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CATATAN GEOLOGI
Geological Notes

Ultrasonic investigation of the Kuala Lumpur Granite, Peninsular Malaysia

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Abstract: Samples from the Kuala Lumpur Granite were tested in the laboratory for their ultrasonic velocities. The P-wave velocity (*Vp*) of the fresh samples are mainly between 4700 and 5500 ms^{-1}, and S-wave velocity (*Vs*) between 2500 and 3200 ms^{-1}. Their dynamic elastic constants, index of quality (*IQ*) and P-wave anisotropy are summarized. The relationship between the ultrasonic velocities and physical properties (grain size, density and porosity) is briefly discussed. The ultrasonic velocities are also correlated with the uniaxial compressive strength, point load index and Brazil tensile strength.

INTRODUCTION

Laboratory tests were carried out to determine the ultrasonic velocities of samples obtained from the Kuala Lumpur Granite. Most of the samples were fresh and some were slightly deformed. The samples were collected from quarries and road cuts in the eastern part of Kuala Lumpur (Fig. 1).

The primary objective of this investigation is to provide information on the ultrasonic velocities and related dynamic properties of the granites, as little data on these subjects have been published for Malaysian rocks. It is also intended to correlate the ultrasonic velocities with the strength (mechanical property) of the granite. Inasmuch as the ultrasonic investigation is non-destructive, it would be very useful if the ultrasonic velocities can be used to predict the rock strength. The relationships between the ultrasonic velocities and physical properties are also studied.

THE KUALA LUMPUR GRANITE

The Kuala Lumpur Granite is a large granitic body which is predominantly megacrystic consisting of K-feldspar megacrysts set in an allotriomorphic to hypidiomorphic groundmass. The major minerals are K-feldspar, plagioclase and quartz, while biotite, muscovite and tourmaline usually occur in minor amounts, except in the late phase differentiates where the last two minerals may be dominant.

The Kuala Lumpur Granite consists of several textural and mineralogical varieties (Ng, 1992). On that basis four main units of granites have been distinguished in the eastern part of Kuala Lumpur (Fig. 1). Unit 1 consists of megacrystic biotite granite (Fig. 2), while Unit 2 comprises megacrystic muscovite-biotite granite (Fig. 3) which represents the typical Kuala Lumpur Granite. Unit 3 is made up of equigranular tourmaline-muscovite granite (Fig. 4) and Unit 4 comprises mainly microgranite, aplite-pegmatite complexes and pegmatites. The rocks of Units 1 and 2 are mainly medium to coarse-grained, while Units 3 and 4 are mainly fine-grained (except the pegmatites). In this study, Unit 3 and aplites of Unit 4 are grouped together in the statistical analysis due to the similarities in their texture and mineralogy.

Crosscutting relationships indicate that Unit 4 is the youngest. Units 1 and 2 are intruded by Unit 3, and hence they are older than Unit 3. Relative ages between Units 1 and 2 are not clear, though Unit 1 is very likely to be the oldest. The Kuala Lumpur Granite experienced several episodes of deformation. A diverse

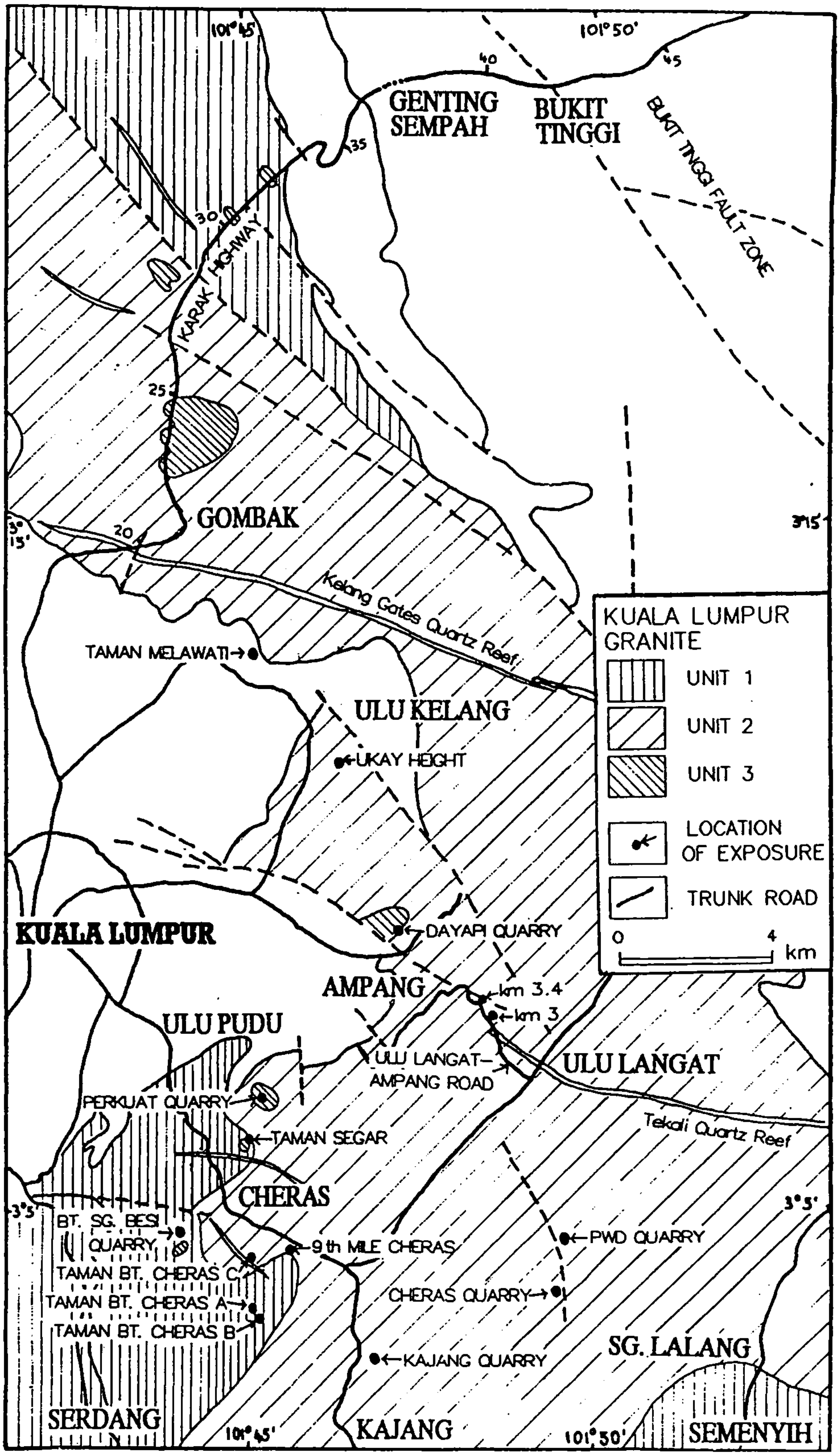


Figure 1: Sketch map showing the distribution of the various units of the Kuala Lumpur Granites in the eastern part of Kuala Lumpur. Most of the samples in this study were collected from the quarries indicated in this map, and along the Karak highway.

assemblage of sheared granites are formed, including fault breccia, cataclasite and mylonite.

DESCRIPTION OF THE GRANITE SAMPLES

Degree of weathering

Most of the samples were fresh or slightly discoloured/stained, and thus belong to Grade I of the ISRM (1978) weathering grade. Only two slightly weathered samples (Grade II, sample KL9 and KL10) were tested.

Mineral content

The granite samples are principally composed of K-feldspar (11-52%), quartz (18-41%) and plagioclase (15-47%), while biotite, muscovite and tourmaline occur in subordinate amounts. The composition of the samples of the various units of granite obtained by point counting of stained slabs and thin sections are summarised in Table 1. The majority of the samples can be classified as monzogranite (80%), while subordinate syenogranite (15%) occurs in Units 1 and 2, and granodiorite (5%) in Unit 3.

Grain size

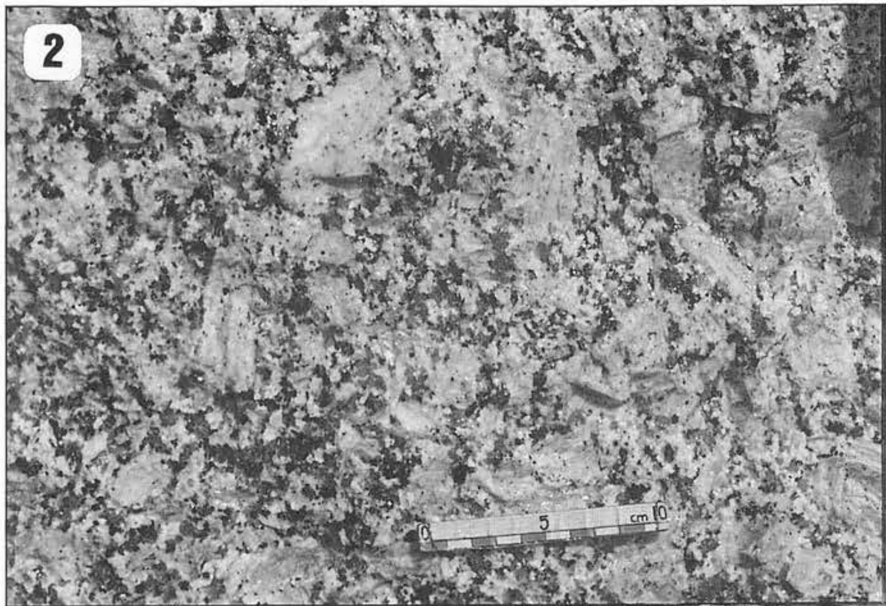
Samples of Unit 1 have the coarsest grain size, with the average diameter (*d*) ranging from 3.0 to 5.4 mm (mean 4.41 mm; standard deviation, *s*, 0.98 mm). It is followed by Unit 2 with *d* ranging from 1.9 to 5.35 mm (mean 3.45 mm, *s* 0.84 mm), while Unit 3 and aplite of Unit 4 have the finest grain size and their *d* is between 0.6 and 1.3 mm (mean 1.00 mm, *s* 0.26 mm). Units 1 and 2 are megacrystic and they contain an average of 21% and 10% of K-feldspar megacrysts respectively. The megacrysts average about 1.5 to 3 cm in length. Some of the samples are weakly sheared but competent (protocataclasite and protomylonite). These samples have grain size finer than their undeformed protolith.

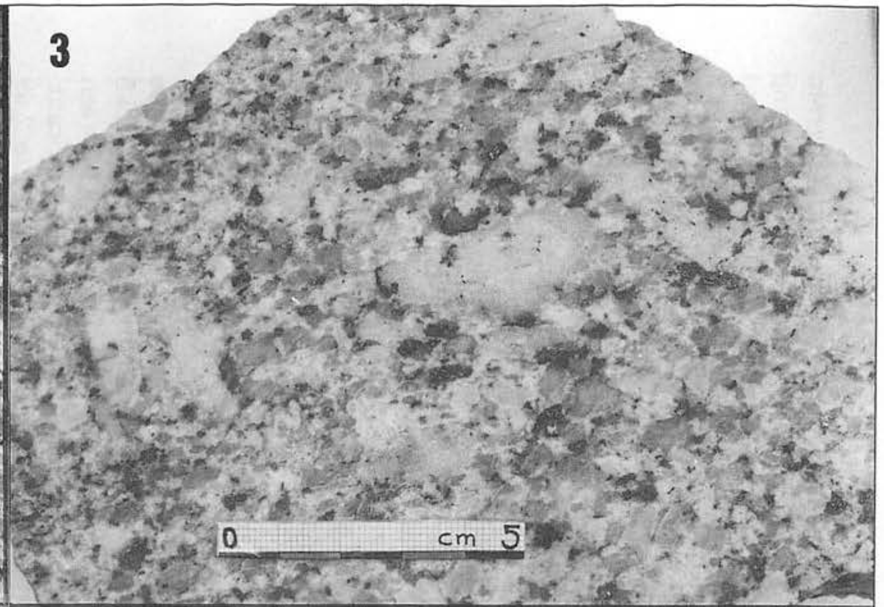
Density and porosity

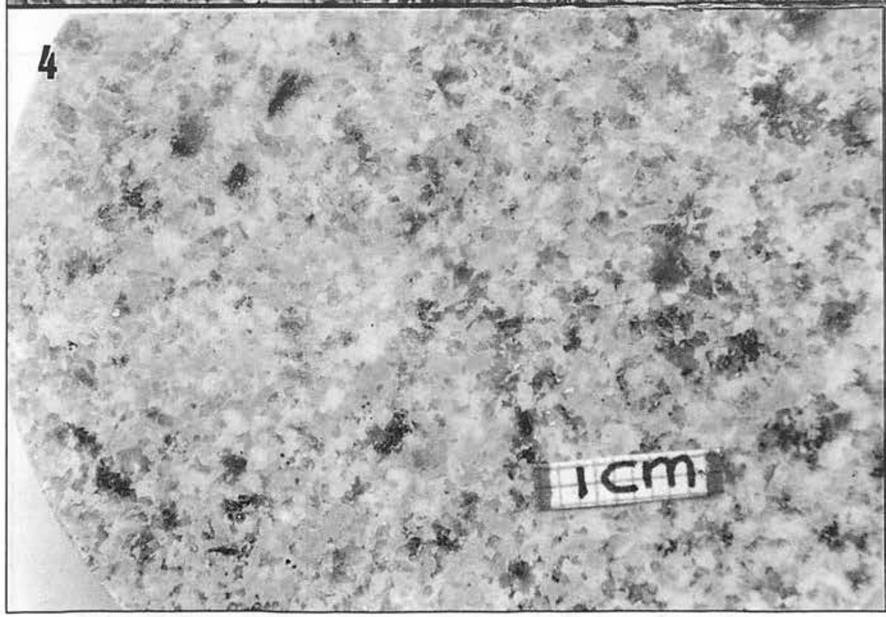
The dry density of the samples ranges from 24.7 to 25.9 kNm^{-3}, but about 70% of the samples have a dry density of more than 25.5 kNm^{-3}. The differences of dry density between the various granite units are not significant. The specific gravity ranges from 2.60 to 2.69 and about 85% of the samples have values between 2.62 and 2.67.

Table 1: Summary of the mineral content in various units of the Kuala Lumpur Granite. *s*=standard deviation.

		Unit 1	Unit 2	Unit 3	Unit 4
Quartz (%)	Range Mean±*s*	21.4-38.5 28.0±3.8	20.1-41.0 31.0±4.6	19.4-36.5 28.0±4.7	18.2-36.4 29.2±4.7
K-Feldspar (%)	Range Mean±*s*	33.9-58.1 41.2±5.9	27.4-51.8 37.0±5.4	20.4-41.5 35.2±7.5	10.6-39.8 30.0±6.9
Plagioclase (%)	Range Mean±*s*	17.5-33.3 22.9±3.3	14.8-31.5 24.3±3.3	24.1-45.8 31.3±7.1	29.9-47.0 35.0±3.9
Biotite (%)	Range Mean±*s*	3.6-11.6 6.9±2.0	1.8-7.5 4.2±1.7	<0.5	<.05
Muscovite (%)	Range Mean±*s*	<0.5	0.5-4.1 1.9±1.2	1.2-5.3 3.2±1.6	0.5-6.8 2.4±1.9
Tourmaline (%)	Range Mean±*s*	<0.5	<0.5	0.5-5.9 2.0±1.6	0.5-7.0 3.8±1.5







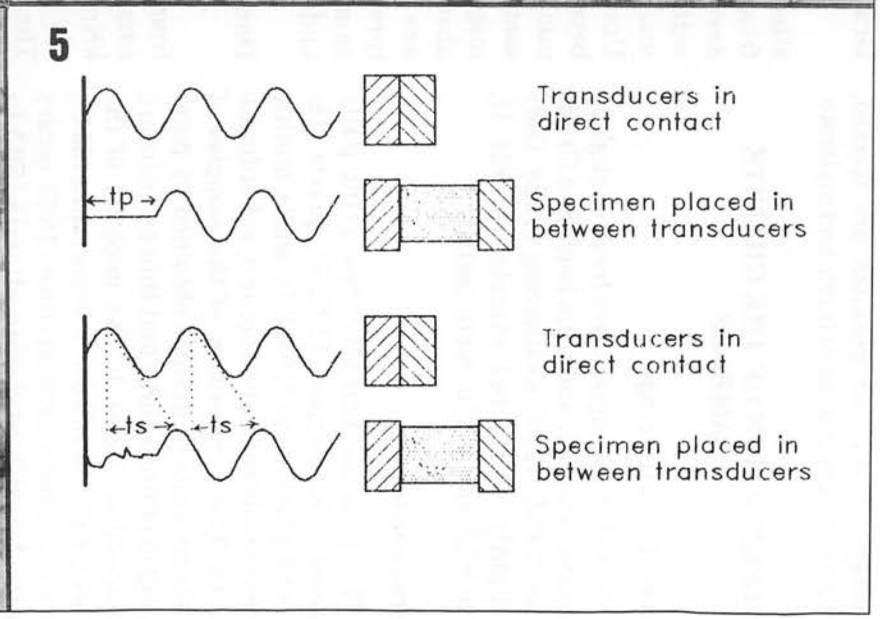


Figure 2: Handspecimen of a typical megacrystic biotite granite (Unit 1).

Figure 3: Handspecimen of a megacrystic muscovite-biotite granite (Unit 2).

Figure 4: Handspecimen of equigranular tourmaline-muscovite granite (Unit 3).

Figure 5: Measurement of the flight time of P-wave (tp) by matching the first arrival of ultrasonic pulse and the flight time of S-wave (ts) by measuring the phase difference of the ultrasonic pulse.

Their effective porosity ranges from 0.11 to 3.8%, but most of them have very low values (88% of the samples have effective porosities less than 1.5%). The total porosity is also low, with 80% of the samples having a total porosity of less than 2.0%.

MEASUREMENT PROCEDURE

Rock blocks measuring up to 40x30x30 cm^3 were collected from quarries and slope cuts during field investigations. Cylindrical specimens were then cored from these blocks using an NX size (about 54 mm in diameter) diamond bit. All the core specimens from a single block were cut parallel to each other. Smaller samples were also cut into rectangular blocks. A total of 70 samples (45 cores and 25 blocks) were tested, consisting of Unit 1 (18), Unit 2 (28), Unit 3 (12) and Unit 4 (aplite=9 and microgranite=3).

The test surfaces of the specimens were finely ground to ensure maximum contact between the transducers and specimens. The length of the specimens tested ranged from 30 mm to 120 mm with all them being oven dried. Generally, 3 to 4 core specimens were tested for each sample, while for the blocks samples, the ultrasonic velocities were determined on all three axis of the block.

The ultrasonic test was carried out using an Oyo New Sonic Viewer, Model 5217A. Transducers of different frequencies were tested, and for P-wave measurements, the performance of the 63 kHz transducers were found to be most satisfactory, while a pair of 33 kHz transducers were selected for the S-wave measurement. The specimens were placed between two transducers, one acting as the transmitter (driver), and the other as the receiver. An ultrasonic pulse was imparted from the transmitter, and then picked up by the receiver. The time taken for the transient pulse to traverse the length of specimen (flight time) was then used to calculate the velocity of the wave : $V = l/t$; where V is the velocity, l is the length of specimen and t the flight time.

Vaseline was used to obtain good contact between the P-wave transducers and the specimen, while no coupling material was used for the S-wave determinations. The flight time of the S-waves was, therefore determined first. The flight time of the P-waves was determined by noting the first arrival of the ultrasonic pulse (Fig. 5). The results were fairly consistent, and thus only 3 measurements were made and averaged for the calculation of the P-wave velocity (*Vp*). The S-wave flight time was obtained by measuring phase differences of the ultrasonic pulse (Fig. 5). The obtained results are, however, fairly inconsistent. For any single specimen, 10 measurements were thus made; the two highest, and two lowest, values being discounted, and the flight time averaged from the other six values. Reasonably good S-wave velocities (*Vs*) were obtained from the average flight time, as indicated by the fairly low coefficient of variation (2-9%) between different specimens from the same sample.

P-WAVE AND S-WAVE VELOCITIES

The average P-wave velocity (*Vp*) of the fresh samples range from 4230 to 5830 ms^{-1}, with about 76% of them being between 4700 and 5500 ms^{-1} (Tables 2a & 2b). These results are comparable with the P-wave velocities of fresh granitic rocks reported by other workers (e.g. Vijaya *et al.*, 1977; Telford *et al.*, 1976; Toombs, 1978; and Dayre and Giraud, 1986). The slightly weathered samples have, however, much lower *Vp* values of 2880 ms^{-1} (sample KL9) and 2680 ms^{-1} (sample KL10). The range of the *Vp* values of the various units of granite, the mean and standard deviation (*s*) are summarized below :

Unit	*Vp* (ms^{-1})		
	Range	mean	*s*
Unit 1	4350–5470	4820	300
Unit 2	4380–5440	5080	210
Units 3&4	4890–5690	5360	210

Unit 1 has the lowest mean *Vp* while the samples of Unit 2 records a slightly higher mean *Vp*. Unit 3 and the aplite of Unit 4 show the highest mean *Vp*. The increase in *Vp* can be correlated with the decrease in grain size of the samples.

The *Vs* of the fresh samples ranges from 2140 to 3150 ms^{-1}, but most samples (73%)

Table 2a: P-wave and S-wave velocities and dynamic elastic constants of the samples from Units 1, 3 and 4 (aplite and microgranite) of the Kuala Lumpur Granite. *Vp*=P-wave velocity; *Vs*=S-wave velocity; *E*=modulus of elasticity; *G*=modulus of rigidity; *K*=bulk modulus; *υ*=Poisson's ratio; *s*=standard deviation; n=number of specimen; b=block specimen.

	Sample		*Vp*, ms^{-1}		*Vs*, ms^{-1}		*Vs*	*E*, GPa		*G*, GPa		*K*, GPa		v	
		n	mean	*s*	mean	*s*	*Vp*	mean	*s*	mean	*s*	mean	*s*	mean	*s*
UNIT 1	KL15	4	4840	120	2580	140	0.533	45.6	4.6	17.5	1.9	38.1	1.4	0.300	0.019
	KL28	4	4930	130	2870	70	0.580	53.7	2.4	21.6	1.1	35.0	2.1	0.244	0.008
	K212	b	4650	170	2500	80	0.538	41.6	2.7	16.0	1.1	34.2	3.0	0.297	0.010
	KR29	b	4820	180	2690	105	0.558	48.0	1.9	19.0	1.5	35.7	6.5	0.269	0.054
	KR30	b	4890	60	2620	30	0.536	46.4	1.0	17.9	0.4	38.6	1.5	0.299	0.008
	KL3	3	5010	135	2700	130	0.539	49.0	4.3	18.9	1.9	39.8	1.4	0.295	0.013
	KL13	4	5470	115	3005	130	0.549	61.3	4.6	23.9	2.1	47.2	1.0	0.284	0.014
	K211	b	4350	120	2270	45	0.522	34.7	0.9	13.2	0.5	30.9	3.2	0.311	0.023
UNIT 1 – sheared	KL14	4	5050	120	2710	60	0.537	49.7	1.5	19.2	0.8	41.0	3.6	0.297	0.002
	KL23	4	4690	80	2505	90	0.534	42.5	2.7	16.4	1.2	35.4	1.2	0.300	0.013
	KL24	4	4820	150	2560	105	0.531	41.8	5.2	17.1	1.4	37.9	4.9	0.301	0.033
	KL25	4	4230	190	2140	70	0.506	30.7	1.9	11.5	0.7	26.9	3.6	0.326	0.019
	K201	b	5980	410	3480	310	0.582	79.1	12.9	31.8	5.6	51.6	5.3	0.245	0.016
	K202	b	6130	450	3620	250	0.591	85.3	8.5	34.6	4.8	53.3	8.0	0.233	0.007
	K210	b	4750	195	2550	190	0.537	44.2	5.7	17.0	2.4	36.4	1.8	0.298	0.019
	KR295	b	4520	160	2430	70	0.538	39.4	2.5	15.2	1.0	32.5	2.7	0.297	0.004
	KR321	b	4930	100	2630	165	0.533	46.9	4.9	18.1	2.2	39.1	4.3	0.300	0.022
	KR322	b	5150	240	2910	160	0.565	55.1	5.8	21.9	2.4	39.3	3.1	0.265	0.007
UNIT 3	KL1	3	5330	90	3130	100	0.587	63.5	3.2	25.7	1.6	40.0	1.4	0.235	0.015
	KL2	3	5110	140	2920	120	0.571	55.9	4.1	22.2	1.8	38.1	1.8	0.257	0.014
	KL9	1	2880		1440		0.500	14.0		5.2		14.0		0.333	
	KL16	4	5500	140	3215	90	0.584	67.1	3.5	27.1	1.6	43.0	3.8	0.239	0.023
	KL29	3	5250	50	3050	80	0.580	60.3	2.4	24.2	1.2	39.5	0.4	0.246	0.013
	K128	1	5490		3140		0.572	65.6		26.1		45.0		0.257	
UNIT 3–sheared	KL22	4	5255	170	2940	185	0.559	57.8	6.4	22.7	2.9	42.2	1.9	0.276	0.024
	K803	3	5760	50	3495	115	0.607	77.4	3.5	32.1	2.2	48.0	5.4	0.207	0.027
	KK3	1	5510		3460		0.623	73.4		31.3		37.6		0.174	
	K805	2	5745	10	3420	30	0.595	74.8	0.7	30.5	0.4	45.4	10.0	0.226	0.008
	KR311	b	5110	390	2860	80	0.560	53.9	8.1	21.2	3.3	39.3	6.4	0.270	0.020
	KR312	b	5170	340	2970	110	0.581	56.9	5.1	22.7	1.7	38.6	7.1	0.252	0.028
UNIT 4–aplite	KL11	2	5300	110	3050	85	0.575	60.5	3.2	24.1	1.3	40.7	1.3	0.252	0.005
	KL17	4	5690	50	3410	150	0.599	74.2	4.6	30.5	2.7	44.2	2.6	0.218	0.032
	KL20	4	5555	80	3330	130	0.599	70.5	3.9	29.0	2.2	41.8	2.5	0.218	0.029
	KL31	3	5370	170	3050	80	0.568	60.6	1.6	24.1	1.3	42.8	6.5	0.260	0.039
	K134	b	5430	140	3140	90	0.578	65.1	3.6	26.1	1.5	43.3	2.1	0.249	0.004
	K715	b	5520	120	3210	50	0.581	66.9	2.2	26.8	8.0	43.8	3.7	0.245	0.007
	K717	b	4890	170	2500	140	0.511	43.4	4.4	16.5	1.8	40.7	2.3	0.322	0.012
	K718	b	5530	80	3220	40	0.582	67.3	1.7	27.0	7.0	43.8	2.0	0.244	0.009
	KR23	b	5410	260	3240	180	0.599	66.0	7.0	27.2	3.0	39.7	3.4	0.227	0.012
UNIT 4–microgranite	K1103	b	5830	100	3510	170	0.602	76.6	7.8	32.6	3.2	46.1	2.0	0.207	0.033
	K1104	b	5200	100	3020	180	0.581	59.0	5.5	23.7	2.7	38.7	2.2	0.244	0.033
	K1105	b	5520	375	3260	110	0.591	68.9	6.4	28.0	2.0	43.1	8.1	0.230	0.028

Table 2b: P-wave and S-wave velocities and dynamic elastic constants of the samples from Unit 2 of the Kuala Lumpur Granite. *Vp*=P-wave velocity; *Vs*=S-wave velocity; *E*=modulus of elasticity; *G*=modulus of rigidity; *K*=bulk modulus; *υ*=Poisson's ratio; *s*=standard deviation; n=number of specimen; b=block specimen.

	Sample	n	*Vp*, ms⁻¹ mean	*s*	*Vs*, ms⁻¹ mean	*s*	*Vs*/*Vp*	*E*, GPa mean	*s*	*G*, GPa mean	*s*	*K*, GPa mean	*s*	v mean	*s*
UNIT 2	KL12	4	5090	70	2805	130	0.551	52.6	3.8	20.5	1.9	41.0	2.0	0.280	0.027
	KL18	4	5130	140	3000	130	0.585	58.7	4.3	23.7	2.1	37.6	2.2	0.239	0.022
	KL19	4	4990	50	2840	110	0.569	53.4	3.5	21.2	1.8	37.2	0.8	0.260	0.020
	KL21	4	4940	60	2700	90	0.547	51.2	5.0	19.0	1.3	38.4	0.6	0.300	0.033
	KL26	4	5005	220	2805	80	0.560	52.3	1.9	20.6	1.1	38.1	3.2	0.270	0.025
	KL27	4	5010	85	2810	120	0.561	52.0	3.6	20.7	1.7	38.2	0.5	0.270	0.018
	KL36	3	5220	90	2980	80	0.571	58.1	2.3	23.2	1.3	39.9	3.2	0.256	0.024
	KL5	3	5400	360	2990	60	0.554	59.8	2.0	23.4	0.9	45.1	3.5	0.279	0.009
	KL6	3	4380	420	2280	30	0.521	32.1	5.0	13.5	0.4	31.9	1.0	0.314	0.008
	KL8	1	5070		2720		0.536	50.2		19.3		41.4		0.298	
	KL10	1	2680		1320		0.493	11.8		4.4		12.3		0.340	
	KL32	3	5440	30	2970	130	0.546	58.9	4.1	22.9	2.0	46.3	2.0	0.287	0.022
	KL33	3	5050	110	2830	110	0.560	53.2	3.6	20.9	1.6	38.9	0.4	0.272	0.013
	K736	4	4870	150	2680	70	0.550	47.7	2.1	18.6	1.0	36.8	3.8	0.282	0.022
	K407	1	5140		2650		0.516	48.4		18.3		44.6		0.319	
	K408	2	5085	80	2480	30	0.488	53.2	1.2	20.9	0.4	39.2	1.5	0.274	0.004
	K750	b	5360	70	2900	60	0.541	57.0	1.5	22.1	0.9	45.8	3.2	0.292	0.020
	K801	3	5140	130	2980	160	0.580	58.5	5.4	23.5	2.7	38.4	1.9	0.246	0.027
	K802	3	5000	100	2810	150	0.562	52.7	4.6	20.8	2.2	38.1	0.9	0.269	0.023
	K1202	b	5070	170	2840	50	0.560	53.5	2.3	21.0	0.8	39.0	2.9	0.271	0.007
	K804	2	5180	20	2985	40	0.576	58.7	0.8	23.4	0.5	39.4	1.2	0.252	0.011
UNIT2–sheared	KL4	3	4980	130	2730	110	0.548	51.1	4.0	19.4	1.5	38.5	2.0	0.587	0.015
	KL7	3	5235	360	2880	170	0.550	56.3	6.7	21.6	2.5	42.9	6.5	0.283	0.016
	KL34	3	5350	30	2900	170	0.542	55.6	5.1	21.9	2.6	44.9	3.8	0.289	0.038
	K506	b	5035	210	2735	80	0.543	50.0	2.8	19.5	1.1	40.2	4.8	0.289	0.025
	K614	b	4820	210	2600	160	0.539	46.0	5.0	17.6	2.0	37.2	2.7	0.296	0.012
	K703	b	5660	310	3140	280	0.555	65.8	10.7	25.8	4.6	49.0	2.8	0.277	0.024
	K739	2	4990	100	2755	100	0.552	50.5	3.4	19.7	1.6	38.4	0.6	0.280	0.012

have velocities between 2500 and 3150 ms^{-1}. The slightly weathered samples, KL9 and KL10 have lower *Vs* of 1440 and 1320 ms^{-1} respectively. The *Vs* of the fresh samples also increase from Unit 1 to Unit 2 to Units 3 and 4, as summarized below :

Unit	*Vs* (ms^{-1}) Range	mean	*s*
Unit 1	2240–3005	2600	220
Unit 2	2280–3000	2790	170
Units 3&4	2920–3410	3140	240

It is well known that the ultrasonic velocities of rocks are governed by their elastic properties, density and degree of fissuring (Toombs, 1978; Goodman, 1989). Thus, sheared or deformed rocks are expected to have lower ultrasonic velocities when compared with their unsheared equivalents. Most sheared samples, however, do not show any reduction in both *Vp* and *Vs*. In contrast, several sheared samples (K201, K202,K803, K805, K703) have higher *Vp* and *Vs* than their unsheared equivalents. The probable explanations for this are that : i) most of the pore spaces and microfractures of the sheared granite have been filled or healed as shown in the thin section studies, and ii) shearing caused a grain size reduction, thus increasing the ultrasonic velocities. Significantly lower *Vp* and *Vs* are recorded in sample KR25, a sheared granite with open microfracture (fissures).

An overall increment in the calculated *Vs/Vp* ratios of the samples is observed as the *Vp* and *Vs* increase. It indicates that the rate of increment of *Vs* is faster than that of *Vp*, but the causes of this phenomenon remain unknown. The *Vs/Vp* ratio ranges from 0.506 to 0.580 (mean = 0.545) for Unit 1, from 0.521 to 0.585 (mean = 0.550) for Unit 2, and from 0.511 and 0.628 (mean = 0.581) for Unit 3 and the aplite of Unit 4.

INDEX OF QUALITY (*IQ*)

Fourmaintraux (1976) proposed the index of quality (*IQ*) as an indication of the degree of fissuring (microcracking) within rock specimens. *IQ* is calculated as the ratio (in percentage) between the measured *Vp* and the calculated P-wave velocity (*Vp**). *Vp** is calculated from the mineralogical composition of the specimen.

$$IQ\ \% = 100Vp/Vp^*$$

$$1/Vp^* = \sum_{i=1}^{n} \frac{c_i}{Vp_i}$$

where c_i = is the volume proportion of mineral i; and Vp_i = is the *Vp* of mineral i.

The average *Vp* of quartz is 6050 ms^{-1}, K-feldspar 5800 ms^{-1}, plagioclase 6250 ms^{-1}, muscovite and biotite 5800 ms^{-1} (Fourmaintraux, 1976; Kern and Wenk, 1985).

The range of *IQ* varies from 70.7% to 96.2% (Table 3) and the mean *IQ* increases from Unit 1 to Unit 2 to Unit 3 and aplite as shown in the table below :

Unit	*IQ*,%		
	Range	mean	*s*
Unit 1	70.7–91.3	81.0	5.2
Unit 2	74.0--1.1	84.8	5.3
Units 3&4	85.3–96.2	89.9	3.3

The degree of fissuring is obtained by plotting IQ values against total porosity. All the samples plot in the slightly fissured field (Fig. 6).

P-WAVE VELOCITY ANISOTROPY

The *Vp* anisotropy is indicated by differences in the *Vp* of block samples measured in 3 different directions. The calculated difference between the maximum and minimum *Vp* ranges from 3% to 15% of the mean *Vp* (Table 4). Most samples having a high *Vp* anisotropy (difference >10%) are sheared with well developed planar fabric. A texturally homogeneous microgranite sample, K1105 also shows high *Vp* anisotropy, probably caused by the presence of microfractures (fissures) within the specimen. Aplite specimens with weak mineral banding do not show any significant *Vp* anisotropy.

DYNAMIC ELASTIC CONSTANTS

The dynamic elastic constants were calculated from the dry density and the ultrasonic velocities using the equations given by Lama and Vutukuri (1978). These constants are given in Tables 2a and 2b. Of the above constants, the modulus of elasticity (*E*) and Poisson's ratio (υ) are most commonly quoted in engineering testing of rocks and they may be used in solving engineering problems. The dynamic modulus of elasticity ranges from 30.7 to 77.4 GPa with Unit 1 having the lowest values (mean=45.7 GPa; sheared samples K201 and K202 with extremely high *E* are excluded). Mean *E* value of Unit 2 is 52.8 GPa. Highest mean *E* value is observed in Unit 3 and aplite (mean=64.1 GPa). This increment in *E* values correlates with the increment in both *Vp* and *Vs*, as well as a decrease in grain size.

Poisson's ratio (υ) can reflect freshness as well as "compactness" of rock material. It increases to a maximum value of 0.5 as weathering increases and compactness decreases. The Poisson's ratio of the studied samples ranges from 0.207 to 0.326 (Tables 2a & 2b) with the mean ratios decreasing from

Table 3: Index of quality (*IQ*) of samples from the the Kuala Lumpur Granite. *IQ* is the ratio (in percentage) between the calculated (*Vp**) and measured (*Vp*) P-wave velocities.

	Sample	*Vp**	*Vp*	*IQ*
UNIT 1	KL15	5960	4840	81.2
	KL28	5960	4930	82.7
	K212	5900	4650	78.8
	KR29	5980	4820	80.6
	KR30	5980	4890	81.8
	KL3	5950	5010	84.2
	KL13	5990	5470	91.3
	KL210	5990	4570	79.3
	K211	5990	4350	72.6
	KL14	5925	5050	85.2
	KL23	5980	4690	78.4
	KL24	5980	4820	80.6
	KL25	5985	4230	70.7
	KR29.5	5925	4520	76.3
	KR3281	5990	5170	86.3
	KR3282	5960	5150	86.4
UNIT 3	KL1	5990	5330	89.0
	KL2	5990	5110	85.3
	KL16	5985	5500	91.9
	KL29	6040	5250	86.9
	K128	5985	5490	91.7
	KL22	6020	5255	87.3
	KR3	6080	5310	87.3
	KR3191	5990	5110	85.3
	KR3192	5990	5170	86.3
	K803	6000	5760	96.0
	K805	5975	5745	96.2
UNIT 4 – aplite	KL11	6010	5300	88.2
	KL17	6120	5690	93.0
	KL20	6090	5555	91.2
	KL31	5970	5370	89.9
	K715	6110	5520	90.3
	K718	6030	5530	91.7
	KR23	6020	5410	89.9

	Sample	*Vp**	*Vp*	*IQ*
UNIT 2	KL12	5975	5090	85.2
	KL18	5980	5130	85.8
	KL19	5970	4990	83.6
	KL21	5985	4940	82.5
	KL26	5990	5005	83.6
	KL27	5990	5010	83.6
	KL36	6010	5220	86.9
	KL5	5980	5400	90.3
	KL6	5920	4380	74.0
	KL8	5950	5070	85.2
	KL32	5970	5440	91.1
	KL33	5990	5050	84.3
	K407	5980	5140	86.0
	K408	6025	5085	84.4
	K736	5970	4870	81.6
	K750	6070	5360	88.3
	K801	6000	5140	85.7
	K802	6015	5000	83.1
	K804	5985	5180	86.5
	K1102	5990	5070	84.6
	KL4	5960	4980	83.6
	KL7	5900	5235	88.7
	KL34	6120	5350	87.4
	K506	5990	5035	84.1
	K614	5985	4820	80.5
	K739	5950	4990	83.9
UNIT 4 – microgranite	K1103	6080	5830	95.9
	K1104	6030	5200	86.2
	K1105	6040	5520	91.4

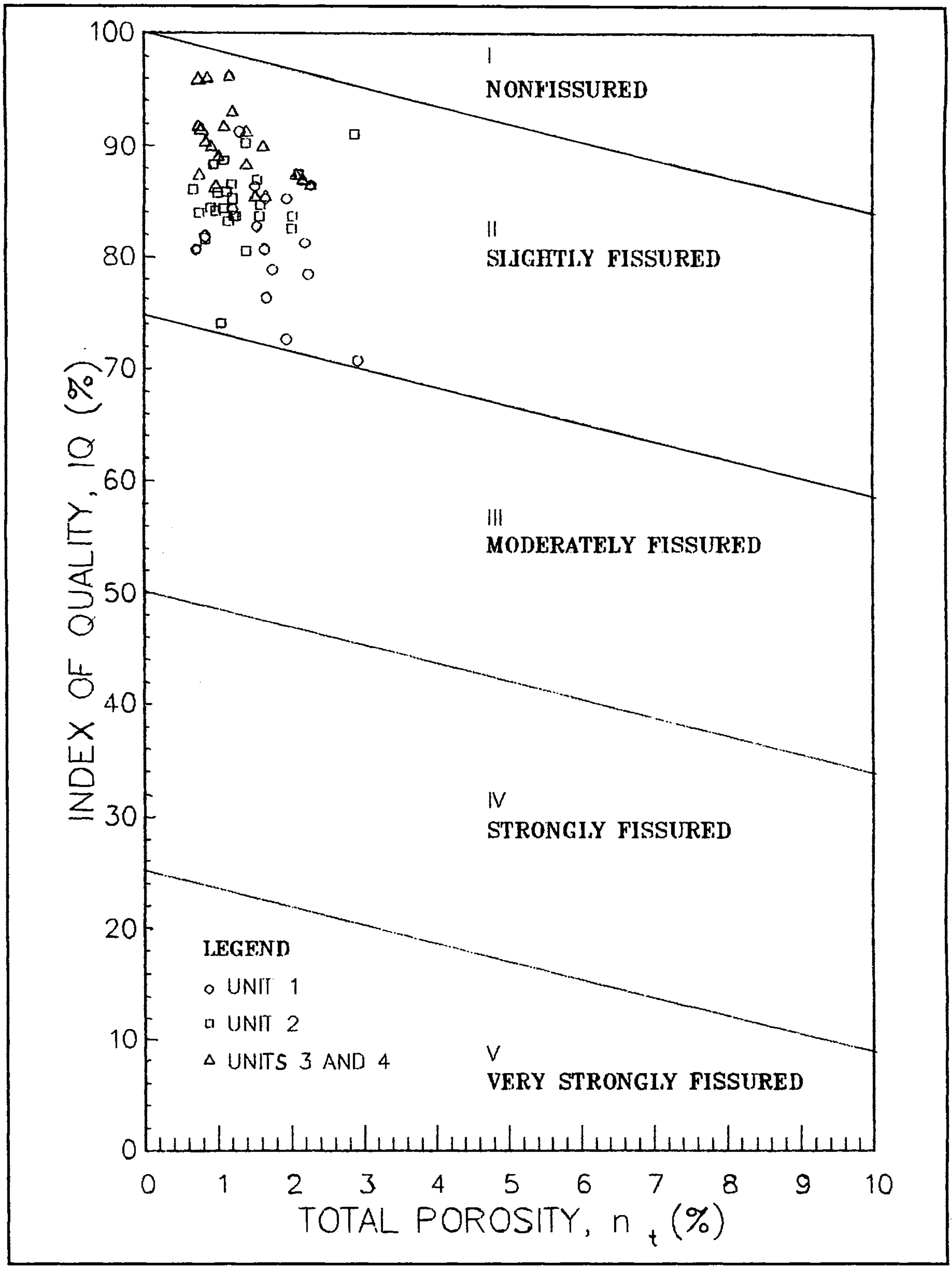


Figure 6: Classification scheme for fissuring in rock sample based on index of quality (*IQ*) and porosity (after Fourmaintraux, 1976). All samples from the Kuala Lumpur Granite fall in the slightly fissured category.

Table 4: P-wave velocity (*Vp*) anisotropy of selected block samples from the Kuala Lumpur Granite. Velocity anisotropy is indicated by the difference between the maximum and minimum velocities (ΔVp) of a block sample measured at different directions.

Unit	Sample	Vp, ms^{-1} max	Vp, ms^{-1} min	Vp, ms^{-1} mean	ΔVp,%
UNIT 1	K212	4770	4450	4650	6.9
	KR30.1	4970	4830	4890	2.9
	KR30.2	4950	4820	4890	2.7
	K201	6380	5570	5980	13.5
	K202	6570	5080	6130	14.5
	K210	4920	4540	4750	8.0
	K211	4450	4210	4350	5.5
	KL23	5700	5200	5410	9.2
	KR29.5	4710	4420	4520	6.4
	KR3281	5000	4810	4930	3.9
	KR3282	5300	4880	5150	8.2
UNIT 2	K1102	5190	4900	5070	5.7
	K750	5440	5300	5360	2.6
	K506-1	5060	4740	4920	6.5
	K506-2	5370	5000	5150	7.2
	K614	5020	4600	4820	8.7
	K703	5940	5330	5660	10.8
UNIT 3	KL29	4930	4610	4820	6.6
	KR3191	5470	4700	5110	15.1
	KR3192	5530	4850	5170	13.5
UNIT 4 – aplite	K134	5590	5350	5430	4.4
	K715	5620	5390	5520	4.2
	K717	5000	4690	4890	6.3
	K718	5590	5430	5530	2.9
UNIT 4 – microgranite	K1103	5940	5760	5830	3.1
	K1104	5320	5130	5200	3.7
	K1105	5860	5120	5520	13.4

Unit 1 to Unit 2 to Unit 3 and aplite (Unit 4) as follows:

Unit	Range	Mean	*s*
Unit 1	0.233–0.326	0.287	0.025
Unit 2	0.239–0.319	0.275	0.027
Units 3&4	0.207–0.322	0.247	0.026

The values of modulus of rigidity (*K*) and bulk modulus (*G*) are summarized below :

Modulus of Rigidity, *K* (GPa)

Unit	range	mean	*s*
Unit 1	26.9–53.3	38.5	6.7
Unit 2	31.9–49.0	40.2	3.7
Units 3&4	37.6–48.0	41.9	2.7

Bulk Modulus, *G* (GPa)

Unit	range	mean	*s*
Unit 1	11.5-34.6	19.5	5.8
Unit 2	13.5-25.8	20.8	2.4
Units 3&4	16.5-32.1	25.9	3.8

RELATIONSHIP BETWEEN ULTRASONIC VELOCITIES AND PHYSICAL PROPERTIES

Finer grained rocks are known to have higher ultrasonic velocities than their coarse grained equivalents (Lama and Vutukuri, 1978). The same conclusion can be made for the samples of the Kuala Lumpur Granite. Negative relationships between grain size (*d*) and P-wave velocity (*Vp*), and between grain size and S-wave velocity (*Vs*) is clearly demonstrated in the grain size versus ultrasonic velocity plots, some scattering of points notwithstanding (Fig. 7). The correlation is highly significant when the measurements of the various granite units are analyzed together (using least square regression and Student-t test was performed). The degree of significance progressively decreases from Unit 3 and aplite to Unit 2 to Unit 1, and in the case of Unit 1, the correlation is insignificant.

Theoretically, the ultrasonic velocity of a rock depends upon the rock's elastic properties and density (Goodman, 1989). Thus, the relationships between the density and *Vp*, and between density and *Vs* are expected to be significant and direct ones. In this study, considerable scattering of points occurs in the graphs of dry density (ρ_d) versus *Vp*, and ρ_d

versus *Vs* (Fig. 8). Their relationships are statistically significant and are positive (i.e. *Vp* and *Vs* increase with increasing ρ_d), though the degree of significance is very low. When analyzed separately, the degree of significance for the various granite units are variable and low, and for Unit 2, the ρ_d versus *Vp*, and ρ_d versus *Vs* relationships are not significant.

The plots of total porosity versus ultrasonic velocities (*Vp* and *Vs*) show a considerable scattering of points (Fig. 9). However, statistical tests indicate that the correlations are significant, though the degree of significance is very low. The relationships are negative, the ultrasonic velocities decrease in respond to the increase in porosity. Negative relationships are also reported by Fourmaintraux (1976) and Lama and Vutukuri (1978) in their studies of various rock types.

RELATIONSHIP BETWEEN DYNAMIC AND MECHANICAL PROPERTIES

Uniaxial compressive, point load and Brazil tensile tests were carried out on the samples after the ultrasonic tests. Correlations were made from the results obtained. Positive relationships are clearly shown in the plots of the ultrasonic velocities (*Vp* and *Vs*) versus strength values (dry uniaxial compressive strength, point load index and Brazil tensile strength) (Figs. 10, 11 & 12). The statistical analysis shows a highly significant correlation when data of all the various granite units are analyzed together. When analyzed separately, however, their significance decreases, and for Unit 2, the correlations are not significant. The ultrasonic velocities, thus cannot be used to provide a reliable quantitative approximation of rock strength. They, however, may be used to evaluate the rock strength qualitatively, for example, a rock material with higher ultrasonic velocities is expected to yield higher strength, than a rock material with lower ultrasonic velocities.

The correlation between index of quality (*IQ*) and uniaxial compressive strength is significant. This positive relationship can be observed in the plots of index of quality versus uniaxial compressive strength (Fig. 13).

The rock strength is related to the stiffness (indicated by modulus of elasticity) and rigidity (indicated by Poisson's ratio) of the rock (Goodman, 1989). Highly significant correlations are obtained between dynamic modulus of elasticity (*E*) and uniaxial compressive strength (Fig. 14), and between dynamic Poisson's ratio (υ) and uniaxial compressive strength (Fig. 15). The relationship between the former is positive, while the latter exhibits a negative relationship.

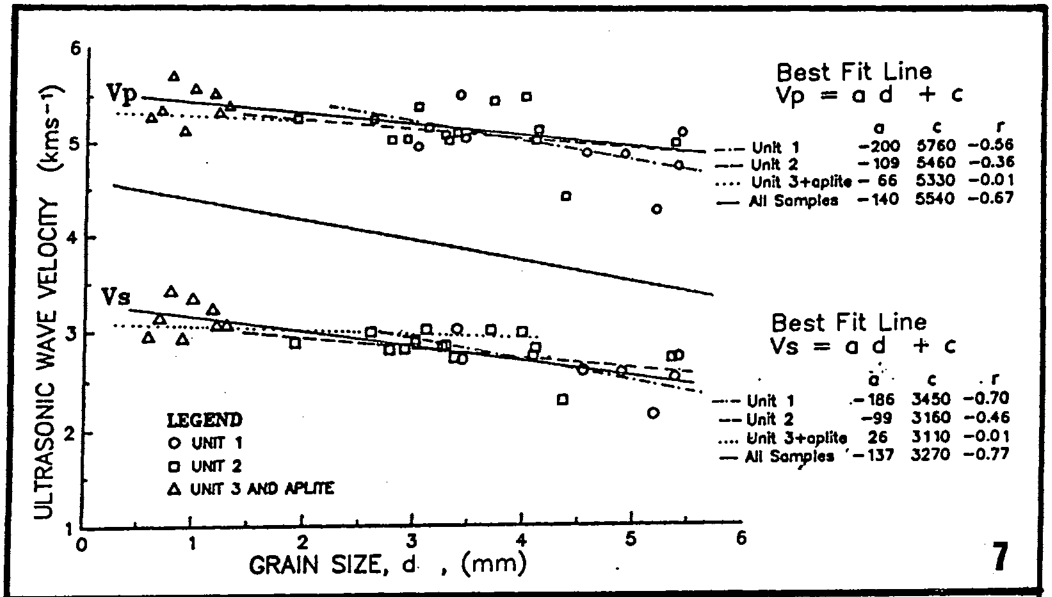
CONCLUSION

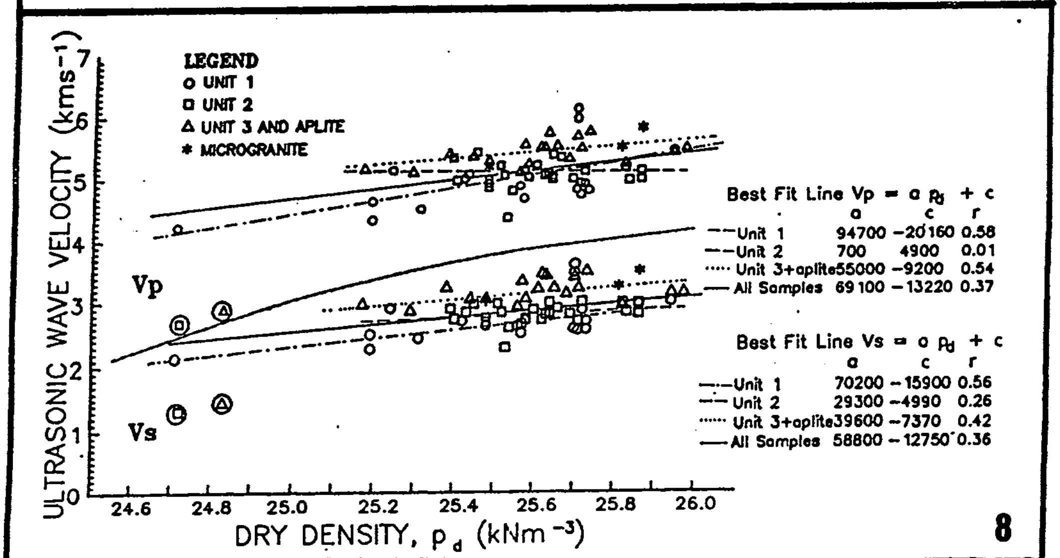
Laboratory ultrasonic tests carried out on the samples of the Kuala Lumpur Granite yielded reasonably reproducible results. The P-wave velocity (*Vp*) of the fresh samples are mostly between 4700 and 5500 ms^{-1}, and S-wave velocity (*Vs*) between 2500 and 3200 ms^{-1}. No significant reduction in ultrasonic velocity is recorded in sheared granite samples which are cohesive with healed microfractures. The calculated index of quality (*IQ*) ranges from 71 to 96% and the undeformed samples of the Kuala Lumpur granite have low *Vp* anisotropy.

The ultrasonic velocities increase with decreasing grain size. This is depicted by the progressively increasing *Vp* and *Vs* of the samples from Unit 1 which have the coarsest grain size, to Unit 2 and then to Units 3 and 4 which are the finest. The P-wave and S-wave velocities are influenced by the dry density and total porosity. The correlations between the ultrasonic velocities and the rock strength are only moderately significant. The strength of the rock materials of the Kuala Lumpur Granite, thus cannot be estimated quantitatively from the ultrasonic tests.

ACKNOWLEDGEMENT

This paper forms part of a M.Phil. dissertation at the Institute for Advanced Studies (IPT), University of Malaya and I would like to thank Dr K.R. Chakraborty and Dr J.K. Raj for their supervision. This study is financed in part by research grants F169/88 and PJP280/89 from University of Malaya.





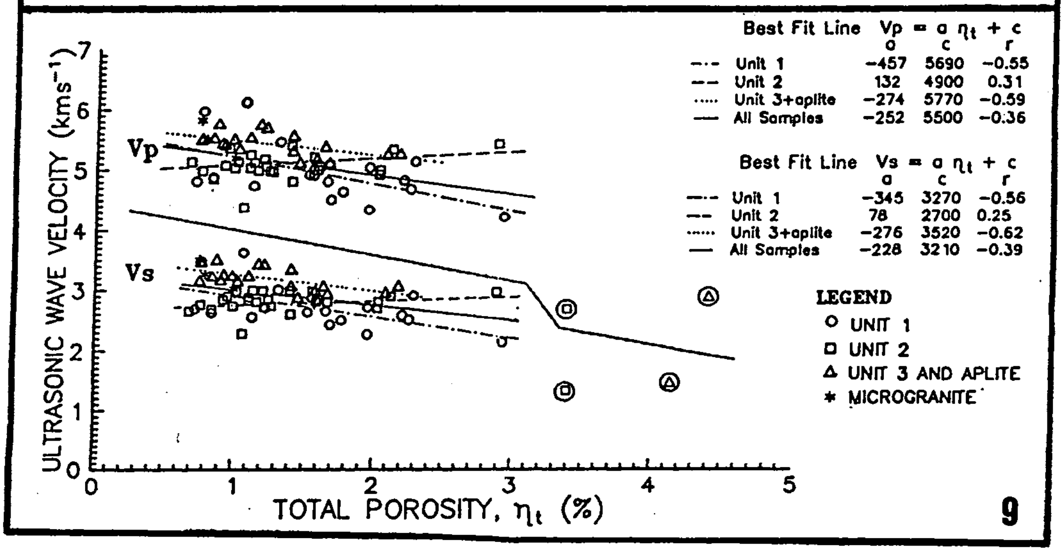
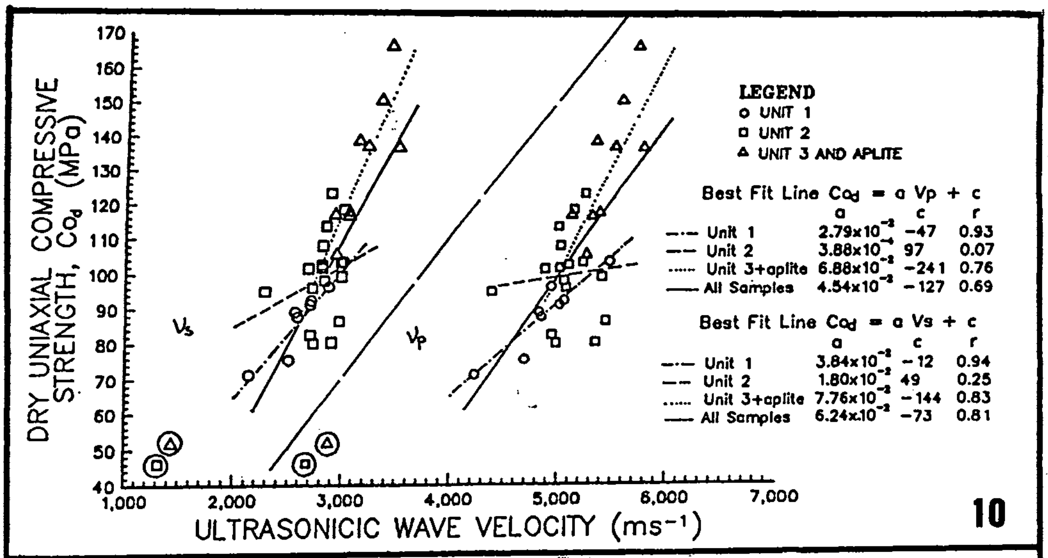
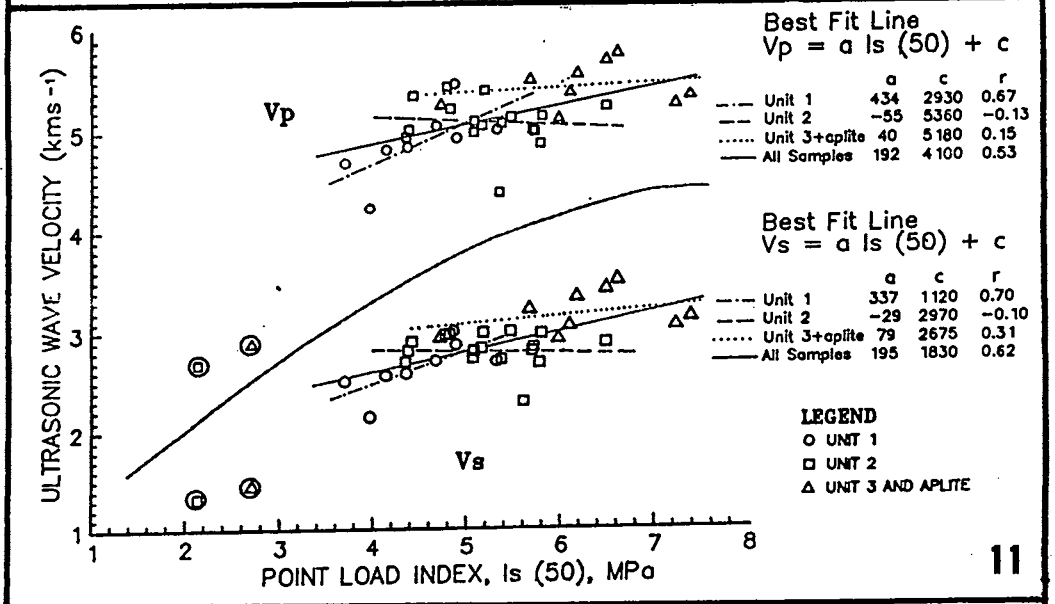


Figure 7: Relationship between ultrasonic velocities and grain size.

Figure 8: Relationship between ultrasonic velocities and dry density.

Figure 9: Relationship between ultrasonic velocities and total porosity. The parameters of the best fit lines are: a=slope; c=intercept; and r=coefficient of correlation. Note that the two slightly weathered samples (circled) are excluded from the regression.





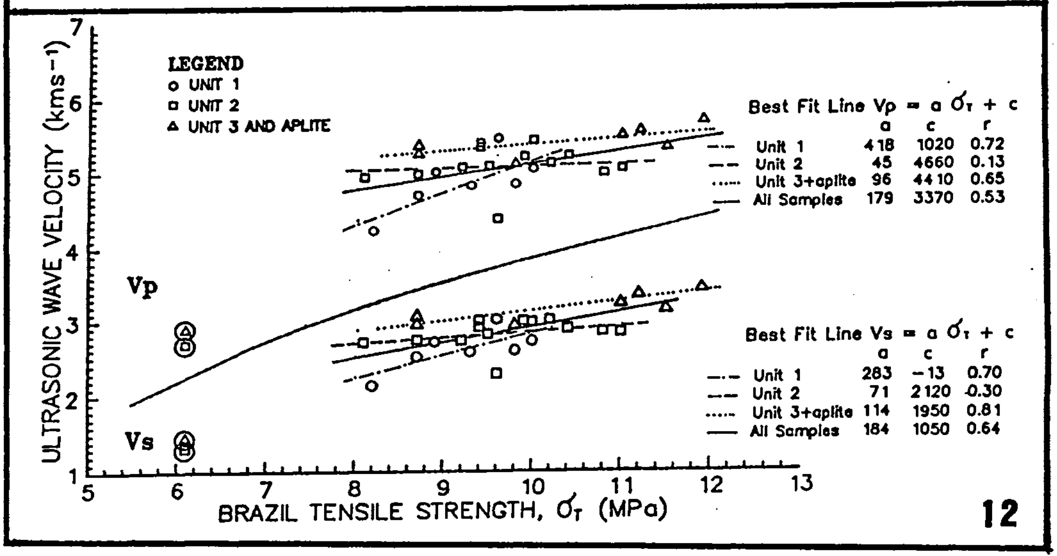
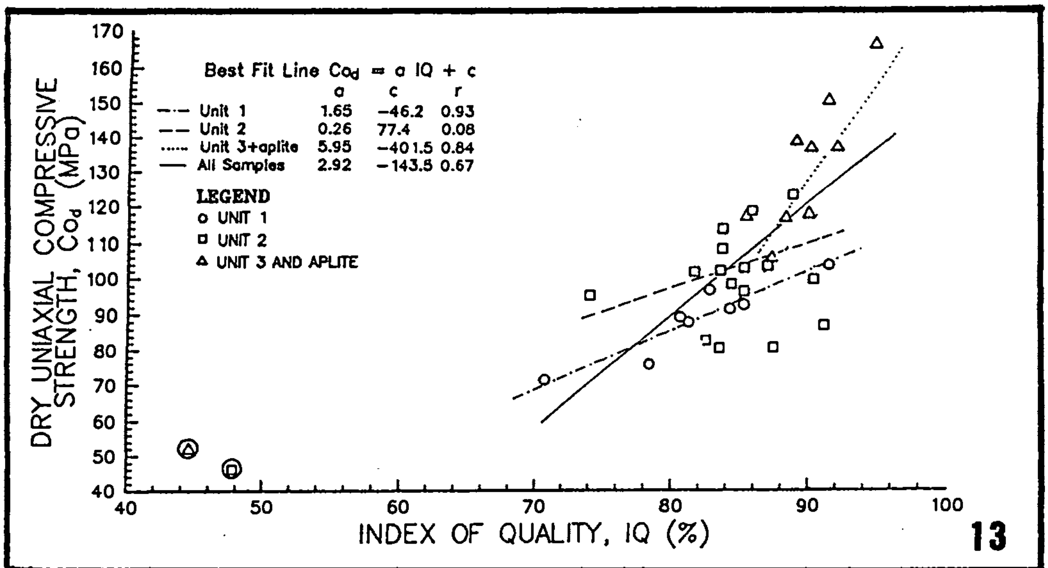
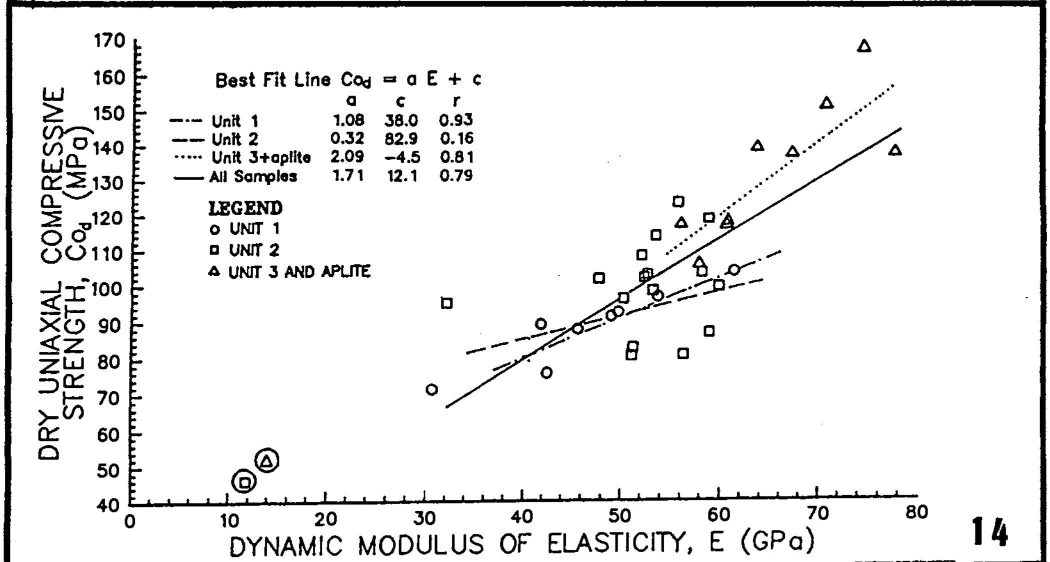


Figure 10: Relationship between dry uniaxial compressive strength and ultrasonic velocities.
Figure 11: Relationship between ultrasonic velocities and point load index.
Figure 12: Relationship between ultrasonic velocities and Brazil tensile strength. The parameters of the best fit lines are: a=slope; c=intercept; and r=coefficient of correlation. Note that the two slightly weathered samples (circled) are excluded from the regression.





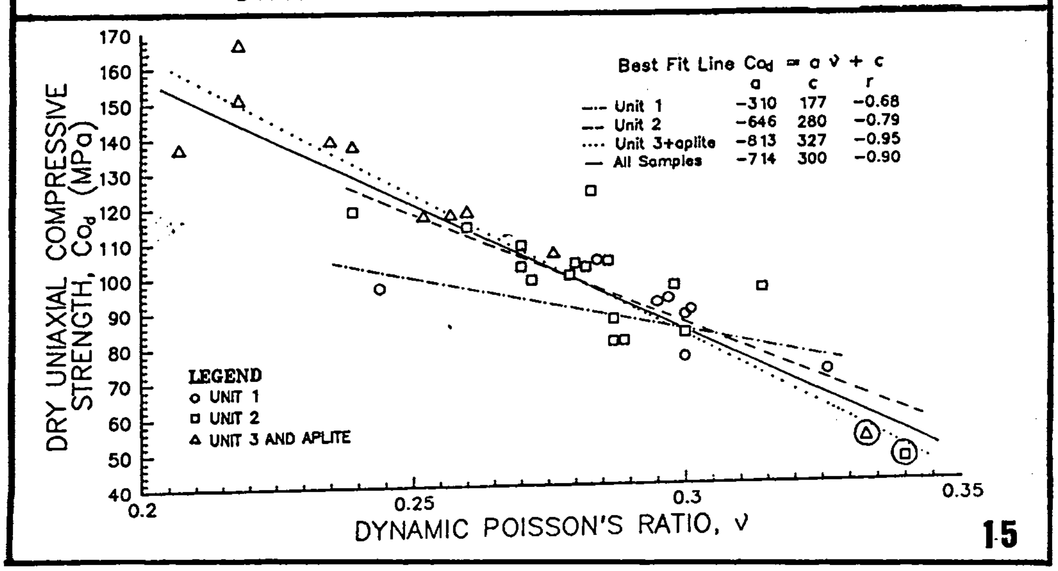


Figure 13: Relationship between uniaxial compressive strength and index of quality.
Figure 14: Relationship between uniaxial compressive strength and dynamic modulus of elasticity.
Figure 15: Relationship between uniaxial compressive strength and dynamic Poisson's ratio. The parameters of the best fit lines are: a=slope; c=intercept; and r=coefficient of correlation. Note that the two slightly weathered samples (circled) are excluded from the regression.

REFERENCES

DAYRE, M. & GIRAUD, A., 1986. Mechanical properties of granodiorite from laboratory tests. *Eng. Geol.*, 23:109-124.

FOURMAINTRAUX, D., 1976. Characterization of rocks, laboratory tests. *In:* Marc Panet et al (eds), *La Mecanique des roches appliquee aux ouvrages du genie civil*. Ecole Nationale des Ponts et Chausees, Paris.

GOODMAN, B.E., 1989. *Rock Mechanics*. 2nd Ed., John Wiley and Sons, New York.

ISRM, 1978. Suggested method for the quantitative description of discontinuities in rock masses. *Int. J. Rock Mech. Min. Sci. & Geomech. Abstr.*, 15:319-368.

KERN, H. & WENK, H.-R., 1985. Anisotropy in rocks and the geological significance. *In:* Wenk, H.-R. (ed) *Preferred Orientation in Deformed Metals and Rock : An introduction to Modern Texture Analysis*. Academic Press Inc., Orlando, p537-556.

LAMA, R.D. & VUTUKURI, V.S., 1978. *Handbook on Mechanical Properties of Rocks. Vol II.* Trans Tech Publ., Clausthal, 455p.

NG, T.F., 1992. *Petrography, structure and geotechnical studies of the Kuala Lumpur Granite, eastern part of Kuala Lumpur, Peninsular Malaysia.* Unpubl. M.Phil dissertation, Univ. Malaya.

TELFORD, W.M., GELDART, L.P., SHERIFF, R.E. & KEYS, D.A., 1976. *Applied Geophysics*. Cambridge University Press, Cambridge.

TOOMBS, A.F., 1978. *The propagation of ultrasonic waves in strong rocks*. TRRL Supplementary Report 384, Crowthorne.

VIJAYA, M.S., JAWAHAR, G. & SHERBAKOVA, T.V., 1977. An ultrasonic profiling investigation on some fresh and weathered granites of Hyderabad, India. *Geophys. Prospect.*, 25:768-779.

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Manuscript received 12 January 1993

PERTEMUAN PERSATUAN
Meetings of the Society

Ceramah Teknik & Seminar (Technical Talks & Seminar)

Jane A. Plant : 1) Regional Geochemistry — a basis for development and environment planning?

2) Geochemistry in the development of metallogenic models and exploration criteria for SEDEX and MVT base metal deposits

Two technical talks and one seminar were delivered by Dr. Jane Plant at the University of Malaya, Kuala Lumpur on 7 September 1992. She repeated the two technical talks at the Geological Survey Department, Ipoh on the following day for the benefit of GSM members in the northern region.

Dr. Jane Plant is the Assistant Director and the Head of the Mineral and Geotechnical Surveys Division of the British Geological Survey. Her trip to Malaysia was sponsored by the Association of Exploration Geochemists (A.E.G.) of which she is the current Distinguished Lecturer (1992). This occasion marks the second time that the A.E.G. has sent its Distinguished Lecturer to speak before the Society [Prof. Dr. K. Fletcher, Distinguished Lecturer (1991)].

The talks in Kuala Lumpur were well-attended with 60-plus members present. They were held in comfortable surroundings in the auditorium of the Institute for Advanced Studies, University of Malaya Abstracts of the two talks are reprinted below. The audience in the afternoon seminar was smaller with about 40-plus members present. Nevertheless, with its title on "The lithogeochemistry of granites and acid volcanics; implications for base metal, tin-uranium and gold exploration", it never failed to draw lively discussions and questions.

The talks at the Geological Survey, Ipoh saw a smaller crowd (35 for the first talk and 15 for the second talk). However, they too attracted some good questions and requests for reprints of technical papers related to the two titles.

Dr. Jane Plant delivered her talks illustrated throughout by excellent colour slides through the use of two projectors. Her lectures were delivered smoothly from one point to the next, leaving the audience at the end firmly grasping every word and convinced of the concepts of her talks. She also charmed everyone she met with her disarming smile and friendliness despite her formidable knowledge of geochemistry.

Jimmy Khoo

Regional Geochemistry – a basis for development and environment planning?

Abstrak (Abstract)

By the mid-1960s pollution had become a matter of serious international concern, and while predictions had made that there would be world shortage of metalliferous minerals, no comprehensive data existed on the background levels of metals in the

environment or on the metalliferous mineral potential of large areas of the earth's crust. Since that time, many country have initiated programmes to prepare regional geochemical maps at the national scale, showing the surface distribution of chemical elements of economic and environment significance. Such maps can be used for a range of purposes, including:

1. Mineral exploration – to identify occurrences of metalliferous minerals of potential economic significance.
2. Mineral Resource Assessment and Land Use Planning to identify areas of potential mineralization, so that they are not sterilised by inappropriate development.
3. Pollution studies – to provide reliable information on the natural and artificial levels of elements, so that realistic assessment of contamination can be made.
4. Agriculture and medical geography – to provide data which can be used directly in statistical studies of the epidemiology and degenerative diseases of man, animals and crop.
5. Geological mapping – to provide information on lithological compositional and regional structures which may be difficult to detect by other means.
6. Studies of the geochemical aspect of crustal development and ore forming processes to develop metallogenic models and derive exploration criteria for exploration.

Examples of the value of such map to the exploration industry, which is trying to operate in a climate of increasing environmental concern, are discussed and the availability of appropriate data worldwide is considered. Methods of preparing geochemical maps are reviewed including the advantages and disadvantages of different sampling media (such as rocks, soils, stream sediments, overbank and water samples) and different sub-sampling and analytical strategies and methods of data processing and presentation.

Geochemistry in the development of metallogenic models and exploration criteria for SEDEX and MVT base metal deposits

Abstrak (Abstract)

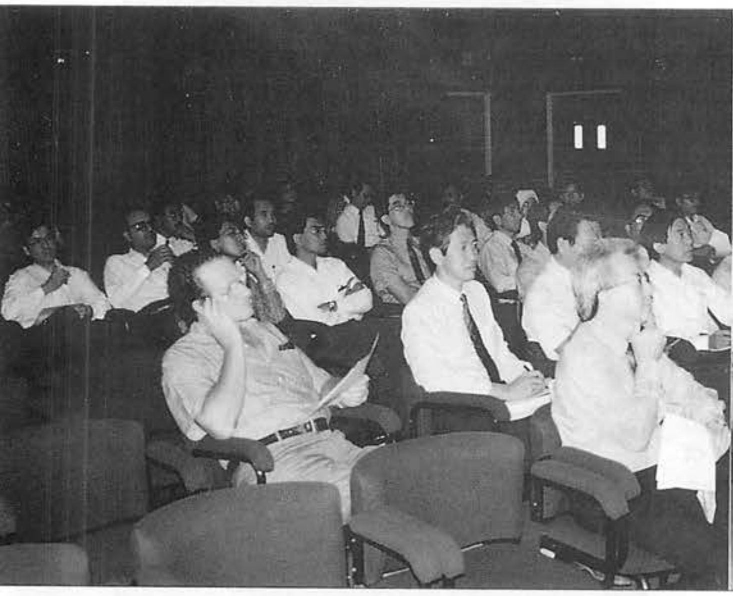
Regional resource evaluation and exploration for metalliferous mineral deposits (particularly at the area selection stage) is based increasingly on the analysis and integration of spatially related datasets using Image Analysis System (IAS) or Geographical Information System (GIS). Such system can be used for the rapid analysis and interaction of one or more images (maps) for a wide range of geological data. In Central Finland, for example, the identification of areas with potential for Cu-Zn mineralization was made by the analysis and integration of more than 70 variables (including geochemical, geophysical, geological and remotely sensed data) using statistical image processing techniques. Areas favourable for gold mineralization in Nova Scotia were also identified by integrating statistical parameters derived from lake sediment geochemistry with geological and geophysical parameters using a GIS. This approach is of particular value in exploration for deposits which are associated with volcanic or plutonic igneous rocks in basement terrains and which have a clear signature in drainage geochemical samples.

Exploration for buried carbonate-hosted Sedimentary Exhalative (SEDEX) and Mississippi Valley Type (MVT) deposits requires a different approach, however, whereby exploration criteria derived from conceptual and fluid flow mineral deposit models are combined using an IAS identify prospective areas. This lecture presents a review of studies carried out to identify areas prospective for buried carbonate-hosted SEDEX or

MVT deposits in England and Ireland. The methods described include lithogeochemistry and basin analysis which are more commonly employed for hydrocarbon exploration. The two deposit types are shown to be related to different phases in the tectonic evolution of the Foreland of the Hercynian orogen. The SEDEX deposits are related to phases of crustal extension and basin formation associated with the rise of hot asthenosphere beneath the crust, which was characterised by basaltic magmatism, high geothermal gradients and listric faulting. In contrast, MVT deposits were formed following a period characterised by declining geothermal gradients, regional subsidence of the crust, and over-pressuring of sedimentary basin from which ore fluids, similar to oil field brines, were expelled. Specific exploration criteria are developed and detailed models and prospectivity maps presented.

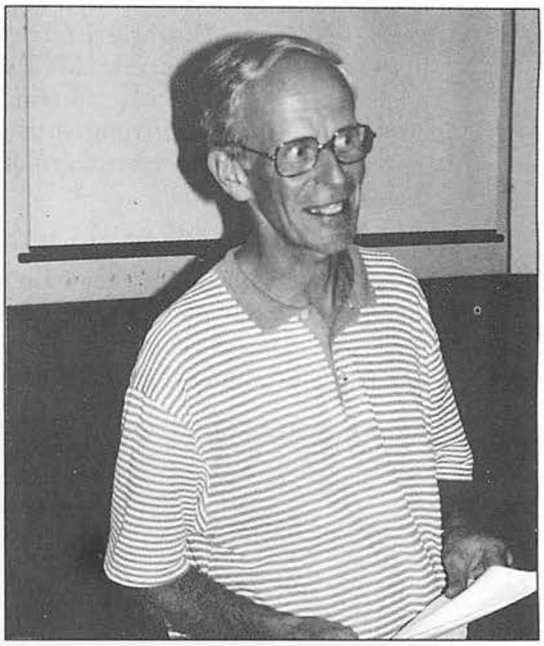
The value of regional geochemical data and the organic and inorganic geochemistry of limestone and shale (the sink and source respectively of the ore fluids) are reviewed in relation to other datasets including remotely sensed (SPOT and TM) and geophysical data. An expert system demonstrator (BURMIN) for identifying the two types of ore deposits in sedimentary basin sequences is discussed.

Dr. Jane A. Plant



Chris M.L. Bowler : Mineral development and the environment – A geologist's dilemma?

Laporan (Report)



Dr. Chris M.L. Bowler (Principal Lecturer in Economic and Environment Geology, University of Plymouth, United Kingdom) presented the above talk on 11th September 1992 at the Department of Geology, University of Malaya. What follows is an abstract of the talk prepared by the speaker.

Abstrak (Abstract)

Mining in many parts of the world has often turned out to be basically exploitive not only of the mineral (the aim) but also of the people involved and of the natural environment. With dramatic rises in demand and in population we become increasingly aware that the impacts of mining can have a lasting detrimental effect on the environmental systems and land use capability – this includes vegetation removal, soil removal, rock excavation, dewatering, coarse and fine waste, noise due to blasting, transport, buildings or plants and Society. Examples will be considered from the UK, Ireland, Canada and Central Africa and the question asked how these compare to the situation in Malaysia? Do Geologist have a dual responsibility and even experience something like a dilemma, as naturalist and also as exploiter? If so, how should this be resolved.

Mazlan B. Hj. Madon : Paleoenvironment analysis of upper Miocene sedimentary sequence, Jerneh field, Malay Basin

Laporan (Report)

Encik Mazlan B. Hj. Madon (PETRONAS PRI) presented the above talk on 12th October 1992 at the Department of Geology, University of Malaya. What follows is an abstract of the talk prepared by the speaker.

Abstrak (Abstract)

A paleoenvironmental interpretation of the reservoir section in the Jerneh field was made using logs and cores from several wells. The reservoir section is interpreted as being deposited during progradation, aggradation, and retreat of a delta in response to relative sea-level changes. The delta probably represents the southern end of a low-gradient alluvial-deltaic system which developed along the axis of the Malay Basin during the Miocene.

Forum on Dam Geology and Damsite Visit

Laporan (Report)

The half-day Forum on Dam Geology was held on 28th September '92 at the Dept. of Geology, University of Malaya. Four speakers presented case studies on various dams in Peninsular Malaysia, covering topics on tectonic setting, geology, site/soil investigations, foundation treatment, construction problems, etc. The programme is as below:

1:55 pm	OPENING REMARKS
	SESSION I
2:00–2:30 pm	MR. SHU YEOH KHOON *(Geological Survey Malaysia)* Seismo-tectonic Setting of Peninsular Malaysia
2:30–3:00 pm	MR. SAIM SURATMAN *(Geological Survey of Malaysia)* Geology and Related Activities, Batu Dam Case History.
3:00–3:30 pm	COFFEE BREAK
	SESSION II
3:30–4:00 pm	MR. KOAY LEONG THYE *(Ranhill Bersekutu)* Upper Muar Dam, Negeri Sembilan – A Case Study
4:00–4:30 pm	MR. TAN BOON KONG *(Universiti Kebangsaan Malaysia)* The Story of Gemencheh Dam, Negeri Sembilan
4:30–5:00 pm	DISCUSSION
5:00 pm	CLOSING REMARKS

Following the half-day Forum, site visits to the Batu Dam (DID) and the Klang Gates Dam (PWD) in the Kuala Lumpur area were conducted on 29th September 1992. The Batu Dam is sited on Hawthornden Schist & granite, while the Klang Gates Dam is sited on the Klang Gates Quartz Ridge. Briefings on the damsite geology, construction problems, features of the dams, etc. were given by the respective resident engineers (and Sdr. Saim Suratman of Geosurvey for the geology of Batu Dam). Some photos of the damsite visits are shown in Plates 1 to 6.

On behalf of the Society, I thank the speakers, DID, PWD, the Geology Dept. (Universiti Malaya), the Geological Survey of Malaysia, and all members who have participated in the Forum and/or site visits for making this "event" a success.

Tan Boon Kong
Chairman
Working Group on Engineering
Geology & Hydrogeology

GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATIONS

BULLETIN OF THE GEOLOGICAL SOCIETY OF MALAYSIA

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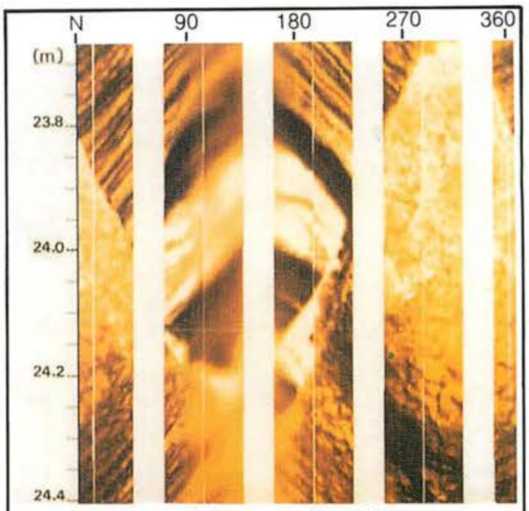

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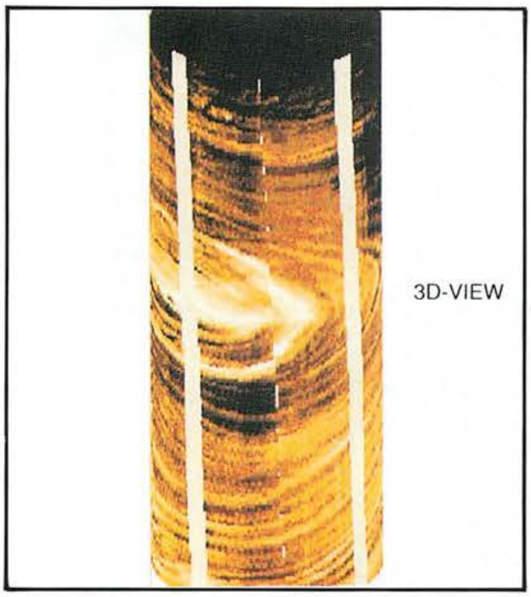

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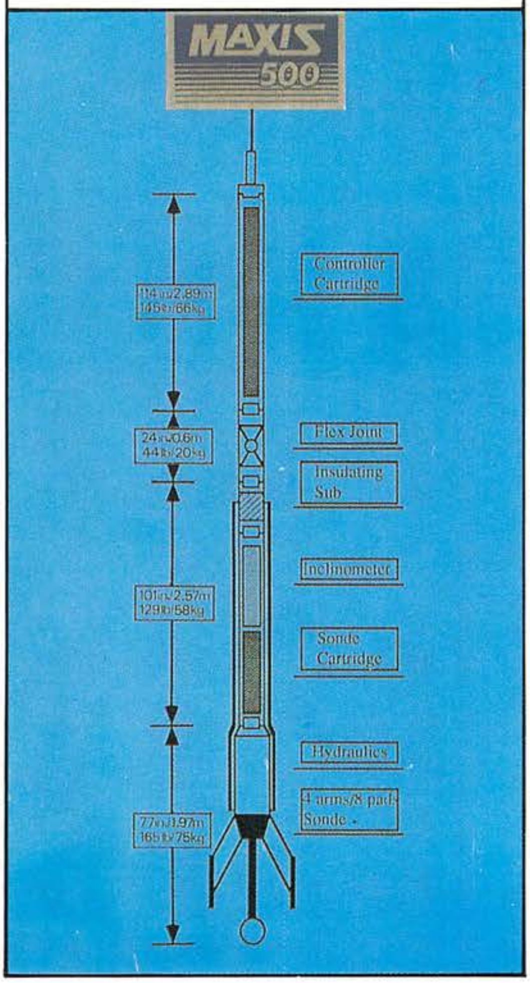

Schlumberger

FORUM ON DAM GEOLOGY

1. Y.K. Shu on seismo-tectonic setting of Peninsular Malaysia.
2. Muhinder Singh with a question.
3. Saim Suratman on the Batu Dam.
4. L.T. Koay on the Upper Muar Dam.
5. Tan Boon Kong on the Gemencheh Dam.

DAMSITE VISIT

1. Group photo at Batu Dam (earthfill dam).
2. Relaxing by the cool resevoir/shade area.
3. Sdr. Saim Suratman showing rock bolting of the schist.
4. Group photo at the Klang Gates Dam (concrete arch dam).
5. A view of the arch dam abutting on the Quartz Ridge.
6. Resident engineer briefing on the history and features of the Klang Gates Dam.

BERITA-BERITA PERSATUAN
News of the Society

Keahlian (Membership)

The following applications for membership were approved:

Student Members

1. Woo Chaw Hong
   Dept. of Geology, University of Malaya, 59100 Kuala Lumpur.
2. Lim Teck Kean
   School of Physics, 11800 USM, Pulau Pinang.
3. Goh Lay Choo
   School of Physics, 11800 USM, Pulau Pinang.
4. Tan Teong Swee
   School of Physics, 11800 USM, Pulau Pinang.
5. Ng Bong Seng
   School of Physics, 11800 USM, Pulau Pinang.
6. Ng Say Joo
   School of Physics, 11800 USM, Pulau Pinang.
7. Magdeline Pokar
   School of Physics, 11800 USM, Pulau Pinang.
8. Choo Kim Wang
   School of Physics, 11800 USM, Pulau Pinang.
9. Othman Kangsar
   School of Physics, 11800 USM, Pulau Pinang.
10. Lim Chye Guan
    School of Physics, 11800 USM, Pulau Pinang.
11. Tew Meang Sheng
    School of Physics, 11800 USM, Pulau Pinang.

Pertukaran Alamat (Change of Address)

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

1. Chin Lik Suan
   26 Persiaran Jelutong, Damansara Heights, 50490 Kuala Lumpur.
2. Jim Blake
   Geological Services, 10 Anson Road #15-14 International Plaza Singapore 0207.
3. Mohd. Nasir Sheik Mohammad
   35A Jalan 17A/5, 46400 Petaling Jaya, Selangor.
4. Sierra Geophysics
   152 Beach Road, #30-01/04 Gateway East, Singapore 0718.
5. Total Exploration Production
   331 North Bridge Road #22-04/06, Odeon Towers, Singapore 0718.
6. Dale Brunotte
   307 Third St. NE, Mitchellville, Iowa 50169 U.S.A.

7. Ian M. Cross
IEDS Fields Services Ltd., Branch Office, 10 Anson Road #17-11, International Plaza, Singapore 0207.

8. Petroconsultants S.A. (Information Research Division)
P.O. Box 152, 24, Chemin de la Mairie, 1258 Perly-Geneva, Switzerland.

Pertambahan Baru Perpustakaan (New Library Additions)

The Society has received the following publications:

1. Annales Academiae Scientiarum Fennicae no. 156, 1992.
2. IMM Section A: vol. 101, May-Aug 1992.
3. AAPG Explorer, July & Aug 1992.
4. Commonwealth Science Council, July-Aug 1992.
5. SOPAC News, vol. 9, no. 1, 1992.
6. Metallogenic study & mineral deposit data sheets: Dorrigo-Coffs Harbour 1:250,000: metallogenic map SH/56-10, SH/56-11, 1992.
7. Journal of Hebei College of Geology, vol. 14, nos. 2 & 3, 1991.
8. Bulletin of the Chinese Academy of Geological Sciences, nos. 22, 23 & 24, 1991.
9. Contributions from the various organizations of ministry of geology and mineral resources, PRC, 1990.
10. IMM Bulletin no. 1007 & 1008, 1992.
11. Service Geologique de Belgique, Professional paper 1992/2-19992/6.
12. Special publication of the Central Geological Survey, no. 6, 1992.
13. Seatrad Bulletin, vol. XIII, no. 1, 1992.
14. Oklahoma Geology Survey Notes vol. 52, nos. 1-3, 1992.
15. Journal of Science of the Hiroshima University, vol. 9, no. 3, 1992.
16. Earthquake & volcanoes, vol. 22, no. 6, 1990, vol. 23, no. 1, 1992.
17. USGS Professional Paper 1991: 1416-B.
18. USGS Bulletin 1992: 1917-1.
19. Chronique de la Recherche Miniere, no. 508, 1992.
20. Annual Report, Chinese Academy of Geological Sciences, 1990.
21. Costam Newsletter, no. 5, 1992.

BERITA-BERITA LAIN
Other News

IAGOD 1994

9th IAGOD Symposium of the International Association on the Genesis of Ore Deposits

AUGUST 12-18, 1994
BEIJING CHINA
Sponsored by
Chinese Academy of Geological Sciences Commission on Mineral Deposits,
Geological Society of China

DATE AND VENUE

The 9th Symposium of the International Association on the Genesis of Ore Deposits will be held in Beijing International Convention Centre, Beijing, China from August 12 to 18, 1994. The sponsors sincerely invite you to attend the symposium to enjoy all its activities.

SCIENTIFIC PROGRAMME

The programme will include invited lectures, paper presentation and poster sessions. There will be a display of super large ore deposits of China and investigations on the country's major metallogenic provinces (belts).

TOPIC AND RELATED COMMISSIONS

The symposium will provide a forum for the IAGOD Commissions and Working Groups.

1. Commission on Tectonics of Ore Deposits (CTOD)
   CTOD WG1: Global Tectonics and Metallogeny
   CTOD WG2: Structure of Ore Field and Ore Deposits
   CTOD WG3: Statistical Treatment of Tectonic and Mineral Deposits Data
   CTOD WG4: Tectonic-Magmatic Activization (DTWA)
   CTOD WG5: Remote Sensing Methods for Tectonics and Prospecting
2. Commission on Paragenesis (PAC)
3. Commission on Ore-Forming Fluids in Inclusions (COFFI)
4. Commissions on Fluorite and Barite Deposits (COFAB)
   COFAB WG1: Working Group on Physical Chemistry (PCWG)
   COFAB WG2: Working Group on Isotope Geochemistry (IGWG)
5. Commission on Manganese (COM)
6. Commission on Ore Deposits in Mafic and Ultramafic Rocks
7. Working group on Skarn Deposits
8. Working Group on Tin and Tungsten Deposits
9. Working Group on Ores and Metamorphism
10. Working Group on Metallogeny of the Bohemian Massif.

There are also some specific topics which are preliminarily proposed as follows:

11. Kinetics and Thermodynamics in Ore-Forming Hydrothermal Systems
12. Ore-Forming Theory for Super-Large Ore Deposits

13. Experimental Modelling of Metallogeny
14. Special Ore-Forming Processes, Such as Biogenesis and Metallogeny, Rift and Metallogeny, Heat-Driving Meteoric Water Circulation and Metallogeny, Shear Structure and Metallogeny, and Hydrothermal Sedimentation and Metallogeny
15. Stratiform and Stratabound Deposits
16. Modern Ore Formation
17. Evolution of Metallogenic Province
18. Isotopics and Trace Element Geochemistry of Mineral Deposits.

If you have any other subject to put forward, please let us know so that they could be included in the final programme.

PUBLICATIONS

Abstracts are due by January 1, 1994, and more details will be given in the Second Circular. Invited lectures and contributed papers will be published in the proceedings of the symposium.

LANGUAGE

The official language of the symposium will be English.

EXHIBITION

Exhibition booths for books, specimens and equipments will be available at a cost to be specified in the Second Circular. Potential exhibitors should send all correspondence concerning the exhibition to the following address:

Dr. Huang Zhengzhi
Geological Museum of China
Xi Si
Beijing 100034, China

REGISTRATION FEES

	Preregistration	Late Registration
Participating member	USD 250	USD 300
Accompanying member	180	230
Student in 1994	160	200

The fees include the rights to attend scientific events associated with the meeting, to receive meeting publications and to take part in social event especially organized for the symposium.

ACCOMMODATION

The Beijing International Convention Centre, comprising Convention Building, Hui Bin Office, Intercontinental Hotel, Hui Yuan Apartments, Recreation Palac, Hui Zhen Restaurant, Shopping Centre and International School, is an ideal complex of services for participants and accompanying members to enjoy their stay in Beijing. It serves various styles of food and provides rooms of different ranks at reasonable prices.

FIELD TRIPS

Nineteen field trips are planned to view the typical ore deposits in China, out of which Nos. 2, 4, 5, 6, 7, 8, 10, 11, 14, 15, 16 and 17 Trips will be arranged as both pre-meeting and post-meeting.

1. Precambrian Metamorphic Rocks, Granites, Laiwu Iron Mines and Zhaoyuan gold Ore deposits in Shandong Province

   Duration: 8 days Max. No.: 40

Contents of visit: Precambrian metamorphic rocks in Mount Tai and the nearby Laiwu skarn iron deposits, Zhaoyuan super giant gold ore deposits, including Linglong-type and Jiaojia-type gold deposits, and Qingdao-Laoshan alkaline granite. During the trip participants will enjoy excellent sightseeing of Mount Tai, Laoshan Mt., and Confucian Temple.

2. REE-Nb-Iron Deposits and Gold Deposit in Baiyun Obo, Inner Mongolia

   Duration: 4 days Max. No.: 40

Contents of visit: Super large Baiyun Obo REE-Nb-iron deposit – main eastern and western ore bodies and their occurrences, ore types, metasomatic alterations, REE minerals, open pit, skarn minerals and contact relation between biotite granite and dolomitite. Gold deposits in Baiyun Obo. There will be a sightseeing of grassland scenery and a visit to a Mongolian village on the way back to Baotou.

3. Anshan-Type Iron, Boron, Magnesite and Diamond Deposits in Liaoning Province
   Duration: 7 days Max. No.: 40

Contents of visit: Anshan – Upper Archean banded iron formation and its mineral associations in Gongchangling mine. Dashiqiao – Lower Proterozoic super giant magnesite/talc deposits and boron deposits. Dalian – Palaeovolcanic mechanism, kimberlites, and primary and placer deposits of diamond. During the trip participants will see scenic spots and historical monuments in East Liaoning Peninsula.

4. Porphyry Molybdenum Ore Deposits and Gold Deposits in Shaanxi Province
   Duriation: 6 days Max. No.: 40

Contents of visit: Xiaoqinling gold deposits – geology of the deposits, alteration types and zoning, mineral association and typomorphic characteristics. Jinduicheng veinlet-disseminated molybdenum deposits – mineralization, metasomatic zoning, ore types, mineral association and fabrics of the Mo deposits. Granites in Huashan and Lishan Mountains will be examined. The participants will also visit the ancient capital Xi'an and the Qin Dynasty Museum of Terra-Catta warriors.

5. Tin-Polymetallic Mine in Dachang and Karst Geology in Guilin, Guangxi Zhuang Autonomous Region
   Duration: 5 days Max. No.: 40

Contents of visit: Super giant tin-polymetallic deposits of veinlet banded cassiterite-sulphide deposits, various sulfosalt minerals, and Lamo-Sn-Cu-Zn skarn deposits, and typical geological scenery in Guilin, such as karst landscape, karst caves and stalactite.

6. Tungsten, Tin, Lead, Zinc and Rare Metal Deposits in Hunan Province and Karst Geology in Guilin
   Duration: 8 days Max. No.: 40

Contents of visit: Super giant Shizhuyuan deposit – examining marble-type tin deposits, skarn type copper-tin deposits, skarn-type, greisen-type, and mixed skarn-greisen-type W-Sn-Mo-Bi deposits. Huangshaping large Pb-Zn mine – examining rich Pb-Zn ore body and volcanic breccia. Yaogangxian tungsten mine – observing quartz-wolframite vein and granites. Karst geology in Guilin.

7. Fe-Cu-S Ore Deposits in Middle and Lower Reaches of the Yangtze river
   Duration: 8 days Max. No.: 35

Contents of visit: Wuhan-Daye – skarn type iron and copper ore deposits. Jiujiang – skarn and porphyritic and massive sulphide mixed type copper deposits. Tongguanshan – skarn copper deposits. Ma'anshan – porphyrite type iron ore deposits. The participants will also visit the scenery of Industrial Corridor along the Yangtze River.

8. Gannan Tungsten Ore Deposits and Rare Metal Deposits in Jiangxi Province
   Duration: 5 days Max. No.: 35

Contents of visit: Yichun – granitic type rare metal deposits, super large Xihuashan quartz vein wolframite deposits. Piaotong – skarn type and quartz vein mixed type tungsten deposits. Dajishan – rare metal and tungsten deposits.

9. Dabaoshan-Fankou Pb-Zn Polymetallic Deposits in Guangdong Province
   Duration: 7 days Max. No.: 35

Contents of visit: Dabaoshan – massive sulfide Fe-Pb-Zn-Cu polymetallic deposits and porphyritic W-Mo deposits. Fankou – typical carbonate hosted Pb-Zn-Hg deposits controlled by syngenetic fault.

10. Xikuangshan Antimony Ore Deposits and Woxi W-Sb-Au Ore Deposits in Hunan Province
    Duration: 6 days Max. No.: 35

Contents of visit: Geology and metallogeny of super large Sb deposits in Xikuangshan mine and W-Sb-au deposits in Woxi mine. The participants will see 2 super giant Sb deposits hosted in Devonian carbonates and the W-Sb-Au deposits hosted in Precambrian slates in Woxi.

11. Cu-Pb-Zn Massive Sulfide Deposits and Cu-Ni Deposits in Gansu Province
    Duration: 6 days Max. No.: 40

Contents of visit: Baiyinchang – examing copper deposits of lower Paleozoic spilite-keratophyric sequence formed by sea-floor eruption and the associated minerals, ore-bearing country rock (quartz keratophyric tuff), main ore formation and various ore minerals. Super large Jinchuan Cu-Ni sulfide deposits – examing dunite, lherzolite, plagio-peridotite and liquating-injected orebodies. Examing the super giant Changba stratabound Pb-Zn polymetallic massive sulfide deposits.

12. Gejiu Tin-Polymetallic Deposits in Yunnan Province
    Duration: 7 days Max. No.: 35

Contents of visit: A large tin-polymetallic deposit of cassiterite-sulfide and skarn type and typical geological scenery on the Yunnan-Guizhou Plateau.

13. Panzhihua Vanado-Titano-Magnetite Ore Deposits and Limahe Cu-Ni Deposits in Sichuan Province
    Duration: 8 days Max. No.: 35

Contents of visit: Panzhihua mafic-ultramafic layered intrusion and its super large V-Ti-magnetite deposits. Limahe small intrusion and its Cu-Ni sulphide deposits. Graben and horst structures in Xichang. Sight-seeing to Mount Emei, Wulong Temple and Leshan Buddha.

14. Rare Metal Pegmatite and Saline Minerals in Xinjiang Uygur Autonomous Region.
    Duration: 7 days Max. No.: 40

Contents of visit: Koktokay – Li, Be, Nb, Ta and other rare metal minerals in No. 3 and No. 2 pegmatite veins. Urumqi – saline minerals in neighboring Daban Town Salt Lake, and glacial landform in the Heaven Pool region.

15. Ancient Porphyry Cu and Stratabound Cu Deposits in Zhongtiaoshan in Shanxi Province
    Duration: 5 days Max. No.: 40

Contents of visit: Tongkuangyu – Proterozoic porphyry Cu deposits in sodium altered granodiorite porphyry. Bizhigou and Hujiayu – calcareous and carbonaceous metamorphic rocks hosted stratabound Cu deposits, as well as the relationship of the two types of deposits and their mineral associations.

16. Shilu Iron Ore Deposits and Seashore Placer Ilmenite in Hainan Province
    Duration: 6 days Max. No.: 35

Contents of visit: This trip is a round-the-island tour. The participants will visit the Shilu iron ore field, the seashore placer of ilmenite near Sanya City and bauxite deposits and their source rock – Cenozoic basalt. They will see sedimentary-metamorphic hematite beds along opencast, Mesozoic granite, and Late Proterozoic Shilu Group. Some scenery spots will also be visited.

17. Zedang-Luobusha Ultramafic Intrusion and Chromite Deposits in Tibet Autonomous Region
    Duration: 8 days Max. No.: 30

Contents of visit: The large ultramafic intrusion and chromite deposits in Zedang-Luobusha, tectonic structures of the Yarlung Zangbo suture zone, the Yangbajain geothermal field and the Gangdise island-arc structure, as well as sight-seeing in Lhasa.

18. Cu-Au-Pb-Zn-Ag Ore Deposits in Northeastern and Central Jiangxi Province
    Duration: 7 days Max. No.: 35

Contents of visits: Large porphyry copper deposits related to Mesozoic granodiorite porphyrite in Tongchang mine, Pb-Zn-Ag (upper) and Cu-Au (lower) ore vein related to volcanics in Yinshan mine, and sediments (Upper Paleozoic) hosted in stratabound Cu-S-W deposits in Rongpin and Dongxiang mines.

19. Fe-Cu Ore Deposits in Central Yunnan Province
    Duration: 7 days Max. No.: 35

Contents of visit: A metallogenetic series of copper deposits related to Proterozoic rift, Xikuangshan-type Cu deposits containing magnetite breccia, Tongchuan-type sediments hosted in Cu beds, Shikushan-type Cu deposits occurring in black slate and Lannipin-type Cu deposiits in the surface of unconformity.

ADDRESS FOR CORRESPONDENCE

Dr. Wang Zejiu
9th IAGOD Symposium
Chinese Academy of Geological Sciences
26 Baiwanzhuang Road
Beijing 100037, China

IMPORTANT DATES

Second Circular	April, 1993
Abstract deadline	1st January, 1994
Preregistration deadline	1st May, 1994
Third Circular	June, 1994

1993

▶ April 1993

♦♦♦ **April 1–3**
FRACTALS AND DYNAMICS SYSTEMS IN GEOSCIENCES (International Meeting), Frankfurt/Main, Germany (Jörn H. Kruhl, Geology-Paleontology Institute, JW Goethe-University, Senckenberganlage 32, D-6000 Frankfurt/Main, Germany. Phone: 0049-69-7982695)

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

♦♦♦ **April 4–8**
REMOTE SENSING AND GLOBAL ENVIRONMENTAL CHANGE (25th International Symposium), Graz, Austria. (Dorothy M. Humphrey, ERIM, P.O. Box 134001, Ann Arbor, MI 43113–4001, USA. Phone: (313) 994–1200, ext. 2290; telefax: (313) 994–5123)

♦♦♦ **April 5–8**
GLOBAL WARMING, int'l. mtg., Chicago. (Sinyan Shen, Natural Resource Management Division, SUPCON International, One Heritage Plaza, Woodridge, III. 60517–0275. Phone: 708/910-1551; 419/372-8207. Fax: 708/910-1561)

♦♦♦ **April 17–20**
INTEGRATED METHODS IN EXPLORATION AND DISCOVERY (International Conference), Denver, Colorado, USA. (SEG Conference '93, P.O. Box 571, Golden, CO80402, USA. Telefax: (303) 279–3118)

♦♦♦ **April 21-25**
GEOSCIENCE EDUCATION AND TRAINING (International Conference), Southampton, UK. (Mrs. Esther Johnson, GEOED Conference Secretariat, Department of Geology, University of Southampton, Southampton S09 5NH, UK. Phone: (0703) 593049; telefax: (0703) 593052; telex: 47662 SOTONU G)

♦♦♦ **April 19–23**
REMOTE SENSING, int'l mtg., Enschede, The Netherlands, by international Institute for Aerospace Survey and Earth Sciences, and others. (Myriam Fahner, Box 6, 7500 AA Enschede, The Netherlands. Phone: 31-53-874 255. Fax: 31-53-874 436) Deadline for manuscripts: March 11.

♦♦♦ **April 25–28**
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (Annual Meeting), New Orleans, Louisiana, USA. (Convention Department, AAPG, Box 979, Tulsa, OK 74101, USA. Phone: (918) 584-2555; telefax: (918) 584-0469)

▶ May 1993

♦♦♦ **May 5–8**
PROTECTING THE EARTH – CHALLENGES TO SCIENCE AND TECHNOLOGY (1st International Fair and Congress), Koln, Germany. (Alfred-Wegener-Stiftung zur Forderung der Geowissenschaften, Wissenschaftszentrum Ahrstraße 45, Postfach 20 14 48, D-5300 Bonn 2, Germany. Phone: 02 28/302-260); telefax: 02 28/302-270; telex: 885 420 wzd).

♦♦♦ **May 5–8**
GEOTECHNICA '93 (International Sumposium), Cologne, Germany. (Hans Teetz, Cologne International Trade Fairs Inc., 21st Floor, 666 Fifth Ave., New York, NY 10103–0165, USA. Phone: (212) 974–8836; telefax: (212) 974–8838)

♦♦♦ **May 15–21**
ENVIRONMENTAL HYDROLOGY AND HYDROGEOLOGY (2nd USA/CIS Joint Conference), Arlington, Virginia, USA. (Americal Institute of Hydrology, 3416 University Avenue, SE. Minneapolis, MN 55414–3328, USA. Phone: (612) 379–1030; telefax: (612) 379–0169)

♦♦♦ **May 17–19**
GEOLOGICAL ASSOCIATION OF CANADA/ MINERALOGICAL ASSOCIATION OF CANADA (Joint Annual Meeting), Edmonton, Alberta, Canada. (J.W. Kramers, Alberta Geological Survey, P.O. Box 8330, Station F, Edmonton, Alberta T6H 5X2, Canada. Phone: (403) 438-7644; telefax: (403) 438-3644)

◆◆◆ **May 25–June 15**
BASIN TECTONIC AND HYDROCARBON ACCUMULATION (International Conference), Nanjing, China. Professor Shi Yangshen, Department of Earth Sciences, Nanjing University, Nanjing, China. Phone: 86–25–634651, ext. 2890; telefax: 86–25–302728; telex: 34151 PRCNU CH. Or David Howell, U.S. Geological Survey, 345 Middlefield Road, MS 902, Menlo Park, CA 94025, USA. Phone: (415) 354–5430; telefax: (415) 354–3224)

◆◆◆ **May 31–June 2**
APPLIED MINERALOGY, int'l. mtg., Perth, Western Australia. (Jim Graham, ICAM '93, Private Bag, P.O. Wembley 6014, Australia. Phone: 619/387-0371)

▶ June 1993

◆◆◆ **June 1–5**
GEOTECHNICAL ENGINEERING (International Meeting), St. Louis, Missouri, USA. (Norma R. Fleming, 119 ME Annex, University of Missouri, Rolla, MO 65401-0249. Phone: (314) 341-6061; (800) 752-5057. telefax: (314) 341-4992)

◆◆◆ **June 7–16**
SUBCOMMISSION ON CARBONIFEROUS STRATIGRAPHY 1993 FIELD AND GENERAL MEETING (International Symposium), Liège, Belgium, and field excursions to Belgium, Germany, and the Pyrenees in France. (Dr. M. Streel, Paléontologie, Université de Liège, 7 Place du Vingt-Aoèt, B-4000 Liège, Belgium)

◆◆◆ **June 20–27**
ZEOLITES (International Meeting), Boise, Idaho, USA. Sponsored by International Committee on Natural Zeolites. (F.A. Mumpton, Dept. of Earth Sciences, State University of New York, Brockport, 14420. Phone: 716/395-2635; 716/637-2324. Fax: 716/395-2416)

◆◆◆ **June 21–25**
ROCK ENGINEERING (Meeting and Workshop), Lisbon, Portugal. Sponsored by the International Society for Rock Mechanics. (Luis Ribeiro e Sousa, Portuguese Society for Geotechnique, Laboratório Nacional de Engenharia Civil, Av. do Brasil, 101, 1799 Lisboa Codex Portugal. Phone: 848 21 31; telefax: 89 76 60)

◆◆◆ **June 28–July 2**
INTERNATIONAL ASSOCIATION OF HYDROGEOLOGISTS: HYDROGEOLOGY OF HARD ROCKS (24th IAH Congress), Oslo, Norway. (Geological Survey of Norway, P.O. Box 3813, Ulleväl Hageby, N–0805 Oslo, Nowway. Phone: 47–2–950895)

▶ July 1993

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

◆◆◆ **July 5–8**
ROCK FRAGMENTATION BY BLASTING (4th International Symposium), vienna, Austria. (Dr. H.P. Rossmanith, Institute of Mechanics, Technical University Vienna, Wiedner Haupstraße 8–10/325, A–1040 Vienna, Austria. Phone: (222) 588 01 5514 or 5519; telefax: (222) 587 5863)

◆◆◆ **July 5–9**
FLUVIAL SEDIMENTOLOGY (5th International Conference), Brisbane, Australia. (Continuing Professional Education, The University of Queensland, Queensland 4072, Australia. Phone: 61 7 365 7100; telefax: 61 7 365 7099; telex: UNIVQLD AA40315)

◆◆◆ **July 5–16**
VERY LOW GRADE METAMORPHISM: MECHANISMS AND GEOLOGICAL APPLICATIONS (IGCP Project 294 Thematic Meeting and Field Excursions), Xi'an, People's Republic of China. (Dr. Wu Hanquan, Xi'an Institute of Geology and Mineral Resources, 116 Easy Youyi Road, Xi'an 710054, People's Republic of China)

◆◆◆ **July 17–24**
GEOLOGICAL AND LANDSCAPE CONSERVATION, int'l. mtg., Great Malvern, U.K. (Margaret Phillips, The Company, St. John's innovation Centre, Cowley Road, Cambridge C84 4WS. Phone: (0223) 421124. Fax: (0223) 421158

◆◆◆ **July 18–23**
CLAY CONFERENCE (10th International Conference in conjunction with Commission VII of the International Soil Science Society), Adelaide, South Australia. (Dr. Tony Eggleton, Geology Department, ANU, GPO Box 4, Canberra, ACT 2601, Australia)

◆◆◆ **July 25–30**
ORIGIN OF PARENTAL ANORTHOSITE MAGMAS, TECTONIC AND METAMORPHIC PROCESSES IN THE EVOLUTION OF ANORTHOSSITES (Conference), Kadalaksha, Kola Peninsula, Russia. Sponsored by International Geological Correlation Programme Project 290. (Michael Higgins, Sciences de la Terre, Université du Québec à Chicoutimi, Chicoutimi, Québec G7H 2B1, Canada. Phone: (418) 545–5012)

▶ August 1993

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

◆◆◆ **August 1–6**
GEOCHEMISTRY OF THE EARTH SURFACE (3rd International Symposium), University Park. Pennsylvania, USA. (Lee Kump, Department of Geosciences, Pennsylvania State University, 210 Deike Bldg., University Park, PA 16802, USA. Phone: (814) 863–1274; telefax: (814) 865–3191)

◆◆◆ **August 4–7**
PALEOZOIC MICROVERTEBRATES (IGCP Project-328) (2nd International Symposium), Berlin, Germany. In conjunction with the birthday anniversary of Professor Walter Gross. (Dr. S. Turner, Queensland Museum, P.O. Box 3300, South Brisbane, Qld 4101, Australia. Telefax: 617 846 1918. Or Prof. H. Jaeger, Museum fur Naturkunde, Invalidenstr. 43, 00–104 Berlin, Germany)

◆◆◆ **August 8–12**
STRATIGRAPHIC RECORD OF GLOBAL CHANGES: CLIMATE, SEA LEVEL, AND LIFE (SEPM Meeting), University Park, Pennsylvania, USA. (Mike Arthur, Department of Geosciences, Pennsylvania State University, University Park, PA, 16802, USA. Phone: (814) 865–6711)

◆◆◆ **August 11–15**
GEOSCIENCE IN URBAN DEVELOPMENT (International Conference), Beijing, China. (Professor Wang Sijing, Chairman LANDPLAN IV, Institute of Geology, Academia Sinica, P.O. Box 634, Beijing 100029, China. Phone: 86–1–2027766; telefax: 86–1–4919140; telefax: 22474 ASCHI CN c/o Institute of Geology)

◆◆◆ **August 15–19**
CARBONIFEROUS TO JURASSIC PANGEA: A GLOBAL VIEW OF ENVIRONMENTS AND RESOURCES (International Symposium), Calgary, Alberta, Canada. (Dr. Benoit Beauchamp or Dr. Ashton Embry, Geological Survey of Canada, 3303 33rd St. NW, Calgary, Alberta T2L 2A7, Canada. Phone: (403) 292–7190; telefax: (403) 292–4961

◆◆◆ **August 23–29**
GEOMORPHOLOGY (3rd International Conference), Hamilton, Ontario, Canada. (3rd International Geomorphology Conference, Department of Geography, McMaster University, Hamilton, Ontario L8S 4K1, Canada. Phone: (416) 525–9140, ext. 4535; telefax: (416) 546–0463; E-mail: GEOMORPH)

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

◆◆◆ **August 28–September 15**
LANDSLIDES (International Meeting and Workshop), Czech and Slovak Federal Republic. (ICFL–C.S. Landslides '93, c/o NOVOSAD IG/EG, I. Sekaniny 1801, CS–70800 Ostrava 4, Czechoslovakia. Phone: (42–69) 473028; telefax: (42–2) 381848)

▶ September 1993

◆◆◆ **September 5–11**
NUCLEAR-WASTE MANAGEMENT, int'l mtg., Prague, Czech and Slovak Federal Republic, by American Society of Mechanical Engineers. Czech and Slovak Mechanical Engineering Society, and the Czech and Slovak Nuclear Society. (Radovan Kohout, Ontario Hydro (H11 A2), 700 University Ave., Toronto, Ontario M5G 1X6. Phone: 416/592-5384. Fax: 416/592-4485)

◆◆◆ **September 6–8**
STRUCTURES AND TECTONICS AT DIFFERENT LIGHOSPHERIC LEVELS (International Conference), Graz, Austria. (Wolfgang Unzog, Department of Geology, University of Graz, Heinrichstrasse 26, A–8010 Graz, Austria. Phone: 43 316 380 5584; telefax: 43 316 38 28 85)

♦♦♦ **September 8–13**
JURASSIC GEOLOGY (Arkell International Symposium), London, UK. (Dr. Stewart Brown, Conference Secretary, Petroleum Science and Technology Institute, 25 Ravelston Terrace, Edinburgh EH4 3EX, UK. Phone: 031 451 5231; telefax: 031 451 5232)

♦♦♦ **September 8–17**
LAYERING IN IGNEOUS COMPLEXES – WAGER AND BROWN 25th ANNIVERSARY COMMEMORATIVE MEETING (Symposium), Johannesburg, South Africa. (Professor R. Grant Cawthorn, Department of Geology, University of the Witwatersrand, P.O. Wits 2050, Republic of South Africa. Phone: 11 716 2711 or 2608; telefax: 11 339 1697 or 430 1926)

♦♦♦ **September 14–16**
AFRICAN GEOLOGY (16th International Colloquium), Ezulwini, Swaziland. (The Chairman or Secretary, Organizing Committee, 16th Colloquium of African Geology, P.O. Box 9, Mbabane, Swaziland. Phone: 42411; telefax: 45215; telex: 2301 WD; telegram: GSM)

♦♦♦ **September 21–23**
ANDEAN GEODYNAMICS (2nd International Symposium), Oxford, UK. Sponsored by University of Oxford and Institut Francais de Recherche Scientifique pour le Développement en Coopération (Orstom). (Pierre Soler, ISAG 93, Orstom, CS1, 213 rue Lafayette, 75480 Paris Cedex 10, France. Telefax: 33 1 48 03 08 28)

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

♦♦♦ **September 27–30**
ENVIRONMENTAL BIOGEOCHEMISTRY (11th International Symposium), Salamanca, Spain. (Dr. J.F. Gallardo Lancho, I.E.T./CSIC, Aptdo. 257, Salamanca 37071, Espana, Spain. Phone: (923) 219606; telefax: (923) 219609)

♦♦♦ **September 27–29**
GLOBAL BOUNDARY EVENTS (Interdisciplinary Conference of IGCP Project 293, Geochemical Marker Events in the Phanerozoic), Kielce, Poland. (Barbara Studencka, Muzeum Ziemi PAN, Al.Na Skarpie 20/26, 00–488 Warszawa, Poland. Phone: (4822) 217–391; telefax: (4822) 297–497. Or Helmut H.J. Geldsetzer, Geological Survey of Canada, 3303–33rd St. NW, Calgary, Alberta T2L 2A7, Canada. Phone: (403) 292–7155; telefax: (403) 292–5377)

♦♦♦ **September 28–October 1**
ENVIRONMENTAL POLLUTION (International Conference), Barcelona, Spain. (ICEP Conference Office, ICTR Secretariat, 11–12 Pall Mall, London SW1Y 5LU, UK. Phone: 44 71 930–6825; telefax: 44 71 976–1587; telex: 925312 REICO)

▶ October 1993

♦♦♦ **October 4–9**
BASIN INVERSION (International Conference), Oxford, UK. (James G. Buchanan, British Gas Exploration and Production Limited, 100 Thames Valley Park Drive, Reading, Berkshire RG6 IPT, UK. Phone: 0734–353222; telefax: 0734–353484; telex: 846231)

♦♦♦ **October 10–15**
INTERNATIONAL ASSOCIATION FOR MATHEMATICAL GEOLOGY (Silver Anniversary Meeting), Prague, Czechoslovakia. (John C. Davis, Kansas Geological Survey, University of Kansas, Lawrence, KS 66047, USA. Phone: (913) 864–3955; telefax: (913) 864–5317; E-mail: john_davis.moore_@msmail.kgs.ukans.edu. Europe, Africa, and Asia: Jan Harff, Institute for Baltic Sea Research, Seestr. 15, 0–2530 Warnemuende, Germany. Phone: 49 381 58 261; telefax: 49 381 58.336; E-mail: harff@geologie.io-warnemuende.dbp.de)

♦♦♦ **October 11–24**
INTERGEMS '93 (2nd International Symposium on Precious and Decorative Stones), Prague, Czechoslovakia. Sponsored by Czech and Slovak Geological Services and Museums. (Secretariat INTERGEMS, Malostranske nam. 19, CS–11821 Praha 1, Czechoslovakia. Phone: 535 357; telefax: 533 564)

♦♦♦ **October 17–20**
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (International Meeting), The Hague, The Netherlands. (AAPG, Box 979, Tulsa, OK 74101, USA. Phone: (918) 584–2555; telefax: (918) 584–0469)

◆◆◆ **October 18–23**
NEW DEVELOPMENTS IN GEOTHERMAL MEASUREMENTS IN BOREHOLES (Meeting), Klein Koris, Germany. (Prof. E. Hurtig, GFZ Potsdam, Telegrafenberg A45, 0–1561 Potsdam, Germany. Phone: 49 331 310 347; telefax: 49 331 310 610; E-mail: gth@gfz-postsdam.dbp.de)

◆◆◆ **October 25–28**
GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Boston, Massachusetts, USA. (Vanessa George, GSA, P.O. Box 9140, Boulder, CO 80301, USA. Phone: (303) 447–2020)

▶ November 1993

◆◆◆ **November 15–30**
LOW TEMPERATURE METAMORPHISM: PROCESSES, PRODUCTS AND ECONOMIC SIGNIFICANCE (IGCP Project 294 Thematic Meeting), Santiago, Chile. (Professor M. Vergara, Universidad de Chile, Departmento de geologia y Geofisica, Casilla 13518-Correo 21 Santiago, chile. Telefax: 56 2–6963050)

1994

◆◆◆ **June 6–10**
EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS (56th) Annual Meeting and Exhibition), Austria Center, Vienna, Australia. (Evert Van der Gaag, Business Manager, European Association of Exploration Geophysicists, Utrechtseweg 62, NL-3704 HE Zeist, the Netherlands. Phone: (03404) 56997; telefax (03404) 62640; telex:33480)

1995

◆◆◆ **May 29–June 2**
EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS (57th Annual Meeting and Exhibition), Glasgow, UK. (Evert van der Gaag, European Association of Exploration Geophysicists, Utrechtseweg 62, NL-3704 HE Zeist, The Netherlands. Phone: (03404) 56997; telefax: (03404) 62640; telex: 33480)

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

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

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

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

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

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

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

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

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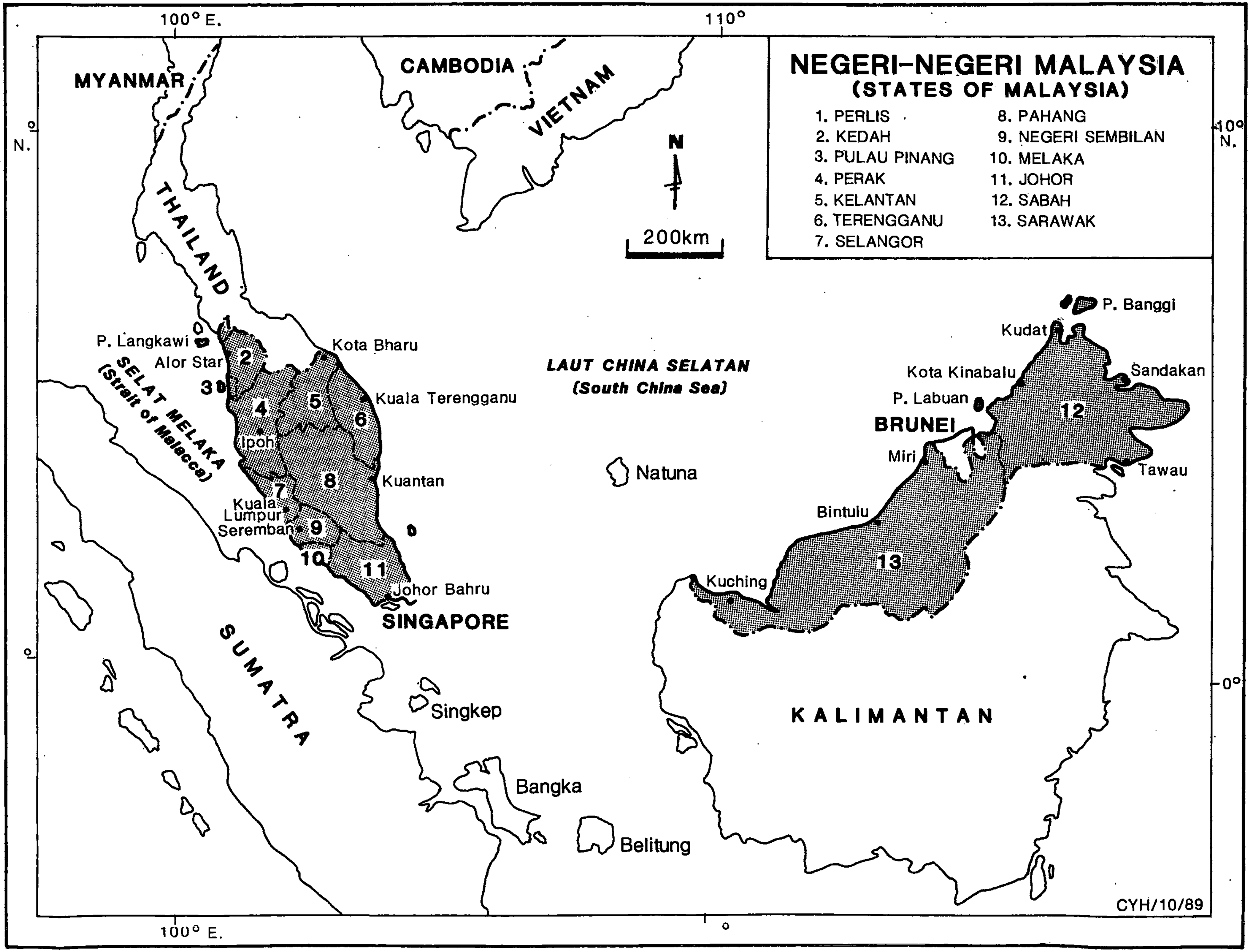
NEGERI-NEGERI MALAYSIA
(STATES OF MALAYSIA)
1. PERLIS
2. KEDAH
3. PULAU PINANG
4. PERAK
5. KELANTAN
6. TERENGGANU
7. SELANGOR
8. PAHANG
9. NEGERI SEMBILAN
10. MELAKA
11. JOHOR
12. SABAH
13. SARAWAK
100° E.
110°
10° N.
0°
N
200km
MYANMAR
CAMBODIA
VIETNAM
THAILAND
P. Langkawi
Alor Star
Kota Bharu
Kuala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