

# PERSATUAN GEOLOGI MALAYSIA

# WARTA GEOLOGI

## NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MALAYSIA

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GEOLOGICAL SOCIETY  
OF MALAYSIA

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

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

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## **Ultrasonic pulse velocities and elastic moduli of marble cores from the Kuala Lumpur Limestone**

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**Abstract:** Laboratory measurements show the ultrasonic pulse velocities of compressional and shear waves in marble cores from the Kuala Lumpur Limestone to be dependent upon their inherent textural features. Fine grained marble cores show mean compressional and shear wave velocities of 5,147 m/sec, and 2,556 m/sec, whilst medium grained cores show mean velocities of 5,641 m/sec, and 2,609 m/sec, and coarse grained cores mean velocities of 5,741 m/sec, and 2,687 m/sec, respectively. The decrease of ultrasonic pulse velocities with the decrease in grain size reflects the increasing number of intergranular boundaries associated with the increasing effects of deformation within the marble cores. Elastic moduli calculated from the measured pulse velocities are also dependent upon the inherent textural features and decrease in values with the decrease of grain size.

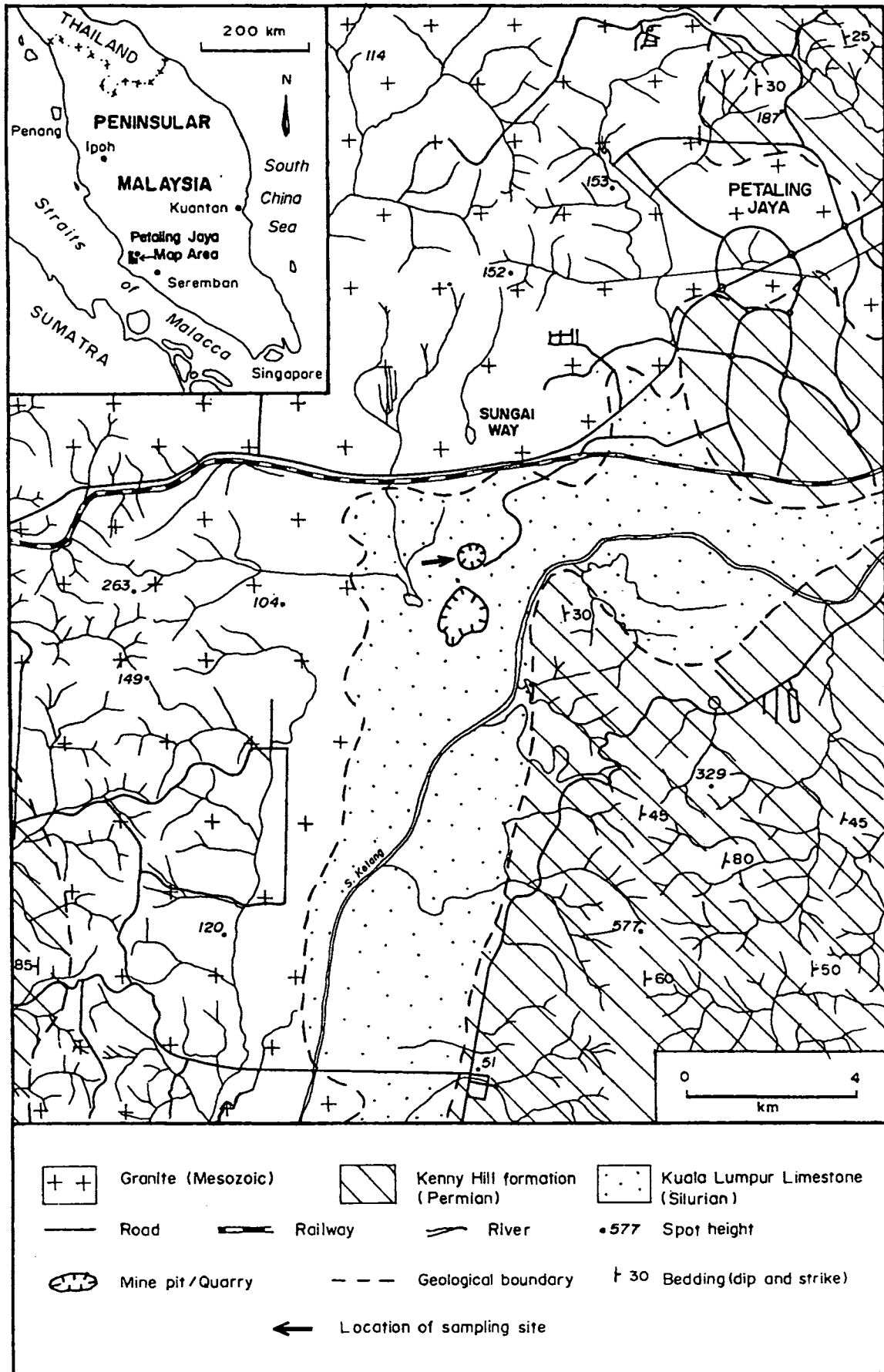
### **INTRODUCTION**

Properties of rock material are usually only considered from the point of view of their reaction to static stresses, i.e. the stresses to which a structure in rock would normally be subjected. However, during the construction phase of engineering projects — and possibly later if earthquakes or nuclear explosions are considered — a rock material may be subjected to transient dynamic loading from the action of explosives, often exceeding by many orders of magnitude any static stress to which it may be subjected (Farmer, 1968). The way in which a rock material may accept or reject these dynamic stresses is of fundamental importance to the design of structures in rock (Farmer, 1968) and towards this end a knowledge of the dynamic elastic moduli of the rock material is extremely useful.

Various techniques can be utilized for determination of the dynamic elastic moduli of a rock material, though the simplest and most commonly used laboratory technique involves their calculation from measurements of the propagation velocities of compressional and

shear waves (ASTM, 1976). Such a calculation procedure is possible in view of the fact that the existence and velocity of all body waves in an elastic medium is a function of its density and elasticity (Obert and Duvall, 1976). It is to be noted that where pulse frequencies, above the audible range, are used for determination of the compressional and shear wave velocities, the calculated moduli are termed ultrasonic elastic moduli (ASTM, 1976; AIT, 1981). The terms sonic and dynamic are also sometimes applied to these moduli, though they have been considered to not describe them precisely (ASTM, 1976).

In this paper are presented the results of the laboratory determinations of compressional and shear wave velocities of ultrasonic pulses through marble cores from the Kuala Lumpur Limestone. Results and procedures for calculation of various elastic moduli are also presented. The cores, though chemically and mineralogically homogenous, are texturally and structurally variable, and the effects of these inherent features on the measured velocities and calculated moduli are also discussed.



**Figure 1.** Bedrock geology of the Sungai Way area, Peninsular Malaysia (after Yin, 1976). Note — Alluvial deposits are not shown.

**Table 1.** Hand specimen and thin-section features of different varieties of marble cores.

VARIETY	HAND-SPECIMEN	THIN-SECTION
Light grey, fine grained marble	Crystalline, fine grained marble with sub-vertical, thin (< 3 mm wide), light and dark grey bands.	Heterogranular-granoblastic texture. Mainly fine grained calcite crystals (0.02-0.06 mm size) with some coarser (0.2-0.6 mm size) grained ones. Coarse grained crystals < 30% of all crystals.
Light grey, medium grained marble	Crystalline, medium grained marble with sub-vertical, thin (< 5 mm wide), light and dark grey bands.	Heterogranular-granoblastic texture. Fine grained (0.02-0.1 mm size) and coarse grained (0.2-1.0 mm size) calcite crystals. Coarse grained crystals are about 50% of all crystals.
Light grey, coarse grained marble	Crystalline, coarse grained marble with sub-vertical, thin (< 5 mm wide), light and dark grey bands.	Heterogranular-granoblastic texture. Mainly coarse grained calcite crystals (0.2-1.5 mm size) with some finer grained ones (0.02-0.1 mm size). Coarse grained crystals > 70% of all crystals.

**Table 2.** Formulae for calculation of elastic moduli.

MODULUS		FORMULA
Poisson's Ratio	$\nu$	$\nu = \frac{1}{2} \left[ \frac{(V_p/V_s)^2 - 2}{(V_p/V_s)^2 - 1} \right]$
Modulus of Elasticity (Young's Modulus)	$E$	$E = \frac{V_s^2 \rho}{g} \left[ \frac{3(V_p/V_s)^2 - 4}{(V_p/V_s)^2 - 1} \right]$
Bulk Modulus (Compressibility)	$K$	$K = \frac{\rho}{g} V_s^2 \left[ \frac{V_p^2}{V_s^2} - \frac{4}{3} \right]$
Modulus of Rigidity (Shear Modulus)	$G$	$G = \frac{E}{2(1 + \nu)}$
Lame's Constant	$\lambda$	$\lambda = \frac{E \nu}{(1 + \nu)(1 - 2\nu)}$

**Note:**  $V_p$  Compressional wave velocity;  $\rho$  = Unit weight  
 $V_s$  Shear wave velocity;  $g$  = gravitational acceleration

**Table 3.** Ultrasonic pulse velocities and elastic moduli of marble cores from orientated boreholes.

Sample No.	Unit Weight kN/cu.m.	S Wave Velocity m/sec	P Wave Velocity m/sec	Poisson's Ratio	Modulus Elasticity GPa	Bulk Modulus GPa	Modulus Rigidity GPa	Lame's Constant GPa
1a	26.580	2,486	5,065	0.341	44.94	47.19	16.75	36.02
1b	26.591	2,508	4,939	0.326	45.24	43.40	17.05	32.02
1c	26.590	2,495	4,925	0.327	44.80	43.28	16.87	32.03
1d	26.595	2,501	5,042	0.337	45.35	46.34	16.96	35.03
2b	26.591	2,707	5,732	0.356	53.90	62.60	19.87	49.35
2c	26.621	2,620	5,767	0.370	51.07	65.42	18.64	52.99
2d	26.600	2,711	5,804	0.360	54.24	64.80	19.93	51.51
2e	26.611	2,711	5,838	0.363	54.34	65.88	19.94	52.58
2f	26.619	2,624	5,821	0.372	51.31	67.05	18.69	54.58
2g	26.620	2,624	5,785	0.371	51.22	65.93	18.69	53.47
3a	26.609	2,693	5,768	0.361	53.55	64.05	19.68	50.93
3b	26.595	2,502	5,479	0.368	46.44	58.77	16.97	47.46
3c	26.596	2,525	5,490	0.366	47.25	58.69	17.30	47.15
4a	26.616	2,462	5,383	0.368	45.00	56.70	16.45	45.73
4b	26.624	2,622	5,820	0.373	51.23	67.08	18.66	54.63
4c	26.622	2,623	5,740	0.368	51.11	64.54	18.68	52.08
5a	26.619	2,604	5,518	0.357	49.95	58.10	18.41	45.82
5b	26.619	2,593	5,645	0.366	49.88	62.17	18.25	50.00
5c	26.619	2,622	5,694	0.366	50.95	63.15	18.66	50.70
5d	26.619	2,630	5,775	0.369	51.41	65.51	18.77	52.98
9a	26.620	2,598	5,674	0.367	50.11	62.96	18.32	50.74
9b	26.619	2,593	5,609	0.364	49.77	61.06	18.24	48.89
9c	26.608	2,709	5,638	0.350	53.75	59.71	19.91	46.43
9d	26.613	2,589	5,697	0.370	49.83	63.84	18.19	51.71
9j	26.612	2,541	5,579	0.369	47.97	61.12	17.52	49.44
11c	26.619	2,686	5,866	0.367	53.54	67.30	19.58	54.24
11d	26.617	2,638	5,784	0.369	51.70	65.63	18.89	53.04
11e	26.619	2,644	5,764	0.367	51.85	64.90	18.97	52.25

### KUALA LUMPUR LIMESTONE

In the Sungai Way area of Selangor State in Peninsular Malaysia (Fig. 1) are found marbles (recrystallized limestones) that have been mapped as a part of the Kuala Lumpur Limestone (Yin, 1976). The Formation consists almost entirely of carbonates with relatively little impurity, though regional metamorphism, and a superimposed contact metamorphism close to Mesozoic granite intrusions, has caused marmorization and largely obliterated the original sedimentary features (Gobbett, 1964). The Formation is of a Middle to Upper Silurian age, and over most of its mapped area, is a

crystalline calcitic limestone, frequently containing a small percentage of magnesium, while dolomitic limestone and dolomite are locally dominant. Surface outcrops are limited to a few localities and the Formation is mostly only found in mine pits and subsurface quarries beneath a cover of alluvial sediments of variable thickness.

### SAMPLING SITE

In the Sungai Way area, the marble bedrock forms an irregular, pinnacle and trough topography beneath gravelly to sandy and clayey alluvial sediments of some 5 to 35 m in thickness.

**Table 4.** Ultrasonic pulse velocities and elastic moduli of marble cores from vertical boreholes.

Sample No.	Unit Weight kN/cu.m.	S Wave Velocity m/sec	P Wave Velocity m/sec	Poisson's Ratio	Modulus Elasticity GPa	Bulk Modulus GPa	Modulus Rigidity GPa	Lame's Constant GPa
21c	26.587	2,581	5,000	0.318	47.61	43.72	18.06	31.67
21d	26.582	2,529	5,059	0.333	46.25	46.24	17.34	34.68
21e	26.607	2,568	5,272	0.345	48.10	51.57	17.89	39.64
21f	26.614	2,675	5,379	0.336	51.89	52.63	19.42	39.67
21r	26.589	2,716	5,291	0.321	52.84	49.24	20.00	35.90
23b	26.604	2,674	5,848	0.368	53.05	66.93	19.39	54.00
23c	26.601	2,783	5,616	0.337	56.20	57.53	21.02	43.51
23d	26.617	2,743	5,761	0.353	55.29	62.84	20.43	49.22
23e	26.619	2,812	5,761	0.344	57.69	61.46	21.47	47.14
26.590	2,532	5,663	0.375	47.80	63.77	17.38	52.18	
24h	26.616	2,682	5,492	0.343	52.44	55.83	19.52	42.81
24i	26.619	2,683	5,352	0.332	52.07	51.68	19.54	38.65
24m	26.611	2,653	5,551	0.352	51.66	58.15	19.10	45.41
25d	26.597	2,720	5,779	0.358	54.49	63.81	20.07	50.43
25e	26.588	2,704	5,551	0.344	53.29	57.11	19.82	43.89
25f	26.589	2,704	5,709	0.355	53.75	61.92	19.83	48.69
25g	26.594	2,632	5,539	0.354	50.89	58.16	18.79	45.63
26b	26.614	2,799	5,761	0.346	57.20	61.75	21.25	47.57
26c	26.613	2,697	5,790	0.362	53.74	64.67	19.73	51.51
26d	26.599	2,765	5,820	0.354	56.17	64.21	20.74	50.37
26e	26.593	2,701	5,789	0.361	53.86	64.49	19.79	51.29

**Table 5.** Ultrasonic pulse velocities and elastic moduli of light grey, fine grained marble cores.

Sample No.	Unit Weight kN/cu.m.	S Wave Velocity m/sec	P Wave Velocity m/sec	Poisson's Ratio	Modulus Elasticity GPa	Bulk Modulus GPa	Modulus Rigidity GPa	Lame's Constant GPa
1a	26.580	2,486	5,065	0.341	44.94	47.19	16.75	36.02
1b	26.591	2,508	4,939	0.326	45.24	43.40	17.05	32.02
1c	26.590	2,495	4,925	0.327	44.80	43.28	16.87	32.03
1d	26.595	2,501	5,042	0.337	45.35	46.34	16.96	35.03
21d	26.582	2,529	5,059	0.333	46.25	46.24	17.34	34.68
21e	26.607	2,568	5,272	0.345	48.10	51.57	17.89	39.64
21f	26.614	2,675	5,379	0.336	51.89	52.63	19.42	39.67
24h	26.616	2,682	5,492	0.343	52.44	55.83	19.52	42.81
Mean	26.597	2,556	5,147	0.336	47.38	48.31	17.73	36.49
Std. Dev.		81	194	0.000	3.12	4.15	1.15	3.50
21c#	26.587	2,581	5,000	0.318	47.61	43.72	18.06	31.67
21r*	26.589	2,716	5,291	0.321	52.84	49.24	20.00	35.90
24i*	26.619	2,683	5,352	0.332	52.07	51.68	19.54	38.65
24m*	26.611	2,653	5,551	0.352	51.66	58.15	19.10	45.41

**Note:** \* — Specimen with moderately dipping, healed fracture plane  
# — Specimen with vertical, healed fracture plane

**Table 6.** Ultrasonic pulse velocities and elastic moduli of light grey, medium grained marble cores.

Sample No.	Unit Weight kN/cu.m.	S Wave Velocity m/sec	P Wave Velocity m/sec	Poisson's Ratio	Modulus Elasticity GPa	Bulk Modulus GPa	Modulus Rigidity GPa	Lame's Constant GPa
3a	26.609	2,693	5,768	0.361	53.55	64.05	19.68	50.93
3b	26.595	2,502	5,479	0.368	46.44	58.77	16.97	47.46
3c	26.596	2,525	5,490	0.366	47.25	58.69	17.30	47.15
5a	26.619	2,604	5,518	0.357	49.95	58.10	18.41	45.82
5d	26.619	2,630	5,775	0.369	51.41	65.51	18.77	52.98
9a	26.620	2,598	5,674	0.367	50.11	62.96	18.32	50.74
9b	26.619	2,593	5,609	0.364	49.77	61.06	18.24	48.89
9c	26.608	2,709	5,638	0.350	53.75	59.71	19.91	46.43
9d	26.613	2,589	5,697	0.370	49.83	63.84	18.19	51.71
11e	26.619	2,644	5,764	0.367	51.85	64.90	18.97	52.25
Mean	26.612	2,609	5,641	0.364	50.39	61.76	18.48	49.44
Std. Dev.		65	115	0.000	2.38	2.82	0.92	2.61
5b*	26.619	2,593	5,645	0.366	49.88	62.17	18.25	50.00
5c*	26.619	2,622	5,694	0.366	50.95	63.15	18.66	50.70
9j*	26.612	2,541	5,579	0.369	47.97	61.12	17.52	49.44
11c#	26.619	2,686	5,866	0.367	53.54	67.30	19.58	54.24
11d*	26.617	2,638	5,784	0.369	51.70	65.63	18.89	53.04

**Note:** \* — Specimen with moderately dipping, healed fracture plane  
# — Specimen with vertical, healed fracture plane

**Table 7.** Ultrasonic pulse velocities and elastic moduli of light grey, coarse grained marble cores.

Sample No.	Unit Weight kN/cu.m.	S Wave Velocity m/sec	P Wave Velocity m/sec	Poisson's Ratio	Modulus Elasticity GPa	Bulk Modulus GPa	Modulus Rigidity GPa	Lame's Constant GPa
2c	26.621	2,620	5,767	0.370	51.07	65.42	18.64	52.99
2d	26.600	2,711	5,804	0.360	54.24	64.80	19.93	51.51
2e	26.611	2,711	5,838	0.363	54.34	65.88	19.94	52.58
2f	26.619	2,624	5,821	0.372	51.31	67.05	18.69	54.58
4a	26.616	2,462	5,383	0.368	45.00	56.70	16.45	45.73
4b	26.624	2,622	5,820	0.373	51.23	67.08	18.66	54.63
4c	26.622	2,623	5,740	0.368	51.11	64.54	18.68	52.08
23b	26.604	2,674	5,848	0.368	53.05	66.93	19.39	54.00
23c	26.601	2,783	5,616	0.337	56.20	57.53	21.02	43.51
23d	26.617	2,743	5,761	0.353	55.29	62.84	20.43	49.22
23e	26.619	2,812	5,761	0.344	57.69	61.46	21.47	47.14
25d	26.597	2,720	5,779	0.358	54.49	63.81	20.07	50.43
25g	26.594	2,632	5,539	0.354	50.89	58.16	18.79	45.63
26b	26.614	2,799	5,761	0.346	57.20	61.75	21.25	47.57
26c	26.613	2,697	5,790	0.362	53.74	64.67	19.73	51.51
26d	26.599	2,765	5,820	0.354	56.17	64.21	20.74	50.37
Mean	26.611	2,687	5,741	0.359	53.31	63.30	19.62	50.22
Std. Dev.		89	125	0.011	3.18	3.35	1.29	3.43
2b#	26.591	2,707	5,732	0.356	53.90	62.60	19.87	49.35
2g*	26.620	2,624	5,785	0.371	51.22	65.93	18.69	53.47
23f*	26.590	2,532	5,663	0.375	47.80	63.77	17.38	52.18
25e*	26.588	2,704	5,551	0.344	53.29	57.11	19.82	43.89
25f*	26.589	2,704	5,709	0.355	53.75	61.92	19.83	48.69
26e#	26.593	2,701	5,789	0.361	53.86	64.49	19.79	51.29

**Note:** \* — Specimen with moderately dipping, healed fracture plane  
# — Specimen with vertical, healed fracture plane



**Table 8.** Mean values of ultrasonic pulse velocities and elastic moduli of different varieties of marble cores.

Marble Variety	Unit Weight kN/cu.m.	S Wave Velocity m/sec	P Wave Velocity m/sec	Poisson's Ratio	Modulus Elasticity GPa	Bulk Modulus GPa	Modulus Rigidity GPa	Lame's Constant GPa
Light grey, fine grained marble	26.597	2,558	5,147	0.336	47.38	48.31	17.73	36.49
Light grey, medium grained marble	26.612	2,609	5,641	0.364	50.39	61.76	18.48	49.44
Light grey, coarse grained marble	26.611	2,687	5,741	0.359	53.31	63.30	19.62	50.22

The pinnacles, which are of various shapes and sizes, are often pock-marked with cavities and are separated by troughs of sinuous and elongate shape. The tops of the pinnacles furthermore, show an approximately accordant surface which dips eastward at about 5°.

The bedrock is variously coloured from white to light and dark grey and is fine to coarse grained. These colours and textures are patchily distributed in the area, though a thin inter-banding of light and dark grey layers is commonly found. Secondary calcite veins are also found within the bedrock which is cut by several joints and faults of variable strikes and dips. Along these structural discontinuity planes, which show very irregular to smooth faces, secondary iron oxide and hydroxide stains are sometimes found.

In thin-sections, the bedrock shows effects of both recrystallization and deformation, though these effects are variably distributed in the area. The thin-sections also show that the bedrock consists exclusively of recrystallized calcite, though secondary iron oxide grains are seen in weathered samples.

#### METHOD OF STUDY

In the course of a rock slope stabilisation program at an old mine pit/quarry in the Sungai Way area, several orientated (dipping 30° towards North), and vertical, boreholes were drilled some 10 m apart over an area of about 2,000 m<sup>2</sup>. Continuous cores of about 0.5 to 1 m

long from several of these boreholes were made available for laboratory tests. These cores of mainly 47.35 mm diameter were first sawn into shorter specimens of 90 to 110 mm long, whilst thin sections were prepared of representative samples. The ends of the shorter core specimens were then finely ground, before their visible textural and structural features were described. The bulk densities and unit weights of these specimens were also determined according to the suggested saturation and buoyancy method of ISRM (1979).

The short core specimens were then oven-dried overnight at 105°C before the ultrasonic pulse velocities of compressional and shear waves were measured using an OYO Corporation New Sonic Viewer (Model 5217A). Compressional, and shear, wave transducers of 63 kHz, and 33 kHz, frequency respectively, were used; the shear wave velocities being determined first, as grease was applied to ensure proper contact for the compressional wave velocity measurements.

Thin-sections show the tested specimens to have a hetero-granular-granoblastic texture with coarse, irregular anhedral of calcite (of 0.2 to 1.5 mm size) scattered through a much finer grained mosaic (of 0.02 to 0.1 mm size). The coarser grained crystals, which are often elongate and lensoid in shape, occur in streaky bands of variable width that alternate with also streaky bands of the finer grained crystals. The finer grained bands can be considered to represent material that has been granulated by shearing

and that has recrystallized after deformation ceased, whilst the coarser bands are composed of strained calcite in process of granulation (Williams, Turner and Gilbert, 1969). The relative percentages of the coarse and fine grained crystals are variable from sample to sample and allow for differentiation of three broad textural groups (Table 1).

### ELASTIC MODULI

The fundamental basis of elastic theory is the linear relationship between applied stress and the resulting strain; an elastic medium being one in which all strain is instantaneously and totally recoverable on removal of the applied stress (Farmer, 1968). In such a medium furthermore, the existence and velocity of all body waves is a function of its density (or unit weight) and elasticity; the propagation velocities of compressional (or longitudinal or primary) waves ( $V_p$ ), and shear (or transverse or secondary) waves ( $V_s$ ) being related to the elastic moduli by the following equations (after Obert and Duvall, 1976):-

$$V_p = \left[ \frac{E_g(1 - \nu)}{\rho(1 + \nu)(1 - 2\nu)} \right]^{1/2} \quad V_s = \left[ \frac{G_g}{\rho} \right]^{1/2}$$

where  $E$  is the modulus of elasticity or Young's modulus;  $G$  is the modulus of rigidity;  $\rho$  is the unit weight;  $\nu$  is Poisson's ratio and  $g$  is the acceleration of gravity.

By determining the propagation velocities of compressional ( $V_p$ ), and shear ( $V_s$ ), waves through an elastic medium, as well as its unit weight ( $\rho$ ), it is thus possible to calculate the various elastic moduli. Equations for the calculation of these moduli, as well as the Bulk Modulus ( $K$ ) and Lamé's Constant ( $\lambda$ ), from the measurements of compressional and shear wave velocities, are shown in Table 2. These equations have been used in many recent studies to derive the elastic moduli of rock material, though it has been pointed out that there are few demonstrations that these equations are applicable (Birch, 1966).

It is furthermore, to be noted that the said equations are only valid if a material is

isotropic, homogeneous and linear-elastic (Obert and Duvall, 1976). Rock material, however, is usually anisotropic, heterogeneous and behaves non-linearly when subjected to large stresses, though its behaviour can be considered to be linear for sufficiently small changes in stress (Fjaer *et al.*, 1992). Comparisons of moduli of rigidity or compressibility derived from measurements of velocities, and measurements of changes of length under hydrostatic pressure furthermore, show fair agreement and justify the use of the said equations at moderately high pressures (Birch, 1966).

### RESULTS AND DISCUSSION

Results of determinations of the compressional and shear wave velocities of core specimens from the orientated and vertical boreholes (Tables 3 and 4) show a range of values that are comparable with published data, as Youash (1970) who quotes compressional, and shear, wave velocities of 4,390 to 5,102 m/sec, and 2,636 to 2,683 m/sec, respectively for the Yule Marble of Mississippian (Early Carboniferous) age. Zaleski *et al.* (1967) furthermore, quote average compressional, and shear, wave velocities of 4,080 and 2,800 m/sec, respectively for a medium grained, Palaeozoic calcitic marble from Kibikkordon, whilst Fitch (1978) quotes average longitudinal, and transverse, wave velocities of 5.95, and 3.16, km/sec, measured at room pressure and temperature, for the Solenhofen Limestone.

Elastic moduli calculated from the measured velocities show a range of values (Tables 3 and 4), though higher values of moduli and velocities are associated with the cores of greater unit weights. This is to be expected as the velocities of body waves increase with increasing density (Lama and Vutukuri, 1978). The calculated moduli are also comparable with published data, as Zaleskii *et al.* (1967) who quote a Poisson's ratio of 0.24, a modulus of elasticity of 38.5 GPa and a shear modulus of 21.3 GPa, for the marble from Kibikkordon, and Belikov *et al.* (1967) who quote an average Poisson's ratio of 0.40 and an average modulus of elasticity of 95.13 GPa for fine grained marbles from Gazan, and a modulus of elasticity of 73.55 GPa for coarse grained marbles from Sultanizdat.

When the results are grouped according to inherent textural and structural features of individual core specimens (Tables 5, 6 and 7) distinct patterns emerge, with the coarse grained marbles showing higher velocities and elastic moduli than the medium grained marbles which in turn show higher values than the fine grained marbles. Textural differences are thus seen to influence the propagation velocities and calculated moduli; there being a decrease of velocities and moduli with a decrease in grain size (Table 8). This influence of grain size most likely results from the increasing number of intergranular boundaries with decreasing grain size; the decrease of grain size reflecting increasing effects of deformation on the original marble. This influence of intergranular boundaries is also considered by Zaleskii *et al.* (1967) to account for discrepancies between experimental data and theoretical calculations of propagation velocities and elastic moduli in monomineralic rock materials.

It is finally interesting to note that healed fractures in the core specimens do not strongly affect the compressional and shear wave velocities (Tables 5, 6 and 7), though in some cases the shear wave velocities are lower. This absence of influence of the healed fractures has also noted by other workers as Youash (1970) who has pointed out that the data from some dynamic tests can be more useful than data from static tests as the dynamic tests are not affected by fractures and other features.

## CONCLUSIONS

It is concluded that inherent textural features of marble cores from the Kuala Lumpur Limestone influence the propagation velocities of ultrasonic pulses and calculated elastic moduli. A decrease of compressional and shear wave velocities, as well as elastic moduli, is associated with a decrease in grain size; this decrease resulting from the increasing number of intergranular boundaries that reflect increasing effects of deformation within the cores. Fine grained marble cores show mean compressional, and shear, wave velocities of 5,147 m/sec and 2,556 m/sec, whilst medium grained cores show mean velocities of 5,641 m/sec, and 2,609 m/sec, and coarse grained cores mean velocities

of 5,741 m/sec, and 2,687 m/sec, respectively.

## ACKNOWLEDGEMENTS

This study forms part of an on-going research project on the geotechnical properties of earth materials in Malaysia and is supported by IRPA Grant 04-07-04-172 from the Malaysian Government. Mr. Roshdy is thanked for drafting the figure.

## REFERENCES

- AIT, 1981. Sonic velocity test for intact rock material. Chpt. XI in 'Laboratory Manual for Rock Testing', Div. of Geotechnical Engineering & Transportation Engineering, Asian Inst. of Technology, Bangkok, Thailand, 175-189.
- ASTM, 1976. Standard method for laboratory determination of pulse velocities and ultrasonic elastic constants of rock. *American Society for Testing and Materials*, ANSI/ASTM D 2845-69, ASTM Standards, 341-348.
- BELIKOV, B.P., 1967. Plastic constants of rock-forming minerals and their effect on the elasticity of rocks. In: B.V. Zaleskii (Ed.), *Physical and Mechanical Properties of Rocks*, IPST, Jerusalem, 124-140.
- BELIKOV, B.P., ZALESSKII, B.V., ROZANOV, A.Y., SANINA, E.A. AND I.P. TIMCHENKO, 1967. Methods of studying the physico-mechanical properties of rocks. In: B.V. Zaleskii (Ed.), *Physical and Mechanical Properties of Rocks*, IPST, Jerusalem, 1-58.
- BIRCH, F., 1966. Compressibility; Elastic Constants. Chpt. 7 in 'Handbook of Physical Constants', *Geol. Soc. America*, Mem. 97, 97-168.
- FARMER, I.W., 1968. *Engineering Properties of Rocks*. E & F.N. Spon Ltd., London, 180p.
- FJAER, E., HOLT, R.M., HORSRUD, P., RAAEN, A.M. AND RISNES, R., 1992. *Petroleum Related Rock Mechanics*. Dev. In Petroleum Science, 33, Elsevier, Amsterdam, 338p.
- FRITZ, I.J., 1978. Ultrasonic in Solenhofen Limestone at high pressures. *Geophysics*, 43(5), 1014-1017.
- GOBBETT, D.J., 1964. The Lower Palaeozoic rocks of Kuala Lumpur, Malaysia. *Federation Museums Journal*, 9, 67-79.
- ISRM, 1979. Suggested methods for determining water content, porosity, density, absorption and related properties and swelling and slake durability index properties. *Int. J. Rock Mech. Min. Sci. & Geomech. Abstr.*, 16, 141-156.
- ISRM, 1981. Suggested methods for determining sound velocity. In: Brown, E.T. (Ed.), *Rock*

- Characterization, Testing and Monitoring*. ISRM Suggested Methods, International Society Rock Mechanics, Pergamon Press, 105-110.
- LAMA, R.D. AND VUTUKURI, V.S., 1978. *Handbook on Mechanical Properties of Rocks — Testing Techniques And Results, Vol. II*, Trans Tech Publications, Germany, 481p.
- OBERT, L. AND DUVAL, W.I., 1976. *Rock Mechanics and The Design of Structures in Rock*. John Wiley and Sons Inc., New York, 650p.
- WILLIAMS, H., TURNER, F.J. AND GILBERT, C.M., 1969. *Petrography — An Introduction to the Study of Rocks in Thin Sections*. Vakils, Feffer and Simons Private Ltd., Bombay, 406p.
- YIN, E.H., 1976. Geological Map of Kuala Lumpur, Map Sheet No. 94, New Series, Pen. Malaysia, Scale 1:63,360, Director-General, Geological Survey of Malaysia.
- YOUASH, Y.Y., 1970. Dynamic physical properties of rocks: Part II, experimental results. *Proc. 2nd Cong., Int. Soc. Rock Mech., 21-26 Sept. 1970, Beograd, Yugoslavia*, 1, 185-195.
- ZALESSKII, B.V., SILAERA, O.I., KOROTKOVA, O.N., LIKHACHERA, Y.S. NIKOLAEV, S.V. AND V.N. ANDREEV, 1967. Dynamic elasticity characteristics of certain minerals and monomineralic aggregates. In: B.V. Zaleskii (Ed.), *Physical and Mechanical Properties of Rocks*. IPST, Jerusalem, 117-123.

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Manuscript received 25 June 1994

# CATATAN GEOLOGI

## Geological Notes

### Fracture axial-plane cleavage by soft-sediment deformation

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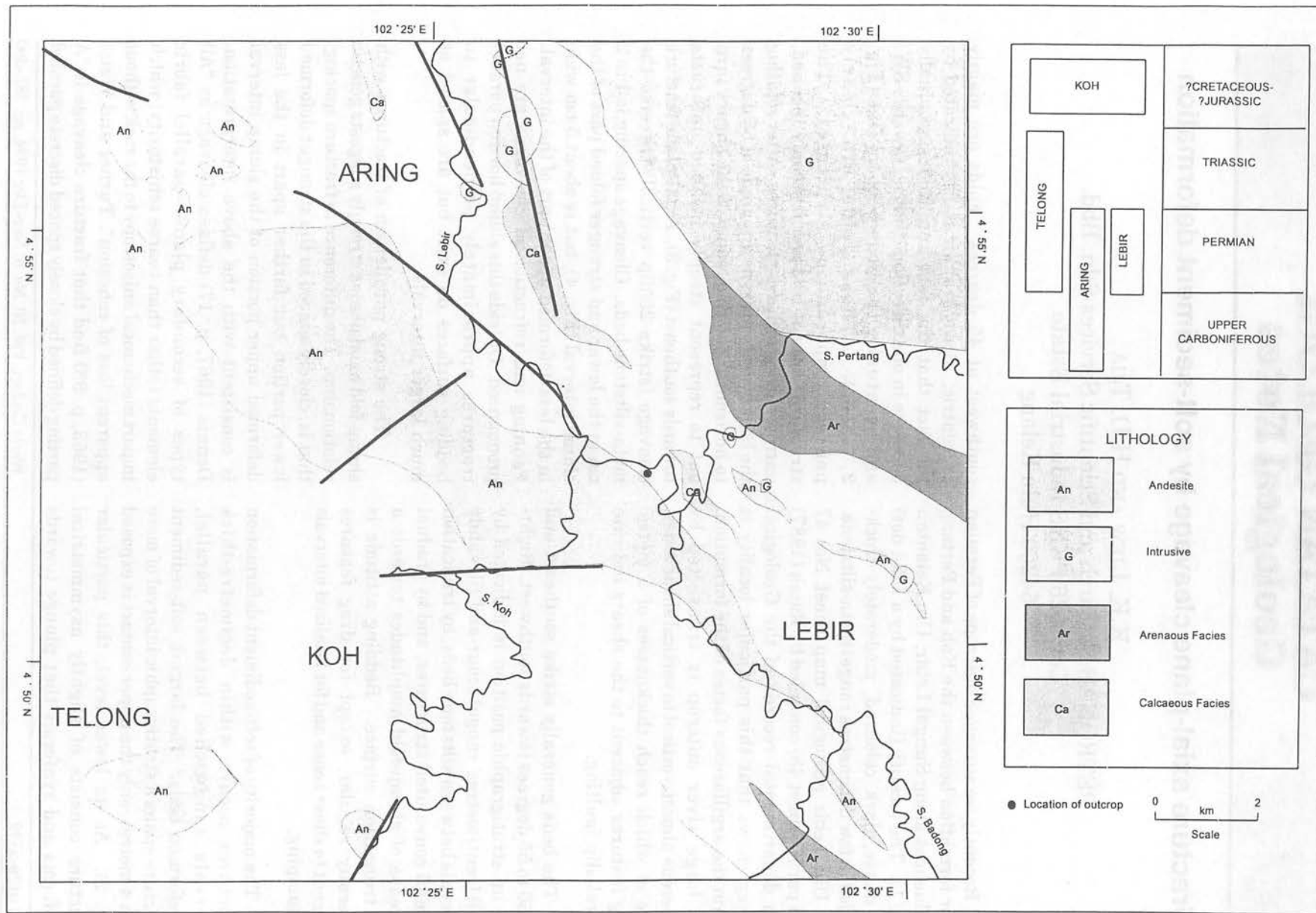
Recently we surveyed outcrops of Permian Lebir formation between the Koh and Pertang confluences along Sungai Lebir, Ulu Kelantan (Fig. 1). The locality (indicated by a solid dot) has dense, dark coloured, moderately thick-bedded (a few decimetres range) meta-siltstone. The Ulu Lebir geological map sheet No. 47 (and part of sheet 48) compiled by Rajah (1987) from departmental records of the Geological Survey shows that this particular locality is within the argillaceous facies of the formation. The large river outcrop is transected by numerous almost-vertical to vertical shear zones, some of which reach thicknesses of a metre. Drag features adjacent to the shears indicate lateral-slip faulting.

The beds generally strike southeast and dip 50 to 55 degrees towards southwest. Right-side up stratigraphic position is indicated by small (centimetres' range) scour-and-fill sandy intervals between siltstone beds, by truncation of small convoluted structures, and by gradual decrease of slump-fold amplitudes towards a flat truncation surface. Bedding attitude is generally regular, except for drag features adjacent to shear zones and for localized intervals of slumping.

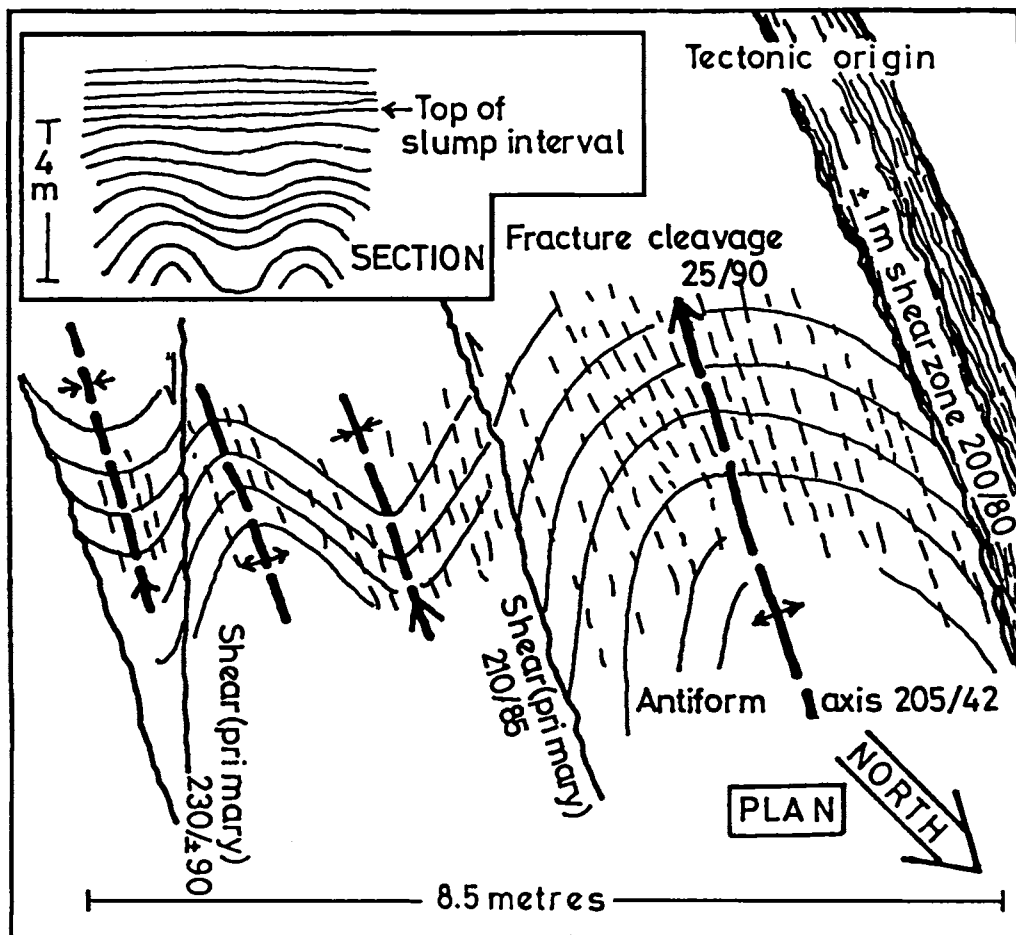
The majority of soft-sediment deformation structures occurs within decimetre-thick intervals sandwiched between parallel, undeformed beds. The largest soft-sediment structure spans a stratigraphic interval of more than 4 metres; only the upper contact is exposed (Fig. 2). At its lower level, this particular structure consists of slightly asymmetrical antiforms and synforms that plunge towards

southwest at 45 degrees. Folds are mainly concentric. Stratigraphic top is indicated by the fact that the fold amplitudes gradually decrease in one direction (that is, towards SW) and eventually the beds become flat (Fig. 2, inset). These folds are clearly penecontemporaneous structures. The structures are cut by several steeply inclined, narrow shears with drag features. After rotating the beds over its present dip-angle of 55 degrees to horizontal position, some of the shears turn out to represent steeply inclined upthrusts towards southeast (Fig. 3). Axial-plane fracture cleavage (strike 25/dip vertical) traverse the meta-siltstone beds. Cleavage spacing is 1 to 2 cm in the lower and stronger folded part of the slump interval (Fig. 4), but is about 5 cm wide in the less deformed upper part of the interval. Fanning and refraction of cleavages are not pronounced. Outside this slump horizon parallel fractures approximately perpendicular to bedding surfaces do exist but are spaced at much larger intervals.

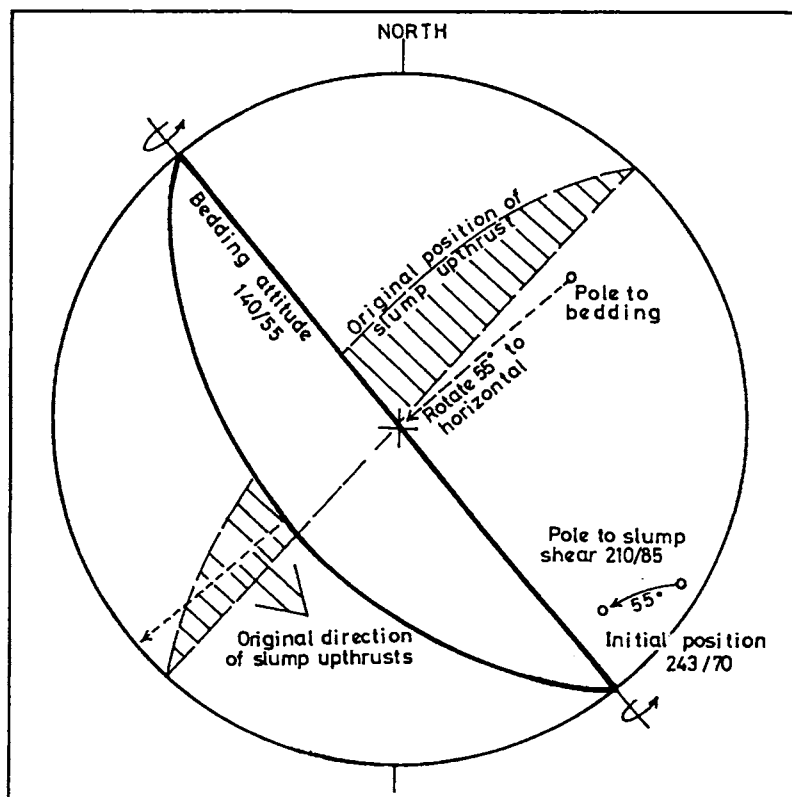
The strong parallelism of fractures with slump-fold axial planes strongly suggests genetic relationship. The difference in fracture spacing, that is, closely spaced in the stronger deformed lower portion but farther apart in the less deformed upper portion of the slump interval is consistent with the above interpretation. Dennis (1967, p. 17) defines cleavage as "All types of secondary planar parallel fabric elements (other than coarse schistosity) which impart mechanical anisotropy to the rock without apparent loss of cohesion". Turner and Weiss (1963, p. 98) find that fracture cleavage is "A parting defined by closely spaced discrete parallel



**Figure 1.** Geological map and location of the studied outcrop (solid dot in the Lebir formation). Map based on 1:63,360 scale geological maps of Sungai Aring (Aw, 1978) and Ulu Lebir (Rajah, 1987).



**Figure 2.** Slump folds, shears and axial-plane fracture cleavage in metasiltstone of the Permian Lebir formation in the studied outcrop along Sungai Lebir (see Fig. 1). Inset shows attenuation of slump-fold intensity towards its stratigraphic top.



**Figure 3.** Equal-area plot of bedding and slump faults (shears) in the outcrop of Figure 2, and rotation to their original position before the beds became tilted 55 degrees about its NW-SE strike.



**Figure 4.** Axial-plane fracture cleavage in slump structures of the Permian Lebir formation, studied outcrop along Sungai Lebir.

fractures, ideally independent of any planar preferred orientation of grain boundaries that may exist in the rock. Can occur in almost all rock types”.

Our observations on the parallel fractures in penecontemporaneously deformed metasiltstone beds of the Permian Lebir formation indicate the following points:

- (1) Fracturing parallel to fold axial planes can develop as *primary structures* in semi(?) -consolidated fine-grained clastic material.
- (2) Intensity of fracturing increases with increase in slump-fold amplitude or, with increase in degree of fold tightness.
- (3) These fractures stay preserved as the rocks undergo low-grade metamorphism.

#### ACKNOWLEDGEMENT

We thank the Management of PRSS for permission to publish this brief communication.

#### REFERENCES

- Aw, P.C., 1978. [Geological map] *Sungai Aring, Sheet 46 and part of Sheet 58, Kelantan, 1:63,360*. Geological Survey of Malaysia, Kuala Lumpur.
- Dennis, J.G., 1967. *International Tectonic Dictionary. English terminology*. American Association of Petroleum Geologists, Memoir 7, 196p.
- Rajah, S.S., 1987. [Geological map] *Ulu Lebir, Sheet 47 and part of Sheet 48, Terengganu, Kelantan and Pahang, 1:63,360*. Geological Survey of Malaysia, Kuala Lumpur.
- Turner, F.J. and Weiss, L.E., 1963. *Structural Analysis of Metamorphic Tectonites*. McGraw-Hill, New York, 545p.

Manuscript received 1 July 1994



## **PERTEMUAN PERSATUAN** **Meetings of the Society**

### **Ceramah Teknik (Technical Talk)**

#### **Australian and Malaysian perspectives on sustainable development (ecological and environmental) and environmental management programme (EMP) implementation**

YIN K. FOONG

##### **Laporan (Report)**

Mr. Yin K. Foong on a visit to Kuching recently gave a talk on "Australian and Malaysian perspectives on sustainable development (ecological and environmental) and environmental management programme (EMP) implementation" at the Department of the Geological Survey of Malaysia, Sarawak at 9.00 am on 8 November 1994.

Mr. Foong is a Life Member of the Geological Society after completing his MSc. in Engineering Geology from the Royal Melbourne Institute of Technology, Australia he worked as a groundwater hydrologist for a number of international consultant companies in Australia and is currently the Business Development Manager Environment Division, CMFS&F Pty. Ltd. undertaking a research study in Malaysia on "Malaysia Vision 2020: Understanding the environmental concept, implications and challenges".

In his talk, Mr. Foong introduced the concept of sustainable development and referred to the Earth Summit in Brazil 1992 which called for effective environment legislation. He then discussed the Australian initiative under which the Ecologically Sustainable Development Group has established to assist the government in determining policy directions. Definitions, goals, objectives and principles were set up and sectoral issues related to agriculture, fisheries, forest use, manufacturing, mining, urban and transport planning, tourism and energy; addressed in detail. Under the Malaysian perspective, he discussed the development of environmental regulations and actions adopted by the government, the Environmental Quality Act (1974), the EIA procedure of 1988 and other policy statements related to the environment in the Malaysian Plans and Outline Perspective Plan.

The talk was arranged by the Geological Society of Malaysia through its regional representative Mr. Victor Hon and was attended by about 40 people including GSM members and invited guests from related agencies from the private and public sectors.

##### **Sinopsis (Synopsis)**

The adverse effects of human activities on the environment have accelerated in the last few decades. Desertification, ozone layer depletion and extinction of species are some of the more profound changes to affect the planet. Consequently, most nations are giving priority to protecting the environment. The Earth Summit in Brazil in 1992 called for decisive action from all governments to completely overhaul not only their environmental protection management, but the entire approach to economic development, social equity and obligations

to the international community in terms of support for under developed countries and prevention of trans-boundary pollution. It was agreed that all countries (including Australia and Malaysia) must enact effective environmental legislation if sustainable development were to be achieved.

Under the Australian initiative, the Ecologically Sustainable Development (ESD) Group was established to assist the government to determine policy directions. Definitions, goals, objectives and principles were set firstly. Sectional issues were addressed in detail namely, Agriculture, Fisheries, Forest Use, Manufacturing, Mining, Urban and Transport Planning, Tourism and Energy. Furthermore, Environmental Management Issues were reviewed. They include the EIA-Commonwealth Review, Coastal Protection, Environmental Management Programmes and Plans.

In terms of the Malaysian Perspective, great strides in economic development has taken place over the last 37 years since her independence in 1957. In the earlier rush to industrialise, little heed was paid to the environment resulting in damage to the environment, although environment management was practised through various legislations under sectoral agencies similar to that of Australia. It was only in 1974 with the enactment of the Environmental Quality Act (EQA) and subsequent formation of the Department of Environment did environment management take on a formalised and structured form.

In the Third Malaysia Plan (1976-80), Malaysia's overall environmental policy objectives were to "..... balance the goals for socio-economic development and the need to bring the benefits of development to a wide spectrum of population ..... against the maintenance of sound environmental conditions". However, this was further strengthened in the Outline Perspective Plan (OPP) of 1991-2000 which categorically states that "adequate attention will be given to the protection of the environment and ecology so as to maintain the long term sustainability of the country's development. The land must remain productive and fertile, the atmosphere clear and clean, the water unpolluted, the forest resources capable of regeneration, able to yield the needs of the national development.

Pollution control regulations and orders have been introduced to strictly enforce and ensure that they are carried out. They include, agrobased water pollution, Municipal and Industrial Waste water pollution, Industrial and Motor Emissions, Toxic and Hazardous. Waste Management, Ozone Layer Depletion, Environment and Development Integration. In 1988, the introduction of the EIA procedure is another step towards protection of the environment for several major projects which need DOE approval. This initiative will ensure sustainable developments are in line with proper environmental guidelines.

Victor Hon



## The tectonic interpretation of variations in the gravity field over Southeast Asia as revealed by satellite altimeter measurements

CLIVE A. FOSS

### Laporan (Report)

Dr. Clive A. Foss gave the above talk on 30th November 1994 at 5.30 pm at the Geology Department, University of Malaya.

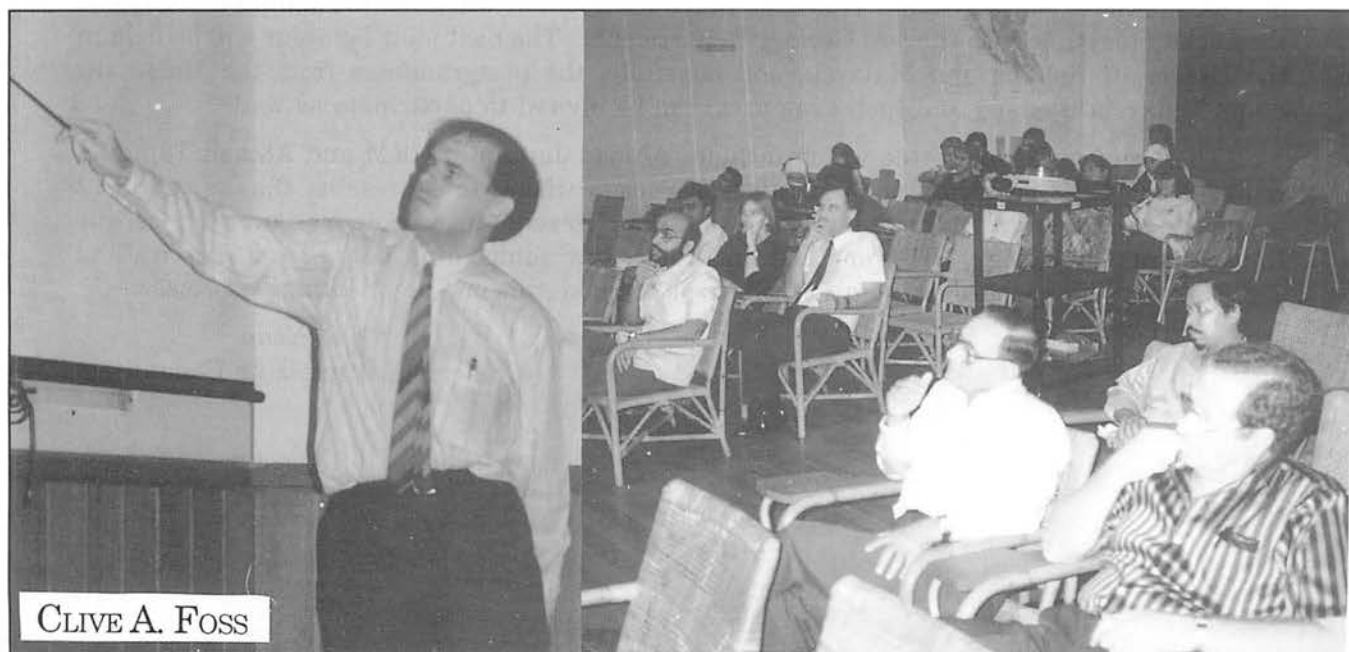
### Abstrak (Abstract)

Satellite altimetry has been used to map the elevation of the earth's sea surface to a much higher resolution than has been possible before. The resulting maps show undulations which are due to variations in the strength of the earth's gravity field. Where the gravity field has high values the water is ponded up causing a topographic high, and conversely where there is a gravity low the sea surface is depressed. The sea surface elevation maps have been transformed to provide representations of the (free air) gravity variations over the marine parts of the earth's surface. For this study the Sandwell 1993 gridded data has been used.

The free air gravity map for marine Southeast Asia was corrected for gravity variations due directly to changes in water depth to provide a Bouguer gravity map which shows variations due predominantly to changes in density in the underlying rocks. A sketch interpretation is presented for this map and for various transforms of it computed to sharpen and enhance the image. Features which are resolved include deep crustal faults, some of which are surprisingly long. The size of structural domains defined by the extent of areas with subparallel fault directions is also surprisingly large considering the complexity of the geological history of the area.

Some of the mapped gravity variations can be related to changes in thickness of the sedimentary cover. In several cases these observed gravity variations are of markedly lower amplitude than is predicted from the known sediment thickness - indicating that the crustal structure of those sedimentary basins incorporates crustal thinning to produce a positive gravity variation which partially cancels the negative variation due to the low density of the sediments infilling the basin.

G.H. Teh



## **Seminar Calon Lepas Ijazah Jabatan-Jabatan Geologi Universiti Malaya dan Universiti Kebangsaan Malaysia — Laporan (Report)**

**Anjuran bersama Persatuan Geologi Malaysia, Jabatan Geologi, Universiti  
Malaya dan Jabatan Geologi, Universiti Kebangsaan Malaysia**

The above Seminar by Post-Graduate students was held in the Lecture Hall of the Department of Geology, University of Malaya on the 10th December, 1994. This is the first time that a Seminar of such nature was organized by the Geological Society of Malaysia jointly with the Departments of Geology, University of Malaya and Universiti Kebangsaan Malaysia. Normally, the two Departments of the two Universities would organize such seminar internally but this time with the collaboration of the Geological Society of Malaysia the Seminar is opened to a much broader audience which includes working and professional members of the Society.

The objectives of the Seminar are:

1. To allow members of the Geological Society of Malaysia and the public in general to be aware of the research being carried out by postgraduate students in the two Departments of Geology.
2. To promote academic interactions among staff, undergraduate and postgraduate students of the two Departments of Geology and members of the Geological Society of Malaysia.
3. To give exposures to postgraduate students in geology to present seminars to an academic and professional audience.

Altogether 12 papers on varied research topics were presented in the Seminar, out of which 7 were by postgraduate students from the Department of Geology, University of Malaya and 5 from the Department of Geology, Universiti Kebangsaan Malaysia. 115 members, the majority being students and staff of the two Universities attended the Seminar. Packed lunch was provided to those who attended. It is hope that such Seminar can become an annual activity of the Society together with the two Geology Departments. The next joint Seminar will be held in the Universiti Kebangsaan Malaysia and hopefully, the postgraduates from the Universiti Sains Malaysia (Penang and Ipoh campuses) can be invited to participate as well.

The organizing committee which includes Ahmad Jantan of UKM and Ahmad Tajuddin representing GSM on behalf of the Geological Society wishes to express its thanks to the 12 postgraduate students who put in a lot of effort to present the various research topics, the Departments of Geology, UKM and UM and others (including Anna Lee, Fan, J. Pereira and T.F. Ng) for their cooperation and contributions to make this one day Seminar a success.

**E.B. Yeap**  
Chairman, Organizing Committee

# Seminar Calon Lepas Ijazah Jabatan-Jabatan Geologi Universiti Malaya dan Universiti Kebangsaan Malaysia

Anjuran bersama Persatuan Geologi Malaysia, Jabatan Geologi, Universiti  
Malaya dan Jabatan Geologi, Universiti Kebangsaan Malaysia

## PROGRAM SEMINAR

**Tarikh** : 10hb Disember, 1994  
**Tempat** : Jabatan Geologi, Universiti Malaya  
**Masa** : 9.00 pagi - 5.30 petang

8.30 pagi : Pendaftaran  
 9.00 pagi : Upacara Pembukaan Seminar  
 9.15 pagi : Jamuan Teh (Anjuran Persatuan Geologi Malaysia)

### SESSI I

PENGERUSI: KETUA, JABATAN GEOLOGI, UM

- 9.30 pagi : The geological prospectivity of Malaysia  
*Teoh Lay Hock*
- 10.00 pagi : Pengimejan batuan karbonat dengan kaedah seismos  
*Abdul Rahim Md. Arshad*
- 10.30 pagi : Pengesanan kemasinan air tanah pada akuifer ke dua dengan menggunakan kaedah kerintangan geoelektrik. Kajian kes: Di sepanjang kawasan pantai utara Kelantan  
*Haryono*
- 11.00 pagi : Potensi batu kapur Formasi Kodiang dan Formasi Gua Musang sebagai batu dimensi  
*Samsulbahrin bin Saim*
- 11.30 pagi : Geotechnical aspects of development over mine ponds in the Kinta Valley  
*Chow Weng Sum*
- 12.00 pagi : Multiphase deformations within the Late Permian strata of Raub Gold Mine, Pahang  
*Mustaffa Kamal Shuib*
- 12.30 pagi : Siesmic modeling of the subsurface geological structure in the Khuff Field, Sirte Basin, Libya  
*Abdurrazagh Ahmed Ezzeddin*
- 1.00 petang : Makan Tengah Hari (Anjuran Persatuan Geologi Malaysia)

# Seminar Calon Lepas Ijazah Jabatan-Jabatan Geologi Universiti Malaya dan Universiti Kebangsaan Malaysia

## PROGRAM SEMINAR

### SESSI II

PENGERUSI: KETUA, JABATAN GEOLOGI, UKM

- 2.00 petang : Sedimentology and stratigraphy of the Lambir Formation, Miri, Sarawak  
*Boniface Bait*
- 2.30 petang : Prototype computer-based petroleum geological data base management system (PGDBMS) for the Klias Peninsula and Labuan Island, Sabah, East Malaysia  
*Sanasivam Sivaji*
- 3.00 petang : Kajian palinologi Formasi Silantek: Suatu hasil awal  
*Nor Asmah binti Abdul Aziz*
- 3.30 petang : Performance of various test methods for assessing the potential alkali-silica reaction  
*Sazali Yaacob*
- 4.00 petang : Struktur geologi kawasan utara Formasi Machinchang, Baratdaya Langkawi, Kedah  
*Hamid Ariffin*
- 4.30 petang : Upacara Penutup
- 4.40 petang : Jamuan Teh (Anjuran Persatuan Geologi Malaysia)

## SEMINAR CALON LEPAS IJAZAH

### Captions to Photos

- |  |   |
|--|---|
| 1. At the registration desk.                         | 15. Session Chairman, J.K. Raj, congratulating Abdurrazagh.           |
| 2. Organising Chairman, E.B. Yeap, with his address. | 16. Mustaffa Kamal Shuib on multiphase deformations.                  |
| 3. J.K. Raj declaring the Seminar open.              | 17. S. Sivaji elaborating on PGDBMS.                                  |
| 4-7. Various moods of the audience.                  | 18. Nor Asmah on palynology.  |
| 8. Teoh Lay Hock starting off.                       | 19. Sazali Yaacob on alkali-silica reaction.                          |
| 9. Abdul Rahman on carbonate imaging.                | 20. Hamid Ariffin responding to a question.                           |
| 10. Haryono on groundwater salinity.                 | 21. Session Chairman, Hamzah Mohamad, with a token for Boniface Bait. |
| 11. Samsulbahrin on dimension stones.                | 22-23. Tea before departure.  |
| 12. Chow Weng Sum with his presentation.             |   |
| 13-14. Pack lunch.                                   |   |

# SEMINAR CALON LEPAS IJAZAH



# Seminar Calon Lepas Ijazah Jabatan-Jabatan Geologi Universiti Malaya dan Universiti Kebangsaan Malaysia

## ABSTRACT OF PAPERS

### The geological prospectivity of Malaysia (Potensi mineral di Malaysia berdasarkan geologi)

TEOH LAY HOCK

Jabatan Penyelidikan Kajibumi Malaysia  
Bangunan LUTH, Kuala Lumpur

The three main geographic regions of Malaysia, namely, Peninsular Malaysia, Sabah and Sarawak display contrasting geology and styles of mineralisation.

Mineralisation in Peninsular Malaysia is characterised by a central gold-base metal belt sandwiched between a western and an eastern tin belt. The western tin belt hosts some of the world's largest tin deposits and has traditionally been the major tin producing region. Several significant tin deposits are also found along the eastern side of the peninsula and hence the name. Recently there has been major gold discoveries within the eastern tin belt. Most of Peninsular Malaysia's major gold and base metal deposits are located within the Central Belt.

In Sabah, the major metalliferous mineral deposits are located along a 'central belt' stretching from the northern islands of Banggi and Malawali, through Taritipan, Gunung Kinabalu and the Labuk Valley to the upper Segama Valley-Darvel Bay area and Semporna Peninsula in the southeast. Precious metal (Au, Ag, PGM) and base metal (Cu, Pb, Zn, Ni, Cr) mineralisation is associated with four main groups of rocks, namely, the pre-Triassic metamorphic and igneous basement rocks, the Cretaceous ophiolitic rocks, the Late Tertiary volcanics and associated hypabyssal rocks and the Pliocene granitic intrusions. Outside the 'central belt' extensive coal seams have been located in the Tertiary basins in southern Sabah, specifically in Maliau and Melibau.

In Sarawak, two main metallogenic provinces separated by the Lupar Line can be recognised. The metalliferous deposits, mainly gold and base metals are generally confined to west Sarawak. In central-north Sarawak, the mineral deposits are mainly sedimentary in nature. Large reserves of coal are found in the Tertiary basins at Balingian, Merit-Pila and Bintulu.

Geologically, there is good potential for the discovery of economic deposits of gold and base metals in the Central Belt of Peninsular Malaysia, the 'central belt' of Sabah and in west Sarawak. Prospects for the development of coal is promising with the best areas located in the Tertiary basins in central-north Sarawak and southern Sabah. There are also good prospects for the development of non-metallic mineral resources especially limestone, ball clay, kaolin, silica sand, rock aggregate, and sand and gravel.



*Ketiga-tiga wilayah utama Malaysia berasaskan geografi, iaitu Semenanjung Malaysia, Sabah dan Sarawak menunjukkan perbezaan dalam geologi dan gaya pemineralan.*

*Pemineralan di Semenanjung Malaysia dicirikan oleh Jaluran Tengah Emas-Logam bes yang terapat di antara Jaluran Timah Barat and Jaluran Timah Timur. Jaluran Timah Barat mengandungi beberapa mendapan timah yang terbesar di dunia dan secara tradisi adalah pengeluar timah utama di negara ini. Beberapa mendapan timah bernilai juga dijumpai di sepanjang bahagian timur Semenanjung Malaysia, oleh yang demikian telah diberikan nama Jaluran Timah Timur. Walau bagaimanapun, baru-baru ini beberapa kewujudan emas yang ketara telah dijumpai di dalam jaluran ini. Kebanyakan mendapan emas dan logam bes di Semenanjung Malaysia terletak di sepanjang Jaluran Tengah.*

*Di Sabah, longgokan utama mendapan mineral berlogam terletak di sepanjang satu 'jaluran tengah', menganjur daripada bahagian utara Kepulauan Banggi dan Malawali, ke Taritipan, Gunung Kinabalu dan Lembah Labuk ke bahagian atas Lembah Segama, kawasan Teluk Darvel dan tenggara Semenanjung Semporna. Pemineralan logam berharga (Au, Ag, PGM) dan logam bes (Cu, Pb, Zn, Ni, Cr) adalah berkait rapat dengan empat kumpulan batuan utama iaitu batuan metamorf Pra-Trias dan batuan igneus dasar, batuan ofiolit Kretas, batuan vulkanik Tertiar Lewat dan persekutuan di antara batuan hipabisal dengan perejahan granit Pliosen. Di bahagian luar 'jaluran tengah', terdapat lapisan batu arang yang luas, terletak di dalam Lembangan Tertiar di selatan Sabah iaitu di Maliau dan Melibau.*

*Di Sarawak, dua wilayah metalogeni utama boleh dikenalpasti di mana keduanya dipisahkan oleh Garis Lupar. Secara umumnya, mendapan berlogam, terutamanya emas dan logam bes terbatas di barat Sarawak. Di bahagian tengah utara Sarawak, kebanyakan longgokan mineral adalah asalan sediman. Rezab batu arang yang luas dijumpai di Lembangan Tertiar iaitu di Balingian Merit-Pila dan Bintulu.*

*Dari segi geologi, terdapat potensi yang baik bagi menemui longgokan emas dan logam bes berekonomi di Jaluran Tengah Semenanjung Malaysia, jaluran tengah Sabah dan barat Sarawak. Prospek bagi perkembangan batu arang adalah cerah dengan kawasan terbaik terletak di Lembangan Tertiar di bahagian tengah utara Sarawak dan selatan Sabah. Terdapat juga prospek yang baik bagi perkembangan sumber mineral bukan logam terutamanya batu kapur, lempung bebola, kaolin, pasir silika, batu agregat, pasir dan batu kerikil.*

## **Pengimejan batuan karbonat dengan kaedah seismos**

ABD RAHIM MD ARSHAD<sup>1</sup>, UMAR HAMZAH<sup>2</sup> DAN ABD RAHIM SAMSUDIN<sup>2</sup>

<sup>1</sup>Petronas Research and Scientific Services Sdn. Bhd.

Ulu Klang, Kuala Lumpur

<sup>2</sup>Jabatan Geologi, Fakulti Sains Fizik dan Gunaan

Universiti Kebangsaan Malaysia

Mengimej batu kapur dengan tepat dari segi kecondongan dan kedalaman, terutamanya lapisan-lapisan batu yang terdapat di bawahnya, adalah antara masalah-masalah yang dihadapi dalam pemrosesan data seismos. Hal ini adalah disebabkan oleh dua perkara:

Berlakunya penyerapan tenaga seismos pada batu kapur.

Perubahan mendadak halaju media; misalnya dari halaju batu pasir yang perlahan kepada halaju batu kapur yang sangat cepat.

Salah satu penyelesaian kepada masalah di atas ialah melakukan migrasi kedalaman pra-gabungan ke atas kumpulan titik tembak bersama (CSG). Kaedah ini boleh berjaya kerana konsep di sebalik atur kerja dan algorithmnya mengambil kira gerak-luar masa perjalanan yang tidak hiperbolik. Sebagai perbandingan kaedah pemrosesan seismik secara konvensional juga akan dibincangkan.

---

## **Pengesahan kemasinan air tanah pada akuifer ke dua dengan menggunakan kaedah kerintangan geoelektrik. Kajian kes: Di sepanjang kawasan pantai utara Kelantan**

HARYONO

Jabatan Geologi  
Fakulti Sains Fisis dan Gunaan  
Universiti Kebangsaan Malaysia

Kajian geofizik telah dilakukan di sepanjang kawasan pantai utara Kelantan dengan tujuan untuk mengesan kemasinan air tanah pada akuifer ke dua.

Kaedah kerintangan geoelektrik telah digunakan di dalam penyelidikan ini. Data geoelektrik yang diperolehi ditafsirkan dengan bantuan data lubang gerudi dan data hidrogeokimia.

Hasil penafsiran kerintangan geoelektrik menunjukkan bahawa air tanah pada akuifer ke dua mempunyai kepekatan klorid  $\geq 250$  mg/l sehingga 6 km dari garis pantai.

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## **Potensi batu kapur Formasi Kodiang dan Formasi Gua Musang sebagai batu dimensi**

SAMSULBAHRIN BIN SAIM

Jabatan Geologi, Fakulti Sains Fisis dan Gunaan  
Universiti Kebangsaan Malaysia, Bangi

Batu kapur merupakan batu dimensi kedua terkenal selepas granit. Penggunaannya di Malaysia kini semakin berkembang. Oleh itu kajian terperinci perlu dilakukan terhadap simpanan batu kapur di negara ini untuk industri batu dimensi. Kajian terhadap batuan ini lebih ditekankan kepada sifat fizikal dan mekanikalnya. Kecantikan, kekerasan, ketahanan dan analisis ketakselajaran batuan merupakan maklumat-maklumat yang diperlukan di dalam kajian ini. Setakat ini ujian untuk menentukan nilai mampatan sepaksi, kekerasan Shore, modulus keelastikan, indeks kekuatan tensi, indeks beban titik, porositi, peratus resapan air dan ketumpatan batuan telah dilakukan. Kajian awal menunjukkan batu kapur Formasi Kodiang mempunyai kepelbagaian warna dan tekstur. Ia terdiri daripada sekurang-kurangnya 10 litofasies yang sebahagiannya belum terhablur semula. Batu kapur Formasi Gua Musang kebanyakannya mempunyai warna kelabu cerah hingga gelap yang biasanya terhablur semula. Kedua-dua formasi ini mempunyai ketebalan lapisan daripada nipis hingga tebal dan masif. Analisis ketakselajaran menunjukkan purata jarak ketakselajaran di Formasi Kodiang lebih rapat sehingga boleh mencapai kurang daripada 0.1 meter terutama di lapisan nipis manakala

di Formasi Gua Musang purata jarak ketakselanjaraannya melebihi 0.4 meter. Petanda mutu batuan sepanjang garis imbasan batu kapur Formasi Kodiang juga menunjukkan nilai yang lebih rendah jika dibandingkan dengan Formasi Gua Musang. Kedua-dua batu kapur mempunyai ketumpatan yang tinggi iaitu antara 2.6 hingga 2.8 g/cm<sup>3</sup>. Peratus resapan air pula kurang daripada 0.5%. Sifat mekanikal batu kapur terutamanya nilai kekuatan mampatan sepaksi menunjukkan bacaan yang melebihi 55 MPa manakala nilai kekerasan Shore adalah sekitar 60Sh iaitu bersesuaian dengan piawai yang dipilih.

## Geotechnical aspects of development over mine ponds in the Kinta Valley

CHOW WENG SUM

Jabatan Penyiasatan Kajibumi Malaysia  
Ipoh, Perak

Alluvial tin mining operations in the Kinta Valley over the past century has left behind a legacy of thousands of mined-out ponds scattered on the valley floor. Recent rapid industrialisation around the urban centre of Ipoh in the Kinta Valley had led to the construction of residential houses, commercial and industrial buildings on reclaimed mined-out ponds.

Reclamation of mined-out ponds are faced with many constraints. The karstic bedrock topography at the bottom of ponds often act as natural slime traps. The drawdown of pond water during reclamation may lead to slope instability of the mine sides. The slime at the bottom of ponds are often very soft without any significant shear strength or bearing capacity.

To find a solution to the reclamation of slime-filled ponds, characterisation of the physio-chemical properties of slime in two ponds were undertaken.

There are many options for various methods of reclamation, amongst which, one, is to remove the slime prior to filling the ponds with sand or soil. The transference of slime from one pond to another is environmentally not acceptable. Hence, such slime should be utilised as raw industrial material for the making of brickwares or used as liners for the construction on toxic waste or solid waste depositories. Another option is to use chemicals to dewater the slurry slime whereby the solids content of the slurry slime can be increased and subsequently used as foundation material. A third option is to improve the physical and geotechnical properties of the slime by admixing with sand.

In the final analysis, the method of reclamation that is to be applied should be environmentally acceptable, technically feasible and economically viable.

*Kegiatan melombong timah di Lembah Kinta seabad yang lalu telah mengujudkan beribu-ribu tinggalan bekas lombong bertaburan di bahagian dasar lembah. Pembangunan yang pesat pada masa ini di sekitar pusat bandar utama iaitu Ipoh di Lembah Kinta, mengakibatkan pembinaan kawasan penempatan, bangunan kormersil dan kilang di atas bekas lombong yang telah ditebusguna.*

*Kerja-kerja menebusguna bekas lombong terdapat banyak kesukarannya. Batu dasar yang bertopografi karst di bahagian dasar lombong selalu bertindak sebagai perangkap lumpur semulajadi. Proses surutan air lombong semasa kegiatan tebusguna boleh mengakibatkan kesan ketakstabilan cerun pada bahagian tepi lombong. Lumpur yang terdapat pada bahagian*

dasar lombong kebiasaannya adalah sangat lembut dan tiada kekuatan ricih dan keupayaan galas yang berkesan.

Untuk mencari penyelesaian bagi masalah lombong tebusguna yang mengandungi lumpur, penentuan sifat kimia-fizik lumpur lombong dari dua lombong berlainan telah dilakukan.

Terdapat banyak pilihan untuk pelbagai kaedah tebusguna, diantaranya ialah, pertama, dengan membuang lumpur lombong dan digantikan dengan pasir atau tanah. Memindahkan lumpur lombong dari satu lombong ke lombong lain tidak dibenarkan kerana ia boleh menjejaskan alam sekitar. Maka, lumpur lombong tersebut boleh dimanfaatkan sebagai bahan mentah industri pembuatan batu-bata atau digunakan sebagai struktur pengepungan dalam perlupusan sisa-sisa beracun dan sisa-sisa pepejal. Pilihan lain ialah dengan menggunakan bahan kimia untuk mengeringkan dan sekaligus menambahkan bahagian yang keras pada lumpur lombong, seterusnya boleh digunakan sebagai bahan tapak (*foundation material*). Pilihan ketiga ialah dengan meningkatkan sifat-sifat fizikal dan geoteknikal lumpur lombong dengan mencampurkannya dengan bahan pasir.

Kaedah tebusguna yang dilakukan haruslah memenuhi kehendak alam sekitar, berkeupayaan dari segi teknikal dan ekonomik.

## Multiphase deformations within the Late Permian strata of the Raub Gold Mine, Pahang

MUSTAFFA KAMAL SHUIB

Jabatan Geologi  
University of Malaya

The Raub Gold Mine is one of the rare places along or within the Bentong-Raub Zone where good exposure are found. The exposed Late Permian strata have undergone multiple deformations.

The most common structure seen within the mine are chevron folds with conjugate kink band geometry believed to be among the latest structures to developed. The fold axes trend NNW with variable plunges ranging from moderate to sub-horizontal. Within a 3 m thick reversed fault zone, these folds are tight and developed an axial planar cleavage, ( $S_2$ ).

The mine is dominated by an anticlinorium that predates the above folds. Associated minor folds ( $F_1$ ) are tight to isoclinal, upright to slightly inclined, sinusoidal forms with gentle plunge. These folds have the following characteristics:-

1. Doubly plunging (periclinal form) towards NNW and SSE.
2. Associated with 2 sets of cleavages having a variable angle between them of  $5^\circ$  to  $15^\circ$ . The earliest of the ( $S_{1a}$ ) is always slaty while the later ( $S_{1b}$ ) may have a crenulation form with offset according to lithology. On profile plane,  $S_{1a}$  is curvilinear and at the zone where  $S_{1a}$  is perpendicular to layering it does not coincide with the hinge zone but anticlockwise of it.  $S_{1b}$  is superimposed on  $S_{1a}$ , axial planar and fans slightly about the axial plane. On the hinge surface  $S_{1a}$  transects the hinge line by about  $10^\circ$  clockwise while  $S_{1b}$  may be parallel or slightly transecting.
3. Diverging hinges and axial traces, attributed to oblique flattening.

4. Pyrite crystals in thin sections cut parallel to the cleavages (axial plane) exhibit pressure fringes with 2 main phases of development. The dominant early fibres are sub-vertical and then succeeded progressively by sub-horizontal fibres suggesting a non-coaxial stretching history involving early vertical extension followed by later sub-horizontal extension.
5. The limbs may be stretched, boundinaged, sedimentary clasts pull-aparted and in places a chocolate-tablet boundinage structure developed, revealing a history of early sub-vertical followed by later sub-horizontal stretching.
6. The limbs may be cut by sub-vertical faults with associated steeply plunging drag folds. Deformed diamictites shows clast aligned in 2 directions parallel to both  $S_{1a}$  and  $S_{1b}$  and exhibit dextral shear bands suggesting a history of late sub-horizontal extension.

Collectively, all the above characteristics, suggest that  $D_1$  structures developed in a regime that involved early sub-horizontal compression that progressively changes into dextral strike-slip motion. In other words, the early deformations was multi-phased and developed in a dextral transpressive regime.

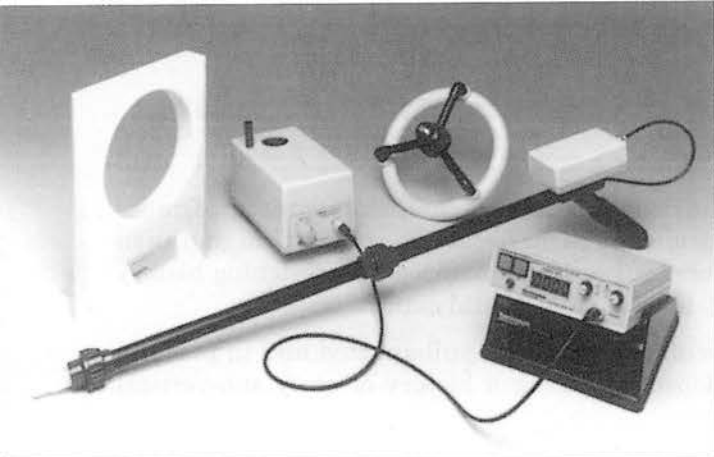
## Seismic modeling of the subsurface geological structure in the Khuff field, Sirte Basin, Libya

ABDURRAZAGH EZZEDDIN, ABDUL RAHIM SAMSUDIN AND MOHAMED ZAHOR FARSHORI

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Bangi, Selangor

The applicability of the seismic modeling for re-evaluation of previous geological interpretation has been investigated at Khuff field, Sirte Basin, Libya. A GX II computer system was used and this computer applications programs system have been developed by "GX Technology". With this system geological model can be developed and tested in order to study the dispersal of energy through a multi layered medium including gases, liquids and solids. The simulated reflection data of the propagation of the acoustic energy provides informations on the internal geological structure of a thick carbonate deposits of the Upper Cretaceous (Maastrichian) to Eocene sediments. The resulting two-dimensional (2-D) synthetic seismic section demonstrated the use of a simple technique to validate a prospective exploration target.

*Pemodelan seismos telah dilakukan untuk Lapangan Khuff, Sirte Basin, Libya bagi menilai semula data geologi yang sedia ada. Sistem program komputer GX II telah digunakan dan sistem ini telah di bangunan oleh "GX Technology". Sistem ini membolehkan model geologi dibina dan diuji untuk mengkaji penyerakan tenaga seismos dalam berbagai media termasuklah gas, cecair dan pepejal. Simulasi data pantulan hasil rambatan tenaga seismos ini telah dapat memberikan maklumat struktur dalam batu kapur tebal (Kapur Aras) dan sedimen (Eosen). Keratan seismos sintetik dua matra (2D) menunjukkan kaedah mudah boleh digunakan untuk mencari target penjelajahan carigali minyak.*



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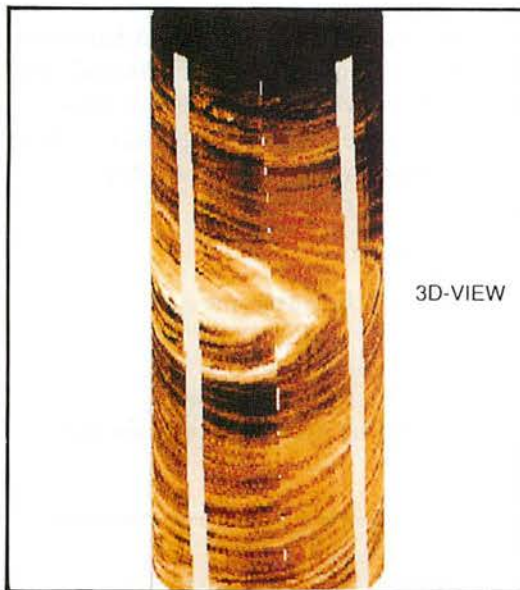
# Fullbore Micro Imager\*

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

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

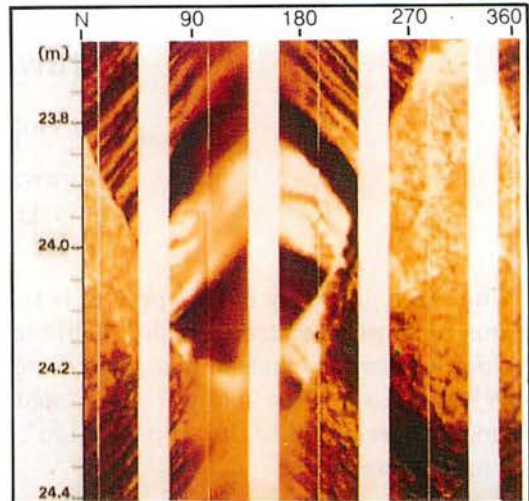
The FMI tool combines high-resolution measurements with almost fullbore coverage in standard diameter boreholes, thus assuring that virtually no features are missed along the borehole wall. Fully processed images and dip data are provided in real time on the MAXIS 500 imaging system.

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

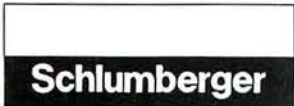
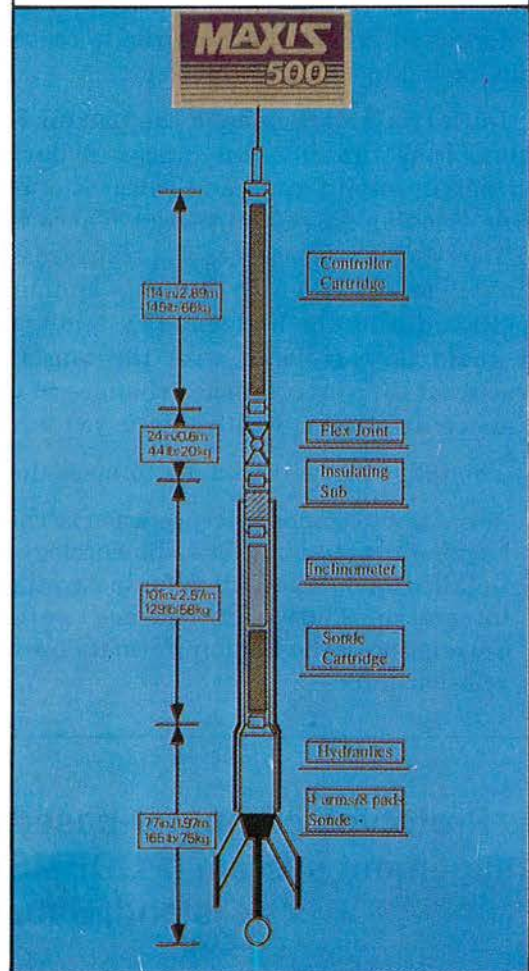


3D-VIEW

"Bullseye" structure



Fault without associated drag



## **Sedimentology and stratigraphy of the Lambir Formation, Miri, Sarawak, Malaysia**

BONIFACE BAIT

Sarawak Shell Berhad  
Lutong, Miri

The main objective of this project is to analyse the Lambir Formation of onshore Sarawak in terms of sequence stratigraphy. This opportunity is provided by the excellent and almost continuous outcrops exposed along the sea cliff at Kampong Bungai to Tanjung Batu area which will be logged as a "type section". The "spot outcrops" or road cuts along the Miri-Bintulu Road will then be correlated to the "type section". The distance between these two subparallel section is some 20 kilometers.

The Miocene Lambir Formation in the Miri area is thought to represent the onset of the present Baram Delta, which is presently exploited for its hydrocarbon in the offshore area. It was deposited in a shallow marine to coastal environment and overlies the open marine shale-dominant Setap Shale Formation.

Initial field work done in the Lambir Formation reveal excellent geological features which resulted from the different processes during the development of the delta. Several highly bioturbated, fossiliferous and calcareous beds have been seen which suggests the maximum marine flooding (MFS) surfaces. These bioturbated horizons overlie laminated to massive mudstones which represents the transgressive system tract (TST). This is in turn overlain by laminated mudstones with thin silty lamina and sand-rich tidal-influenced intervals suggesting deposition during the highstand system tract (HST). This overlying sand-rich intervals of the HST could be correlated with the topsets in seismic sequence stratigraphy. The overall character of the vertical facies changes in the Lambir Formation suggests a type 2 sequences. The above definitions will be discussed in relation to the outcrops.

The following will be done to meet the above objectives:

1. Aerial photographs interpretation to check continuity of the outcrops.
2. Logging the outcrops for sedimentology/ichnofacies.
3. Detailed sample collection for biostratigraphy.
4. Integration of above for sequence stratigraphic analysis of the outcrops.
5. Correlation of the Lambir Formation with the surrounding area to determine the evolutionary relationship.

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## **Prototype computer-based petroleum geological data base management system (PGDBMS) for the Klias Peninsula and Labuan Island, Sabah, East Malaysia.**

SANASIVAM SIVAGI

Jabatan Geologi  
University of Malaya

The Klias Peninsula and Labuan island, which is part of the Northwest Borneo sedimentary basin is situated in the west coast of Sabah, East Malaysia. Extensive field studies followed by



integrated laboratory investigations have been undertaken by the researcher with the aim of reconstructing the depositional environment and sedimentation history of the area in order to assess their implications on the hydrocarbon potential of the area.

Data gathered is processed and stored digitally by using a computer-based Petroleum Geological Data Base Management System, which is being developed as part of the on-going research.

This paper illustrates that integrated data base management and processing techniques incorporated with GIS graphics data browsing and mapping system can enhance analytical capabilities, presentation and visualisation of exploration geology data.

## **Kajian palinologi Formasi Silantek — suatu hasil awal**

NOR ASMAH BT. ABDUL AZIZ

Jabatan Geologi  
Universiti Kebangsaan Malaysia

Kawasan kajian terletak di bahagian Sri Aman (sekitar Lembah Lupar), Sarawak. Kajian palinologi ini diharap dapat membantu dalam menentukan usia Formasi Silantek dengan lebih tepat. Pengkajian semula jujukan stratigrafi yang dicadangkan oleh Tan (1979) juga dilakukan berdasarkan himpunan palinomorf yang ditemui. Pengaruh igneus di beberapa tempat dalam Formasi Silantek menyukarkan pengecaman palinomorf yang ditemui. Pengecaman setiap palinomorf dan penamaan sistematik belum dapat diperincikan kerana kajian ini masih berada di peringkat awalan.

## **Performance of various test methods for assessing the potential alkali-silica reaction**

SAZALI YAACOB

Fakulti Kejuruteraan  
Universiti Malaya

Aggregates form a major component of concrete and have important influence on its durability. Certain deleterious minerals, if present in these aggregates, may have reaction with the cement component, leading to reduction in strength and durability of the concrete. Unstable silica minerals such as tridymite, cristobalite, chalcedony, strained quartz, cryptocrystalline and microcrystalline quartz, may react with cement to form a gel which expand upon adsorption of water. The expansion often results in the cracking of concrete.

One preventive measure to avoid having alkali-silica reactivity (ASR) in concrete is to restrict the usage of aggregates which contains reactive silica. As such, laboratory testing is vital in the selection of suitable aggregates.

One method which is widely accepted for testing the alkali-silica reactivity of aggregates is the standard mortar bar method. However, this method takes too long to complete, taking up to six or twelve months. There are other test methods to test the "ASR" of rocks, such as the

petrographic examination of aggregates, the quick chemical test, pat test and accelerated mortar bar test, but their reliability is questionable at times.

This paper presents results of eight rock samples tested for ASR by the various methods mentioned above and the results are compared with the standard mortar bar test. Results showed that for preliminary assessment, the pat test should be used, albeit petrographic examination is also acceptable. For quick confirmation of ASR, the accelerated mortar bar test is recommended. The quick chemical test gives only an indication of the ASR of rocks and is not always compatible with all types of aggregates.

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## Struktur geologi kawasan utara Formasi Machinchang, Baratdaya Langkawi, Kedah

HAMID ARIFFIN

Jabatan Geologi  
Universiti Malaya

Formasi Machinchang di bahagian Baratdaya Pulau Langkawi menunjukkan ianya telah mengalami beberapa fasa canggaan yang hebat. Fasa canggaan ini menyebabkan sebahagian daripada lapisan asalnya telah terbalik dan sebahagian daripada singkapannya menunjukkan lipatan terbalik telah dilipat semula kepada beberapa fasa selepasnya (superimposed recumbent fold).

Formasi Machinchang telah mengalami sekurang-kurangnya 3 fasa canggaan yang hebat. Sekurang-kurang 5 struktur utama dicatatkan di sini.

1. Lipatan Baring (recumbent fold)
2. Sesar tujuh Datai (Datai Thrust fault)
3. Lipatan silang dengan paksi BBL-TTg (cross folding)
4. Lipatan Buta (Buta anticline) dan sesar Songsang Buta
5. Lipatan terbuka Datai dan sesar tegak Anak Datai

Kehadiran struktur-struktur utama ini yang mempamirkan arahan jurus yang berbeza-beza menunjukkan arahan daya canggaan sentiasa berubah-ubah dari masa ke semasa bagi formasi ini.

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## BERITA-BERITA PERSATUAN News of the Society

### KEAHLIAN (Membership)

The following applications for membership were approved:

#### Full Members

1. Joseph J. Lambiase  
Dept. of Petroleum Geoscience, Universiti  
Brunei Darussalam, Gadong 3186, Brunei.
2. Mat Niza bin Abdul Rahman  
P.O. Box 1015, 30820 Ipoh, Perak.
3. Harry Michael Loraine Mustard  
Level 1, Lot 9 & 10, Block H, Taman Sri  
Sarawak, Jalan Borneo, 93100 Kuching.
4. Nasir bin Din  
24A, Jalan Ang Seng 4, Brickfields, 50470  
Kuala Lumpur.

#### Student Members

1. Mazlee Abdul Latif  
Jabatan Geologi, Universiti Malaya, 59100  
Kuala Lumpur.
2. Najmiyah Binti Mansor  
Jabatan Geologi, Universiti Malaya, 59100  
Kuala Lumpur.
3. Md. Nor Han Yusof  
Jabatan Geologi, Universiti Malaya, 59100  
Kuala Lumpur.

#### Associate Member

1. Kwang Ah Tsai @ Kwong Kee Tsai  
P.O. Box 10266, 88803 Kota Kinabalu.

GSM

### PETUKARAN ALAMAT (Change of Address)

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

1. Lee Ju Shen  
2A Lorong Cinta Alam F, Country Heights,  
43000 Kajang, Selangor.

GSM

## PERTAMBAHAN BAHARU PERPUSTAKAAN (New Library Additions)

The Society has received the following publications:

1. Seatrad Centre, Report of investigation no. 93-95, 1994.
2. Tin International, vol. 67, nos. 8 & 9, 1994.
3. Geological Bulletin of Turkey, vol. 37, no. 1, 1994.
4. Commonwealth Science Council Newsletter March-April 1994.
5. AAPG Explorer, Nov & Dec 1994.
6. American Museum Novitates, nos. 3098 & 3105, 1994.
7. Bulletin of the American Museum of Natural History, nos. 220, 1994.
8. Monthly Statistics on Mining Industry in Malaysia, Jul & Aug 1994.
9. AAPG Bulletin, vol. 78/10, 1994.
10. Geologie, vol. 102 (1-4), 1993.
11. IMM, Bulletin 1021, 1994.
12. Mineralogical Society of Poland, vol. 22(1 & 2), 1991; vol. 23(1 & 2), 1992, and vol. 24(1 & 2), 1993.
13. Petromin, Novenver 1994.
14. Petromin, December 1994
15. Man-ape ape-man by R.E. Leakey & L.J. Slikkerveer.
16. Man-ape ape-man by M. Bouquet.
17. Scripta Geologica no. 105, 1994.
18. Monthly statistics on mining industry in Malaysia, Sept, 1994.
19. Chronicle of Mineral Research & Exploration, no. 515 & 516, 1994.
20. Geological Survey of New South Wales, Bull. 32(3), 1994.
21. U.S. Geological Survey, Professional Paper (1994): 1538-D, 1409-H, 1414-D, 1044-L.
22. U.S. Geological Survey Bulletin (1994): 2073, 2069, 2000-C, D, 2059-C, 2055, 2075, 2071, 1997, 2021-D, 2087-A. (1993): 1904-J.
23. U.S. Geological Survey Circular (1994): 1106, 1103-B, 1097, 1107.
24. Journal of Geology and Mineral Resources: 1991 Vol. I No. 2 & 3; 1992 Vol. II No. 4, 5, 6, 9, 10, 11, 12, 13, 14 and 15; 1993 Vol. III no. 16, 17, 18 & 19; 1994 Vol. IV No. 29, 32, 33 & 34.
25. Geosurvey Newsletter: 1991 Vol. XII No. 248 & 249; 1992 Vol. XIII No. 251, 252, 254, 255, 256, 257, 258, 259, 261 & 263; 1993 Vol. XIV No. 264, 265, 266, 267, 268, 269, 270, 273, 274 & 275; 1994 Vol. XV No. 276, 277, 278, 279 & 280.

## BERITA-BERITA LAIN Other News

### Local News

#### Huge mineral resources still untapped

SABAH's huge mineral resources of gold, copper and coal silica worth billions of ringgit remain untapped although its forest resources have been well exploited.

The Secretary of Natural Resources in the Chief Minister's Department, Datuk William Shim said last Friday the minerals industry was probably the least developed economic sector.

He said there were no restrictions on the type of mineral which could be prospected and mined in Sabah, nor on incentives.

Shim estimated that about 30 per cent of Sabah, or 25,000 sq km along the central belt from the northern islands through Mt Kinabalu and upper Segama down to Semporna peninsula, had been identified as having base metal and precious metal potential.

In the past 18 years, he said, about half-a-million tonnes of copper valued at RM1.4 billion had been extracted and 200,000 tonnes more valued about RM1.3 billion had been identified in the lower Labuk valley.

Shim said in his paper on *Resource development in Sabah — trends, strategies and opportunities* that gold deposits and copper-associated gold valued at RM500 million had been located. The venture is awaiting development.

He said in the south central part of Sabah, 700,000 ha of coal basins had been found, with four major coal fields identified far.

The biggest of these, the Maliau coal field,

occupied about 39,000 ha of virgin forest in central Sabah, with surface indications alone put at two million tonnes.

Shim said known limestone deposits alone occurred over 3,000 ha and contained an estimated 700 million tonnes of resource, which could be developed into clinker for cement, lime for agriculture and industrial uses as well as marble for the construction industry.

*"If only 20 per cent of the known resource is released for development it could sustain a limestone industry for 30 years,"* he added.

He said there was also potential for mineral water production in Sabah but only one company had applied for a licence to produce mineral water.

Shim said the state's impending legislation on the mineral industry would see the introduction of incentives covering the prospecting of large areas of 400 to 20,000 ha, longer time frame for exploration permits and longer tenure of mining leases.

Shim said the incentives also provided 100 per cent equity for foreigners during the prospecting and mining stages, with the state government reserving the right to participate at only the mining stage in important projects.

Export duty for most minerals had been reduced and the state government was also speeding up the process of approving licences and leases, he added.

*Star, 28.11.1994*

## English for universities

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The Universities and University Colleges Act will be amended to allow English be used as a medium of instruction in institutions of higher learning.

Education Minister Datuk Amar Dr. Sulaiman Daud said yesterday the Government needed to allow English to be used as a medium of instruction in such institutions alongside the national language.

He said the restriction of allowing only Bahasa Malaysia to be used as a medium of instruction would be a disadvantage to the country.

*"This (the restriction) does not allow for recruitment of foreign teaching staff who are efficient in English but not in the national language,"* Dr. Sulaiman told reporters after receiving Libya's Youth and Scientific Research Minister, Mr. Maatog Mohd Maatog, at his

ministry.

He was commenting on Prime Minister Datuk Seri Dr. Mahathir Mohammad's statement on a provision in the Universities and University Colleges Act that does not allow other medium of instruction but Bahasa Malaysia in universities.

Dr. Mahathir said this restriction had hampered the development of teaching at university level.

Dr. Sulaiman said the Government must act in order to stop a "brain drain" in institutions of higher learning.

He added that there were several provisions in the Act which would be changed but declined to elaborate except to say that he would bring the matter up at the next Cabinet meeting.

*Star, 6.12.1994*

## Petronas takes over Esso oilfields

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PETRONAS subsidiary Petronas Carigali Sdn. Bhd. will expand its role in the oil and gas industry in Peninsular Malaysia when it takes over operations of five producing oilfields off the coast of Terengganu.

Esso Production Malaysia Inc. (EPMI) will hand over control of the five fields to Petronas Carigali in April next year, in exchange for majority control of seven other fields until well after 2000.

With the takeover, Petronas Carigali will operate nine fields altogether.

At present, it is the operator of four fields — Dulang and Duyong off Terengganu, and Baram Delta and Tembungo off Sabah.

It is also involved in exploration activities in Vietnam.

Petronas president and chief executive officer Tan Sri Azizan Zainul Abidin said the five fields to be transferred from EPMI would continue to be developed as some new discoveries have been made in the area.

He would not elaborate, but said additional investments would also be made under the third phase of development of the fields, whereby new equipment would be set up to recover remaining reserves.

The first two phases involve the setting up of

operational platforms.

Azizan was speaking to reporters after a signing ceremony between Petronas and EPMI for two production sharing contracts (PSCs) and joint operating agreements in Kuala Lumpur yesterday.

The two PSCs, which will replace an earlier PSC with EPMI signed in 1976, will effectively make Petronas Carigali the operator of the five fields.

Under the 1976 PSC, EPMI was awarded the PM-9 block which now consists of 12 producing oil fields. The fields now have total remaining reserves of 1.5 billion barrels and 9.5 trillion cu ft of gas.

Petronas Carigali and EPMI will split majority shareholding in the individual fields under the new PSCs.

EPMI will continue to operate and maintain its 78 per cent interest in seven fields — Semangkok, Irong Barat, Tabu, Guntong, Palas, Tapis and Seligi — for 17 years. Petronas Carigali will own the remaining 22 per cent.

In turn, Petronas Carigali will hold the majority 60 per cent stake for 24 years in the PM-9 block with EPMI owning the remaining 40 per cent.

*NST, 8.12.1994*

## Cameron to Genting highway gets green light ---

The Government will go ahead with the proposed highway linking Cameron Highlands, Fraser's Hill and Genting Highlands as it is confident the proposed project will not affect the highlands, works minister Datuk Leo Moggie said today.

Speaking to reporters after opening the Asian Strategy and Leadership Institute's (ASLI) conference on "Update on construction technology", the Minister added that the use of the latest technologies would minimise disturbance and tree cutting in the affected areas.

*"The highway would have viaducts and tunnels to prevent any damages to the area. Once the project starts, the Government would enforce all relevant laws to the fullest,"* Moggie said.

He was asked to comment on the recent landslides at Cameron Highlands which have raised concerns on whether development at highland areas would have adverse effects on the environment of the areas involved.

He pointed out that other countries already have highways in highland areas and these did not produce any environmental problems.

Moggie said the Government has decided to privatise the highway project since the project was too expensive for them to undertake. However, he said no company has been identified

as yet. The proposed 240-kilometre highway project was first announced in 1988 and estimated to cost up to RM600 million.

Earlier, in his opening speech, Moggie said he had asked the Board of Architects to introduce a Clients' Charter to be used as a guide for producing quality work in the construction industry.

Moggie added that consumers, however, must demand that the industry follows the charter since the guidelines are voluntary and not a law.

The Minister also said the Construction Industry Development Board (CIDB), to be officially launched on December 16, is expected to play the role of spearheading the construction industry towards increased professionalism and competitiveness.

*"Usage of computers and relate technologies would be widespread in the future and the construction industry must develop expertise to remain abreast with the developments,"* said Moggie.

About 30 participants from the industry attended the one day conference. ASLI chairman Mirzan Mahathir was also present during the opening ceremony.

*NST, 13.12.1994*

## 38 islands gazetted marine parks ---

Effective tomorrow, 38 "protected" islands in Peninsular Malaysia and Labuan will be gazetted as marine parks for conservation and tourism purposes.

This follows the enforcement of the Establishment of Marine Parks Malaysia Order 1994 under which the Fisheries Department will introduce measures to protect the fragile marine ecosystem while promoting the parks for tourism.

Fisheries officer Ahmad Sani Ahmad Shukor said today the department was drafting the necessary regulations which, among other things, would spell out penalties for various offences.

The draft is expected to be ready next year and submitted to the Attorney-General for further scrutiny.

Ahmad Sani was speaking to reporters after reading a paper, *The Tourism Potential of Marine*

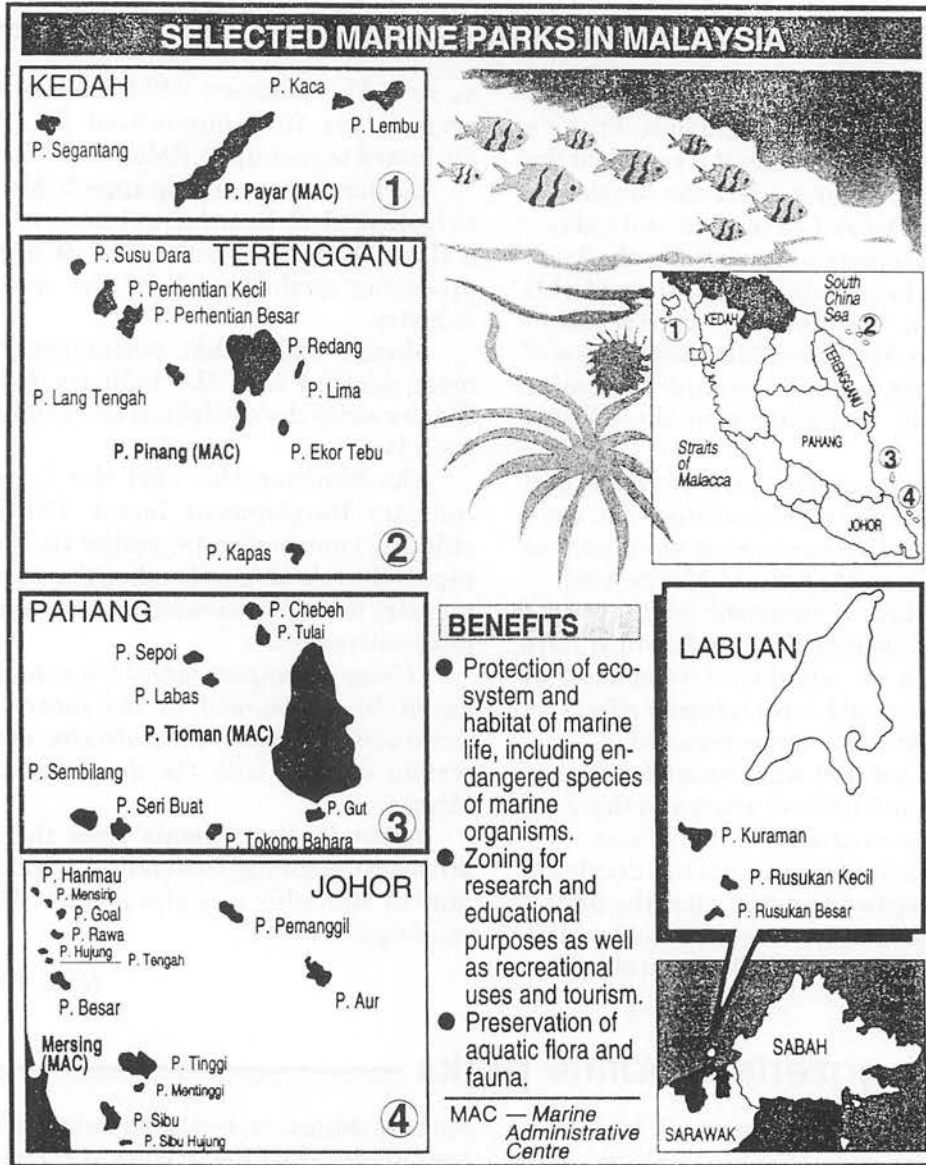
*Parks in Malaysia*, by the department's marine park branch chief Kevin Hiew Wai Phang at the Malaysian Institute of Maritime Affairs.

Ahmad Sani said the Order, which takes force tomorrow, stated that the limit of the islands established as a marine park would be two nautical miles (3.2 km) seaward from the outermost points of the islands as measured at the low-water mark.

But in the case of Pulau Kapas (Terengganu), the marine park would be one nautical mile (1.6 km) from the outermost point of the island.

Ahmad Sani said that five other islands would be classified as protected areas from tomorrow under the Fisheries (Prohibited Areas) Regulation 1994.

The islands are Terengganu's Pulau Nyireh and Pulau Tenggol and Sarawak's Pulau Talang-Talang Besar, Pulau Talang-Talang Kecil and



Pulau Satang Besar.

He said as protected areas, no one was allowed to collect shells, molluscs or corals within the prohibited areas, unless “a person holds a licence issued under section 11 of the Act stating the respective location specified as the fishing base.”

Offenders could be fined RM500 to RM11,500.

Under the Fisheries Act 1985, a marine park is defined as an area of the sea zoned as a sanctuary for the coral reef community where activities including water skiing, speedboat racing, fishing, spear fishing, collection of corals and other aquatic life are strictly prohibited.

Also prohibited are the anchoring of boats

over coral areas, and carrying of using weapons that endanger aquatic life.

The permitted activities are underwater photography, swimming, observation and appreciation of aquatic flora and fauna, scuba diving and snorkelling.

Hiew, in his paper, said 35 islands in the peninsula had been grouped into four marine parks.

They are: Pulau Payar Marine Park, Kedah, Pulau Redang Marine Park, Terengganu, Pulau Tioman Marine Park, Pahang and Mersing Marine Park, Johor.

Marine park administrative centres are being set up in these areas. They will also serve as tourist information-exhibition centres.



Hiew said the private sector could participate actively in the development of the marine parks by operating as boat operators, dive-guides and chalet operators.

But he warned that these islands must not be over-developed as it could cause deterioration of the natural environment, especially the coral reef ecology.

*"If the coral reefs and the natural environment deteriorate, tourists — be they foreign or local — will not come,"* he said.

According to the Fisheries Department marine park branch, 50 per cent of the country's coral reefs had been destroyed in the past 20 years because of human activities such as stepping on the coral, large-scale coral harvesting, development and poor sewage or drainage as well as storms and other natural disasters.

The branch carries out research on coral reefs, including its benefits in medical science, its role in the food chain and the types of species that inhabit coral reefs.

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To ensure that certain species of coral are not wiped out, the Fisheries Department recovers such species by transplanting them in areas conducive for growth.

The success rate of coral recovery is high overseas and the department uses Thailand as a model for its success in recovery work.

The marine parks advisory council is vested with the role to ensure that areas gazetted as marine parks and marine reserves are free from pollution.

If the parks are adversely affected by development, the council will ask the Fisheries Department to advise the Department of Environment accordingly.

Hiew hoped the private sector would come up with more ideas on how to develop the eco-tourism sector.

The Government will play its the role as facilitator and regulator.

He said the natural resources could be developed and be sustainable and economically viable if implemented carefully and properly.

Hiew said businessmen must bear in mind that the attractions for the tourists were the natural resources environment.

*"If these are damaged and destroyed or become extinct, tourists will not come and the businesses will definitely fail."*

Hiew also said that with the growing popularity of sport fishing, the Government, through the Fisheries Department was actively encouraging of the sub-sector by providing some infrastructure as well as incentive and training.

*"The private sector is expected to play a major role by providing some of the infrastructure such as jetties or marina, passenger boats and even fish lures or artificial reefs to attract fishes for anglers."*

But he pointed out that while angling was strictly prohibited within the marine parks, it was encouraged outside the prohibited zone.

*"The department is gazetting regulations to enable the private sector to provide such facilities to encourage sportfishing,"* he said, adding that if managed properly the country had the potential to become a major destination for sportfishing in the world.

*NST, 15.12.1994*

## DOE classifies water quality of rivers

Concerned with the long term impact on health from drinking contaminated water and the depletion of fish supply caused by polluted rivers, the Department of Environment (DOE) has classified 16 rivers according to their water quality.

The rivers: Muda, Perak, Kelang, Linggi, Muar, Pahang, Selangor, Bernam, Kelantan, Sugut, Perlis, Juru, Perai, Sarawak, Melaka and Rompin were classified after a 10-year study conducted in five phases involving five local universities and one consultancy.

They are Universiti Malaya, Universiti Pertanian Malaysia, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia and Universiti Teknologi Malaysia and Syed Muhammad, Hooi and Binnie Consultancy.

More rivers would be classified in future.

The specific segments of the rivers are classified according to domestic water supply, marine conservation, recreation, livestock drinking, irrigation and agricultural use.

The classification is based on analysis and information on existing beneficial uses, land-

use, hydrological conditions, population, pollution sources, aquatic ecology and socio-economic development.

A "Class I" river is "excellent" and no treatment is required for water supply and could be used for the conservation of sensitive aquatic species while a "Class II" river (rated as good) needs conventional treatment like chlorination and filtration and is suitable for recreational pursuits.

"Class III" river (rated as slightly polluted) has water suitable only for livestock drinking and if is used as domestic water supply, more treatment is required. Class IV (rated moderately polluted) is only meant for irrigation and Class V (rated polluted) is unfit for all specified beneficial uses.

Most of Sungai Selangor's tributaries are in Class III with the exception of Sungai Sendat and Sungai Liam which are in Class I and Sungai Buloh which is under Class II (see chart).

For Sungai Kelantan, its main tributaries — Sungai Lebir and Sungai Galas — are in Class III while the rest are mostly in Class II. They include Sungai Nenggiri, Sungai Berok and Sungai Betis.

Sungai Prai and its tributaries — Sungai Kubang Semang and Sungai Jarak are in Class IV while Sungai Kulim in Class V.

Sungai Juru, all of its tributaries are in Class V while for Sungai Melaka, most of its tributaries are in Class III.

DOE director general Datuk Dr. Abu Bakar Jaafar said the classification of rivers provided the department a systematic and uniformed way of monitoring river quality.

Under the Environmental Quality Act (section 21), the Science, Technology and Environment Minister is empowered to specify conditions for the discharge of wastes/effluent and may set aside an area within which the discharge is prohibited or restricted.

Abu Bakar was speaking to reporters after receiving the 12-volume report on the *Classification of Malaysian Rivers* from the Institute of Higher Education of University Malaya dean, Professor Mohd Ali Hashim.

When asked why in the annual DOE environmental quality reports, the overall quality of rivers continued to deteriorate, Abu Bakar said some of the measures which should be taken to control the sources of pollution was beyond the mandate of the DOE.

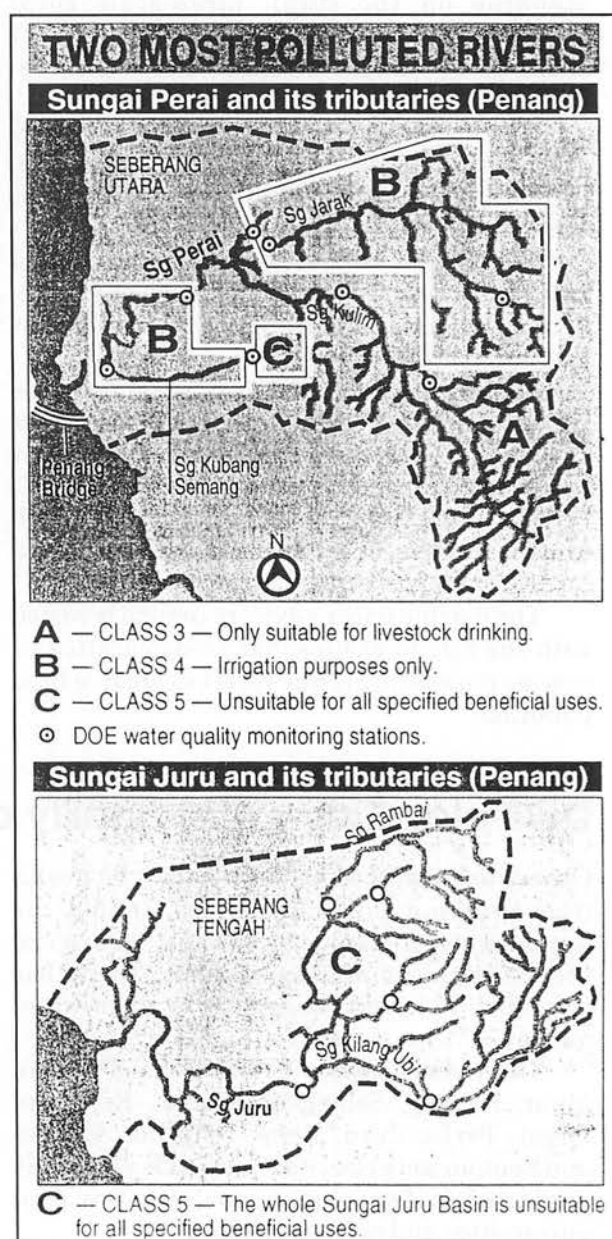
*"This is when the State Government should*

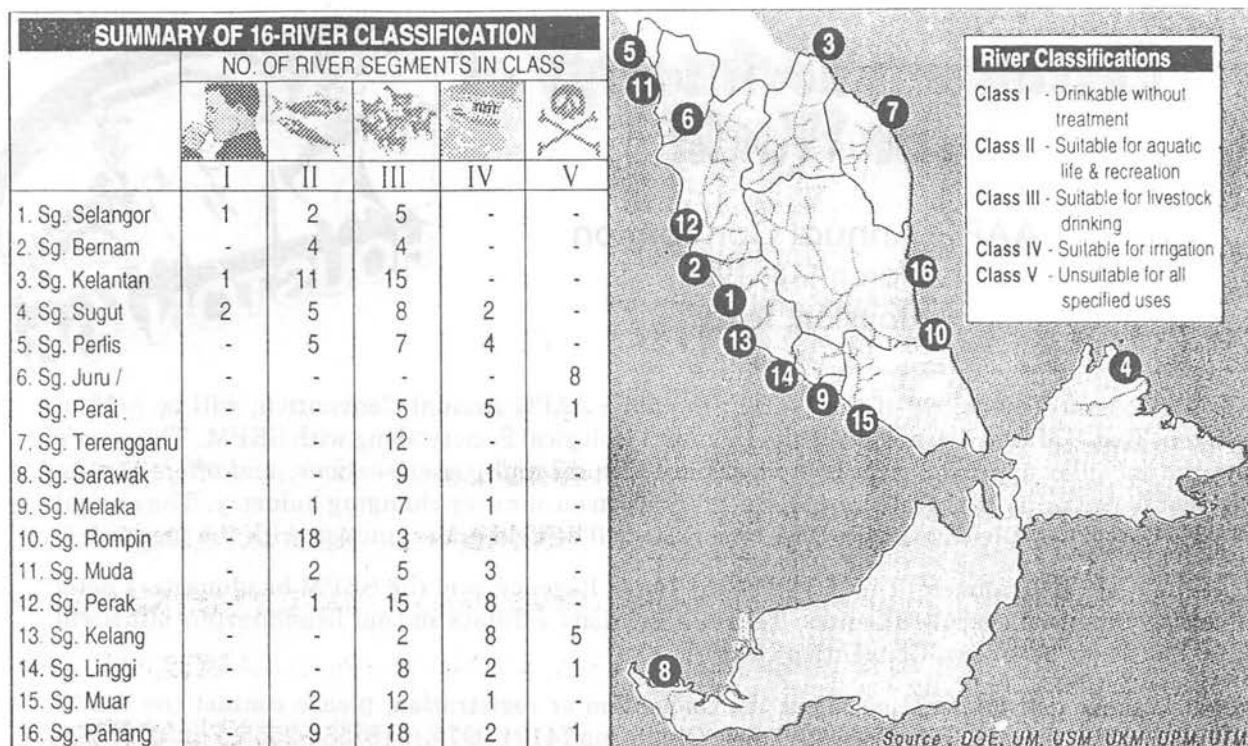
*come in since land and water resources are under their jurisdiction,"* he said.

In Penang, Sungai Juru continues to live up to its name as the "river of filth". Having been classified as "Class V" by the DOE, several fishermen in Pengakalan Batu, said the classification was justified.

Fisherman Pok Chik Min, 42, claimed that several factories and a small and medium sized boats repair yard operating along the river were among the main polluters. He said the toxic waste dumped by these culprits had poisoned the fish in the river.

*NST, 22.12.1994*





## It's a gold mine at Raub golf course

The Pahang government is prepared to relocate a golf course in Raub to enable interested parties to mine gold situated beneath the course.

Menteri Besar Tan Sri Haji Mohamed Khalil Yaakob said studies conducted by miners showed that there was abundance of gold deposit in the golf course site.

"The state is willing to discuss with mining companies who were willing to extract gold from the area and we will re-locate the golf course to facilitate mining.

"However, open cast mining will not be allowed as it requires a lot of space," he told reporters after a state exco meeting.

Khalil said a survey by the geological survey department showed the course was sitting on a gold mine worth hundreds of millions.

He said there were several existing mine shafts there but inadequate mining expertise in

the old days did not enable miners to extract all the gold deposits.

He said the gold deposits were at least 50 meters below the surface and this would require high technology to extract the deposits.

"In fact, the entire Raub town is sitting on a gold mine. The only possible way to get the gold is to bore a tunnel to get underneath the town," he said.

Khalil said there were no plans to relocate the town although studies showed there was an abundance of gold deposits below the surface.

He said the government had identified 11 blocks (4,800 hectares) of gold belts in Raub, Kuala Lipis and Jerantut, adding the state had the potential to become one of the biggest producers of gold in future.

Star, 23.12.1994

# Petroleum Technology of the World

**AAPG Annual Convention**  
**March 5-8, 1995**  
**Houston, Texas**



"Petroleum Technology of the World", the 1995 AAPG Annual Convention, will be held in Houston, Texas, March 5-8, hosted by the Houston Geological Society along with SEPM. This year's program includes approximately 600 papers in technical and poster sessions, and offers you an excellent opportunity to acquire up-to-date information on our ever-changing industry. The annual meeting of AAPG's Division-EMD, DPA, and DEG will be held in conjunction with the meeting.

The AAPG headquarters hotel will be the Hyatt Regency, and the SEPM headquarters hotel will be the Doubletree at Allen Center. Technical sessions, exhibits and our headquarters office will be at the George R. Brown Convention Center.

For additional information about the convention or registration, please contact the AAPG Convention Department, P.O. Box 979, Tulsa, Oklahoma 74101-0979, (918) 584-2555, Fax (918) 584-2274, or E-mail 73163.3035 @ Compuserve.com.

## The Pan Asian **MINING CONGRESS '95**

**Emerging Markets, Prospectivity & Regulation in Key Mining  
 Destinations**

**Organised by: AIC Conferences**  
**13-15 March 1995**

**The Marina Mandarin Hotel, Singapore**

### **A high-powered strategic forum with case studies and discussion reviewing:**

- Issues and opportunities in the evolution of Asian mining
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- Location and type of proven resources
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relations

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- People's Republic of China
- Vietnam
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- Republic of Indonesia

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- Malaysia
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- He Lt Gen Kyaw Min, Minister of Mines, The Government of the Union of Myanmar
- Ir. M. Simutupang, Indonesian Mining Association, ASEAN Mining Association
- John Lorainne, Normandy Poseidon, Malaysia
- Dr. Bill Prast, The Mining Journal, United Kingdom
- John MacLeod, Council for International Business Affairs, Australia
- Zeng Shajin, Geological Exploration Department, Peoples Republic of China
- Dr. Allen L. Clark, East West Centre, Hawaii

With base metal prices bouncing back, mining companies are increasing development and exploring for new projects. Asia is one of the emerging regions for exploration and development.

In an ideal environment, mining companies and the greater investment community will have an accurate record of mineral prospectivity, geological maps and data, an acceptable form of title, accessible tenement maps and a solid resource law for any new area of exploration and then development. Being fully aware of all the information is the key to a successful investment decision.

The 1995 Pan Asian Mining Congress offers comprehensive coverage of mining exploration, mining acts and mining in the emerging hotspots. Exploration and mining companies are increasingly seeking investment opportunities in Asia, China, Malaysia, Thailand and Vietnam. Indonesia, Myanmar and Papua New Guinea offer land of high mineral prospectivity which has had relatively low exposure to modern exploration techniques and concepts. Significant challenges exist for miners seeking to develop this area, with the reward of delineating economically viable ore bodies for mining.

Investment in these emerging minerals destinations requires sound assessment of:

- ◆ mineral prospectivity
- ◆ infrastructure
- ◆ regulatory requirements — particularly tenement acquisition and security
- ◆ the political environment

This conference is designed to provide delegates with pertinent, practical, comparative and detailed information on these evolving economies to actively inform and assist with the investment decision and start-up guidelines for mining in this region.

At the Pan Asian Mining Congress '95, government leaders survey country opportunities, investment incentives and other issues important in each country's relationships with foreign resource investors. Mining executives brief delegates on the realities of exploration and development in each country. Senior analysts with extensive in-country experience will provide their assessment of the relative impact on investors of the various regulatory, taxation and incentive structures in these key countries.

### **The 1995 Pan Asian Mining Congress '95**

- Profiles the mining industries of 7 key Asian destinations
- Highlights the mineral prospectivity and records available
- Describes the political stability and current risk
- Outlines the investment and taxation legislation within this region
- Documents, by case study, the various exploration projects and mining developments underway
- Features joint venturing opportunities
- Emphasizes attitude towards foreign investors of 7 key Asian mining destination

Don't miss this opportunity to gain a competitive lead in these rich resource markets by learning the practical realities of development and investment in Pan-Asia's resource industry. How better to evaluate these realities than to question and meet the country's foremost industry and government decision makers?

For further information about this important industry event please contact:

Richard Ireland, Director, International Resources Division, AIC Conferences, Sydney, Australia on:

Tel: (612) 210 5700 Fax: (612) 223 8126

Registration Line	Mail	Fax
Singapore	51 Anson Rd #09-55	Singapore
(65) 222 8550	Anson Centre	(65) 226 3264
	Singapore 0207	

## Symposium and Workshop on THE MESOZOIC IN THE EASTERN PART OF INDONESIA Finding and Producing Next Century's Hydrocarbons

**Jakarta  
March 21-22, 1995**

### Background

More than two years elapsed since PERTAMINA held the first one-day symposium on EXPLORATION IN EASTERN INDONESIA in Jakarta April 29, 1992. The Symposium was attended by some 180 participants. Eight selected papers on the geology and hydrocarbon potential in Eastern Indonesia were presented and a panel discussion deliberated economical, operational and logistical aspects of the region.

Since that time, many changes occurred in the Eastern part of Indonesia. A significant oil discovery in the Mesozoic section of Oseil-1 well on Seram Island and gas-condensate in Mesozoic-Lower Tertiary sequences in Wiriagar Deep well, onshore Bintuni Basin increase attention to the region. Most importantly, the Indonesian Government issued New Incentive Packages to improve the economic regime of operators working in frontier, deep water and Eastern part of Indonesia in particular. Presently, the split for oil is 65-35 and for gas 60-40.

Due to its complexity however, the Mesozoic petroleum system in Eastern Indonesia is still not fully understood. Therefore, it is time for explorationists to re-think, consolidating the knowledge and exchange the experience to solve its geological questions. The theme of this symposium "THE MESOZOIC IN THE EASTERN PART OF INDONESIA" may accommodate problem solving to unravel the geology of the Mesozoic, a proven global geological section which may hopefully be producing Next Century's Hydrocarbons!

### 2 Day Seminar & Workshop

- **1 Day Seminar**  
*March, 21st 1995*
- **1 Day Workshop**      — Working Group on Geological Field Excursions  
*March 22nd 1995*        — Working Group on Eastern Indonesia Sequence Stratigraphy  
                                 — Working Group on Airborne Surveys  
                                 — Working Group on Mesozoic Biostratigraphy  
                                 — Working Group on Mesozoic Stratigraphic Lexicon  
                                 — "Other" Working Groups

### The Topics

Beside keynote addresses from dignitaries and presentation of invited papers from experts in the industry, the following key topic areas for the Seminar and Workshop are proposed:

- |  |   |
|--|---|
| • Pre-Tertiary Exploration Status        | • Regional Tectonics of Eastern Indonesia         |
| • Mesozoic Rocks in Eastern Indonesia    | • Petroleum System in the Mesozoic                |
| • Case studies in Mesozoic Exploration   | • Mesozoic Prospectivity in Eastern Indonesia     |
| • Sedimentary Records of Climate Changes | • Play Concept, Business Strategy and Opportunity |

### Dates and Venue

The Symposium and Workshop will be held in Jakarta, in March 21-22, 1995.

PERTAMINA is the organizer. No registration fee is needed. However, delegates will be responsible for their own travel arrangements and accommodation.

### Contact Address

For registration and additional information please contact:

Yanto R. Sumantri or Lukman Kartanegara  
PERTAMINA E & P, Jl. Kramat Raya No. 59 Jakarta 10510  
Phone: (62)(21) 310.1933/310.3111  
Fax: (62)(21) 390.9180/310.6564

## The 1995 Asia Pacific

# WATER AND SEWAGE CONFERENCE

27-29 March 1995  
 Shangri-La Hotel, Bangkok  
 Organised by: AIC Conferences

Meeting the region's urgent and desperate need for adequate provision of water supply and sewage facilities is perhaps the greatest challenge yet and one which also represents an area of tremendous opportunity. The World Bank has estimated that in this decade, US\$70 billion will be invested in Asia for water treatment facilities and another US\$80 billion for waste water treatment.

Faced with such overwhelming demands for finance, national governments are turning increasingly to the private sector for both funds and expertise to improve water and wastewater facilities. What was once considered to be the domain of the public sector, has now become an area of great opportunity for private sector players.

With this scenario setting the stage for most countries, AIC is pleased to organise a highly topical and timely event: **THE 1995 ASIA PACIFIC WATER AND SEWAGE CONFERENCE**.

### Issues to be addressed include: —

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	Singapore 0207	

# Cenozoic evolution of the Indochina peninsula

## *Tectonics and sedimentary basins*

Hanoi & Nha-Trang, Vietnam  
April 25-29, 1995

Symposium organised by University of Hanoi, Université Paris 6,  
Ecole Normale Supérieure Paris

### Invitation

The Organizing Committee has the pleasure to invite all scientists interested in and working on the Indochina region to participate in the International Workshop on Cenozoic evolution of the Indochina peninsula, to be held in Hanoi and Nha Trang (Vietnam) in April 1995.

### Theme and objectives of the Workshop

The pattern of opening of the Eastern Sea of Vietnam (South China Sea) controls the Cenozoic geological evolution of the Indochina peninsula, its margins, and the associated sedimentary basins. Recent studies in geophysics, structural geology, stratigraphy, paleomagnetism, radiochronology, petrology and geochemistry concerning the Indochina peninsula will be presented and discussed. The still debated geodynamic framework of this area will help to better understand the evolution of the Cenozoic sedimentary basins with oil potential present within or around the Indochina peninsula.

The major debate will be oriented on the deformation of the Indochina peninsula and its margins, particularly within Vietnam with emphasis on existing links between onland and offshore deformations.

The objective is to better understand the style and timing of extension and shortening episodes within the Cenozoic sedimentary basins from offshore Vietnam to the East to the Thai Basins to the West.

The Workshop will also aim to create a forum for interaction between academic scientists and oil companies involved in exploration in this area.

### Official languages

The official languages of the Workshop will be English, Vietnamese and French. Using language will be preferably English, due to limitations in simultaneous translation.

### Submission of abstracts

Paper and poster selection will be based upon the scientific evaluation by the Organizing Committee and the Scientific Committee.

Authors are requested to submit one page abstracts (approximately 300 words without figures), in English only, including title, author's names, address of first author and text.

Please send abstracts to Nicolas CHAMOT-ROOKE (CNRS/ENS Paris) or PHAN DZUY Nga (Hanoi University) before January 15, 1995, together with your registration form.



## Excursions

For logistic reasons, the number of participants is limited from 10 to 20 per field trip. Priority will be given to early registration.

### **Excursion 1: Hué-Danang area trip**

**Leaders:** Phan Van Quynh, Claude Rangin

**Dates:** April 30-May 5

### **Excursion 2: Nha Trang-Dalat area trip**

**Leaders:** Dang Vu Khuc, Philippe Huchon

**Dates:** April 30-May 4

**Approximate cost** will be 300 US\$ for excursion 1 (except transfer from Danang to Hanoi or Ho Chi Minh City) and 250 US\$ for excursion 2.

## Publications

Papers presented at the meeting are expected to be published in the *Bulletin de la Société géologique de France* (in English or in French). We would like to collect manuscripts during the meeting, or not later than three months later, in order to produce the volume as soon as possible (early 1996). The papers may be published also in "Geology of Vietnam" serie B (in English) and serie A (in Vietnamese).

Instructions to authors will be sent to participants willing to submit a manuscript.

## Registration fees

	<i>Before February 15, 1995</i>	<i>Late Registration</i>
Academic scientists:	250 US\$	300 US\$
Students:	100 US\$	120 US\$
Oil companies and private agencies: (including free field trip)	2500 US\$	3000 US\$

Registration fees are to be sent by check or transfer to one of the Workshop accounts:

1. BPC (Banque Parisienne de Crédit) — Paris Monge Branch — France  
Account 30488/00077/0004770578-93 - Reference: SGF Conférence Vietnam
2. Paleontological Association of Vietnam — 47-49 Ly Thai To to Street, Hanoi, Vietnam  
Account 362 390.371 066 - Reference: for Geological Workshop
3. In exception case, you may pay at the registration desk of the Workshop

NB: no refund will be accepted after March 15, 1995 in case of cancellation.

## Important Deadlines

January 15, 1995: Deadline for receipt of abstracts and registration form.

January 31, 1995: Notification to authors of acceptance or rejection of proposed papers (oral or poster).

February 15, 1995: Deadline for receipt of payment of registration fees and hotel deposits.

April 15, 1995: Deadline for receipt of arrival date in Hanoi.

# PRECIOUS STONES AND METALS

## 3RD BI-ANNUAL MEETING "INTERGEMS"

June, 24th – July, 1st 1995

Hrubá Skála Castle  
Turnov, Czech Republic

### FOREWORD

The 3rd Bi-annual Meeting of Precious Stones and Metals will be held from June 24-July 1, 1995 at the Hrubá Skála castle, near Turnov. Previous meetings were held in Prague, in 1991 and 1993. Turnov is situated 86 km NE of Prague the capital of Czech Republic. The choice of Turnov is based not only on attractiveness of surrounding landscape called The Czech Paradise with famous sandstone rock town, but mainly on the gem and lapidary tradition of Turnov, being also called the Town of Precious Stones.

### TOPICS TO BE CONSIDERED

The topics to be considered in the main program include but not limited to:

- Synthesis of gemstones, theory, experiment, and resulting implications
- Processing of gemstone's raw material
- Database and automated procedures
- Recent advances in the crystal chemistry of gemstone miners
- Gemstone bearing mineralisation associated with pegmatites, etc.
- Gemstones and their classifications
- Diagnostic methods of natural gems and their imitations
- Ore bearing formations of precious metals
- History of the development of gemstone manufacturing
- Mineralogical museums and gemology — preservation of cultural heritage

### EXHIBITION

Exhibition of gem stones as well as jewel making, scientific equipment, and book will be organized. Potential exhibitors should contact the organizing committee.

### LANGUAGE

The official language of the meeting will be English. No simultaneous translation services will be provided.

### ADDRESS FOR CORRESPONDENCE

Tomás Rídkosil, Department of Mineralogy and Gemology OMCR, Skálova 71, 511 01 Turnov  
phone: +42-436-22106 Fax: +42-436-21148 E-mail: PRECIOSA@FALCO.VSLIB.CZ  
Abstract and Summary Deadline: February 28, 1995

## **Bengkel Teknikal Geologi: Jura-Kapur Malaysia Sempena 25 Tahun UKM — Ogos 1995**

Masih banyak aspek batuan Jura Kapur Malaysia yang belum difahami Sempena menyambut UKM 25 Tahun, Jabatan Geologi bercadang menganjurkan satu bengkel teknik sehari bertemakan "Jura-Kapur Malaysia".

Bengkel ini diharapkan akan mengupas sebanyak mungkin aspek Jura-Kapur Malaysia, termasuklah masalah lithostratigrafi, paleontologi, struktur & tektonik, dan aspek pemineralan & potensi mineral ekonomi, potensi hidrokarbon dan geoestetik.

Pembentangan kertas kerja terbuka kepada sesiapa saja yang berminat dan menyelidik batuan Jura-Kapur Malaysia.

Ahli-ahli Persatuan dipelawa membentangkan apa saja masalah, aspek atau penemuan baru tentang batuan Jura-Kapur Malaysia. Masa pembentangan dan perbincangan ialah 30 minit.

Bengkel ini dicadangkan diadakan sekitar Ogos 1995.

Sila berhubung dengan:

Dr. Ahmad Jantan  
Jabatan Geologi,  
Universiti Kebangsaan Malaysia  
43600 Bangi  
Selangor

## KALENDAR (CALENDAR)

### 1995

**January 18-19**

**SOUTH EAST ASIAN SYMPOSIUM ON TUNELLING AND UNDERGROUND SPACE DEVELOPMENT**, Bangkok Thailand. (SEASTUD Secretariat in Thailand, c/o M. Sugimoto (Dr.), Division of Geotechnical and Transportation Engineering, Asian Institute of Technology, G.P.O. Box 2754, Bangkok 10501, Thailand. Phone: +66-2-5245517; Fax: +66-2-5245509; Telex: 84276TH)

**February 13-24**

**MINERAL DEPOSIT EVALUATION**, South Kensington, London. (Sally Verkaik, Continuing Education Centre, Imperial College, Room 558 Sherfield Building, South Kensington, London SW7 2AZ, UK. Tel: +44 (0) 171 594 6882 or 6881, Fax: +44 (0) 171 594 6883, email: s.verkaik@ic.ac.uk)

**February 14-18**

**GEOSEA '95**, Mandaluyong, Metro Manila, Philippines. (Dr. Guillermo R. Balce, GEOSEA '95 Secretariat, National Institute of Geological Sciences, University of the Philippines, Diliman, Quezon City 1101, Philippines. Phone: 97 60 46, 97 60 47 Fax: (632) 711 3077, (632) 712 4656, (632) 95 1635, (632) 99 85 44)

**February 20-25**

**SOUTH ASIA GEOLOGICAL CONGRESS, COLOMBO, SRI LANKA**. (N.P. Wijayananda, GEOSASS II Secretariat, NARA, Crow Island, Mattakkuliya, Colombo 15, Sri Lanka. Phone: 941 555008. Fax: 941 522932)

**March 5-8**

**AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS**, ann. mtg., Houston. (AAPG, Box 979, Tulsa, Okla. 74101. Phone: 918/584-0469)

**March 6-9**

**SOCIETY FOR MINING, METALLURGY, AND ENGINEERING**, ann. mtg., Denver. (SME, Box 625002, Littleton, Colo. 80162-5002. Phone: 303/973-9550. Fax: 303/979-3461)

**April 2-5**

**5TH CONFERENCE SINKHOLES, ENGINEERING AND ENVIRONMENTAL IMPACTS IN KARST**, Gatlinburg, TN. Abstracts deadline: September 2, 1994. B.F. Beck, P.E. Lamoreaux & Associates, Inc., Box 4412, Oak Ridge, TN 37831-4412

**April 10-13**

**GEOLOGY AND ORE DEPOSITS OF THE AMERICAN CORDILLERA**, mtg., Reno/sparks, Nev. (Bob Hatch, Geological Society of Nevada, Box 12021, Reno, 89510. Phone: 702/323-4569. Fax: 702/323-3599)

**May 8-13**

**CRETACEOUS ENVIRONMENTAL CHANGE IN EAST AND SOUTH ASIA**, 3rd Symposium, IGCP Project 350, Quezon City, Philippines. (Dr. Priscilla J. Militante-Matias, Regional Coordinator, IGCP 350 Philippines, National Institute of Geological Sciences College of Science, University of the Philippines, Diliman, Quezon City 1101 Philippines. Phone: (632) 97-60-46, (632) 97-60-06 to 69 ext. 7117, 7445. Fax: (632) 97-60-47, (632) 97-12-66)

**May 15-19**

**EXPLORING THE TROPICS**, int'l mtg., Townsville, Queensland, Australia. (Russell Myers, 171GES, National Key Centre in Economic Geology, James Cook University, Townsville, 04814. Phone: 077-814486. Fax: 61-77-815522)

**May 16-18**

**INTERNATIONAL SYMPOSIUM ON SEQUENCE STRATIGRAPHY IN SOUTHEAST ASIA**, Jakarta, Indonesia. (International Symposium on Sequence Stratigraphy in Southeast Asia, Indonesia Petroleum Association, Jl. M. Ikhwan Ridwan Rais 3, Jakarta 10110, Indonesia. Fax: (62-21) 375228)

**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)

**June 5-12**

**XVIII PACIFIC SCIENCE CONGRESS: POPULATION, RESOURCES AND ENVIRONMENT — PROSPECTS AND INITIATIVES**, Beijing China. (Mr. XIAO Jianzhang, Dept. Exhibition, China International Conference Center for Science and Technology, No. 44 Kexueyuan Nanlu Rd., Shuangyushu, Haidian District, Beijing 100086, China. Tel: (+86)-1-2575672 Fax: (+86)-1-2575691/2546498)

**June 11-16**

**AMERICAN NUCLEAR SOCIETY**, ann. mtg., Atlantic City, N.J. (ANS, 555 N. Kensington Ave., La Grange Park, Ill. 60525. Phone: 312/352-6611)

**June 12-16**

**ORDOVICIAN SYSTEM**, int'l. mtg., Las Vegas, Nev. (Margaret Rees, Dept. of Geosciences, University of Nevada, Las Vegas, 89154-4010. Phone: 702/739-3262. Fax: 702/597-4064)

**June 18-22**

**RAPID EXCAVATION AND TUNNELING**, mtg., San Francisco. (Society for Mining, Metallurgy, and Engineering, Box 625002, Littleton, Colo. 80162-5002. Phone: 303/973-9550. Fax: 303/979-3461)

**June 18-23**

**INTERNATIONAL ASSOCIATION OF GEOMORPHOLOGISTS SOUTHEAST ASIA CONFERENCE ON GEOMORPHOLOGY**, Singapore. (Dr. GOH Kim Chuan, Division of Geography/NE Nanyang Technological University, 469 Bukit Timah Road, Singapore 1025. Fax: 65 469 8433)

**July 2-14**

**INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS**, mtg., Boulder, Colo. (IUGG General Assembly, c/o American Geophysical Union, 2000 Florida Ave. N.W., Washington, D.C. 20009)

**August 28-September 1**

**TECTONIC AND METALLOGENY OF EARLY/MID PRECAMBRIAN OROGENIC BELTS: AN INTERNATIONAL CONFERENCE**, Montreal, Canada. (J.A. Percival, Geological Survey of Canada, 601 Booth St., Ottawa, Ontario, Canada, K1A 0E8. Phone: (613) 995-4723; Fax: (613) 995-9273)

**August 28-September 2**

**ORIGIN OF GRANITES**, Hutton Symposium, College Park, Md. (Michael Brown, Dept. of Geology, University of Maryland, College Park, 20742. Phone: 301/405-4082. Fax: 301/314-9661)

**October 10-14**

**PALEOCEANOGRAPHY**, int'l mtg., Halifax, Nova Scotia. (Larry Mayer, Ocean Mapping Group, Dept. of Surveying and Engineering, Box 4400, Fredericton, New Brunswick, Canada E3B 5A3)

**November 4-6**

**GEOLOGY OF SOUTHEAST ASIA AND ADJACENT AREAS**, Joint Meeting of IGCP Projects 306, 321 & 359, Hanoi, Vietnam. (Prof. Dang Vu Khuc, Geological Museum, 6 Pham Ngu Lao, Hanoi, Vietnam. Phone: 84.4.266.802, Fax: 84.4.254.734)

**November 6-9**

**GEOLOGICAL SOCIETY OF AMERICA**, ann. mtg., New Orleans. (Vanessa George, 3300 Penrose Place, Boulder, Colo, 80301. Phone: 303/447-2020. Fax: 303/447-1133)

**1996****August 4-14**

**30TH INTERNATIONAL GEOLOGICAL CONGRESS**, Beijing, China. (Prof. Zhao Xun, Deputy Secretary General, 30th IGC, P.O. Box 823, Beijing 100037, P.R. China)

**October 28-31**

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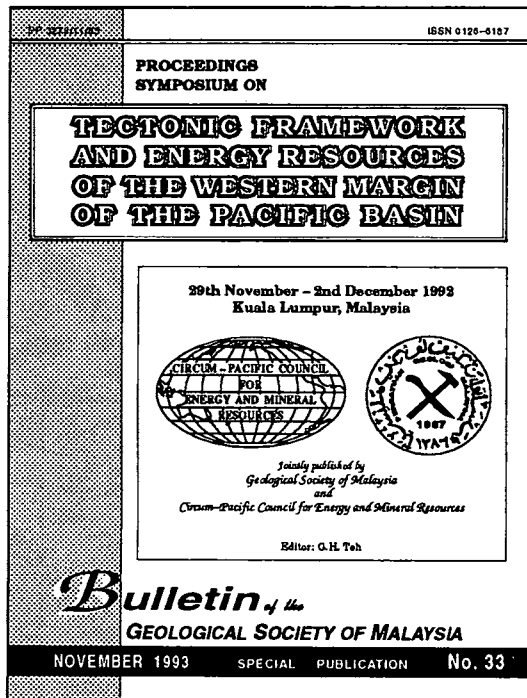
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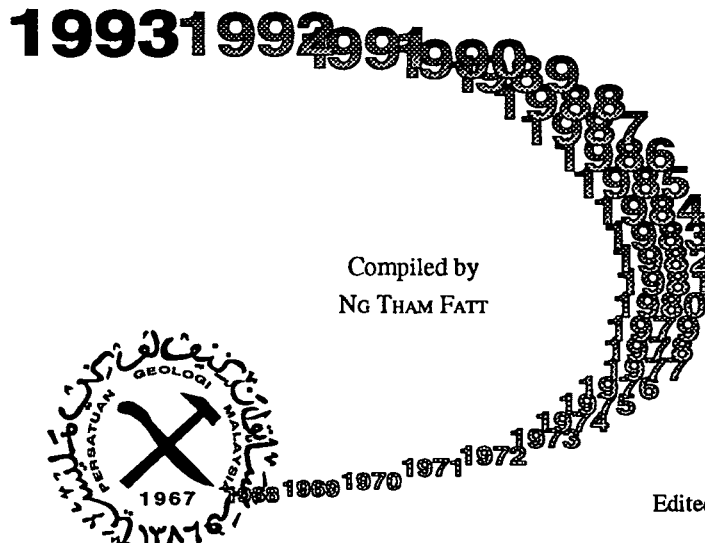
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- Bulletin 2** (Dec 1968). 152 p. Bibliography and Index of the Geology of West Malaysia and Singapore by D.J. Gobbett. Price: RM10.00 - Softcover, M\$15.00.
- Bulletin 3** (Mar 1970). 146 p. Papers in Geomorphology and Stratigraphy (with Bibliography supplement). Edited by P.H. Stauffer. Price: RM10.00.
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- Bulletin 5** (Feb 1973). 70 p. The Search for Tungsten Deposits by K.F.G. Hosking. Price: RM10.00.
- Bulletin 6** (Jul 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: RM22.00 - hardcover only.
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- Bulletin 9** (Nov 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. Price: RM25.00. Out of stock.
- Bulletin 10** (Dec 1978). 95 p. A collection of papers on the geology of Southeast Asia. Edited by C.H. Yeap. Price: RM10.00. Out of stock.
- Bulletin 11** (Dec 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: RM50.00.
- Bulletin 12** (Aug 1980). 86 p. A collection of papers on geology. Edited by G.H. Teh. Price: RM20.00.
- Bulletin 13** (Dec 1980). 111 p. A collection of papers on geology of Malaysia and Thailand. Edited by G.H. Teh. Price: RM20.00.
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- Bulletin 18** (Nov 1985). 209 p. Special Issue on Petroleum Geology. Edited by G.H. Teh & S. Paramanathan. Price: RM30.00.
- Bulletin 19** (Apr 1986) & **20** (Aug 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. Paramanathan. Price for both Bulletins 19 & 20: Members - RM50.00, Non-Members - RM125.00.
- Bulletin 21** (Dec 1987). 271 p. Special Issue on Petroleum Geology Vol. II. Edited by G.H. Teh. Price: RM40.00.
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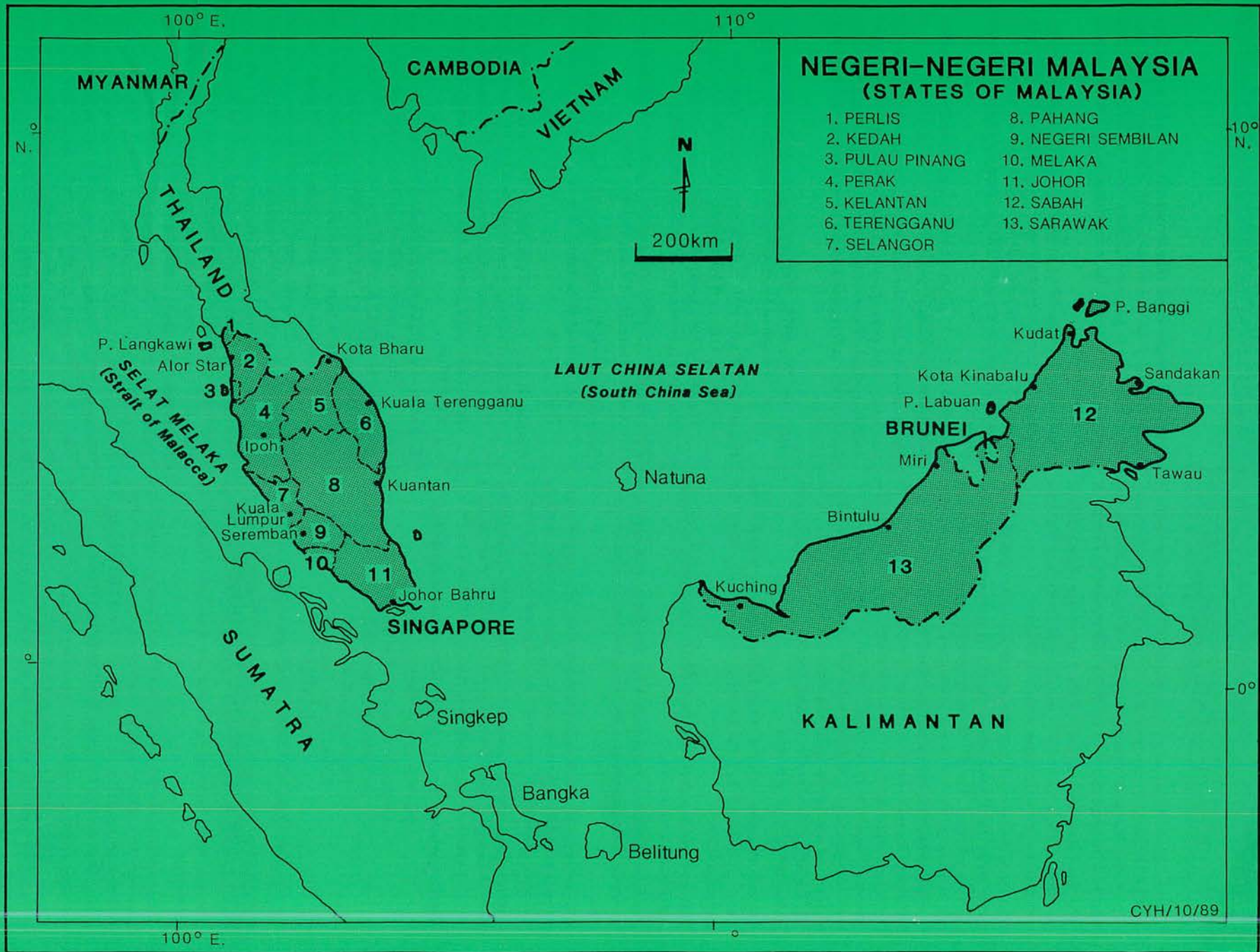
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