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

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# CATATAN GEOLOGI

## Geological Notes

### Ultrasonic pulse velocities and elastic moduli of igneous rock materials from the Ajil area, Terengganu Darul Iman

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**Abstract:** Laboratory measurements show the ultrasonic pulse velocities of compressional and shear waves in igneous rock materials from the Ajil area to be dependent upon inherent mineral compositions and textures. Medium grained granites show mean compressional and shear wave velocities of 5,091 and 3,013 km/s, and their sheared equivalents, 5.053 and 2.844 km/s, respectively, whilst medium grained adamellites show mean velocities of 4.987 and 2.850 km/s, and their sheared equivalents, 4.786 and 2.842 km/s, respectively. Fine grained quartz dolerites show mean compressional and shear wave velocities of 5.031 and 3.001 km/s, whilst fine grained dolerites show mean velocities of 5.278 and 3.020 km/s, and very fine grained dolerites, mean velocities of 5.035 and 2.826 km/s, respectively. Elastic moduli calculated from the measured velocities are also variable and similarly reflect the inherent mineral compositions and textures.

#### 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 subject 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 direct importance to the design of structures (Farmer, 1968) and towards this end a knowledge of its dynamic elastic moduli is extremely useful.

Various methods can be used for determination of the dynamic elastic moduli of rock material; the most common laboratory method involves 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 in determination of the compressional and shear wave velocities, the calculated moduli are termed ultrasonic elastic moduli (ASTM, 1976; AIT, 1981).

In this paper are presented results of the laboratory determinations of the compressional and shear wave velocities of ultrasonic pulses through igneous rock materials from the Ajil area of Terengganu Darul Iman. Procedures for calculation of the ultrasonic elastic moduli are also presented, together with a discussion on the influence of mineral compositions and textures.

#### AJIL AREA — GEOLOGICAL SETTING

In the Ajil area is found a large ridge that steeply rises above the surrounding undulating to flat terrain underlain by unconsolidated

alluvial sediments (Fig. 1). The ridge and a number of other small hills in its vicinity are developed over acidic igneous rocks that form part of the Jerengau Forest Pluton (Cobbing and Mallick, 1987). A Rb/Sr date of  $230 \pm 6$  Ma shows these rocks to be of a Lower Triassic age (Mohd. Anuar, 1986).

In the central part of the area, to the north and east of Bt. Lading (Fig. 1), the igneous rocks show little textural variation, being a non-porphyrific to weakly porphyritic, medium to coarse grained biotite granite. The rocks are usually pink to pinkish grey in colour, except along fault zones, where they are pinkish green in colour. Ovoid, dark grey, fine grained xenoliths of up to about 0.5 m length are also found, though they are not of common occurrence.

Intruding the granitic rocks are a number of steeply dipping to vertical, dolerite and quartz dolerite dykes of limited lengths, but of variable trends and widths. The fine to very fine grained, dark grey dolerite dykes range in width from 0.2 to 15 m, and generally trend  $315^\circ$ , whilst the fine grained, greenish quartz dolerite dykes are up to 10 m wide and mostly trend  $60^\circ$ .

The granitic rocks are on the whole strongly jointed and cut in several places by small to large scale faults. The joints, which mainly strike  $60^\circ$ ,  $330^\circ$  and  $90^\circ$  with steep to vertical dips, are also found in the basic dykes, whilst the faults are marked by narrow shear zones, that mainly strike  $60^\circ$  to  $120^\circ$ , and  $330^\circ$  with steep to vertical dips.

### METHOD OF STUDY

As a part of a study on the geotechnical properties of the rock materials of Terengganu Darul Iman, several large blocks of igneous rocks exposed in quarries in the Ajil area were collected (Fig. 1). Thin-sections and slabs for staining were prepared from these blocks before they were sawn into smaller, tetrahedral blocks. The sides of the smaller blocks were then finely ground before their visible textural and structural features were described. Densities, unit weights and porosities of these blocks were then determined according to the suggested saturation and buoyancy method of ISRM (1979).

The blocks were then oven-dried at  $105^\circ\text{C}$

for 12 hours before the ultrasonic pulse velocities were measured using an OYO Corporation Sonic Viewer (Model 5217A) with compressional and shear wave transducers of 63 kHz and 33 kHz frequency. In order to investigate possible anisotropy, velocity measurements were carried out through all three parallel faces of the blocks. For determination of the compressional wave velocities, which were carried out after measurements of the shear wave velocities, grease was applied between the transducers and the sides of the blocks to ensure proper contact.

### PETROGRAPHY OF INVESTIGATED IGNEOUS ROCK MATERIALS

On the basis of visual colour and textures, the investigated rock materials can be differentiated into two broad groups, comprising acidic and basic igneous rocks. The acidic rocks are characteristically pink in colour, non-porphyrific to weakly porphyritic and medium to coarse grained with inequigranular crystals of quartz, alkali feldspar, plagioclase and biotite, whilst the basic rocks are dark green to black in colour and fine to very fine grained.

In hand specimens, the acidic igneous rocks appear to be mineralogically homogenous, though the point counting of several slabs (with selective staining of feldspars according to the method of Bailey and Stevens, 1960) shows that they can be termed as granite and adamellite (Table 1). In thin-section, they are seen to be holocrystalline, hypidiomorphic and inequigranular with the essential minerals being alkali feldspar, plagioclase, quartz and biotite, whilst the accessory minerals include sphene, epidote and zircon and the secondary minerals, chlorite, sericite and iron oxides. Subhedral to euhedral, tabular alkali feldspars are the dominant feldspars and mostly 1 to 8 mm in size, whilst subhedral to anhedral, plagioclase feldspars are 1 to 6 mm in size and of oligoclase to andesine composition. The anhedral quartz crystals of some 0.5 to 5 mm in size show irregular boundaries and occur interstitially between the feldspars. The biotites, which occur as euhedral, individual flakes, or in small clusters, are up to 3 mm in size and sometimes partially to completely chloritized.

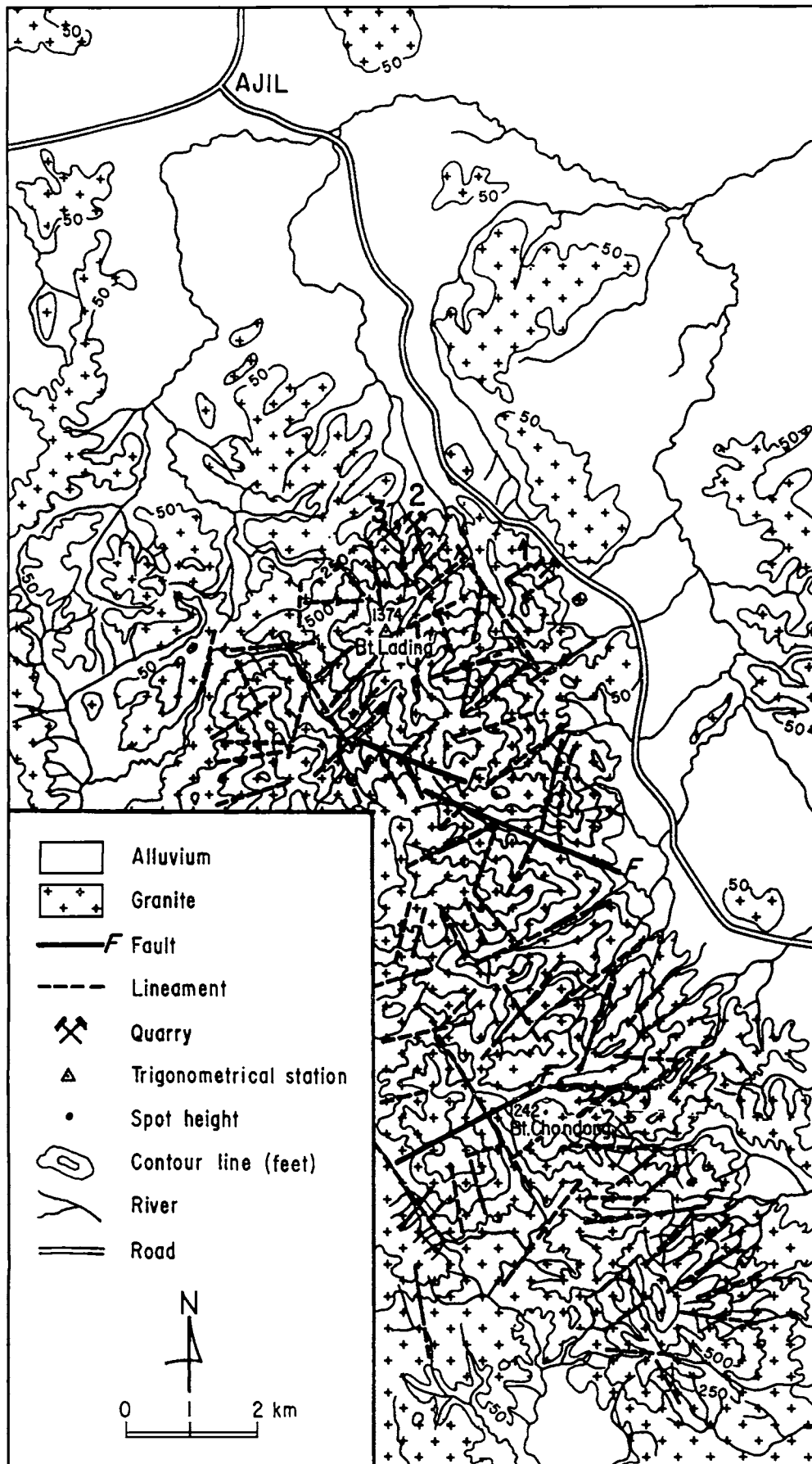


Figure 1. Geological sketch map of the Ajil area, Terengganu Darul Iman.

In thin-section, the basic igneous rocks are seen to be holocrystalline, hypidiomorphic to allotriomorphic and inequigranular with fine to medium grained crystals of up to 1.0 mm in size. They consist essentially of plagioclase feldspar (of mainly andesine) and augite with some olivine, iron oxides and chlorite and can be classified as dolerites. They do show

variations in grain size; some being very fine grained (with plagioclase laths of about 0.1 mm x 0.4 mm) and others coarser grained (with plagioclase laths of about 0.5 mm x 0.8 mm). Some of the basic rocks can also be termed quartz dolerites for they consist essentially of plagioclase feldspar (of mainly andesine and up to 0.3 mm x 0.6 mm size), hypersthene and

**Table 1.** Mineral compositions of acidic igneous rock materials from the Ajil area, Terengganu Darul Iman.

Sample Number	Quartz %	Alkali Feldspar %	Plagioclase Feldspar %	Mafics %	Rock Material Classification
2A	34.7	45.0	16.4	3.9	Pink, medium grained, Granite.
2B	34.1	49.0	15.0	1.9	Greenish pink, medium grained, Granite.
4	32.1	44.4	21.4	2.1	Pinkish grey, medium grained, Granite.
6	32.2	30.6	35.2	2.0	Pinkish grey, medium grained, Sheared Adamellite.
10	36.1	32.5	29.4	2.0	Pink, medium grained, Adamellite.
11	23.5	49.2	22.3	5.0	Pinkish grey, medium grained, Granite.
12	33.2	33.7	30.1	3.0	Pinkish grey, medium grained, Adamellite.

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

MODULI	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) $E$	$E = \frac{Vs^2 \rho}{g} \left[ \frac{3(V_p/V_s)^2 - 4}{(V_p/V_s)^2 - 1} \right]$
Bulk Modulus (Compressibility) $K$	$K = \frac{\rho}{g} Vs^2 \left[ \left( \frac{V_p}{V_s} \right)^2 - \frac{4}{3} \right]$
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;  
 $V_s$  = Shear wave velocity;

$\rho$  = Unit weight  
 $g$  = gravitational acceleration

quartz with some iron oxides and chlorite.

### ELASTIC MODULI

The fundamental basis of the 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, the existence and velocity of all body waves is a function of its density (or unit weight) and elasticity; the propagation velocities of compressional waves ( $V_p$ ), and shear waves ( $V_s$ ) being related to the elastic moduli by the following equations (after Obert and Duvall, 1976):-

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

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 and shear waves through an elastic medium, as well as its unit weight, it is thus possible to calculate the various elastic moduli as shown in Table 2. These equations have been used in many studies to derive the elastic moduli of rock material, though it has been pointed out that there are few demonstrations where these equations are truly applicable (Birch, 1966). These equations are also 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 subject 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 also show fair agreement and justify use of the said equations at moderately high pressures (Birch, 1966).

### RESULTS AND DISCUSSION

Results of all the determinations of compressional and shear wave velocities, as well as computed elastic moduli, (Table 3), show a wide range of values, though the larger values are seen to be associated with greater unit weights. This is to be expected as the velocity of compressional and shear waves increases with an increase in density (Lama and Vutukri, 1978). When the results are grouped according to inherent mineral compositions and textures, a clearer relationship is seen with the acidic rock materials (granite and adamellite — Table 4) showing lower velocities and moduli than the basic rock materials (dolerite and quartz dolerite — Table 5) which have greater unit weights.

The compressional wave velocities and computed elastic moduli of the acidic igneous rock materials are furthermore, comparable with published data, as Belikov (1967) who quotes mean compressional velocities of 5.190 to 5.330 km/s, Poisson's ratios of 0.22 to 0.24, and moduli of elasticity of 59.429 to 66.784 GPa, for medium grained biotite granites from the Ukrainian Shield, and a compressional velocity of 5.755 km/s, a Poisson's ratio of 0.22 and a modulus of elasticity of 75.51 GPa for fine grained granites. Belikov (1967) also quotes an average compressional wave velocity of 5.465 km/s, a Poisson's ratio of 0.25 and a modulus of elasticity of 65.90 GPa for coarse grained biotite granites from the Baltic Shield. Youash (1970) quotes ultrasonic compressional and shear wave velocities of 5.008 km/s and 3.018 km/s, and 4.570 km/s and 2.924 km/s, respectively for Pre-Cambrian coarse, and medium, grained biotite granites.

The pulse velocities and calculated elastic moduli of the basic igneous rock materials are also comparable with some published data as Ramana and Venkatanarayana (in Lama and Vutukuri, 1978), who quote compressional wave velocities of 5.22 to 6.48 km/s, shear wave velocities of 2.78 to 3.73 km/s, Poisson's ratios of 0.15 to 0.33, moduli of elasticity of 62.5 to 109.3 GPa and bulk moduli of 38.6 to 90.6 GPa for dolerites from India. Belikov *et al.* (1967) furthermore, quote a dynamic Poisson's ratio of 0.26 and a modulus of elasticity of 115 GPa for Pre-Cambrian diabases from the Ukraine.

**Table 3.** Ultrasonic pulse velocities and elastic moduli of igneous rock materials from the Ajil area, Terengganu Darul Iman.

Sample No.	Unit Weight $\text{kNm}^{-3}$	S Wave Velocity $\text{kms}^{-1}$	P Wave Velocity $\text{kms}^{-1}$	Poisson's Ratio	Modulus of Elasticity GPa	Bulk Modulus GPa	Modulus of Rigidity GPa	Lame's Constant GPa	Rock Material Classification
1	28.204	2.835	5.046	0.270	58.669	42.435	23.107	27.023	Very fine grained, grey DOLERITE.
1	28.204	2.818	5.024	0.271	58.017	42.155	22.831	26.927	
2A	25.723		4.917						Medium grained, pink GRANITE.
	25.723	2.953	5.118	0.251	57.197	38.224	22.869	22.970	
2B	25.635		4.965						Medium grained, greenish pink, SHEARED GRANITE.
	25.635	2.844	5.052	0.268	53.610	38.546	21.137	24.448	
	25.635		5.141						
3A	27.430	2.958	5.096	0.246	60.977	40.008	24.471	23.686	Fine grained, green QUARTZ DOLERITE.
	27.430	3.019	5.004	0.214	61.882	36.045	25.491	19.042	
	27.430	2.998	5.151	0.244	62.538	40.686	25.141	23.918	
3B	27.175	3.034	4.924	0.194	60.897	33.185	25.500	16.177	Fine grained, green QUARTZ DOLERITE.
	27.175	2.999	4.907	0.202	59.896	33.504	24.916	16.885	
	27.175		5.107						
4A	25.753	3.178	5.134	0.189	63.087	33.854	26.522	16.164	Medium grained, pinkish grey, GRANITE.
	25.753	3.147	5.160	0.204	62.612	35.272	26.000	17.930	
	25.753		4.953						
4B	25.772		5.113						Medium grained, pinkish grey, GRANITE.
	25.772	3.064	5.071	0.213	59.820	34.711	24.664	18.260	
	25.772		5.088						
5A	28.430	3.072	5.413	0.263	69.065	48.485	27.351	30.242	Fine grained, grey DOLERITE.
	28.430		5.355						
	28.430		5.254						
5B	28.557	2.981	5.245	0.261	65.284	45.599	25.879	28.337	Fine grained, grey DOLERITE.
	28.557		5.308						
	28.557		5.297						
5C	28.646	2.946	5.055	0.243	63.026	40.841	25.358	23.927	Fine grained, grey DOLERITE.
	28.646	3.081	5.297	0.244	69.009	45.003	27.728	26.508	
6A	25.790	2.854	4.820	0.230	52.703	32.548	21.423	18.259	Medium grained, pinkish grey, SHEARED ADAMELLITE.
	25.790		4.672						
	25.790		4.802						
6B	25.750	2.829	4.850	0.242	52.213	33.750	21.018	19.731	
	25.750		4.784						
10A	25.571	2.670	5.031	0.304	48.465	41.230	18.582	28.836	Medium grained, pink, ADAMELLITE.
	25.571		4.987						
	25.571		4.781						
11	25.835	2.932	5.220	0.269	57.512	41.577	22.653	26.468	Medium grained, pinkish grey, GRANITE.
	25.835		5.073						
	25.835		5.188						
11A	25.835	2.807	5.058	0.277	53.043	39.722	20.762	25.874	
12	25.862	2.924	4.832	0.211	54.617	31.498	22.552	16.456	Medium grained, Pinkish grey, ADAMELLITE.
	25.862		5.057						
	25.862		5.235						



**Table 4.** Ultrasonic pulse velocities and elastic moduli of acidic igneous rock materials from the Ajil area, Terengganu Darul Iman.

Sample No.	Unit Weight $\text{kNm}^{-3}$	S Wave Velocity $\text{kms}^{-1}$	P Wave Velocity $\text{kms}^{-1}$	Poisson's Ratio	Modulus of Elasticity GPa	Bulk Modulus GPa	Modulus of Rigidity GPa	Lame's Constant GPa	Rock Material Classification	
2A	25.723	2.953	4.917	0.251	57.197	38.224	22.869	22.970	Pink, medium grained, GRANITE.	
	25.723		5.118							
4A	25.753	3.178	5.134	0.189	63.087	33.854	26.522	16.164		
	25.753	3.147	5.160	0.204	62.612	35.272	26.000	17.930		
4B	25.753	3.064	4.953	0.213	59.820	34.711	24.664	18.260		
	25.772		5.113							
	25.772		5.071							
11	25.772	2.932	5.088	0.269	57.512	41.577	22.653	26.468		
	25.835		5.220							
11A	25.835	2.807	5.073	0.277	53.043	39.722	20.762	25.874		
	25.835		5.188							
<b>MEAN</b>	<b>25.780</b>	<b>3.013</b>	<b>5.091</b>	<b>0.234</b>	<b>58.879</b>	<b>37.227</b>	<b>23.912</b>	<b>21.278</b>		
2B	25.635	2.844	4.965	0.268	53.610	38.546	21.137	24.448	Greenish pink, medium grained, SHEARED GRANITE.	
	25.635		5.052							
	25.635		5.141							
<b>MEAN</b>	<b>25.635</b>	<b>2.844</b>	<b>5.053</b>	<b>0.268</b>	<b>53.610</b>	<b>38.546</b>	<b>21.137</b>	<b>24.448</b>		
10A	25.571	2.775	5.031	0.281	51.450	39.240	20.075	25.850		
	25.571		4.987							
	25.571		4.781							
12	25.571	2.924	4.781	0.211	54.617	31.498	22.552	16.456		
	25.862		4.832							
	25.862		5.057							
6A	25.862	2.850	5.235	0.246	53.034	35.369	21.314	21.153		
	25.862		4.987							
<b>MEAN</b>	<b>25.717</b>	<b>2.850</b>	<b>4.987</b>	<b>0.246</b>	<b>53.034</b>	<b>35.369</b>	<b>21.314</b>	<b>21.153</b>		
6A	25.790	2.854	4.820	0.230	52.703	32.548	21.423	18.259	Pinkish grey, medium grained, SHEARED ADAMELLITE.	
	25.790		4.672							
6B	25.790	2.829	4.802	0.242	52.213	33.750	21.018	19.731		
	25.750		4.850							
6B	25.750	2.842	4.784	0.236	52.458	33.149	21.220	18.995		
	25.750		4.784							
<b>MEAN</b>	<b>25.774</b>	<b>2.842</b>	<b>4.786</b>	<b>0.236</b>	<b>52.458</b>	<b>33.149</b>	<b>21.220</b>	<b>18.995</b>		

**Table 5.** Ultrasonic pulse velocities and elastic moduli of basic igneous rock materials from the Ajil area, Terengganu Darul Iman.

Sample No.	Unit Weight kNm <sup>-3</sup>	S Wave Velocity kms <sup>-1</sup>	P Wave Velocity kms <sup>-1</sup>	Poisson's Ratio	Modulus of Elasticity GPa	Bulk Modulus GPa	Modulus of Rigidity GPa	Lame's Constant GPa	Rock Material Classification
1	28.204	2.835	5.046	0.270	58.669	42.435	23.107	27.023	Grey, very fine grained, DOLERITE.
1	28.204	2.818	5.024	0.271	58.017	42.155	22.831	26.927	
<b>MEAN</b>	<b>28.204</b>	<b>2.826</b>	<b>5.035</b>	<b>0.270</b>	<b>58.343</b>	<b>42.295</b>	<b>22.969</b>	<b>26.975</b>	
5A	28.430	3.072	5.413	0.263	69.065	48.485	27.351	30.242	Grey, fine grained, DOLERITE.
	28.430		5.355						
	28.430		5.254						
5B	28.557	2.981	5.245	0.261	65.284	45.599	25.879	28.337	
	28.557		5.308						
	28.557		5.297						
5C	28.646	2.946	5.055	0.243	63.026	40.841	25.358	23.927	
	28.646		3.081						5.297
<b>MEAN</b>	<b>28.532</b>	<b>3.020</b>	<b>5.278</b>	<b>0.253</b>	<b>66.596</b>	<b>44.982</b>	<b>26.579</b>	<b>27.254</b>	
3A	27.430	2.958	5.096	0.246	60.977	40.008	24.471	23.686	Green, fine grained, QUARTZ DOLERITE.
	27.430	3.019	5.004	0.214	61.882	36.045	25.491	19.042	
	27.430	2.998	5.151	0.244	62.538	40.686	25.141	23.918	
3B	27.175	3.034	4.924	0.194	60.897	33.185	25.500	16.177	
	27.175	2.999	4.907	0.202	59.896	33.504	24.916	16.885	
	27.175		5.107						
<b>MEAN</b>	<b>27.303</b>	<b>3.001</b>	<b>5.031</b>	<b>0.220</b>	<b>61.238</b>	<b>36.686</b>	<b>25.104</b>	<b>19.941</b>	

Apart from the expected variations between the groups of acidic and basic igneous rock materials, there are also seen some significant variations within them. The medium grained granitic material for instance, shows mean compressional and shear wave velocities of 5.091 and 3.013 km/s, respectively, whilst its' sheared equivalent shows corresponding values of 5.053 and 2.844 km/s, respectively (Table 4). The medium grained adamellite material furthermore, shows mean compressional and shear wave velocities of 4.987 and 2.850 km/s, whilst its' sheared equivalent shows corresponding values of 4.786 and 2.842 km/s. The lower pulse velocities of the sheared rock materials (in comparison with the unaffected rock material) is likely due to its' greater number of inter-granular boundaries; a feature that

has also been noted by Zaleskii *et al.* (1967). Differences in velocities furthermore, lead to differences in the values of the calculated elastic moduli (Tables 3 and 4). It is also to be noted that there are no really significant differences in velocities and calculated elastic moduli of the granitic and adamellite rock materials; a feature that is probably due to their closely similar mineral compositions and textures.

The basic igneous rock materials also show some variations in pulse velocities and calculated elastic moduli; the variations probably related to differences in textures and mineral compositions. The fine grained dolerites for instance, show higher velocities than the very fine grained dolerites, whilst the quartz dolerites show lower velocities due to the presence of quartz and lower unit weights.

## CONCLUSIONS

It is concluded that inherent mineral compositions and textures influence the propagation velocities of ultrasonic pulses, as well as the calculated elastic moduli, of igneous rock materials from the Ajil area. Medium grained granites show mean compressional and shear wave velocities of 5.091 and 3.013 km/s and their sheared equivalents, 5.053 and 2.844 km/s, whilst medium grained adamellites show mean velocities of 4.987 and 2.850 km/s and their sheared equivalents, 4.786 and 2.842 km/s, respectively. Fine grained quartz dolerites show mean compressional and shear wave velocities of 5.031 and 3.001 km/s, whilst fine grained dolerites show mean velocities of 5.278 and 3.020, km/s, and very fine grained dolerites show mean velocities of 5.035 and 2.826 km/s, respectively. Elastic moduli computed from the measured velocities are also variable and similarly reflect the inherent mineral compositions and textures.

## ACKNOWLEDGEMENTS

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Manuscript received 12 August 1995

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# CATATAN GEOLOGI Geological Notes

## Hyper-steep foreset laminations in a Tembeling sandstone, Pahang

H.D. TJIA

Petronas Research & Scientific Services Sdn. Bhd.  
Lot 1026 PKNS Industrial Estate  
54200 Hulu Kelang

An outcrop between Padang Piol and village, Pahang (Fig. 1), shows Jurassic-Cretaceous Tembeling strata of conglomerate, Sungai Peta along the road towards Terisik

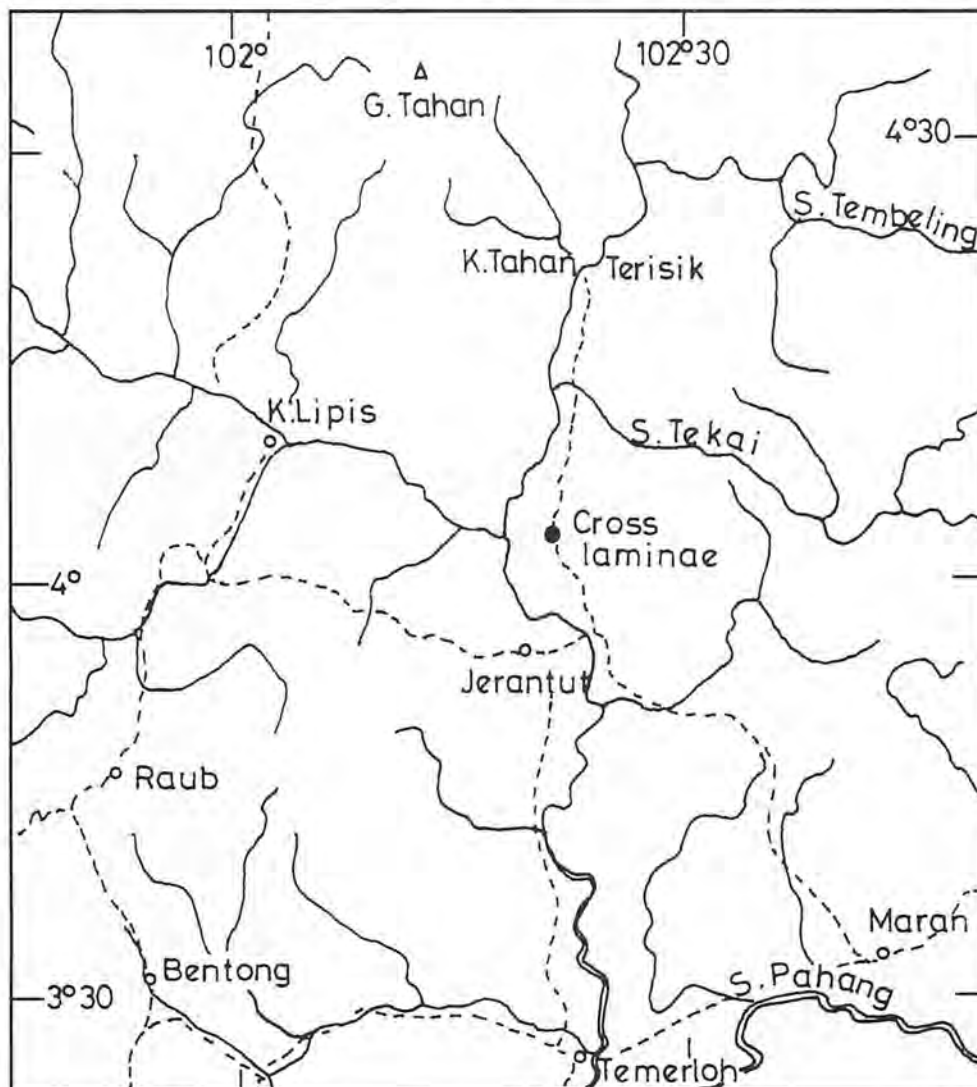
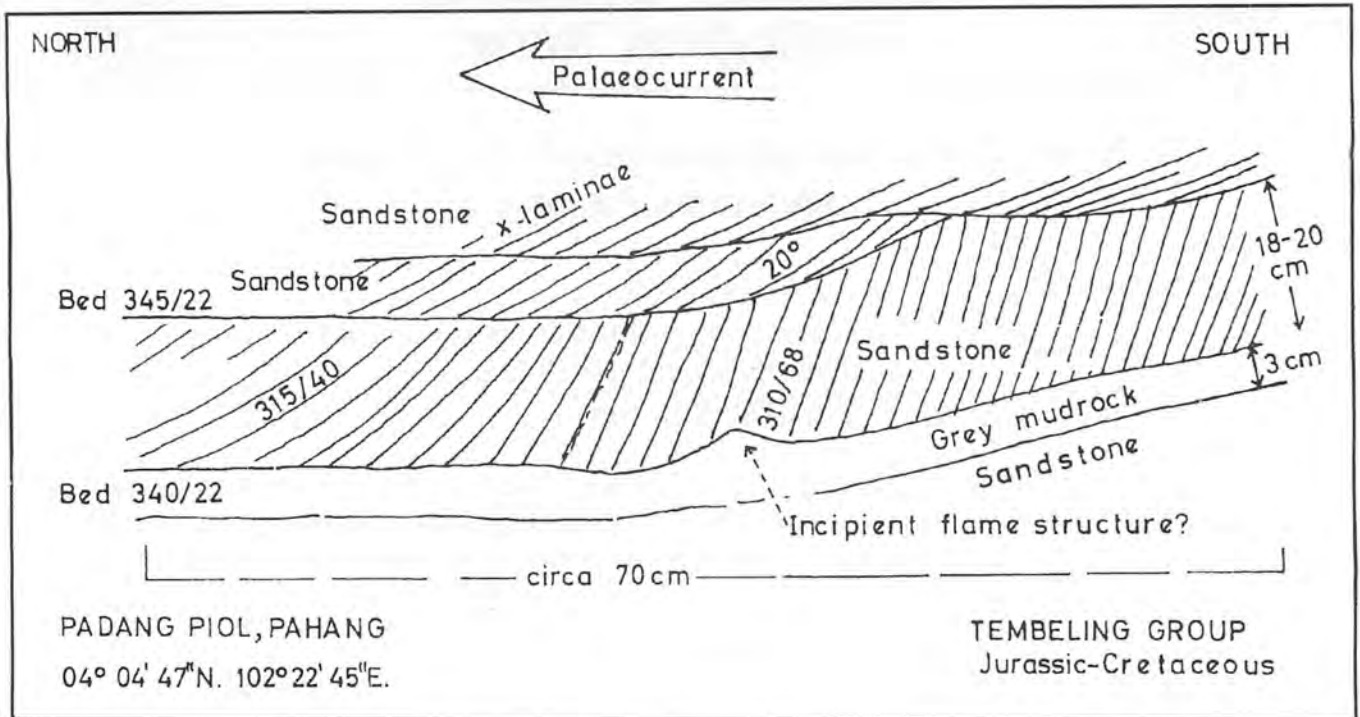


Figure 1. Location of outcrop showing hyper-steep cross laminations.



**Figure 2.** Hyper-steep laminations to the south of the double dash line and normal-inclined cross laminations to its north. Note the triangular upward protrusion of grey mudrock. Palaeocurrent was towards north-northeast. Part of roadcut between Padang Piol and the bridge across Sungai Peta, Pahang.



**Figure 3.** Photograph of hyper-steep and normal cross-laminated sandstone layers in Tembeling beds near Padang Piol, Pahang.

conglomeratic sandstone, cross-laminated sandstone, and grey and reddish mudrock. The mudrock is subordinate in the outcrop. Extremely steep tabular cross laminae occur in a layer of well-sorted, fine to medium grained sandstone, that through a handlens appears as sublitharenite or subarkose. One 18-20 cm thick sandstone layer has cross laminae at angles of 68 degrees, while the containing stratum dips 22 degrees. The dips are towards N40°E and N70°E, respectively (Figs. 2 and 3). After rotating the bed to horizontal, the cross laminae still dip 49 degrees, which is much too steep for an angle of repose of loose material with good sorting. Dry, loose material of good sorting commonly possesses repose angles of about 35 degrees. Deposited in water, such material achieves yet gentler angles of repose. A classical paper on angle of repose was written by Von Burkalow (1945). Figure 2 shows the hyper-steep cross laminae to persist over an outcrop length of about 45 cm. Towards south its continuation is masked by very weathered material; towards north the dips of cross laminae change into normal inclinations. The change in dips occurs indistinctly at about the double dash line. Cross laminae in sandstone layers overlying the stratum in question are also of normal dips towards NNE. The palaeocurrent sense was clearly north-northeastward. The sandstone with hyper-steep cross laminae is underlain by a 3-cm thick, grey mudrock. The

mudrock has even thickness except at one spot where a triangular protrusion juts into the overlying sandstone. This protrusion most probably represents an incipient flame structure.

The hyper-steep cross laminations are interpreted to have formed as a consequence of **early diagenesis** of the cross-laminated sandstone to the south of the double-dash line, succeeded by slight **rotation** and **en bloc sliding** northward that oversteepened the cross-laminae. In other words, the sandstone with hyper-steep cross laminae was sufficiently consolidated as to have reacted as a unit. The sliding was facilitated by the mudrock base, while the push was probably provided by palaeocurrents running to north-northeast. The cross-laminae with normal dips in the same sandstone layer to the north of the double dash line were most probably produced as prograding foresets after the sliding ceased.

#### ACKNOWLEDGEMENT

This communication is published with the approval of PRSS management.

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*Manuscript received 18 August 1995*

# Souvenirs For Sale

In Response to requests by members, the Society has now prepared several souvenir items for sale as follows:

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Key Chain



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

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

#### **Engineering geology considerations of LRT System Two for Kuala Lumpur**

MUHINDER SINGH

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

Mr. Muhinder Singh, Manager (Geotechnical), Pengurusan LRT Sdn. Bhd. gave the above talk to a packed hall at the Geology Department, University of Malaya on the 19th January 1996. The Light Rail Transit (LRT) System for KL has apparently generated a lot of interest not only for geologists and engineers but also professionals in related fields.

After his informative, well illustrated presentation, the speaker showed a video of the Tunnel Boring Machine (TBM) before ably answering the many queries put forward.

##### **Abstrak (Abstract)**

The LRT System 2 for Kuala Lumpur currently being constructed by PUTRA, the concession holders, comprises a 30 km route linking Gombak to the northwest and Lembah Subang to the southeast of Kuala Lumpur. The route alignment will be completed partly elevated and partly underground with certain short sections at-grade. A total of 17 elevated stations, 5 underground stations and 1 station at-grade with a depot area and marshalling yard at either end will be constructed.

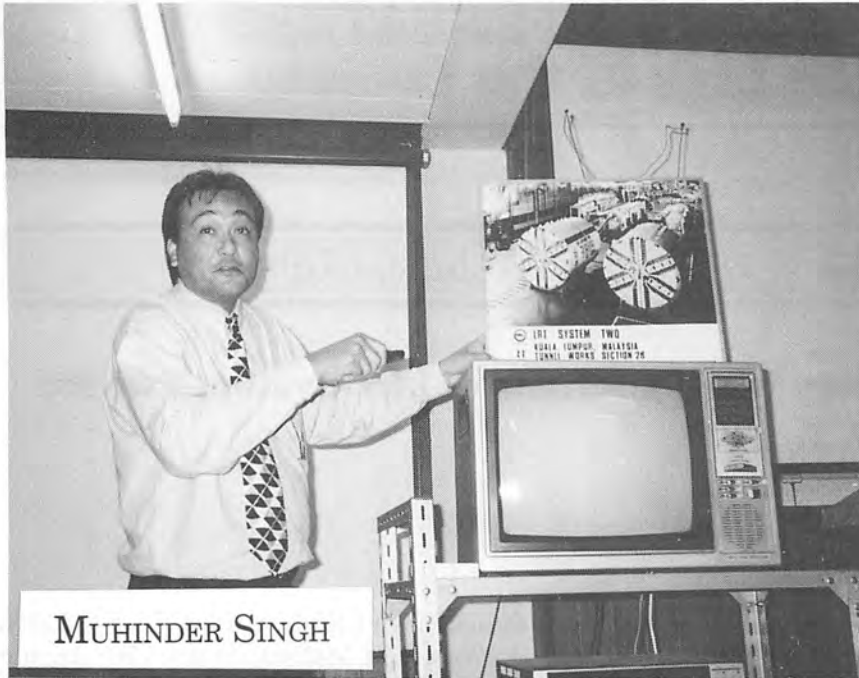
The geology along the alignment is generally complex. The northern section is predominantly Hawthorden schist before the transition into the overlying Kenny Hill Formation in the central region of Kuala Lumpur. Limestone is also encountered at deeper levels beneath the Kenny Hill Formation. The route alignment along the southern section interfaces between the Kenny Hill Formation and granite, independently outcropping at various locations. The Kuala Lumpur area in general, is also characterised by deep deposits of alluvium due to extensive mining activities carried out in the past.

The elevated sections are constructed using a sophisticated pre-cast launching system. The underground stations are constructed by top-down cut and cover whereas the tunnel sections by tunnel boring machines. The two types of machines used are the Closed Face Earth Pressurised Shield Tunnelling Machine and the Open Faced Rotary Backhoe Tunnel Boring Machine.

Precautionary measures undertaken by PUTRA include extensive building and structure risk assessments, instrumentation monitoring and advanced building protection prior to construction. Pengurusan LRT Sdn. Bhd. the Project Managers have also set-up a Geotechnical Engineering Database Management System (GEDMS) to systematically record all geotechnical information in electronic format for access prior to, during and after construction.

G.H. Teh

## Ceramah Teknik (Technical Talk)



MUHINDER SINGH



## Gondwana dispersion and Asian accretion

I. METCALFE

### Laporan (Report)

Dr. Ian Metcalfe who is presently with the Department of Geology & Geophysics, University of New England, Armidale NSW 2351, Australia gave the above talk to an audience of 20 at the Geology Department, University of Malay on 9th February 1996.

Dr. Metcalfe who is on his way back from a meeting in France was here to share with members his latest research data on Gondwana dispersion and Asia accretion.

### Abstrak (Abstract)

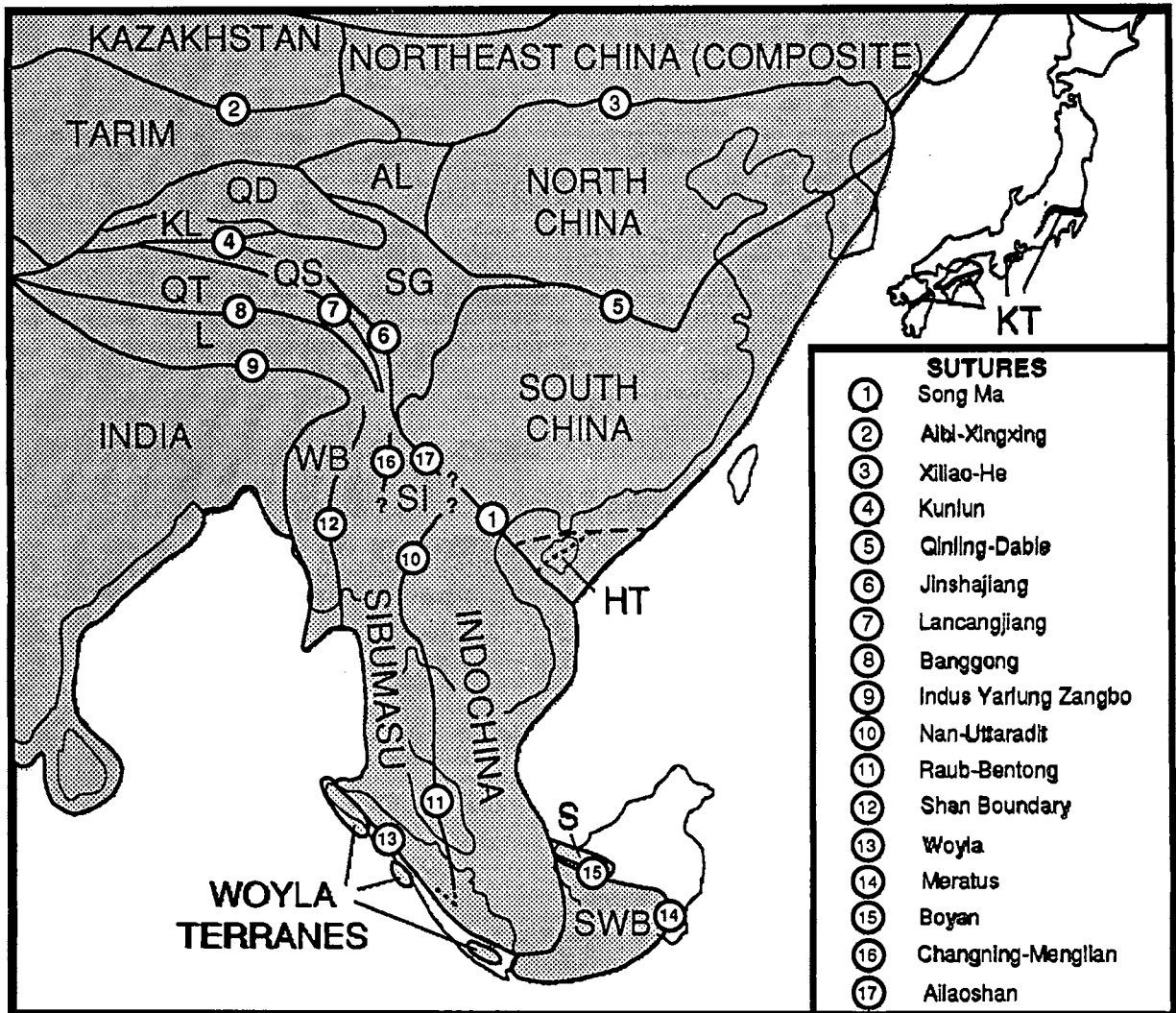
During the last decade, a wide range of geological and geophysical data has led to the recognition of various continental terranes in East and Southeast Asia (Fig. 1) which, on tectonostratigraphic, palaeobiogeographic and palaeomagnetic grounds are "suspect" or allochthonous in nature. Some of the recognised terranes may be composite and there is some disagreement with regard to the number of terranes and their boundaries. The continental terranes are bounded by sutures (representing former oceans), by narrow mobile belts or major fault zones. Comparative studies of the stratigraphy, palaeontology, and palaeomagnetism of the various continental terranes of East and Southeast Asia suggests that they were all derived directly or indirectly from Gondwanaland. Asian continental terranes that are placed on the India-Australian margin of Gondwanaland in the Early Palaeozoic include Tarim (here regarded to include the Kunlun and Ala Shan terranes), Qaidam, Indochina (which includes the Qamdo-Simao block of western China), North and South China, Sibumasu, Qiangtang, Lhasa, Kurosegawa, NW and SE Hainan, West Burma and the Woyla terranes. The evolution of Gondwanaland and Tethys during the Palaeozoic and Mesozoic involved the rifting of continental slivers/fragments from northern Gondwanaland, and the northwards drift and amalgamation/accretion of these to form proto East and Southeast Asia. Three continental slivers were rifted from the northern margin of Gondwanaland in the Early to Late Devonian (North China, South China, Indochina/East Malaya/Qamdo-Simao, Qaidam and Tarim terranes); Early-Middle Permian (The Cimmerian continent including the Sibumasu and Qiangtang terranes and possibly NW and SE Hainan); and Late Triassic to Late Jurassic (Lhasa, West Burma and Woyla terranes). The northwards drift of these terranes was accompanied by the opening and closing of three successive oceans, the Palaeo-Tethys, Meso-Tethys and Ceno-Tethys.

Assembly of Gondwanaland-derived Asian terranes began with the amalgamation of South China and Indochina/East Malaya along the Song Ma/Song Da zone during the Late Devonian/Early Carboniferous to form "Cathaysialand". Palaeomagnetic, climatic and biogeographic data indicates that Cathaysialand and North China were located within the Palaeo-Tethys at low northern/equatorial latitudes during the Late Carboniferous and Permian. Palaeomagnetically determined palaeolatitudes are consistent with the development of tropical Cathaysian floras on these terranes. The Tarim, Kunlun, Qaidam and Ala Shan terranes accreted to Kazakhstan/Siberia in the Permian.

A major episode of rifting occurred on the northern margin of Gondwanaland in the Late Carboniferous-Early Permian and the Cimmerian continent separated in the late Early Permian resulting in the opening of the Meso-Tethys. Suturing of Sibumasu and Qiangtang to Cathaysialand occurred in the Late Permian-Triassic, closing a major branch of the Palaeo-Tethys. South and North China amalgamated and then accreted to Laurasia by Late Triassic-Early Jurassic times. The highly disrupted Kurosegawa terrane of Japan, possibly derived from Australian Gondwanaland, accreted to Japanese Eurasia, also in the Late Jurassic.

The Lhasa, West Burma and Woyla terranes rifted from NW Australian Gondwanaland in the Late Triassic to Late Jurassic and drifted northwards during the Jurassic and Early Cretaceous as the Ceno-Tethys opened and the Meso-Tethys was destroyed by subduction beneath Eurasia. Accretion of these terranes to proto-Southeast Asia occurred in the

Cretaceous. The South West Borneo and Semitau terranes were derived from the South China/Indochina margin by the opening of a marginal basin in the Cretaceous which was subsequently destroyed by southwards subduction during the rifting of the Reed Bank-Dangerous Grounds terrane from South China when the South China Sea opened. The NW and SE Hainan terranes, which formed part of Early Palaeozoic Gondwanaland, reached their current positions, relative to South China, sometime in the Jurassic-Cretaceous.



**Figure 1.** Distribution of principal continental terranes and sutures of East and Southeast Asia. WB = West Burma, SWB = South West Borneo, S = Semitau Terrane, HT = Hainan Island terranes, L = Lhasa Terrane, QT = Qiangtang Terrane, QS = Qamdo-Simao Terrane, SI = Simao Terrane, SG = Songpan Ganzi accretionary complex, KL = Kunlun Terrane, QD = Qaidam Terrane, AL = Ala Shan Terrane, KT = Kurosegawa Terrane.



## I. METCALFE

### Further reading

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G.H. Teh

## **Expert System: Potential applications in teaching and research in earth sciences**

SAHIBIN ABDUL RAHIM

### **Laporan (Report)**

Dr. Sahibin Abd Rahim (a lecturer in the Department of Earth Sciences, Universiti Kebangsaan Malaysia Sabah) presented the above talk at 11.00 am on 10 February 1996 at the Geology Department, Universiti Kebangsaan Malaysia. Dr. Sahibin discussed all the benefits and potential applications of the Expert System in various field of earth sciences in front of about 30 participants. Dr. Sahibin also demonstrated on personal computer two examples of Expert System, one that he developed on land evaluation and the other on mineral identification which is still under construction. The talk and demonstration was followed by a lively discussion with several questions from the audience.

The following is an abstract of Dr. Sahibin's presentation.

### **Abstrak (Abstract)**

Research and teaching in earth sciences demand a lot of time and hardwork from their experts. In research ample time is spent in a routine and non routine methods of solving problem exercises. In teaching, apart from giving lectures, the expert is also required to train student in practical. Although in this case a demonstrator can be employed but sometimes the proportion of student per demonstrator is still large thus reducing the chances of student being entertained by the so called expert.

Some problems in research and teaching may be solved by employing simple expert system. Expert systems are computer programs designed to solve problems which require high expertise. In other word the expertise of an expert can be captured and programmed into a computer so that it can be used and referred by the student any time. In research this expert system can be employed to do the routine job thus relieving the experts from most of the working routine to achieve the required result.

It is thought that expert system has a lot to offer in the field of earth sciences and it is time that the teaching of this subject is considered?

Mohd Shafeea Leman

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## Associate Member

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| 1. Brandtner, Michael Johannes<br>B-3-7, 212 Jalan Ampang, 50450 Kuala<br>Lumpur. | 2. David K. Johnston<br>c/o U.S. Information Service, American<br>Embassy, Singapore. |
|---|---|

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## PETUKARAN ALAMAT (Change of Address)

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

- |  |   |
|--|---|
| 1. Abd Hanan B Ahmad Nadzeri<br>No. 7, Jalan 9C/6, Taman Setapak Indah,<br>53100 Kuala Lumpur. | 3. Paul Ponar Sinjeng<br>Geological Survey of Malaysia, Km. 3,<br>Penampang Road, Locked Bag 2042, 88999<br>Kota Kinabalu, Sabah. |
| 2. Cheng Kam Leong<br>45 Jalan Merpati 6, Bandar Puchong Jaya,<br>47100 Puchong.               |   |



## CURRENT ADDRESS WANTED

The GSM is seeking the address of the following member. Anyone knowing the new address please inform the Society.

1. Dr. Mario Wannier  
Sarawak Shell Bhd., 98100 Lutong,  
Sarawak.

GSM

## PERTAMBAHAN BAHARU PERPUSTAKAAN (New Library Additions)

The Society has received the following publications:

- |   |  |
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| <ol style="list-style-type: none"> <li>1. Monthly statistics on mining industry in Malaysia, October–November 1995.</li> <li>2. Geosurvey Newsletter, nos. 290–296, 1995.</li> <li>3. Journal of geology and mineral resources, nos. 43, 46–49, 1995.</li> <li>4. Monthly statistics on mining industry in Malaysia, Oct &amp; Nov, 1995.</li> <li>5. Acta Geoscientific Sinica, no. 3, 1995.</li> <li>6. Journal of Hebei College of Geology, vol. 18, no. 3, 1995.</li> <li>7. Acta Palaeontologica Sinica, vol. 34, 2–4, 1995.</li> <li>8. Palaeontological abstracts, vol. 10, nos. 2 &amp; 3, 1995.</li> <li>9. Acta Micropalaeontologica Sinica, vol. 12, nos. 2 &amp; 3, 1995.</li> <li>10. Bulletin of the Institution of Mining &amp; Metallurgy no. 1027, 1995.</li> <li>11. American Museum Novitates, no. 3149, 1995.</li> <li>12. AAPG Explorer, Dec 1995.</li> <li>13. Explanatory text of the geologic map of Taiwan: scale 1:50,000: sheet 17: Tachia, 1994.</li> <li>14. Explanatory text of the geologic map of Taiwan: scale 1:50,000: sheet 12: Miaoli, 1994</li> </ol> | <ol style="list-style-type: none"> <li>15. Episodes, vol. 18, no. 3, 1995.</li> <li>16. Bulletin of the Central Geological Survey, no. 9, 1994.</li> <li>17. Berliner geowissenschaftliche abhandlungen, Band 166 (1994); 167 (1994); 169 (1995); 170 (1995); 171 (1995); 172 (1995).</li> <li>18. Buletin Sukutahun, Jul–Sept '95.</li> <li>19. AAPG Bulletin, vol. 79/12, 1995.</li> <li>20. SOPAC: proceedings of the 24th session, 1995.</li> <li>21. Tin International, vol. 68, no. 10, 1995.</li> <li>22. Southeast Asia collection, Oct–Dec 1995.</li> <li>23. Geological literature of USSR. Bibliographical yearbook for 1989 year, vols. I &amp; II, 1994.</li> <li>24. U.S. Geological Survey: Bulletin: 1995: 1904-U, 2112, 2064–A–R, 1995-L, 2056, 2115-B, 2000-H, 2118, 2138, 2000-L, 2094-D, 2063, 2129, 2000-J, 2140, 1989-G, 2122, 2093, 1995-J, K.</li> <li>25. U.S. Geological Survey Professional Paper: 1995: 1538-Q, 1538-R, 1538-S, 1386-C, 1525, 1566, 1406-A.</li> <li>26. U.S. Geological Survey Circular, 1995: 1124.</li> </ol> |
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GSM

# BULETIN

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## MALAYSIA



GEOLOGICAL  
SOCIETY OF  
MALAYSIA

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JULY 1994

No. 35

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## BERITA-BERITA LAIN Other News

### Local News

#### Work on tin mining museum

After more than two years in hibernation, the much-touted tin mining museum in Klang will soon be reopened to the public.

A conservation plan has been prepared for the Gedung Raja Abdullah to be renovated before it is re-opened, said a State Museum spokesman.

She said extensive renovation has to be carried out and a team of architects and engineers will handle the conservation plan.

*"We will soon call for a tender for repair and renovation work," she said.*

The museum was closed in late 1993 when the Works Department found faults in the ceiling.

*"Although the fault is not extensive, we*

*decided to close it for the sake of public safety," she said.*

The renovations are expected to take four months.

She said the artifacts, some dating as far back as the 1800s during the rule of Raja Abdullah, are safe in the storeroom.

*"We need more items to be exhibited and they don't need to be of historical values," she said, adding that the museum welcomed anything to do with tin or mining.*

The museum is located next to the Klang police district headquarters in Jalan Stesen.

*M. Mail, 2.1.1996*

#### Pahang poised to emerge as nation's top gold producer

Pahang will become the country's leading producer of top quality gold when two mining companies begin prospecting for the mineral in the western part of the State at the end of the year.

Specific Resources Sdn. Bhd. (SRSB), a subsidiary of Canada-based Avocet Ventures Inc. and AK Holding Sdn. Bhd., have received approval from the State Government to prospect for gold on a 361.6 ha area in Penjom, Kuala Lipis and 260 ha area in Bukit Koman, Raub respectively.

The two mines are expected to produce 2.92 million grammes of gold worth RM94 million per year. Of these, SRSB will produce 1.55 million grammes annually for 10 years while AK Holding will produce 1.37 million grammes every year for five years.

Director of Mines (east) Mohamad Yunus Abdul Karim said the SRSB mine was expected

to commence operation in October.

*"SRSB has completed its feasibility study for Penjom last October and the company was working out a deal with a foreign financial institution to finance the project," he said.*

He said SRSB's loan was expected to be approved in March and construction of the mine and processing plant costing RM30 million would start the following month and would be ready in September.

Mohamad Yunus said AK Holding was expected to install facilities at its mine in two or three months's time.

*"Both companies will adopt the 'Carbon in Leach' and 'Carbon in Pulp' and use cyanide in processing gold prospected from the areas," he said.*

He added the State Government would collect five per cent royalty from the two companies.

*NST, 5.1.1996*

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### Resources of Southeast Asia

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Other related activities include pre- and post-conference workshops, short courses and geological fieldtrips. Social events and tours for delegates are also available.

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*NST, 5.1.1996*

## Hillslope comes crashing down

Tonnes of earth and concrete at Gua Tempurung, along the most expensive stretch of the North-South Expressway, came crashing down in a massive landslide yesterday, killing a container truck co-driver.

Rescue workers are still searching for other possible victims as eyewitnesses had reported that a van, a car and motorcycle were also buried.

The concrete slope of the highway, which had been reinforced with rock anchors, collapsed at about 7.30 am with a deafening noise, sweeping the container truck off the road.

The body of Abdul Hamid Kodin, 34, was pulled out by rescuers about four hours later.

The driver, Hasri Hamid, 41, who crawled out of the truck with minor injuries was warded in the hospital for observation.

*"There was very loud noise and the ground shook. I saw earth and concrete sweeping down,"* said Bah Man, a worker at the Gua Tempurung lay-by rest area.

Some 300 rescue workers were forced to stop twice when parts of the slope came crumbling down.

The first minor landslide occurred at about 11.20 am. Minutes later, there was a second one. At about 12.42 pm, another section of the slope fell.

A siren was sounded each time, sending the workers scurrying to safety. At about 6 pm, the search was put off for an hour because of a down-pour.

Besides rescue workers from the army, police, Fire Services Department, Civil Defence Corps and PLUS, eight excavators, 14 lorries and 14 backhoe tractors were used to remove the earth covering a 100 m area.

According to a PLUS officer, the 30.3 km Tapah-Gopeng stretch had cost almost RM20 million per km to build.

Experts said the massive landslide at the scenic stretch had raised questions about adequate maintenance of the highway and also methods used in its construction, taking into consideration the limestone terrain.

Last September, Samy Vellu was reported to have said that between RM3 billion and RM4 billion was needed to repair damaged areas along hillslopes.

He said the ministry had so far received reports on 120 landslide areas in the country. Sixty-five of the landslips occurred along the East-West Highway.

*Star, 7.1.1996*

## Mining law a boon for waterways

Upcoming legislation of the tin-mining industry under the proposed Federal Mining Act augurs well for Malaysia's rivers and waterways. Department of Mines director-general Sukeri H. Osman said better regulations on environmental protection, conservation and rehabilitation of the water systems were expected.

Sukeri yesterday said the two major impacts of mining in Malaysia had been physical water pollution and disturbance of land surface.

A well-planned environmental management plan is the best way to minimise environmental degradation from mining and quarrying, he said.

*Star, 8.1.1996*

## Erosion risk map ready by mid-1997

A map of high erosion risk sites in the peninsula will be available by the middle of the year, according to a soil management expert.

With the *Erosion Risk Map of Peninsular Malaysia*, areas with high risks can be identified and ruled out for development, said Dr. Lim Jit Sai of the Agriculture Department.

Dr. Lim, who is the soil management branch assistant director, said if development was

unavoidable, such areas should be subjected to stringent soil conservation measures or placed under strict surveillance.

He said soil erosion losses were now being monitored according to soil types on the various terrain classes.

The map would be produced from the results of this exercise, he said in the paper, *Soil Resources in Malaysia — An Overview*, jointly

written by him and three others.

Of the total land area of 33 million hectares in Malaysia, he said, the forest area occupied 20.3 million hectares or 61 per cent while 10.2 million hectares or 31 per cent was suitable for

agriculture, with settlements and other uses occupying the balance.

Of the land suitable for agriculture, 5.45 million hectares have been cultivated.

*Star, 8.1.1996*

## Perak to study stability of limestone understrata

The state government will conduct a study on the stability of limestone understrata at the site of a multi-million ringgit project about 0.5 km from Gua Tempurung.

A RM459 million integrated tourist and residential centre had been proposed for the site.

Menteri Besar Tan Sri Ramli Ngah Talib said the study was to ensure public safety in the wake of the landslide which killed a truck driver along the Tapah-Gopeng stretch of the North-South Expressway two days ago.

He said Australian consultants, who were engaged to beautify the Gua Tempurung limestone caves, would be directed to carry out the study.

*"We will also ask the consultants to ensure that the caves are safe for tourists,"* he told reporters after launching the Kelab Seri Perak

Darul Ridzuan sports meet here yesterday.

Last year, the state government signed a memorandum of understanding to allow Heritage Acres Sdn. Bhd., a joint venture company between Malaysian Kuwait Development Ventures and a statutory body, Yayasan Perak, to develop the area within 10 years. Projects proposed to attract tourists to the area include beautifying the Gua Tempurung caves, building campsites and a caravan park, hilltop adventure sites, water park, heritage park, safari world and golf course.

Ramli said the first phase of the project would be completed by the end of the year.

On the landslide, Ramli said the state would seek a detailed report from Projek Lebuhraya Utara-Selatan on the cause of the incident.

*Star, 8.1.1996*

## Prospecting licences for foreign firms

The state government has agreed to approve prospecting licences only to international companies which are willing to share their expertise with local companies.

Menteri Besar Datuk Nik Abdul Aziz Nik Mat also said fewer prospecting licences would be issued to local companies.

*"We have decided that this is the only way to revive and capitalise on the potential of the*

*mining industry in the state.*

*At the moment, the mining industry in Kelantan is fragmented, with too many small-scale mining companies,"* he said yesterday.

*"These companies are unable to bring in any meaningful new technology or make any major in-roads despite having operated here for years,"* he added.

*Star, 11.1.1996*

## LRT work

Huge mechanical moles will start burrowing under the most congested part of the city early next month as work on the LRT System II goes underground.

The job is to create 4.4 km of parallel tunnels for the LRT coaches to run — at the average rate of between 10 and 12 metres daily.

There will be no disruption to the surface, assured project concessionaire Projek Usahasama Transit Ringan Automatik Sdn. Bhd. (Putra).

The RM4.35 billion System II project covers 29 km of elevated, on ground and underground tracks from the People's Park in Petaling Jaya to



Taman Melati.

The elevated portion covers Taman Bahagia-Paramount Garden-Asia Jaya-Taman Jaya-Universiti-Kerinci-Abdullah Hukum-Bangsar-KL Grand Central Station-Central Market.

From then, the track comprising two parallel tunnels goes 15 to 20 metres underground to the stations in Benteng-Jalan Sultan Ismail-Kampung Baru-KLCC-Ampang Park Station.

It surfaces just before the Damai Police Quarters, north of Jalan Ampang.

It then continues on elevated and on ground tracks from Damai to Gombak via Pasar Keramat-Datuk Keramat-Setiawangsa-Setapak Jaya-Wangsa Maju-Taman Melati.

A Putra spokesperson said the first quarter of the track from People's Park in Petaling Jaya to the Central Market is expected to be ready before the Commonwealth Games in 1998.

However, the rest will only be operational after the Games in early 1999.

Tunnelling work will be carried out by Hazama Corporation of Japan and Hyundai-Pati Consortium from Korea which have brought in two tunnel boring machines (TBM).

The spokesperson said the first TBM, constructed and built by Hyundai, came here last October and was assembled at the site in Jalan Damai.

The 251-ton machine has a thrust force of about 2,000 tons and will be used to construct the tunnel from the Damai portal to the station

in Ampang Park.

**Portion:** It will then proceed to work its way to the KLCC and Kampung baru stations.

The other contractor, Hazama Corporation, has three TBMs to construct the tunnel from the Sultan Ismail station to the Benteng station and also to the Kampung Baru station.

Unlike the TBM used by Hyundai, the spokesperson said these machines function on an outer and inner pressure system whose balance is maintained by a self-driving and automatic control system.

Putra has a concession agreement with the Government to build, operate and own the LRT System II for 60 years.

It would be the second part of the Government's LRT system Phase One plans for the Klang Valley.

Once completed, the 29 km stretch will become the world's longest fully-automated rail system. It is fashioned after the Skytrain network, which has been in operation in Vancouver, Canada, for the past eight years.

**System:** The Klang Valley LRT system is divided into two phases. Apart from Putra, a portion of Phase One — from Ampang to Jalan Sultan Ismail — was awarded to Sistem Transit Aliran Ringan Sdn. Bhd. (STAR).

STAR was also awarded the first portion of Phase Two that links its Jalan Chan Sow Lin station with the Commonwealth Games Village in Bukit Jalil.

*M. Mail, 15.1.1996*

## Simpang Pulai-Cameron's road faces erosion threat

The completed 23 km stretch of the RM150 million Simpang Pulai-Kampung Raja road is being threatened by erosion and landslides.

In view of this, the contractor for the remaining stretch, MTD Bhd., has been told to re-design certain parts of the remaining 40 km stretch to Kampung Raja in Cameron Highlands.

Infrastructure and public utilities committee chairman Datuk Ong Ka Chuan said work on the highway will continue as the federal government has given the green light to finish the road.

The scenic road is expected to boost tourism and highland agriculture.

However, the completed 23 km stretch up to Pos Selim, an orang asli village, is under threat

of serious damage from landslides and slope erosion which occurred in recent months.

Deep cracks have appeared in parts of the road which is currently mainly used by loggers and leisure seekers.

In the last four sections, landslides have sent the drainage system tumbling 100 m down the slopes.

At another stretch, a cliff supported by a 4 m high retaining wall is found to be cracking up.

Ong said MTD, which is expected to begin work soon after the environmental impact assessment report is approved, has been told not to cut too deeply into the slopes.

*"Where it is necessary, we may have to build*



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## Schlumberger's New Fullbore Formation MicroImager Doubles Your Coverage With Core-Like Clarity

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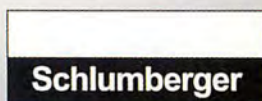
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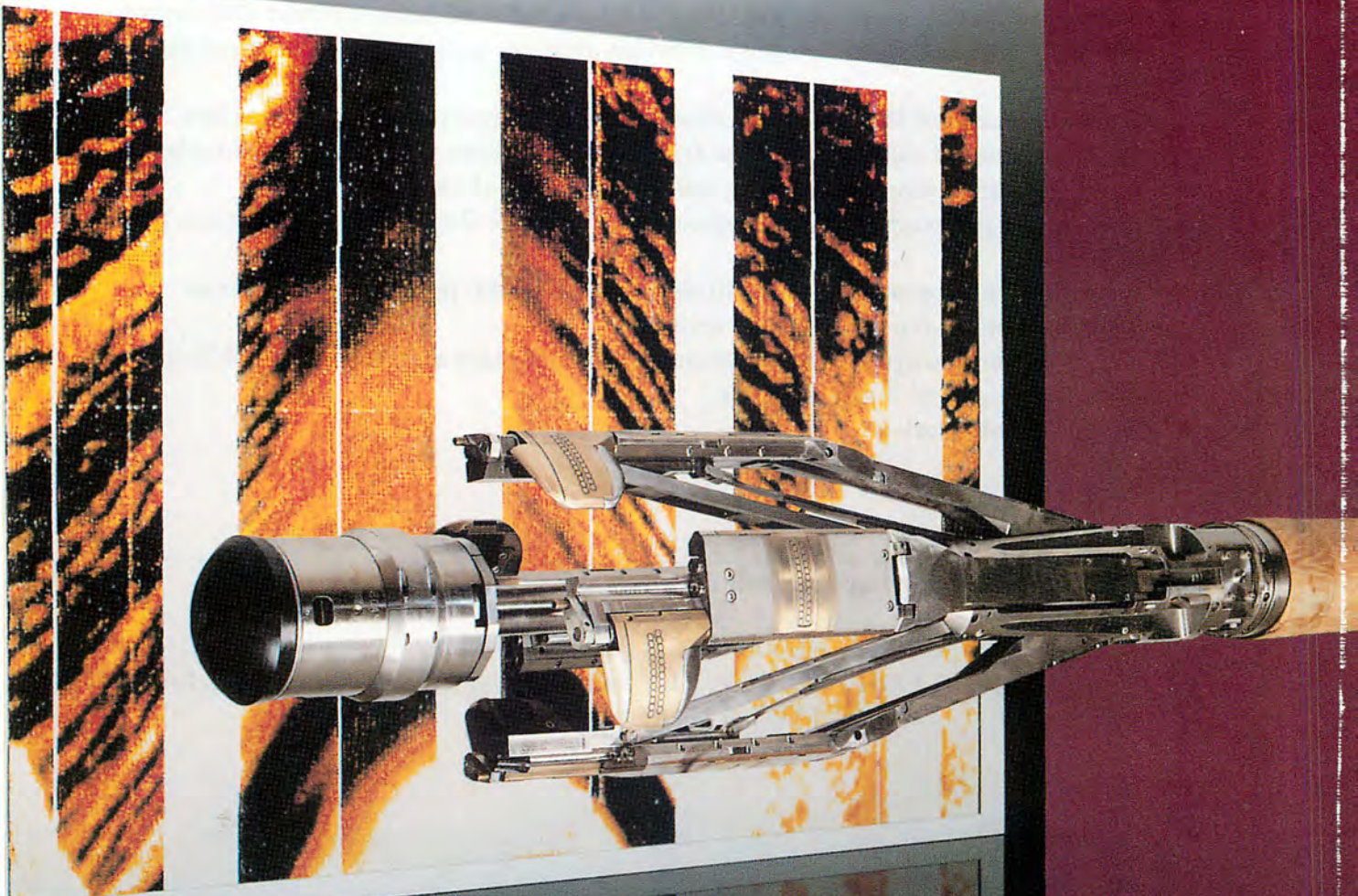
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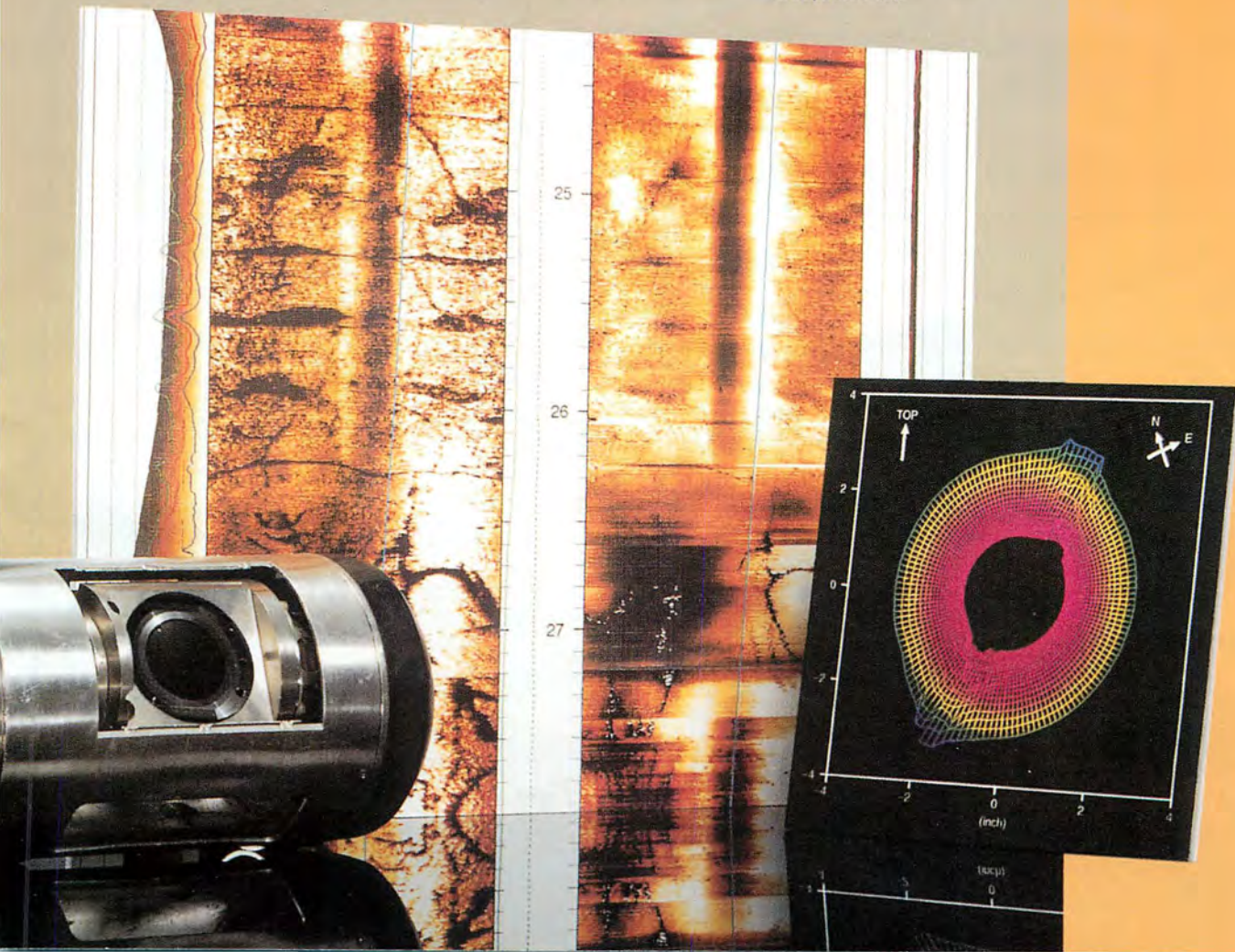
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# GEOSEA '98

## ANNOUNCEMENT

### Ninth Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia

Kuala Lumpur, Malaysia • 17–19 August 1998

The Geological Society of Malaysia is organising the GEOSEA '98 in Kuala Lumpur from 17 to 19 August 1998. The GEOSEA Congress is held triennially in Southeast Asia and it offers an excellent opportunity to exchange scientific and technical information and advancement in geology, mineral and energy resources among geoscientists from within and outside the region. The GEOSEA Congress is a premier geoscientific event in the region and has been well attended by the geoscientific community world-wide.

The technical program of GEOSEA '98 consists of oral and poster presentations on geology and related aspects of the GEOSEA core region – Brunei, Cambodia, Indonesia, Hong Kong, Laos, Malaysia, Myanmar, Papua New Guinea, Philippines, Singapore, Thailand and Vietnam. A scientific and technical exhibition will run concurrently with GEOSEA '98, displaying the latest state-of-the-art products and systems.

Other related activities include pre- and post-conference workshops, short courses and geological fieldtrips. Social events and tours for delegates are also available.

Make a note in your diary and join us in Kuala Lumpur for GEOSEA '98.

For further information, please contact:



The Organising Secretary,  
GEOSEA '98  
Geological Society of Malaysia  
c/o Department of Geology,  
University of Malaya,  
50603 Kuala Lumpur  
Malaysia  
Tel: +(603) 757 7036  
Fax: +(603) 756 3900  
Email: [geologi@po.jaring.my](mailto:geologi@po.jaring.my)



GEOLOGICAL  
SOCIETY OF  
MALAYSIA

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# BULETIN

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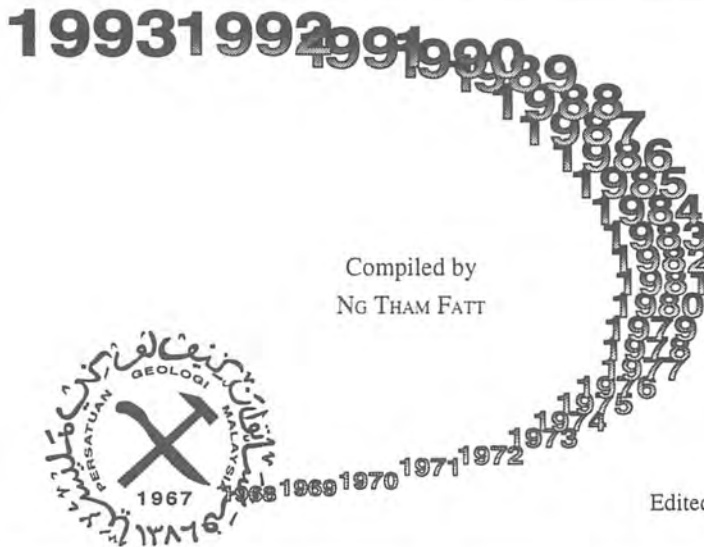


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NG THAM FATT



Edited by G. H. TEH

# *Bulletin* of the GEOLOGICAL SOCIETY OF MALAYSIA

DECEMBER 1993

SPECIAL ISSUE

No. 34

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50603 Kuala Lumpur, MALAYSIA

programme for diamonds over 600 sq km.

*"We are going aggressively into mining because it is one of the historical core businesses of the company. We will be active all over the world — we will go where the deposits are,"* emphasised Ibrahim after the company's extraordinary general meeting in Kuala Lumpur yesterday.

He elaborated that countries such as Indonesia, Canada, Australia, and several African and Latin American countries hold much potential for mining.

Although MMC had its beginnings in the tin mining industry in Malaysia, it has no domestic mining operations today. It is, however, exploring for gold in Merapoh, Pahang, Ibrahim said.

About 50 per cent of MMC's group turnover is derived from the mining activities of associate companies Plutonic Resources Ltd. and Ashton Mining. The former is in gold mining, the latter in diamond mining.

Ibrahim acknowledged that the 10 to 12 per cent rise in gold prices world-wide would have

an impact on its revenues this year.

The MMC group is engaged also in manufacturing and engineering. It will diversify into the timber business once its purchase of a 30.9 per cent stake in PT Artika Optima Inti of Indonesia is approved.

*"The understanding is that we will only make the purchase after the Indonesian company has been listed, which we expect to be by the middle of this year,"* Ibrahim explained.

Asked for the latest on its joint-venture East-Coast Highway project, Ibrahim said the company was still negotiating terms with the government. It expects the concession agreement to be signed before the middle of the year.

He declined to elaborate on its oil project in Iraq, saying only that it was "just in the discussion stage".

Primary Industries Minister Datuk Seri Dr. Lim Keng Yaik had said last month that MMC had signed a memorandum of understanding for an appraised bloc, an area with known oil reserves.

*NST, 7.2.1996*

## Nature to blame

The Genting bypass landslide that killed 21 people and injured 23 others on June 30 last year has been attributed to natural causes.

A technical committee which investigated the tragedy found:

- no evidence of forest clearing or external development activities within the catchment area;
- construction activities, including blasting works up to the time of the incident, did not influence the debris flow;
- the area within Genting Sempah is prone to landslides as evident by history of recurrences analysed from aerial photography records;
- the overburden soil of the area relatively thin and as such it had been continuously saturated from heavy rainfall especially in June 1995 where it exceeded the normal long-term average by more than 156%;
- the two hours of continuous rain on the evening of June 30 triggered major landslides into the stream of the developing debris flow; and
- the debris accumulated at two major locations above road level heights hastened

the flow downwards.

The report, entitled *Technical report on the investigation into the debris flow on the slip road to Genting Highland*, was endorsed by the cabinet yesterday. Works Minister Datuk Seri S. Samy Vellu released it to the press today.

The report will be sold at RM500 each next month.

The 600-pages report, which includes several appendices with maps, technical graphics and site photographers, is based on three months of investigations by the 22-member technical committee headed by Selangor Public Works Department director Datuk Abu Bakar Mohamed Amin.

Only 150 copies will be printed and so far only 60 copies have been circulated, including 36 to ministers, 14 to the press and the rest to the relevant authorities.

A technical committee recommended several measures to be taken before the Genting sliproad leading to Genting Highlands can be reopened.

The 22-member committee comprising officials from 12 government agencies also want strict measures to identify potential danger spots in the area.

## Construction of second causeway begins

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The two-kilometre bridge will connect Kampung Ladang at Tanjung Kupang on the Malaysian side with Jalan Ahmad Ibrahim at Tuas in Singapore.

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*NST, 17.1.1996*

## Johor fund for R&D at 7 universities

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It is the first state to make such an allocation.

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Ghani said he hopes the fund will inspire other states and the private sector to follow suit.

The fund is open to undergraduate and advanced degree students to pursue research relating to the state.

Under the MoU, the state will allocate RM100,000 a year to each university until the year 2000.

*"The fund is open to Malaysians and they will not be compelled to serve in the state after completing their studies," Ghani said.*

The MoU was signed between the Johor state government, the Johor Education Foundation and the seven universities — Universiti Malaya, Universiti Kebangsaan Malaysia, Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Pertanian Malaysia, Universiti Utara Malaysia and the International Islamic University.

Moves are afoot to extend the fund to universities in Sabah and Sarawak.

Education Minister Datuk Seri Najib Abdul Razak, who launched the fund, said the move is commendable.

*"Priority should be given to research," Najib said. "At present, less than 2% of the gross national product is being spent on R&D. In order to retain that competitive edge, the figure should be nearer 5%."*

*Sun, 19.1.1996*



## Gold fabrication to increase by 25pc

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*Star, 22.1.1996*

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*"Among the requirements are a geo-technology report and proposed development research report,"* he told reporters after visiting the Bertam Valley new village here.

He said other requirements were:

- SLOPE stabilisation;
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Dr. Ting said the guidelines encompassed all salient points of the amendments and new laws on highland development.

*"The Government does not encourage highland development,"* he said, adding that those who still wanted to do so must fulfil all requirements.

They must also "prove that their proposed development will not have adverse effects on surrounding areas."

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*Star, 23.1.1996*

## Shell to review ops in Sabah and Sarawak

Shell Malaysia has started a major internal exercise to review the company's entire organisation structure in its oil and gas exploration and production department in Sabah and Sarawak.

The review, said Sarawak Shell Bhd./Sabah Shell Petroleum Co. Ltd. (SSB/SSPC) managing director Tan Ek Kia, was to enable the company here to undergo a complete overhaul in order to face the new challenges emerging in the global oil and gas industry.

*"In order to build new capabilities to meet long-term goals, the company is embarking on an organisation review exercise."*

*"So far, an improvement of work processes in the company has been achieved through our business re-engineering programme with cost-savings from the unit margin enhancement and benchmarking efforts,"* he said at a company function on Saturday at the Shell Club in Lutong

near Miri.

Shell, which started operations in Malaysia more than a century ago, was responsible for discovering the nation's first oil well on top of Canada Hill in Miri on December 22, 1910. Four years later, the company constructed Malaysia's very first oil refinery at a site about 10 km from the town centre here.

SSB/SSPC is responsible for the exploration and production of oil and gas. It operates as a contractor to Petronas and joint venture partner to Petronas Carigali Sdn. Bhd. under a production-sharing contract.

SSB/SSPC has 10 highly specialised departments.

At the function, Tan paid tribute to some 16 long-serving Shell employees who have accumulated a combined total of 460 years of service with SSB/SSPC.

*Star, 23.1.1996*

## Govt may build parallel highway

The Government may build a parallel north-south expressway along the west coast to link smaller towns by-passed by the PLUS highway.

Works Minister Datuk Seri S. Samy Velly said the new western coastal road proposal was awaiting approval from the Economic Planning Unit before being implemented.

*The western coastal road will link Lumut, Teluk Intan, Sabak Bernam, Kuala Lumpur, Muar, Segamat and Johor Baru,"* he said after laying the foundation stone for a Hindu temple

at Nova Scotia Estate yesterday.

He said besides bringing development to the existing towns, the new expressway was also expected to pave the way for new townships.

The proposal was submitted by a private firm recently and is expected to be included under the privatisation scheme.

Asked whether the second north-south highway would effect PLUS revenue, Samy Vellu said it would not since "PLUS has placed its highway in a strategic location."

*Star, 23.1.1996*

## New lease of life for Raub gold mine

What used to be one of the biggest gold mines in the world a century ago will be given a new lease of life when a Malaysian-Australian joint venture begins operations by the end of the year.

The company — Raub Australian Gold Mining Sdn. Bhd. — yesterday signed an agreement to develop a tailings project at Bukit Koman in Raub, Pahang.

The tailings dumps were left by the mine's former Australian operator and are estimated to contain about 7,500 kg of gold. The area still has gold deposits as mining methods used previously were not sophisticated, allowing gold constituents to flow into the tailings area.

Akay Holdings Sdn. Bhd. managing director Andrew Kam Tai Yeow said after the signing ceremony in Kuala Lumpur yesterday that the

mine would be one of the largest and most profitable in Southeast Asia.

The signing was witnessed by the Menteri Besar of Pahang, Tan Sri Khalil Yaakob.

Akay Holdings holds a 51 per cent stake in Raub Australian, while Australian Stock Exchange-listed Wells Gold Corporation NL owns the balance.

The management company, Raub Australia Gold Management Company Sdn. Bhd., is owned in reverse proportions.

The deal makes Akay Holdings the largest share-holder in Wells Gold with a stake of about 45 per cent.

*"We estimate a net profit of not less than RM5 million a year from the joint venture,"* Kam stated, adding that local demand for gold exceeded supply.

With such bright prospects, Akay Holdings hopes to seek a listing for Wells Gold on the Kuala Lumpur Stock Exchange main board.

*"We are exploring with Australian and Malaysian authorities the feasibility of adding to Wells Gold's listing on the Australian Stock Exchange a sister listing on the Kuala Lumpur Stock Exchange."*

Should this fail, Akay would seek to list the joint venture on the Kuala Lumpur Stock Exchange. Kam said the company's profit forecasts would help it meet listing requirements.

He told reporters that the tailings dumps, which would be mined over five years, were the

catalyst for future development of hard rock mining in Raub.

After the five years, the area is believed to have hard rock potential of 15 to 20 years.

*"This will be a major mine,"* Kam stated.

The deposits would be processed at a RM30 million plant to be built by Raub Australian soon. It is expected to process between 1.5 million to two million tonnes per annum, with an estimated operating cost of RM450 per ounce.

Kam said the joint venture would result in spinoffs such as support industries and industrial estates.

Once it has been mined, the area would be redeveloped into an 18-hole golf course with clubhouse, and a theme park.

In his speech, Kam explained that his family shared rights with the Pahang State Government, French mining house BRGM and Perak Motors to explore and develop gold mining prospects in surrounding areas.

The Bukit Koman mine has an intriguing history. The site was first mined 800 years ago by ancient Khmers who travelled by elephant from what is today known as Cambodia.

In 1889, a group of Australians and Malaysian set up The Great Raub Australian Gold Mine, then one of the biggest in the world.

The mine produced more than one million ounces of gold for its former owners between 1889 and 1961 before it was acquired by Kam's family.

*NST, 24.1.1996*

## Picking the cheapest route

The route for the proposed highland highway was chosen not because it is the least destructive to the environment but because it will be cheaper to build.

According to the *Preliminary Engineering and Engineering Feasibility Study*, engineering consultancy firm Minconsult considered three options — the ridge route, the valley route and the government-proposed route — and proposed one containing features of all three.

The Work Ministry, in the terms of agreement for the project, has also stipulated that the highway must:

- Be located over 1,000 m above sea level;
- Provide access to potential agriculture sites and scenic views for road users; and

- Be designed to minimise earthworks and adverse environmental impacts.

The report said the ridge route was the least destructive as it would follow the top of hills to avoid cuttings in steep slopes.

Although considered the most environmentally sympathetic due to the relatively small amount of earthworks involved in its construction, it would involve expensive engineering features.

Its cost could be prohibitive, according to the report.

Preliminary assessment indicated that 30 per cent of the road would be in tunnel, of which 75 per cent would be at a gradient of 3.5 to 5.5 per cent.

The valley route follows the valleys between the three hill resorts.

The report said that as it was located at a lower altitude, construction would require major earthworks in areas adjacent to water courses. As such, this route was potentially the most damaging to the environment.

It would encounter severe constraints on the alignment due to the narrow valley base and to reach potential agricultural sites, access roads would have to be built along steep gradients. Severe instability of the mainly colluvium side

slopes was also expected.

The route proposed by the Government traverses at a level of 1,500 m and adopts the criteria specified in the terms of agreement.

The consultants' proposed route, which was agreed upon by the Works Ministry, follows closely the government route but provides a compromise between the ridge and valley route.

The route will start from the Genting Highland access road about 1.2 km north of the Awana roundabout, and end at the Tapah-Tanah Rata trunk road about 6 km south of Ringlet.

*Star, 28.1.1996*

## Kuala Baram set to be major centre for oil exploration

The Kuala Baram Industrial Estate, about 25 km from Miri, is poised to become one of the most vibrant industrial hubs in Sabah and Sarawak by the turn of this century.

Aside from being earmarked as a major zone for heavy-, medium- and small-scale industries, the area will soon become another major centre for oil exploration, State Industrial Development Minister Datuk Abang Johari Tun Abang Haji Openg said yesterday.

*"Many foreign investors have expressed their intention to put in huge investments in that area."*

*"Over the next five years, Kuala Baram will see a rapid increase in industrial activities,"* he told reporters after witnessing the signing ceremony for the construction of a RM204 million medium-density fibreboard factory between Samling Fibre Board Sdn. Bhd. and a few Japanese companies.

The factory, to be located at the Kuala Baram Industrial Estate, will start operations in late

1997. Initial production is estimated at 100,000 cu m per year.

The partners in the fibreboard plant venture are Glenealy Plantations (Malaya) Bhd., Nissho Iwai Corp and Dainippon Ink & Chemicals.

On the oil exploration prospects in Kuala Baram, Abang Johari said Petroliam Nasional Bhd. (Petronas) had decided to maintain its supply base in Miri to facilitate oil exploration in the Kuala Baram region.

*"I have recently contacted the president of Petronas on plans for the region and he has indicated that Petronas would not relocate its supply base outside of Miri,"* he said, adding that about 200 ha of prime land in Kuala Baram would be reserved to facilitate oil exploration there.

The minister added that an integrated timber downstream processing complex would also be built in Kuala Baram soon.

*Star, 6.2.1996*

## MMC plans to undertake alluvial mining overseas

Malaysia Mining Corporation Bhd., now engaged in the mining of gold and diamonds through its Australian associate companies, will expand into alluvial mining on its own overseas.

The company is conducting preliminary negotiations with the governments of Guinea and Ghana in Africa to undertake exploration programmes for gold, chief executive Tan Sri Ibrahim Menudin said.

MMC and Laotian company Bunduon were

recently given the rights to explore, evaluate and mine minerals in Laos.

The joint venture, in which MMC has the majority stake, will start its exploration programme for economic gold and base metal deposits next month. Its concession covers 6,000 sq km.

MMC is also considering a joint venture with Australian-based associate company Ashton Mining Ltd. to conduct an exploration



programme for diamonds over 600 sq km.

*"We are going aggressively into mining because it is one of the historical core businesses of the company. We will be active all over the world — we will go where the deposits are,"* emphasised Ibrahim after the company's extraordinary general meeting in Kuala Lumpur yesterday.

He elaborated that countries such as Indonesia, Canada, Australia, and several African and Latin American countries hold much potential for mining.

Although MMC had its beginnings in the tin mining industry in Malaysia, it has no domestic mining operations today. It is, however, exploring for gold in Merapoh, Pahang, Ibrahim said.

About 50 per cent of MMC's group turnover is derived from the mining activities of associate companies Plutonic Resources Ltd. and Ashton Mining. The former is in gold mining, the latter in diamond mining.

Ibrahim acknowledged that the 10 to 12 per cent rise in gold prices world-wide would have

an impact on its revenues this year.

The MMC group is engaged also in manufacturing and engineering. It will diversify into the timber business once its purchase of a 30.9 per cent stake in PT Artika Optima Inti of Indonesia is approved.

*"The understanding is that we will only make the purchase after the Indonesian company has been listed, which we expect to be by the middle of this year,"* Ibrahim explained.

Asked for the latest on its joint-venture East-Coast Highway project, Ibrahim said the company was still negotiating terms with the government. It expects the concession agreement to be signed before the middle of the year.

He declined to elaborate on its oil project in Iraq, saying only that it was "just in the discussion stage".

Primary Industries Minister Datuk Seri Dr. Lim Keng Yaik had said last month that MMC had signed a memorandum of understanding for an appraised bloc, an area with known oil reserves.

*NST, 7.2.1996*

## Nature to blame

The Genting bypass landslide that killed 21 people and injured 23 others on June 30 last year has been attributed to natural causes.

A technical committee which investigated the tragedy found:

- no evidence of forest clearing or external development activities within the catchment area;
- construction activities, including blasting works up to the time of the incident, did not influence the debris flow;
- the area within Genting Sempah is prone to landslides as evident by history of recurrences analysed from aerial photography records;
- the overburden soil of the area relatively thin and as such it had been continuously saturated from heavy rainfall especially in June 1995 where it exceeded the normal long-term average by more than 156%;
- the two hours of continuous rain on the evening of June 30 triggered major landslides into the stream of the developing debris flow; and
- the debris accumulated at two major locations above road level heights hastened

the flow downwards.

The report, entitled *Technical report on the investigation into the debris flow on the slip road to Genting Highland*, was endorsed by the cabinet yesterday. Works Minister Datuk Seri S. Samy Vellu released it to the press today.

The report will be sold at RM500 each next month.

The 600-pages report, which includes several appendices with maps, technical graphics and site photographs, is based on three months of investigations by the 22-member technical committee headed by Selangor Public Works Department director Datuk Abu Bakar Mohamed Amin.

Only 150 copies will be printed and so far only 60 copies have been circulated, including 36 to ministers, 14 to the press and the rest to the relevant authorities.

A technical committee recommended several measures to be taken before the Genting slip road leading to Genting Highlands can be reopened.

The 22-member committee comprising officials from 12 government agencies also want strict measures to identify potential danger spots in the area.

It will also require precautionary steps to minimise danger from unanticipated landslide and debris flow.

Other recommendations on the slip road include:

- the owner should carry out a thorough risk and hazards mapping of the hillslopes along the entire length of the access road to Genting Highlands; and,
- the owner must adhere to engineering solutions to contain possible slides of slope materials from the road.

The committee also made recommendations for all highland roads. They include:

- relevant authorities should carry out regular aerial surveillance and photography to detect potential development of dangerous locations;

- developers or owners should report any lease for occupation around the highlands;
- rainfall gauging stations be established and maintained at landslide-prone areas by the Malaysian Meteorological Service and Drainage and Irrigation Department;
- the Survey Department and the Geological Survey of Malaysia should identify potential hazardous areas;
- an integrated approach to catalogue all natural and constructed slopes should be initiated by the relevant authorities; and
- mandatory regular inspection of high risk slopes affecting the public need to be identified and precautionary measures must be instigated by the owner.

Sun, 9.2.1996

## 200 ha with gold deposits found in Terengganu

The State Economic Development Corporation has identified 200 hectares with gold deposits large enough to be commercially exploited.

SEDC general manager Datuk Hamzah Muhammad said in addition, soil tests were also being conducted in the districts of Setiu and Dungun to find out the estimated gold reserves there.

*"We have to open new areas because the existing mining areas covering 80 hectares in Lubuk Mandi is almost exhausted. Preliminary studies in the new areas look promising but we need to conduct more tests."*

*"However, I have to withhold details about the location for safety and security reasons,"* he said after presenting Hari Raya gifts to old folk at the Taman Tasik welfare home in Marang today.

On illegal gold-panning activities, Hamzah said the number of people involved was small but "they are a persistent lot who are only endangering their lives by panning for gold outside our mining area.

He hoped the enforcement officers from the Land and Mines Department, local authorities and the police would cooperate to stop the illegal activities.

*"We fear that when they learn about our new gold-bearing areas, they will swarm the site before we can start mining,"*

Hamzah said some of the illegal panners were always on the lookout and monitored the movement of guards.

*"These people are active even at 2 am. They risk falling into pits in the dark while trying to scoop sacks of earth to be processed in their homes."*

On reports that gold in the Pmint Mineral Sdn. Bhd. processing plant was being stolen by villagers, he said there was no truth in the report because security there was always tight.

*"Even if I were to enter the plant area, I will not know where the gold deposits are in the automated and highly complex processing system."*

*"Once the earth from the stockpile enters the mill, no one can see the process,"* he said.

NST, 12.2.1996

## Shell survey of block SB-G promising

A seismic survey carried out in the deepwaters off Sabah, known as block SB-G, has shown encouraging prospects of oil and gas reserves.

*"If we find it viable, we'll start drilling some time this year. And if we do find something there, it will be the first oil and gas find in waters deeper than 1,000 feet,"* Shell Malaysia Ltd. chairman and chief executive Megat Zaharuddin Megat Mohd Nor said.

The survey, which has been under way since June last year, was carried out by the three production sharing contractors — Sabah Shell Petroleum Company, Shell Sabah Selatan Sdn. Bhd. and Petronas Carigali Sdn. Bhd.

Megat Zaharuddin said: *"We are very hopeful of finding something. We have seen some encouraging signs and very good structures."*

The two dimensional seismic survey covered 3,500 sq km for the entire SB-G block, which lies about 100 km from Labuan. The programme was started a week after the completion of the Kebangunan three dimensional survey, which detected oil at 450 feet.

Megat Zaharuddin, in his first Press conference since assuming the top position in August last year, said Shell intends to explore in more deepwater exploration.

*"In future, we'll go even deeper to as much as 5,000 feet deep. We have got the most skilled workers in deepwater exploration from the Shell Group worldwide working with us,"* he said at Bangunan Shell in Kuala Lumpur yesterday.

The cost of deep-sea drilling in the industry is usually between US\$25 million and US\$30 million.

Shell Malaysia hopes to do it cheaper through regional cooperation by using skilled staff and technical equipment from other Shell companies worldwide.

The SB-G block is the fifth deepwater block to be awarded and the first deepwater PSC off the coast of Sabah.

The profit split for oil is in favour of Shell, which will get 86 per cent for the first 50,000 bpd, 82 per cent for the next 50,000 bpd and 63 per cent for volumes exceeding 100,000 bpd.

The profit will be equally split for a cumulative production beyond 300,000 barrels. The ceiling cost for recovery is 75 per cent.

For gas, the profit split will be 60 per cent in favour of Shell for the first 2.1 trillion cubic feet (TCF) of gas sold. Beyond this volume, the split will be 40:60 in favour of Petronas. Cost recovery ceiling for gas will be 60 per cent.

Due to the longer lead time required in deepwater operations, the exploration period is extended to seven years, the development to six years while the production period is lengthened to 25 years.

Megat Zaharuddin said Shell was hopeful that the block would yield oil rather than gas because the LNG market was getting competitive.

*"Countries like Indonesia, Qatar, Oman and Australia are in the market already."*

On the overall performance of the company, he said the Shell group of companies in Malaysia expects to maintain a RM8 billion group turnover in the current year with an estimated eight per cent growth.

He added that refinery margins were expected to remain tight this year in view of new capacity coming onstream in Thailand, Indonesia and China.

To a question, he said the company's oil production had been rather static at about 180,000 bpd because new fields were not producing as expected.

*"Add to this, our oldest field is winding down after being in production since 1968. And some of the production has been taken over by Petronas after the lease and extension have expired,"* he said.

Apart from exploration and production activities, Shell Malaysia would also place more emphasis on its distribution network and the upgrading of its 800 petrol stations — the largest network in Malaysia.

Megat Zaharuddin said the demand for oil products in Malaysia, which was growing at a rate of more than eight per cent a year, remained buoyant.

*NST, 15.2.1996*

**CARACAS AGAIN!**  
**II AAPG/SVG**  
**International Congress and Exhibition**  
**Caracas, Venezuela**  
**8-11 September 1996**

**Host:**

**The American Association of Petroleum Geologists (AAPG)** (*An International Geological Organization*)  
**Sociedad Venezolana de Geólogos (SVG)**  
**Co-Sponsored by the Society of Exploration Geophysicists (SEG)**

**Technical Program Summary**

**Monday, 9 September** =====

**Morning Oral**

- Future of Exploration and Production Business
- Petroleum Systems of the Gulf of Mexico
- Remote Sensing in Exploration and Production

**Morning Poster**

- Reservoir Geochemistry
- Reservoir Models
- Fine Tuning of the Chronostratigraphic Framework

**Afternoon Oral**

- Exploration and Production Technology Management
- Petroleum Systems of Venezuela
- Fractured Reservoirs

**Afternoon Poster**

- Deep-Water Reservoirs
- Organic Geochemistry

**Tuesday, 10 September** =====

**Morning Oral**

- International Risk Assessment: The Best of the San Diego Hedberg Conference
- Petroleum Systems of the Caribbean
- Reservoir Management

**Morning Poster**

- Production from Low-Resistivity Sands
- Advances in Sequence Stratigraphy
- Petroleum Systems of South Atlantic Margins

**Afternoon Oral**

- Reservoir Characterization
- Petroleum Systems of the Subandean Basins
- Optimizing Field Development

**Afternoon Poster**

- Petroleum Systems of Venezuela
- Production Technology
- Geophysical Applications

**Wednesday, 11 September** =====

**Morning Oral**

- Revitalizing Mature Fields
- Petroleum Systems of Colombia
- Seismic Imaging of Complex Geology

**Morning Poster**

- Sedimentology and Stratigraphy
- Geological Data Management

**Afternoon Oral**

- New Plays in Old Basins
- Petroleum Systems of the Southern Cone of South America

**Afternoon Poster**

- Petroleum Geology of Thrust Belts
- Recent Developments in Geophysical Indicators of Oil and Gas Structural Geology

### Short courses

#### Course # 1. Petroleum Geology of Venezuela

*Date:* Saturday, 7 September, through Sunday, 8 September, 8:00 a.m.–5:00 p.m.

*Instructors:* Felipe E. Audemard, Jairo Lugo (Petróleos de Venezuela, S.A., Caracas, Venezuela)

#### Course # 2. Low-Resistivity, Low-Contrast Productive Pays

*Date:* Saturday, 7 September, through Sunday, 8 September, 8:00 a.m.–5:00 p.m.

*Instructors:* Robert M. Sneider (Robert M. Sneider Exploration, Houston, Texas, USA), John T. Kulha (Loren & Associates, Inc., Houston, Texas, USA)

#### Course # 3. Multidisciplinary Reservoir Description — Techniques to Improve Reservoir Modeling

*Date:* Thursday, 12 September, through Friday, 13 September, 8:00 a.m.–5:00 p.m.

*Instructors:* Diana Morton-Thompson (Earth Resources International, Kalamazoo, Michigan, USA), Arnold M. Woods (Consultant, Casper, Wyoming, USA)

### Field Trips

**Trip # 1.** A cross Section from the Oil-Rich Maturin Sub-Basin to Margarita Island — The Geodynamic Relations between South American and Caribbean Plate

*Date:* Wednesday, 4 September, 8:30 a.m., through Saturday, 7 September, 6:00 p.m.

*Coordinator:* Lagoven, S.A.

**Trip # 2.** Cretaceous and Paleocene Para-Autochthonous and Allochthonous Terrains on Mainland and Islands of Northeastern Venezuela

*Date:* Thursday, 12 September, 6:00 a.m., through Saturday, 14 September, 7:00 p.m.

*Coordinator:* Corpoven, S.A.

**Trip # 3.** Recent Carbonate Facies in Eastern Falcón

*Date:* Wednesday, 4 September, 8:00 a.m., through Saturday, 7 September, 1:00 p.m.

*Coordinator:* Maraven, S.A.

**Trip # 4.** An Integrated View of the Eocene Misoa Formation, Maracaibo Basin

*Date:* Wednesday, 11 September, 6:00 p.m., through Saturday, 14 September, 9:00 a.m.

*Coordinator:* Maraven, S.A.

### Registration Information

**Preregistration Deadline: 1 August 1996**

*By Fax* — 1-918-560-2684

*By Phone* — 1-918-560-2617

*By Mail* —

AAPG/SVG International Congress  
P.O. Box 979  
Tulsa, OK 74101-0979 USA

or

AAPG/SVG International Congress  
1444 S. Boulder Ave.  
Tulsa, OK 74119-3604 USA

# LIMESTONE '96

November 13-15, 1996

Kuala Lumpur

# LIMESTONE

INTERNATIONAL SYMPOSIUM ON LIMESTONE

Organised by:

The School of Materials and Mineral Resources Engineering

Universiti Sains Malaysia

Perak Branch Campus

31750 Tronoh, Perak, Malaysia

Tel: 605-3676901 (Ext. 5501/5507); Fax: 605-3677444

Email: Khairun @ kcp.usm.my

Co-Organiser:

The Institute of Quarrying (Malaysia Branch)

**LIMESTONE** has recently appeared as the most important industrial mineral in many countries.

Limestone industries, including quicklime, hydrated lime, ground calcium carbonate, precipitated calcium carbonate, construction aggregates, dimension stone etc. are expanding both in volume and value.

The ground calcium carbonate is used as filler, extender and coating material in various industrial products such as paper, plastic and polymer, rubber, paint, ceramics and glazes, glass, fertilizers, insecticides, food additives, tooth paste, cosmetics, adhesives and sealants, insulating cables and wires and many others.

Because of its whiteness, availability, low cost and many other physical and chemical properties limestone is replacing many other mineral fillers in industrial products.

Malaysia has abundant limestone deposits and currently a large number of limestone quarries are in operation. There is wide scope for competitive value added limestone products in the local as well as overseas market.

## OBJECTIVE

The main objective of the symposium is to provide an international platform to researchers, engineers and those engaged in limestone quarrying, processing, upgrading, advanced industrial applications and marketing to express their views, expound their contributions and achievements and share their experiences.

This symposium is expected to develop a better understanding of limestone resources, processing, technological advances among local as well as overseas participants for future cooperation and research.

## THEMES

Quarrying, geology, mineral resources, processing, upgrading, value added-products, technological advances, future applications and marketing.

## SUBMISSION OF ABSTRACTS

Authors are invited to submit printed abstracts of about 200 words in single spacing before **March 15, 1996**. Authors will be notified on acceptance of their papers by April 15, 1996 and will receive the second circular regarding submission of the full manuscript of their papers.

## LANGUAGE

The official language of the symposium is English.

## FURTHER INFORMATION

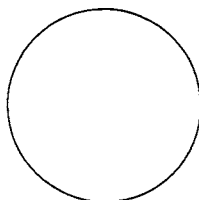
*The Secretariat of the International Symposium on Limestone (LIMESTONE '96)*

School of Materials and Mineral Resources  
Engineering

Perak Branch Campus  
Universiti Sains Malaysia  
31750 Tronoh, Perak, Malaysia  
(Attn: Badarudin Bin Pai)

# INTERNATIONAL CONFERENCE ON URBAN ENGINEERING IN ASIAN CITIES IN THE 21ST CENTURY

November 20-23, 1996  
The Central Plaza Hotel  
Bangkok, Thailand



*Organized by*

**School of Civil Engineering  
Asian Institute of Technology  
Bangkok, Thailand**

## Conference Theme

The rapid development of the Asian economy naturally leads to numerous demands being made on the natural resources and infrastructure of countries in Asia. The conference will provide a forum for scientists, engineers, planners, consultants, contractors and researchers to discuss problems, solutions and exchange of views and experiences associated with urban environmental and civil engineering practices in Asian cities in the 21st century.

## Subject Areas

The following topics of Urban Engineering are scheduled for discussion at the conference:

- A. Urban Environment
- B. Geotechnical Engineering
- C. Infrastructure Planning and Management
- D. Structural Engineering and Construction
- E. Transportation Engineering
- F. Water Resources Engineering
- G. Computer Applications and Software for Civil Engineering Applications
- H. Urban Disaster Management

## Call for Papers

Authors are invited to submit abstracts of papers of not more than 500 words on any of the above topics on letter size paper. The above topics are not exhaustive and abstracts which fall within the theme of the conference will be accepted and considered for presentation. Only papers presented at the conference will be included in the Proceedings. The subject area to which the paper belongs should be specified.

## Paper Review Schedule

Abstracts due by 15 March 1996  
Decision on abstracts by 15 April 1996

Full papers due by 31 July 1996  
Acceptance of full papers 15 September 1996

## Registration Fee

The conference registration fee of US\$375.00 (Baht 9,375.00) includes opening night reception, refreshment breaks, lunches, final day dinner, technical tour and a copy of the conference proceedings. Registration fee for an accompanying person is US\$150.00 (Baht 3,750.00). This includes special programs, opening night reception, refreshment breaks, lunches, final day dinner and technical tour.

## Technical Tour

A one-day technical and cultural tour will be organized for conference participants. The technical tour will include visits to large civil engineering projects. More details will be given in the next announcement.

## Venue

The conference will be held at the Central Plaza Hotel, Bangkok, a five-star hotel with excellent auditoriums, meeting space and facilities.

## Further Information

Professor Tawatchai Tingsanchali  
Chairman, Organizing Committee  
International Conference on Urban  
Engineering in Asian Cities in the 21st  
Century  
School of Civil Engineering  
Asian Institute of Technology  
P.O. Box 2754  
Bangkok 10501, Thailand

Telephone: (66-2) 524-6057, (66-2) 524-6051  
Fax: (66-2) 524-6059, (66-2) 516-2126  
E-mail: anilcw@rccsun.ait.ac.th

# **Tectonics, Stratigraphy & Petroleum Systems of Borneo**

## ***An International Workshop***

**22–25 June 1997**

**Hosted by the Department of Petroleum Geoscience,  
Universiti Brunei Darussalam**

## ***First Circular***

**Venue: University of Brunei Darussalam  
Bandar Seri Begawan  
Brunei Darussalam**

**O**bjective: To improve the understanding of the Cretaceous to Recent tectonic and stratigraphic histories of Borneo and their contribution to the island's petroleum systems.

**T**echnical Sessions: Tectonics and Structural Development, Stratigraphic Sequences and Petroleum Reservoirs, Geochemistry and Petroleum Source Rocks, Geochronology and Volcanism.

**F**ield Trips: Sedimentology of the Baram Delta Province, Sarawak (3 days)  
Tectonics and Stratigraphy of Western Sabah (4 days)

## **F**or Further Information:

Dr. Joseph J. Lambiase (Asia/Pacific)  
Department of Petroleum Geoscience  
Universiti Brunei Darussalam  
Bandar Seri Begawan 2028  
Brunei  
Fax: 673-2-427003

Mr. Richard W. Murphy (UK/Europe)  
34 Bridge Street  
Walton-on-Thames  
Surrey KT12 1AJ  
UK  
Fax: 44-1932-232-141

Dr. James W. Granath (N. America)  
Conoco Inc.  
600 North Dairy Ashford  
Houston, Texas 77079-6651  
U.S.A.  
Fax: 1-713-293-1333



International Association of Engineering Geology

**INTERNATIONAL SYMPOSIUM ON**

**ENGINEERING GEOLOGY AND THE ENVIRONMENT**

**Engineering Geology Committee of the Geological Society  
of Greece (Greek National Group of IAEG)**

*Co-Sponsors*

- International Association of Hydrogeologists (IAH)
- Cogeoenvironment (IUGS)

**An IAEG sponsored International Symposium  
Athens, Greece, June 23–27, 1997**

**PURPOSE**

*“Be mindful, when visiting a new city, of the air,  
the soils and the water”,*

*Hippocrates*

Despite what Hippocrates said, it is only recently that people have become more and more interested in the protection and preservation of the environment. The earth, the only suitable habitat we have, is a closed system and its resources are limited. With the explosion of development in the last decades, the expansion of cities, the excessive land use and the problem of disposal of waste material, the environmental protection has become a matter of first order priority. Engineering Geology, by knowledge and experience, is aware of the behaviour of the earth, therefore is in an excellent position to contribute in a dynamic way; not only by protecting, but also by supporting development without harming at the same time the environment.

This Symposium will give a timely opportunity to review world-wide experience promoting the interdisciplinary collaboration in the fields of Geology and Geotechnical Engineering and in particular the contribution of Engineering Geology. The themes and objectives of the Symposium have been chosen to present an attractive venue to all scientists interested in the protection of the environment.

Specialists from related and other disciplines are warmly welcome.

**THEMES**

1. Engineering geology and geomorphological processes
2. Natural and man-made hazards
3. Geological environment in urban and regional planning and management
4. Engineering Geology and Hydrogeology for environmental health — Waste disposal
5. Impact from the exploitation of mines and quarries
6. Environment aspects of the design and construction of large engineering works and schemes
7. Protection of geological and geographical heritage
8. Protection of historical and architectural heritage
9. Strategies and legislation related to geological conditions, processes and hazards affecting the environment
10. Environmental courses in geological and geotechnical education

**PROGRAMME**

It is planned that Monday, Tuesday, Thursday and Friday will be devoted to scientific sessions. Invited speakers will present state of the art reviews and special lectures will be given by well known experts. Speciality sessions will provide opportunity for participants to present accepted papers. Wednesday is devoted for a full day trip in Northern Peloponnese.

Technical visits with a special emphasis on environmental aspects are planned to be made, during the symposium, in the *Acropolis of Athens* and the temple of Parthenon (5th century BC — stability protection measures, preservation of the marbles), the *main land fill of Athens*, the *Athens Metro* (under construction) and the *Malakassa landslide*, at the outskirts of Athens, along the Athens-Thessaloniki highway (stabilization measures).

## OFFICIAL LANGUAGES

The official languages of the Symposium will be English, French and Greek. Papers should be presented in English or French.

A simultaneous translation is planned.

## CALL FOR PAPERS

### Guidelines for Abstracts and Papers

Contributing papers in all themes are welcome. The subject matter of a paper must strictly fall within the framework of the Symposium themes, in order to be acceptable.

The contributions shall present information which has not been published yet and reports real progress in the study field concerned. Papers

with practical applications and case histories of particular interest are also invited for submission.

## PUBLICATIONS

The volumes of the Proceedings of the Symposium with all the accepted papers, published by '**A.A. Balkema Publisher**', will be distributed to participants upon their registration. A post-symposium volume will contain special lectures, general and panel reports and discussions.

## CORRESPONDENCE

All correspondence should be addressed to:

*Hellenic Committee of Engineering Geology*  
*Athens 1997 Symposium Secretariat*  
P.O. Box 19140, GR-117 10 Athens —  
GREECE

Tel: ++30-1-3813900, ++30-1-3804375, ++30-1-9225835

Fax: ++30-1-3813900, ++30-1-9242570 (Prof. Paul G. Marinos)

## CALENDAR OF MAIN EVENTS

- |                           |   |
|---------------------------|---|
| <i>September 30, 1996</i> | Deadline for receipt of manuscripts             |
| <i>December 1996</i>      | Notification of acceptance of final manuscripts |

## KALENDAR (CALENDAR)

### 1996

#### January 5-9

*NATURAL DISASTER MITIGATION* (World Conference in conjunction with 10th International Seminar on Earthquake Prognostics), Cairo, Egypt. (Dr. Amany Asfour, 14 Syria St., Mohandeseen, Guiza, Egypt. Phone and Telefax: (202) 701482; Telex: 21274 VIPCO UN)

#### January 19-22

*DISASTERS AND MITIGATION* (International Conference), Madras, India. (S. Rajarathnam, Dept. of Geology, Anna University, Madras 600025, Tamil Nadu, India. Phone: 91 235 05 26; Telefax: 91 44 235 03 97; E-mail: annalib@sirnetm.ernet.in)

#### January 22-24

*CANADIAN MINERAL DEPOSIT TYPES — CURRENT CONCEPTS* (GSC Minerals Colloquium '96), Ottawa, Canada. (Room 686, Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8, Canada. Phone: 613 992 1600; Telefax: 613 996 9820; E-mail: colloq96@gsc.emr.ca)

#### January 29-31

*HYDROCARBON TRAPPING SEALS — IMPORTANCE FOR EXPLORATION AND PRODUCTION*, Trondheim, Norway. (Norwegian Petroleum Society, P.O. Box 1897, Vika, N-0124 Oslo, Norway. Phone: 47 2211 4614; Telefax: 47 2255 4630)

#### February 6-7

*GEOLOGY AND EXPLORATION OF PLATINUM GROUP, RARE METAL AND RARE EARTH ELEMENTS*, Calcutta, India. (A.K. Tikku, c/o Geological Survey of India, 27 Jawahar Lal Nehru Rd., Calcutta 700 016, India. Phone: 249 6941; Telefax: 033 249 6956)

#### February 19-23

*GEOSCIENCE IN THE COMMUNITY* (13th Australian Geological Convention and Jubilee of BMR/AGSO) Canberra, Australia. (ACTS, G.P.O. Box 220, Canberra ACT, 2601 Australia)

#### February 20-22

*TECTONIC, MAGMATIC AND DEPOSITIONAL PROCESSES AT PASSIVE CONTINENTAL MARGINS*, London, UK. (N. Kuszniir, University of Liverpool, Department of Earth Sciences, Liverpool L69 3BX, UK)

#### February 27-29

*GEOLOGICAL REMOTE SENSING: EXPLORATION, ENVIRONMENT AND ENGINEERING* (11th Thematic Conference), Las Vegas, USA. (R. Rogers, ERIM, P.O. Box 134001, Ann Arbor, MI 48113-4001, USA)

#### March 5-6

*CONTINENTAL TRANSPRESSIONAL AND TRANSTENSIONAL TECTONICS*, London, UK. (R. Holdsworth, Department of Geological Sciences, University of Durham, Durham DH1 3LE, UK. Telefax: (44) 19 137 42 510; E-mail: R.E.Holdsworth@durham.ac.uk)

#### March 5-8

*NATURAL DISASTER REDUCTION* (Int'l Conf.), Washington, D.C. by American Society of Civil Engineers. (NDR '96, American Society of Civil Engineers, 345 E. 47th St., New York, 10017. Phone: 800/548-2723. Fax: 212/705-7975)

#### March 6-7

*BIOGEOGRAPHY AND GEOLOGICAL EVOLUTION OF SE ASIA*, London UK. (Professor R. Hall, Dept. of Geology, Royal Holloway, University of London, Egham, Surrey TW20 0EX, UK. Phone: 44 1784 443592; Telefax: 44 1784 471780; E-mail: cameron@gl.rhbc.ac.uk)

#### March 6-7

*MID OCEAN RIDGES: DYNAMICS OF PROCESSES ASSOCIATED WITH THE CREATION OF NEW CRUST*, London, UK. (C. Johnson, The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG, UK)

#### March 6-7

*THE ROLE OF BASEMENT REACTIVATION IN CONTINENTAL DEFORMATION*, London, UK. (R. Butler and G. Lloyd, Department of Earth Sciences, University of Leeds, Leeds LS2 9JT, UK. Telefax: (44) 113 23 35 259; E-mail: tsg@earth.leeds.ac.uk)

**March 8-15**

**GEOLOGICAL SURVEYS AND SUSTAINABLE DEVELOPMENT** (Conference to mark the Centennial of the Geological Survey of Egypt), Cairo, Egypt. (M. El Hinnawi, Geological Survey of Egypt, 3 Salah Salem Road, Abbassiya, Cairo, Egypt. Telefax: 002 02 820 128)

**March 11-13**

**GEOPHYSICS FOR LITHOLOGY PREDICTION**, Kristiansand S., Norway. (Norwegian Petroleum Society, P.O. Box 1897, Vika, N-0124 Oslo, Norway. Phone: 47 2211 4614; Telefax: 47 2255 4630)

**March 18-22**

**LUNAR AND PLANETARY SCIENCE** (27th International Conference), Houston, Texas. (L. Simmons, LPI, Publications and Programme Services Dept., 3600 Bay Area Boulevard, Houston TX 77058-1113, USA. Phone: 713 486 2158)

**March 27**

**ENVIRONMENTAL AND LEGISLATIVE USES OF REGIONAL GEOCHEMICAL BASELINE DATA FOR SUSTAINABLE DEVELOPMENT** (International Workshop of IGCP 360) Nottingham, UK. (Professor P. Simpson, British Geological Survey, Keyworth, Nottingham NG12 5GG, UK. Telefax: 0115 936 3200)

**March 27-29**

**METAL BULLETIN'S 4TH INTERNATIONAL TIN CONFERENCE**, Miami, Florida, USA. (Jackie Gregson, Metal Bulletin Conferences, Park House, Park Terrace, Worcester Park, Surrey, KT4 7HY, UK. Tel: +44 (0)171 827 9977; Fax: +44 (0) 181 337 8943)

**March 31 - April 4**

**V.M. GOLDSCHMIDT CONFERENCE** (International Conference for the Advancement of Geochemistry), Heidelberg, Germany. (Volker Brzezinski, Lab. für Geochronologie, Ruprecht-Karls-Universität Heidelberg, Im Neuenheimer Feld 234, 69120 Heidelberg, Germany. Telefax: 49 (0)6131 371051; E-mail: goldconf@geobar.mpch-mainz.mpg.de)

**April 1-3**

**GLOBAL WARMING** (Int'l Conf.), Vienna, Austria. (Global Warming International Center, Box 5275, Woodridge, III. 60517. Phone: 708/910-1551; Fax: 708/910-1561)

**April 9-12**

**TRIASSIC BIOSTRATIGRAPHY** (Int'l Conf.), Brisbane, Australia, by Int'l. Union of Geological Sciences, and others. (John Rigby, Conf. on Triassic Biostratigraphy, School of Geology QUT, Box 2434, G.P.O. Brisbane Qld 4001. Fax: 61-7-3864-1535)

**April 9-12**

**GEOMORPHOLOGY** (3rd Regional Conference of International Association of Geomorphologists), Budapest, Hungary. (M-F André, Dépt. de Géographie, Université de Limoges, 39 rue C Guérin, 87036 Limoges cedex France. Telefax: 55 43 56 03)

**April 9-12**

**TRIASSIC BIOSTRATIGRAPHY** (International Conference), Brisbane, Australia. (J. Rigby, School of Geology, QUT, Box 2434, Qld 4001, Australia. Phone: 61 7 864 1638; Telefax: 61 7 864 1535)

**April 15-17**

**ADVANCED TECHNOLOGY FOR IMPROVED EXPLORATION AND RESERVOIR CHARACTERISATION** (2nd Middle East Geosciences Conference), Bahrain. (Jalil Al-Samahiji, P.O. Box 25510, Awali, Bahrain. Phone: 973 753475; Telefax: 973 753 475)

**April 15-18**

**APPLIED GEOSCIENCE** (International Conference, 1st Biennial Meeting of the Geological Society), Warwick, UK. (Conference Dept., Geological Society, Burlington House, Piccadilly, London W1V 0JU, UK. Phone: 0171 434 9944; Telefax: 0171 439 8975)

**April 15-19**

**ENVIRONMENTAL POLLUTION** (International Conference, ICEP 3) Budapest, Hungary. (B. Nath, 253 Kilburn Lane, London W10 4BQ, UK. Phone: 44 181 960 1597; Telefax: 44 181 960 1597)

**April 16-19**

**APPLICATION OF GEOGRAPHIC INFORMATION SYSTEMS IN HYDROLOGY AND WATER RESOURCE MANAGEMENT** (HYDROGIS '96 International Conference), Vienna, Austria. (c/o Austropa-Interconvention, P.O. Box 30, A-1043 Vienna, Austria. Phone: 43 1 588 00110; Telefax: 43 1 586 7127)

**April 22-23**

*NEW DEVELOPMENTS IN METALLOGENIC RESEARCH*, Townsville, Queensland Australia by EGRU. (Pat Williams, Phone: 077/815223; Fax: 077/251501)

**April 24-27**

*NATURAL HAZARDS, LAND-USE PLANNING AND THE ENVIRONMENT* (6th Spanish Congress and International Conference), Granada, Spain. (Clemente Iligaray Fernández, Departamento de Ingeniería Civil, Facultad de Ciencias, Universidad de Granada, Campus Fuentenueva, 18071 Granada, Spain. Phone/Telefax: 34 58 243 367; E-mail: jchacon@ugr.es)

**April 28 - May 1**

*HIMALAYA-KARAKORAM-TIBET* (11th International Workshop), Flagstaff, Arizona, USA. (Allison Macfarlane, Department of Geography and Earth Systems Science, George Mason University, 1E2, Fairfax, VA 22030-4444, USA. Phone: 703 993 1207; Telefax: 703 993 1216; E-mail: amacfarl@osfl.gmu.edu)

**April 28 - May 1**

*APPLICATION OF GEOPHYSICS TO ENGINEERING AND ENVIRONMENTAL PROBLEMS* (Mtg.), Keystone Resort, Colo. (Mark Cramer, Environmental and Engineering Geophysical Society. Phone: 303/771-6101; Fax: 303/843-6232; E-mail: 74261.524@Composerv.comm. www: http://www.esd.ornl.gov/EEGS)

**May 6-9**

*OFFSHORE TECHNOLOGY* (Conf.), Houston, by American Association of Petroleum Geologists. (AAPG Convention Dept., Box 979, Tulsa, Okla, 74101. Phone: 918/584-2555)

**May 13-16**

*TIDAL SEDIMENTOLOGY* (Int'l Conf.), Savannah, Ga. (V.J. Henry Jr., Coastal Research Laboratory, Georgia Southern University, 10 Ocean Science Circle, Savannah, 31411. Fax: 912/598-2366; E-mail: henry@skio.peachnet.edu)

**May 14-18**

*PALEOGENE OF SOUTH AMERICA* (Congress), Santa Rosa, La Pampa, Argentina. (Dr. S. Casadio, Dpto. Ciencias Naturales, Universidad nacional de La Pampa, Uruguay 151, 6300 Santa Rosa, La Pampa, Argentina.

Phone: 54 954 33093; Telefax: 54 954 33408; E-mail: rpmelcho@arcriba)

**May 19-21**

*INDUSTRIAL MINERALS* (Ann. Forum), Laramie, Wyo., by Wyoming State Geological Survey. (Ray E. Harris, Wyoming State Geological Survey, Box 3008, University Station, Laramie, 82071. Phone: 307/766-2286. Fax: 307/766-2605)

**May 19-22**

*AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS* (Annual Conference), San Diego, California, USA. (AAPG Convention Department, P.O. Box 979, Tulsa, OK 74101, USA. Phone: (918) 584-2555)

**May 27-29**

*GEOLOGICAL ASSOCIATION OF CANADA and MINERALOGICAL ASSOCIATION OF CANADA* (Joint Annual Meeting), Winnipeg, Manitoba, Canada. (G.S. Clark, Department of Geological Sciences, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2. Phone: (204) 474-8857; (204) 261-7581)

**May 27 - June 2**

*PEAT* (10th International Congress), Bremen, Germany. (Dr. J.D. Becker-Platen, Deutsche Gesellschaft für Moor and Torfkunde e. V., P.O. Box 510153, D-30631 Hannover, Germany. Phone: 511 643 2459; Telefax: 511 643 2304)

**June 2-6**

*4TH CONFERENCE ON PETROLEUM GEOCHEMISTRY AND EXPLORATION IN THE AFRO-ASIAN REGION*, Arusha-Tanzania. (The 4th AAPG Conference Secretariat, Tanzania Petroleum Development Corporation, P.O. Box 5233, Dar Es Salaam, Tanzania, East Africa. Phone: 255-51-29661/2 & 36086; Fax: 255-51-29663/20775; Telex: 41219 Oil Exp. Attn: Mr. Y.S. Mwalyego, Ms. F.K. Mpanju, Mr. E.A. Kilembe)

**June 3-7**

*EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS and EUROPEAN ASSOCIATION OF PETROLEUM GEOLOGISTS* (EAEG 58th Annual Assembly and EAPG 8th Annual Congress), Amsterdam, Netherlands. (EAPG, Attention of Mr. E. van der Gaag, P.O. Box 298, NL-3700 AG, Zeist, Netherlands. Telefax: 31 30 696240)

**June 6-8**

*ASIAN CONFERENCE ON X-RAYS AND RELATED TECHNIQUES IN RESEARCH AND INDUSTRY*, Tronoh, Malaysia. (The Secretariat, ACXRI '96, School of Materials and Mineral Resources Engineering, Universiti Sains Malaysia, Perak Branch Campus, 31750 Tronoh, Perak, Malaysia, Attn: Dr. Zainal Arifin Ahmad. Tel: (605) 3676901 ext. 5545/5501; Fax: (605) 3677444; E-mail: mrzainal@kcp.usm.MY)

**June 8-9**

*ECONOMIC GEOLOGY AND TECTONICS OF MALAYSIA AND THE SOUTHEAST ASIAN REGION* (Annual Geological Conference '96), Kota Kinabalu, Sabah, Malaysia. (The Organising chairman, Annual Geological Conference 1996, Geological Society of Malaysia, c/o Department of Geology, University of Malaya, 50603 Kuala Lumpur, Malaysia. Phone: (603) 757 7036; Fax: (603) 756 3900)

**June 9-12**

*NORTH AMERICAN PALEONTOLOGICAL CONVENTION* (6th). Washington, DC, USA. (NAPC-VI, c/o Department of Paleobiology, Mail Stop 121, National Museum of Natural History, Washington, DC, 20560, USA)

**June 10-12**

*ENVIRONMENTAL GEOTECHNOLOGY* (Int'l Symposium), San Diego. (Eleanor Nothelfer, Fritz Engineering Lab., Lehigh University, Bethlehem, Pa. 18015-3176. Phone: 610/758-3549; Fax: 610/758 4522; E-mail: esno@lehigh.edu)

**June 15-20**

*THE CLAY MINERALS SOCIETY* (Ann. Mtg.), Gatlinburg, Tenn. (Patricia Jo Ebert, The Clay Minerals Society, Box 4416, Boulder, Colo. 80306. Phone: 303/444-6405; Fax: 303/444-2260)

**June 17-21**

*LANDSLIDES* (7th International Symposium), Trondheim, Norway. (Norwegian Geotechnical Society, P.O. Box 40, Taasen N-0801, Oslo, Norway)

**June 22-27**

*CARBONATES AND GLOBAL CHANGE* (Mtg.), Wildhaus, Switzerland. (Maria Mutti, Geological Institute, ETH, Sonneggstrasse 5, CH-8092, Zurich. Phone: 41-1 632-3673; Fax:

632-1080; E-mail: maria@erdw.ethz.ch)

**June 22-29**

*INTERNATIONAL PALYNOLOGICAL CONGRESS* (9th), Houston, Texas. (Dr. Vaughn M. Bryant, Department of Anthropology, Texas A & M University, College Station, TX 77843, USA. Phone: 409 845 5242; Telefax: 409 845 4070; E-mail: glwrenn@lsuvm.sncc.lsu.edu)

**June 24-27**

*INTERNATIONAL AIRBORNE REMOTE SENSING* (Mtg. and Exhibit), San Francisco. (Robert Rogers, ERIM, Box 134001, Ann Arbor, Mich. 48113-4001. Phone: 313/994-1200, ext. 3234; Fax: 313/994-5123. Internet: raeder@erim.org)

**June 27-28**

*MINERALISATION IN THE CALEDONIDES* (The Mike Gallagher Memorial Meeting), Royal Museum of Scotland, Edinburgh. (The Conference Office, The Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR. Phone: +44-(0)171-580 3802; Fax: +44-(0)171-436 5388)

**June 30 - July 5**

*INTERNATIONAL ORGANIZATION OF PALEOBOTANY* (Conf.), Santa Barbara, Calif. (Bruce H. Tiffney, Dept. of Geological Sciences, University of California, Santa Barbara, 93106. Fax: 805/893-2314; E-mail: tiffney@magic.ucsb.edu)

**July 7-13**

*EXTENT AND FOSSIL CHAROPHYTES*, Madison, Wisconsin, USA. (Colloque Charophytes, Laboratoire de Paléobotanique, UM2, 34095 Montpellier Cedex 05, France. Telefax: 33 6704 202; E-mail: mofeist@isem.univ-montp2.fr)

**July 8-13**

*GEODYNAMICS OF LITHOSPHERE AND EARTH'S MANTLE* (Workshop), Trest, Czech Republic, by the Geophysical Institute of the Czech Academy of Sciences and the Center for High Pressure Research. (Jaroslava Plomerova, Geophysical Institute, Czech Academy of Sciences, Bocni II, 14131 Praha 4, Czech Republic. Phone: 42-2-67-103-049; Fax: 42-2-76-15-49; E-mail: jpl@ig.cas.cz)

**July 15-19**

*EROSION AND SEDIMENT YIELD: GLOBAL AND REGIONAL PERSPECTIVES*

(International Symposium), Exeter, UK. (Professor D. Walling, Department of Geography, University of Exeter, Rennes Drive, Exeter EX4 4RJ, UK. Phone: 44 392 263345; Telefax: 44 392 263342)

#### July 22-28

*GEOCHEMISTRY OF THE EARTH'S SURFACE* (Int'l Symposium), likely, Yorkshire, England. (GES-IV Conference Secretariat, Dept. of Continuing Professional education, Leeds University, Leeds LS2 9JT, England. Phone: 01132-333-241; Fax: 01132-333-240)

#### July 29 - August 2

*PAN PACIFIC HAZARDS '96* (Int'l Conf.), Vancouver, British Columbia, Canada. (Program Committee, Pan Pacific hazards '96 Conf., The University of British Columbia, Disaster Preparedness Resources Centre, Fourth Floor, 2206 East Mall, Vancouver, V6T 1Z3. Phone: 604/822-5518; Fax: 604/822-6164; E-mail: dprc@unixg.ubc.ca)

#### August 4-9

*THE SILURIAN SYSTEM* (2nd International Symposium), Rochester, New York, USA. (Markes Johnson, Department of Geology, Williams College, Williamstown, MA 01267, USA. Phone: 413 597 2329; Telefax: 413 597 4116; E-mail: markes.e.johnson@williams.edu)

#### August 4-14

*INTERNATIONAL GEOLOGICAL CONGRESS* (30th), Beijing, China. (Prof. Zhao Xun, Deputy Secretary General, 30th IGC, P.O. Box 823, Beijing 100037, P.R. China. Phone: 86 1 8327772; Telefax: 86 1 8328928)

#### August 7-9

*COASTAL ENVIRONMENT '96* (Environmental Problems in Coastal Regions, Conf.), Rio de Janeiro, by Federal University of Rio de Janeiro and Wessex Institute of Technology. (Sue Owen, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton England SO40 7AA. Phone: 44/1703-293223; Fax: 44/1703-292853; E-mail: cmi@ib.rl.ac.uk)

#### August 10-11

*MINERALISATION AND ALKALINE MAGMATISM IN THE DECCAN IGNEOUS PROVINCE AND IN OTHER PARTS OF THE WORLD* (Workshop WB03 of 30th IGC), Beijing, China.

#### August 12-17

*INTEGRATED MANAGEMENT AND SUSTAINABLE DEVELOPMENT IN COASTAL ZONES* (Coastal Zone Canada '96, International Conference), Rimouski, Quebec, Canada. (Professor M El-Sabh, GREC, Université du Québec, 310 allée des Ursulines, Rimouski, Québec, Canada G5L 3A1. Phone: 418 724 1701; Telefax: 418 724 1842; E-mail: mohammed\_el\_sabh@uqar.uqubec.ca)

#### August 13-15

*INTERNATIONAL CONFERENCE ON GROUND CONTROL IN MINING*, Golden, Colo., by Colorado School of Mines and others. (Colorado School of Mines, Office of Special Programs and Continuing Education, Golden, 80401. Phone: Colo. residents, 303/273-3321; outside of Colo., 800/446-9488, ext. 3321; Fax: 303/273-3314)

#### August 18-24

*CRETACEOUS OF BRAZIL* (4th Symposium), Rio Claro, Brazil. (Organizing Committee, CP 178, Departamento de Geologia Sedimentar IGCE-UNESP Campus de Rio Claro, 13506-900 Rio Claro, Brazil. Phone and telefax: (0195) 34 0327; E-mail: dgs@geo001.uesp.ansp.br)

#### September 2-5

*PREDICTION AND PERFORMANCE IN ROCK MECHANICS AND ROCK ENGINEERING* (Eurock '96 International Symposium), Tyrin, Italy. (c/o AGI Associazione Geotecnica Italiana, via Baglivi 5, 00198 Rome, Italy. Telefax: 39 6 44249274)

#### September 2-8

*DIATOM RESEARCH* (Mtg.), Tokyo, by International Society of Diatom Research. (Hiromu Kobayashi, Tokyo Diatom Institute, Honcho, 3-8-9-813, Koganei-shi, Tokyo 184, Japan. Phone: +81-423-84-7795; Fax: +81-423-84-7495; E-mail: mayama@u-gakugei.ac.jp)

#### September 3-6

*MINERALS, METALS AND THE ENVIRONMENT* (2nd International Conference), Prague, Czech Republic. (Conference Officer, Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, UK. Phone: 44 171 580 380-2; Telefax: 44 171 436 5388)

**September 4-11**

*AGE AND ISOTOPES OF SOUTH AMERICAN METALLOGENIC PROVINCES* (Final Meeting of IGCP Project 432), Salvador, Bahia, Brazil. (Aroldo Misi, IGEO, Univ. Fed. Da Bahia, Rua Caetano Moura, 123 Federacao, Salvador, Bahia 40210-340 Brazil. Phone: 55 71 2356789; Telefax: 55 71 2473004; E-mail: misi@ufba.br)

**September 8-12**

*CONTAMINATED LAND AND GROUNDWATER, FUTURE DIRECTIONS* (32nd Annual Conference of the Engineering Group of the Geological Society), Portsmouth, UK. (D.N. Lerner, Department of Civil and Environmental Engineering, University of Bradford, Bradford BD7 1DP, UK. Phone: 01274 3854; Telefax: 01705 842 244)

**September 9-12**

*MINEXPO INTERNATIONAL '96* (Conf.), Las Vegas, by National Mining Association. (MINExpo, 5420 LBJ Freeway, Suite 410, Dallas, 75240. Phone: 800/693-3216; Fax: 214/702-1042)

**September 10-20**

*KARST WATERS AND ENVIRONMENTAL IMPACTS* (Mtg.), Beldibi, Turkey, by the International Association of Hydrological Sciences, and others. (Gultekin Gunay, UKAM, Hacettepe University, 06532 Beytepe, Ankara, Turkey)

**September 15-20**

*DEEP SEISMIC PROFILING OF THE CONTINENTS* (Int'l Symposium), Asilomar, Calif., by Stanford University, and U.S. Geological Survey (Simon Klemperer, Dept. of Geophysics, Mitchell Building, Standard University, Stanford, Calif. 94305-2215. Phone: 415/723-8214; Fax: 415/725-7344; E-mail: klemp@pangea.stanford.edu)

**September 16-20**

*COMPUTER APPLICATIONS IN THE MINERAL INDUSTRIES* (26th International Symposium, APCOM '96), Pennsylvania, USA. (K. Henry, Dept. of Mineral Engineering, Pennsylvania State University, 104 Hosler Building, University Park, PA 16802-5000 USA)

**September 17-19**

*ANDEAN GEODYNAMICS* (3rd International Symposium, ISAG '96), St. Malo, France. (D. Gapais, Géosciences Rennes, Université de Rennes 1, 35042 Rennes cedex, France. Phone: 33 99 28 67 36; Telefax: 33 99 28 61 00; E-mail: isag96@seth.univ-rennes1.fr)

**September 22-24**

*PETROLEUM GEOLOGY AND HYDROCARBON POTENTIAL OF THE BLACK SEA AREA* (2nd symposium), Sile, Turkey. (S. Derman, TPAO Turkey. Phone: 90 312 286 9040; Telefax: 90 312 286 9049)

**September 22-25**

*EARTH SCIENCE EDITING* (30th Annual Meeting of the Association of Earth Science Editors), Sudbury, Ontario, Canada. (c/o MNM, B4-933 Ramsey Lake Rd., Sudbury, Ontario, Canada P3F 6B5. Phone: (705) 670 5765; Telefax: (705) 670 5770)

**September 25-27**

*CALIBRATION AND RELIABILITY IN GROUNDWATER MODELLING* (International Conference, CARE '96), Golden, Colorado, USA. (International Groundwater Modelling Center, Colorado School of Mines, Golden, Colorado 80401, USA. Phone: 303 273 3103; Telefax: 303 273 3278; E-mail: igwme@mines.colorado.edu)

**September 25-29**

*CHARNOKITE AND GRANULITE FACIES ROCKS* (International Symposium), Madras, India. (Dr. V. Ram Mohan, Dept. of Geology, University of Madras, AC College Campus, Madras, India PIN 600 025. Phone: 091 44235 1137; Telefax: 091 44 235 2870)

**September 29 - October 3**

*SCIENTIFIC DATA IN THE AGE OF NETWORKING* (15th International CODATA Conference), Tsukuba, Japan. (Codata '96, Express Co., Ltd., Daiichi Shibuya Shimizu Building, 1-11-8 Shibuya, Tokyo 150, Japan. Phone: 81 3 54851200; Telefax: 81 3 54851266; E-mail: kayo@express.co.jp)

**September 30 - October 3**

*GROUND PENETRATING RADAR* (6th International Conference), Sendai, Japan. (Dr. M. Sato, Dept. of Resources Engineering, Tohoku University, Sendai 980-77, Japan)



# GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATIONS

## BULLETIN OF THE GEOLOGICAL SOCIETY OF MALAYSIA

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**September 4-11**

**AGE AND ISOTOPES OF SOUTH AMERICAN METALLOGENIC PROVINCES** (Final Meeting of IGCP Project 432), Salvador, Bahia, Brazil. (Aroldo Misi, IGEO, Univ. Fed. Da Bahia, Rua Caetano Moura, 123 Federacao, Salvador, Bahia 40210-340 Brazil. Phone: 55 71 2356789; Telefax: 55 71 2473004; E-mail: misi@ufba.br)

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**KARST WATERS AND ENVIRONMENTAL IMPACTS** (Mtg.), Beldibi, Turkey, by the International Association of Hydrological Sciences, and others. (Gultekin Gunay, UKAM, Hacettepe University, 06532 Beytepe, Ankara, Turkey)

**September 15-20**

**DEEP SEISMIC PROFILING OF THE CONTINENTS** (Int'l Symposium), Asilomar, Calif., by Stanford University, and U.S. Geological Survey (Simon Klemperer, Dept. of Geophysics, Mitchell Building, Stanford University, Stanford, Calif. 94305-2215. Phone: 415/723-8214; Fax: 415/725-7344; E-mail: klemp@pangea.stanford.edu)

**September 16-20**

**COMPUTER APPLICATIONS IN THE MINERAL INDUSTRIES** (26th International Symposium, APCOM '96), Pennsylvania, USA. (K. Henry, Dept. of Mineral Engineering, Pennsylvania State University, 104 Hosler Building, University Park, PA 16802-5000 USA)

**September 17-19**

**ANDEAN GEODYNAMICS** (3rd International Symposium, ISAG '96), St. Malo, France. (D. Gapais, Géosciences Rennes, Université de Rennes 1, 35042 Rennes cedex, France. Phone: 33 99 28 67 36; Telefax: 33 99 28 61 00; E-mail: isag96@seth.univ-rennes1.fr)

**September 22-24**

**PETROLEUM GEOLOGY AND HYDROCARBON POTENTIAL OF THE BLACK SEA AREA** (2nd symposium), Sile, Turkey. (S. Derman, TPAO Turkey. Phone: 90 312 286 9040; Telefax: 90 312 286 9049)

**September 22-25**

**EARTH SCIENCE EDITING** (30th Annual Meeting of the Association of Earth Science Editors), Sudbury, Ontario, Canada. (c/o MNM, B4-933 Ramsey Lake Rd., Sudbury, Ontario, Canada P3F 6B5. Phone: (705) 670 5765; Telefax: (705) 670 5770)

**September 25-27**

**CALIBRATION AND RELIABILITY IN GROUNDWATER MODELLING** (International Conference, CARE '96), Golden, Colorado, USA. (International Groundwater Modelling Center, Colorado School of Mines, Golden, Colorado 80401, USA. Phone: 303 273 3103; Telefax: 303 273 3278; E-mail: igwme@mines.colorado.edu)

**September 25-29**

**CHARNOKITE AND GRANULITE FACIES ROCKS** (International Symposium), Madras, India. (Dr. V. Ram Mohan, Dept. of Geology, University of Madras, AC College Campus, Madras, India PIN 600 025. Phone: 091 44235 1137; Telefax: 091 44 235 2870)

**September 29 - October 3**

**SCIENTIFIC DATA IN THE AGE OF NETWORKING** (15th International CODATA Conference), Tsukuba, Japan. (Codata '96, Express Co., Ltd., Daiichi Shibuya Shimizu Building, 1-11-8 Shibuya, Tokyo 150, Japan. Phone: 81 3 54851200; Telefax: 81 3 54851266; E-mail: kayo@express.co.jp)

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*ENVIRONMENTAL ISSUES AND WASTE MANAGEMENT IN ENERGY AND MINERAL PRODUCTION* (4th International Symposium), Cagliari, Italy. (R. Ciccu, Dipartimento di Geingegneria et Tecnologie Ambientali, Universita degli Studi di Cagliari, Piazza d'Armi, 09 123 Cagliari, Italy. Phone: 39 7022 2317; Telefax: 39 7027 2031)

**October 9-12**

*NATURAL HAZARDS AND DISASTERS* (2nd Caribbean Conference), Kingston, Jamaica. (Dr. B. Carby, Dept. of Geology, UWI, Mona, Kingston, Jamaica)

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*MINERAL DEVELOPMENT IN ASIA PACIFIC — CHALLENGES IN THE 21ST CENTURY*, Jakarta, Indonesia. (Indonesian Mining Association (IMA), Jl. Prof. Dr. Supomo SH. No. 10, Jakarta 12870, Indonesia. Phone: (62-21) 830 3632, 828 0763; Fax: (62-21) 830 3632, 828 0763).

**October 28-31**

*GEOLOGICAL SOCIETY OF AMERICA* (Annual Meeting), Denver, Colorado, USA. (Jean Kinney, GSA Headquarters, Box 9140, 3300 Penrose Place, Boulder. CO 80301, USA. Phone: 303/447-2020. Fax: 303/447-1133)

**November 10-15**

*A WORKSHOP ON TUFFS — THEIR PROPERTIES, USES, HYDROLOGY, AND RESOURCES*, Santa Fe, New Mexico. (Grant Heiken, Earth and Environmental Sciences Division, EES-1, Los Alamos National Laboratory, Los Alamos, New Mexico, 87545 USA. Phone: 505-667-8447; Fax: 505-665-3285; E-mail: heiken@lanl.gov)

**November 17-22**

*HYDROLOGY IN THE HUMID TROPICAL ENVIRONMENT* (International Symposium), Kingston, Jamaica. (A.I. Johnson, Water and Soils Consulting, 7474 Upham Court, Arvada, CO 80003, USA. Phone and telefax: 303 425 5610)

**1997**

*ASSOCIATION OF EUROPEAN GEOLOGICAL SOCIETIES* (10th Meeting), Karlovy Vary, Czechoslovakia. (Geological Society, Burlington House, Piccadilly, London W1V 0JU, UK. Phone: +44 (0) 71 -434 9944)

*CANADIAN INSTITUTE OF MINING, METALLURGY AND PETROLEUM* (99th annual general meeting), Vancouver, British Columbia, Canada. (John Gaydos, Meetings Manager, Canadian Institute of Mining and Metallurgy, 1 Place Alexis Nihon, 1210-3400 de Maisonneuve Boulevard West, Montreal, Quebec H3Z 3B8, Canada. Phone: (514) 939-2710; Telefax: (514) 939-2714)

**January**

*DROUGHT, GROUNDWATER POLLUTION AND MANAGEMENT* (International Workshop), Dindigul, India. (Managing Director, Tamilnadu Water Supply and Drainage Board, TWAD House, Chepauk, Madras 600 005, India)

**January 6-8**

*INTERNATIONAL CONFERENCE ON LAND MANAGEMENT*, London, UK. (Dr. Richard K. Bullard, School of Surveying, University of East London, Longbridge Road, Dagenham, Essex, RM8 2AS, UK. Tel: +44 (0181) 590 7722; Fax: +44 (0181) 849 3618; E-mail: Bullard@UEL.AC.UK)

**May 25-30**

*GEOCHEMICAL EXPLORATION* (18th International Symposium of AEG), Jerusalem, Israel. (IGES Secretariat, P.O. Box 50006, Tel Aviv, 61500 Israel. Telefax: 972 3 5140000; E-mail: iges@mail.igs.gov.il)

**June 15-21**

*CLAY CONFERENCE*, Ottawa, Canada. (J.B. Percival, Geological Survey of Canada, 601 Booth St., Ottawa, Ontario, K1A 0E8. Phone: 613/992-4496; Fax: 613/943-1286; E-mail: percival@gsc.emr.ca)

**June 23-27**

**ENGINEERING GEOLOGY AND THE ENVIRONMENT** (International Symposium of IAEG), Athens, Greece. (Symposium Secretariat, P.O. Box 19140, GR-117 10 Athens, Greece. Telefax: 301 381 3900; 301 924 2570)

**August 28 - September 3**

**GEOMORPHOLOGY** (4th International Conference of International Association of Geomorphologists), Bologna, Italy. (Planning Congressi, s r l Via Crociali 2, I-40138 Bologna, Italy)

**September 1-5**

**GEOLOGY AND ENVIRONMENT** (50th Geological Congress of Turkey), Istanbul, Turkey. (Secretary GEOENV '97, PK 464, Kizilay, 06424 Ankara, Turkey. Phone: 90 312 4343691; Telefax: 90 312 4342388; E-mail: jdogan@et.cc.hun.edu.tr)

**September 2-6**

**GEOLOGY AND ENVIRONMENT** (Int'l. Symposium), Istanbul, Turkey, by the Chamber of Geological Engineers. (I. Yilmazer, GEOENV '97, P.K. 464 Kizilay, 06424 Ankara, Turkey. Phone: 9-0-312-4343601; Fax: 9-0-312-4342388; E-mail: jdogan@et.cc.hun.edu.tr)

**September 21-27**

**GROUNDWATER IN THE URBAN ENVIRONMENT** (27th IAH Congress) (Professor J.D. Mather, Geology Dept., Royal Holloway and Bedford New College, Egham, Surrey TW20 0EX, UK. Telefax: 784 471780)

**September 30 - October 3**

**CONCEPTS AND MODELS FOR SUSTAINABLE WATER RESOURCES MANAGEMENT** (FRIEND '97 Conference on Regional Hydrology), Postojna, Slovenia. (Dr. M. Brilly, FGG Hydraulics Division, Hajdrihova 28, 6100 Ljubljana, Slovenia. Phone: (386) 61 1254 333; Telefax: (385) 61 219 987; E-mail: mitja.brilly@uni-lj.si)

**1998**

**CANADIAN INSTITUTE OF MINING, METALLURGY AND PETROLEUM** (100th annual general meeting), Quebec, Canada. (John Gaydos, Meetings Manager, Canadian Institute of Mining and Metallurgy, 1 Place Alexis Nihon, 1210-3400 de Maisonneuve Boulevard West, Montreal, Quebec H3Z 3B8, Canada. Phone: (514) 939-2710; Telefax: (514) 939-2714)

**10TH IAGOD SYMPOSIUM**, Australia. (Professor I.R. Plimer University of Melbourne, Parkville, VIC 3052, Australia. Phone: 613 3446520; Telefax: 613 3447761)

**June 29 - July 18**

**8TH INTERNATIONAL PLATINUM SYMPOSIUM** (IAGOD/CODMUR), Johannesburg, South Africa. (Dr. C.A. Lee, P.O. Box 68108, Bryanston, South Africa. Phone: 2711 411 2253; Telefax: 2711 692 3693)

**August 9-15**

**INTERNATIONAL MINERALOGICAL ASSOCIATION: IMA '98** (17th General Meeting) Toronto, Canada. (Professor A.J. Naldrett, Department of Geology, University of Toronto, Canada M5S 3B1. Phone: (461) 978 3030; Telefax: (416) 978 3938; E-mail: ima98@quartz.geology.utoronto.ca)

**October/November**

**PHYSICAL, CHEMICAL AND BIOLOGICAL ASPECTS OF AQUIFER-STREAM SEDIMENT INTERRELATIONS** (28th IAH Congress) (Dr. J. Rosenschein, USGS MS 414, National Center, Reston Va 22092, USA; Telefax: 703 648 5722)

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