PP 188/12/90 ISSN 0126-5539

PERSATUAN GEOLOGI MALAYSIA

WARTA GEOLOGI

NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MALAYSIA

Jil. 17, No. 3 (Vol. 17, No. 3) **May-Jun 1991**

KANDUNGAN (Contents)

GEOLOGICAL SOCIETY OF MALAYSIA

DIKELUARKAN DWIBULANAN
ISSUED BIMONTHLY

PERSATUAN GEOLOGI MALAYSIA
Geological Society of Malaysia

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.

Published by the Geological Society of Malaysia,
Department of Geology, University of Malaya, 59100 Kuala Lumpur.
Tel: 603-757 7036 Fax: 603-756 3900

Printed by Art Printing Works Sdn. Bhd., 29 Jalan Riong, 59100 Kuala Lumpur.

Systematic approach in the characterisation of granitic weathering profiles in tropical terrains

IBRAHIM KOMOO, KADDERI MD DESA, HAMZAH MOHAMAD,
ABDUL GHANI RAFEK & TAN BOON KONG,
Department of Geology, Universiti Kebangsaan Malaysia,
Bangi, Selangor, D.E.

Abstract: A systematic approach towards weathering profile characterisation by using some major material features is proposed. The features include degree of discolouration, the degree of textural preservation, degree of mineral alteration, and cohesiveness/friability of soil or relative strength of rock materials. The procedure can easily be extended to produce a complete profile weathering index map and can also be transformed directly for weathering classification of rock mass.

Abstrak: Suatu pendekatan sistematik dalam pencirian profil luluhawa menggunakan beberapa fitur bahan yang utama disarankan. Fitur tersebut termasuklah darjah penyahwarnaan, pengawetan tekstur, darjah perubahan mineral, dan kejelekitan/kegemburan tanah atau kekuatan relatif bahan batuan. Tatacara ini boleh diperluaskan dengan mudah untuk menghasilkan peta indeks profil luluhawa yang lengkap, disamping boleh diubah bentuk secara terus bagi tujuan pengelasan luluhawa jasad batuan.

INTRODUCTION

The tropical regions are characterized by hot and humid climatic conditions under which weathering of rock masses is very intense. The intensity of weathering is normally reflected by a great thickness of weathering profile. Although the degree of rock mass weathering changes with depth, the general trend that the rocks are completely weathered near the surface and become less weathered as the depth increases, is however, not always the case. There are many factors which influence the intensity and pattern of rock mass weathering. The most common, amongst others, are the inherent structural features such as fractures, joints and faults, groundwater conditions, and topography. As such, weathering intensity does not necessarily follow the vertical path, and as a result the repetition of the same weathering grade with depth within a profile is not uncommon.

A detailed investigation on a pilot profile representing typical coarse-grained granite rock revealed that a systematic approach in the characterisation of weathering profile is possible. This short note attempts to address the need for proper characterisation of weathered products as an approach towards the geotechnical assessment of weathered materials. This note forms part of an ongoing research on characterisation and classification of weathering profiles in tropical terrains.

PRESENT WEATHERING CLASSIFICATION

The present weathering classification is derived from previous works by Moye (1955), Ruxton and Berry (1957) and Little (1969). Later, it was refined by Dearman (1976) and finally with minor modification was adopted by IAEG (1981) and ISRM (1981) as their proposed standard weathering classification of rock mass. Generally, the present classification recognise six different weathering zones, namely residual soil (VI), completely weathered (V), highly weathered (IV), moderately weathered (III), slightly weathered (II), and fresh rock (I). This classification is based on material and mass descriptions, that is degree of decomposition and/or disintegration of rock material to soil, degree of structural/fabric destruction, degree of rock discolouration and rock:soil ratio. The classification is generally suitable for broad rock mass description but lack material characterisation which has become very important in detailed geotechnical investigation.

Deep weathering in tropical conditions produces a very thick weathering profile, characterized by layers of varying degrees of rock alteration, and variable chemical and mineralogical properties. These layers can be viewed as pseudo-stratifications of weathered materials, with each stratified material displaying different geotechnical properties and behaviour. The practical classificaton of weathering profile should utilise the concept of identifying the differences and the behaviour of each pseudo-stratification of weathered material.

PROPOSED PROFILE CHARACTERISATION

Characterisation of weathering profile in the field requires a detail observation of some major diagnostic features of weathered materials. These include the degree of discolouration, the degree of textural preservation, mineralogical changes, and material cohesiveness/friability and relative strength of rock. Some other features, as summarized by Lee and de Frietas (1989), may be used as supportive evidence especially when a more detailed description and classification of weathering materials is required.

Discolouration

Discolouration of the rock material involves fading of the original colour, partially to completely, followed by the enhancement of a secondary colour. The terms such as partially and completely discoloured, and total changes may be applied to describe discolouration.

Textural preservation

Textural preservation refers to mineral fabrics, such as mineral form, grain-boundary characteristics and any specific features of a particular mineral. The degree of textural preservation can be differentiated using terms such as completely and partially preserved, and completely destroyed.

Mineral composition

Decomposition due to chemical weathering will gradually change most of the primary minerals to secondary minerals. In granitic rocks, quartz will be reduced in size, whereas plagioclase, potash feldspar, biotite and muscovite will ultimately decompose to clay minerals. Since the weathering stability of each mineral differs greatly, some being easily decomposed compared to the others, the existence of recognisable minerals on a particular layer can be used to describe a weathering profile. The term "recognisable mineral" means that a particular mineral may have undergone some degree of alteration, but its texture and field identification properties are still preserved.

Cohesiveness/friability and relative strength

These terms are important to describe the visual condition of weathered materials. For soil materials, it can be divided into two types: either cohesive or cohesionless materials. For more accurate descriptions, soil texture, such as clayey, sandy, silty can be incorporated. On the other hand, rock materials are somewhat more difficult to describe. However, its relative strength seems to be a useful indicator for degree of weathering. Therefore, the terms *weak, medium, hard* and *very hard* can be used to describe relative strength of material.

Based on the above diagnostic features the weathered materials can be divided into 10 different indices (Table 1). Each index corresponds to weathered materials of varying degrees of chemical decomposition. This weathering index is suggested to be used as a basis for the systematic characterisation and classification of weathered materials for geotechnical purposes.

Table 1 : The proposed scheme for the systematic characterisation and classification of weathered materials for geotechnical purposes.

WEATHERING			PHYSICAL CHARACTERIZATION			
Term	Grade	Index	Dis-colouration	Textural Preservation	Mineral Composition	Friability/ Relative Strength
Residual soil	VI	10 9	D_6 D_5	T_3 T_3	Q,C Q,C	F_5 F_5
Completely Weathered	V	8 7	D_5,M D_5,M	T_2 T_1	Q,C,PF Q,C,PF,M	F_4 F_4
Highly Weathered	IV	6 5	D_4,M D_3,M	T_0 T_0	Q,PF,M,B,C Q,PF,M,B,P,C	F_4 F_3
Moderately Weathered	III	4 3	D_2 D_1	T_0 T_0	Q,PF,M,B,P Q,PF,M,B,P	F_2 F_2
Slightly Weathered	II	2	D_o (P-faded)	T_0	Q,PF,M,B,P	F_1
Fresh	I	1	D_o	T_0	Q,PF,M,B,P	F_0

<u>Discolouration</u>

Total Changes
- D_6 Brownish yellow
- D_5 Brownish red

Completely discoloured
- D_4 Brownish
- D_3 Yellowish
- M Mottled

Partially discoloured
- D_2 Reddish
- D_1 Yellowish

No Changes
- D_0

<u>Textural Preservation</u>

Completely destroyed
- T_3 100% destroyed

Partially preserved
- T_2 <50% preserved
- T_1 >50% preserved

Completely preserved
- T_0

<u>Mineral Composition</u>

- Q Quartz
- P Plagioclase
- PF Potash Feldspar
- B Biotite
- M Muscovite
- C Clay Minerals

<u>Friability/Relative Stregth</u>

Soils
- F_5 Cohesive
- F_4 friable

Rocks
- F_3 Weak
- F_2 Medium
- F_1 Hard
- F_0 Very Hard

PROFILE WEATHERING INDEX MAPPING

For geotechnical purposes, it is necessary to prepare maps or cross-sections, indicating the distribution of weathering indices in space or both in the vertical and horizontal direction. The detailed weathering index mapping of a profile on a roadcut at km 26.5 Kuala Lumpur - Karak Highway will be used to discuss the technique. The weathering index mapping involves various stages. The first stage involved geometric survey of the profile utilizing theodolite to properly mark various points for profile description. The entire profile surface is then divided into 2 x 2 meter grids, thus resulting in profile description resolution of the same size. The utilization of the grid system enables a full description of the profile surface which takes into account vertical, inclined and horizontal variations.

The second stage involved material description and indexing based on the above proposed method. Some difficulties will be encountered due to material inhomogeneity. Within the same grid system one can have materials of various indices. This can be overcome by reducing the size of the grid (that is, 1 x 1 or 0.5 x 0.5 meter) depending on the level of accuracy required. The most practical approach is to recognise only the most dominant index within the particular grid.

Finally, both the profile geometry and weathering index data were fed into computer for automatic data analysis. A simple program, specially developed for this research project, is used for vertical projection of the profile. The projection represents a vertical cross-section of the entire slope face showing pseudo-stratification of the weathering materials. Figure 1 shows an example of a computer plot of weathering index map which illustrates the nature of the entire weathering profile.

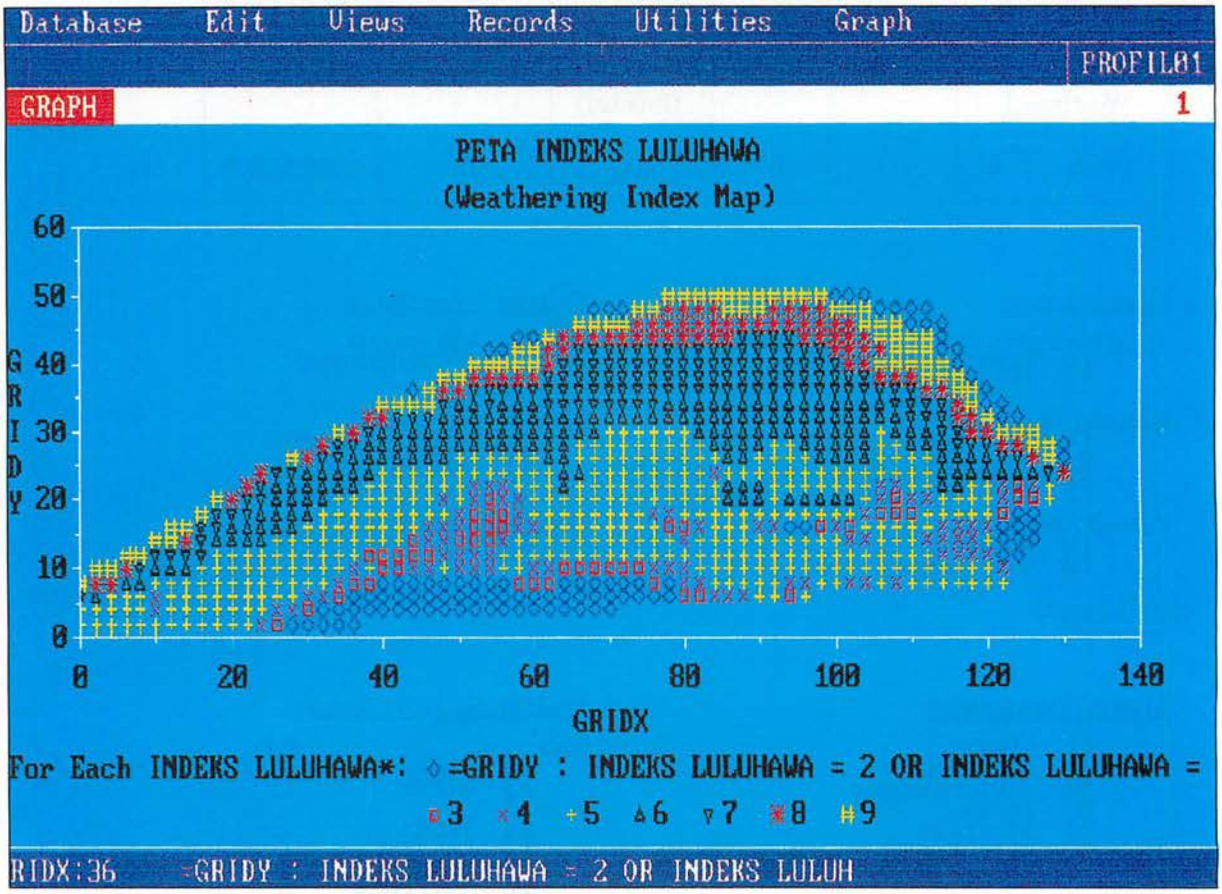


Figure 1 : Computer plot, showing the spatial distribution of weathered materials, of different indices, on a projected vertical profile face (the length and height of the profile is in meters).

CONCLUSION

A systematic approach of material characterization of granitic weathering profile in tropical terrain is proposed. The characterization procedures utilize some major diagnostic features, that is discolouration, textural preservation, mineral alteration and frability/cohesiveness or relative strength. This approach has many advantages. Among others, the data generated can easily be used to produce a complete weathering index map and later if required can be transformed directly for weathering classification of rock mass.

ACKNOWLEDGEMENTS

This is part of IRPA Project 4-07-03-03 "The characterization of weathering profiles in tropical terrains", funded by the Government of Malaysia. We would like to thank the following for their assistance in the course of the project: Salmah Abdul Rashid, Abdul Halim Mohd Yusoff, Azmi Ismail, Abu Bakar Zainal, Noraini Surip, Shaharin Md. Zain, Jailani Miskam, Abd. Aziz Ngah, Yaakob Othman and Mahani Samad.

REFERENCES

DEARMAN, W.R., 1976. Weathering classification in the characterization of rock: A revision. *Intl. Assoc. Engng. Geol. Bull.*, **13**, 123-127.

IAEG, 1981. Rock and soil description for engineering geological mapping. *Intl. Assoc. Engng. Geol. Bull.*, **24**, 235-274.

ISRM, 1981. Basic geotechnical description for rock masses. *Intl. J. Rock Mech. Min. Sci. and Geomech. Abstr.*, **18**, 85-110.

LEE, C.F. & DE FREITAS, 1989. A revision of the description and classification of weathered granite and its applications to granites in Korea. *Q.J. Engng. Geol.*, **221**, 31-48.

LITTLE, A.L., 1969. The engineering classification of residual tropical soils. *Proc. Intl. Conf. Soil Mech. and Found. Engng.*, Mexico, **1**, 1-10.

MOYE, D.G., 1955. Engineering geology of the Snowy Mountain Scheme. *J. Inst. Eng. Australia*, **27**, 281-299.

RUXTON, B.P. & BERRY, L., 1957/ Weathering of granite and associated erosional features in Hong Kong. *Bull. Geol. Soc. of America*, **68**, 1263-1292.

* * * * *

Manuscript received 18 May 1991

The Niggli number *al-alk* as an indicator of increasing clay mineral content and weathering intensity

HAMZAH MOHAMAD, IBRAHIM KOMOO, KADDERI MD. DESA, TAN BOON KONG & ABDUL GHANI RAFEK
Department of Geology, Universiti Kebangsaan Malaysia, Bangi, Selangor, D.E.

Abstract : The applicability of *al-alk*, a derivative of Niggli number *al* and *alk* to indicate increasing clay mineral content and weathering intensity is argued, based on published data. Its advantages, limitations and practical uses are also discussed and suggested.

Abstrak : Kebolehpakaian *al-alk*, iaitu terbitan nombor Niggli *al* and *alk* untuk menunjukkan pertambahan kandungan mineral lempung dan keamatan luluhawa diketengahkan, berlandaskan data kajian yang diterbitkan. Kelebihan, batas kemampuan serta kegunaan praktiknya juga dibincangkan dan disarankan.

INTRODUCTION

The manner in which granitoid rocks behave during chemical weathering, chemically and mineralogically, had been discussed in the classic work of Goldich (1938). Numerous field observations on weathering profiles and laboratory works published later either duplicated Goldich's findings, or revealed the transformation processes and mechanisms in greater details. With the present level of knowledge, the mineralogical and chemical changes that take place during the chemical weathering of a granitoid of typical composition can be broadly summarised as follows.

MINERALOGICAL CHANGES

Ferromagnesian minerals, that is olivine, pyroxene, amphibole and biotite are highly susceptible to alteration (Deer *et al.*, 1966); with the relative rates being in the order given above. Olivine weathers into serpentine, giving magnesium ions and precipitates ferric hydroxide. Pyroxene, amphibole and biotite alter to become calcium-sodium montmorillonite, releasing some dissolved silica, ions of Ca, Na and Mg, as well as precipitating ferric hydroxide. Potassium feldspar (orthoclase, microcline) disintegrate into illite and sericite (a fine-grained variety of muscovite, a secondary mineral), while releasing dissolved silica and sodium ions. The prolonged alteration of muscovite give way to kaolinite, in an acidic condition, or to gibbsite in an alkaline condition. Sodium feldspar (albite) and calcium feldspar (anorthite) produce sodium montmorillinite and calcium montmorillinite, respectively.

CHEMICAL CHANGES

Sodium and calcium diminish almost immediately after the onset of weathering, followed by potassium and magnesium. Relatively, the weathering residue is enriched with water, titanium, aluminium, and silicon. Ferrous iron oxidises immediately to very soluble ferric ion, which then hydrate and precipitate as $Fe(OH)_3$.

In conclusion, during chemical weathering granitoid rocks alter into phyllosilicate minerals (or more popularly known as clay minerals), silica in solution, and alkali and alkaline earth cations.

The present study is aimed at promoting a chemical parameter, called *al-alk* (pronounced *al* minus *alk*) to be used in the study of chemical weathering of granitoid in general and acidic rocks, such as granite and granodiorite in particular. Its formulation is based on the overall chemical and mineralogical behavior outlined above. Its validity as an indicator of increasing clay mineral content and its significance as an indicator of weathering intensity, is portrayed in a number of test plots, using published data on clay mineral composition in rocks, as well as chemical data from some weathering profiles of known direction of increasing intensity.

al-alk: THE BASIC FOUNDATION OF FORMULATION

For fresh rocks, the bulk Al_2O_3 is shared between feldspar and mica, and between muscovite and clay minerals in their weathering residues. Other important constituents of feldspar are K_2O, which occur in specific molecular ratios with Al_2O_3, that 1:1 in both albite and the K-feldspar, Bulk rock Al_2O_3 and the alkalis (Na_2O + K_2O) may be represented by the Niggli number *al* and *alk* respectively (Niggli, 1954).

It follows that *al-alk* in albite and K-feldspar is zero or negligibly small, and the small value of *al-alk* in fresh acidic rocks is the representative of amphibole and mica, which commonly occur in small amounts. The gradual increase in the amount of clay mineral on the expense of the disintegrating feldspar is reflected as the gradual increase in *al-alk* of the rock.

Table 1 summarises the composition and the calculated *al-alk* values of some minerals which are always present in acidic rocks and its weathered equivalent. It is obvious that the *al-alk* for primary minerals such as quartz, feldspar and mica are either negligible or less than 30 or so, in contrast to the extremely high values for clay minerals.

Table 1: The aluminium to alkali ratios and the *al-alk* values of common minerals in acidic igneous rocks and their weathered equivalent.

Mineral	Al:(Na_2O + K_2O)	*al-alk*
Quartz	–	0
Orthoclase/ microcline	1:1	< 5
Albite	1:1	< 5
Biotite	0.5:1	< 10
Vermiculite	1:0	≈ 20
Chlorite	1:0	≈ 25
Muscovite	3:1	≈ 40
Illite	1:0	≈ 40
Montmorillonite	1:0	≈ 60
Kaolinite	1:0	> 95
Gibbsite	1:0	≈ 100

THE APPLICABILITY OF *al-alk* AS AN INDICATOR OF CLAY MINERAL INDEX

Example 1

Fig. 1(A) shows the distribution of quartz, kaolinite, mica and chlorite in the mudrock sequence of Westphalian age (Pearson, 1979). The percentage of individual minerals in the clay portion have been recalculated by the present authors to give the percentages to the rock as a whole (for example H13 gives 15.04% quartz, 43.11% kaolinite, 24.82% mica and 11.96% chlorite). The Niggli numbers, and consequently *al-alk* were then calculated for the samples using their bulk chemical composition. The *al-alk* for the rocks are plotted against their respective kaolinite, mica and chlorite percentages (Fig. 1B). The figure shows a well-defined positive correlation between *al-alk* and the amount of kaolinite, a negative correlation between *al-alk* and mica, and no obvious changes in chlorite content with increasing *al-alk*. The phyllosilicate minerals increase with increasing *al-alk*. *Al-alk* is capable of representing the increasing amount of kaolinite in particular, and perhaps the clay minerals in general.

Example 2

Sedimentary trends of chemical variation were identified in staurolite and sillimanite grade rocks of Connemara, Ireland (Senior & Leake, 1978). In this extensive study, the parameter *al-alk* was used as a measure of the Al in the original sediments contained in the clay minerals and micas, rather than Al added in feldspars. Ti, Fe, K, Rb, Y, Nb, Cr, Ni, Ga, Zn and possibly Ba and Mn were at least

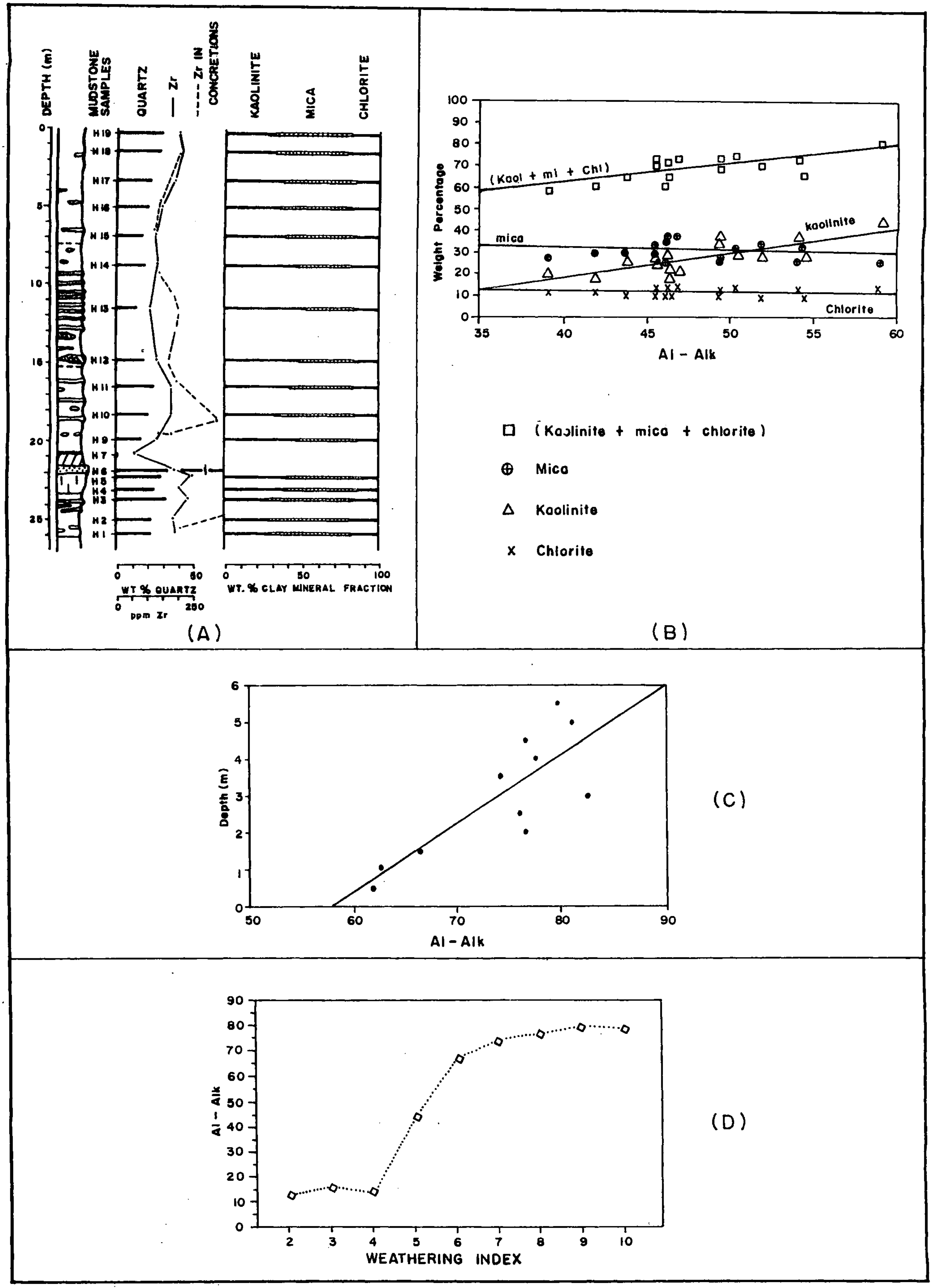


Figure 1. (A) The distribution of quartz, kaolinite, mica and chlorite in the mudrock sequence of Hapworth (modified after Pearson, 1979). **(B)** The correlations between *al-alk* and the amount of kaolinite, mica, chlorite and the phyllosilicate minerals of Fig. 1A. **(C)** A positive correlation between *al-alk* and depth in a granite weathering profile at Seremban-Kuala Pilah road (constructed using data of Kardinal Kusnaeny, 1973). **(D)** A positive correlation between *al-alk* and the weathering indices in a granite weathering profile at Kuala Lumpur-Karak highway.

substantially added in sheet minerals, as inferred from their positive correlation with *al-alk*.

Example 3

The major element geochemistry of metapelites, semipelites and psammites of greywacke type from Angus, Scotland were studied (Hamzah Mohamad, 1984). One of the major chemical variation in the series metapelites -psammites in terms of Niggli values is a well-defined negative correlation between *si* and *al-alk*. This variation also exists in published analyses of argillaceous rocks compiled from literature and reflect a decreasing proportion of "clay minerals" with increasing quartz content of the original sediments.

The three examples indicate that the *al-alk* can successfully be used as a clay mineral index.

THE APPLICABILITY OF *al-alk* AS AN INDICATOR OF INCREASING WEATHERING GRADE

Example 1

The *al-alk* for fourteen samples of weathered materials representing a wide range of weathering grade collected from a granite weathering profile at kilometer 20 Seremban-Kuala Pilah road (Kardinal Kusnaeny, 1973) were recalculated. The *al-alk* is plotted against the depth (m) of the respective sample in the profile, in which a strong positive correlation exists (Figure 1C).

Example 2

The *al-alk* for 94 samples representing a wide range of weathering grades (fresh coarse-grained porphyritic two-mica granite to residual soils) from a weathering profile at kilometer 26.7 Kuala Lumpur-Karak highway have been calculated. The existence of increasing intensity across the profile has been established via field characterization (Abdul Ghani Rafek *et al.*, 1991), mineralogy, geochemistry and physico-chemistry (Hamzah Mohamad, 1987; Hamzah Mohamad *et al.*, 1990; Kadderi Md. Desa & Hamzah Mohamad, 1991), as well as rock and soil engineering properties (Tan & Ibrahim Komoo, 1991). Figure 1D shows a well-defined positive correlation between the calculated *al-alk* and the weathering index (representing weathering grade). By using *al-alk*, an "rock-soil" interface has been recognised to be located between index 3 and 5.

THE ADVANTAGES AND THE LIMITATION OF *al-alk*

The advantages

Ideally, the derivation of *al-alk* requires a partial whole rock analysis of seven elements (Al_2O_3, Fe_2O_3, FeO, MgO, CaO, Na_2O and K_2O). However, by making a few assumptions (which of course incorporate some errors), it is possible to reduce the ingredient parameters to 5, that is: 1) for granitic rocks, Fe is calculated as FeO; for granitic soil Fe is calculated as Fe_2O_3, in which case only the total iron has to be known, and 2) the amount of CaO is generally low in granitic rocks and almost negligible in granitic soils, so CaO concentration might not be required.

The formulation of *al-alk* does not involve the rocks' silica, SiO_2. This is of great advantage in minimizing scatter due to variable amount of silica added to the rock system after its formation (after solidification), for example by intruding quartz dykes and veins. Sampling process will be more flexible and easily performed.

The limitations

Al-alk might not be useful, even erroneous, in the case of alkali rich clay minerals, such as illite and glauconite (both contain 7-8% K_2O). There are tendencies of underestimating the amount of the clay minerals, due to the anomalously high value of *alk*. Fortunately, illite and glauconite are less common minerals found in granitic soil profiles, as compared to montmorillonite, kaolinite and gibbsite. If, for some reason appreciable amount of feldspar survive disintegration, the amount of clay mineral as inferred from the rocks' *al-alk* value will be overestimated due to the fact that parts of the *al* actually belongs to the feldspar.

RECOMMENDATION FOR THE PRACTICAL USE OF *al-alk*

It is strongly believed that every major granitoid (for example granite, granodiorite, syenite, diorite, etc.) has a specific curve of *al-alk* against weathering grade, which differ in shape from each other. Also it is anticipated that the same type of rock from two different climatic conditions will produce two different curves.

A series of standard curves (according to the rock type) might be useful in monitoring "drilling into bedrock through *in situ* soil", for example in site selection projects. By extrapolating *al-alk* values of samples to the standard curve, the weathering grade of the material is readily indicated. Moreover, it might be possible to differentiate 'hanging' rock block within soil and the actual bedrock, as the *al-alk* value of the former will deviate considerably from the standard curve.

CONCLUSION

The *al-alk* has proven to be a strong and useful indicator of increasing clay mineral content in general, as well as an indicator of weathering grades, at least for granitic/granodioritic rocks. It is use as an indicator of increasing clay mineral content however is limited to some degree by the possible occurrence of illite, glauconite and/or "persistent" feldspar in the soil profile.

ACKNOWLEDGEMENT

This is a part of IRPA Project 4-07-03-03 "The characterization of weathering profiles in tropical terrains", funded by the Government of Malaysia. We would like to thank the following for their assistance: Salmah Abdul Rashid, Abu Bakar Zainal, Noraini Surip, Shaharin Md. Zain, Jailani Miskam, Abd. Aziz Ngah, Yaakob Othman, Mahani Samad and Md. Sis Maswan.

REFERENCE

ABDUL GHANI RAFEK, IBRAHIM KOMOO & KADDERI MD. DESA, 1991. Survei lapangan profil luluhawa batuan granit. *In* : Zakri A. Hamid *et al.* (Eds.), *Prioriti penyelidikan untuk kemajuan sains dan teknologi.* Penerbit Universiti Kebangsaan Malaysia, Bangi, 552-560.

DEER, W.A., HOWIE, R.A. & ZUSSMAN, J., 1966. *An introduction to the rock forming minerals.* Longman, London, 528 pp.

GOLDICH, S.S., 1938. A study in rock weathering. *Jour. Geology*, **46**, 17-58.

HAMZAH MOHAMAD, 1984. Beberapa trend kimia dan mineralogi batuan endapan dalam batuan metamorf. *Sains Malaysiana*, **13(1)**, 75-91.

HAMZAH MOHAMAD, 1987. Pendekatan mineralogi terbitan dalam kajian profil luluhawa granit kawasan tropika. *Warta Geologi*, **13(2)** (Abstract).

HAMZAH MOHAMAD, KADDERI MD. DESA, IBRAHIM KOMOO, ABDUL GHANI RAFEK & TAN, B.K., 1990. Luluhawa batuan granit: Perlakuan mineral, unsur dan sifat fiziko-kimia. *Prosiding Persidangan Sains Bumi dan Masyarakat*, UKM Bangi, Julai 1990, 292-305.

KADDERI MD. DESA & HAMZAH MOHAMAD, 1991. Mineralogi, geokimia dan fiziko-kimia profil luluhawa batuan granit. *In* Zakri a. Hamid *et al.* (Eds.). *Prioriti penyelidikan untuk kemajuan sains dan teknologi.* Penerbit Universiti Kebangsaan malaysia, Bangi, 531-539.

KARDINAL KUSNAENY, 1973. Profil luluhawa batuan granit. *Sains Malaysiana*, **2(2)**, 105-149.

NIGGLI, P., 1954. *Rocks and mineral deposits.* Freeman, San Fransisco, 559pp.

PEARSON, M.J., 1979. Geochemistry of the Hapworth Carboniferous sediment sequence and origin of the diagenetic iron minerals and concretions. *Geochim. Cosmochim. Acta*, **43**, 927-941.

SENIOR, A., & LEAKE, B.E., 1978. Regional metasomatism and the geochemistry of the Dalradian metasediments of Connemara, Western Ireland. *J. Petrology*, **19**, 585-625.

TAN, B.K., & IBRAHIM KOMOO, 1991. Sifat kejuruteraan bahan tanah dan batuan profil luluhawa granit. *In* Zakri A. Hamid *et al.* (Eds.). *Prioriti penyelidikan untuk kemajuan sains dan teknologi.* Penerbit Universiti Kebangsaan Malaysia, Bangi, 540-547.

* * * * *

Manuscript received 18 May 1991

PERTEMUAN PERSATUAN
Meetings of the Society

Annual Geological Conference '91 — Laporan (Report)

The GSM Annual Geological Conference '91 was held on the 4th & 5th May 1991 at the Holiday Inn, Kuching, Sarawak.

40 papers and 2 posters were presented. In addition there were 2 Pre-Conference fieldtrips and 2 Post-Conference fieldtrips. This is the second time the Society has conducted a programme in Sarawak. The last time was in July 1970.

Despite the distance and the vast South China Sea to negotiate, the Annual Geological Conference '91 attracted a record crowd of near 200 participants. Present to perform the official opening of the Conference the Society was fortunate to have Y.B. Awang Tengah bin Ali Hassan, Menteri Muda Perancangan Sumber Sarawak.

The 40 papers were well received. Dr. N.S. Haile and Prof. C.S. Hutchison sparked off and maintained lively discussions during question time of most papers with their valuable comments reflecting their vast knowledge of the geology of Borneo. For the first time, posters were included in the Conference programme. The 2 posters by Shell proved to be worthy contributions with their excellent, vivid displays. It is hoped that posters will become a regular feature in future GSM Annual Conferences.

For the first time – Pre- and Post-Conference fieldtrips were held. They proved to be popular and informative and generated valuable discussions and interpretations amongst participants from the universities and industry.

Once again members who were familiar with the areas visited contributed immensely during discussions at the various outcrops; they include Dr. Haile, Ho Chee Kwong, Boniface Bait, John Huong, Dr. Lopez-Lopez and James Lau. Most of all Dr. Azahar Hj. Hussin and Victor Hon must be congratulated for so successfully organising the fieldtrips.

Another noteworthy feature of those who went on the fieldtrip to Batu Gading was the aeroplane-designed speedboats which skimed the surface of the waters of Sg. Baram and its tributaries at jet speeds. Of course it ended with a not-to-forget stay at the long house at Long Laput where everyone tasted local food, danced and witnessed the many cultural songs and dances and most of all the friendly and warm Sarawak hospitality. We have Justine Jok Jau to thank for the elaborate evening at his longhouse.

The Annual Geological Conference Dinner was again sponsored by Malaysia Mining Corporation and was held at the Damai Beach Resort. It was a night to remember for some who participated 'live' on stage with the Sarawak Cultural Village dancers.

In making everything possible in Kuching and Sarawak we have to thank the Director of Geological Survey Sarawak, Chen Shick Pei, and his efficient officers Lam Sia Keng, Richard Mani and Justine Jok Jau for their tireless efforts.

Last but not least, I would like to take this opportunity to thank the many organisations and companies that came forward to donate or sponsor the lunches and dinners for the Conference this year, and the many helpers for their excellent cooperation.

G.H. TEH
Organising Chairman

Speech by the Organising Chairman, Dr. Teh Guan Hoe, at the Opening Ceremony, Annual Geological Conference '91, 4 & 5th May 1991, Holiday Inn, Kuching, Sarawak.

Tuan Pengerusi Majlis,

Y.B. Awang Tengah Bin Ali Hassan,
Menteri Muda Perancangan Sumber Sarawak,

Encik Fateh Chand,
Timbalan Ketua Pengarah Jabatan Penyiasatan Kajibumi Malaysia,

Encik Chen Shick Pei,
Pengarah Jabatan Penyiasatan Kajibumi Sarawak,

Y. Bhg. Encik Ahmad Said,
Presiden Persatuan Geologi Malaysia,

Dato'-Dato',

Tuan-Tuan dan Puan-Puan,

Bagi pihak Majlis Persatuan Geologi Malaysia saya mengucapkan terima kasih kerana sudi menghadiri Upacara Pembukaan Persidangan Tahunan Geologi Yang Keenam.

Ladies & Gentlemen,

On behalf of the Council of the Geological Society of Malaysia I would like to thank all of you for sacrificing your morning to attend the opening ceremony of the 6th Annual Geological Conference and the technical sessions that follow.

I would like to thank in particular Y.B. Awang Tengah Bin Ali Hassan, Menteri Muda Perancangan Sumber Sarawak, for so kindly consenting to declare open our Annual Conference here in Kuching, Sarawak this year.

I would also like to record my sincere thanks to the members of the Organising Committee Mr. Ng Tham Fatt and Mr. Khoo Kay Khean and in particular my counterparts in Sarawak Mr. Chen Shick Pei and Mr. Lam Sia Keng for their prompt, reliable and painstaking help.

We planned an ambitious programme this year and I am happy to say that the response to this Conference has been most encouraging, in fact overwhelming. We are filled to the brim with 44 papers and 2 posters for the 2-day Conference. The number of registrants have increased and the Pre-Conference and Post-Conference Fieldtrips have been fully booked and we are sorry we have to turn away others because of restricted places.

My appreciation too to the Dr. Azhar Hj. Hussin for coordinating the fieldtrips and those helping him namely Mr. Victor Hon, Mr. Boniface Bait, Mr. Richard Mani, Mr. Ting Ching Soon and Mr. Chieng Yih Yaw.

With such good support, the Annual Geological Conference series is slowly but surely becoming a **MUST** on the calendar of geoscientists in this region in addition to the Society's highly successful Annual Petroleum Geology Seminars.

Finally in terms of financial support, the Conference is also gaining momentum achieving a new high. I would like to take this opportunity to thank the following organisations for their generous contributions: Malaysia Mining Corporation Berhad, Osborne & Chappel International Sdn. Bhd., Mamut Copper Mining Sdn. Bhd., SGS (Malaysia) Sdn. Bhd., Kalimantan Enterprise Sdn. Bhd., Syarikat Sebangun Sdn. Bhd., Bukit Young Goldmine Sdn. Bhd., Sierra Geophysics, Inc., and Malaysia Airlines.

During the course of the Conference we will be happy too to welcome further contributions.

Thank you.

Welcoming Address by President, Geological Society of Malaysia at the 6th Annual Geological Conference Opening in Kuching

YB Awang Tengah bin Ali Hassan
Menteri Muda Perancang Sumber Sarawak,

Pengerusi, Jawatankuasa Pengelola
Persidangan Tahunan Geologi Yang Ke-Enam,

Tan Sri-Tan Sri, Dato'-Dato',

Tuan-Tuan dan Puan-Puan hadiran sekalian,

Assalammualaikum dan Selamat Pagi.

Bagi pihak Persatuan Geologi Malaysia terlebih dahulu saya mengucapkan setinggi-tinggi ucapan terima kasih kepada YB Awang Tengah bin Ali Hassan, Menteri Perancang Sumber Sarawak, di atas kesudian beliau menerima undangan kami untuk menyampaikan ucapan perasmian, seterusnya merasmikan Persidangan Geologi Tahunan Kali Ke-Enam 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 6th Annual Geological Conference.

We are indeed very honoured to have YB Awang Tengah bin Hassan, Assistant Minister for Resource Planning, Sarawak present here today to grace this occasion which is a significant event for us.

This year's conference is the 6th Annual Conference to be organized by the Society and is one of the 2 major events organized by the Geological Seminar, the other being the Annual Petroleum Geology Conference which is now in its 15th year of running. This year's conference is especially significant as this is the first time it is being organized in Sarawak, which was not only has had a long history of geological exploration but also one of the larger concentration of geologists outside of Kuala Lumpur.

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. The conference always has provided new knowledge on regional and local geology and we are very pleased that this year we have attracted a total of 44 technical papers, covering areas from Perlis to Sabah. The papers will occupy a very full 2 days programme.

Also, in conjunction with the conference, 4 geological fieldtrips have been planned for conference participants, two one-day fieldtrips in the Kuching area on 3rd May, just prior to the conference and another 2 fieldtrips to be held after the conference, one being a 3-day drive from Kuching to Miri to study the regional geology and the other being a 2-day trip to the Batu Gading area.

We would like to extend our gratitude to the fieldtrip leaders and all those involved in organizing these trips, all of which have had a tremendous response and were fully booked weeks ahead. 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.

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. Apart from the 2 main conferences to be organized this year, the Society will also be organizing a one-day workshop on Advances in Petroleum Geochemistry in Malaysia and S.E. Asia to be held on 27th July in Kuala Lumpur.

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 Circum Pacific Energy and Mineral Resources Symposium to be held in November 1992 and the AAPG International Conference to be held in August/September 1994. The Society is sure that these conferences will be a great success especially with your continued support.

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 27 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 540 members.

Apart from upgrading the knowledge of geology in this country, the Society is also always striving to upgrade the professionalism of local geologists, to ensure that they play a significant role in the country's development, especially in the important minerals, energy, engineering geology and groundwater sectors.

We are pleased to note that the draft Registration of Geologist Act is now being finalized and will be forwarded to the Minister of Primary Industries soon. This Act will certainly give further recognition to the important role of geologists and also regulate their activities for the benefit of society.

Ladies and Gentlemen,

On a concluding note, the Society would like to record its appreciation to the Organizing Committee for this Conference led by Dr. Teh Guan Hoe, who also successfully organized last year's conference in Ipoh. The Organizing Committee has again done a wonderful job this year with the great help of the people in Sarawak, especially Encik Chen Shik Pei, Pengarah Jabatan Penyiasatan Kajibumi Malaysia, Sarawak.

The Society is also very grateful to the various sponsors of the luncheon and dinners including Malaysian Mining Corporation who have traditionally hosted the Conference dinner over the past few years, and Bukit Young Goldmine Sdn. Bhd. and Mamut Copper Mining Sdn. Bhd. for hosting luncheons for all participants.

Finally, I would like again to thank all our distinguished guest especially YB Menteri Muda and all participants for all their support and kind attendance this morning.

Thank you.

Dengan ini saya dengan hormatnya menjemput YB Awang Tengah bin Ali Hassan, Menteri Muda Perancang Sumber Sarawak menyampaikan ucapan pembukaan beliau, seterusnya merasmikan Persidangan ini. Di-persilakan ......

Opening Address by Y.B. Awang Tengah Bin Ali Hassan, Assistant Minister of Resource Planning, Sarawak at the Annual Geological Conference 1991 on 4 May 1991 at Holiday Inn, Kuching

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 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 from the universities, government and semi-government bodies and the private sector.

Being in the Sarawak State Ministry of Resource Planning, I can say that I am with the right 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 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 Semenanjung Malaysia, whereas oil and gas have led to the development of the Miri oil town and the Bintulu industrial centre in Sarawak. You, therefore, can be proud of the fact that you 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 have 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.

Sarawak is quite well endowed with minerals. Besides oil and gas which have dominated the economy of Sarawak, other minerals such as coal, gold, silica sand and stone aggregates have also contributed significantly to the economy. With the extensive coal exploration by the Geological Survey of Malaysia and private companies and the opening up of two mines in Merit Pila and Silantek, coal is emerging as one of the important minerals in Sarawak. In 1990, coal production was maintained at about 100,000 tonnes. Silica sand has been an important mineral export in Sarawak since 1976; more than 2 million tonnes have been mined and exported to Japan. The Geological Survey in its evaluation programme for silica sand have identified several deposits in the Lundu-Sematan, Tatau and Bintulu areas. With the opening up of another new mine at Kampung Gelam, near Lundu, production of silica sand is expected to increase significantly. Gold has also been an important revenue earner for Sarawak. To-date, more than 40,550 kg of gold have been mined from the Bau Mining District. With the proposed opening up of more gold mines, and the introduction of new gold extraction technology, and the increased participation in gold exploration by the Geological Survey and other private companies, it is anticipated that gold production will definitely increase in the future.

It is very significant that this conference is being held in Sarawak, since the State has a long history of geological exploration and mineral development activities dated well back into the last century when gold was mined in the Bau area. Our country's petroleum industry also had its birth in Sarawak with the first oil field discovery in Miri in 1910. Although the search for petroleum has moved mostly offshore, we are pleased that PETRONAS is successful in encouraging exploration again in the onshore areas of Sarawak. Currently, 3 onshore blocks have been awarded in Sarawak plus a number of blocks in onshore Sabah. One new onshore oil discovery has already been made in Asam Paya. This is the first onshore discovery in 80 years and we hope that more such discoveries will be made. I am sure that a lot of secrets still lay hidden beneath our land and it is entirely up to the geologists to uncover and tap these hidden wealth.

It is the desire and intention of the Sarawak 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 through import substitution. The mineral deposits such as coal, which are generally situated in the more remote part of Sarawak, 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 of the rural area.

To give further impetus to mineral development, the State Government has funded the airborne geophysical survey project covering 23,000 km^2 of the west Sarawak area which is considered to have the best potentials for minerals. The airborne geophysical data, when made available later this year, will provide additional information which will be very useful in the search and discovery of more mineral deposits.

In order to safeguard the interests of geologists in the country, I have been formed 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 Sarawak, the need of geologic input for urban planning is not difficult to visualize, as most of our urban centres are located in the so-called geologically hazardous areas such as the coastal deltas or river floodplains which are low lying and in large areas underlain by peat and 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 Geologist and the enforcement of the Geologist Act, I hope you will have a proper venue and mandate to work more closely with the planners and engineers to plan and build our society to the best harmony with the environment.

I have just been told that the Geological Society is celebrating its 25th Anniversary this year and I think you have made the right choice to hold this 6th Annual Conference in Kuching to commemorate the Society's anniversary.

I wish you all happy deliberations in your conference and I have the pleasure now to declare the 6th Annual Geological Conference officially open.

Sekian, terima kasih.

PERSIDANGAN TAHUNAN GEOLOGI 1991
ANNUAL GEOLOGICAL CONFERENCE 1991

PERSIDANGAN TAHUNAN GEOLOGI 1991
ANNUAL GEOLOGICAL CONFERENCE 1991

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

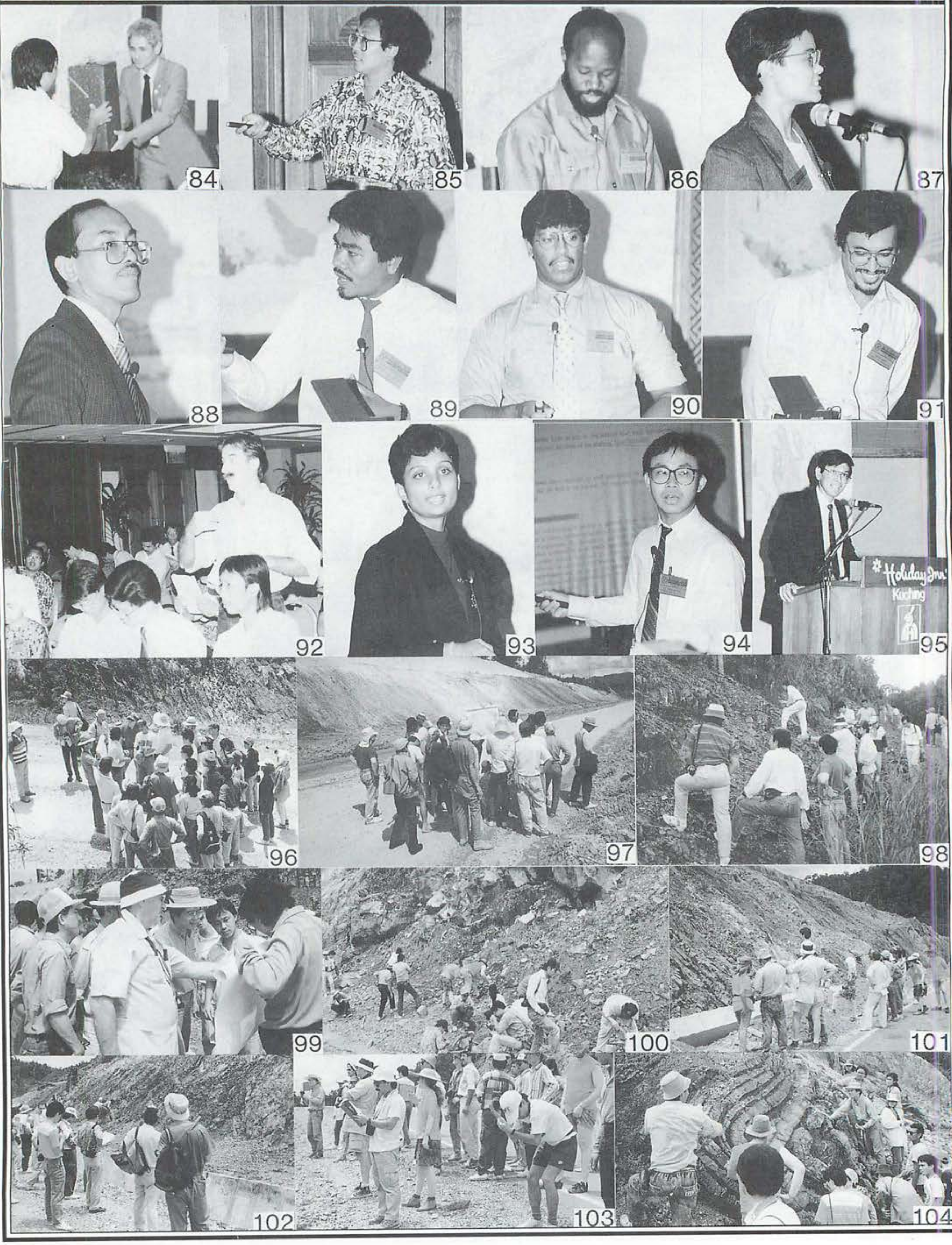
38

39

PERSIDANGAN TAHUNAN GEOLOGI 1991
ANNUAL GEOLOGICAL CONFERENCE 1991

PERSIDANGAN TAHUNAN GEOLOGI 1991
ANNUAL GEOLOGICAL CONFERENCE 1991

PERSIDANGAN TAHUNAN GEOLOGI 1991
ANNUAL GEOLOGICAL CONFERENCE 1991



PERSIDANGAN TAHUNAN GEOLOGI 1991
ANNUAL GEOLOGICAL CONFERENCE 1991


105


106


107


108


109


110


111


112


113


114


115


116


117


118


119


120


121


122

PERSIDANGAN TAHUNAN GEOLOGI 1991
ANNUAL GEOLOGICAL CONFERENCE 1991


123


124


125


126


127


128


129


130


131


132


133


134


135


136

Pre-Conference Economic Geology Fieldtrip

1. Mr. James Lau explaining the mineralisation at Jugan gold ore deposit.
2. At the SW slope of G. Sirenggok studying the granodiorite porphyry stock.
3. A panoramic view of Bau from the SW slopes of G. Sirenggok.
4. Mr. James Lau showing mineralisation at Bukit Young open pit.
5. Looking down at Tai Parit open pit.
6. Mr. James Lau showing the ore body of the Tai Parit deposit.
7. At the ore treatment plant, Bukit Young Gold Mine.
8. GSM President Ahmad Said thanking Mr. James Lau for the lunch hosted by Bukit Young Gold Mine Sdn. Bhd.
9. Lunch at Dewan Suarah Bau.

10-11. Mr. Generosa Revilla explaining the mineralisation at Saburan Gold Mine.

12. Participants collecting samples at old gold mine working at Kusa Mining Sdn. Bhd.

Pre-Conference Kuching-Bau Fieldtrip

13. Participants being briefed by Dr. Azhar Hussin at Serikin Valley.

14-15. At Bukit Kapur looking at Bau Limestone.

16. Dr. Azhar explaining the outcrop at Krokong.
17. Crossing Sg. Bako on the ferry.
18. At Batu Kitang looking at the Pedawan Formation.

'Ice-Breaker' Dinner – Hosted by Syarikat Sebangun Sdn. Bhd.

19-22. There was plenty to eat and talk about at the buffet dinner.

23. GSM President presenting Mr. Tie with momento.
24. The main table at the dinner.

Opening Ceremony

25-26. Arrival of the guest of honour.

27. Organising Chairman, G.H. Teh, with his speech.
28. GSM President, Ahmad Said, with his welcoming address.
29. Y.B. Awang Tengah bin Ali Hassan with the Opening Address.

30. A token of appreciation for the Menteri Muda.
31. The large crowd at the Opening Ceremony.

Technical Sessions

32. N.S. Haile kicking off the Technical Sessions.
33. Ting Ching Soon on the Jagoi-Serikin area.
34. Juhari Mat Akhir on Landsat images.
35. A question from Richard Batoi.
36. Wan Zawawie on the VLF-Resistivity Electromagnetic technique.
37. Hamzah Mohamad on the Dinding Schist protolith.
38. M.B. Munawir receiving his momento from C.S. Hutchison, the Session Chairman.
39. Richard Mani Banda on the geological evolution of Sawarak.
40-41. Discussions during Coffee Break.
42. J. Huong with his Poster on the Baram Delta.
43. J.A. Lopez-Lopez with his Poster on the Miri Anticline.
44-45. Lunch hosted by Bukit Young Goldmine Sdn. Bhd.
46. GSM President Ahmad Said presenting a token of appreciation to Mr. Ling.
47. R.E. Besems receiving his momento from Session Chairman, M.K. Choo.
48. Mohd. Shafeea on Permian brachiopods.
49. Mohamad Ali Hasan on mineral water standard.
50. Robert Tate on the Mulu Shear Zone.
51. Wan Fuad on the schoenfliesite-wickmarite series.
52. Mazlan Madon on the Tenggol Arch.
53. Mustaffa Kamal on the Singa Formation.
54. J.A. Lopez-Lopez with a question.
55. Ahmad Jantan on the Crocker Formation.
56. Khalid Ngah putting forward a comment.
57. Alexander Yan on epithermal gold mineralisation.
58. James Lau pops a question.
59. Felix Tongkul on the tectonic evolution of Sabah.
60. Fateh Chand with a question.
61. Tan Teong Hing on gypsum deposits.
62. Aw Peck Chin asking a question.

Conference Dinner hosted by Malaysia Mining Corporation Sdn. Bhd.

63-66. The participants at the dinner at Damai Beach.
67. GSM President Ahmad Said presenting MMC representative, Albert Loh, with a token of appreciation.
68. Sarawak cultural dance performance.
69-71. Participants trying out the dances.

Technical Sessions

72. Kamal Roslan on the Tembeling Group.
73. Ng Tham Fatt receiving a momento from Session Chairman, C.S. Hutchison.
74. Mohammed Hatta on hydrogeological investigations.
75. Lee Chai Peng on Wang Kelian Redbeds.
76. M.B. Idris on the Lian Cave area.
77. G.H. Teh receiving a momento from Session Chairman, Syed Sheik Almashoor.
78. Zaiton Harun on the Genting Peres fault zone.
79. Ibrahim Abdullah on the Tekai Valley.
80. M.K. Choo with a comment.
81-82. Lunch hosted by Mamut Copper Mining Sdn. Bhd.
83. GSM President presenting Mr. Keith Chan with a token of appreciation.
84. Session Chairman, Herman Soediono, presenting Boniface Bait with a momento.
85. Azhar Hussin on the Pedawan Basin.
86. Sidibe Yaya on the Kuantan Group.
87. D. Rodziah on Triassic limestone.
88. Abd. Rahim Samsudin on magnetic survey.
89. Askury Abd. Kadir on granitoids in Johor.
90. G. Mahendran on the Batu Arang area.
91. Basin Jasin on the Chert-Spilite Formation.
92. J.A. Lopez-Lopez with a comment.
93. Joy Periera with her presentation.
94. Ho Chee Kwong on the Tatau-Belaga Formations.
95. G.H. Teh with the Closing Remarks.

Post Conference Fieldtrip – Kuching-Miri Transect

96. The first stop at Marup Quarry with the Silantek Formation.
97. A new roadcut of the Lupar Formation, Lupar Valley.
98. At Skrang looking at the Layar Member of the Belaga Formation.
99. N.S. Haile indicating the area on the map.
100. Exotic limestone blocks in the Belaga/Tatau Formation.
101. On the Arip-Tatau road, looking at the Belaga Formation.
102-103. Studying the basal member of the Tatau Formation.
104. The tightly folded Bawang Member of the Belaga Formation.
105. Boniface Bait showing the shallow massive shelf deposits of Baun Formation.
106. Studying the fluvial/distributory channel sequence of the Nyalau formation.
107-108. At the tide dominated coastal sequence of Nyalau Formation, Tg. Kidurong.
109. A close look at sedimentary structures, MLNG Gate, Tg. Kidurong.
110. Azhar Hussin showing the structures at Bukit Subis.
111. Examining the coral-algal reef Subis limestones.
112. Studying the Sg. Seman outcrop.
113. Taking notes at the outcrop of the Lambir Formation.

Dinner Hosted by Shell at Lutong

114. The sumptuous buffet dinner.
115. The main table
116. Dr. Roger Birch admiring the token of appreciation.
117-119. Participants at the dinner.

Post Conference Fieldtrip – Batu Gading Area

120. All on board for Batu Gading up the Baram River.
121. No it's not a plane, it is a boat!
122. Studying the Batu Gading limestone from outside the boat.
123. Azhar Hussin briefing participants at Holly Stone Quarry.
124-125. Examining fossils at Bt. Gading.
126. Studying structures at Bt. Bersungai North.
127. The plane-looking boat in Baram River leaving Batu Gading.
128. Arrival at Longhouse at Long Laput.
129. Dinner at the Longhouse local delicacies.
130. A token of appreciation from the Organising Chairman to Justin Jok Jau's father.
131. Justine Jok Jau with the 'ngajat perseorangan'.
132-136. Participants having at go at the 'ngajat'.

PERSIDANGAN TAHUNAN GEOLOGI 1991
ANNUAL GEOLOGICAL CONFERENCE 1991

PROGRAMME

FRIDAY, 3rd May, 1991

08:00 : PRE-CONFERENCE FIELDTRIPS
Bau Goldmining or Kuching–Bau Stratigraphy

12:40 : LUNCH at BUKIT YOUNG GOLDMINE SDN. BHD.

19:30 : 'Ice Breaker' DINNER — Hosted by SYARIKAT SEBANGUN SDN. BHD.

POSTER SESSION

B. CALINE & J. HUONG
New insight into the recent evolution of the Baram Delta from satellite imaging

J. HUONG & J.A. LOPEZ-LOPEZ
The Miri Anticline

SATURDAY, 4th May, 1991

08:00 : Late Registration

08:20 : Arrival of Invited Guests

08:30 : Arrival of YB Menteri Muda Perancangan Sumber, Sarawak

08:40 : Speech by Chairman, Organising Committee

08:45 : Welcoming Address by President, Geological Society of Malaysia

08:55 : Opening Address by Y.B. Awang Tengah bin Ali Hassan,
Menteri Muda Perancangan Sumber, Sarawak

09:10 : COFFEE BREAK

SESSION I

09:40 : N.S. HAILE
Some puzzling questions about the Cretaceous–Cenozoic geology of west Borneo and the South China Sea

10:00 : UMAR HAMZAH, ABDUL RAHIM SAMSUDIN & ABDUL GHANI RAFEK
Preliminary results of geoelectrical survey and water analysis of several hot springs in Peninsular Malaysia

10:20 : TING CHING SOON
Jurassic–Cretaceous palaeogeography of the Jagoi–Serikin area, Bau, Sarawak

10:40 : JUHARI MAT AKHIR
Lineamen-lineamen dalam imej Landsat yang ditingkatkan: satu kajian di kawasan barat laut Semenanjung Malaysia

11:00 : YEAP EE BENG
The mineralogical and petrological factors in the alkali-silica reactions in concrete

11:20 : WAN ZAWAWIE BIN WAN AKIL & DORANI BIN JOHARI
Mapping of coal seams by VLF-Resistivity Electromagnetic Technique in Kupit–Silong area, Merit–Pila caolfield, Sarawak

11:40 : HAMZAH MOHAMAD
Tabii protolitos Syis Dinding: Suatu tafsiran geokimia

12:00 : M.B. MUNAWIR, M.B. IDRIS & N.B. NORAZLAM
Geology of the Rompin–Endau area, Pahang Darul Makmur–Johor Darul Takzim

12:20 : RICHARD MANI BANDA
A review of some concepts on the geological evolution of Sarawak

12:40 : LUNCH — Hosted by BUKIT YOUNG GOLDMINE SDN. BHD.

SESSION II

14:00 : R.E. BESEMS
The role of palynology in the oil industry

14:20 : MOHD. SHAFEEA BIN LEMAN
Brakiopod Perm di utara Hutan Lipur Terenggun, Kuala Lipis, Pahang Darul Makmur

14:40 : MOHAMAD ALI HASSAN
Beberapa komen tentang piawaian (standard) air galian Malaysia

15:00 : KAMALUDIN BIN HASSAN
Quaternary geological investigation at Pulau Kelumpang archaeological site, Perak, Peninsular Malaysia

15:20 : ROBERT B. TATE
The Mulu Shear zone — a major structural feature of NW Borneo

15:40 : COFFEE BREAK

SESSION III

16:10 : MAZLAN HJ MADON
Dolerite and rhyolite in the basement of the Tenggol Arch, offshore Terengganu

16:30 : WAN FUAD WAN HASSAN
A mineral of the schoenfliesite-wickmanite series from Sg. Gau, Pahang

16:50 : MUSTAFFA KAMAL SHUIB
Significance of cleavages in the Singa Formation strata

17:10 : AHMAD JANTAN, LILIANA CYRIL & CHE AZIZ ALI
Depositional model of the Croker Formation sedimentary sequence along Tandek–Samparita Road, Bengkoka Peninsula, Sabah

17:30 : ALEXANDER S.W. YAN
Features of volcanic-hosted epithermal gold mineralization in the Nagos and Mantri areas, Semporna Peninsula, Eastern Sabah

19:00 : BUS RIDE TO DAMAI BEACH

20:00 : DINNER — Hosted by MALAYSIA MINING CORPORATION BHD. at HOLIDAY INN DAMAI BEACH

SUNDAY, 5th May 1991

SESSION IV

08:10 : FELIX TONGKUL
Tectonic evolution of Sabah, Malaysia

08:30 : TAN TEONG HING
Indications of gypsum deposits in Northern Peninsular Malaysia

08:50 : NG THAM FATT
Aplite-pegmatite complexes of the Kuala Lumpur granite, Peninsular Malaysia

09:10 : KAMAL ROSLAN MOHAMED, UYOP SAID, IBRAHIM ABDULLAH, AHMAD JANTAN, ABDUL RAHIM SAMSUDDIN & CHE AZIZ ALI
Stratigrafi batuan Kumpulan Tembeling di Lembah Tekai, Pahang

09:30 : MOHAMMED HATTA ABD. KARIM
Hydrogeological investigation and design of rain water pond with catchment area at Lubok Punggor, Kota Samarahan, Sarawak

09:50 : MAZLAN HJ MADON, KAMALUDIN HASSAN, NOOR AZIM IBRAHIM & ISMAIL IMAN
Quaternary deposits at Pantai Remis, Perak: Preliminary results and significance to tectonics and sea-level changes

10:10 : COFFEE BREAK

SESSION V

10:40 : M.B. IDRIS & A.R.A. MUBIN
Geology of the Lian Cave area, Sabah

11:00 : AHMAD JANTAN, KAMAL ROSLAN MOHAMAD, CHE AZIZ ALI, IBRAHIM ABDULLAH, UYOP SAID & ABD. RAHIM SAMSUDIN
Relationship and depositional setting of the Lanis Conglomerate, Mangkin Sandstone and Termus Shale of the Tembeling Group in Tekai Valley, Pahang

11:20 : G.H. TEH, SHARUL AMIN AHMAD, MOHD. SUHAIMI & ABD. KHALIK HJ. WOOD
Gold and REE distribution patterns in Tasik Cini volcanogenic massive sulphide deposits

11:40 : ZAITON HARUN
Zon sesar di Genting Peras

12:00 : LEE CHAI PENG & AZHAR HJ. HUSSIN
The Wang Kelian Redbeds, a possible extension of the Unnamed Devonian Unit (Rebanggun Beds) into Perlis?

12:20 : LUNCH — hosted by MAMUT COPPER MINING SDN. BHD.

SESSION VI

14:00 : B. BAIT & R. ASUT
Sedimentological and depositional facies changes in the Tatau–Bintulu area

14:20 : IBRAHIM ABDULLAH, KAMAL ROSLAN MOHAMAD, ABDUL RAHIM SAMSUDIN, AHMAD JANTAN & UYOP SAID
Gaya struktur batuan Kumpulan Tembeling di Lembah Tekai, Pahang

14:40 : AZHAR HJ. HUSIN
Large-scale collapses of the late Jurassic–Cretaceous Pedawan Basin margin: Evidence from the Batu Kitang–Siniawan area, Sarawak

15:00 : SIDIBE YAYA TIEMOKO, AHMAD JANTAN & TAN TEONG HING
Lithostratigraphy and sedimentology of Upper Paleozoic Kuantan Group in N.E. Pahang and South Terengganu

15:20 : H. FONTAINE, D. RODZIAH, D. VACHARD & H.P. KHOO
Note on Triassic limestone at Kampung Lambok, west of Kuala Betis, West Kelantan

15:40 : COFFEE BREAK

SESSION VII

16:10 : ABDUL RAHIM SAMSUDIN, IBRAHIM ABDULLAH & KAMAL ROSLAN MOHAMAD
Results of magnetic survey in Tekai Valley, Pahang

16:30 : ASKURY ABD. KADIR
Four isolated granitoid plutons in Johor: An overview on their petrochemistry and genesis

16:50 : G. MAHENDRAN, MUSTAFFA KAMAL SHUIB & J.K. RAJ
The stratigraphy of the Batu Arang area

17:10 : BASIR JASIN
Significance of radiolarian chert from the Chert Spillite Formation, Telupid, Sabah

17:30 : YEAP E.B., TAN B.K., RAYMOND N. YONG, HO C.C., CHOW W.S., ZAABA ISMAIL & DZULKARNAIN KAMARUZZAMAN
Physical and chemical characterization of the slimes in selected Malaysian tin slurry ponds for reclamation purposes

17:50 : HO CHEE KWONG
The Tatau–Belaga Formations of North Central Sarawak: New findings and regional implications

18:10 : CLOSING REMARKS

MONDAY, 6th – WEDNESDAY, 8th May 1991

POST CONFERENCE FIELDTRIP 1

Kuching–Sibu–Bintulu–Miri

THURSDAY, 9th – FRIDAY, 10th May 1991

POST-CONFERENCE FIELDTRIP 2

Batu Gading Area

ABSTRACTS OF PAPERS

POSTER

New insight into the recent evolution of the Baram Delta from setellite imaging

B. CALINE & J. HUONG
Reservoir Geology/Sedimentology Section,
Sarawak Shell Berhad, Lutong

The synoptical effect of remote sensing imaging allows a new vision of active environments of deposition and is now successively applied to the study of modern deltas. Two recent satellite pictures of the Baram River have been interpreted in order to provide a better understanding of the recent evolution of a tropical delta.

The first satellite picture covers the deltaic plain of the Baram River (1:250,000 scale). The upper deltaic plain is characterised by the extensive development of freshwater swamps, mainly covered by peat deposits. The lower deltaic plain is restricted to a narrow fringe of salt-tolerant vegetation which develops on both sides of the distributaries. The abandoned river network can be delineated. Reconstruction of the paleo-meandering belts clearly shows the interconnection between the modern Baram, Belait and Miri Rivers. Major structural features are visible on the satellite image. A continuous flexure line, extending from the Miri Hill to the North East is buried under the lower deltaic plain deposits. A recent active fault sharply delineates the deltaic deposits and the northern flank of the Lambir Hills.

The second satellite picture gives a detailed view of the Baram lower deltaic plain which extends from Kuala Belait in Brunei to Miri in Sarawak (the satellite image was processed at a 1:50,000 scale). The subtle colour variations are related to different vegetation covers and have been used to differentiate between mature (dome-shape) and immature peat deposits. Characteristic arcuate features outline the course of abandoned meandering rivers.

A series of low-altitude aerial photographs illustrates the main sedimentological features associated with the meandering river channel and the river mouth. Oxbow lakes which formed by neck cut-off of the meandering river, locally occur. Sedimentation in the abandoned loops is restricted to suspended matter (silt and mud) introduced into the oxbows during overbank flooding from the main stream. Crevasse splay also occurs along the Baram River. The radial-shape crevasse splay results from the break of a subaerial levee which probably occurred during a combined spring tide and high river discharge period.

The sand belt which develops at the mouth of the Baram River, has an overall semi-circular shape. The preferential growth of the elongated sand bars which form on both sides of the river mouth, indicates a predominant westward to southwestward sand transport direction. Rapid sand deposition along these intertidal levees results in the characteristic pincer-shape river mouth. The subtidal mouth bar is cut by a network of shallow channels. These channels correspond to the extension of the Baram River which rapidly bifurcates due to the energy dispersion occurring at the river mouth. The channels are oriented to the West and South-West, as a result of the regional longshore current direction generated by the northeastern monsoon winds.

Interpretation of the satellite pictures, ^{14}C datation of peat deposits (Esterle, 1990) and complementary aerial survey have been used to prepare five schematic maps which summarise the recent evolution of the Baram deltaic plain.

5,400 years B.P. - The early Holocene sea level rise led to the complete floording of the study area. Following this marine flooding, estuarine deposits formed in the inner bay, south of the Marudi "bottle-neck". These deposits consisted of mangrove clays and elongated sand bars developed in the active fluvial/tidal distributaries.

5,000 years B.P. - The gradual filling of the inner bay resulted in the first peat deposits. Peat accumulation proceeded as the coastline prograded following the stabilisation of mudflats by seawater-tolerant mangrove vegetation. The mangrove and fluvial/tidal channels belt prograded to the outer bay (north of the Marudi "bottle-neck").

4,000 years B.P. - As the longshore currents reworked the Pleistocene sand patches, adjacent to the delta plain, a coastal barrier system gradually closed the outer bay where peat rapidly accumulated. A coastal barrier islands system formed the seaward edge of the delta plain and developed parallel to the structural flexure which extends from the Miri Hill axis to the North-East.

3,000 years B.P. - The progradation of the lower deltaic plain was controlled by the constant sediment supply from the three main distributaries and from the reworking of the relic sand patches. A mangrove belt grows in a series of lagoons limited by the inactive barrier and the new barrier.

2 000 years B.P. - The river network evolved with a predominant, central distributary (Baram River) and two adjacent, secondary distributaries (Miri and Belait Rivers). The abandonment of the meander belt, north of Lambir Hills, is probably related to a moderate uplift/tilting of the area as indicated by the presence of an active fault.

POSTER

The Miri Anticline

J. HUONG & J.A. LOPEZ-LOPEZ
Sedimentology Section
Sarawak Shell Berhad, Lutong

Some puzzling questions about the Cretaceous–Cenozoic geology of west Borneo and the South China Sea

N.S. HAILE
PETRONAS Petroleum Research Institute
54200 Ulu Kelang, Selangor Malaysia

Puzzling features of Borneo geology remain, in spite of the steady advance in detailed knowledge from the efforts of the Geological Survey, Universities, and oil companies. Perhaps a re-examination of some of these can lead the way to a better understanding of the geology, or suggest areas where more work could be fruitful.

The features discussed are:

a) The first order boundary of the Lupar Line. Is this a suture? If so what kind? Has there been strike slip movement along it, and if so, in what sense? How could this be further investigated?

b) Australian-Indonesian mapping in West Kalimantan along the strike continuation of the Lupar Line shows Cretaceous rocks to the north (supposedly on oceanic crust) adjacent to Cretaceous shelf sedimentary rocks on continental crust. What is the nature of this contact?

c) The Serabang Formation in extreme west Sarawak shows similarities to the Lupar Formation and Lubok Antu Melange, but appears to be somewhat older. Is it a fragment of an earlier subduction zone, and, if so, did this extend north to the Natuna Islands?

d) In West Sarawak, the Kayan Sandstone in the Kayan and Penrissen Synclines is believed to be Upper Cretaceous to Paleogene on palynological evidence, although it seems identical lithologically and structurally to the Plateau Sandstone, which is upper Eocene or younger. On the southeast, the Kayan Sandstone overlies Cretaceous Pedawan Formation, apparently conformably, but on the northwest it mainly overlies the Cretaceous Serabang Formation, which is in an entirely different facies. What happens beneath the Kayan Syncline?

e) The Rajang Group is one of the most remarkable, thickest, and problematical piles of turbidites known. There seems to be nothing comparable in Southeast Asia. what was its source? West Borneo, the Sunda Shelf, continental Asia, or a foundered mountainous landmass in the area of the present China Sea Basin?
Was it deposited where it now is, relative to West Borneo, or has it moved a long way?
How deeply was it buried and by what?
How can we visualize the sedimentary regime to explain the younging along strike into Sabah?

f) Are the remarkable strike changes shown by the Rajang Group (e.g. of 90° between the Rajang and Baram headwaters) due to oroclinal bending, and if so, when did this occur?

g) Remarkably, while intensive sedimentation and tectonism was going on in Sabah, at Melinau from late Eocene to early Miocene foraminiferal-algal limestone was accumulating in a shallow sea with only slight interruption. Similarly, in West Sarawak, during the Cretaceous to Miocene, steady stable-shelf marine sedimentation giving way to continental sand deposition, took place only 100 km or so from the deep-water trough where many thousands of metres of turbidites were accumulating, and were being folded and accreted, and where the Lubok Antu Melange was being created.

Probably geologists working in this area on subsurface and outcrop data will have already thrown light on some of these problems in studies yet unpublished. For future progress, reconstruction of **paleogeography** and **sedimentary history** are important. Information on the **probable depth of burial** of the Cretaceous-Paleogene rocks, from **vitrinite reflection** and other studies, could give an indication of the amount of sedimentary cover that has been removed from them by erosion. More geophysical data are needed - such as deep seismic over the shelf, and **gravity surveys** over the Lupar and Serabang Lines, and their offshore extensions. **Paleomagnetic studies** have already given some information about possible rotation of parts of Borneo, and if applied to the Paleogene rocks of the "accretionary prism" may give an indication of the amount of oroclinal bending; the Melinau Limestone at Mulu and Batu Gading could yield significant results.

Preliminary results of geoelectrical survey and water analysis of several hot springs in Peninsular Malaysia

UMAR HAMZAH, ABDUL RAHIM SAMSUDIN & ABDUL GHANI RAFEK
Jabatan Geologi,
Universiti Kebangsaan Malaysia
43600 Bangi

Geoelectrical survey was carried out at 20 locations of hot springs in Peninsular Malaysia together with water sampling for chemical analysis. The behaviour of geoelectrical curves and its relationship with water content and temperature were studied. Values of resistivity were found to be very low ranging from 1 to 100 ohm-meter with an average of about 10-20 ohm-meter. Depth of low resistivity zones were calculated to be between 1-40 meter. The low resistivity is probably due to a high concentration of dissolved salts as the result of high water temperatures (45-95°C) observed in the area. Locations of the hot springs are found to be situated along a zone from North Johor to North Perak close to western boundary of Main Range Granite. The occurrence of the hot springs is probably related to seepage of geothermal waters along weak zones formed by small size faults trending northwest-southeast which are predominant along western zone of the Main Range Granite.

Sebanyak 20 kawasan air panas di Semenanjung Malaysia telah dilawati dan dilakukan pengukuran duga dalam geoelektrik di kawasan sekitarnya. Disamping itu pensampelan air bagi analisis kimia juga telah dibuat. Sifat-sifat lengkung geoelektrik jasad batuan di kawasan ini serta hubungannya dengan kandungan kimia air dan suhu dikaji. Nilai kerintangan zon air panas berkisar dari 1 ohm-meter hingga 100 ohm-meter dengan purata sebesar 10-20 ohm-meter dan kedalaman zon kerintangan rendah itu adalah dari 1-40 meter. Nilai kerintangan yang rendah ini mungkin disebabkan oleh kepekatan kandungan garam-garam terlarut yang disebabkan oleh suhu air yang tinggi (45-95°C). Zon-zon air panas ini terletak di sepanjang satu garisan dari Johor utara ke Perak utara dan hampir selari dengan sempadan barat Granit Banjaran Besar. Ini memberikan satu petanda bahawa ada kemungkinan kewujudan mereka berkait rapat dengan pengeluaran air geoterma di sepanjang rekahan yang dibentuk oleh sesar-sesar kecil yang berarah barat laut-tenggara di sepanjang jalur barat Granit Banjaran Besar.

Jurassic–Cretaceous palaeogeography of the Jagoi - Serikin area, Bau, Sarawak

TING CHING SOON
Department of Geology, University of Malaya
59100 Kuala Lumpur

The Jagoi-Serikin area is underlain by the Early Jurassic Jagoi Granodiorite which is non-conformably overlain by the Bau Limestone Formation (Late Jurassic to Early Cretaceous) and on which the Pedawan Formation (Late Jurassic to Late Cretaceous) overlie conformably. All of them have been intruded by Tertiary diabase dykes.

A reef complex with minor patch reef and mud-mound model is postulated for the Bau Limestone. Mudstone, wackestone and packstone representing the back reef area are mostly distributed in close proximity to the Jagoi Granodiorite. Stromatoporoid-coral-algal boundstone representing ecologic reef with minor packstone are mainly distributed in the centre of embayment and farther out in the slope of the basin.

The Jurassic-Cretaceous palaeogeography of the area is modelled as the margin of a landmass, where Gunung Jagoi and Gunung Kisam act as two promontaries bordered by a fringing reef complex. A rapidly subsiding basin in which the Pedawan Formation was deposited occurred on the basinal side of the fringing reef.

Lineamen-lineamen dalam imej Landsat yang ditingkatkan: satu kajian di kawasan barat laut Semenanjung Malaysia

(Lineaments in enhanced Landsat images: a study from a portion of northwest Peninsular Malaysia)

JUHARI MAT AKHIR
Jabatan Geologi
Universiti Kebangsaan Malaysia
43600 Bangi

Lineamen-lineamen daripada data penderiaan jauh kerap digunakan sebagai petunjuk bagi fitur-fitur dekat permukaan batuan. Di masa lampau, tafsiran lineamen di Malaysia dibuat menggunakan fotograf udara dan imej satelit yang secara umumnya tidak ditingkatkan. Beberapa imej di kawasan barat laut Semenanjung Malaysia telah dihasilkan menggunakan data Landsat MSS yang diproses secara digit bertujuan untuk meningkatkan lagi kenampakan lineamen-lineamen. Peta lineamen berskala 1:250,000 bagi kawasan kajian dipaparkan yang berpunca daripada imej-imej yang diproses.

Lineamen-lineamen yang dipetakan dianalisa dan dibandingkan dengan pola sesar di atas peta geologi yang diterbitkan. Persekaitan yang baik wujud antara lineamen-lineamen dan sesar yang telah dipetakan. Beberapa lineamen baru yang menonjol dan berkemungkinan mewakili sesar juga diperhati dan direkodkan bersama-sama beberapa fitur membulat baru, maka, peta geologi struktur kawasan ini mungkin boleh dikemaskinikan.

Remotely sensed lineaments are often used as indicators of fractures in near-surface rocks. Previous lineament interpretations of Malaysia have used aerial photographs and relatively unenhanced satellite images. New images of part of north west of Malaysia Peninsula have been produced from Landsat MSS data using several digital image processing techniques intended to enhance the visibility of lineaments. Lineament map of the 1:250,000 of the study area is presented that is derived from the processed images.

Mapped lineaments are analyzed and compared to fault patterns on the published geological map. A good correlation, both in terms of direction and location, exists between image lineaments and previously mapped faults. New prominent lineaments which are probably faults were delineated and recorded along with new circular features, thus, updating the structural geologic map of the area.

The mineralogical and petrological factors in the alkali-silica reactions in concrete

YEAP EE BENG
Department of Geology, University of Malaya
59100 Kuala Lumpur

Reactive silicas which can cause Alkali-Silica Reactions (ASR) are opal, SiO_2-rich volcanic glass, chalcedony (or fibrous quartz) and tridymite. Opal is a hydrous cryptocrystalline or colloidal form of silica ($SiO_2.nH_2O$) with a water content of around 6% to 10%. Silica-rich volcanic glass is a component of many young volcanic rocks. Chalcedony is a compact variety of silica composed of minute (crypto- or micro-crystalline) crystals of quartz (SiO_2) enclosing submicroscopic pores. Tridymite is a rare hexagonal high temperature polymorph of quartz with a S.G. of 2.28.

Opaline silica and silica-rich volcanic glass are regarded as the most reactive. Chalcedony, tridymite and some forms of crypto- and microcrystalline quartz occurring in acidic volcanics, chert and flint are regarded as of intermediate reactivity. Strained macrocrystalline quartz can cause ASR but only under certain conditions.

A factor which may influence the reactivity of particular aggregate is the proportion of reactive materials that is present in the aggregates. For a very reactive opaline silica the worst expansion may occur when it is found in the order of 2% to 5% (in the coarse aggregate), that is the pessimum. The pessimum for silica-rich volcanic glass is unknown. In the case of the strained macro-crystalline quartz, the pessimum being 100% that is quartzite containing wholly of strained quartz. The pessium for the intermediate reactive silica is not known, but could well be higher than that of the opaline silica and definitely lower than that of strained quartz.

A multitude of rocks can cause ASR and there are many others which will not. Common rock types often used for aggregates can be grouped into: (i) Inherently reactive (ii) Potentially reactive if pessimum amounts of reactive silicas are present and (iii) Innocous unless impregnated by secondary reactive silica minerals. Fine aggregates can also cause ASR to produce distress in concrete.

A sweeping ban on all volcanic aggregates for use in concrete may give a false sense of confidence for the control of ASR in Singapore. Banning of alkali-rich cement/clinker is a better way of controlling ASR as well as other alkali-aggregate reactions.

Mapping of coal seams by VLF-Resistivity Electromagnetic Technique in Kupit–Silong area, Merit–Pila caolfield, Sarawak

WAN ZAWAWIE BIN WAN AKIL & DORANI BIN JOHARI
Geological Survey of Malaysia, Sarawak
Peti Surat 560, 93712 Kuching, Sarawak

This paper describes the interpretation of VLF-resistivity electormetric survey data as an aid in geological mapping.

The survey has demonstrated that at least four sequences of the Nyalau Formation can be identified on the basis of their distinct resistivity and depth penetration, even though subdued topography and surficial cover reduces bedrock exposure to a minimum. A total of nine coal seams have been successfully located by the survey.

Laporan ini menghuraikan interpretasi data VLF-resistiviti elektromagnetik sebagai bantuan dalam pemetaan geologi.

Survey ini telah mengesahkan sekurang-kurangnya empat jujukan batuan Formasi Nyalau, berdasarkan resistiviti dan kedalaman penembusan, walaupun topografi beralun dan singkapan terhad. Sejumlah sembilan lipit batu arang telah berjaya dikesan melalui survei ini.

Tabii protolitos Syis Dinding: Suatu tafsiran geokimia

(The nature of Dinding Schist protolith: A geochemical interpretation)

HAMZAH MOHAMAD
Jabatan Geologi
Univsiti Kebangsaan Malaysia
43600 Bangi

Syis Dinding (Ordovisi ? - Silur Bawah) yang tersingkap di Ulu Kelang, Selangor, terdiri daripada syis kuarza-mika, syis kuarza dan metakuarzit. Lapisan-lapisan nipis berkapur juga wujud dalam unit psamit dominan ini. Himpunan mineralnya ialah klorit + fengit + kuarza + mikrokin + oksida besi ± zirkon ± turmalin ± albit ± ortoklas ± biotit ± pirit ± apatit ± ilmenit ± rutil. Metamorfisme rantau pada fasies syis hijau ini telah mewujudkan foliasi kuat dan batuan berporfiroblas, terdiri daripada kuarza, mikroklin dan albit bersaiz pasir dan berciri pra-tektonik. Tabii protolitos syis ini kabur dan sukar diramalkan.

Dua puluh tiga sampel Syis Dinding yang segar telah ditentukan kandungan 10 unsur major dan lapan unsur surihnya (S, Cr, Zn, Ga, Rb, Sr, Zr dan Ba). Nilai-nilai nombor Niggli si, al, alk, fm, c, mg, k dan al-alk telah digunakan untuk meramalkan tabii endapan asal, terutaman sekali nisbah mineral lempung terhadap klas menggunakan nilai al-alk. Dengan disokong kajian petrografi, dicadangkan protolitos Syis Dinding ialah endapan berklas pasiran kumpulan wak (wackes), mungkin sejenis wak arkos. Pembandingan dengan komposisi kimia greiwak yang didaptai daripada literatur, termasuk komposisi unsur surih menyokong ramalan ini. Kajian seperti ini dijangka berguna apabila maklumat tabii protolitos batuan metamorf rantau bergred rendah hingga sederhana diperlukan bagi tujuan pemetaan geologi dan penafsiran sekitaran pengenapan, misalnya bagi kes formasi Bukit Kenny dan Syis Taku.

Geology of the Rompin-Endau area, Pahang Darul Makmur–Johor Darul Takzim

M.B. MUNAWIR[1], M.B. IDRIS[2] & N.B. NORAZLAM[2]
[1]Department of Geology, University of Malaya, 59100 Kuala Lumpur
[2]Sarawak Shell Berhad, Lutong, Miri Sarawak

Three main rock types are found in the Rompin-Endau area. These are volcanics, igneous intrusives and sedimentary sequences. Metamorphic rocks occur only at Gunung Lesong. The volcanic rocks are referred to as the Jasin volcanics and represent the oldest rocks of the area, probably of Mid-Permian to Triassic age. Some of these rhyolites are also mylonitised. A granite batholith found on the western flank of the area can be termed a biotite-adamellite granite. This granite pluton which has intruded the volcanic rocks, is similar to those found in other parts of the Ulu Endau area and has been dated to be of Late Triassic Age.

On the eastern plateau, sedimentary sequences of sandstone, shale, siltstone and mudstone overly the volcanics. A similar sequence of sediment is seen capping the granite hill 1448 on the western side, forming a mesa. These sediments are referred to as the Tebak Formation which is of continental origin and exhibits subhorizontal dips. Plant fossils were recorded from light grey mudstone beds in the tributaries of Sungai Telentang, and a boulder of silicified wood was found in Sungai Anak Seladang on the western flank of Sungai Kinchin. The plant fossil has been identified as *Frenelopsis malaine* Ko'ono, which is a foliage of a conifer plant, giving an age of Upper Jurassic - Lower Cretaceous. The silicified wood is also that of a conifer plant *Araucarioxylon telentangensis* Idris with a minimum age Late Triassic. A major fault trending 345-350° runs along Sungai Kinchin.

A review of some concepts on the geological evolution of Sarawak

RICHARD MANI BANDA
Geological Survey of Malaysia, Sarawak
Peti Surat 560, 93712 Kuching, Sarawak

The geology of Sarawak is recognised as belonging to two main provinces namely: West Sarawak and Central-North Sarawak. West Sarawak forms part of the West Borneo Basement, consisting of Paleozoic and Mesozoic rocks. Central-North Sarawak is geologically, younger and forms part of the so-called "Northwest Borneo Geosyncline".

Syntheses of the geotectonics of Sarawak have changed with time. In the early 1960's, the geosynclinal model was used; in the 1970's plate tectonic models were preferred in explaining the tectonic setting of Sarawak. Haile's geosynclinal and Hutchison's plate tectonic concepts are discussed and a new tectonic model proposed in this review. The proposed model is a combination of the plate tectonic models proposed by earlier workers. It is suggested that the Lupar Line and the Mersing Line mark the subduction zones of the South China Sea plate under the continental plate as a result of the opening of the South China Sea and the anti-clockwise rotation of Borneo.

The role of palynology in the oil industry

R.E. BESEMS
Sarawak Shell Berhad
Lutong, Miri, Sarawak

Palynology is the study of the acid-resistant organic fraction in sedimentary rocks, which includes terrestial pollens and spores, marine microplanktons (dinoflagellates and acritarchs), algae and organic debris (woody material and bacterially transformed organic matter). It is a tool which has been used in the oil industry since the late thirties. In the early days, palynology was purely used as a dating tool. The main objective was to provide a biostratigraphic framework for well to well correlations. The emphasis in these palynological studies was focussed on the qualitative/quantative analysis of morphological recognizable palynomorphs.

In the following decades up to the present day, the provision of a sound biostratigraphic framework remained one of the main tasks of a palynologist working in the oil industry. However, due to the vast amount of scientific research, often spin-offs from the oil industry, the contribution to palynology became more diversified. Currently, palynofacies analysis enable the recognition of depositional environments which can be used both in exploration and production of hydrocarbons. Other useful applications of palynology are the assessment of the organic maturity and the evaluation of source rock potential and properties of sedimentary deposits.

Brakiopod Perm di utara Hutan Lipur Terenggun, Kuala Lipis, Pahang Darul Makmur

(Permian brachiopods in north Hutan Lipur Terenggun, Kuala Lipis, Pahang Darul Makmur)

MOHD. SHAFEEA BIN LEMAN
Jabatan Geologi
Universiti Kebangsaan Malaysia
43600 bangi

Enapan volkanoklastik merah di Hutan Lipur Terenggun telah ditafsirkan di masa lepas sebagai dasar kepada batuan sedimen Kumpulan Lipis. Penemuan fosil dalam jujukan syal-batulumpur bertuf yang menindih selaras enapan volaknoklastik yang serupa di utara empangan Terenggun menunjukkan bahawa enapan merah ini adalah berusia Perm Atas. Fauna yang ditemui mengandungi *Leptodus tennuis, Leptodus catenata, Oldhamina* sp, *Retimarginifera lipisensis, ?Dictyoclostus gratiosus, Uncinunellina timorensis* dan *Spiriferellina* sp. Fauna brakiopod ini merupakan lanjutan Syal *Leptodus* Formasi Gua Musang yang tersebar luas di baratluat Pahang dan selatan Kelantan.

The red volcanoclastic sediment at Hutan Lipur Terenggun has been interpreted in the past as the base of the Triassic sediment of Lipis Group. Fossils discovery within the tuffaceous shale-mudstone immediately overlying similar volcanoclastic sediment north of Terenggun dam shows that the red sediment are Upper Permian in age. The fauna found include *Leptodus tennuis, Leptodus catenata, Oldhamina* sp, *Retimarginifera lipisensis, ?Dictyoclostus gratiosus, Uncinunellina timorensis* and *Spiriferellian* sp. These brachiopod faunas are the extension of the *Leptodus* Shale of Gua Musang Formation which is widespread in the northwest of Pahang and south of Kelantan.

Beberapa komen tentang piawaian (standard) air galian Malaysia

MOHAMAD ALI HASSAN
Jabatan Geologi, Universiti Malays
59100 Kuala Lumpur

Draf Peraturan bagi 'Natural Mineral Water' dan draf Peraturan bagi 'Bottled Drinking Water' telah disediakan oleh Jawatankuasa Kecil Mendraf Peraturan Makanan pada Disember 1990, yang dilantik oleh pihak Kementerian Kesihatan Malaysia. Draf-draf tersebut disediakan setelah peraturan 359. Peraturan-peraturan Makanan 1985 dimansuhkan untuk dikaji semula. Pandangan pihak pengeluar air galian (mineral) telah diambilkira didalam draf tersebut, disamping Peraturan berasaskan CODEX standard for Natural Mineral

Waters (European Regional Standard) dan Malaysian Standard bagi Air di bawah Peraturan-peraturan Makanan 1985. Draf peraturan bagi 'bottled drinking water' didraf berasaskan cadangan pihak pengeluar air galian dan juga standard bagi air di bawah Peraturan-peraturan Makanan 1985. Di antara piawaian yang penting di bawah draf-draf peraturan tersebut ialah punca air, kandungan elemen (termasuk mineral), kandungan kontaminan, piawai mikrobiologi dan pelabelan.

Pembentangan kertas kerja ini akan menumpu kepada draf peraturan bagi 'Natural Mineral Water' untuk Malaysia sahaja dalam konteks persekitaran dan pengalaman keadaan negara ini. Tumpuan akan diberikan antara lain kepada (i) Definasi natural mineral water, (ii) Punca 'natural mineral water terutamanya adalah kritikal mengawal kesahihan punca berkenaan dari segi kedalaman telaga atau strata tanah atau lain-lain aspek, (iii) Jadual ke 26 draf peraturan berkenaan dari segi kesesuaiannya dalam mengawal natural mineral water tempatan, (iv) Syor ke arah mengadakan 'standard' (piawaian) air galian Malaysia, dan (v) Beberapa maklumat muktahir kajian penulis tentang air galian Malaysia.

Adalah diharapkan dengan pembentangan kertas kerja ini, akan tersebar luas maklum balas serta perbincangan pihak ahli-ahli geologi ke arah bekerjasama menghasilkan air galian Malaysia yang dapat di percayai dan diyakini.

Quaternary geological investigation at Pulau Kelumpang archaeological site, Perak, Peninsular Malaysia

KAMALUDIN BIN HASSAN
Jabatan Kajibumi Malaysia
P.O. Box 1015, 30820 Ipoh, Malaysia

Pulau Kelumpang prehistoric settlements form seven elongated dry land sites elevated slightly higher than the generally wet and sloppy mangrove surroundings. The investigations basically differentiate eight types of deposits classified into natural sediments, disturbed natural sediments and deposits accumulated mainly due to human activities. Marine clay characterises the basal sediments at all the sites. Cockles *(Anadara granosa)* had formed the most popular food of the inhabitants, as indicated by the common occurrences of shells throughout the deposits.

The physiography of the coasts and physical setting of the settlements indicate that the latter had evolved on the banks and shores of the Selinsing River mouth and estuary. Presently the Selinsing River mouth and estuary had respectively shifted and prograded way off the located settlements. The radiocarbon dates show that the settlements had existed since 2000 BP.

GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATIONS

BULLETIN OF THE GEOLOGICAL SOCIETY OF MALAYSIA

WARTA GEOLOGI - NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MALAYSIA

ADVERTISING SPACE ORDER FORM

	WARTA GEOLOGI Format: 20 cm X 28 cm		BULLETIN Format: 18 cm X 25 cm	
RATES:	**Black & White**	**Colour**	**Black & White**	**Colour**
Inside full page per issue	M$300	M$600	M$1000	M$1500
Inside half page per issue	M$200	M$500	M$500	M$800
Inside full page for 6 issues	M$1500	M$3000	-	-
Inside half page for 6 issues	M$1000	M$2500	-	-

Artwork and positive films or slides (for colour or black & white) should be supplied by the advertiser.

Please send the completed form below together with remittance payable to "Geological Society of Malaysia' to

The Editor,
Geological Society of Malaysia
c/o Dept. of Geology,
University of Malaya,
59100 Kuala Lumpur, Malaysia.

For further information, please ring 03-7577036.

The Editor,
Geological Society of Malaysia,
c/o Dept. of Geology,
University of Malaya,
59100 Kuala Lumpur.

We would like to take up advertising space in WARTA GEOLOGI/BULLETIN in the form (please tick as appropriate):

	WARTA GEOLOGI		BULLETIN	
	Black & White	**Colour**	**Black & White**	**Colour**
Inside full page	one issue ☐ six issues ☐	one issue ☐ six issues ☐	one issue ☐ issues ☐	one issue ☐ issues ☐
Inside half page	one issue ☐ six issues ☐	one issue ☐ six issues ☐	one issue ☐ issues ☐	one issue ☐ issues ☐

Artwork/Positive film/slide* enclosed ☐ not enclosed ☐

Company ....

Address ....

....

Enclosed cheque/money order/bank draft* .... for M$ ....

Person to be contacted .... Tel ....

Designation .... Signature ....

* Please delete as appropriate

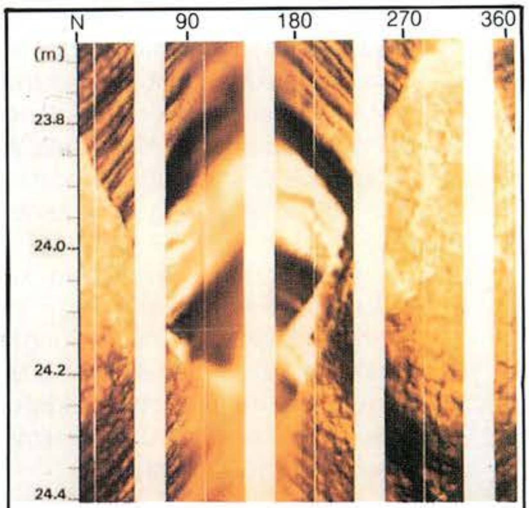
Fullbore Micro Imager*

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.

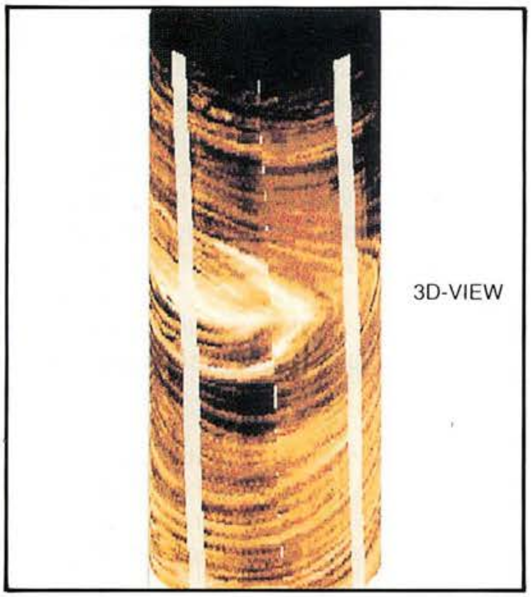
The FMI log, in conductive muds, provides electrical images almost insensitive to borehole conditions and offers quantitative information, in particular for analysis of fractures.

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.

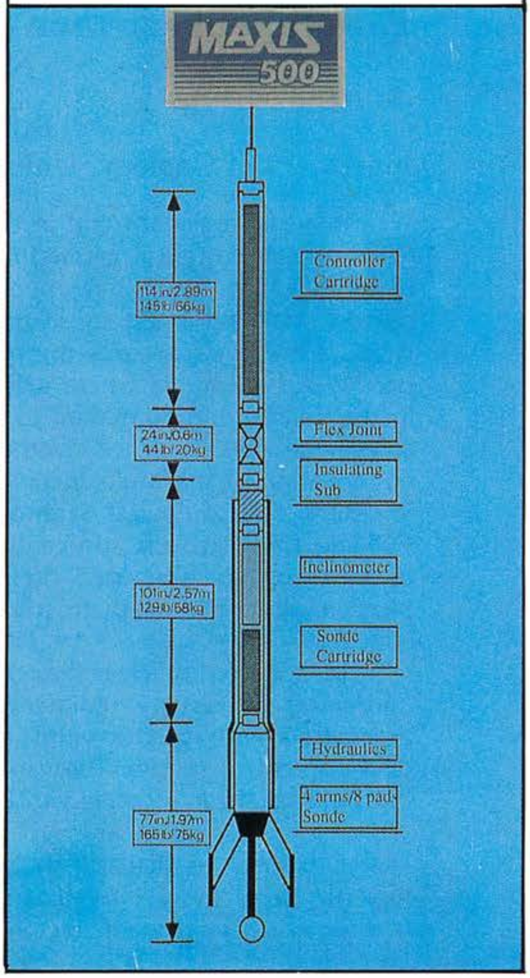
The tool's multiple logging modes allow wellsite customization of results to satisfy client needs without compromising efficiency.



Fault without associated drag



"Bullseye" structure



Schlumberger

Tujuh penempatan pra sejarah didapati di Pulau Kelumpang dimana rupa bentuk yang membujur panjang adalah di tunjukkan dan mempunyai keadaan tanah kering dan lebih tinggi jika dibandingkan dengan kawasan persekitaran paya bakau yang lembab dan lembik. Dari kajian yang telah dijalankan lapan jenis longgokan dapat dibezakan dimana ianya boleh diklaskan kepada sedimen asal, sedimen asal yang diganggu dan longgokan disebabkan oleh aktiviti manusia. Lempung marin adalah sedimen dasar didapati dikesemua tempat. Kerang *(Anadara granosa)* adalah makanan popular dimana ianya ditunjukkan oleh kulit-kulit kerang yang tersebar luas diseluruh longgokan.

Fisiografi kawasan dan kedudukan fisikal penempatan menunjukkan kawasan-kawasan penempatan ini telah berkembang di tebing dan prsekitaran pantai di kuala dan muara Sungai Selinsing. Dimasa ini muara S. Selinsing telah beralih manakala persekitaran Kuala Selinsing telah mengalami proses penokokan dan telah menyebabkan kedudukan sekarang yang berbeza. Tentumur radiokarbon menunjukkan petempatan telah berlaku sejak 2000 BP (2000 tahun sebelum 1950 Masehi).

The Mulu Shear zone — a major structural feature of NW Borneo

ROBERT B. TATE
Department of Geology, University of Malaya, 59100 Kuala Lumpur

A major regional trend in the geomorphology, geology and hydrocarbon fields of NW Borneo is aligned NE-SW and parallel to the Mulu shear zone, a tectonic feature which has imposed a cleavage only on the lower part of the massive Melinau Limestone in north Sarawak. The cleavage dies out at higher stratigraphy levels towards the northwest. The Mulu shear zone can be traced northwards to Brunei where it forms a narrow belt of intensely sheared rocks in the Temburong Formation as well as causing overconsolidation in younger, softer sediments. Evidence of other shear zones which are possibly the displaced continuation of the Mulu shear zone or major shear zones parallel to it, occur in central and southwest Sarawak between Miri and Bintulu, in the Tatau and Kuching areas. In west and central Sabah, NE-trending faults are prevalent and at least one fault between circular sedimentary basins has associated dioritic plugs, indicating a deep structural weakness.

In addition to cleavage, other manifestations of the shear zone are a hardening of Tertiary sediments which spall on exposure, ptgymatic folds associated with quartz veins and the imposition of schistosity with the development of sericite. The various manifestations probably represent differing reactions to shear according to depth.

Offshore, particularly in Sabah, seismic sections across the main NE regional trend show splayed fault patterns which converge at depth to what is assumed to be a major tectonic fracture zone in basement.

Fault systems in Indonesian Kalimantan also are examined to determine the extent of NE-trending transcurrent movement. Age relationships and genetic connotations of the Mulu Shear Zone and its associated structures are discussed. It seems probable that a remnant transform system underlies northwest Borneo.

Dolerite and rhyolite in the basement of the Tenggol Arch, offshore Terengganu

MAZLAN HJ MADON
PETRONAS Petroleum Research Institute
54200 Ulu Kelang

This paper describes basement rocks of the Tenggol Arch penetrated at Malong 5G-17.2 well, 150 km off the east coast of Terengganu.

The rocks consist of highly fractured porphyritic rhyolite in sharp vertical contact with dolerite, suggesting that the dolerite is a dyke that has intruded into the rhyolite. The dolerite intrusion is possibly related to the late Cretaceous or Cenozoic basic igneous rocks that occur on land in Peninsular Malaysia.

A mineral of the schoenfliesite-wickmanite series from Sg. Gau, Pahang

WAN FUAD WAN HASSAN
Jabatan Geologi
Universiti Kebangsaan Malaysia
43600 Bangi

A mineral of the schoenfliesite - wickmanite series found in an abandoned, skarn-type tin mine in Sg. Gau, Pahang, is described.

This mineral is essentially composed of SnO_2 (48.15-54.51%) and FeO (24.46-28.85%) and very little (less than 1%) of other metallic elements, is an iron-rich member of the series.

Significance of cleavages in the Singa Formation strata

MUSTAFFA KAMAL SHUIB
Department of Geology, University of Malaya
59100 Kuala Lumpur

Penecontemporaneous folds, lineations, foliations and other related structures are common in the Singa Formation strata of south-western Langkawi Islands. Some of the slump folds show axial planar cleavages defined by:

1) stringers of sand-silt domains parallel to the axial planes of slump folds.

2) parallel alignments of inequant grains especially phyllosilicates. The cleavages are believed to have developed during slumping. Folding during slumping could have resulted in compaction and rapid expulsion of water which expedite the rotation of inequant grains and the disruption of the sand-silt laminae giving rise to the development of the axial planar primary foliations.

Superimposed on the primary foliations and the slump folds are two sets of cleavages. The first set of cleavages commonly occur as crenulation cleavages but where they are well developed they occur as slaty cleavage. These cleavages (S1) make low angles with bedding. The other set (S2) occur entirely as crenulation cleavages. They are generally weakly developed and occur at the hinges of minor folds and make higher angles with bedding.

From these observations it is concluded that the Singa Formation strata have undergone an early phase of soft-sediment deformation as a result of downslope gravity driven slumping and two phases of tectonic deformations. The soft-sediment deformational structures in places were well developed and may resemble those of tectonic origin and may be mistaken for tectonic structures. Failure to recognise them in strata that have undergone multiple deformations like the Singa Formation may lead to the interpretation of a more complicated history of deformation than it should be.

Depositional model of the Croker Formation sedimentary sequence along Tandek–Samparita Road, Bengkoka Peninsula, Sabah

AHMAD JANTAN, LILIANA CYRIL & CHE AZIZ ALI
Department of Geology, Universiti Kebangsaan Malaysia
43600 Bangi

Road cut sections along Tandek-Samparita road, Bengkoka Peninsula, Sabah, exhibit typical complex abyssal plain to submarine fan sequence consisting of repeated cycles of varied styles and thicknesses of thickening and coarsening upward sequence, beginning ideally from mudstone, mudstone-dominant interbedded mudstone and sandstone, equally dominant interbedded mudstone and sandstone, sandstone-dominant interbedded sandstone and mudstone, thick sandstone with mudstone intercalations, and stacked-up channelised sandstone, representing minor lobe progradation, major lobe progradation with channels, fan complex progradation with overlapping channels, and slope apron coalescence and stacking-up.

Interlobe and interfan complex mudstone cut by extended minor lobe channel will also be demonstrated.

Features of volcanic-hosted epithermal gold mineralization in the Nagos and Mantri areas, Semporna Peninsula, Eastern Sabah

ALEXANDER S.W. YAN
Jabatan Kajibumi Malaysia
Kota Kinabalu, Sabah

Two small gold prospects, showing features of epithermal type of mineralization were delineated by a joint-venture company while prospecting under license in the Sempoma area, South-eastern Sabah. The features which are indicative of epithermal mineralization include hydrothermal alteration from propylitic to advanced argillic alteration, silicification, veining, hydraulic brecciation and ore textures.

The two prospects which is only 40 km apart are however classified as belonging to two distinct type of epithermal mineralization. The Nagos prospect belongs to the high sulphur or acid-sulphate type, whereas the Mantri prospect belongs to the low sulphur or adularia-sericite type.

Tectonic evolution of Sabah, Malaysia

FELIX TONGKUL
Earth Science Department,
Universiti Kebangsaan Malaysia, Sabah Campus,
Locked bag No. 62, 88996 Kota Kinabalu, Sabah, Malaysia

Southeastward subduction of an oceanic lithosphere in front of the rifted continental block of southern China under an emergent oceanic basement in the eastern part of Sabah controlled the development of an elongate basin trending NE-SW. This basin became the site for the deposition of middle Eocene - early Miocene sediments.

Active opening of the South China Sea basin in NW-SE and N-S directions during the middle Oligocene - middle Miocene caused further subduction and narrowing of the basin. As a result the middle Eocene - early Miocene sediments were compressed into a fold-thrust belt trending approximately NE-SW in the western part of Sabah and NW-SE in the northern and eastern part of Sabah. The subduction was accompanied by volcanic activity in the eastern part of Sabah during the early-middle Miocene.

The deformed sedimentary pile and underlying oceanic basement were then subjected to a NW-SE extension related to the opening of the Sulu Sea basin during the early-middle Miocene. This resulted in the development of extensive chaotic deposits in the eastern and central part of Sabah. This extension also controlled the development of several circular basins for the deposition of the thick, early-late Miocene sediments. Continued extension in this region resulted in further southeastward subduction in southeastern Sabah producing the late Miocene-Quaternary volcanics.

Indications of gypsum deposits in Northern Peninsular Malaysia

TAN TEONG HING
Department of Geology, Universiti Kebangsaan Malaysia
43600 Bangi

Gypsum and other evaporite deposits have not been reported in Malaysia. Gypsum ($CaSO_4.2H_2O$) has been mined elsewhere for use in the construction industry (eg. plasters, wallboards, roof tiles), cement industry (as clinkers mixed with shale and limestone) and paper industry (as fillers).

The gypsum deposits in Kedah/Perlis area occur as thin lenses interbedded with shale and mudstone in the upper section of the Kubang Pasu Formation. The economic potential of the deposits have yet to be fully evaluated, but nevertheless its presence suggests that the paleoclimate during the deposition of the upper Kubang Pasu Formation (in Permian time) was arid to tropical.

Hydrochemical methods can be used to target gypsum deposits. Well waters in the vicinity of gypsum deposits have anomalous concentrations of Ca^{+2} and SO_4^{-2}.

Aplite-pegmatite complexes of the Kuala Lumpur granite, Peninsular Malaysia

NG THAM FATT
Institute for Advanced Studies
University of Malaya, 59100 Kuala Lumpur

The Kuala Lumpur Granite is cut by widespread late magmatic aplite-pegmatite complexes. The aplite-pegmatite complexes occur as gently to moderately dipping and weakly curved composite sill-like bodies. They display prominent grain size layering defined by altemating layers of pegmatite and aplite. Mineral zoning is conspicuous in the pegmatites. The aplites commonly exhibit a fine scale, 5 to 100 mm thick, internal rhythmic layering. The rhythmic layering is defined by modal differences in tourmaline, muscovite, quartz and feldspars.

The aplite-pegmatite complexes are formed by multiple injection of volatile-rick granitic magma, each injection is initially homogenous and subsequently segregated into pegmatite and aplite. The rhythmic layering of the aplite is originated from *in-situ* local fractionation of granitic magma. Volatile pressures played an important role in the development of rhythmic layering.

Stratigrafi batuan Kumpulan Tembeling di Lembah Tekai, Pahang

KAMAL ROSLAN MOHAMED, UYOP SAID, IBRAHIM ABDULLAH, AHMAD JANTAN, ABDUL RAHIM SAMSUDDIN & CHE AZIZ ALI
Jabatan Geologi
Universiti Kebangsaan Malaysia
43600 Bangi

Satu kajian geologi telah dilakukan di Lembah Tekai, Pahang untuk menentukan stratigrafi, sedimentologi dan struktur batuan yang terdapat di sini. Keseluruhan batu Jura-Kapur yang di kaji di sepanjang Sungai Tekai ini adalah termasuk dalam Kumpulan Tembeling.

Khoo (1977) membahagikan Kumpulan Tembeling kepada empat formasi iaitu dari muda ke tua sebagai; Lapisan Merah Termus, Batu Pasir Mangkin, Konglomerat Lanis dan Formasi Kerum. Harbury *et al.* (1990) telah mengeluarkan Formasi Kerum dari Kumpulan Tembeling dan tinggal tiga formasi sahaja dalam Kumpulan Tembeling, iaitu dikenali oleh beliau sebagai Syal Termus, Batu Pasir Mangkin dan Konglomerat Lanis. Ketiga-tiga formasi ini adalah terletak selaras di antara satu sama lain, dan beliau masih lagi mengekalkan Formasi Kerum selaras di bawah Kumpulan Tembeling.

Dalam kajian yang dilakukan di sepanjang Sungai Tekai dan juga di beberapa batang jalan balak yang terdapat di kawasan ini, kesimpulan yang dapat dibuat ialah Formasi Kerum yang terdiri daripada batuan volkaniklastik merupakan sebahagian daripada Formasi Semantan dan Kumpulan Tembeling terdiri daripada tiga formasi, iaitu Konglomerat Lanis, Batu Pasir Mangking dan Syal Termus (susunan dari tua ke muda). Dari tafsiran hubungan antara fasies dan geologi struktur, didapati ketiga-tiga formasi ini adalah saling menjejari antara satu sama lain dan bukannya selaras secara mutlak. Ini bermakna, pemendapan ketiga-tiga formasi ini berlaku serentak pada masa Jura-Kapur di sekitaran pengendapan yang bersebelahan. Kumpulan Tembeling terletak secara selaras di atas Formasi Semantan.

Hydrogeological investigation and design of rain water pond with catchment area at Lubok Punggor, Kota Samarahan, Sarawak

MOHAMMED HATTA ABD. KARIM
Geological Survey of Malaysia,
Sarawak

A few investigations were undertaken to overcome the acute water shortage for daily consumption in Lubok Punggor especially during the dry season. From the investigations, it is considered that the most appropriate source of water is rain water which can be stored in ponds.

This paper illustrates the approach that was used to choose the most suitable site for the ponds with a catchment area, the method to obtain the hydraulic conductivity of the soil for water balance analysis and the optimum size of the catchment area and pond for the village concerned.

Memandangkan masaalah air kegunaan harian yang ketara di Lubok Punggor lebih-lebih lagi di musim kemarau, maka beberapa kajian telah dijalankan untuk mengatasinya. Dari kajian-kajian tersebut dapat dirumuskan bahawa punca air yang sesuai untuk Kampung Lubok Punggor adalah dari air hujan yang ditakong di dalam kolam.

Kertas ini membentangkan cara pendekatan yang digunakan dalam pemilihan tapak kolam dan kawasan tadahan yang sesuai, cara memperolehi nilai ketelapan untuk analisa perseimbangan air dan luas optima kawasan tadahan dan kolam yang dicadangkan untuk kampung yang berkenaan.

Quaternary deposits at Pantai Remis, Perak: Preliminary results and significance to tectonics and sea-level changes

MAZLAN HJ MADON[1], KAMALUDIN HASSAN[2], NOOR AZIM IBRAHIM[1] & ISMAIL IMAN[2]
[1]PETRONAS Petroleum Research Institute, 54200 Ulu Kelang
[2]Geological Survey Department, Jln Scrivenor, 30820 Ipoh

A 20 m-thick Quaternary sequence is exposed at the Pantai Tin Mine, near Pantai Remis, Perak. The sequence consists of two lithostratigraphic units:

1) a **lower unit** (≈ 17 m thick) of alternating fining-upward sand and peat layers. This unit is interpreted as nonmarine to brackish fluvial and peat-swamp deposits.

2) an **upper unit** (≈ 3 m) of shelly gravelly sand overlain by mud, interpreted as nearshore-marine deposits.

The contact between the **lower** and **upper** units, at 1.5 m below present sea-level, is marked by an irregular unconformity surface underlain by an indurated humic sandstone with root casts, identified as a paleosol. Large oysters found in living position on this surface suggest that the unconformity is in part a marine hardground.

Preliminary results of radiocarbon dating indicate that the **lower unit** is no younger than 50000 yrs. Based on published records of Quaternary sea-levels, the undoubtedly marine **upper unit** cannot be older than 6-7000 yrs when the Holocene sea-level had risen to within 2 m below present level. The hardground and paleosol therefore represent a significant hiatus of at least 40000 yrs in the Pleistocene sedimentary record, probably due to removal of part of the sequence as a result of uplift of the area during the late Pleistocene. The top of the **upper unit**, at 1 m above present sea-level, may be interpreted as evidence for a higher sea-level in the Holocene. Our data suggest that tectonics may have influenced sea-level changes during the Quaternary, and should be considered when interpreting ancient sea-level changes.

Geology of the Lian Cave area, Sabah

M.B. IDRIS & A.R.A. MUBIN
Sarawak Shell Berhad,Lutong, Miri, Sarawak

The Lian Cave lies in the Crocker Range on the northwestern part of the Keningau Plain in interior Sabah. It occurs within a limestone body embedded in a marine clastic sequence. A few larger limestone blocks were discovered on the western ridge of the adjacent river in the area. No cavern system were developed in these blocks.

Stratigraphically, these occurrences are assigned to the topmost part of the Crocker Formation. The limestones are essentially carbonate build-ups and they indicate protected and back-reef environments. A diverse fossil assemblage that consists of forams, algae, echnoids and bivalves are present in the limestones. They suggest a late Eocene age. The marine clastic sequence, generally exhibit typical deeper marine medial-distal turbiditic features. However, possible shallower marine indications just below the limestones are observed.

The possible origins of these limestones will be discussed.

Relationship and depositional setting of the Lanis Conglomerate, Mangkin Sandstone and Termus Shale of the Tembeling Group in Tekai Valley, Pahang

AHMAD JANTAN, KAMAL ROSLAN MOHAMAD, CHE AZIZ ALI, IBRAHIM ABDULLAH, UYOP SAID & ABD. RAHIM SAMSUDIN
Department of Geology
Universiti Kebangsaan Malaysia
46300 Bangi

The Tembeling Group in Tekai Valley, Pahang, now considered to be made up of only three formations, consists of conglomerate-dominant Lanis Conglomerate, sandstone-dominant Mangkin Sandstone, and mudstone-dominant Termus Shale.

The Lanis Conglomerate consists dominantly of 1 to 3 m thick, internally massive-bedded, very poorly sorted, grossly upward-fining, angular-grained conglomerate to sandstone beds, with subordinate massive-bedded sandstone with conglomerate lenses, and minor reddish-purple mudstone. The Mangkin Sandstone consists of repeated upward-fining, dominantly medium scaled tabular and trough cross-bedded sandstones, minor laminated sandstones, subordinate reddish-purple mudstone and minor conglomerate. The Termus Shale consists dominantly of reddish-purple mudstone, and minor thinly, parallel laminated sandstones.

The Lanis Conglomerate, Mangkin Sandstone and Termus Shale are interpreted to represent coarse-grained fan-delta (alluvial fan), low-sinuosity fluvial and floodplain sequence respectively, and are in lateral facies relationship.

Gold and REE distribution patterns in Tasik Cini volcanogenic massive sulphide deposits

G.H. TEH[1], SHARUL AMIN AHMAD[1], MOHD. SUHAIMI[2] &
ABD. KHALIK HJ. WOOD[2]
[1]Department of Geology, University Malaya, 59100 Kuala Lumpur
[2]Unit Tenaga Nuklear, Kompleks Puspati, Bangi 43000 Kajang

A study was made of the rare earth elements (REE) in the volcanogenic massive sulphide deposits in the Tasik Cini area, Pahang Darul Makmur, to see whether their distribution patterns can serve as hydrothermal tracers during ore genesis.

Taking advantage of the neutron activation analysis (NAA) technique, gold (Au) was also analyzed to see its vertical and lateral distribution pattern so typical of volcanogenic exhalative massive sulphide deposits.

Results of the study show certain patterns and relationships between REE and gold distribution in different parts of the massive sulphide ore bodies due in part to the ore minerals present, the nature of the hydrothermal solution and the water-rock interactions.

Zon sesar di Genting Peras

ZAITON HARUN
Jabatan Geologi
Universiti Kebangsaan Malaysia
43600 Bangi

Alexander (1968), Shu (1969, 1971) pernah melaporkan kehadiran sesar Bukit Tinggi dan sesar Kuala Lumpur di Selangor dan Negeri Sembilan. Di Genting Peras (di sempadan Negeri Sembilan - Selangor) suatu singkapan yang mengandungi kedua-dua sesar tersebut dan sesar Peras memotong batuan syis.

Sesar Peras berjurus UBL ditafsirkan sebagai sesar mendatar ke kanan, manakala sesar Bukit Tinggi berjurus BL dan sesar Kuala Lumpur berjurus BBL sebagai sesar mendatar ke kiri. Sesar Peras ditafsir mewakili jalur sesar tertua akibat tegasan hampir U-S. Tegasan yang bertindak dalam julat arah TTG hingga TTL menggerakkan sesar Bukit Tinggi dan sesar Kuala Lumpur. Tegasan termuda bertindak dalam julat arah 350° - UTL telah mencergaskan semula sesar-sesar berjurus BL hingga U-S.

The Wang Kelian Redbeds, a possible extension of the Unnamed Devonian Unit (Rebanggun Beds) into Perlis?

LEE CHAI PENG & AZHAR HJ. HUSSIN
Department of Geology, University of Malaya
59100 Kuala Lumpur

A 35 m thick redbed sequence of fossiliferous mudstones and muddy sandstones is located between underlying limestones of the Setul Formation and overlying dark pebbly mudstones and graywackes of the Singa Formation at roadcut 6.8 km from Wang Kelian along the Wang Kelian to Kaki Bukit road in northern Perlis.

The sequence consists of predominantly brownish red mudstones with *Posidonia* and small fragmentary trilobites and subordinate poorly sorted muddy sandstones and siltstones which show graded bedding, scoured bases and rippled tops in places. Channeling is present in some of the sandstone beds with rare cross-beds including the herring-bone type typical of tidal environments.

A comparable sequence of fossiliferous red mudstones with bivalves, trilobites, ammonites, crinoids and gastropods interbedded with thick and occasionally pebbly sandstone horizons found at Guar Sawar near Utan Haji suggests that this redbed sequence is quite widespread in Perlis.

Both these sequences are likely correlatives of the Unnamed Devonian Unit or Rebanggun Beds of Pulau Langkawi exposed on Pulau Langgun, Pulau Rebak Besar and around Air Hangat.

Since no type section has been defined for the Unnamed Devonian Unit, we propose the Wang Kelian redbeds as the most suitable type section for this widespread and distinctive Paleozoic redbed sequence due to its clear stratigraphic position, accessibility and likelihood to be left undisturbed by development.

Sedimentological and depositional facies changes in the Tatau–Bintulu area

B. BAIT & R. ASUT
Sarawak Shell Berhad,
Lutong, Miri, Sarawak

The sections along the road between Tatau and Bintulu towns transect the Belaga, Tatau, Buan and Nyalau Formations. They range in age from middle/late Eocene to early Miocene. The sequence of the sediments in this area represents the gradual basin-margin fill of the northwest Borneo sedimentary basin complex.

A number of different depositional facies were recognised. These are:-

a) deep marine/'distal' turbidites (Belaga Formation)

b) deep marine/'proximal' turbidites (Tatau Formation)

c) shallow marine shelf deposits (Buan Formation)

d) shallow marine, tidal and coastal plain deposits (Nyalau Formation)

Shallowing/prograding depositional sequences are exposed along the Tatau-Bintulu road and they typify the continuous depositional evolution of the area during Eocene/Miocene time.

Gaya struktur batuan Kumpulan Tembeling di Lembah Tekai, Pahang

IBRAHIM ABDULLAH, KAMAL ROSLAN MOHAMAD, ABDUL RAHIM SAMSUDIN, AHMAD JANTAN & UYOP SAID
Jabatan Geologi
Universiti Kebangsaan Malaysia
43600 Bangi

Keseluruhan batuan Kumpulan Tembeling di Lembah Tekai yang terdiri daripada Konglomerat Lanis, Batu Pasir Mangkin dan Syal Termus telah terlipat membentuk siri antiklin dan sinklin dengan tunjaman ke arah sekitar 340°. Antiklin dan sinklin dengan panjang gelombang boleh mencapai 10 km ini ditentukan berdasar kepada taburan litologi dan perubahan arah jurus dan nilai sudut kemiringan. Daripada hubungan batuan ini dengan batuan yang lebih tua serta ketidaksimetrian lipatan, ditafsirkan keseluruhan siri antiklin - sinklin tersebut membentuk satu sinklinorium dengan paksinya terletak selari dengan Sungai Termus - Sungai Senuak yang selari dengan arah paksi lipatan. Bersempena dengan itu struktur itu dinamakan sinklinorium Termus - Senuak. Bahagian paksi sinklin ditempati oleh Syal Termus manakala bahagian rabung antiklin ditempati oleh Batu Pasir Mangkin atau Konglomerat Lanis.

Pada bahagian rabung antiklin didapati banyak lipatan bersais sederhana dengan panjang gelombang sekitar 10 meter dan ada yang mencapai 20 meter. Bahagian palung sinklin pula terutaman berhampiran Sungai Termus terdapat ira sabak yang mewakili ira satah paksi. Di samping lipatan, terdapat bukti batuan Kumpulan Tembeling telah mengalami penyesaran secara mendatar dan penyesaran songsang.

Large-scale collapses of the late Jurassic–Cretaceous Pedawan Basin margin: Evidence from the Batu Kitang–Siniawan area, Sarawak

AZHAR HJ. HUSIN
Department of Geology, University of Malaya
59100 Kuala Lumpur

New exposures along the realigned Batu Kitang-Siniawan road provide new insights into the sequences of sedimentary facies and facies relationships of the late Jurassic-Cretaceous Pedawan Formation of West Sarawak.

Against the background of black carbonaceous shale, which in places are marked by the presence of sideritic/limonitic nodules aligned along the bedding planes, thin and thick graded beds of feldspathic sandstone, coarse-tail graded, polymictic extraformational conglomerate sheets and channels and several horizons of mass-flow deposits occur.

These mass flow deposits have stratigraphic thicknesses ranging from a meter to thicknesses in excess of 80 meters. They occur within a variety of facies association; thinner ones within sequences of thin-bedded turbidite sandstone and shale, and the thicker ones within coarse, thick-bedded sandstone, channellised and sheet conglomerate and minor shale sequence. Most of the blocks in the thicker deposits consists of contorted beds of thick turbidite sandstone which exhibits a spectrum of soft sediment deformational features resulting in the beds being in coherent, semi-coherent to incoherent state. These blocks range in size from a few centimeters to more than 8 meters in diameter. Closely associated with these contorted beds are shale diapirs, supporting the interpretation that beds were deformed in a high pore pressure condition through elastic and plastic behavior. The matrix of these deposits consists mainly of mud, but in some of the thicker beds the matrix are muddy sand. The sedimentological features suggest that the thicker mass flow deposits originated in the slope and base of slope environments where thick-bedded turbidite and conglomerate were initially deposited. Thinner bedded mass flow deposits could either represent the collapse of the basinal sediments or that they are the distal portion of much larger mass flow deposits.

The frequency of these mass flow deposits and the turbidites suggests that the margin of the Pedawan basin intermittently collapsed shedding their deposits into the deeper part of the basin. The paleoslope of the Pedawan basin determined from the sequence in the Batu Kitang-Siniawan area was to the west and southwest.

The main provenance for the sediments of the Pedawan Formation in the Batu Kitang-Siniawan area is inferred to be uplifted volcanics, older sandstone and chert to the east and northeast. Regional consideration suggests that the sediments of the Pedawan Formation in west Sarawak could have been deposited in several small basins separated by uplifted landmass. These probably resulted in these basins being barred, providing a suitable condition for the accumulation of carbonaceous shale.

Lithostratigraphy and sedimentology of Upper Paleozoic Kuantan Group in N.E. Pahang and South Terengganu

SIDIBE YAYA TIEMOKO, AHMAD JANTAN & TAN TEONG HING
Geology Department
Universiti Kebangsaan Malaysia
43600 Bangi

The Upper Paleozoic Kuantan Group, which crops out in Sg. Lembing-Panching, Bukit Pak Sagor, and westem Gambang areas in Pahang, and Ceneh-Air Putih-Bukit B. Besi areas in Terengganu, is made up of three formations, namely, the Charu Formation, the Panching Limestone and the Sagor Formation.

The Charu Formation, which consists of interbedded sandstone, siltstone and shale and well exposed in the area drained by Sg. Charu, along road cuts at Kuantan-Sg. Lembing road, is divided into three lithologic units, assigned the category of member, namely, from oldest to youngest, the Kolek, Berkelah and Lepar Members.

The Kolek Member, with type section at Kg. Kolek and a total thickness of about 1300 m, consists of steeply dipping beds of sandstone, siltstone and shale, and is considered to be of Lower Carboniferous (Visean) age. It comprises of tuffaceous sandstone facies and laminated shale-mudstone facies.

The Berkelah Member is found along the Kuantan-Temerloh road while the Lepar Member, along roads in the Felda Lepar Hilir. Both members consist of tuffaceous sandstone, laminated mudstone, shale and siltstone.

The Panching Limestone, which is conformable on the Charu Formation, is exposed at limestone hills of Bt. Panching, Bt. Charas, Bt. Sagu and Bt. Tenggek. The limestone, which is massive bedded and partly recrystallised has a faunal assemblage suggesting an age range from Visean (Lower Carboniferous) to Namurian (Lower to Middle Carboniferous).

The Sagor Formation, which is also conformable on the Panching Limestone and well exposed at the type locality, just 3 miles north of Bukit Pak Sagor, has a total thickness of about 1400 m consisting of conglomerate, sandstone, shale and mudstone and is assigned an Upper Carboniferous age.

Unconformably overlying the Sagor Formation, the rock unit described by Tan (1972) as Taweh Beds, is assigned a status of Formation, i.e. the Taweh Formation, which consists of interbedded conglomerate, sandstone, quartzite and carbonaceous shale. It is classified as part of the Jurassic-Triassic rocks in Pahang (Tembeling Group).

In south Terengganu, sediments and metasediments, showing different degrees of thermal metamorphism in Ceneh-Air Putih-B. Besi areas, consist mainly of soft argillaceous siltstone, tuffaceous sandstone, interbedded sandstone-mudstone, shale, schist, phyllite, of Lower Carboniferous age, and acidic and undifferenciated granitic rocks assigned an Upper Carboniferous age. Interbedded medium sandstone-mudstone with high ratio of sand/mud constitutes a C facies, while interbedded standstone (fine-medium) - mudstone forms A D facies of Bouma sequence.

Note on Triassic limestone at Kampung Lambok, west of Kuala Betis, West Kelantan

H. FONTAINE[1], D. RODZIAH[2], D. VACHARD[1] & H.P. KHOO[3]
[1]CCOP, Bangkok
[2]PETRONAS Petroleum Research Institute
[3]Geological Survey of Malaysia

Karstic limestone forming cliffed hills extending 9 km north to south in the Kampung Lambok area in west Kelantan were mapped as Permian in the past. The particular limestones which formed these hills have not been paleontologically studied before and the Permian age was assigned on the basis of a lithological correlation with other limestones of Peninsular Malaysia.

Paleontological analysis on the limestone samples collected in 1989 from these hills revealed a foraminiferal assemblage dominated by *Meandrospira dinarica* Kochansky-Devide & Pantic 1966. This foraminifera is associated with a few other foraminifera such as *Endothyranella wirzi* Koehn-Zaninetti, *Endothyra cf kuepperi* Oberhauser, and other benthic forms which indicate a Triassic (Anisian) age. *Meandrospira dinarica* was recorded to occur only in Kedah and Pahang.

With the recognition of the species in Kelantan, Triassic carbonates are more widespread than previously thought. This finding, therefore suggests

i) a continuous deposition of carbonate thoughout Permian to lower Middle Triassic, and

ii) a greater extent of Mesozoic sequence in west Kelantan.

Results of magnetic survey in Tekai Valley, Pahang

ABDUL RAHIM SAMSUDIN, IBRAHIM ABDULLAH &
KAMAL ROSLAN MOHAMAD
Jabatan Geologi
Universiti Kebangsaan Malaysia
43600 Bangi

A ground magnetic survey was conducted in the Tekai Valley area, Pahang. The intensity of the total magnetic field was measured along several traverses including logging tracks and the Tekai River which runs approximately NNW and cuts through the Jurassic rocks of the Tembeling Group.

The magnetic results show no obvious correlation between the intensity of the magnetic field and the surface geology observed along the traverses. However a sharp increase of intensity was recorded in an area between Sungai Termus and Sungai Jemar, the tributaries of Tekai River. This feature appears to be related to a zone of highly fractured and brecciated rocks which could be associated with a major thrust fault observed in the area.

Satu survei magnet telah dijalankan di kawasan lembah Tekai, Pahang. Keamatan medan magnet telah diukur di beberapa rentisan jalan balak dan di sepanjang Sungai Tekai yang berarah utara barat laut dan memotong batuan Jura dari Kumpulan Tembeling.

Keputusan yang diperolehi menunjukkan tidak ada korelasi yang jelas di antara keamatan medan magnet dengan geologi permukaan di sepanjang garis-garis rentisan. Waiau bagaimanapun terdapat kenaikan keamatan magnet yang jelas di kawasan antara Sungai Termus dan Sungai Jemar iaitu cawangan Sungai Tekai. Fitur ini mempunyai kaitan dengan zon batuan teretak dan terbreksi tinggi yang boleh diasosiasikan dengan sesar sungkup utama yang terdapat di kawasan tersebut.

Four isolated granitoid plutons in Johor: An overview on their petrochemistry and genesis

ASKURY ABD. KADIR
Geological Survey of Malaysia, Ipoh

Four isolated granitoid plutons in Johor viz. Gunung Ledang (Mt. Ophir), Bt. Mor, Lenga (Ma'Okil) and Batu Pahat were studied petrographically and chemically. Texturally, they range from medium- to coarse-grained porphyritic- to non-porphyritic biotite granite to fine-grained biotite granite or microgranite. Late phase intrusions included pegmatites in Bt. Mor and granophyres in Lenga during the middle-Triassic to Tertiary (?) respectively.

The ages of these granitoids range from Permian (173 Ma) to Cretaceous (78 Ma) according to available Rb-Sr data.

The Q-A-P, Q-P, A-B, Q-B-F and Qz-Ab-Or plots show that these granitoids do not vary considerably in composition as evidenced by their limited SiO_2 contents (67 to 79%). They fall within the granite and adamellite fields and are commonly peraluminous in nature.

All of the four plutions are characterized as ilmenite-series granites, with values of magnetic susceptibility of less than 15% x 10^{-10} SI unit. The Gunung Ledang, Bt. Mor and Lenga plutons are categorized as I-type granites, which were apparently derived from an igneous source through the partial melting at the mantle. However, the perquartzose Batu Pahat pluton can be categorized as an S-type which was presumably derived from sedimentary rocks by the process of partial remelting or anatexis.

Petrochemical evidence based on Harker and other variation diagrams show that the plutons are not genetically related to one and another. Magmatic differentiation trends are suggested and restricted only within individual pluton. These four granitoid plutons were probably emplaced separately from different magmatic sources. They are believed to represent high level epizonal intrusions and had crystallized under relatively low pressure from a minimum melt.

The stratigraphy of the Batu Arang area

G. MAHENDRAN, MUSTAFFA KAMAL SHUIB & J.K. RAJ
Department of Geology, University of Malaya
59100 Kuala Lumpur

The Tertiary of Peninsular Malaysia witnessed the development of a few Tertiary basins, one of which is the Batu Arang basin. The NW-SE trending roughly oval-shaped basin consists of 2 units of sedimentary rocks namely,

1) The Tertiary Coal Measures and

2) The Boulder Beds

These basinal sediments overly pre-Tertiary basement rocks.

The Tertiary Coal Measures, consist of very fine sandstone interbedded with carbonaceous/bituminous shales and few coal seams. Two major coal seams can be distinguished, a lower seam and a upper seam which attains a thickness of 7 m and 13 m respectively. Palynological studies show that the lower seam is of Late Oligocene to Early Miocene age and the upper seam to be of Late Miocene age. The presence of fresh water gastropod, *Viviparus sp* and plant fossils indicate that the rocks were deposited in a non-marine environment. The sedimentary structures found in these rocks indicate a fluvio-lacustrine environment.

Unconformably overlying the Coal Measures are the Boulder Beds which consist predominantly of pebble to boulder size clasts of quartzite and subordinate chert and vein quartz in a muddy to sandy matrix. They were derived from a nearby source and the paleocurrent studies shows a multidirectional flow mainly from the NE-SW direction. These deposits are believed to have accumulated rapidly as a subaerial debris flow deposited in an alluvial fan setting under a semi-arid condition.

The angular unconformity between the basinal sediments and the basement rocks is exposed at the northeastern part of the area where the gently dipping Tertiary rocks rest on the folded pre-Tertiary rocks. These pre-Tertiary rocks consist of alternating sequence of quartzite and phyllite and yields ammonoid fragments and crinoid stems which show similarities to the Permian aged Kenny Hill Formation of Kuala Lumpur.

The Tertiary basin is bounded by a NW-SE trending fault. The presence of the rapidly deposited Boulder Beds and fault breccia suggests that the basin is a fault-controlled basin.

Significance of radiolarian chert from the Chert Spillite Formation, Telupid, Sabah

BASIR JASIN
Jabatan Geologi
Universiti Kebangsaan Malaysia
43600 Bangi

Chert in the Telupid area is found associated with basalt, serpentinite and peridotite. This rock association may represent a part of an ophiolite sequence. The chert occurs as thinly bedded chert interbedded with siliceous shale. The chert is red to reddish brown in colour. The chert contains abundant skeletons of radiolaria. The radiolaria were retrieved from their siliceous matrix by leaching with hydrofluoric acid. Several species of radiolaria were identified and their age were determined. Geochemical analysis of bedded radiolarian chert exhibits a very high percentage of silica (more than 95%). Most of them are biogenic silica. The low content of Al_2O_3 and CaO suggests that the chert was deposited very far away from sources of terrigenous detritus and below the calcite compensation depth.

Rijang di kawasan Telupid didapati berasosiasi dengan basalt, serpentinit dan peridotit. Asosiasi batuan ini mewakili sebahagian jujukan ofiolit. Rijang ini wujud sebagai lapisan nipis yang berselang lapis dengan syal bersilika. Rijang ini berwarna merah hingga merah-perang. Rijang mengandungi kelimpahan rangka radiolaria. Radiolaria dikeluarkan daripada matrik silika dengan melarutkan dalam asid hidrofluorik. Beberapa spesies radiolaria dikenalpasti dan usia telah ditentukan. Analisis geokimia lapisan rijang berradiolaria menunjukkan peratusan silika yang tinggi (lebih 95%), kebanyakannya silika biogen. Kandungan Al_2O_3 dan CaO yang rendah mencadangkan rijang ini diendapkan jauh daripada punca gersik terigen dan diendapkan di bawah kedalaman pampasan kalsit.

Physical and chemical characterization of the slimes in selected Malaysian tin slurry ponds for reclamation purposes

YEAP E.B.[1], TAN B.K.[1], RAYMOND N. YONG[2], HO C.C.[1], CHOW W.S.[3], ZAABA ISMAIL[4] & DZULKARNAIN KAMARUZZAMAN[5]
[1]University of Malaya, 59100 Kuala Lumpur
[2]McGill University, Montreal, Canada
[3]Geological Survey of Malaysia, Ipoh
[4]Universiti Teknologi Malaysia, Skudai, Johor
[5]Mines Department, Ipoh

As part of the national research project on the Malaysian Tin Slurry Pond Reclamation, which was financed largely by the International Development Research Centre, Canada (IDRC), two ponds were selected for characterization. A large pond within the Mines Research Station, Malim Nawar, Perak, represents a pond left over from the dredging operation while a smaller pond located at Pengkalan, Perak, was a former slime pond of a gravel pump-palong operation. Both ponds are underlain by limestone/marble bedrock though the deeper bedrock of the Malim Nawar pond was never exposed during the dredging operation.

Manual sampling of the soft slime layer from both ponds was accomplished using a triple cluck-valve sampler adapted onto light weight alloy drilling rods. Two flat bottom boats rigged together provided a catamaran style platform for the sampling. Sampling was carried out on grids of 80 m by 40 m and 40 m by 40 m, and slime samples were collected for every 1 m vertical interval. The sampling points were fixed using a EDM Tellerumeter based at strategic positions by the pond edge.

The slime samples collected were analysed in the laboratories of University of Malaya, Universiti Teknologi Malaysia, Geological Survey Laboratories and the Mines Research Institute, for their chemical, physical, mineralogical and engineering properties. The pond water and the slime pore fluid were also tested for their anion and cation contents.

Based on the engineering properties, soft slime from the two ponds are not suitable as foundation materials unless treated. Mineralogically, the major component of the slime is kaolinite (60% to 75%), with significant amounts of illite (from 8% to 10%). In addition, the Malim Nawar pond contained amorphous clay while the Pengkalan pond contained montmorillonite. The average solid concentration of the slime is around 52% while the specific gravity is 2.6.

The specific surface area of the solids in the slime is higher in the Malim Nawar (35.5 m/g) compared to the Pengkalan pond (24.1 m/g). The cation and anion contents of the pond water and pore fluid are within the normal range though the calcium content in the pond water is relatively higher; 17 ppm for Malim Nawar and 37 ppm for Pengkalan. The calcium content in the pore fluid of the slime is even higher; 50 ppm for Malim Nawar and 239 ppm for Pengkalan. Concentrations of exchangeable cations in the slime are low with the exception of calcium. Organic content of the slime, ranging from 1.5% to 2.0% and the bacteria content of 1.3 x 10^3 to 2.9 x 10^4 colonies/g, must be regarded as low and will not affect slime properties to any marked extent.

An increase with depth in the particle size and specific gravity of the slime is observed in the Malim Nawar pond and is less clear or erratic in the Pengkalan pond. The solid concentration of the slime in the Malim Nawar pond shows a broader range of increase with depth compared to that of the Pengkalan pond.

Studies on the electrophoretic mobilities indicate that clay particles of the slime from the Malim Nawar pond show a higher negative surface charge compared to that of the Pengkalan pond, which apparently was neutralized by the calcium ions which were present in much higher concentrations in the water.

Based on the differences of several physical and chemical parameters, it is concluded that the slime from the Malim Nawar pond (dredging) had settled at a slow rate after it had been discharged into the pond. In the case of the Pengkalan pond, the slime, after having separated from the sand by the spray-stacked method, had settled down fast and en masse. It is also suggested that the high content of the calcium ions in the mine water which came into direct contact with the limestone bedrock during the mining (gravel pump-palong) had probably helped to neutralize the surface charges of the montmorillonite (in the Pengkalan slime) to make it settle faster than under normal circumstances.

The next stage of the research is aimed at identifying a suitable chemical for dewatering the slime, which will then allow it to be effectively surcharged and drained to achieve platform or foundation grade material.

The Tatau-Belaga Formations of North Central Sarawak: New findings and regional implications

HO CHEE KWONG
PETRONAS Petroleum Research Institute,
Lot 1026, PKNS Industrial Estate, 54200 Ulu Kelang

The relationship between the Tatau and Belaga Formations which form part of the Eocene-Oligocene sequence in north central Sarawak is still poorly understood. Their boundary has been inferred as an unconformity.

Recent fieldwork has shown that: (a) Most of the area mapped as the Tatau Formation in the Arip-Pelagau anticline is indistinguishable from the Belaga Formation; (b) A major angular unconformity is exposed at the NE and SW flanks of the Tatau Horst. The observed unconformity is believed to be the contact between the two formations.

Integration of present observations with published data enables a re-interpretation of the boundary of the Tatau and Belaga Formations, and of the geological history of north central Sarawak.

Ceramah Teknik (Technical Talk)

John W. Shelton: Geological Aspects of Horizontal Wells (Masera Corp. Tulsa, OK.)

Laporan (Report)

Dr. John Shelton, who was on a short visit to Kuala Lumpur recently, gave a talk to the society on "Geological Aspects of Horizontal Wells" at 5.35 p.m. on 31 May 1991 at the PETRONAS Petroleum Research Institute (PRI), Ulu Kelang. This is the first time that a society lecture is held at the PETRONAS research laboratory. Fifteen people from oil and service companies, including PRI staff, attended the talk.

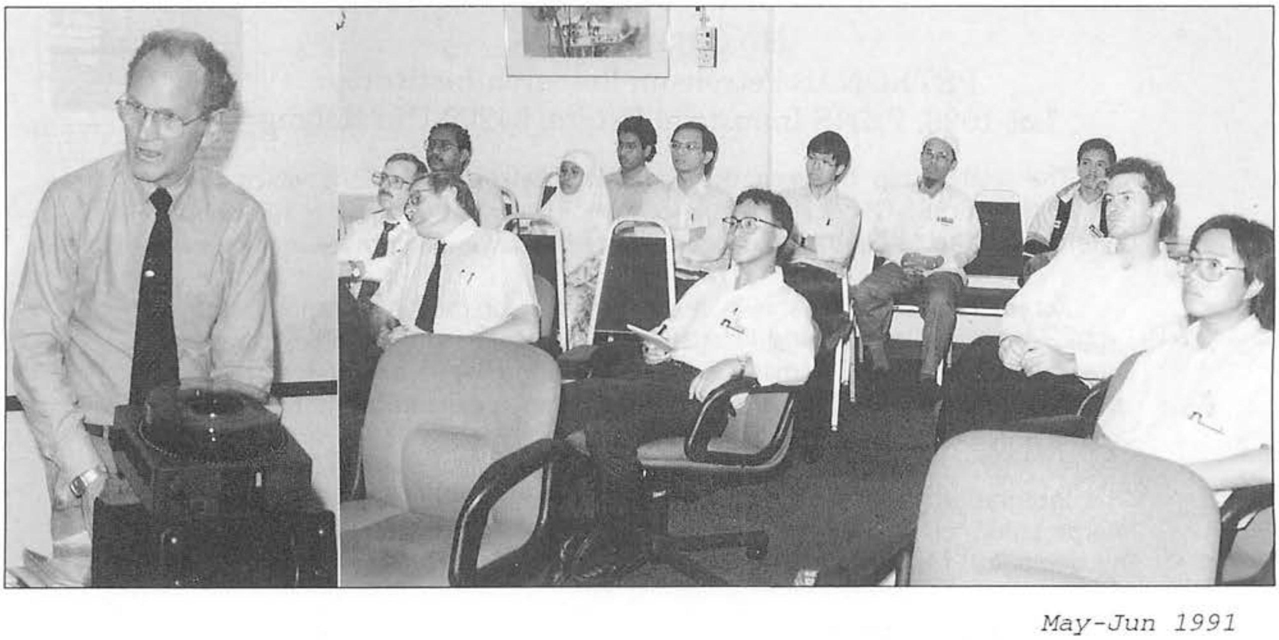
Dr. Shelton first worked with Shell Research in Houston after receiving his Ph.D. at Illinois in 1953. He then taught at Oklahoma State University (OSU) for a few years. He later joined other research laboratories for several years before coming back to OSU. He is now heading a consulting firm in Tulsa and is Emeritus Professor at OSU. Dr. Shelton has served as vice-president and editor of AAPG, and is recently made Honorary Member of AAPG in recognition for his contributions. His research interests include sandstone depositional environments, growth faults and regional basin analysis.

In his talk, Dr. Shelton presented some of the geological aspects that need to be considered before deciding on a horizontal well programme. The key questions to be answered are: what should be drilled horizontally and in what direction should the well be drilled? He showed some examples from North America where horizontal wells have been used successfully in optimizing hydrocarbon production. Examples of geological situations in which horizontal wells have been drilled include:

1. Production from fractured source-rocks, e.g. Bakken Shale.
2. Paleo-karsts (different types of karsts require different drilling programs.)
3. Chalk, e.g. Austin Chalk.
4. Coal-bed methane production.
5. Heterogeneous reservoirs (e.g. thin sands) and stratigraphic traps (a variety of situations were briefly shown to emphasize the importance of understanding the geometry of the reservoir before locating a horizontal well.)

Dr. Shelton showed an example from a producing karstic reservoir in South China where horizontal wells have greatly reduced the water-cut. In another example horizontal wells gave better control of water coning when producing low-gravity oil.

Mazlan Hj Madon



Ceramah Teknik (Technical Talk)

V. Nadarajah: The design and construction of Continuous Reinforced Concrete Pavement (CRCP) for the Urban Toll Expressway between Seremban and Ayer Hitam, Malaysia

Laporan (Report)

The above talk was held at 5.30 pm in the Geology Department, University of Malaya on 14th Tune 1991. It attracted an audience of about 25. What follows is a synopsis of the talk prepared by the speaker.

Synopsis

The principles of the original design of Continuous Reinforced Concrete Pavement (CRCP) viz. traffic flows, thickness of slab, functions and quantification of steel reinforcement are explained. Special treatment for tranverse joints, construction joints and for the road surface to improve skid resistance are described.

The type of sub-base support and frictional restraints produced therefrom and the designed concrete strength, control crack spacing, crack pattern and crack width which are significant performance parameters. Cracks manifest the quality of CRCP.

Some local experiences including materials, plant, equipment, laboratory tests and construction techniques with ensuing results have been described. Characteristics of CRCP have been shown.

Some recent research have been described and suggestions for future improvement have been made.

This CRCP was completed in July 1987 and had been in use since then for heavy construction traffic and for public use since April 1989. It would be reasonable to forecast that it would serve the design life of 40 years quite satisfactorily.

V. Nadarajah

Endau-Rompin Fieldtrip – Laporan (Report)

The Endau-Rompin Fieldtrip, organised by the Society's Tectonics & Structure Working Group, was held from the 27-30 June 1991.

This trip was made possible with the kind cooperation of Mr. Heah Hock Heng, the camp commandant at the Base Camp at Sg. Kinchin, Endau-Rompin.

Two 4-wheel drive vehicles were used to transport the 10 participants, food and other necessities up to Sg. Endau, and then by boat to the Base Camp at Sg. Kinchin.

The timber track used proved to be a real-life "Camel Trophy" adventure even for 4-wheel drive vehicles. Bridges of tree trunks needed to be repaired in order to get the vehicles across some of the streams and the winches were constantly used to pull the stucked vehicles out of the many soft, muddy stretches.

The Base Camp was adequately equipped with a kitchen, dormitories and toilets. The kitchen proved to be the most popular place, where Mr. Heah, besides his many stories on the area, also kept everyone happy with his excellent cooking and variety of cuisine.

Two full days were devoted to seeing the geology of the area. For that we were fortunate to have Munawir Muslim, who has done extensive research in the area. The outcrops of the Jasin Volcanics, the Tebak Formation and biotite adamellite were within walking distance from the Base Camp. A boat was also used to ferry us to outcrops along the rivers.

Other then the variety of rocks and fossils for the geologists, the beautiful, unspoilt nature of life at Endau-Rompin will continue to be its main attraction.

G.H. Teh
Fieldtrip Organiser

ENDAU-ROMPIN FIELDTRIP

1. Loading the 4WDs.
2. Even the 4WDs are stuck!
3. Arrival by boat at the base camp.
4. Dinner at the kitchen, the favourite place at the base camp.
5. Cozy beds, don't feel like waking up.
6. Breakfast time and everyone is happy.
7. Ready for the day's fieldtrip.
8. Tired but still smiling at the Tebak Formation, G. Keriong.
9. By boat to Sg. Kernam to see the b iotite adamellite rocks.
10. Drenched but still smiling sitting on the biotite adamellite boulders after a heavy downpour.
11. Next morning, warm, fresh and still smiling.
12. At the scenic waterfall on Sg. Taku with rhyolite exposures of the Jasin Volcanics.
13. It is lunch time, on the road!
14. Interpreting the mylonitised rhyolite of Jasin Volcanics in Sg. Kinchin near the base camp.
15. Time to load for home. That's no rocket but our canvas boat!
16. Back at the Rest House at Kuala Rompin, of course all still smiling.

ENDAU – ROMPIN FIELDTRIP


1


2


3


4


5


6


7


8

ENDAU - ROMPIN FIELDTRIP


9


10


11


12


13


14


15


16

BERITA-BERITA PERSATUAN
News of the Society

Keahlian (Membership)

The following applications for membership were approved:

Full Members

1. Vong Nee Toh
SESCO H.Q., Development Project Section, Petra Jaya, Kuching, Sarawak.

2. Andrew S. Cuthbertson
CRA Exploration, P.O. Box 420KBY, Jakarta 12001, Indonesia.

3. Jock Graham
At. 902-A, Trade Ctr. Apts., P.O. Box 9229, Dubai, United Arab Emirates.

4. Anthony F. Williams
WMC Petroleum, P.O. Box 11990, 50764 Kuala Lumpur.

5. Anthony K.C. Yeo
Exlog, Lot 2065, Piasau Ind. Est., Jalan Bulatan, 98000 Miri, Sarawak.

6. Terrance R. Walker
WMC Petroleum, P.O. Box 11990, 50764 Kuala Lumpur.

Student Member

1. Shafari Muda
Jabatan Geologi, Universiti Malaya, 59100 Kuala Lumpur.

Institutional Member

1. Robertson Singapore
55 Ayer Rajah Crescent #06-16, Ayer Rajah Ind. Est., S'pore 0513. Attn: S. David Flett.

Pertukaran Alamat (Change of Address)

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

1. Abdul Rahim Abu Bakar
Treasury Dept., Petronas, P.O. Box 12444, 50778 Kuala Lumpur.

2. Teng Mee Kee
P.O. Box 153, 98109 Lutong, Sarawak.

3. V. Srimugayogam
No. 39, Jalan 12/14, 46200 Petaling Jaya, Selangor.

4. Basri Bakar
Lot 5.07, 5th Floor, Wisma Stephens, Jalan Raja chulan, 50200 Kuala Lumpur.

Pertambahan Baru Perpustakaan (New Library Additions)

The Society has received the following publications:

1. U.S. Geological Survey Bulletin: 1989: 1808-G. 1990: 1925, 1924, 1914, 1923, 1866-F, 1704-B, 1573, 1917-B, 1907, 1946, 1741-G, 1910, 1929, 1917-C, 1917-A, 1737-F, 1704-C, 1906, 1741-E, 1937, 1932, 1704-D, 1738-D, 1674-E. 1991: 1930, 1935.
2. Memoires pour servir a l'Explication des Cartes Geologiques et Minieres de la Bergique, mem. 30, 1991.
3. Digital elevation models. Data users guide. 1990.
4. Geosurvey Newsletter, vol. 22, nos 19, 22, 23, 24 (1990).
5. Akademic der Wissenschaften der DDR, nos. 69 & 113, 1990.
6. Oklahoma Geology notes, vol. 50, nos. 4, 5, 6, 1990.
7. Annual Report no. 16, 1990.
8. Exploration & research for atomic minerals, vols. 1 (1988), vol. 2 (1989).
9. Sopac News, vol. 7, no. 2, 1990.
10. AGID News, no. 65, 1991.
11. Datation palynologique de Gisements tertiaires de l'entre-sambre-et-Meuse by E.R. Ermolli, 1991.
12. Annual Report: Chinese Academy of Geological Sciences, 1988.
13. U.S. Geological Survey Professional Paper 1990: 1404-F, 1505-D, 1502, 1503, 1508, 1507, 1200-us, 1513-A. 1991: 1506-C.
14. U.S. Geological Survey Circular 1990: 1033, 1057, 1061, 1054, 1075. 1991: 1062.
15. IMM Bulletin nos. 998, 999, 1000, 1991.
16. IMM Section A, vol. 100, 1991.
17. Earthquakes & Volcanoes, vol. 22, no. 2, 1990.
18. Acta Micropalaeontologica Sinica, vol. 7, nos. 3 & 4, 1990.
19. Palaeontological Abstracts, vol. 5, no. 3 & 4, 1990; vol. 6, no. 1, 1991.
20. Acta Palaeontoloigca Sinica, vol. 29, nos. 3-6, 1990; vol. 30, nos 1 & 2, 1991.
21. Geologie, vol. 99, nos. 1 & 2, 1990.
22. AAPG Explorer, May, June 1991.
23. Proceedings of the 19th Session, 1990.
24. Exploration & research for atomic minerals, vol. 1 (1988), vol. 2 (1989).
25. Annual Report, Inst. of Geoscience, The Univ. of Tsukuba, no. 16, 1990.
26. Scripta Geologica, nos. 92-94, 1990.
27. Commonwealth Science Council, March-April, 1991.
28. Bulletin of the National Science Museum, vol. 16, nos. 3, 4, 1990.
29. Acta Micropalaeontologica Sinica, vol. 8, no. 1, 1991.
30. Palaeontologica Sinica, no. 179, 1990.
31. Science reports of the Institute of Geoscience, Univ. of Tsukuba, vol. 12, 1991.
32. Berliner Geowissenschaftliche Abhandlungen, Reihe A, Band 118, Band 124, 125, 126, 127 & 129, 1990.
33. Earthquakes and volcanoes, vol. 21, no. 6, 1989, & vol. 22, no. 1, 1990.
34. Eruptions of Hawaiian volcanoes: past, present & future, 1987.

GONDWANA DISPERSION

AND ASIAN ACCRETION

3rd International Symposium and Field Excursion Preliminary Announcement

The 3rd International Symposium and Field Excursion of IGCP Project 321 will be organized and hosted by the Malaysian Working Group with the support and cooperation of the Malaysian National IGCP Committee, the Department of Geology of University of Malaya and the Geological Survey of Malaysia. All colleagues, friends and scientists interested in the aims of the project are cordially invited to participate in the Symposium and Field Excursion.

Tentatively the Symposium will be held in the University of Malaya, Kuala Lumpur and the Field Excursion will be made to look at all three Belts of Peninsular Malaysia and the western margin of the Central Belt. The tentative program is given below.

PROGRAM

ALL DATES AND PLACES TENTATIVE

Symposium : 23-24 August 1993 in University of Malaya, Kuala Lumpur.

Field Excursion :	25 August 1993	: Kuala Lumpur area (Western Belt)
	26 August 1993	: Raub-Bentong line
	27 August 1993	: Central & Eastern Belt
	28 August 1993	: Back to Kuala Lumpur – End

Please note that the above program is tentative and will be confirmed only in the First Circular to be posted later. In the meanwhile address all your queries to Dr. C.P. Lee, Organizing Secretary IGCP 321, Dept. of Geology, University of Malaya, 59100 Kuala Lumpur, Malaysia (Tel: 7555466 Ext. 203, Fax: 7563900).

Obituary

Dr. R.A.M. Wilson, DSc, MIMM, FGS

Robert "Bob" Wilson died in Cyprus in February 1991, at the age of 67. He served in the Royal Navy on HMS *Revenge*, and later on minesweepers. After graduating from Glasgow University in 1951 he worked with the Geological Survey Department in Cyprus, mapping the Troodos massif, and challenged the view of the then Director that the massif consisted of isoclinally folded lavas. Bob's fieldwork convinced him that it was a dyke complex in which there was little or no host rock present - a difficult concept to accept in those pre-plate tectonic days. Bob resisted considerable pressure from the Director, and stuck to his views, which were completely vindicated as understanding of ophiolite complexes became more complete.

In 1958 Bob was transferred to the Geological Survey of what is now East Malaysia, and was posted to Sabah (then North Borneo), where he applied his knowledge of ophiolites to the Sabah ultrabasic rocks and identified them as being of oceanic crustal and mantle origin. (I remember being somewhat sceptical of Bob's theory and remarking that if this were so, there was no need to drill the "Mohole", a project then planned - but so far still not executed - to drill a hole to the mantle through oceanic crust. Perhaps I spoke truer than I knew! - NSH). In Sabah he mapped the Banggi Island and Sugut River area (Memoir 15), and the Labuan and Padas Valley area (Memoir 17), this completing the set of Memoirs covering the whole of Sarawak, Brunei, and Sabah. In 1965 he was awarded a DSc by Glasgow university for his publications on Cyprus and Sabah.

Bob became Deputy Director and Director of the Borneo Geological Survey before retiring in 1966. He applied his Cyprus knowledge in promoting mineral exploration using geochemical methods, and was involved in the discovery, evaluation, and exploitation of the Mamut porphyry copper deposit.

On leaving Sabah, Bob joined Union Carbide in Vancouver, Canada, and in 1969 returned to the UK and from then, until his retirement in 1984, worked for Carter Consolidated, eventually as Chief Geologist. In the late '80s Bob and Jane retired to their beloved Cyprus, having had a house built in the attractive village of Paramytha a few miles north of Limassol.

Bob Wilson was a Scot, of which his voice was a constant reminder, and which was demonstrated by his expertise in Scottish dancing. He was a man of great personal charm with a quiet sense of humour. Sailing was his life-long passion. A skilled yachtsman, he was Commodore of the Jesselton Yacht Club during his time in Sabah. Bob married Jand Gunner at St. Paul's Church, Nicosia, in 1953. He was very much a family man and was liked and admired by the young. Perhaps this is why all of his three children (Hamish, Dugald, and Sandra) became geologists and why they in turn married geologists! He will long be remembered with affection by those who had the privilege of knowing him. These include only the most senior geologists in Malaysia, but more will have met him at second hand through his geological publications, still the primary references for the areas described, although now both unfortunately out of print.

I.G. Gass

N.S. Haile

April 1991

KALENDAR (CALENDAR)

1992

October 17–22
HYDROLOGY AND HYDROGEOLOGY, mtg., Portland, Ore. (American Institute of Hydrology, 3416 University Ave. S.E., Minneapolis, 55414-3328. Phone: 612/279-1030)

October 18–23
LATE PRECAMBRIAN TECTONICS AND THE DAWN OF THE PHANEROZOIC, GSA Penrose Conference, Death Valley, Calif. (Ian W.D. Dalziel, Institute for Geophysics, University of Texas, Austin, 78759-8345. Phone: 512/471-6156. Fax: 512/471-8844)

October 19–21
BIO-LEACHING MINERALS AND MINERAL-LAND RECLAMATION, mtg. and workshop, Sacramento, Calif. (Yung Sam Kim, Nevada Institute of Technology, Box 8894, Campus Station, Reno, Nev. 89507. Phone :702/673-4466)

October 25–30
IN-SITU MINERALS RECOVERY, mtg., Santa Barbara, Calif. (Engineering Foundation, 345 E. 47th St., New York, 10117. Phone : 212/705-7835. Fax: 212/705-7441)

October 26–28
EXTRACTIVE METALLURGY OF GOLD AND BASE METALS, int'l. mtg., Kalgoorlie, Western Australia. (V.N. Misra, Kalgoorlie Metallurgical Laboratory, Box 881, Kalgoorlie, 6430, Australia. Phone: (090) 220 120. Fax: (090) 912 762) Papers invited.

October 26–29
GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Cincinnati, Ohio, USA. (Jean Kinney, GSA Headquarters, P.O. Box 9140, Boulder, Colo. 80301, USA. Phone: (303) 447-2020).

November 8–13
WATER RESOURCES AND ENVIRONMENTAL ENGINEERING, mtg., Santa Barbara. Calif. (C.V. Freiman, Engineering Foundation, 345 E. 47th St., New York, 10017. Phone: 212/705-7835. Fax: 212/705-7441)

November 29–December 2
TECTONIC FRAMEWORK AND ENERGY RESOURCES, mtg., Kuala Lumpur, Malaysia. (Secretariat, c/o Dept. of Geology, University of Malaya, 59100 Kuala Lumpur, Malaysia)

November 30–December 3
OFFSHORE SOUTHEAST ASIA, mtg., Singapore. (Society of Petroleum Engineers, Box 833836, Richardson, Texas 75083-3836. Phone: 214/669-3377. Fax: 214/669-0135)

December 28–31
GEODYNAMICS OF THE ARABIAN LITHOSPHERE, int'l. mtg., Baghdad. (Sahil Alsinawi, Dept. of Geology, College of Science, University of Baghdad, Jadiryah, Iraq)

1993

April 17–20
EXPLORATION AND DISCOVERY, mtg., Denver, by Society of Economic Geoloiists, Society of Exploration Geophysicists, and others. (J. Alan Coope, SEG Conference '93, Box 571, Golden, Colo. 80402. Phone: 303/837-5819. Fax: 303/837-5851)

April 25–28
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, ann. mtg., New Orleans. (AAPG, Box 979, Tulsa, Okla. 74101-0979. Phone: 918/584-2555. Fax: 918/584-0469)

May 16–20
ENVIRONMENTAL HYDROLOGY AND HYDROGEOLOGY, mtg., Washington, D.C. (Secretariat, Americal Institute of Hydrology, Second USA/USSR Conference, 3416 University Ave. S.E., Minneapolis, 55414-3328. Phone: 612/379-1030. Fax: 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, mtg., Nanjing, People's Republic of China, by Nanjing University. USGS, Society of Petroleum Geology of China, and others. (David G. Howell, MS902, USGS, 345 Middlefield Road, Menlo Park, Calif. 94025. Phone: 415/329-5430. Fax: 415/354-3224)

June 1–5
GEOTECHNICAL ENGINEERING, int'l. mtg., St. Louis. (Norma R.Fleming, 119 ME Annex, University of Missouri, Rolla, 65401-0249. Phone: 314/341-6061; 800/752-5057. Fax: 314/341-4992)

June 7–11
EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS (55th Annual Meeting and Exhibition), Forum, Stavanger, Norway. (Evert van der Gaag, Business Manager, European Association of Exploration Geophysicists, Utrechtseweg 62, NL-3704 HE Zeist, The Netherlands. Phone: (03404) 56997)

June 20–27
ZEOLITES, int'l. mtg., Boise, Idaho, 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, mtg. and workshop, Lisbon, Portugal, by International Society for Rock Mechanics. (Luis Ribeiro e Sousa, Portuguese Society for Geotechnique, Laboratorio Nacional de Engenharia Civil, Av. do Brasil, 101, 1799 Lisboa Codex Portugal. Phone: 848 21 31. Fax: 89 76 60)

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 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)

August 23–29
GEOMORPHOLOGY (3rd International Conference), Hamilton, Ontario, Canada. (3rd International Conference on Geomorphology, McMaster University, Hamilton, Ontario L8S 4Kl, Canada. Phone: (416) 525-9140, ext. 4535; telefax: (416) 546-0463; telex: 061-8347)

August 23–29
COASTAL SEDIMENTOLOGY, mtg., Hamilton, Ontario. (William F. Tanner, Dept. of Geology B-160, Florida State University, Tallahassee, 32306. Phone: 904/644-3208)

September 25–October 1
INTERNATIONAL ASSOCIATION OF VOLCANOLOGY AND CHEMISTRY OF THE EARTH'S INTERIOR, mtg., Canberra, Australia. (IAVCEI ACTS, GPO Box 2200, Canberra ACT 2601, Australia. Phone: 61/6/257-3299. Fax: 61/6/257-3256)

1994

June 6–10
EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS (56th) Annual Meeting and Exhibition), Austria Center, Vienna, Australia. (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)

GONDWANA DISPERSION AND ASIAN ACCRETION

3rd International Symposium and Field Excursion Preliminary Announcement

The 3rd International Symposium and Field Excursion of IGCP Project 321 will be organized and hosted by the Malaysian Working Group with the support and cooperation of the Malaysian National IGCP Committee, the Department of Geology of University of Malaya and the Geological Survey of Malaysia. All colleagues, friends and scientists interested in the aims of the project are cordially invited to participate in the Symposium and Field Excursion.

Tentatively the Symposium will be held in the University of Malaya, Kuala Lumpur and the Field Excursion will be made to look at all three Belts of Peninsular Malaysia and the western margin of the Central Belt. The tentative program is given below.

PROGRAM

ALL DATES AND PLACES TENTATIVE

Symposium	: 23-24 August 1993 in University of Malaya, Kuala Lumpur.	
Field Excursion	: 25 August 1993	: Kuala Lumpur area (Western Belt)
	26 August 1993	: Raub-Bentong line
	27 August 1993	: Central & Eastern Belt
	28 August 1993	: Back to Kuala Lumpur – End

Please note that the above program is tentative and will be confirmed only in the First Circular to be posted later. In the meanwhile address all your queries to Dr. C.P. Lee, Organizing Secretary IGCP 321, Dept. of Geology, University of Malaya, 59100 Kuala Lumpur, Malaysia (Tel: 7555466 Ext. 203, Fax: 7563900).

ORDER FORM

GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATION

Date: ....

The Hon. Assistant Secretary,
Geological Society of Malaysia,
c/o Department of Geology,
University of Malaya,
59100 Kuala Lumpur,
MALAYSIA

Dear Sir,

Please send me the following publications. I enclose US$/M$*.......................... in cheque/money order/bank draft.*

Item	No. of Copies	Price
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....

Sub–Total ____________

Total ____________

Signature:............................

*Delete where applicable

Please mail to : ....
(Please print) ....
....
....

GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATIONS
Back Issues Available

Bulletin 1 (1968). 79p. Studies in Malaysian Geology. Edited by P.H. Stauffer. A collection of papers presented at a meeting of the Geological Society on 31st January 1967. Price: M$3.00 (US$1.50). **Out of stock**

Bulletin 2 (1968). 152 p. Bibliography and Index of the Geology of West Malaysia and Singapore by D.J. Gobbett. Price: M$10.00 (US$5.00) — Softcover; M$15.00 (US$7.50).

Bulletin 3 (1970). 146 p. Papers in Geomorphology and Stratigraphy (with Bibliography supplement). Edited by P.H. Stauffer. Price: M$10.00 (US$5.00).

Bulletin 4 (1971). 100 p. Papers in Petrology, Structure and Economic Geology. Edited by P.H. Stauffer. Price: M$10.00 (US$5.00).

Bulletin 5 (1973). 70 p. The Search for Tungsten Deposits by K.F.G. Hosking. Price: M$10.00 (US$5.00).

Bulletin 6 (1973). 334 p. Proceedings, Regional Conference on the Geology of Southeast Asia. A collection of papers, Kuala Lumpur, March, 1972. Edited by B.K. Tan. Price: M$22.00 (US$11.00) — hardcover only.

Bulletin 7 (1974). 138 p. A collection of papers on geology. Edited by B.K. Tan. Price: M$12.00 (US$6.00).

Bulletin 8 (1977). 158 p. A collection of papers on geology. Edited by T.T. Khoo. Price: M$12.00 (US$6.00).

Bulletin 9 (1977). 277 p. The relations between granitoids and associated ore deposits of the Circum-Pacific region. A collection of papers presented at the IGCP Circum-Pacific Plutonism Project Fifth Meeting. 12–13 November 1975, Kuala Lumpur. Edited by J.A. Roddick & T.T. Khoo. Proce: M$25.00 (US$12.00). **Out of stock**

Bulletin 10 (1978). 95 p. A collection of papers on the geology of Southeast Asia. Edited by C.H. Yeap. Price: M$10.00 (US$5.00).

Bulletin 11 (1979). 393 p. Geology of Tin Deposits. A collection of papers presented at the International Symposium of 'Geology of Tin Deposits', 23–25 March 1978, Kuala Lumpur. Edited by C.H. Yeap. Price: M$50.00 (US$22.00).

Bulletin 12 (1980). 86 p. A collection of papers on geology. Edited by G.H. Teh. Price: M$20.00 (US$9.50).

Bulletin 13 (1980). 111 p. A collection of papers on geology of Malaysia and Thailand. Edited by G.H. Teh. Price: M$20.00 (US$9.50).

Bulletin 14 (1981). 151 p. A collection of papers on geology of Southeast Asia. Edited by G.H. Teh. Price: M$30.00 (US$14.00).

Bulletin 15 (1982). 151 p. A collection of papers on geology. Edited by G.H. Teh. Price: M$30.00 (US$14.00).

Bulletin 16 (1983). 239 p. A collection of papers on geology. Edited by G.H. Teh. Price: M$30.00 (US$14.00).

Bulletin 17 (1984). 371 p. A collection of papers on geology. Edited by G.H. Teh. Price: M$35.00 (US$15.00).

Bulletin 18 (1985). 209 p. Special Issue on Petroleum Geology. Edited by G.H. Teh & S. Paramananthan. Price: M$30.00 (US$14.00).

Bulletins 19 & 20 (1986). GEOSEA V Proceedings Vols. I & II, Fifth Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia, Kuala Lumpur, 9–13 April 1984. Edited by G.H. Teh & S. Paramananthan. Price for both Bulletins 19 & 20: Members — M$50.00 (US$21.90), Non-members — M$125.00 (US$53.20).

Bulletin 21 (1987). 271 p. Special Issue on Petroleum Geology Vol. II. Edited by G.H. Teh. Price: M$40.00 (US$17.00).

Bulletin 22 (1988). 272 p. Special Issue on Petroleum Geology Vol. III. Edited by G.H. Teh. Price: M$40.00 (US$17.00)

Bulletin 23 (1989). 215 p. A collection of papers on the geology of Malaysia, Thailand and Burma. Edited by G.H. Teh. Price: M$35.00 (US$15.00).

Bulletin 24 (1989). 199 p. A collection of papers presented at GSM Annual Geological Conference 1987 and 1988. Edited by G.H. Teh. Price: M$35.00 (US15.00).

Bulletin 25 (1989). 161 p. Special Issue on Petroleum Geology Vol. IV. Edited by G.H. Teh. Price M$40.00 (US$17.00).

Bulletin 26 (1990). 223 p. A collection of papers presented at GSM Annual Geological Conference 1989 and others. Edited by G.H. Teh. Price: M$40.00 (US$17.00).

Bulletin 27 (1990). 292 p. Special Issue on Petroleum Geology Vol.V. Edited by G.H. Teh. Price: M$40.00 (US$17.00).

Field Guide 1 (1973). A 7-day one thousand mile, geological excursion in Central and South Malaya (West Malaysia and Singapore). 40 p. by C.S. Hutchison. Price: M$5.00 (US$2.50).

Abstracts of papers. (1972). Regional Conference on the Geology of Southeast Asia, Kuala Lumpur, 1972. 64 p, 8 figs. 3 tables, many extended abstracts. Edited by N.S. Haile. Price: M$6.00 (US$3.00).

Proceedings of the Workshop on Stratigraphic Correlation of Thailand and Malaysia Vol. 1. (1983). Technical Papers. 383 p. Price: M$25.00 (US$12.40) (Members: M$12.00/US$6.50)

WARTA GEOLOGI (Newsletter of the Geological Society of Malaysia). Price: M$5.00 (US$3.20) per bimonthly issue from July 1966.

PACKAGE DEAL 1: Bulletin nos. 2–8, 10 + Field Guide 1

Student Members	: M$10.00 (US$5.60)
Members	: M$20.00 (US$10.00)
Non-Members	: M$40.00 (US$19.00)

PACKAGE DEAL 2: Bulletin nos. 11–14

Student Members	: M$30.00 (US$14.50)
Members	: M$40.00 (US$19.00)
Non-Members	: M$60.00 (US$28.00)

PACKAGE DEAL 3: Bulletin nos. 15–18 and 21

Student Members	: M$60.00 (US$28.00)
Members	: M$80.00 (US$37.00)
Non-Members	: M$100.00 (US$45.90)

PACKAGE DEAL 4: Combination of Package Deals 1-3

Student Members	: M$100.00 (US$45.90)
Members	: M$140.00 (US$64.00)
Non-Members	: M$200.00 (US$90.60)

PACKAGE DEAL 5: Bulletin nos. 19 & 20 + Proceedings of Workshop on Stratigraphic Correlation of Thailand & Malaysia Vol. 1.

Student Members	: M$30.00 (US$14.50)
Members	: M$50.00 (US$21.90)
Non-Members	: M$125.00 (US$53.20)

Please note that the Package Deal offers is limited to ONE order per member only. There is no limit on the number of orders for non-members. Prices may be changed without notice (especially prices in US dollars).

Individual copies of Bulletin nos. 1–10 and Warta Geologi are available to members at half price. All prices quoted are inclusive of postage and packing by surface mail; for airmail, please write in for inquiries. Allow 8–10 weeks for delivery.
Cheques, money orders or bank drafts must accompany all orders.

Orders should be addressed to:

The Hon. Assistant Secretary
Geological Society of Malaysia
c/o Dept of Geology
University of Malaya
59100 Kuala Lumpur
MALAYSIA
TEL: 03-7577036
FAX: 603-7563900

PP 167/12/90 ISSN 0126-6187

BULETIN PERSATUAN GEOLOGI MALAYSIA

BULLETIN OF THE GEOLOGICAL SOCIETY OF MALAYSIA

SPECIAL ISSUE ON PETROLEUM GEOLOGY VOL. VI

KANDUNGAN (CONTENTS)

Editor
G.H. TEH

NOVEMBER 1991 No. 28

Price: M$40.00

Cheques, Money Orders or Bank Drafts must accompany all orders. Please add US$1.30 for bank charges.
Orders should be addressed to: The Hon. Assistant Secretary
GEOLOGICAL SOCIETY OF MALAYSIA
c/o Dept. of Geology
University of Malaya
59100 Kuala Lumpur
MALAYSIA

PP 187/12/89 ISSN 0126-6187

BULETIN PERSATUAN GEOLOGI MALAYSIA

BULLETIN OF THE GEOLOGICAL SOCIETY OF MALAYSIA

SPECIAL ISSUE ON PETROLEUM GEOLOGY VOL. V

KANDUNGAN (CONTENTS)

Editor
G.H. TEH

NOVEMBER 1990 No. 27

Price: M$40.00 (US$17.00)

Cheques, Money Orders or Bank Drafts must accompany all orders. Please add US$1.30 for bank charges.
Orders should be addressed to: The Hon. Assistant Secretary
GEOLOGICAL SOCIETY OF MALAYSIA
c/o Dept. of Geology
University of Malaya
59100 Kuala Lumpur
MALAYSIA

NOW AVAILABLE!

PP 187/12/89 ISSN 0126/6187

BULETIN PERSATUAN GEOLOGI MALAYSIA

BULLETIN OF THE GEOLOGICAL SOCIETY OF MALAYSIA

KANDUNGAN (CONTENTS)

Editor
G.H. Teh

APRIL 1990 No. 26

Price: M$40.00 (US$17.00)

Cheques, Money Orders or Bank Drafts must accompany all orders. Please add US$1.30 for bank charges.

Orders should be addressed to: The Hon. Assistant Secretary
GEOLOGICAL SOCIETY OF MALAYSIA
c/o Dept. of Geology
University of Malaya
59100 Kuala Lumpur
MALAYSIA

KANDUNGAN (CONTENTS)

NOW AVAILABLE!

PP 187/12/88 ISSN 0126-6187

BULETIN PERSATUAN GEOLOGI MALAYSIA

BULLETIN OF THE GEOLOGICAL SOCIETY OF MALAYSIA

KANDUNGAN (CONTENTS)

Editor
G.H. Teh

AUGUST 1989 No. 23

Price: M$35.00 (US$15.00)

Cheques, Money Orders or Bank Drafts must accompany all orders. Please add US$1.30 for bank charges.

Orders should be addressed to: The Hon. Assistant Secretary
GEOLOGICAL SOCIETY OF MALAYSIA
c/o Dept. of Geology
University of Malaya
59100 Kuala Lumpur
MALAYSIA

STILL AVAILABLE!

PP 170/12/87 ISSN 0126/6187

BULETIN PERSATUAN GEOLOGI MALAYSIA

BULLETIN OF THE GEOLOGICAL SOCIETY OF MALAYSIA

SPECIAL ISSUE ON PETROLEUM GEOLOGY VOL. III

KANDUNGAN (CONTENTS)

Editor

G.H. Teh

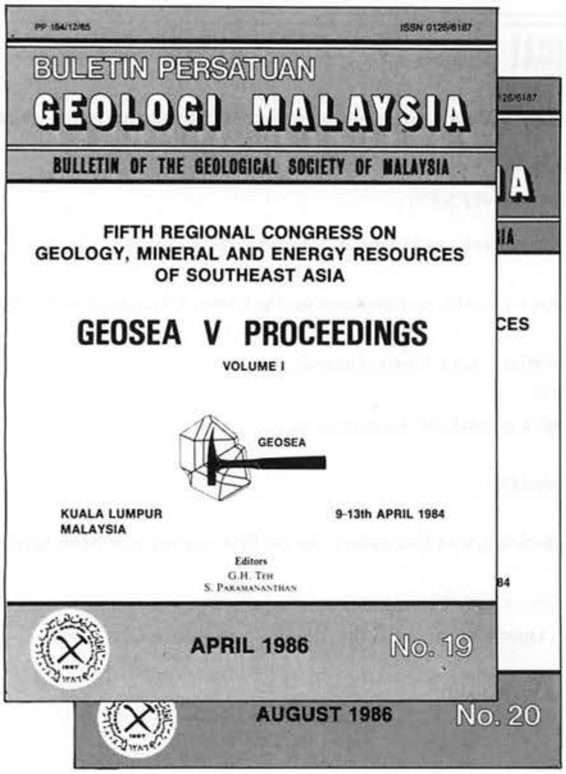
DECEMBER 1988 No. 22

Price: M$40.00 (US$17.00)

GEOLOGICAL SOCIETY OF MALAYSIA

GEOSEA V PROCEEDINGS

VOLUMES I & II
(Bulletin Geological Society of Malaysia Nos. 19 & 20)



Some of the articles appearing include:-

Massive sulphide deposits and their possible significance to other ores — R.W. Hutchinson; **Palaeogeographic development of west Sarawak** — Denis N.K. Tan; **Geological evolution of the Southern Philippines** — C.K. Burton; **Southeast Asia as a part of an early Palaeozoic Australian Gondwanaland** — C. Burrett & B. Stait; **Tertiary basins of S.E. Asia — their disparate tectonic origins and eustatic stratigraphical similarities** — C.S. Hutchison; **Late Palaeozoic palaeogeography of Southeast Asia: some stratigraphical, palaeontological and palaeomagnetic constraints** — I. Metcalfe; **The REE geochemistry of Lingshan W-Sn-bearing granites and their applications to petrogenesis of the granites** — Yuan Zhongxing *et al.*; **Chromite deposits of Papua New Guinea** — P.M. Afenya; **Recent advances in exploration modelling for tin deposits and their application to the SE Asian environment** — R.G. Taylor & P.J. Pollard; **Some thoughts on the development of the alluvial tinfields of the Malay-Thai Peninsula** — D. Taylor; **Base metal exploration in Sabah** — David T.C. Lee & H.S. Weber; **The nature and potential of gold mineralisation in Kelantan** — L.H. Chu & D. Santokh Singh; **Quaternary deposits of Thailand** — P. Dheeradilok & W. Kaewyana; **Soil landscapes in Peninsular Malaysia** — S. Paramananthan & S. Zauyah; **Aspects of the geochemistry of Malaysian cassiterites** — W. Fuad Hassan; **Geological evolution of the Indonesian Archipelago** — H.M.S. Hartono & S. Tjokrosapoetro; **The nature, distribution and genesis of certain authigenic minerals in the stanniferous alluvial deposits of S.E. Asia** — K.F.G. Hosking; **Global tectonics and resources** — W.S. Fyfe; **Tin/tungsten-bearing granites in S. China and their metallogenetic relations** — Xu Keqin & Zhu Jinchu; **Hydrogeological activities in Peninsular Malaysia and Sarawak** — F.S. Chong & Denis N.K. Tan; **Status of uranium exploration in Peninsular Malaysia** — L.H. Chu & F. Chand; **Directions of geologic transport in Peninsular Malaysia** — H.D. Tjia; **Cathaysia, Gondwanaland and the Palaeotethys in the evolution of Continental S.E. Asia** — Y.G. Gatinsky & C.S. Hutchison; **Marginal sea formation by rifting of the Chinese and Australian Continental Margins and implications for Borneo** — C.S. Hutchison; **Mesozoic and Cenozoic regional tectonics and metallogenesis in Mainland S.E. Asia** — A.H.G. Mitchell; **Coal potential and exploration in Sarawak** — S.P. Chen; **The succession of vertebrate faunas in the continental Mesozoic of Thailand** — E. Buffetaut & R. Ingavat; **Regional controls of hydrothermal ore localization in northern Thailand** — P. Asnachinda & S. Chantaramee; **Late Palaeozoic glacial marine facies in S.E. Asia and its implications** — P.H. Stauffer & C.P. Lee. **Cretaceous melange in West Kalimantan and its tectonic implications** — P.R. Williams *et al.*; **Recent advances in the knowledge of geology, mineral and energy resources of Singapore since 1981** — Ansafur Rahman & P.P. Wong; **The integration of remote sensing, terrain evaluation and engineering geology in Southeast Asia** — Beaumont, T.E. & Hunt, T; **Recent advances in the knowledge of geology and mineral resources of Vietnam since 1981** — Le Thai Xinh & Nguyen Xuan An.

This 2-volume GEOSEA V PROCEEDINGS of about 500 pages each contains 95 articles presented at the Fifth Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia held in Kuala Lumpur, April 1984.

To: Hon. Assist. Secretary
Geological Society of Malaysia,
c/o Department of Geology,
University of Malaya,
59100 Kuala Lumpur, MALAYSIA.

Date: ....

Order for GEOSEA V PROCEEDINGS

I wish to place an order for .... set(s) of the GEOSEA V PROCEEDINGS which will be in 2 volumes of about 500 pages each. Volume I will be available in April/May 1986 and Volume II in July/August 1986.

Both Volumes	Price
Members	M$50.00 (US$21.90)
Non-members	M$125.00 (US$53.20)

Name/Company/Institution ....

....

Address ....

....

....

Enclosed cheque/money order/bank draft .... for M$/US$ ....

Prices include surface mail. For airmail please call 03-7577036 or telex UNIMAL MA37453.

GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATIONS

General Information

The Society publishes the *Buletin Geologi Malaysia* (Bulletin of the Geological Society of Malaysia) and the bimonthly *Warta Geologi* (Newsletter of the Geological Society of Malaysia).

Papers of general interest or on the geology of the Southeast Asian region (South China, Burma, Thailand, Indochina, Malaysia, Singapore, Indonesia, Brunei and the Philippines) and also marine areas within the region are welcome for publication in the *Buletin*. Short notes, progress reports and general items of information are best submitted to the *Warta Geologi*.

Papers should be as concise as possible. However, there is no fixed limit as to the length and number of illustrations. Therefore, papers of monograph length are also welcome. Normally, the whole paper should not exceed 30 printed pages and it is advisable that authors of papers longer than 30 printed pages should obtain the consent of the Editor before submission of the papers.

The final decision of any paper submitted for publication rests with the Editor who is aided by an Editorial Advisory Board. The Editor may send any paper submitted for review by one or more reviewers. Scripts of papers found to be unsuitable for publication may not be returned to the authors but reasons for the rejection will be given. The authors of papers found to be unsuitable for publication may appeal only to the Editor for re-consideration if they do not agree with the reasons for rejection. The Editor will consider the appeal together with the Editorial Advisory Board.

Unless with the consent of the Editor, papers which have been published before should not be submitted for consideration.

Authors must agree not to publish elsewhere a paper submitted to and accepted by the Society.

Authors alone are responsible for the facts and opinions given in their papers and for the correctness of references etc.

Twenty-five reprints of each paper are free-of-charge. Contributors should notify the Editor of extra reprints (which are of non-profit costs) required.

All papers should be submitted to the Editor, Geological Society of Malaysia, c/o Department of Geology, University of Malaya, 59100 Kuala Lumpur, MALAYSIA.

Script Requirements

Scripts must be written in Bahasa Malaysia (Malay) or English.

Two copies of the text and illustrations must be submitted. The scripts must be typewritten double-spaced on papers not exceeding 21 × 33 cm. One side of the page must only be typed on.

Figure captions must be typed on a separate sheet of paper. The captions must not be drafted on the figures.

Original maps and illustrations or as glossy prints should ideally be submitted with sufficiently bold and large lettering to permit reduction to 15 × 22 cm: fold-outs and large maps will be considered only under special circumstances.

Photographs should be of good quality, sharp and with contrast. For each photograph, submit two glossy prints, at least 8 × 12 cm and preferably larger. Use of metric system of measurements (ISU) is strongly urged wherever possible.

Reference cited in the text should be listed at the end of the paper and arranged in alphabetical order and typed double-spaced. The references should be quoted in the following manner:

Suntharalingam,T., 1968. Upper Palaezoic 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.

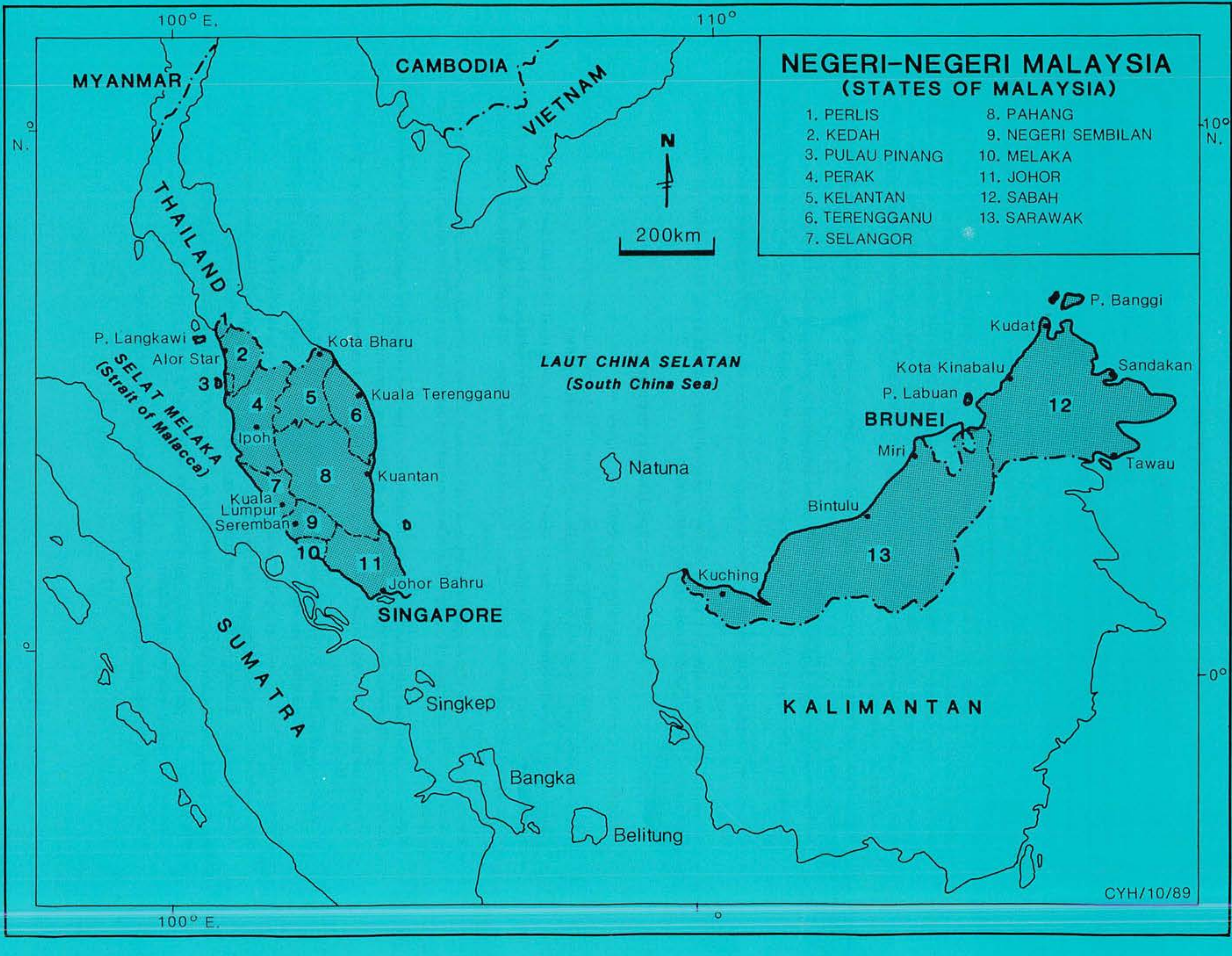
The name of the book or publication must be *underlined* and will be later printed in italics.

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 matters 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
2. KEDAH
3. PULAU PINANG
4. PERAK
5. KELANTAN
6. TERENGGANU
7. SELANGOR
8. PAHANG
9. NEGERI SEMBILAN
10. MELAKA
11. JOHOR
12. SABAH
13. SARAWAK
100° E.
110°
10° N.
0°
N
200km
MYANMAR
CAMBODIA
VIETNAM
THAILAND
P. Langkawi
Alor Star
Kota Bharu
Kuala Terengganu
Ipoh
Kuantan
Kuala Lumpur
Seremban
Johor Bahru
SINGAPORE
SELAT MELAKA
(Strait of Malacca)
LAUT CHINA SELATAN
(South China Sea)
Natuna
SUMATRA
Singkep
Bangka
Belitung
KALIMANTAN
P. Banggi
Kudat
Kota Kinabalu
Sandakan
P. Labuan
BRUNEI
Miri
Tawau
Bintulu
Kuching
CYH/10/89