bed thickness and the tectonism is accompanied by low-grade, sericite metamorphism. Only one period of deformation has occurred and is the result of WNW-ESE compression related probably to the Oligocene rifting and subsequent opening of the South China Sea. The timing of the deformation is narrowed to a short period between the Te_{1-4} and Te_5 Indonesian Letter Stages. No basal conglomerate has been found in the overlying rocks although the unconformity has been recognised as a break in deposition in major platform carbonate sequences in the Melinau Limestone Formation at Melinau, Batu Gading and Keramit as well as the turbiditic limestone at Selidong.

The regional distribution of the Temburong Formation, apparently comprising a predominantly argillaceous succession with little clastic input onshore and platform carbonates accumulating offshore, is discussed in relation to the paleogeography of NW Borneo during the period between two major tectonic events in the post-Eocene and the upper Lower Miocene.

The Holocene history of the West Coast of Peninsular Malaysia

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A study of selected borehole samples, as well as reviews of borehole logs and published literature, shows that the Holocene of the West Coast of Peninsular Malaysia was characterized by depositional and erosional phases related to fluctuations of mean sea-level. Rising, and still-stands, of sea-level were marked by deposition of sediments in a variety of shallow marine and coastal environments, whilst falling sea-level was marked by exposure and erosion of these sediments. On a broad scale, two separate phases of rising, and falling, sea-level can be distinguished as can be two separate phases of still-stands of high sea-level.

At the end of the late Pleistocene, corresponding with the peak of the Wurm Glaciation in the Northern Hemisphere, there was a world-wide low sea-level, some 40 to 60 m below present-day mean sea-level. During this time, the (present-day) coastal plains of the West Coast of Peninsular Malaysia were non-existent and a larger part of the (present-day) Strait of Malacca was sub-aerially exposed. Several northwestward flowing rivers (draining into the Andaman Sea) were present in this sub-aerially exposed Strait; their catchment areas encompassing a larger part of north and central Sumatra, as well as the western part of Peninsular Malaysia. Drainage divides of these catchment areas coincided with present-day drainage divides, except in the southeast where a major sub-continental drainage divide extended through Singapore Island, Pulau Sentosa, St. John's Island, Pulau Batam, Pulau Bintang and the islands of the Riouw and Lingga Archipelagoes before continuing into central Sumatra.

At the beginning of the Holocene, there was a world-wide rise of mean sea-level (following melting of the Wurm glaciers) and this led to the gradual southeastward encroachment of the Andaman Sea into the then sub-aerially exposed Strait of Malacca. Under the present-day coastal plains of the West Coast of Peninsular Malaysia, this first marine transgression is marked in most areas by a sequence (termed the Lower Clays) of soft, dark grey, silty clays with shells and shell fragments that were deposited under mainly sub-tidal conditions. This sequence of silty clays overlies thin peat, or peaty clay, layers as well as light-grey, silty to sandy clays deposited under supra-tidal conditions. In places, these sediments infill valleys incised into, a variety of weathered bedrock, or dense, Pleistocene alluvial sands and gravels with stiff clay interbeds. The Lower Clays decrease in thickness away from the present-day coastline, as well as towards the southeast end of the West Coast and are absent in the eastern part of Singapore Island.

Deposition of the Lower Clays continued with the world-wide rise of sea-level until about 5,500 to 4,000 yrs BP when a mean sea-level, some 3 to 4 m above present-day mean sea-level was attained. In places, raised beach ridges mark this high mean sea-level. As sea-level rose, the then sub-aerially exposed Strait of Malacca was gradually drowned by the Andaman Sea, whilst to the east and southwest of the Malay Peninsula, there was a concomitant rise in sea-level of the South China Sea. At the peak of this sea-level rise about 4,500 yrs BP, the sub-continental drainage divide from Singapore Island through Pulau Sentosa and St. John's Island to the Riouw and Lingga Archipelagoes was first breached leading to establishment of the present-day Strait of Malacca. At this breach, initial movement of sea-water was from the west towards the east, leading to the development of a plunge pool (the present-day Singapore Deep).

From the about 4,000 to 3,000 yrs BP, there was a gradual drop in mean sea-level and this is reflected in places by erosion, exposure and weathering of the upper part of the Lower Clays. From about 3,000 to 2,000 yrs BP, there was another rise in mean sea-level to some 2 m above present-day sea-level. This second high sea-level is marked by raised beach ridges in a number of places, whilst the marine transgression is marked by a sequence (the Upper Clays) of soft, dark grey, silty clays with shells and shell fragments that were deposited under mainly sub-tidal conditions. The Upper Clays also sometimes overlie beach sands as well as thin peaty clay layers. From about 2,500 yrs BP, there has been a gradual drop of mean sea-level to its present-day level, and this is mainly marked by erosion, exposure and weathering of the upper part of the Upper Clays.

Significance of a reverse fault in the Bentong Suture, Ulu Kelantan

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A two-kilometre wide reverse fault zone in phyllite that strikes approximately 340 degrees, outcrops along a newly-constructed dirt-road between Pulai, Ulu Kelantan, and Kampong Raja, Cameron Highlands. The road transects almost perpendicular to the fault's strike. The fault zone actually is an assemblage of several thinner reverse fault zones, each measuring 10-30 m wide, sandwiched between unfaulted slices of phyllite. This phyllite is a tectonic unit of the Bentong Suture.

Strike-slip faults of both left- and right-lateral displacements were also observed. The left-lateral slips strike 330-340 degrees. They are few, and are generally confined in the reversely-faulted sections. The right-lateral slips strike approximately N-S. They are more strongly impressed, and were seen in both the faulted and unfaulted sections.

On a NASA Landsat imagery the Bentong Suture could be identified as a number of strongly-impressed N-S lineaments. One such lineament is noted to pass through the reverse fault zone described above. However, from the lineament and location under discussion, a secondary lineament could be seen branching out in a curved manner towards the northwest. The northwest extension of this secondary lineament is covered by clouds. When it is defined on the 1:500,000 Geosurvey 1985 map and then extrapolated, this secondary lineament first juxtaposes a straight section of Sungai Tuil and then joins the Baubak Fault.

The 330-340 degrees left-lateral slip faults are believed to be related to this secondary lineament. We suggest that owing to structural adjustments of the country rocks to an east-west compression, the Baubak Fault east of the Bentong Suture had been obliterated, whereas the Baubak lineament immediately west of the Suture had been transformed into a curve.

Potential alkali-silica reaction in some Malaysian rock aggregates and their test results

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It is widely known that the deterioration of concrete due to alkali-silica reaction will occur when aggregates containing pessimum amounts of reactive silica minerals are used with high alkali cement. Petrographic examination and expansion tests on several natural rock aggregates collected throughout Peninsular Malaysia indicate some to be potentially alkali-silica-reactive. Petrographic evidences confirm that potential alkali silica reactive minerals in the aggregates consist of chalcedonic (spherulitic) quartz in volcanics, chert clasts in sandstone, strained quartz in quartzite and

microcrystalline and cryptocrystalline quartz in hornfels, volcanics and schists, are the likely causative factors in the expansion of the concrete bar used in the tests.

The hot and humid climatic conditions of this country is conducive for the occurrence of ASR in concrete. Therefore, an appropriate precaution should be taken when using the Malaysian aggregates for production of concrete to avoid the risk of alkali-silica reaction.

P-wave velocity variation in water-saturated sand from shallow seismic refraction

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Recent advances in equipment, sound sources, and computer interpretation techniques have made the seismic refraction methods highly effective and economical for petroleum, mineral, engineering, and to a limited extent, groundwater modelling applications. Direct values of desired interval velocities in subsurface formations can be determined from geometrically ordered first arrival refraction times. The reliability of seismic lithology mapping lies in accurate velocity determination and correct formation identification from a wide range of velocities derived. A problem arises in subsurface mapping of shallow alluvium in Malaysia from the current assignment and interpretation of velocities to various degrees of water saturation in the sands and gravel. Dry sand and soil cover are usually described by a low velocity between 330-500 ms^{-1} , while Young Alluvium and sand filled paleochannels, the later, as prominent targets for placer tin prospecting are assigned a range of velocities between 1600 to 1900 ms^{-1} . Notice however that the velocity of sound wave in water is 1500 ms^{-1} . We are tempted to ask whether the delineation of the Young Alluvium and Transitional Zone, based on refraction velocities, is not an exercise in mapping the ground water-table instead. In the absence of borehole control, water saturated sands can have similar refraction velocities.

The purpose of this study is to examine the variation of P-wave velocity in water saturated sands from velocities derived by shallow seismic refraction. Data was collected from 2 selected wholly sand-filled sites in Penang, with known depth of water table, through the wet and dry seasons. The Gassmann's equation is used next to model and calibrate the effects of water saturation on velocity in this clastic media.

Results of this study indicate that on the contrary, P-wave velocity in porous sand decreases slightly with water saturation. This continues until it is nearly fully saturated when the velocity takes a five-fold increase. We obtained in Balik Pulau and Teluk Kumbar, Penang, values between 340-360 ms^{-1} in 'dry sand' with estimated 10-20% water saturation, and, 1600-1800 ms^{-1} in fully saturated sands with 40% calculated porosity. Velocity measurements derived from shallow seismic refraction methods can only identify 'alluvium' sands to the extent whether it is 'dry' or fully saturated; it is difficult to determine intermediate saturation values. This attribute provides a useful basis for groundwater mapping. Our study suggests the velocity change as due to fully saturated sands demarcated by the level of the water-table only.

The Nenering Tertiary sedimentary basin, Keroh (Hulu Perak), Perak

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A spectacular outcrop of Tertiary age rock sequence is exposed along the new 22-km Kg. Lalang - Kg. Ayer Panas highway, which connects Grik to Betong at the Malaysia-Thai border.

This Nenering Tertiary sedimentary basin, well exposed from km 4 to km 8.8 (from Kg. Ayer Panas) along the new highway in the vicinity of Sg. Kuak and Felda Nenering, has many similarities to the Lawin Tertiary basin, 48 km to the south.

The gently dipping (about 15-24°) Tertiary rock sequence of mudstones, sandstones and conglomerates forms a broad syncline with a NNE-SSW striking axis and is separated from the tightly-folded Baling Formation (of Ordovician - L. Devonian age) by an angular unconformity. Coal seams have yet to be found.

The abundance of the sandstone forming regular channel-shaped bodies suggests a braided stream pattern with the main source material from the NW direction as indicated by the decrease in grain size of the sandstones as well as the decrease in abundance of conglomerates and the size of the clasts in the SE direction.

Further work is being carried out to map out in detail the extent of the Tertiary deposit – this includes among other things, studies on structure, stratigraphy and palynology.

Diagenesis and chertification of the Carboniferous Pancing Limestone, Pahang Darul Makmur

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The Pancing Limestone in Bt. Charas is dominantly of well-sorted algal and foraminiferal biosparites with lesser amount of mollusc-coral biosparudites. Minor algal biolithites are limited to the southern portion this hill. The deposit was probably deposited in a high energy shelf environment. Micritisation of the bioclasts and cloudy, isopachous, stubby circumgranular calcite cementations represent the earliest diagenetic events experienced by these limestones and are interpreted to represent syndimentary marine phreatic diagenesis. Subsequent dissolution, followed by clear, coarse granular calcite cementation and neomorphism affected both the clasts and cements but the lack of features suggesting vadose diagenesis implied that these diagenetic events occurred in freshwater phreatic realms. Burial diagenesis resulted in the formation of these stylolites that affected the whole limestone sequence in this hill.

In Bt. Pancing, the Pancing Limestone is composed predominantly of grey poorly bedded sparse crinoidal biomicrites with lenses of packed encrinites with derived shallow water fauna. The environment of deposition for these limestone types are

the deeper shelf or slope below the wave base. Diagenetic changes in these limestones are less obvious, mainly the growth of neospar in the micrites and poorly developed stylolites.

Two thin horizons of reddish biomicrites with several red chert nodules are found in the new quarry face at Bt. Pancing. These cherts totally replaced micrites within them, but only partially replaced the crinoid stems. Some nodules are deformed in a plastic manner. Their limited occurrence, incomplete replacement of the carbonate clasts and plastic deformation suggest that chertification occurred penecontemporaneously with sedimentation, probably under oxidizing condition.

Investigations for the Tawau Dam, Sabah

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A case study for the investigations of the proposed Tawau damsite and its vicinity is presented. The proposed damsite is located on Sg. Tawau some 10 km upstream from Tawau. The damsite area is underlain by Tertiary and Quaternary volcanics such as andesites, basalts and pyroclastics. These rocks are weathered to various degrees, ranging from grades II to VI. Sub-horizontal fissures are common features of the volcanic rocks, thus resulting in high permeability values of as much as 10^{-3} cm/sec. Possible construction materials include fresh basalt located about 2 km upstream from the damsite (limited quantity) and fresh microdiorite from the Kukusan Hill located some 8 km south of the damsite (enormous supply). Other geological constraints of relevance to the proposed project include: seismicity, recent or active faults and mineral clearance. There is cause for concern from seismicity and faulting as the proposed damsite appears to be located close to two faults, and the Tawau area has experienced earthquakes in recent times, the latest event occurring at the end of 1991.

Mineralogy, bulk composition and trace heavy metal content of some tailing slime in the Kinta Valley

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Slime samples used for this study were collected from several abandoned mining ponds. The mineralogy of the slime, determined semi quantitatively using the X-ray diffraction method, consists mainly of kaolinite, illite, quartz and traces of montmorillonite. The bulk composition of the slime was determined using the Bernas Bomb method where the trace heavy metal contents were also determined. The bulk content of the major elements correlates well with the mineralogy. The pore fluid of the slime was extracted using the saturation extraction method at different pH values, and then analysed using the AAS. An increment is observed in the concentrations of the trace heavy metals as the pH values of the pore fluid extraction decreases.

Geological observations along new roadcuts in the Lupar Valley, Sarawak, and its possible implication on the current concept of the geology of Lupar Valley

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Recent studies of outcrops along the new roadcuts in the Lupar Valley indicate the occurrence of four rock units: the Basal Sandstone Member of the Silantek Formation, shaly bioturbated unit, sandy slump unit and cherty unit. These units are folded, younging southwest. It is preliminarily interpreted that the sediments have been deposited on the shallow to steep slope and deep environments of the northern slope of the Southwest Borneo Basement. The evidence for paleosubduction zone was not apparent in the Lupar Valley during these recent studies by the authors.

Kajian-kajian sekarang di singkapan sepanjang keratan baru pada jalan-jalan di Lembah Lupar terdiri dari Ahli Basal Sandstone dari Formasi Silantek, unit bioturbasi sial berpasir, unit nendatan berpasir dan unit berchert. Unit-unit ini terdiri dari jujukan terlipat, muda ke arah Baratdaya. Interpretasi awal menunjukkan bahawa sedimen telah diendapkan di persekitaran cetek hingga ke tebing curam dan dalam di tebing Timurlaut dari Batuanasas Baratdaya Borneo. Daripada bukti kajian yang dibuat baru-baru ini oleh penulis, bukti-bukti yang menunjukkan zon subduksi kuno di Lembah Lupar tidak ditemui.

Ceramah Teknik (Technical Talk)

D.N.H. Lee, D. Baxendale & Edmund Huang : Geological Modelling and Reservoir Simulation of a Petroleum Field in Malaysia

Laporan (Report)

The geological presentation by D.N.H. Lee, D. Baxendale & Edmund Huang of Shell was held on the 4th of May 1992 at the Department of Geology, University of Malaya.

Abstrak (Abstract)

The work was based on a field situated offshore south west Sabah which was discovered in 1972, and came on stream in 1975. The field produced at an average rate of 47,700 stb/d with a GOR of 1200 scf/stb, and a watercut of 21% during 1988. One of the main reservoirs in the field is the M reservoir, which contains 90 MMstb of the field's 428 expected ultimate recovery. The current drilling campaign has highlighted the need to develop a detailed geological model.

The M reservoir consists of five main lithofacies comprising of stacked, coarsening upward, prograding sandstone sequences, deposited in a storm/wave influenced upper to lower shoreface and inner shelf environment. Detailed reservoir rock characterization was performed based on all the available core data. Having determined the core lithofacies classification, the next step was to identify the different facies in the non-cored wells. This involved adjusting the core depths to the log depths, and calibrating core defined lithofacies to the log responses. A petrophysical program called CLASS, developed by KSEPL¹ was used to automate this procedure. The program analyses the log response of the core defined lithofacies and establishes a learning set. The learning set is the statistical description of the place and orientation of a cluster of data points for a certain lithofacies in a n-dimensional cross-plot, where n is the number of input logs used in the classification. The learning set is then used to derive the facies classification for the uncored wells. This statistical classification technique was applied to 61 wells in order to derive a field wide lithofacies correlation.

Two east-west cross-sectional panels formed the basis of the input into the 2D simulation work, with each lithofacies layer treated as a unique reservoir simulation layer, resulting in a total of 76 simulation layers for one model, and 85 for the other. Application of dynamic pseudo relative permeability and capillary pressure functions proved that the resulting reservoir performance could be duplicated using only 8 simulation layers.

Finally, a full field model was built based on the 2D models, and a comparison was made between the conventional layer cake modelling and the lithofacies formulation. The two geological formulations resulted in significant differences in permeability distributions, which would lead to different performance predictions. This was due to the lithofacies model incorporating the inherent heterogeneity of the formations.

¹ ICEPE Users Manual, Part 6:1: *Petrophysics*, EP 89-0014, SIPM (1989)



D.N.H. Lee

D. Baxendale

Edmund Huang

BERITA-BERITA PERSATUAN News of the Society

Keahlian (Membership)

The following applications for membership were approved:

Full Members

1. Kelly Smoot
801, North D Street, Midland, Tx. 79701,
USA.
2. Zamri Ramli
KM 24, Jalan Jasin, 77300 Merlimau,
Melaka.
3. Mohamed Faizal Zakaria
911 Taman Seri Putri, 31000 Batu Gajah,
Perak.
4. Kamarulbahrin Hashim
JKR 1555, Quarters Kerajaan, Jalan Morib,
42700 Banting, Selangor.
5. Peter J.C. Nagtegaal
SSB (XM), 98100 Lutong, Sarawak.
6. B. Allagu
Jabatan Kajibumi Sabah, Beg Berkunci
2042, 88999 Kota Kinabalu, Sabah.
7. Schor Omar
MMC, 4129A Jalan Tengku Ismail, Off
Jalan Telipot, 15150 Kota Bharu, Kelantan.
8. Lawrence A. Frakes
Dept. of Geology & Geophysics, University
of Adelaide, GPO Box 498, Adelaide, S.
Australia 5001.
9. W.S. Bondame
Wullersdorf Services Sdn. Bhd., TB3211,
Block D, Taman El-Nysa, Jalan Kabota,
91000 Tawau, Sabah.

10. R.J. Rouleau
Atlas Wireline Services, Letter Box 117,
7th Floor, UBN Tower, 10 Jalan P. Ramlee,
50250 Kuala Lumpur.
11. Chandra Kumar
Mara Community College, Km 8, Jalan
Gambang, 25150 Kuantan, Pahang.
12. Lee Kam Hoong
Esso Production, P.O. Box 10857, 50728
Kuala Lumpur.
13. Mohamed Taher A. Taha
Schlumberger, 32 Floor, Menara Promet,
Jalan Sultan Ismail, 50250 Kuala Lumpur.

Student Members

1. Ghazala Roohi
Dept. of Geology, Universiti of Malaya,
59100 Kuala Lumpur.
2. Rozita Musib
Dept. of Geology, University of Malaya,
59100 Kuala Lumpur.
3. Abdul Hadi Abdul Rahman
Department of Geology, University of
Malaya, 59100 Kuala Lumpur.

Perfukaran Alamat (Change of Address)

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

- | | |
|---|---|
| <p>1. Azuhan bin Mohamed
Bahagian Pengairan, Jabatan Pengairan dan Saliran, Malaysia, Jalan Sultan Salahuddin, 50626 Kuala Lumpur.</p> | <p>2. John Hill
c/o Mr. W.E. Mims, 41 Homestead Road, Candaler, n.c. 28715 USA.</p> |
| <p>3. V. Srimugayogam
No. 7, Jalan 8, Taman Sri Rawang, 48000 Rawang, Selangor.</p> | <p>6. S.C. Yarbrough
Jl. Erlangga IV/24, Kebayoran Baru, Jakarta, Indonesia.</p> |
| <p>4. Kong Ing Chung
No. 25, Lot 3618 Taman Timberland, 3rd mile Rock Road, 93250 Kuching.</p> | <p>7. Kong Ing Chung
GMS, Wisma Ko-Perkasa, No. 23-24, Lot 8635-8636, 3rd Floor, Section 64, Jalan Simpang Tiga, 93300 Kuching, Sarawak.</p> |
| <p>5. Yew Chin Chong
Batu 9, Kota Sarang Semuy, 06800 Alor Setar, Kedah.</p> | |

Perambahan Baru Perpustakaan (New Library Additions)

The Society has received the following publications:

- | | |
|---|---|
| <p>1. IMM Transactions, Section A: vol. 100 Sept-Dec 1991.</p> | <p>13. U.S. Geological Survey Bulletin: 1991: 1990-E, 1904-B, 1967, 1808-M, 1913, 1971, 1759-C, 1991, 1960, 1565, 1866, 1959, 1904-E, 1883, 1787-y, 1787-S,T, 1787-V. 1992: 1989-A-C, 1808-L, 2007, 1975.</p> |
| <p>2. Commonwealth Science Council newsletter, Jan-Feb, Mar-Apr, May-Jun 1992.</p> | <p>14. U.S. Geological Survey Professional Paper: 1991: 1408-G, 1513-B, 1366-E-J, 1404-E. 1992: 1408-B.</p> |
| <p>3. Geologie, vol. 99, nos. 3/4, 1990.</p> | <p>15. Explanatory text of the geologic map of Taiwan, scale 1:50,000, Sheet 13, 1991 (Summary)</p> |
| <p>4. Geological Survey of Japan, nos. 10-12, 1991 & vol. 43, nos. 1/2, 1992.</p> | <p>16. Quaternary geology of the Northern foot area of Mount Lawu and along the middle course of the Solo River, Central & East Asia, 1991.</p> |
| <p>5. CCOP Technical Bull. vol. 23, 1991.</p> | <p>17. Geological Research & Development Centre, sp. publication, no. 9 (1989), 10 & 11 (1990).</p> |
| <p>6. The University of Tsukuba, Institute of Geoscience, Annual Report no. 17, 1991.</p> | <p>18. Scripta Geologica, no. 97, 1991.</p> |
| <p>7. National Science Museum, Bulletin, vol. 18, no. 1, 1992.</p> | <p>19. Bulletin of the National Science Museum, vol. 17, no. 4, 1991.</p> |
| <p>8. Science Reports of the Institute of Geoscience, University of Tsukuba, vol. 13, 1992.</p> | <p>20. USGS Circular 1991: 1085. 1992: 1074, 1073.</p> |
| <p>9. AAPG Explorer April 1992.</p> | |
| <p>10. Abstracts of the Geological Congress of Turkey 1991.</p> | |
| <p>11. Geological Bulletin of Turkey, vol. 34, nos. 1, 1991.</p> | |
| <p>12. Chronique de la Recherche Miniere, no. 506, 1992.</p> | |

BERITA-BERITA LAIN Other News

16th International Colloquium of African Geology

Ezulwini Swaziland

14-16 September 1993

Organised by: The Geological Survey and Mines Department of Swaziland

THE HOST COUNTRY

Swaziland is ca 1700 km², bordered on the east by Mozambique and on the north, west, and south by the Republic of South Africa. Geographically the country falls into four strips running north to south. From the west, they are (i) Highveld, a mountainous region of great scenic beauty transected by numerous river valleys. Large parts of the Highveld are covered by man-made pine forests; (ii) the Middleveld, a fertile rolling grassland; (iii) the Lowveld, a typical African bush country with indigenous forests and large sugar estates, and (iv) the Lubombo, an impressive escarpment which runs along the eastern length of the Lowveld, broken by gorges of the Usuthu, Ingwavuma and Imbuluzi rivers. Swaziland has one of the finest climates in the world. In the Highveld, it is near temperate and the rest of the country has a sub-tropical climate. Summers are generally wet and hot while winters are dry and cool. Swaziland is a Land of abundant sunshine.

Siswati and English are the official languages. English is the medium of instruction in all schools and is widely understood by most people.

THE COLLOQUIUM VENUE

The venue for the 16th Colloquium of African Geology is the splendid Royal Swazi Sun Convention Centre situated in the Ezulwini valley, with a hotel complex, an 18-hole golf course, squash courts, bowling greens, floodlit tennis courts, horse-riding opportunities and casino. A nearby thermal spring with a sauna bath is available for relaxing moments. The

Convention Centre has all the facilities for supporting large conferences.

SCIENTIFIC PROGRAMME

The 16th Colloquium of African Geology will be mainly devoted to current geological research work. In Africa i.e., "Results obtained over the past ten years". It is aimed at an exchange of ideas on results of geological research in Africa and any applicable research techniques. The organisers would greatly appreciate if participants could limit their presentations to the following topics.

- 1) Precambrian Geology
- 2) Anorogenic Magmatism
- 3) Basin Analysis
- 4) Tectonics
- 5) Geophysics and Remote Sensing
- 6) Metallogeny
- 7) Environmental and Engineering Geology
- 8) Hydrogeology and water resources

Discussions of a general nature covering regional mapping, geophysical and geochemical surveys will be arranged should there be some interest. Meetings on the geological and tectonic map of Africa under the auspices of the African geological Surveys will also be conducted.

EXCURSIONS

Excursions are designed so as to highlight the geology of Swaziland and the immediate surrounding vicinity. Should there be a significant demand, a 12-day excursion to various mines of neighbouring Republic of South Africa will be arranged at a cost of US\$1,000.

All excursion are optional. A choice of 4 two-day pre-conference excursions are available as follows:

- 1) Precambrian Sedimentary Basins (US\$180)
- 2) Archaean Granites of Swaziland (US\$180)
- 3) Precambrian Iron Formations in Swaziland (US\$180)
- 4) Tin-bearing pegmatites (US\$180)

A further choice of 4 post-conference excursions (3 three-day and 1 twelve-day) are also available as follows:-

- 5) The Ancient Gneiss Complex of Swaziland (US\$270)
- 6) Barbeton Greenstone Belt and Gold mineralisation (US\$270)
- 7) Geological traverse across Swaziland (US\$270)
- 8) Mines and mineralisation in South Africa (12-days, optional, US\$1,000)

COSTS OF COLLOQUIUM

A package deal has been arranged with the Royal Swazi Sun Hotel which includes conference facilities, accommodation, breakfast and lunch at a rate of US\$500 for delegates, US\$200 for students, accompanying persons will pay the same rate for accommodation (meals not included). A complete volume of abstracts for registered participants is also included in the package deal.

PAPERS

Papers covering any of the theme subjects are invited from participants. The titles of the proposed contribution along with an abstract (250 to 450 words) should reach the Organising Committee on or before 15th June 1992. Extended abstracts, including diagrams should be three full pages with no topographical mistakes, should reach the Organising Committee on or before 1st October, 1992. Abstracts received will be scrutinized by the Scientific Programme Subcommittee and those accepted will be provided to the registered participants on arrival. Authors will be notified concerning the acceptance of abstracts by mail, dispatched by December, 1992.

LANGUAGES

All correspondence, abstracts, extended abstracts, papers, poster presentations, trade

exhibits and colloquium proceedings will be in English.

SPEAKERS

Invited keynote addresses (3) by internationally renowned experts will be a highlight of the Colloquium. Suggestions of names of experts who could usefully deliver such addresses may be sent to the Secretary, Organising Committee before 1st September, 1992.

TRAVEL

Flights are generally heavily booked during this period. All participants are advised to make their own arrangements for travel to Manzini and return flight directly, well in advance. There are normally few incoming flights to Swaziland.

VISA REQUIREMENTS

Colloquium participants are advised to ensure compliance with any visa requirement for entry into the Kingdom of Swaziland. Participants wishing to attend the "Barbeton Greenstone Belt and Gold Mineralisation" or the "Mines and Mineralisation in South Africa" excursions, should also comply with any multiple entry visa requirements for both the Republic of South Africa and Swaziland.

WEATHER

The minimum and maximum temperatures in Ezulwini and its neighbourhood generally range from 25°C to 2°C, with an average of about 20°C in September.

INFORMATION

All communications may be addressed to:

The Chairman or Secretary
Organising Committee
16TH COLLOQUIUM OF AFRICAN GEOLOGY
P.O. Box 9
MBABANE
Swaziland

Telephone: 42411
Telex: 2301 WD
Facsimile: 45215
Telegrams: GSM

KALENDAR (CALENDAR)

1993

► April 1993

◆◆◆ April 1-3

FRACTALS AND DYNAMICS SYSTEMS IN GEOSCIENCES (International Meeting), Frankfurt/Main, Germany (Jörn H. Kruhl, Geology-Paleontology Institute, JW Goethe-University, Senckenberganlage 32, D-6000 Frankfurt/Main, Germany. Phone: 0049-69-7982695)

◆◆◆ April 1-30

COMPUTER SIMULATED MINERAL EXPLORATION (22nd Workshop), Fontainebleau, France. (L. Zanone, Ecole des Mines de Paris, CGGM-IGM, 35, rue Saint-Honoré, 77305 Fontainebleau Cedex, France. Phone: (33 1) 64 69 49 30; telefax: (33 1) 64 69 47 01; telex: 694 736F)

◆◆◆ April 4-8

REMOTE SENSING AND GLOBAL ENVIRONMENTAL CHANGE (25th International Symposium), Graz, Austria. (Dorothy M. Humphrey, ERIM, P.O. Box 134001, Ann Arbor, MI 43113-4001, USA. Phone: (313) 994-1200, ext. 2290; telefax: (313) 994-5123)

◆◆◆ April 5-8

GLOBAL WARMING, int'l. mtg., Chicago. (Sinyan Shen, Natural Resource Management Division, SUPCON International, One Heritage Plaza, Woodridge, Ill. 60517-0275. Phone: 708/910-1551; 419/372-8207. Fax: 708/910-1561)

◆◆◆ April 17-20

INTEGRATED METHODS IN EXPLORATION AND DISCOVERY (International Conference), Denver, Colorado, USA. (SEG Conference '93, P.O. Box 571, Golden, CO 80402, USA. Telefax: (303) 279-3118)

◆◆◆ April 21-25

GEOSCIENCE EDUCATION AND TRAINING (International Conference), Southampton, UK. (Mrs. Esther Johnson, GEOED Conference Secretariat, Department of Geology, University of Southampton, Southampton SO9 5NH, UK. Phone: (0703) 593049; telefax: (0703) 593052; telex: 47662 SOTONU G)

◆◆◆ April 19-23

REMOTE SENSING, int'l mtg., Enschede, The Netherlands, by international Institute for Aerospace Survey and Earth Sciences, and others. (Myriam Fahner, Box 6, 7500 AA Enschede, The Netherlands. Phone: 31-53-874 255. Fax: 31-53-874 436) Deadline for manuscripts: March 11.

◆◆◆ April 25-28

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (Annual Meeting), New Orleans, Louisiana, USA. (Convention Department, AAPG, Box 979, Tulsa, OK 74101, USA. Phone: (918) 584-2555; telefax: (918) 584-0469)

► May 1993

◆◆◆ May 5-8

PROTECTING THE EARTH - CHALLENGES TO SCIENCE AND TECHNOLOGY (1st International Fair and Congress), Köln, Germany. (Alfred-Wegener-Stiftung zur Förderung der Geowissenschaften, Wissenschaftszentrum Ahrstraße 45, Postfach 20 14 48, D-5300 Bonn 2, Germany. Phone: 02 28/302-260; telefax: 02 28/302-270; telex: 885 420 wzd).

◆◆◆ May 5-8

GEOTECHNICA '93 (International Symposium), Cologne, Germany. (Hans Teetz, Cologne International Trade Fairs Inc., 21st Floor, 666 Fifth Ave., New York, NY 10103-0165, USA. Phone: (212) 974-8836; telefax: (212) 974-8838)

◆◆◆ May 15-21

ENVIRONMENTAL HYDROLOGY AND HYDROGEOLOGY (2nd USA/CIS Joint Conference), Arlington, Virginia, USA. (Americal Institute of Hydrology, 3416 University Avenue, SE, Minneapolis, MN 55414-3328, USA. Phone: (612) 379-1030; telefax: (612) 379-0169)

◆◆◆ May 17-19

GEOLOGICAL ASSOCIATION OF CANADA/ MINERALOGICAL ASSOCIATION OF CANADA (Joint Annual Meeting), Edmonton, Alberta, Canada. (J.W. Kramers, Alberta Geological Survey, P.O. Box 8330, Station F, Edmonton, Alberta T6H 5X2, Canada. Phone: (403) 438-7644; telefax: (403) 438-3644)

◆◆◆ May 25–June 15

BASIN TECTONIC AND HYDROCARBON ACCUMULATION (International Conference), Nanjing, China. Professor Shi Yangshen, Department of Earth Sciences, Nanjing University, Nanjing, China. Phone: 86-25-634651, ext. 2890; telefax: 86-25-302728; telex: 34151 PRCNU CH. Or David Howell, U.S. Geological Survey, 345 Middlefield Road, MS 902, Menlo Park, CA 94025, USA. Phone: (415) 354-5430; telefax: (415) 354-3224

◆◆◆ May 31–June 2

APPLIED MINERALOGY, int'l. mtg., Perth, Western Australia. (Jim Graham, ICAM '93, Private Bag, P.O. Wembley 6014, Australia. Phone: 619/387-0371)

▶ June 1993

◆◆◆ June 1–5

GEOTECHNICAL ENGINEERING (International Meeting), St. Louis, Missouri, USA. (Norma R. Fleming, 119 ME Annex, University of Missouri, Rolla, MO 65401-0249. Phone: (314) 341-6061; (800) 752-5057. telefax: (314) 341-4992)

◆◆◆ June 7–16

SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY 1993 FIELD AND GENERAL MEETING (International Symposium), Liège, Belgium, and field excursions to Belgium, Germany, and the Pyrenees in France. (Dr. M. Streel, Paléontologie, Université de Liège, 7 Place du Vingt-Août, B-4000 Liège, Belgium)

◆◆◆ June 20–27

ZEOLITES (International Meeting), Boise, Idaho, USA. Sponsored by International Committee on Natural Zeolites. (F.A. Mumpton, Dept. of Earth Sciences, State University of New York, Brockport, 14420. Phone: 716/395-2635; 716/637-2324. Fax: 716/395-2416)

◆◆◆ June 21–25

ROCK ENGINEERING (Meeting and Workshop), Lisbon, Portugal. Sponsored by the International Society for Rock Mechanics. (Luis Ribeiro e Sousa, Portuguese Society for Geotechnique, Laboratório Nacional de Engenharia Civil, Av. do Brasil, 101, 1799 Lisboa Codex Portugal. Phone: 848 21 31; telefax: 89 76 60)

◆◆◆ June 28–July 2

INTERNATIONAL ASSOCIATION OF HYDROGEOLOGISTS: HYDROGEOLOGY

OF HARD ROCKS (24th IAH Congress), Oslo, Norway. (Geological Survey of Norway, P.O. Box 3813, Ullevål Hageby, N-0805 Oslo, Norway. Phone: 47-2-950895)

▶ July 1993

◆◆◆ July

ENVIRONMENTAL CONTEXT OF HUMAN EVOLUTION (International Scientific Congress and Exhibition), The Netherlands and Indonesia. (Dr. Hans Beijer, Geological Survey of The Netherlands, P.O. Box 157, NL-2000 AD Haarlem, The Netherlands. Telefax: 31 23 351614)

◆◆◆ July 5–8

ROCK FRAGMENTATION BY BLASTING (4th International Symposium), Vienna, Austria. (Dr. H.P. Rossmannith, Institute of Mechanics, Technical University Vienna, Wiedner Hauptstraße 8–10/325, A-1040 Vienna, Austria. Phone: (222) 588 01 5514 or 5519; telefax: (222) 587 5863)

◆◆◆ July 5–9

FLUVIAL SEDIMENTOLOGY (5th International Conference), Brisbane, Australia. (Continuing Professional Education, The University of Queensland, Queensland 4072, Australia. Phone: 61 7 365 7100; telefax: 61 7 365 7099; telex: UNIVQLD AA40315)

◆◆◆ July 5–16

VERY LOW GRADE METAMORPHISM: MECHANISMS AND GEOLOGICAL APPLICATIONS (IGCP Project 294 Thematic Meeting and Field Excursions), Xi'an, People's Republic of China. (Dr. Wu Hanquan, Xi'an Institute of Geology and Mineral Resources, 116 Easy Youyi Road, Xi'an 710054, People's Republic of China)

◆◆◆ July 17–24

GEOLOGICAL AND LANDSCAPE CONSERVATION, int'l. mtg., Great Malvern, U.K. (Margaret Phillips, The Company, St. John's Innovation Centre, Cowley Road, Cambridge CB4 4WS. Phone: (0223) 421124. Fax: (0223) 421158)

◆◆◆ July 18–23

CLAY CONFERENCE (10th International Conference in conjunction with Commission VII of the International Soil Science Society), Adelaide, South Australia. (Dr. Tony Eggleton, Geology Department, ANU, GPO Box 4, Canberra, ACT 2601, Australia)

◆◆◆ July 25-30

ORIGIN OF PARENTAL ANORTHOSITE MAGMAS, TECTONIC AND METAMORPHIC PROCESSES IN THE EVOLUTION OF ANORTHOSSITES (Conference), Kadalaksha, Kola Peninsula, Russia. Sponsored by International Geological Correlation Programme Project 290. (Michael Higgins, Sciences de la Terre, Université du Québec à Chicoutimi, Chicoutimi, Québec G7H 2B1, Canada. Phone: (418) 545-5012)

▶ August 1993

◆◆◆ August

INTRAPLATE VOLCANISM: THE POLYNESIAN PLUME PROVINCE (International Workshop), Tahiti, French Polynesia. (Workshop Tahiti 1993, C. Dupuy, Centre Géologique et Géophysique, Case 060, Université de Montpellier II, place E. Bataillon, 34095 Montpellier Cedex 5, France. Phone: (33) 67-634-983; telefax: (33) 67-523-908)

◆◆◆ August 1-6

GEOCHEMISTRY OF THE EARTH SURFACE (3rd International Symposium), University Park. Pennsylvania, USA. (Lee Kump, Department of Geosciences, Pennsylvania State University, 210 Deike Bldg., University Park, PA 16802, USA. Phone: (814) 863-1274; telefax: (814) 865-3191)

◆◆◆ August 4-7

PALEOZOIC MICROVERTEBRATES (IGCP Project-328) (2nd International Symposium), Berlin, Germany. In conjunction with the birthday anniversary of Professor Walter Gross. (Dr. S. Turner, Queensland Museum, P.O. Box 3300, South Brisbane, Qld 4101, Australia. Telefax: 617 846 1918. Or Prof. H. Jaeger, Museum für Naturkunde, Invalidenstr. 43, 00-104 Berlin, Germany)

◆◆◆ August 8-12

STRATIGRAPHIC RECORD OF GLOBAL CHANGES: CLIMATE, SEA LEVEL, AND LIFE (SEPM Meeting), University Park, Pennsylvania, USA. (Mike Arthur, Department of Geosciences, Pennsylvania State University, University Park, PA, 16802, USA. Phone: (814) 865-6711)

◆◆◆ August 11-15

GEOSCIENCE IN URBAN DEVELOPMENT (International Conference), Beijing, China. (Professor Wang Sijing, Chairman LANDPLAN IV, Institute of Geology, Academia Sinica, P.O.

Box 634, Beijing 100029, China. Phone: 86-1-2027766; telefax: 86-1-4919140; telefax: 22474 ASCHI CN c/o Institute of Geology)

◆◆◆ August 15-19

CARBONIFEROUS TO JURASSIC PANGEA: A GLOBAL VIEW OF ENVIRONMENTS AND RESOURCES (International Symposium), Calgary, Alberta, Canada. (Dr. Benoit Beauchamp or Dr. Ashton Embry, Geological Survey of Canada, 3303 33rd St. NW, Calgary, Alberta T2L 2A7, Canada. Phone: (403) 292-7190; telefax: (403) 292-4961)

◆◆◆ August 23-29

GEOMORPHOLOGY (3rd International Conference), Hamilton, Ontario, Canada. (3rd International Geomorphology Conference, Department of Geography, McMaster University, Hamilton, Ontario L8S 4K1, Canada. Phone: (416) 525-9140, ext. 4535; telefax: (416) 546-0463; E-mail: GEOMORPH)

◆◆◆ August 23-29

COASTAL SEDIMENTOLOGY (Meeting), Hamilton, Ontario, Canada. (William F. Tanner, Dept. of Geology B-160, Florida State University, Tallahassee, FL 32306, USA) Phone: 904/644-3208)

◆◆◆ August 28-September 15

LANDSLIDES (International Meeting and Workshop), Czech and Slovak Federal Republic. (ICFL-C.S. Landslides '93, c/o NOVOSAD IG/EG, I. Sekaniny 1801, CS-70800 Ostrava 4, Czechoslovakia. Phone: (42-69) 473028; telefax: (42-2) 381848)

▶ September 1993

◆◆◆ September 5-11

NUCLEAR-WASTE MANAGEMENT, int'l mtg., Prague, Czech and Slovak Federal Republic, by American Society of Mechanical Engineers. Czech and Slovak Mechanical Engineering Society, and the Czech and Slovak Nuclear Society. (Radovan Kohout, Ontario Hydro (H11 A2), 700 University Ave., Toronto, Ontario M5G 1X6. Phone: 416/592-5384. Fax: 416/592-4485)

◆◆◆ September 6-8

STRUCTURES AND TECTONICS AT DIFFERENT LITHOSPHERIC LEVELS (International Conference), Graz, Austria. (Wolfgang Unzog, Department of Geology, University of Graz, Heinrichstrasse 26, A-8010 Graz, Austria. Phone: 43 316 380 5584; telefax: 43 316 38 28 85)

◆◆◆ September 8-13

JURASSIC GEOLOGY (Arkell International Symposium), London, UK. (Dr. Stewart Brown, Conference Secretary, Petroleum Science and Technology Institute, 25 Ravelston Terrace, Edinburgh EH4 3EX, UK. Phone: 031 451 5231; telefax: 031 451 5232)

◆◆◆ September 8-17

LAYERING IN IGNEOUS COMPLEXES - WAGER AND BROWN 25th ANNIVERSARY COMMEMORATIVE MEETING (Symposium), Johannesburg, South Africa. (Professor R. Grant Cawthorn, Department of Geology, University of the Witwatersrand, P.O. Wits 2050, Republic of South Africa. Phone: 11 716 2711 or 2608; telefax: 11 339 1697 or 430 1926)

◆◆◆ September 14-16

AFRICAN GEOLOGY (16th International Colloquium), Ezulwini, Swaziland. (The Chairman or Secretary, Organizing Committee, 16th Colloquium of African Geology, P.O. Box 9, Mbabane, Swaziland. Phone: 42411; telefax: 45215; telex: 2301 WD; telegram: GSM)

◆◆◆ September 21-23

ANDEAN GEODYNAMICS (2nd International Symposium), Oxford, UK. Sponsored by University of Oxford and Institut Francais de Recherche Scientifique pour le Développement en Coopération (Orstom). (Pierre Soler, ISAG 93, Orstom, CS1, 213 rue Lafayette, 75480 Paris Cedex 10, France. Telefax: 33 1 48 03 08 28)

◆◆◆ September 25-October 1

INTERNATIONAL ASSOCIATION OF VOLCANOLOGY AND CHEMISTRY OF THE EARTH'S INTERIOR (Meeting), Canberra, Australia. (IAVCEI ACTS, GPO Box 2200, Canberra ACT 2601, Australia. Phone: 61 6 257-3299. Fax: 61 6 257-3256)

◆◆◆ September 27-30

ENVIRONMENTAL BIOGEOCHEMISTRY (11th International Symposium), Salamanca, Spain. (Dr. J.F. Gallardo Lancho, I.E.T./CSIC, Aptdo. 257, Salamanca 37071, Espana, Spain. Phone: (923) 219606; telefax: (923) 219609)

◆◆◆ September 27-29

GLOBAL BOUNDARY EVENTS (Interdisciplinary Conference of IGCP Project 293, Geochemical Marker Events in the Phanerozoic), Kielce, Poland. (Barbara Studencka, Muzeum Ziemi PAN, Al. Na Skarpie

20/26, 00-488 Warszawa, Poland. Phone: (4822) 217-391; telefax: (4822) 297-497. Or Helmut H.J. Geldsetzer, Geological Survey of Canada, 3303-33rd St. NW, Calgary, Alberta T2L 2A7, Canada. Phone: (403) 292-7155; telefax: (403) 292-5377)

◆◆◆ September 28-October 1

ENVIRONMENTAL POLLUTION (International Conference), Barcelona, Spain. (ICEP Conference Office, ICTR Secretariat, 11-12 Pall Mall, London SW1Y 5LU, UK. Phone: 44 71 930-6825; telefax: 44 71 976-1587; telex: 925312 REICO)

▶ October 1993

◆◆◆ October 4-9

BASIN INVERSION (International Conference), Oxford, UK. (James G. Buchanan, British Gas Exploration and Production Limited, 100 Thames Valley Park Drive, Reading, Berkshire RG6 IPT, UK. Phone: 0734-353222; telefax: 0734-353484; telex: 846231)

◆◆◆ October 10-15

INTERNATIONAL ASSOCIATION FOR MATHEMATICAL GEOLOGY (Silver Anniversary Meeting), Prague, Czechoslovakia. (John C. Davis, Kansas Geological Survey, University of Kansas, Lawrence, KS 66047, USA. Phone: (913) 864-3955; telefax: (913) 864-5317; E-mail: john_davis.moore_@msmail.kgs.ukans.edu. Europe, Africa, and Asia: Jan Harff, Institute for Baltic Sea Research, Seestr. 15, 0-2530 Warnemuende, Germany. Phone: 49 381 58 261; telefax: 49 381 58.336; E-mail: harff@geologie.io-warnemuende.dbp.de)

◆◆◆ October 11-24

INTERGEMS '93 (2nd International Symposium on Precious and Decorative Stones), Prague, Czechoslovakia. Sponsored by Czech and Slovak Geological Services and Museums. (Secretariat INTERGEMS, Malostranske nam. 19, CS-11821 Praha 1, Czechoslovakia. Phone: 535 357; telefax: 533 564)

◆◆◆ October 17-20

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (International Meeting), The Hague, The Netherlands. (AAPG, Box 979, Tulsa, OK 74101, USA. Phone: (918) 584-2555; telefax: (918) 584-0469)

◆◆◆ **October 18-23**

NEW DEVELOPMENTS IN GEOTHERMAL MEASUREMENTS IN BOREHOLES (Meeting), Klein Koris, Germany. (Prof. E. Hurtig, GFZ Potsdam, Telegrafenberg A45, 0-1561 Potsdam, Germany. Phone: 49 331 310 347; telefax: 49 331 310 610; E-mail: gth@gfz-postsdam.dbp.de)

◆◆◆ **October 25-28**

GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Boston, Massachusetts, USA. (Vanessa George, GSA, P.O. Box 9140, Boulder, CO 80301, USA. Phone: (303) 447-2020)

▶ **November 1993**◆◆◆ **November 15-30**

LOW TEMPERATURE METAMORPHISM: PROCESSES, PRODUCTS AND ECONOMIC SIGNIFICANCE (IGCP Project 294 Thematic Meeting), Santiago, Chile. (Professor M. Vergara, Universidad de Chile, Departamento de geologia y Geofisica, Casilla 13518-Correo 21 Santiago, Chile. Telefax: 56 2-6963050)

1994

◆◆◆ **June 6-10**

EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS (56th Annual Meeting and Exhibition), Austria Center, Vienna, Austria. (Evert Van der Gaag, Business Manager, European Association of Exploration Geophysicists, Utrechtseweg 62, NL-3704 HE Zeist, the Netherlands. Phone: (03404) 56997; telefax (03404) 62640; telex:33480)

1995

◆◆◆ **May 29-June 2**

EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS (57th Annual Meeting and Exhibition), Glasgow, UK. (Evert van der Gaag, European Association of Exploration Geophysicists, Utrechtseweg 62, NL-3704 HE Zeist, The Netherlands. Phone: (03404) 56997; telefax: (03404) 62640; telex: 33480)

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Jil. 14, No. 5 (Vol. 14, No. 5)

Sep-Okt 1988

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

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.

Goh Yok Leng, 1975. *Bedrock geology and mineralization of the Seng Mines, Sungei Way, Selangor*. Unpublished University of Malaya B.Sc. (Hons.) thesis, 62 p.

Hutchison, C.S., 1989. *Geological Evolution of South-east Asia*. Oxford Monographs on Geology and Geophysics, 13, Oxford University Press, England, 368p.

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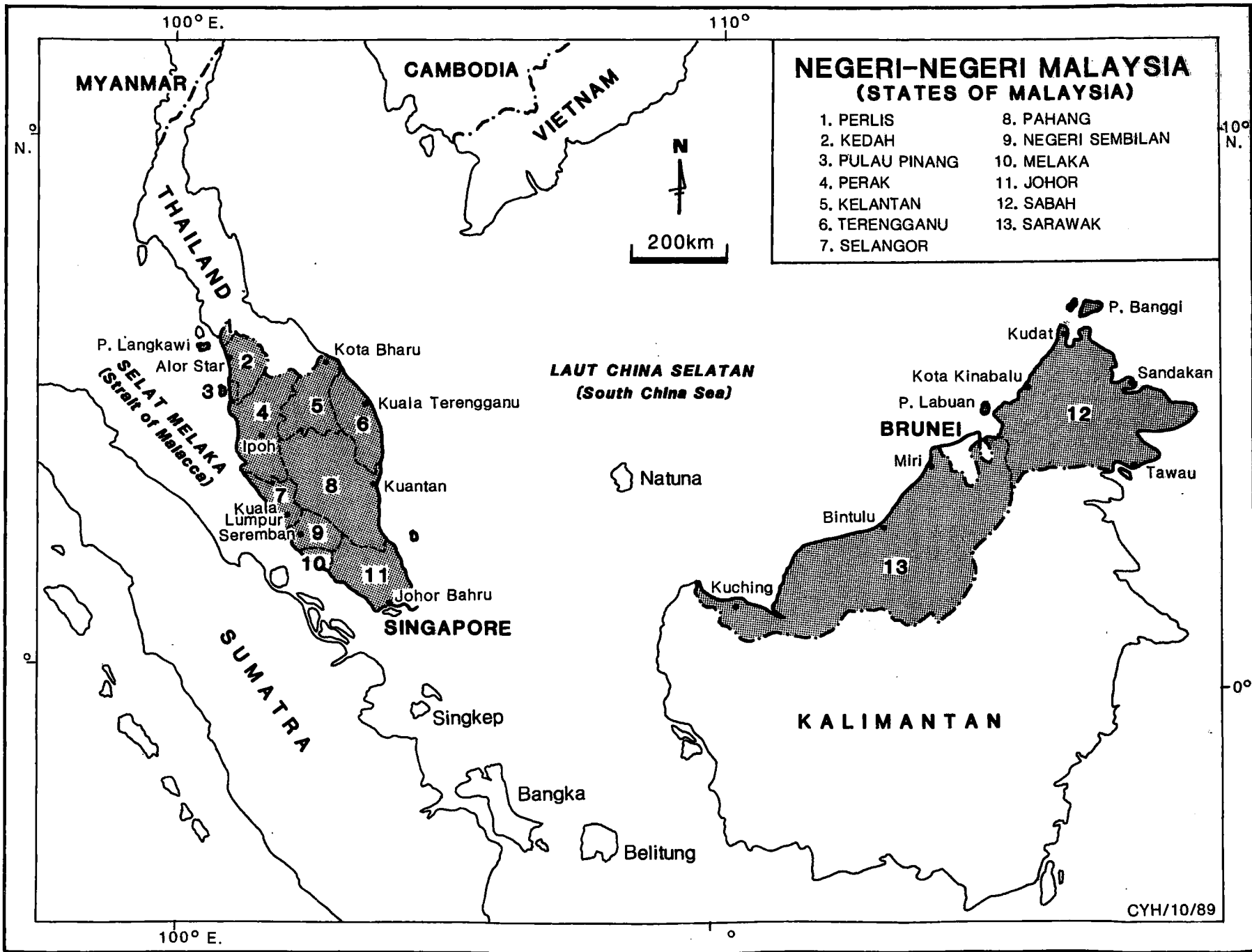
A concise and informative *abstract* in English is required for each paper written in Bahasa Malaysia or English.

A paper written in Bahasa Malaysia must have an abstract in Bahasa Malaysia as well.

For format, kinds of subheadings and general style, use this and the previous *Buletins* as a guide.

The final decision regarding the size of the illustrations, sections of the text to be in small type and other matter relating to printing rests with the Editor.

If authors have trouble over the script requirements, please write in to the Editor.



**NEGERI-NEGERI MALAYSIA
(STATES OF MALAYSIA)**

- | | |
|-----------------|--------------------|
| 1. PERLIS | 8. PAHANG |
| 2. KEDAH | 9. NEGERI SEMBILAN |
| 3. PULAU PINANG | 10. MELAKA |
| 4. PERAK | 11. JOHOR |
| 5. KELANTAN | 12. SABAH |
| 6. TERENGGANU | 13. SARAWAK |
| 7. SELANGOR | |

**LAUT CHINA SELATAN
(South China Sea)**

BRUNEI

KALIMANTAN