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CATATAN GEOLOGI
(GEOLOGICAL NOTES)

SESAR KUATERNER: SUATU PENEMUAN DI DATARAN KENINGAU

QUATERNARY FAULT: A DISCOVERY IN THE KENINGAU PLAIN

Shariff Abd. Kadir S. Omang, Sanudin Hj. Tahir, Umar Hamzah dan Sahibin Abd. Rahim, Jabatan Sains Bumi, FSSA, Universiti Kebangsaan Malaysia, Kampus Sabah

Pendahuluan

Sabah di dalam sejarah geologinya dipercayai telah mengalami beberapa siri tektonik yang berkait rapat dengan pembentukan Geosinklin Baratlaut Borneo (Haile, 1963). Ianya bermula lebih kurang 130 juta tahun dahulu di zaman Awal Kapur di mana berlakunya penurunan benua secara rantau diikuti oleh fasa gunung berapi dasar laut. Aktiviti pengendapan sedimen mengambil tempat pada Eosen di mana berlaku pula perlipatan dan pengangkatan. Pengenapan berterusan hampir di seluruh kawasan Sabah, terutama di bahagian barat sehingga Awal Miosen. Ini diikuti oleh orogeni rantau menyebabkan perlipatan, pengangkatan dan aktiviti volkanik pada Miosen Tengah. Selepas orogeni tersebut kitar sedimentasi bermula lagi dan berakhir pada kala Akhir Miosen (26 - 7 juta tahun). Di sekitar 7 juta tahun yang lalu iaitu pada kala Awal Pliosen berlaku lagi satu pergerakan bumi yang melipat jujukan sedimen sambil meneroboskan batuan igneus di antara lain menghasilkan Gunung Kinabalu dan pergunungan yang lain. Sehingga Akhir Pliosen kebanyakan kawasan telah mengalami proses hakisan untuk membentuk penedataran. Secara amnya zaman selepas 2.5 juta tahun yang silam (Kuaterner) bolehlan dianggap sebagai stabil dari aspek pembentukan gunung-ganang atau orogeni. Walaubagaimanapun Sabah khasnya dan Kepulauan Borneo amnya adalah dianggap masih aktif yakni merupakan zon-zon yang mobil secara tektonik (Leichti, 1960; Wilford, 1968; Tjia, 1983). Pendapat ini dibuat berdasarkan penemuan-penemuan yang merupakan kesan-kesan pergerakan ke atas, pemiringan dan pemungkuman yang dimanifestasikan oleh perubahan paras laut, pengangkatan dan pemiringan permukaan-permukaan hakisan, pemungkuman, perlipatan dan penyesaran sedimen Kuaterner serta gempabumi dan kun-kun lumpur. Dari pengukuran yang dibuat ke atas perubahan paras laut dan pentas-pentas atau permukaan terhakis Kuaterner (Tjia, 1983) telah dapat menyimpulkan bahawa kadar pengangkatan tektonik untuk sebahagian besar Malaysia Timur adalah dari 0.35 - 7 mm/tahun sungguhpun begitu beliau di dalam laporannya mengatakan bahawa cerapan-cerapan di lapangan yang mewakili perlipatan dan penyesaran Kuaterner yang berasalmula tektonik sangat kurang dilaporkan untuk menguatkan lagi bukti-bukti bahawa berlakunya tektonik di Sabah di zaman Kuaterner. Manggon (1987) telah menemui satu set sesar konjugat di dalam aluvium tua di kawasan kajiannya di daerah Keningau. Sehubungan dengan itu kawasan tersebut telah dilawati pada awal Mei 1987 untuk membuat kajian selanjutnya. Singkapan tersebut terletak di Km 18 jalanraya dari Pekan Keningau ke arah Tenom. Singkapan tersebut adalah sepanjang 100 meter dan setinggi hampir 20 meter.

Cerapan di Lapangan

Litologi

Enapan Kuaterner di kawasan ini terdiri dari jenis pengaruh sungai. Bentuk-bentuk palung sungai yang telah terpenggal jelas menunjukkan pergerakan aliran sungai dari kiri ke kanan dan sebaliknya. Selanglapis di antara gravel dan pasir berlempung menjelaskan kekuatan arus sungai yang berubah-ubah dalam masa sejarah pengenapan jujukan tersebut. Tidak terdapat sebarang fauna dan flora yang terawet untuk rujukan usia. Litologi jujukan ini terdiri dari selanglapis gravel kasar dan pasir berlempung dipercayai berpunca dari Formasi Crocker. Namun demikian, beberapa kerikil yang dicerap, sangat bulat, berukuran 3 cm - 7.5 cm di percayai bukan dari Formasi Crocker. Kerikil-kerikil tersebut mempunyai persamaan dengan kerikil-kerikil yang ditemui di dataran daerah Sandakan. Kerikil-kerikil ini telah diterangkan oleh Lee (1972) yang puncanya masih jadi tanda tanya hingga sekarang.

Lapisan Gravel Kasar

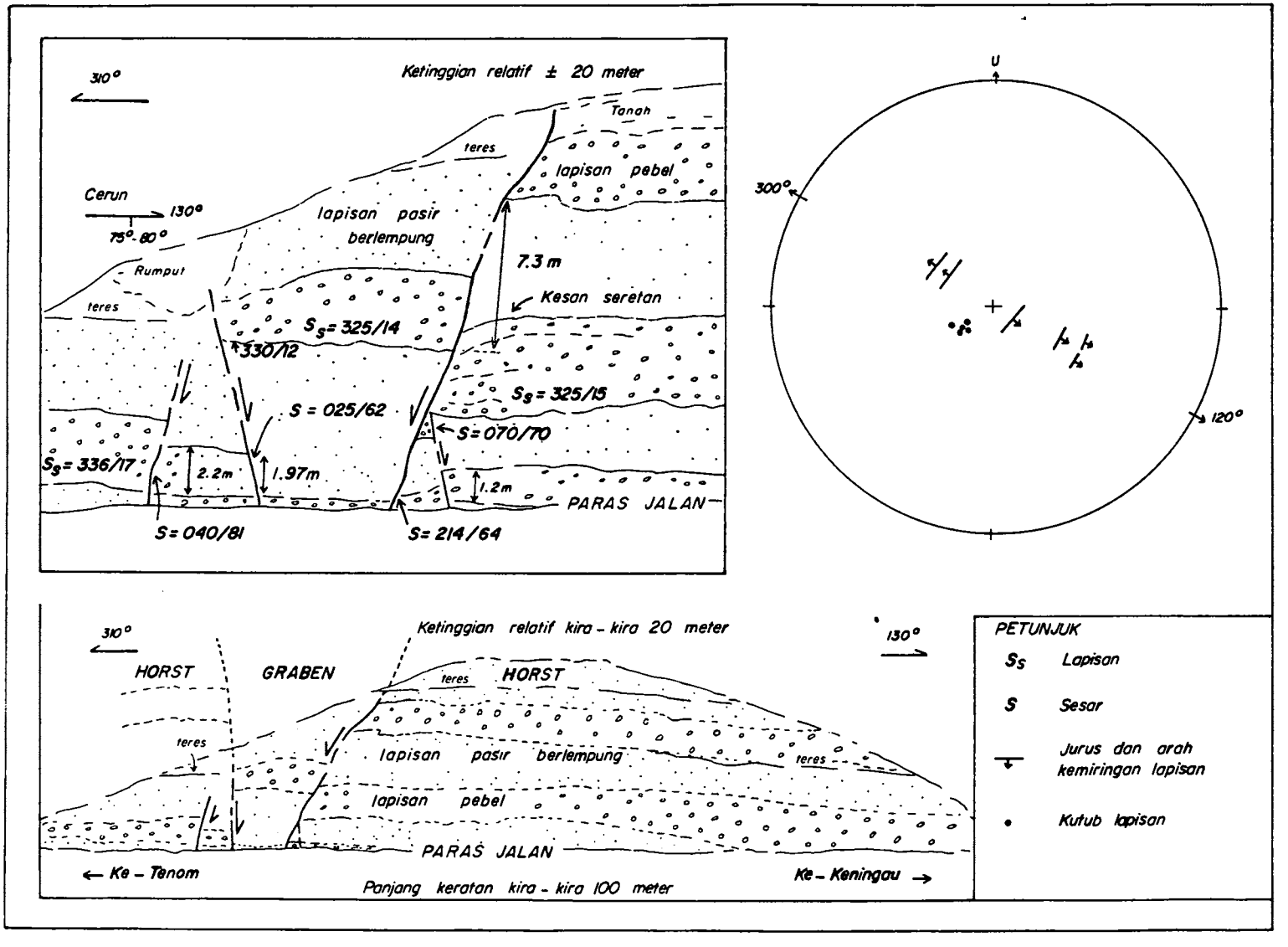
Ini terdiri dari kerikil batupasir separa bulat hingga sangat bulat, bersaiz maksima mencapai 10.5 cm. Lapisan ini berukuran lebih dari 2.0 meter tebal dan mempunyai tentuaturan yang buruk. Lapisan ini lebih tahan terhadap hakisan berbanding dengan lapisan pasir. Di beberapa titik cerapan yang mempunyai saiz kerikil lebih kecil diperhatikan lapisan silang dan bentuk-bentuk palung dapat dikesan dari imbrikasi kerikil. Matriksnya terdiri dari pasir kasar yang juga merupakan hasil dari bahan hakisan Formasi Crocker. Sempadan bawah setiap lapisan sangat jelas menunjukkan garis pemisahan lapisan dengan lapisan pasir, manakala sempadan atas merupakan perubahan saiz butiran dari gravel ke pasir. Walaubagaimanapun perubahan ini sekata secara sisi untuk memisahkan di antara pasir dan gravel. Sempadan-sempadan yang diwakili oleh sempadan bawah palung dapat dikesan dengan jelas.

Lapisan Pasir Berlempung

Lapisan ini kelihatan lebih cerah, berbutir halus hingga sederhana kasar. Sempadan atas biasanya beralun dan sempadan lapisan adalah jelas, manakala sempadan bawah merupakan perubahan saiz butiran kecuali sempadan alur menunjukkan kesan-kesan hakisan. Beberapa bentuk palung dapat dikesan secara kasar pada setiap lapisan. Kerikil-kerikil bersaiz kecil hingga sederhana kasar dapat diperhatikan tersebar secara rawak terutamanya pada garis yang mewakili sempadan sebuah palung. Jujukan menghalus ke atas dapat di kesan dalam lapisan. Sebahagian daripada lapisan pasir berlempung ini telah terluluhawa menjadi tanah liat berwarna keputihan.

Struktur

Rajah 1 menunjukkan beberapa set sesar turun atau sesar normal pada singkapan aluvium Kuaterner yang terdiri daripada selang lapis antara lapisan pasir berlempung dengan gravel. Sesar turun berkonjugat yang ditemui adalah berkedudukan 025/62 dan 214/64. Sesar-sesar turun yang lain berkedudukan 040/81 dan 020/70. Bukti-bukti hala pergerakan sepanjang satah sesar tidak ditemui. Walaubagaimanapun, berasaskan kepada kesan seretan yang ditunjukkan oleh lapisan gravel akibat oleh sesar berjurus 214, berkemiringan 64, dan anjakan lapisan pasir dan lapisan gravel telah



RAJAH 1 : Lakaran singkapan di Km 18 jalan dari Pekan Keningau ke arah Tenom

digunakan sebagai bukti terhadap sesar turun bagi kesemua sesar-sesar pada singkapan ini. Satah-satah sesar ini berkemiringan sederhana curam hingga curam (62 - 81). Gerak sesar tegak yang minima dan maksima bagi sesar konjugat (satah 025/62 dan satah 214/64) masing-masing adalah 1.97 meter hingga 7.3 meter. Sesar-sesar turun selain dari kedua sesar konjugat ini kelihatan seperti sesar naik (songsang) atau sesar mendatar, ini adalah disebabkan oleh satah-satah sesar turun yang hampir tegak dan agak sedikit bergelombang. Bahagian dalam bagi sesar konjugat tersebut membentuk struktur horst manakala bahagian luar adalah membentuk struktur graben yang berdampingan dengan struktur horst (Rajah 1). Struktur horst yang terletak di bahagian baratlau singkapan telah terhakis berbanding dengan di bahagian tenggara singkapan atau di sebelah kanan singkapan struktur graben. Sementara struktur graben sebahagiannya pula telah terhakis, namun sebahagiannya masih boleh dilihat atau terawet. Struktur horst dan graben di singkapan ini bukanlah merupakan struktur berskala besar, ini kerana kalau dilihat daripada nilai gerak sesar tegaknya yang maksima adalah lebih kurang 7.3 meter. Namun demikian, berpandukan kepada geometri dan orientasi struktur ini maka ditafsirkan bahawa pembentukan struktur horst dan graben ini adalah dikawal oleh satah-satah sesar turun yang mana terbentuk oleh tegasan tegangan (tensional stress). Plot satah-satah sesar pada unjuran sama luas menunjukkan bahawa arah tegasan tegangan di lokaliti ini adalah dalam sela 120 - 300 (Rajah 1). Walaubagaimanapun struktur horst dan graben ini boleh juga terbentuk akibat daripada sesar-sesar naik (songsang). Tapi dalam penafsiran ini penulis-penulis lebih yakin bahawa pembentukan gaya struktur di singkapan ini adalah di kawal oleh sesar-sesar turun.

Perbincangan

Penulis-penulis telah menjelajah di beberapa kawasan dataran antara Keningau dan Tenom, malangnya singkapan bagi sesar-sesar turun dalam enapan aluvium hanya ditemui di Kilometer 18 sahaja. Panchatcharasivam (1966) telah memetakan sesar-sesar turun yang terdapat pada bahagian kumpulan tengah teres aluvium Keningau (30 - 40 m tinggi) yang berhampiran dengan Apin-Apin dan telah mengesan adanya pergerakan sebanyak 8 inci.

Keterangan di atas menjelaskan usia relatif bagi sesar tersebut adalah lebih muda berbanding dengan usia enapan aluvium. Fosil kayu yang dikutip dari salah satu teres aluvium di kawasan Dataran Keningau menunjukkan usia 39,000 tahun dahulu (Tjia, 1983: 200). Menurut beliau lagi, pada masa Kuaterner, pergerakan menegak yang disertai oleh pemiringan dan pemungkuman telah mengambil tempat dalam zon mobil tektonik dan juga telah menunjukkan bahawa arah pemiringan rantau bagi kawasan Pantai Barat Sabah mengarah ke Baratlaut atau ke arah Laut Cina Selatan.

Analisis plot satah-satah sesar turun melalui unjuran sama luas menunjukkan arah tegasan tegangan yang menyebabkan sesar-sesar ini mengarah Baratlaut-Tenggara.

Penemuan sesar-sesar di dalam aluvium Kuaterner ini bolehlah dianggap sebagai satu lagi data tambahan disamping maklumat-maklumat pengangkatan paras laut, pentas hakisan dan lain-lain (Tjia, 1983) yang dapat mengukuhkan lagi pendapat yang mengatakan berlakunya aktiviti-aktiviti tektonik pada kala Kuaterner.

Rujukan

Haile, N.S., 1969. Geosynclinal theory and the organizational pattern of the North-west Borneo Geosyncline. *Geol. Soc. London Quart. Jour.* v. 124, 171-195.

Lee, D.T.C., 1972. Sandakan Peninsula, eastern Sabah, East Malaysia. *Geol. Surv. Borneo Reg., Report 6,* 75 p.

Manggon, A., 1987. Geologi am dan gambarudara kawasan dataran Keningau. Tesis Sarjanamuda Sains, UKM Sabah (tidak diterbitkan).

Panchatcharasivam, S., 1966. *Geology of the Apin-Apin area, Sabah, East Malaysia.* B.Sc. thesis, University of Malaya (unpublished).

Tjia, H.D., 1983. Quaternary tectonics of Sabah and Sarawak, East Malaysia. *Sains Malaysiana,* 12(2), 191-215.

Wilford, O.E., 1967. The effects of Late Tertiary and Quaternary tectonic movement on the geomorphological evolution of Brunei and adjacent parts of Sarawak. *Jour. Tropical Geog.,* 24, 50-56.

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On the mineralogy of the black sand of Pasir Hitam, Langkawi

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Pasir Hitam is a spot on the northern coast of Pulau Langkawi well known among the visitors to the island. As the name suggests, the sands on a stretch of beach at the place is black in colour.

During one of the annual student field trip to Langkawi, the writer visited Pasir Hitam during high tide. There was a narrow stretch of beach, about ten feet wide, running between the water edge and the low cliff. Gentle waves were continuously washing the sands, separating the black grains from the light coloured quartz sands. Rough estimate of the depth of the black sand, by digging into the sand using a hammer showed its depth may extend to at least a few feet below the surface.

A sample of the sand was taken and examined in the laboratory. The grains were fine to medium in size, mostly rounded to subrounded. After a heavy liquid separation to remove quartz and other light minerals, the heavies were separated using a Frantz isodynamic magnetic separator and the various fractions were examined. Results of the examination is shown in Table 1.

Table 1

Magnetic fraction	Weight percent	Mineralogical composition
0.2 amp	0.15	magnetites
0.2 amp	0.92	ilmenites; rounded and polished
0.4 amp	10.76	mainly ilmenites, well rounded
0.6 amp	86.09	mainly (over 95%) rounded tourmaline; few grains of monazite and xenotime
0.8 amp	0.14	middlings and composite grains
1.0 amp	0.11	- " -
1.0 amp	1.85	zircon, allanite, rutile, etc.

The composition of the sands of Pasir Hitam shows that the black colour is due to tourmaline. This is interesting because normally ilmenite is more dominant and none normally associates hlack sands on the beach and in the tin tailings in the Peninsular Malaysia with ilmenite.

Jones (1978, p. 171) reported that 'alluvial ilmenite was recovered for a short period prior to the Second World War from the bach sands at Pasir Hitam along the north coast of Pulau Langkawi. The reserves of ore were quickly exhausted and operations were brought to a close after a few months only'. Having examined the samples, the present writer understands better why the ilmenite reserve was so quickly exhausted.

Tourmalinization associated with Langkawi granites is a common phenomena. The granites around the Kuah Jetty is being cut by numerous

tourmaline veins. Pasir Hitam itself is located at the contact between the Gunung Raya granite and the metasediments.

Reference

Jones, C.R., 1981. Geology and mineral resources of Perlis, North Kedah and the Langkawi Islands. *Geological Survey Malaysia, District Memoir 17.*

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THE METHOD OF FLUID INCLUSION STUDY AND ITS APPLICATION TO THE BUJANG MELAKA PLUTON, KINTA VALLEY

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The most important fluid systems H_2O, CO_2, H_2O-NaCl, H_2O-CO_2, H_2O-CO_2-NaCl as well as the system $CaCl_2$-$NaCl_2$-H_2O are presented. On the basis of the phase diagrams, the non-destructive determination by micro thermometric methods (heating and cooling stage attached to a microscope) of the density, composition (H_2O, NaCl, $CaCl_2$, CO_2) pressure and temperature of the fluid is described.

The samples studied during a cooperation project between the Federal Bureau for Geoscience and Natural Resources (BGR) of the Federal Republic of Germany and the Geological Survey of Malaysia on the Bujang Melaka pluton in the Kinta Valley aided in deciphering the evolution of the fluid phase in this Sn-mineralized area (Fig. 1).

Interpretation of the fluid inclusions data

The range of salinities (0-38 wt % NaCl equivalent) and homogenization temperatures (100°-420°C) as well as the presence of mixed CO_2-H_2O inclusions in the Bujang Melaka Pluton are usual features of Sn-W-bearing greisen and veins as summarized by Roedder (1984).

The minimum pressure of entrapment as determined from the CO_2 phase density, salinity and temperature of total homogenization of the CO_2-H_2O-(NaCl) inclusions ranges from 0.25 to 1.9 kb (Fig. 2). This is in agreement with the presence of zeolite (stilbite) in the contact aureole, which is stable up to 3 kb (Winkler, 1974). The lower pressure limit of 0.25 kb corresponds to a depth of 0.9 and 2.5 km under lithostatic and hydrostatic conditions, respectively. The high pressure limit of 1.9 kb implies a depth of 7 km under lithostatic load. The system may have evolved from lithostatic to hydrostatic during the intrusion.

The homogenization temperatures of the mixed CO_2-H_2O inclusions are true minimum trapping temperatures (250°-420°C) whereas the temperatures for the aqueous inclusions (100°-360°C) have to be corrected for pressure. For 1 kb, the pressure correction is 80°-110°C for the homogenization temperature range of 100°-360°C and salinities of 1-25 % (Potter, 1977). Thus the entrapment temperatures corrected for an average pressure of 1 kb are 190°-460°C; they are quite close to the bulk homogenization temperatures of mixed CO_2-H_2O inclusions (250°-420°C)(Fig. 3).

The salinities of the aqueous inclusions in proximity to mixed CO_2-H_2O inclusions are considerably higher than those enclosed in samples without CO_2-bearing inclusions. This suggests that they may have been

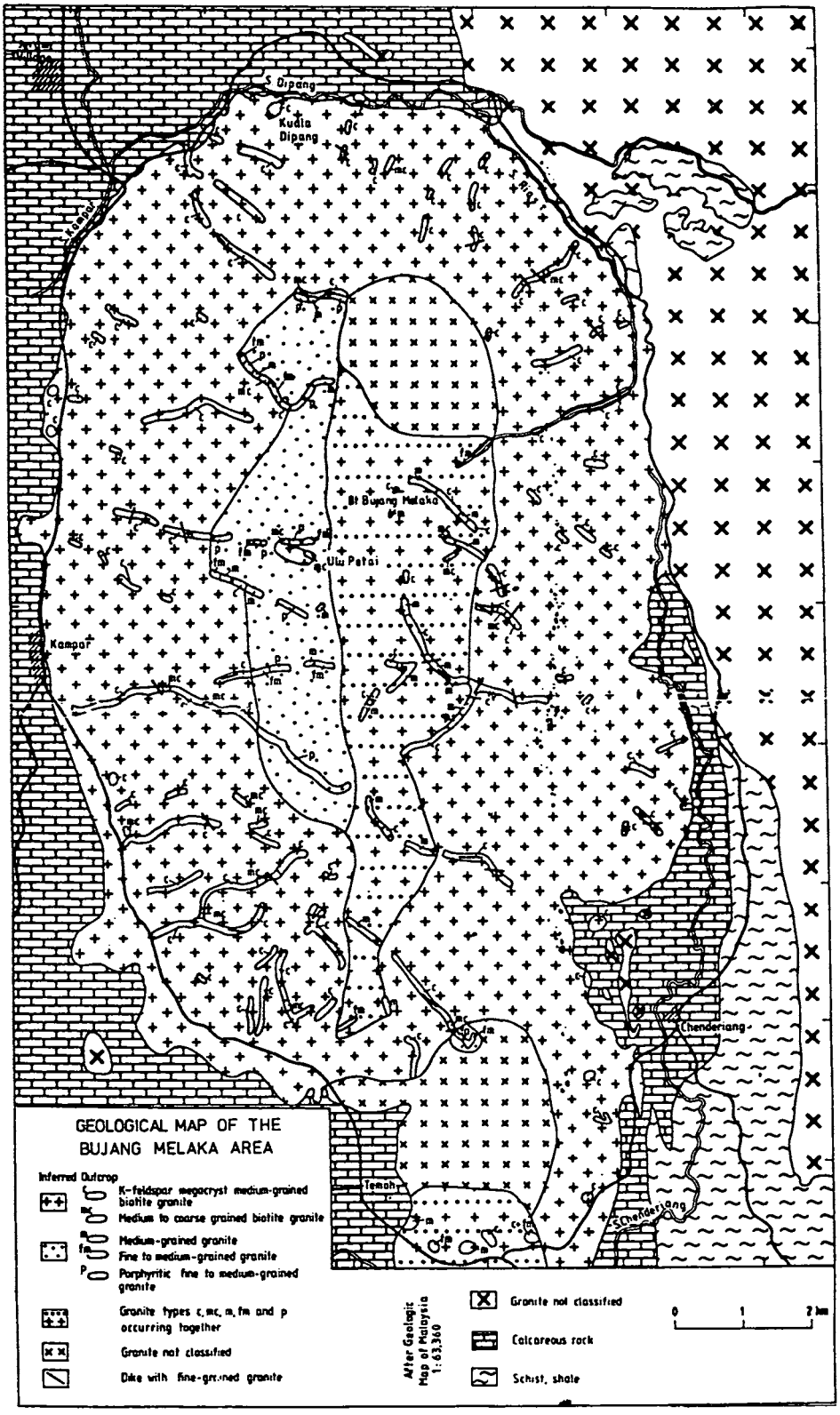

Fig. 1. Geological map of the Bujang Melaka area.

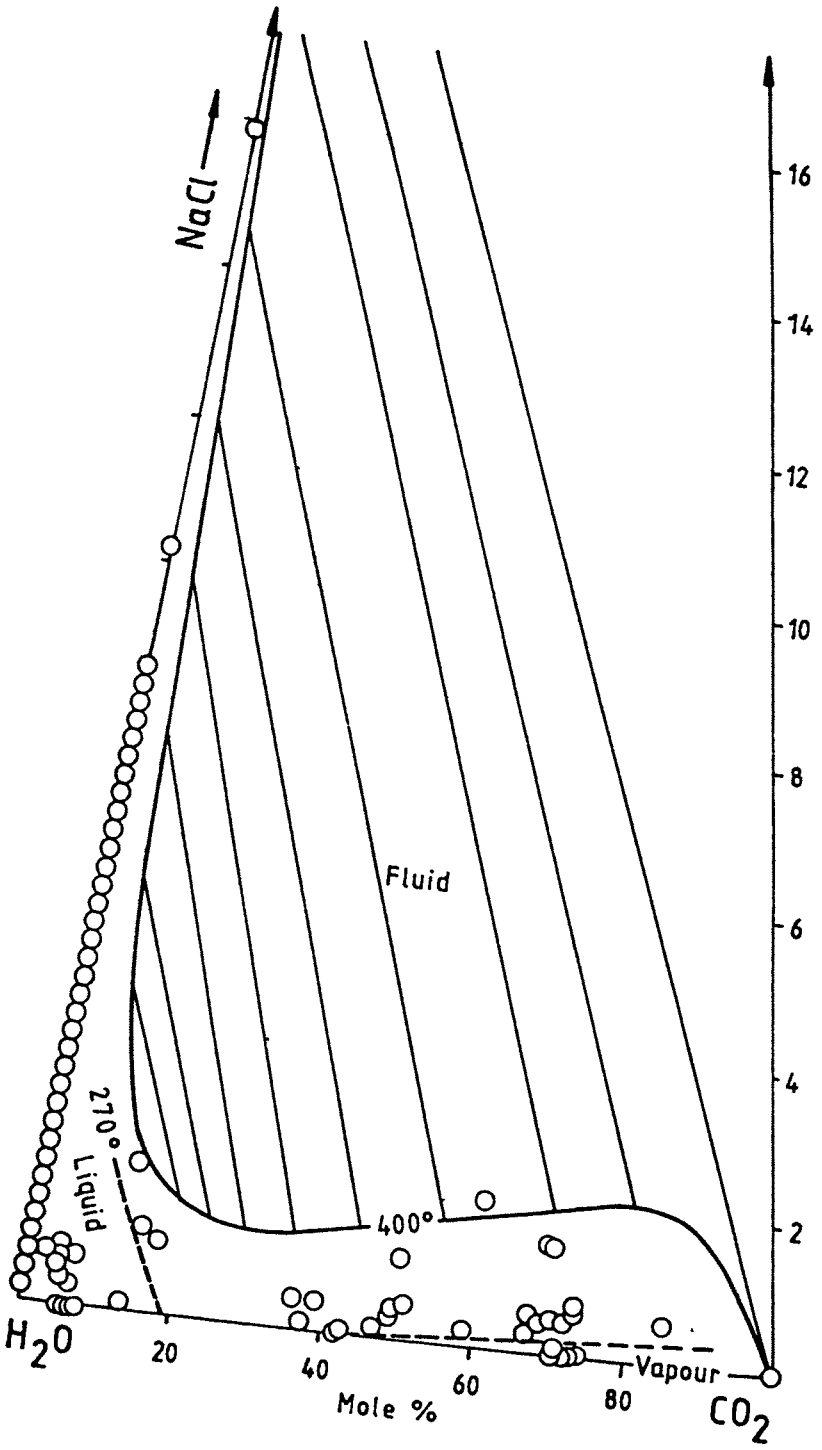

Fig. 2. NaCl-H_2O-CO_2 plot at 1 kb pressure.

trapped from CO_2-H_2O-salt fluids which unmixed into a salt-enriched liquid H_2O phase and salt-poor CO_2-H_2O vapour phase. The presence of salt in mixed CO_2-H_2O fluids increases the temperature of the miscibility gap considerably. The solvus top at 1 kb is raised from 270°C to 410°C by addition of 6% salt (relative to H_2O + salt) to a CO_2-H_2O fluid. Though most experimental data refer to NaCl (e.g. Kennedy, 1950; Gehrig, 1980), the presence of $CaCl_2$, which has been observed in many inclusions, has a similar effect on the solubility of CO_2 in H_2O.

Fig. 2 shows that the inclusions have a composition which makes unmixing a feasable process. Most data in this NaCl-H_2O-CO_2 plot lie between the 400°C and 270°C miscibility gap curves for 1 kb pressure. The tie lines which connect the compositions of coexisting salt-enriched H_2O liquids and salt-poor CO_2-H_2O vapour are only available for 400°C (Bowers and Helgeson, 1983). Assuming that similar tie lines would extend to the 270°C miscibility-gap curve, there many pairs of moderately salt-rich aqueous inclusions and salt-poor CO_2-H_2O inclusions which can be connected by such tie lines, i.e. they may have unmixed from a fluid which was homogeneous at higher temperatures and/or pressures.

In contrast to the mixed CO_2-H_2O inclusions, the pure CO_2 inclusions without any visible H_2O phase have a solitary location without any spatial relationship with the aqueous inclusions of moderate salinity (more than 13 wt %). This suggests that their origin is different and that unmixing is not a feasable process. These fluids may have been trapped as primary inclusions from the fluid exsolving from the crystallizing granite magma. The pressure range at which the entrapment may have occurred is shown by the intersection of the CO_2 isochore for the lowest density (0.57 g/cm^3) and the isochore for the highest density (0.87 g/cm^3) with the granite melting curve. The resulting pressure range of 1.4-3.8 kb is consistent with the minimum-melt-composition derived pressures, which changed from 4-7 kb to 1 kb during magmatic evolution (Fig. 3).

It should be noted that the optically pure CO_2 inclusions may have a thin film wetting the inclusion walls. If this film represents 10% of the inclusion volume then the CO_2 concentration would be only 77 mole % for the inclusion with highest CO_2 density (0.87 g/cm^3) and 66 mole % for the inclusion with the lowest density (0.58 g/cm^3).

The surrounding limestone country rocks are not considered to be a realistic source for the CO_2 because it is unlikely that they furnished pure or highly concentrated CO_2 fluids. Skarn producing fluids have CO_2 concentrations of < 5-30 mole % (Einaudi *et al.*, 1981). A variety of mineral reactions are controlled by the CO_2 concentration of the fluid. Wollastonite, which has been found in quartz-diopside schist near the town of Tapah and in other localities in the Kinta Valley (Ingham and Bradford, 1960), is not stable at 1 kb below 600°C in fluids with more than 40% mole % CO_2 (Greenwood, 1973; Helgeson & Kirkham, 1974). Ingham and Bradford (1960) and Hutchison (1983) also report occurrences of Ca garnet and idocrase in the Kinta Valley. These minerals become unstable at even lower concentrations of CO_2. Ca garnet is stable up to 30 mole % CO_2 below 600°C at 1-2 kb whereas Mg idocrase will only form in fluids with less than 2 mole % CO_2 at 2 kb.

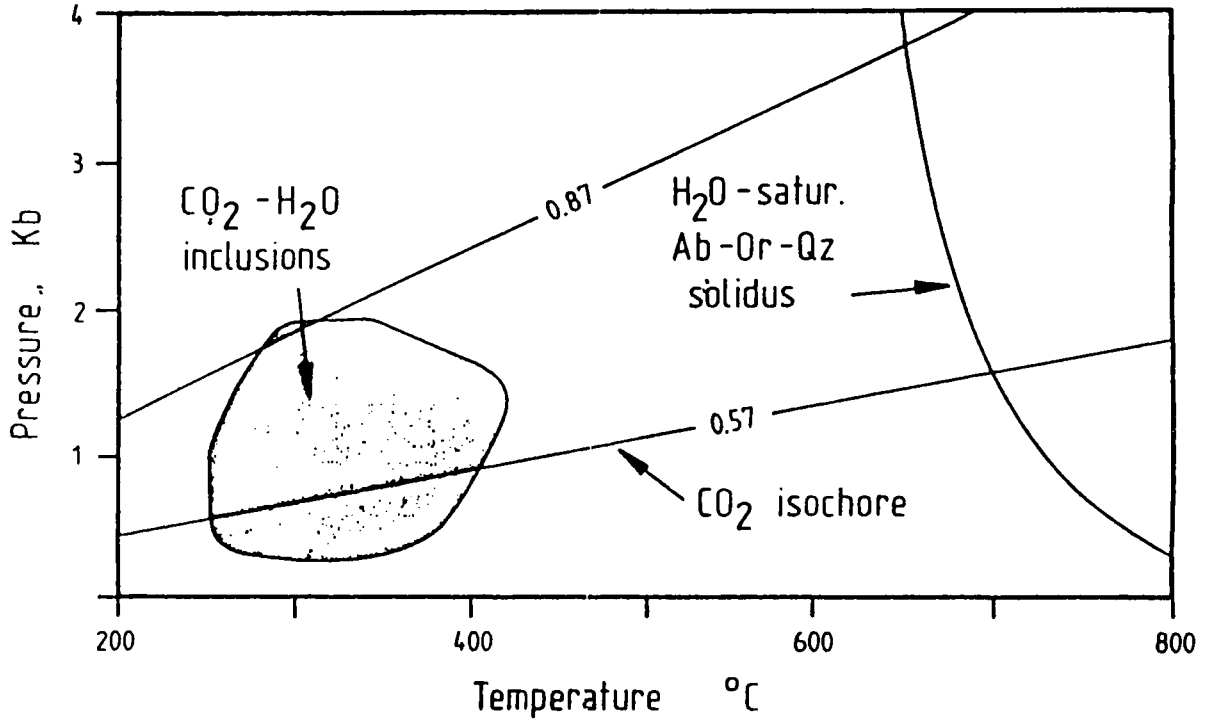

Fig. 3. Pressure-temperature plot for mixed CO_2-H_2O inclusions.

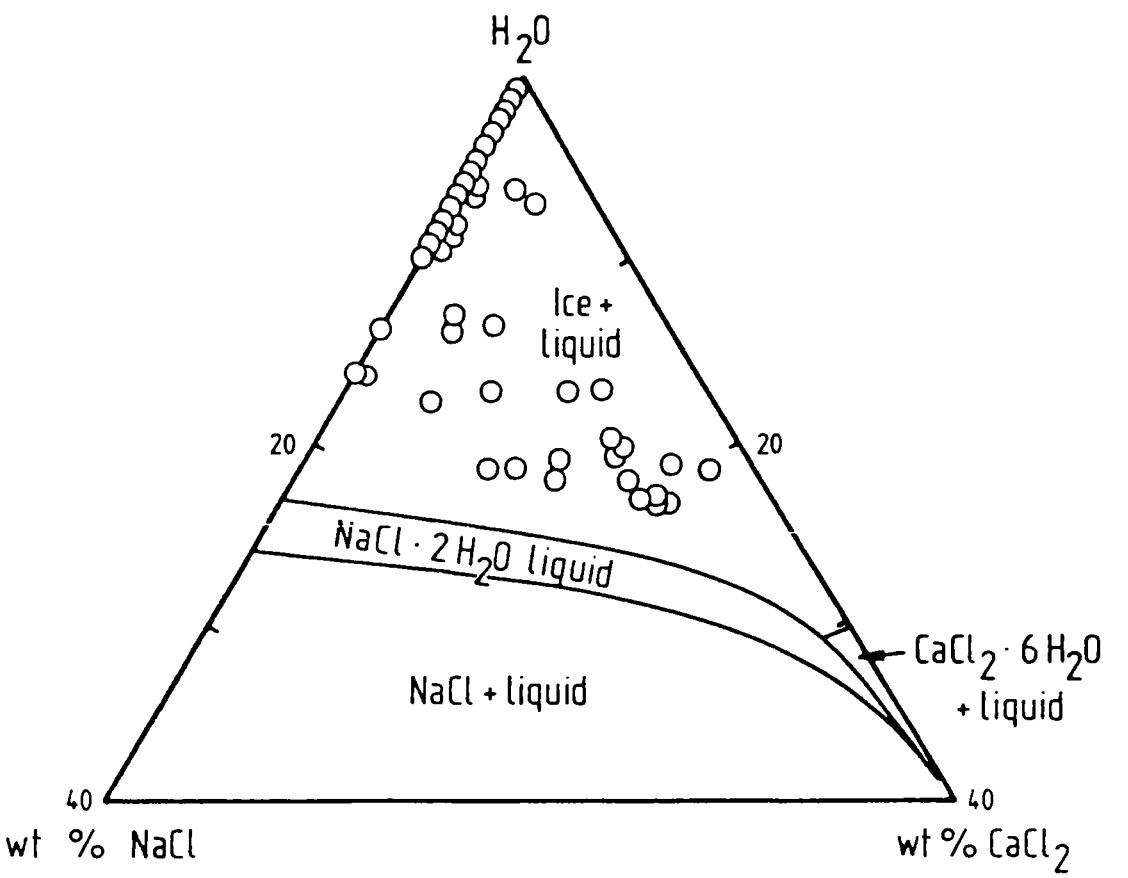

Fig. 4. NaCl-H_2O-$CaCl_2$ plot.

The location of the investigated samples also provides an argument for the magmatic origin of the CO_2 fluids. There is no difference to be noted between the composition of the $CO_2(-H_2O)$ fluid inclusions from the Ulu Petai deposit in centre of the pluton and the inclusions from the Kuala Dipang quarry located near the limestone contact. If the country rock of the granite had a significant influence on the CO_2 concentrations of the fluids then this should be revealed by these two distinct localities.

The fluid inclusion data from the Bujang Melaka differ from those of other Sn-W deposits in that the aqueous inclusions occasionally contain considerable amounts of microthermometrically determined $CaCl_2$ (Fig. 4). This is probably an analytical effect rather than a geological phenomenon, as Konnerup-Madsen (1977, 1979) also found in Norway that $CaCl_2$ bearing fluids are not uncommon in granites.

It is already evident from the salinity versus homogenization-temperature plot (Fig. 5) that fluid inclusions that contain salts other than NaCl (+ KCl) (first melting temperature < - 22.9°C) tend to homogenize at lower temperatures. Ca/Na ratios increase with decreasing temperature of homogenization. This is the same relationship which has been observed in geothermal waters. Though the Bujang Melaka data plot on the low-temperature side of the trend line for molal log ($\sqrt{Ca}/Na$) versus temperature of geothermal waters, there is a good agreement if the homogenization temperatures are corrected for pressure. A 1 kb correction would place the Bujang Melaka data 80°-110°C further towards the high temperature side.

The relationship between Ca/Na ratio and temperature can be explained in terms of silicate reactions. The primary pluton-derived fluid may have had a $CaCl_2$ content of up to 5 molar percent of total dissolved salts (Burnham, 1979; Kwak and Tan, 1981). With decreasing temperature, the concentration of $CaCl_2$ in the fluid is increased by solid-fluid interaction. Calcium from the anorthite component is more readily released to the fluid than sodium from the albite component of plagioclase as the temperature decreases (Lagache, 1984). This relationship is consistent with the bulk chemistry of hydrothermally altered rock, which usually shows a considerable degree of Ca depletion with respect to Na and K.

The $CaCl_2$-enriched fluids were probably trapped after the deposition of cassiterite, as the associated quartz is free of inclusions with measurable $CaCl_2$ content and, in addition, they have lower homogenization temperatures (100°-200°C) then fluid inclusions in quartz associated with cassiterite (160°-340°C). $CaCl_2$ was not an important component of the ore-forming fluids in the Bujang Melaka pluton. The fluids which deposited cassiterite had a low salinity (2-13%) and a temperature of 240°-440°C (corrected for 1 kb). Most probably, these fluids had molal log ($\sqrt{Ca}/Na$) less than - 1.0, i.e. they may have been in equilibrium with the granite near magmatic temperatures as opposed to the $CaCl_2$-enriched inclusions.

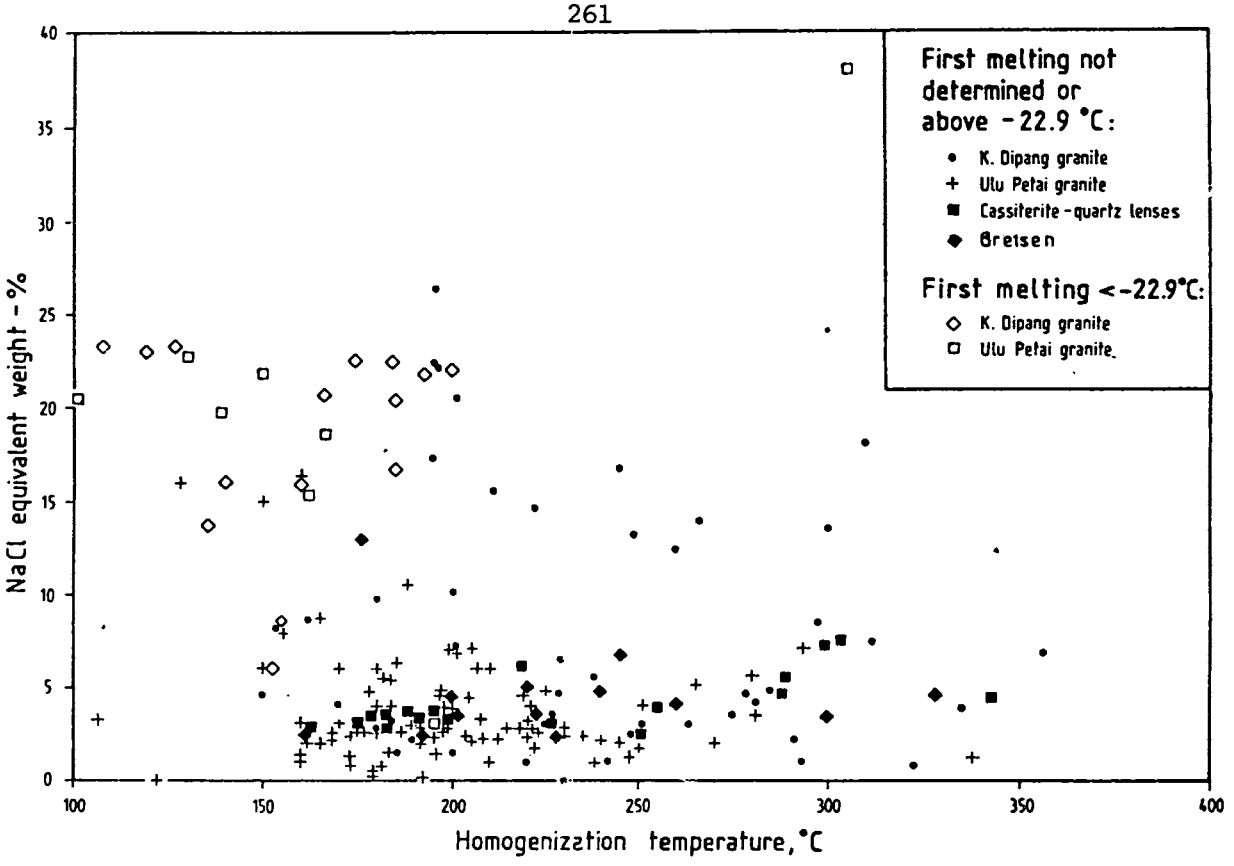

Fig. 5. Salinity vs homogeneization temperature plot.

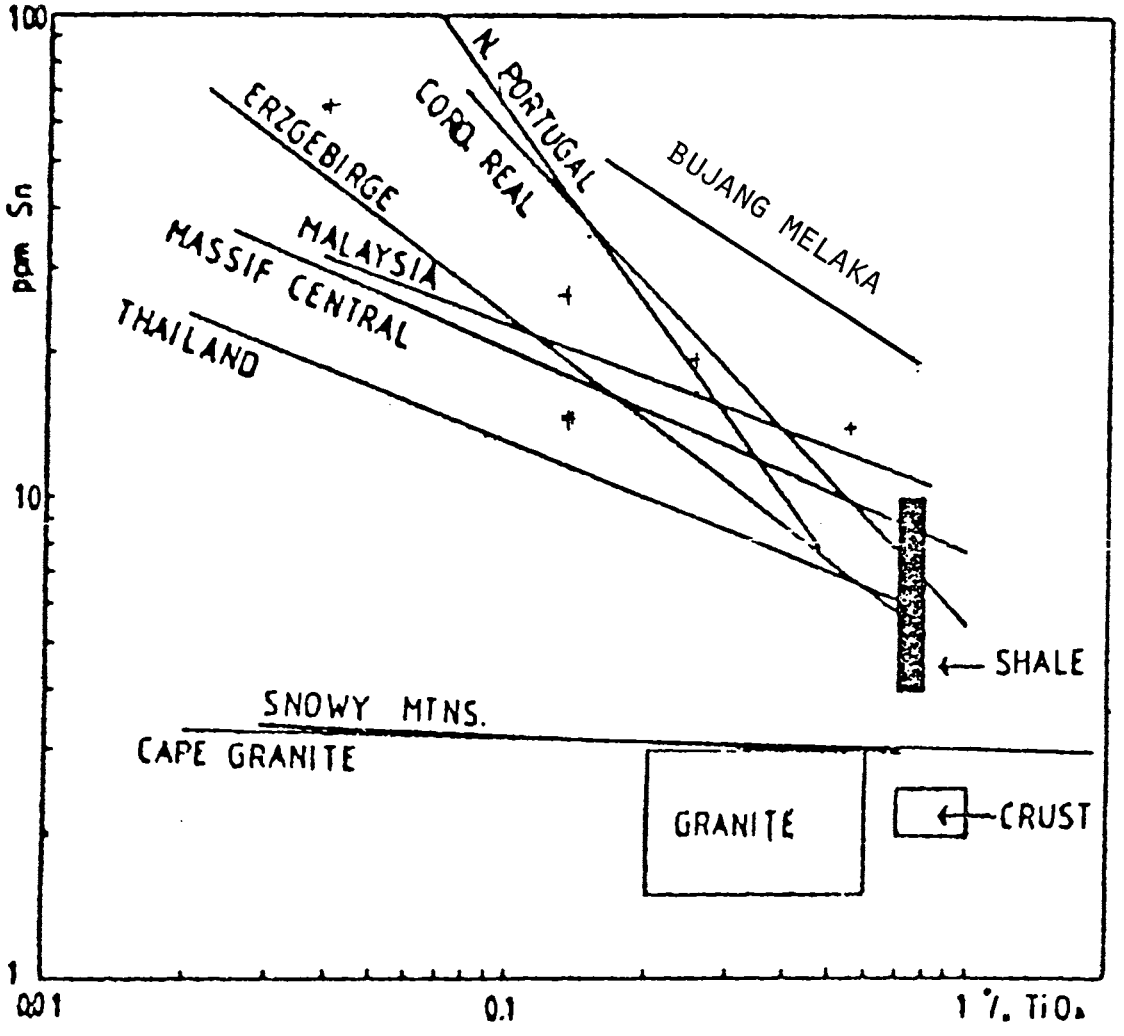

Fig. 6. Sn-TiO_2 plot comparing the Bujang Melaka pluton with other tin mineralized granites.

Model for fluid evolution

The petrographic and chemical studies show that the granite magma was derived from a sedimentary parent rock. The carbonate phases of such a parent rock can provide sufficient CO_2 by decarbonation reaction for the magma to be saturated in CO_2 (Holloway, 1976). The solubility of CO_2 in the granite magma was well below 0.5 wt % (Mysen *et al.*, 1976). In contrast, the magma was undersaturated with respect to H_2O (about 2.5 %). During ascent and crystallization, a fluid phase separated from the magma. The record of the earliest preserved fluid phase are pure CO_2 or highly concentrated CO_2 fluids, which were trapped as solitary inclusions of possible primary origin in magmatic quartz.

A separate aqueous fluid phase, only partly mixed with CO_2, evolved from the crystallizing magma. These fluids, which were the main carrier of tin, had a low salinity (2-13 wt %) and high Na/Ca ratios. Molal log ($\sqrt{Ca}/Na$) was probably less then - 1. The fluids interacted with the solidified part of the granite, cooled and deposited cassiterite before they were trapped in secondary hydrothermal quartz in the temperature range of 440°-240°C (corrected for 1 kb pressure). Decrease in temperature, acidity, salinity and increase in oxygen fugacity are possible causes for the deposition of cassiterite, which is mainly dissolved as reduced Sn-chlorite complexes, other ligands such as fluoride or $(OH)^-$ being very subordinate in neutral to acid fluids.

The oxygen fugacity during the cooling history was below the hematite-magnetite buffer as can deduced from the near absence of hematite and possibly above the fayalite-magnetite-quartz buffer indicated by the absence of stannite (Eadington and Giblin, 1979; Patterson *et al.*, 1981) unless a unrealistic high sulphur fugacity (no bornite present) and acidity are assumed. Most probably, the oxygen fugacity moved in an intermediate position along the Ni-NiO buffer by equilibria involving ilmenite, sphene, and Fe-bearing silicates. Thus oxidation is not a likely mechanism for depositing cassiterite as the oxygen fugacity should decrease rather than increase with falling temperature.

There are no significant changes in salinity of the fluids to be observed. The salt content is within the narrow range of 2-13 wt % NaCl equivalent, except for some fluids not related to mineralization, which probably obtained their higher salt concentration by unmixing as will be discussed below. Thus a decrease in salinity is not likely to be important for the cassiterite deposition either.

The acidity of the fluids has decreased by interaction with the cooling rock in a feldspar-destructive and H^+ ion consuming reaction. But the influence on cassiterite solubility was minor as the changes in pH were mostly controlled by the reaction, feldspar = muscovite (paragonite/kaolinite/montmorillonite) + quartz. Some relict feldspar is usually present in the mineralized areas.

The pH can be estimated for the observed range in fluid composition (2-13% NaCl equivalent) for the Na_2O-Al_2O_3-SiO_2-H_2O system at 1 kb. The pH estimate is 5.2-5.7 for a 2 wt % NaCl (0.34 molal) solution and 4.4-4.9

for a 13 wt % NaCl (2.2 molal) solution in the 440°-240°C temperature range. These estimates are based on the simplification that all salt is present as NaCl. They are, however, little modified when the system K_2O-Al_2O_3-SiO_2-H_2O is considered. Assuming that the KCl concentration is within 0.2-3 molal, which is the usual concentration range for tin deposits (Eadington, 1983), the calculated pH is 3.8-5.1 for temperatures between 440° and 240°C.

According to the thermodynamic calculations, cassiterite would crystallize before arsenopyrite and pyrite from fluids which cool from 440°C to 240°C along the Ni-NiO buffer, followed by chalcopyrite and sphalerite. Late-stage bismuth associated with Bi sulphosalt and galena would crystallize in the low-temperature range, at least below the Bi melting point (264°C at 1 kb), or even below 235°C if it is coexisting with pyrite. This sequence of crystallization is consistent with the observed paragenetic relationships. It is characteristic of host-rock buffered cooling.

Another group of fluids unmixed into a salt-enriched H_2O phase and a salt-poor CO_2-H_2O phase in the 400°-270°C temperature range. The salt-enriched aqueous fluids interacted with the cooling rock thereby increasing their Ca/Na ratio relative to the high temperature fluids before they were trapped between 190°C and 290°C as secondary inclusions unrelated to the cassiterite mineralization. These fluids did not carry important amounts of tin or have lost it due to cooling and rise in pH. A 90% loss of CO_2 caused by unmixing would already increase the pH by about one unit (Hedenquist and Henley, 1985).

Apart from the influence on the acidity, the role of CO_2 for the fluid transport of tin was not important because it is not a ligand forming phase. This is consistent with the observation that CO_2-bearing fluid inclusions are very scarce in secondary hydrothermal quartz associated with cassiterite though the very few inclusions found in cassiterite all contained CO_2.

CO_2-bearing fluids are also common constituents of other tin deposits. Nevertheless, their significance is not as carrier of tin in the fluid phase but as indicators of the sedimentary protolith component of the magma. Many granites related to tin deposits are known to have a sedimentary parent rock (Fig. 6).

References

Burnham, C.W., 1979. Magmas and hydrothermal fluids. *In:* H.L. Barnes (Ed.), *Geochemistry of Hydrothermal Ore Deposits*, 2nd ed., J. Wiley & Sons, 71-136.

Eadington, P.J., 1983. A fluid inclusion investigation of ore formation in a tin-mineralized granite, New England, New South Wales. *Econ. Geol., 78*, 1204-1221.

Einaudi, M.T., L.D. Meinert & R.J. Newberry, 1981. Skarn deposits. *Econ. Geol. 75th Anniv. Vol.*, 317-391.

Equation of state for H_2O-CO_2-NaCl fluids at high pressures and temperatures. *Geochim. Cosmochim. Acta, 47*, 1247-1275.

Greenwood, H.J., 1973. Thermodynamic properties of gaseous mixtures of H_2O and CO_2 between 450°C and 800°C and 0 to 500 bars. *Am. J. Sci., 13*, 1-44.

Hedenquist & Henley, 1984. Effect of CO_2 on freezing point depression measurements of fluid inclusions - evidence from active geothermal systems and application to epithermal studies. *Econ. Geol.*

Helgeson, N.C. & D.H. Kirkham, 1974. Theoretical prediction of the thermodynamic behaviour of acqueous electrolytes at high pressures and temperatures: I. summary of thermodynamic/electrostatic properties of the solvent. *Am. J. Sci., 274*, 1089-1198.

Hutchison, C.S., 1983. *Economic deposits and their tectonic setting.* Macmillian Press Ltd., London.

Ingham, F.T. & E.F. Bradford, 1960. Geology & Mineral Resources of the Kinta Valley, Perak. *Geological Survey District Memoir 9.*

Konnerup-Madsen, J., 1977. Composition and microthermometry of fluid inclusions in the Kleiven Granite, South Norway. *Am. J. Sci., 277*, 673-696.

Konnerup-Madsen, J., 1979. Fluid inclusions in quartz from deep-seated granite intrusions, South Norway. *Lithos, 12*, 13-23.

Kwak, T.A.P. & T.H. Tan, 1981. The importance of $CaCl_2$ in fluid composition trends - evidence from the King Island (Dolphin) skarn deposit. *Econ. Geol., 76*, 955-960.

Lagache, M. & A. Weisbrod, 1977. The System: two alkali feldspars-KCl-NaCl-H_2O at moderate to high temperatures and low pressures. *Contrib. Mineral. Petrol. 62*, 77-101.

Mysen, B.O., 1977. The solubility of H_2O and CO_2 under predicted magma genesis conditions and some petrological and geophysical implications. *Rev. Geophys. Space. Phys., 15*, (3), 351-361.

Patterson, D.J., H. Ohmoto & M. Solomon, 1981. Geologic setting and genesis of cassiterite-sulfide mineralization at Renison Bell, western Tasmania. *Econ. Geol., 76*, 393-438.

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PERTEMUAN PERSATUAN
(MEETINGS OF THE SOCIETY)

CERAMAH TEKNIK (TECHNICAL TALKS)

F. Schokking: Applied Quaternary Geology in the Netherlands.

Drs. Schokking who is with the Geological Survey of the Netherlands presented the abovementioned talk to about 10 members at the Geology Department on the 4th December, 1987. He was jointly involved in conducting a two-week "Workshop on the Quaternary Geology and Shallow Exploration Methods" at the Geological Survey Malaysia, Kuala Lumpur earlier.

Drs. Schokking started off with a brief introduction on the set up of the Geological Survey of Netherlands particularly its Applied Geology section.

He went on to speak about the Quaternary Geology of the Netherlands and their significance or related problems in the various aspects of engineering geology, hydrogeology and urban and landuse planning.

He ended with a description of different schematic maps produced as an aid to planning illustrating with examples from the Netherlands.

Ahmad Tajuddin Hj. Ibrahim

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Ruediger H. Karmann: Advanced Electro-Magnetic Exploration Techniques.

Laporan (Report)

Dr. Ing. R.H. Karmann, an electronics engineer and the president of Metronix Geometra from Braunschweig, Federal Republic of Germany presented the above talk to members of the Society on 10 December 1986 at the Geology Department, University of Malaya, Kuala Lumpur.

Dr. Karmann, who had been involved in research and development in Aeronauties at the German Aeronautical and Space Research Institute (DFVLR) started metronix 11 years ago to develop and manufacture geophysical instruments and to improve existing electromagnetic exploration techniques. Improvements were developed in close collaboration with the universities of Braunschweig, Goettingen and Cologne.

Five main techniques that were discussed by Dr. Karmann and illustrated with examples and case histories were:

- Electrical Conductivity Reference Exploration.
- Real-Time Magnetotellurics.
- Audio Tensor Magnetotelurics.
- Control Source Tensor Magnetotellurics.
- Deep Transient Electromagnetics.

The effectiveness of these techniques, their usefulness and also their limitations were shown. The magnetotelluric techniques which do not require an active source and is highly mobile is a useful reconnaissance tool for rapid exploration of unknown areas at minimum cost. It can also be used in areas where seismics cannot be used, for examples basaltic lavas, volcanics, salts and anhydrides.

Dr. Karmann then went on to show the application of the deep transient electromagnetics, which uses an active source and has a high station density, giving a more detailed picture of the underground conditions. As such it is more useful as a target tool.

During the discussion following his presentation, Dr. Karmann stressed the importance of an intergrated approach in the interpretation of geophysical data, using all sources of information to derive an overall picture of the underground conditions.

A. Ghani Rafek

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F. SCHOKKING

RUEDIGER H. KARMANN

Michael Schwartz: Method of fluid inclusion stuay and its application to the Bujang Melaka Pluton, Kinta Valley.

Dr. Michael Schwartz of the Federal Institute for Geoscience and Natural Resources (BGR), Federal Republic of Germany, gave the above talk to members in the Ipoh area on 14 December 1987 and those in the Kuala Lumpur area on 17 December 1987.

The study was a collaboration between the Federal Institute for Geoscience and Natural Resources (BGR) and the Geological Survey of Malaysia.

Dr. Schwartz has kindly made available his notes on the talk and this has been edited and included under "Geological Notes".

G.H. Teh

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MICHAEL SCHWARTZ

PETROLEUM GEOLOGY SEMINAR 1987 - REPORT

The Geological Society of Malaysia held its 11th Petroleum Geology Seminar on the 7-8th December 1987 at the Ming Court Hotel, Kuala Lumpur.

Again the Seminar proved to be very popular as reflected in the increased audience of 234 participants and 20 papers. In his welcoming address the President of the Geological Society of Malaysia, Dr. Hamzah Mohamad, touched on this steady increase in participation and as such the Society's Petroleum Geology Seminar can be regarded as the leading forum for exchange of ideas and information among petroleum experts in this country.

In her Opening Address, Y.B. Datuk Dr. Siti Zaharah Sulaiman, Deputy Minister in the Prime Minister's Department, noted the positive and encouraging response to the Malaysian Government's revised production sharing contract and efforts to establish more favourable and healthier exploration conditions in Malaysia. Petronas, which is in the process of establishing its own Petroleum Research Institute will one day provide the manpower and expertise necessary to service the country's expanding oil industry. However, the government still recognises the importance of transfer of technology and know-how from foreign sources, she added.

Once again the organisation of the Seminar has been expedited by the financial support from various oil companies, service companies and those related to the petroleum industry. This year's contributing bodies reached a new record. So did the figure, a new high. In return the Society, in the words of the President, would ensure the donors that they will continue to enjoy future Petroleum Geology Seminars, the post seminar publications and related activities.

G.H. Teh

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WELCOMING ADDRESS BY THE PRESIDENT OF THE GEOLOGICAL SOCIETY OF MALAYSIA AT THE PETROLEUM GEOLOGY SEMINAR 1987

Assalamualaikum dan salam sejahtera, Tuan Pengerusi Majlis, Yang Berhormat Datuk Dr. Siti Zaharah Sulaiman, Timbalan Menteri di Jabatan Perdana Menteri, Yang Berbahagia Tan Sri-Tan Sri, Datuk-Datuk, para jemputan kehormat, seterusnya tuan-tuan dan puan-puan peserta seminar sekalian.

Terlebih dahulu bagi pihak Jawatankuasa Penganjur dan Persatuan Geologi Malaysia saya mengucapkan setinggi-tinggi penghargaan kepada Datuk Dr. Siti Zaharah kerana sudi menerima undangan kami untuk merasmikan Seminar Geologi Petroleum Kali Ke-11 ini. Saya juga mengucapkan selamat datang kepada para tetamu dan peserta sekalian.

Tuan Pengerusi Majlis, bagi faedah tetamu dan peserta yang tidak begitu memahami Bahasa Malaysia, yang ramai bilangannya di dewan ini, izinkan saya meneruskan ucapan ringkas ini dalam Bahasa Inggeris.

Ladies and Gentlemen,

It gives me great pleasure to welcome you to the eleventh Petroleum Geology Seminar of the Geological Society of Malaysia. I hope your stay in Kuala Lumpur during the duration of the seminar will be a very pleasant one. As I can see, there are two major tasks of the Geological Society of Malaysia. One is the organising of the yearly Petroleum Geology Seminar since it was first held in 1977. The other one is the organizing of the Society's Annual Geological Conference. Now that with the 11th Petroleum Geology Seminar on its way to a successful session and to be officially declared open soon by Yang Berhormat, we have a good reason this year to celebrate the 20th anniversary of the formation of the Geological Society of Malaysia.

Even though there was a sort of fluctuation in the number of participants and papers presented during the early years of the Seminar, the last six years have recorded not only a steady increase in the number of participants and papers presented, but also in the number of organizations involved, and very welcoming, in the financial support that the society received. Within today and tomorrow representatives from 18 organizations will be presenting a total of 20 papers. Last year the number of papers was 16 and it was 14 in 1982. In 1982 the registered participants was 134. In 1984 the number increased to 178. Today we have about two hundred participants crowding the hall. The number of organizations involved in the seminar session have also increased steadily; 14 in 1983, 16 last year and 18 this year. We interprete this as a sign of recognition shown by companies and organizations related to petroleum industry in this country, that the Petroleum Geology Seminar being regarded as the leading forum for exchange of ideas and information among petroleum experts in this country.

Ladies and Gentlemen,

I would like to express my appreciation to this year's organizing committee, lead by Mr. Hila Ludin for the hard work they put in to make this seminar a successful one. At the same time on their behalf I would like to apologise to you for any inconvenience or anything unforeseen that might accidentally crop out during the two days, and hope you will accept this as human imperfection. As usual the many people in the back stage are actually the ones who make such a big seminar like this one a reality. To them we extend our appreciation. I would also like to extend my thanks to the authors as well as their appropriate organizations for giving the authors permission to make public their valuable information and data.

The organization of this seminar has been expedited by the ever increasing financial support from various oil companies, service companies and other companies related to petroleum industry. To all the donors, please accept of sincere thanks. This year the number of contributing bodies has increased to 26, the highest number so far, with a new record figure of contribution. In return the Society would like to ensure the donors that they will enjoy the continuing petroleum

geology seminar, the post seminar publications, and its other activities.

Tuan Pengerusi Majlis,

Sebelum saya mengundurkan diri, sekali lagi saya ingin merakamkan berbanyak ucapan terima kasih kepada Yang Berhormat Timbalan Menteri kerana sudi bersama kita di pagi yang indah ini.

Sekian, terima kasih.

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Opening Address by Yang Berhormat Datuk Dr. Siti Zaharah Sulaiman, Timbalan Menteri Jabatan Perdana Menteri on the occasion of the opening ceremony of the Petroleum Geology Seminar 1987

Assalamuallaikum, Tuan Pengerusi Majlis, Dr. Hamzah Mohamad, Presiden, Persatuan Geologi Malaysia, En. Hila Ludin Abu Hazim, Pengerusi, Jawatankuasa Pengelola Seminar Geologi Petroleum Yang Ke-11, Tan Sri-Tan Sri, Dato'-Dato', Puan-Puan dan Tuan-Tuan.

I am delighted to be here this morning to officiate the opening of the 11th Petroleum Geology Seminar. But before proceeding further, I would like to take this opportunity to welcome all of you, particularly the international speakers and participants, to our country. I understand that this year marks the 20th Anniversary of the Geological Society of Malaysia. I wish to congratulate the Society for having endeavoured to provide a forum for geologists in the country to inter-act with their international counter-parts thus providing a channel for new and tested technical information to flow into Malaysia. As the search for oil becomes more difficult, it becomes equally imperative for oil and service companies, both local as well as international, to cooperate and exchange data, views and ideas and experiences obtained, particularly from Malaysian petroleum operations. After all, our collective objective, in this process of information of information exchange, should be to chalk up a better wildcat success ratio for Malaysia. Seminars, such as this 11th Seminar, are therefore an excellent focal point for petroleum experts from the oil and service companies, government bodies and academic institutions to discuss methods of improving the exploration effort.

Ladies and Gentlemen,

Malaysia is a country blessed with rich petroleum accumulations and, through the efforts of petroleum experts, such as yourselves, we will be able to continue with optimal exploitation of these resources for the benefit of the nation. Oil to Malaysia is precious. Not only is it one of the largest contributors to export earnings, it is also part of a significant sector of the Malaysian economy in terms of economic and

social development in the country. Unfortunately, it is a depleting and non-replaceable resource. Recognising this, the Malaysian government instituted The National Depletion Policy for Oil in 1980 and has implemented The Four-Fuel Policy for the Power Sector since 1981.

Besides the government policies, the national oil corporation, Petronas has introduced better terms and added incentives into the production sharing contract since 1985 to attract more oil companies to participate in exploration activities in the country.

It is gratifying to note that our efforts in establishing more favourable and healthier exploration conditions in Malaysia have been well received, especially among new foreign oil companies. So far the response of these companies towards our revised production sharing contract has been very positive and encouraging. To date, six new production sharing contracts and five letters of intent and agreement have been signed. These eleven new exploration blocks cover a total area of about 160,000 square kilometres. I understand that other new blocks are under negotiation and I am confident that they will be converted to production sharing contracts in the near future.

Ladies and Gentlemen,

The exploration scenario today demands more than what the existing scientific technology can offer. Gone are the days when oil was easy to find. Today, more than ever, oil has to be sought in remote areas, further away from the shore in deeper waters, and in the heart of tropical rain forests under the most hostile conditions. To be successful in this search, new scientific technology and exploration techniques need to be developed. Hence, to stay ahead in this rapidly-changing exploration scenario, due consideration should be given to research and development activities.

Petronas, on its part, is in the process of establishing its own petroleum research institute. It is the aspiration of the government that, one day, Petronas' petroleum research institute will provide the manpower and expertise necessary to service Malaysia's expanding oil industry, both in the upstream and downstream sectors.

As a developing country, one of the major aims to be achieved so that Malaysia's industrialisation efforts can be carried out smoothly, is the transfer of technology and know-how. This aim is not unique in the petroleum industry but exists in almost all industrialisation plans. The Malaysian government, having recognised that this technology and know-how comes from foreign sources, has continued to extend work permits to expatriates to work in Malaysia, for we recognise the fact that apart from assistance in the form of the latest machineries and tools brought into the country, the most effective part in the process of technology transfer is the expert-willing student kind of human-interaction. Hence, operating oil and service companies should make full use of and thus train Malaysians, particularly the many graduates who are entering the labour market from our local universities.

The search for an eventual production of oil and gas requires numerous supporting facilities and services. Traditionally, oil companies' exploration activities are supported by both the local and foreign service companies. The recent increase in the number of oil companies in Malaysia is an indication of healthy business atmosphere in the service sector. This increase in exploration activities would undoubtedly create ample job opportunities for the service companies to play a more dynamic role in the growth of the Malaysian petroleum industry and in aiding the Malaysian government to reduce the unemployment rate in the country.

It is alarming to note the rather high unemployment level prevailing amongst graduates particularly in the geo-sciences. To improve this situation, creation of new-job opportunities both in the public and private sectors is therefore important. The recent increase in activities in the oil industry has stimulated and generated numerous associated activities. It is the sincere hope of the government that the new oil companies and the service companies will play their part in helping to alleviate the unemployment situation by engaging as many Malaysian geologists, geophysicists and engineers as possible.

In conclusion, may I wish you all fruitful deliberations at this seminar. On this brief note, I have great pleasure in declaring the Eleventh Petroleum Geology Seminar open.

Thank you.

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PETROLEUM GEOLOGY SEMINAR '87

Ming Court Hotel, Kuala Lumpur
7-8th December, 1987

GEOLOGICAL SOCIETY OF MALAYSIA
PETROLEUM GEOLOGY SEMINAR 1987

PROGRAMME

MONDAY, 7th DECEMBER 1987

8.00 am: **REGISTRATION**

8.40 am: Arrival of invited guests

8.50 am: Arrival of Yang Berhormat Datuk Dr. Siti Zaharah Sulaiman
Timbalan Menteri di Jabatan Perdana Menteri

9.00 am: Welcoming Address by Dr. Hamzah Mohamad
President, Geological Society of Malaysia

9.10 am: Opening Address by Yang Berhormat Datuk Dr. Siti Zaharah Sulaiman
Timbalan Menteri di Jabatan Perdana Menteri

9.30 am: **COFFEE BREAK**

10.00 am: Reservoir Geological Modelling of Miocene Shallow Marine Sands in St. Joseph Field, Offshore Sabah
– J. Ranggon, J. W. Chapman & H. D. Johnson (Sabah Shell Petroleum Co. Ltd.)

10.30 am: Log Analysis System Design Criteria — A Practical Perspective
– J. P. Middleton & E. Frost Jr. (Western Atlas International Inc., USA)

11.00 am: Accretion Tectonics in Sabah: Kinabalu Suture and East Sabah Exotic Terrane
– H. D. Tjia (Universiti Kebangsaan Malaysia)

11.30 am: Application of Fracture Analysis of Cores to Reservoir Evaluation
– J. N. Diggens (Robertson Research Int. Ltd., UK)

12.00 pm: **LUNCH BREAK**

1.30 pm: The Probability Problems in the Prospect Appraisal
– Y.Y. Hsu (Chinese Petroleum Corp., Taiwan)

2.00 pm: Some 3D Seismic Applications Offshore Sarawak
– R. C. Hoogenboom, *et al.* (Sarawak Shell Berhad)

2.30 pm: Petrology, Diagenesis and Quality of K Sandstone (Pulai Formation) Reservoirs in the Southeastern Part of the Malay Basin, Offshore West Malaysia
– Nik Ramli Nik Hassan (PETRONAS Laboratory Services Department)

3.00 pm: **COFFEE BREAK**

3.20 pm: Exploration for Unrecognised Sandstone Targets in Well-Explored Basins: Central North Sea — N. S. Haile (Robertson Research Int. Ltd., UK)

3.50 pm: "Super 2D", Innovative Seismic Reprocessing: A Case History
– R. Burnstad (Geophysical Services Inc., Singapore)

GEOLOGICAL SOCIETY OF MALAYSIA
PETROLEUM GEOLOGY SEMINAR 1987

PROGRAMME

TUESDAY, 8th DECEMBER 1987

9.00 am: Satellite Altimetry — A New Geophysical Prospecting Tool
– P. Nordin & B. Lundgren (PetroScan AB, Sweden)

9.30 am: Aspects of Fault Management in Compressional Tectonics
– P. Miller, P. Neri (GECO, Norway) & J. Rasmussen (GECO, Malaysia)

10.00 am: **COFFEE BREAK**

10.20 am: Applying the Modified Stress-Strain Ellipsoid to the Australian and Malaysian Basins
– K.S Kuang (Innovative Technological Geo-exploration, Australia)

10.50 am: A New Dipmeter Provides Geological Answers in Oil-Base Mud Wells
– G. G. Shanor (Schlumberger Overseas S.A., Kuala Lumpur)

11.20 am: Amplitude With Offset Analysis of 'Bright Spot' Block PM1, Malaysia
– N. Poulos (Sun Exploration & Production Co., USA)

11.50 am: **LUNCH BREAK**

1.30 pm: Application of Computer Mapping and Modelling Procedure in EPMI's Development Drilling Activities
– Lee Kam Hoong (Esso Production Malaysia Inc.)

2.00 pm: Sedimentary Sequences Associated With Tidal Inlet Processes
– Noor Azim Ibrahim (PETRONAS Laboratory Services Department)

2.30 pm: Stress Analysis and Hydrofracturing Directions in Malaysia Based on Borehole Breakout Studies
– Mohd Idrus Ismail (PETRONAS Exploration Department)

3.00 pm: Some Applications of the Combined Use of Core Analysis and Electric Log Data
– T. Kennaird (Core Laboratories, Singapore)

3.30 pm: **COFFEE BREAK**

3.50 pm: Structural Elements of Offshore West and Northwest Sabah
– Abdul Manaf Mohammad, Mohd Idrus Ismail (PETRONAS Exploration Department) & K. Hinz (BGR, Germany)

4.20 pm: Petrographic Image Analysis, Pore Classification and the Study of Reservoir Pore Complex
– Abdullah Kinchu (PETRONAS Laboratory Services Department)

4.50 pm: **CLOSING REMARKS**

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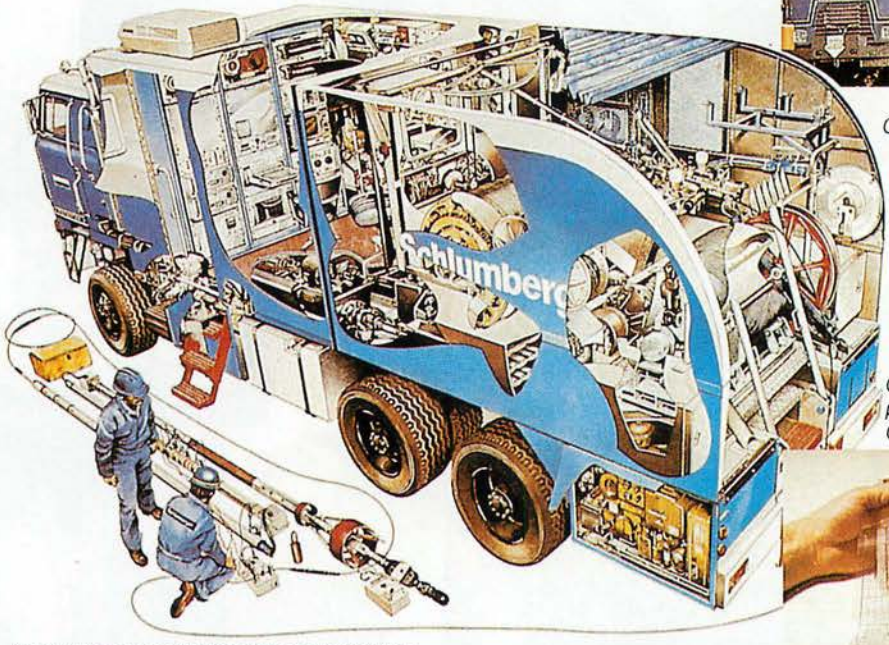
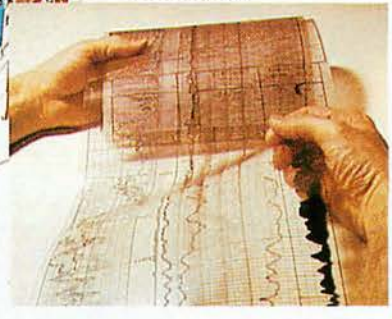
Cyber Service Unit on location.



Schlumberger crew checking a logging tool.

Cyberlook, an interpreted log prepared at the wellsite by the CSU computer.



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Caption to Figures

1-3. At the registration desk.
4. Organising Chairman, En. Hila Ludin Abu Hazim starting off the Opening Ceremony.
5. GSM President, Dr. Hamzah Mohamad with his Welcoming Address.
6. Opening Address by YB Datuk Dr. Siti Zaharah Sulaiman.
7. YB Datuk Dr. Siti Zaharah Sulaiman meeting invited guests.
8-10. Introductions and discussions over tea.
11. Panoramic view of the large turnout.
12-17. Sections of the audience at the Opening Ceremony.
18. J. Ranggon of Sabah Shell on the St. Joseph Field.
19. Mohd Rothi Hamzah of Western Atlas with his paper.
20. Dr. Haile emphasizing a point.
21. Prof. H.D. Tjia on the 'Accretion Tectonics in Sabah'.
22. Dr. J.N. Diggens with his interesting presentation.
23. Y.Y. Hsu of CPC on 'Probability problems in Prospect Appraisal'.
24. R.C. Hoogenboom of Sarawak Shell on '3D Seismic Applications'.
25. Dr. Nik Ramli of PETRONAS Lab. with his presentation on the 'K Sandstone Reservoirs'.
26. Dr. N.S. Haile of Robertson Research with his paper.
27. B. Lundgren of PetroScan on 'Satellite Atimetry'.
28. P. Miller of GECO with his presentation.
29. K.S. Kuang answering a question from the floor.
30. G.G. Shanor of Schlumberger on 'A New Dipmeter'.
31. K.T. Yap with a question.
32. N. Poulos of Sun Exploration with his paper.
33. Lee Kam Hoong of EPMI on 'Computer Mapping and Modelling'.
34. Mohd. Idrus of PETRONAS Exploration being congratulated by Session Chairman Abu Samad.
35-37. Lunch time.
38. Ahmad Said receiving EPMI's contribution from D.E. Francis.
39. Nik Mohamad presenting Shell's contribution to the Seminar.
40. John Bishop of Western Atlas with his speech at the Cocktail.
41. Datuk Mahmud Sulaiman of Laiman Corp. welcoming participants to the Cocktail.
42. Nor Azim of PETRONAS Lab ably answering a question.
43. T. Kennaid of Core Lab. with his presentation.
44. Dr. Nik Ramli with a query.
45. Abdul Manaf with his interesting joint paper.
46. Abdullah Kinchu, PETRONAS Lab., on 'Petrographic Image Analysis'.

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ABSTRACTS OF PAPERS

RESERVOIR GEOLOGICAL MODELLING OF MIOCENE SHALLOW MARINE SANDS IN ST. JOSEPH FIELD, OFFSHORE SABAH

J. Ranggon, J.W. Chapman and H.D. Johnson
Sabah Shell Petroleum Co. Ltd.

The St. Joseph Field is situated along a major wrench-fault zone in offshore Sabah (the Bunbury-St. Joseph-Bambazon 'Ridge') which divides the field into several structural compartments. The most prospective area is the structurally-simple northwest flank (ca. 6 km long and 1 km wide) which dips uniformly to the NW (at ca. 15–20 degree) in a basinwards direction away from the crestal wrench fault zone. The main hydrocarbon-bearing interval comprises a ca. 1350 ft long oil column, which is contained within highly heterogeneous sequences of Late Miocene (Stage 1VC) shallow marine sandstones and shales.

The main geological uncertainties of the northwest flank concern lateral variation in sand development, shale layer continuity and reservoir quality. They have a major impact on reservoir recovery mechanism, pressure maintenance schemes and, hence, on field development strategy. A reservoir geological model was developed, therefore, which incorporates sedimentological studies, well log facies analysis, reservoir mapping and detailed seismic interpretation (utilizing a full reservoir core and 3D seismic data).

These studies demonstrate that depositional processes and tectonic setting had a major impact in controlling the thickness, quality and distribution of these sandstone reservoirs, of which the following were particularly significant: (1) storm-dominated shelf sand depositional system, (2) rapid vertical and lateral switches in sand supply, (3) a tectonically unstable, narrow (ca. 5–15 km wide) shelf, and (4) shelf-edge slump scars.

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LOG ANALYSIS SYSTEM DESIGN CRITERIA — A PRACTICAL PERSPECTIVE

J.P. Middleton and E. Frost Jr.
Atlas Wireline Services, Western Atlas International, Inc.
USA

The development of a complete log analysis system, such as the Atlas Wireline Services Well Data System[SM] (WDS) is achieved by explicitly determining the perceived system-user needs, the actual (must-have) system requirements, and the available resources. Projections relating to future system requirements including new data types, new analysis applications, and hardware improvements are also key design considerations.

The fundamentals of the software life cycle as they relate to log analysis are described. Keys to log analysis system software reliability, understandability, maintainability, and longevity are given particular attention. Practical methods of insuring complex algorithm software integrity are detailed.

The development of the Well Data System, as the state-of-the-art log analysis system, is reviewed and described at every level. Details of this system from file architecture to zone processing are presented, including many actual well data examples. Specific information concerning hardware-to-software compatibility and current hardware development trends is also provided.

ACCRETION TECTONICS IN SABAH: KINABALU SUTURE AND EAST SABAH EXOTIC TERRANE

H.D. TJIA
DEPARTMENT OF GEOLOGY
UNIVERSITI KEBANGSAAN MALAYSIA

The Kinabalu Suture zone consists of Mesozoic to Paleogene rocks, including ophiolite and turbidites, forming a band up to 80 km wide separating the NE-striking structures of West Sabah from East-trending structures of East Sabah. The suture zone extends in broad curves convex westward from Teluk Darvel-Semporna Peninsula across Telupid/Ranau to Teluk Marudu and Banggi Island. In many places the rock within the suture are intensely deformed and at least in the Ranau area cross-sections display typical fan-shaped structures verging away from the suture zone in both directions. The Early Miocene slump deposits of East Sabah are considered to represent the final stages of the closing of an oceanic basin that contained the ophiolite and turbidites. The Early Miocene rocks of East Sabah also contain pyroclastics and probably developed in an island arc setting. Consistent with the spreading history of the South China Basin and its stratigraphy, East Sabah is considered an exotic terrane composed of island arc material that became welded along the Kinabalu Suture to Borneo in mid-Miocene time. The East Sabah terrane most probably originated off the southeast coast of China and together with the North Palawan and Mindoro blocks drifted towards their present positions between 32 and 17 M.y. The large chert-spilite-ultramafic complexes outside the Kinabalu Suture zone (in the Dent Peninsula, e.g.) are probably megaclasts in the Ayer and Labang formations which, therefore, can be classified as olistostromes. During the Late Miocene-Pliocene felsic plutons, like the Kinabalu adamellite, intruded into the suture zone.

APPLICATION OF FRACTURE ANALYSIS OF CORES TO RESERVOIR EVALUATION

J. N. DIGGENS
ROBERTSON RESEARCH INT. LTD.,
U.K

The analysis of macro and microfractures of whole cores results in a fuller understanding of the modification tc permeability envelopes and the predicted fluid migration directions in fractured reservoirs, to the benefit of both petroleum geologists and reservoir engineers.

The analysis includes the relative geometry, frequency, timing and cementation of fractures, relationships to lithology, diagenesis, porosity and permeability of both oriented and unoriented cores. The regional structural relationship of single and multiwell studies are considered.

THE PROBABILITY PROBLEMS IN THE PROSPECT APPRAISAL

HSU YEONG-YAW
CHINESE PETROLEUM CORPORATION
TAIWAN

Prospect evaluators are always concerned of the following two problems associated with a prospect: one is the oil discovery probability, the other is the field size distribution for the prospect. These are the two basic exploration parameters which are necessary for formulating different kinds of exploration strategies.

The exploration estimation parameters are the subjective geological judgement of the analyst; however, by the Bayes' rule, the latest new objective information can be incorporated into the original estimation, therefore, the original subjective judgement can be revised systematically and the revised estimation will be closer to the fact in the future.

This paper will discuss the oil discovery probability of a prospect based on the subjective theory of probability. Then it will show how to use the Bayes' rule in revising the field size distribution, estimated by Monte-Carlo simulation, with a speculative prospect.

SOME 3D SEISMIC APPLICATIONS OFFSHORE SARAWAK

R.C. HOOGENBOOM *ET AL.*
SARAWAK SHELL BERHAD

3D seismic surveys with exploration, appraisal and development objectives, have been acquired in SHELL operated offshore Sarawak acreage since 1984. A total of 11 surveys have been performed covering an area of close to 1500 sq km. 3D surveys offer improved structural delineation and in the case of success allow follow-up appraisal plans to be matured quickly since further infill shooting is unlikely to be required as used to happen with 2D seismic surveys.

The very significant effect of 3D seismic acquisition and processing will be illustrated by a comparison using a conventional 2D seismic line extracted from a 3D survey. Contour maps using 3D seismic data have proved by drilling to be more accurate than maps constructed using only 2D seismic, particularly in complexly faulted areas.

Time-slices can be used directly for fault and contour interpretations and these aspects will be illustrated by various examples.

It is vital to predict and map out potential drilling hazards. In some instances the dense 3D coverage can aid in the delineation of shallow gas anomalies and sea-bottom channels. Examples will be shown.

PETROLOGY, DIAGENESIS AND QUALITY OF K SANDSTONE (PULAI FORMATION) RESERVOIRS IN THE SOUTHEASTERN PART OF THE MALAY BASIN, OFFSHORE WEST MALAYSIA

NIK RAMLI NIK HASSAN
PETRONAS LABORATORY SERVICES DEPARTMENT

The K sandstone consists of braided stream sediments in the northern and northeastern part of the area and fluvial and possibly deltaic sediments in the southern part of the area. The sandstone is made up of mature to supermature sub-chertarenite. It exhibits textural grading from coarse alluvial braided stream sediments to medium and very fine grained delta front sediments. The proportion of cement and matrix in deltaic sandstones are higher than in the braided stream sandstones. Cement in deltaic sandstones occur mainly in the form of quartz overgrowths. Clay present in the K sandstone can be related to depositional facies. Kaolinite formed the dominant clay mineral in braided stream sandstones whilst illite and mixed-layer clays formed the dominant clay mineral in deltaic sandstones.

Diagenetic processes in the K sandstone were mainly controlled by the depositional environment with subsequent modifications by burial diagenesis. Three major diagenetic processes can be observed in the sandstone: (1) Formation of early diagenetic minerals. (2) The transformation of unstable framework grains into clay matrix during meso-diagenesis and the formation of quartz and calcite cement. (3) The dissolution of unstable grains and cement and the formation of pore-fill clay minerals during meso-and late stage diagenesis.

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EXPLORATION FOR UNRECOGNIZED SANDSTONE TARGETS IN WELL–EXPLORED BASINS: CENTRAL NORTH SEA

N. S. HAILE
ROBERTSON RESEARCH INT. LTD.,
U.K.

There are many examples of new plays discovered by accident or design in well-explored basins. In the Central Graben and South Viking Grabens of the North Sea, regarded as well-explored, recently unexpected major discoveries in Tertiary sandstones have led to a reappraisal of the potential targets.

The Alba discovery, Eocene sandstone, reported as about 700 million barrels of oil with up to 750 billion feet3 gas recoverable, was found by the fifth well in a block (size 10' Lat. by 12' Long.; about 19 x 12 km), in an area where the main target was regarded as Lower Cretaceous condensate-bearing sandstone. More recently, a large discovery in Tertiary sandstone (the '9/18' Field) has been reported further north.

Basin analysis using a variety of disciplines, is proving useful in planning exploration strategy for these targets, combining the following approaches :

1) Detailed biostratigraphy, using palynomorphs, foraminifers, and nannofossils, enabling a detailed zonation to be established.
2) Regional correlation of all available wells.
3) Seismic mapping and seismic stratigraphy.
4) Sedimentological interpretation.

Integration of the data from these disciplines enables a reconstruction of environments, paleogeography and depositional regimes, providing a framework within which detailed exploration can be effectively planned.

"SUPER 2D", INNOVATIVE SEISMIC REPROCESSING: A CASE HISTORY

R. BURNSTAD
GEOPHYSICAL SERVICES INC.,
SINGAPORE

The "Super 2D" processing sequence involves taking a randomly oriented grid of multi-vintage 2D seismic data, reprocessing to tie the data where required, then interpolating the data set to a regular grid suitable for 3D processing and interpretation. The case history used to illustrate the process is an Alberta data set provided by a Canadian oil company. This volume comprises fifteen 2D seismic lines collected and processed over a period of six years by a variety of contractors. Field conditions, advances in technology and changing objectives combined to result in a data set that, while densely sampling a small area, did not tie well enough to be interpreted as a whole. Therefore the first objective of reprocessing was to resolve mistie problems. The data processing sequence did resolve all the mistie issues and produced a standardized data volume. This data volume was now suitable for the second stage of this sequence, that is interpolating to a regular grid and subsequent 3D processing. In this case, the volume was 3D migrated, filtered and scaled. The full range of 3D displays and 3D interpretation products can now be used. This, along with standardizing the data set and improving the spatial location of events via 3D migration are the key results of the "Super 2D" sequence

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SATELLITE ALTIMETRY — A NEW GEOPHYSICAL PROSPECTING TOOL

PER NORDIN & BERT LUNDGREN
PETROSCAN AB,
SWEDEN

The force of the earth's gravitational attraction controls the shape of the sea surface. Normally, the sea surface is time-varying in amplitude because of the influence of winds, currents, tides, etc. However, the sea surface also has permanent undulations created by mass variations below the seafloor. Since the water of the sea adjusts to variations in the gravitational pull, the time-independent or static shape of the sea surface will reflect the distribution of mass below.

Satellite altimeters provide data which yield information about the height variations of the sea surface. Procedures have been developed which eliminate the time-varying factors affecting the sea surface and thus information about the static sea surface is achieved. The static sea surface is called a geoid and is also defined as a surface of constant gravity potential.

The satellite altimeters have further become important in determining short wavelength components of this geoid. So efficient are present day's altimeters that they can resolve short wavelength geoidal features with an accuracy of a few centimeters and with a resolution of some tens of kilometers. The short wavelength anomalies arise from shallow variations in the distribution of mass in the earth's outer crust. Other teams of investigators have shown these short wavelength anomalies to correlate with the topography of the ocean floor and of shallow crustal structures. These include spreading centers, deep-ocean trenches and seamount chains. Usually, the geoidal undulations are computed based upon absolute values. This can cause errors when, for instance, ocean tide models are used, especially near land.

In the present work, calculations of geoidal undulations are performed based upon relative values. Dynamic factors can very effectively be eliminated if geoidal waveforms are expressed in relative terms instead of absolute values. Irrespective of how all dynamic factors actually affect the sea surface, "foot-prints" caused by the static conditions will always be present in the sea surface. To obtain information about mass variations in the near sub-surface below the sea bottom, the high-frequency spectra of the geoid are studied after the sea bottom topography effect has been removed. During the last three years, extensive studies have been performed by the authors comparing the calculated relative geoidal undulations of the "residual" geoid to known hydro-carbon producing areas. A significant, empirical correlation has been obtained between known producing areas and depressions in the residual geoid above such hydrocarbon accumulations. Furthermore, no significant hydrocarbon accumulations have been found where bulges in the residual geoid are present.

Satellite altimeter measurements provide data for calculation of the residual geoid which can be used for mapping of density contrasts in the upper crust. This mapping is possible without special on-site work in the area of investigation. Altimeter data, thus processed and interpreted on its own, constitutes yet another cost-effective, geophysical tool.

ASPECTS OF FAULT MANAGEMENT IN COMPRESSIONAL TECTONICS

PALLE MILLER & PHILIP NERI (GECO A.S., NORWAY)
AND JORGEN RASMUSSEN (GECO, MALAYSIA)

Recent developments in integrated interpretation and mapping systems now allow the geologist to correctly represent reverse faulting and strike-slip faulting both during interpretation and on maps and isometric displays. A case history based on real seismic data will highlight the advanced facilities offered by second generation systems, including applications related to image processing, special database structures and user interface concepts.

APPLYING THE MODIFIED STRESS-STRAIN ELLIPSOID TO THE AUSTRALIAN AND MALAYSIAN BASINS

K.S. KUANG
INNOVATIVE TECHNOLOGICAL GEO-EXPLORATION,
AUSTRALIA

Application of the classical stress-strain ellipsoid to the fractures observed in the Malaysian and Australian basins proved to be unsatisfactory. In a new modified ellipsoid, thrust fault is postulated to be bounded by both the synthetic fault and an additional subparallel 'K'-lineament whose sense of displacement is opposite to the synthetic fault. Thrusting occurs where these bounding fault converges, and where they are divergent these are extensional faultings.

In Cooper/Eromanga Basin of Australia, we applied the new ellipsoid from field to regional scales. We then proceed to sub-continental, continental and intercontinental scales, resulting in establishing a correlation between the new E-W right lateral ellipsoid and plate tectonic. The Gippsland Basin and the North West shelf are used as examples to illustrate it as a predictive mapping tool.

Nearly all the fractures in Asia could also be defined by a single new NW-SE right lateral ellipsoid. The necessity to orientate the new ellipsoid for Asia is postulated to be due to its massive collision with the Indian plate. The new ellipsoid are consistent with the fractures defined by B.G.M. Wood for South East Asia (*GSM Bulletin 18*), and the fractures of Malay, Balingian, Baram and NW Sabah Basins. The detail fields data are also consistent, and they strongly support the necessity to introduce the 'K' and associated lineaments.

In summary the new ellipsoid is another mode of describing plate tectonics, and when properly applied can predict the orientations and shapes of faults, anticlines and synclines. However, to be more effective one should also reconstruct their structural history and make use of representative structural styles from field developments.

A NEW DIPMETER PROVIDES GEOLOGICAL ANSWERS IN OIL-BASE MUD WELLS

GORDY G. SHANOR
SCHLUMBERGER OVERSEAS S.A.
MALAYSIA

With the marked increase in the use of oil-based drilling muds (OBM) in both development and exploration wells, the geologist has suffered the loss of reliable dipmeter information. Conventional focussed resistivity dipmeters, equipped with "scratchers" on the electrode pads, have generally not provided confident structural dip computations, even with multiple passes of the tool. The new Oil-Base Mud Dipmeter Tool (OBDT) is a four arm, micro-induction tool which records four micro resistivity curves in boreholes drilled with non-conductive muds. Dip computations from the relative displacements of the four micro-induction curves provide reliable structural dip determination and, in many cases, sedimentary dips enabling paleocurrent and sand body geometry interpretations.

AMPLITUDE WITH OFFSET ANALYSIS OF 'BRIGHT SPOT' BLOCK PM1, MALAYSIA

NICK POULOS
SUN EXPLORATION & PRODUCTION COMPANY
USA

Amplitude with offset theory has been recognized for many years. It is only in recent years that simplification of the Zeoppritz equations has allowed for more practical usage of the technique. Sun Exploration and Production Company has a programme available for workstation analysis. A prominent 'bright spot' occurs in the Seurula Formation in the PM1 Block that is associated with a fault. The event was analysed on workstation and definitely shows an increase in amplitude with offset suggesting a gas filled reservoir.

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APPLICATION OF COMPUTER MAPPING AND MODELLING PROCEDURE IN EPMI'S DEVELOPMENT DRILLING ACTIVITIES

LEE KAM HOONG
ESSO PRODUCTION MALAYSIA INC.

EPMI uses an interactive reservoir mapping and modelling procedure to maintain reservoir descriptions current with development drilling. This system eliminates the tedious and largely mechanical tasks of hand-mapping methods and yet allows the geologist to retain full control of the interpretation of reservoir geometry and continuity. This paper illustrates how field geologists in EPMI utilise this computer mapping procedure to rapidly generate updated reservoir maps, geologic cross-sections and in-place hydrocarbon volumes after drilling a new development well. Application of this technique has also saved time and increased productivity, especially in mapping multi-reservoir fields currently undergoing development.

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SEDIMENTARY SEQUENCES ASSOCIATED WITH TIDAL INLET PROCESSES

NOOR AZIM IBRAHIM
PETRONAS LABORATORY SERVICES DEPARTMENT

Identification of tidal inlet associated sequences in the rock records is difficult due to subtle facies variation. Facies interpretation of these sequences requires the understanding of the complexity of the processes involved. Stratigraphic analysis of Holocene barrier island system using vibracores, boreholes and surface samples shows the importance of tidal inlet processes in the formation of inlet associated sequences. Inlet processes usually rework the adjacent barrier island deposit and replace the characteristic coarsening upward barrier sequence with fining upward tidal inlet associated sequences. The two major processes that influence the development of these sequences are inlet migration and ebb tidal delta sediment bypassing.

Tidal inlet associated sequences form a convex shaped sediment prism perpendicular to depositional strike. This sequences may be elongated parallel to strike assuming inlet migration. The two major components of the sequences are the active back-barrier fill unit comprising of flood tidal delta deposit and the active inlet fill unit. In general, the active back-barrier fill unit is comprised of highly bioturbated fine to medium organic rich silty sand. This unit may interfinger with lagoonal mud and is capped by well developed tidal flat and marsh facies. The sedimentary sequence of the active inlet fill unit is much more variable; it is generally comprised of fine to coarse sand with well preserved primary sedimentary structures ranging from trough cross beds at the base to low angle planar cross beds at the top. This unit may be capped by washover and aeolian facies.

STRESS ANALYSIS AND HYDROFRACTURING DIRECTIONS IN MALAYSIA BASED ON BOREHOLE BREAKOUT STUDIES

MOHD IDRUS ISMAIL
PETRONAS EXPLORATION DEPARTMENT

Orientational data of stress-induced borehole elongations resulting from concentration of present day stress at the borehole can be gathered from the caliper data of the 4-arm dipmeter log. Over 80 wells in Sabah, Sarawak and Peninsular Malaysia show regionally consistent borehole breakout orientation. 5 stress provinces have been recognised in the Sabah and Sandakan Basins. Compression orientation is NW-SE and NNW-SSE in Central Western Sabah and North Western Sabah. In South and Central Western Sabah, the extension orientation is ENE-WSW whereas in North Western and North Sabah it is oriented NW-SE. The generally N-S compression in North Western Sabah and mainland North East Sabah is in agreement with the plate movement orientation during the 'pre-rift' and 'spreading' phases in South China Basin. The N-S breakout orientation in the North Dent Province is related to a compressional field in the E-W orientation. The NW-SE compression orientation in Central Western Sabah indicates a stress field similar to the ones in Sarawak. Sarawak have been divided into 6 stress provinces. Compression orientation is NW-SE in the East Balingian and Baram Delta Provinces and NNW-SSE in West Balingian. Whilst the extensional orientation is dominantly NW-SE, several provinces show a second set of extensional orientation: NNW-SSE in Central Luconia, E-W in East Luconia and East Balingian, and NE-SW in the Southwest Luconia Province The existence of the second set of extensional orientation is believed to be caused by subsidence in the clastic depocentres of the Rajang-Lupar Delta to the west and the Baram Delta to the east respectively. The extensional orientation is ESE-WNW to E-W to ENE-WSW in North and South Malay Basin and NW-SE in Southern Tenggol Arch. The compressional trend in the South Malay Basin is NNW-SSE. Different sets of breakouts within a stress province have been interpreted as the result of the variation of stress field in the vertical section. Present day stress field may be oriented slightly differently from observed older transgressional structures. Other possible uses of the Borehole Breakout Method are in hydrofracturing and wellbore stability control.

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SOME APPLICATIONS OF THE COMBINED USE OF CORE ANALYSIS AND ELECTRIC LOG DATA

T. KENNAIRD
CORE LABORATORIES,
SINGAPORE

Even though accurate assessments of water saturation, and therefore hydrocarbon-in-place, may be derived from electric log data, it does not necessarily follow that a reliable assessment of pay zones can be made on the basis of logs. For example, zones showing an apparent water saturation of greater than 50 percent traditionally often receive no further consideration for testing or production. However water-free oil production has been recorded in sands where the apparent water saturation is as much as 70 percent.

One way to assess whether or not hydrocarbon-bearing zones are potentially productive is to determine values for critical water saturation – which can be defined as the formation water saturation that must not be exceeded if hydrocarbons are to be produced water-free or at a specified water-cut.

Critical water saturation may be derived from core analysis data. By intergrating these values with laboratory-derived electrical properties of the formation rock it is possible to produce a curve for critical resistivity or minimum productive resistivity, Rmp. The true formation resistivity (Rt) must not fall below the Rmp if one is to produce hydrocarbons water-free or at a specified water-cut.

Using transparent film, one can overlay the deep resistivity log with the calculated Rmp curve and quickly identify potential pay zones.

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STRUCTURAL ELEMENTS OF OFFSHORE WEST AND NORTHWEST SABAH

ABD. MANAF MOHAMMAD & MOHD. IDRUS ISMAIL
(PETRONAS EXPLORATION DEPARTMENT)
AND K. HINZ (BGR, GERMANY)

Six structural zones are recognizable along the continental margin and the continental shelf of Offshore West and Northwest Sabah. Each zone is characterized by a particular structural style and phases of deformation:-

- Zone I is characterized by a complex system of horst, tilted block and syn-rift half-grabens, similar to the structural styles known in the Dangerous Grounds.

- Zone II is floored by subsided continental crust and characterized by tilted fault blocks and syn-rift basins. The Oligocene to Early Miocene carbonate platform, unconformably overlaying inferred syn-rift halfgraben infills, extends continuously from the Dangerous Grounds area across the Sabah-Palawan Trough to the western shelf of Sabah.

- Zone III is characterized by a sets of imbricate thrust sheets forming an imbricate thrus sheet system. The thrust sheet system thrusted onto the progressively subsiding continental crust from Middle Miocene to Recent.

- Zone IV contains two thrust sheet complexes on top of each other: The Major Thrust Sheet Systems overrides the Lower Thrust Sheet System by a mechanism of duplex thrusting since Middle Miocene times. Duplex thrusting caused substantial vertical movements.

- Zone V comprises an area of particularly pronounced structural complexity. Zone Va has undergone two Neogene deformation :- The Upper Miocene deformation is related to a compression associated with the underthrusting of the North Palawan Continental Terrain, and the Upper Pliocene deformation is related to a source of compression lying to the northeast. Two models have been proposed to understand the tectonic style in Zone Vb :-

  One model is related to duplex thrusting and an alternative model involves the presence of microcontinental terrain that lies north of Kudat Peninsular probably extending into East of Palawan, onto which the Late Cretaceous allochtonous terrain had been thrusted over.

- Zone VI contains two subzones :- Zone VIa indicates eastward thrusting of an Upper Miocene intensely deformed foldbelt partly over a gently deformed fold belt that had accommodated compression and crustal shortening through simple folding, and Zone VIb is characterized by elongated ridges that probably represents shale piercement related to an advance stage of compression.

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PETROGRAPHIC IMAGE ANALYSIS, PORE CLASSIFICATION AND THE STUDY OF RESERVOIR PORE COMPLEX

ABDULLAH KINCHU
PETRONAS LABORATORY SERVICES DEPARTMENT

Petrographic Image Analysis or "PIA" technique together with the multivariate vector analyses of Extended Cabfac and Q-models may be used in the classification of reservoir pore complex. Such a technique would yield a good number of quantitative variables which can be statistically correlated with conventional petrophysical reservoir parameters such as measured porosity and permeability. Linear Regression Model of measured permeability for example, set against percent pore type optical porosity derived from the PIA technique provides useful insight into the nature of pore interplay reflecting inherent petrographical variations in the reservoir rock.

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BERITA-BERITA PERSATUAN
(NEWS OF THE SOCIETY)

INTERNATIONAL GEOLOGICAL CORRELATION PROGRAMME (IGCP) COMMITTEE

In response to the IGCP's request for representation from the Society, the Council nominated Dr. Teh Guan Hoe.

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KEAHLIAN (MEMBERSHIP)

The following applications for membership were approved:

Full Members

1. Mahisham Ibrahim, Cawangan Bekalan Air, Ting. 6, Ibu Pejabat JKR, Jln. Mahameru, 50582 Kuala Lumpur
2. Updesh Singh, Petronas Laboratory, Lot 1026, PKNS Industrial Estate, 54200 Ulu Kelang
3. Laufeld Sven, GRDC, Jalan Diponegoro, 57 Bandung, Indonesia
4. Michael R. Pillow, Petrofina Far East, 138 Cecil St., 12-01, Singapore 0106
5. Norihiko Sawara, JTO Operating Co., 12 Floor, KL Tower, 179 Jalan Bukit Bintang, 55100 Kuala Lumpur

Student Members

1. Ng Tham Fatt, IPT, Universiti Malaya, Kuala Lumpur
2. Roslan Rajali, Jabatan Geologi, Universiti Malaya, Kuala Lumpur

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PERTUKARAN ALAMAT

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

1. Abdullah Hasbi Hj. Hassan, 29, Jalan Telawi 9, Bangsar Baru, 59100 Kuala Lumpur
2. A.E.L. Morris, Morris Petroleum Inc., P.O. Box 64610, Los Angeles, Ca. 90064, USA
3. R. Vaeravan, No. 12-A, Jln. Udang Geragau, Taman Cuepacs, Segambut, 52000 Kuala Lumpur
4. Roland Lee, Fortress Group Sdn. Bhd., 69-1 (1st Floor), Jalan Kampong Pandan, 55710 Kuala Lumpur
5. James K. Dato, P.O. Box 156, 98100 Lutong, Sarawak
6. C.K. Burton, P.T. Muyup Mas Murni, Setiabudi Bldg., 11, 5th Fl., Suite 504, Jl. H.R. Rasuna Said, Kuningan, Jakarta 12920, Indonesia
7. Cheah Tik Wah, No. 6, Jalan Lempeng 10-04, Singapore 0512
8. Gerard A.M. Kruse, Wasstraat 60, 2313 JK Leiden, The Netherlands

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PERTAMBAHAN BARU PERPUSTAKAAN (NEW LIBRARY ADDITIONS)

The Society has received the following publications:

1. Bulletin of the Chinese Academy of Geological Sciences, nos. 13 & 14, 1986
2. Bulletin of the Institution of Mining and Metallurgy, no. 969, 1987
3. Scripta Geologica, nos. 83 & 84, 1987
4. Mineral distribution study for cassiterite and associated heavy minerals in Ranong, Takuapa and Phangnga Provinces, Thailand by Jaturong Praditwan, 1986
5. Drilling and sampling techniques in tin prospecting at Tebrong area, Lenggang District, Belitung, Indonesia by S. Johan, 1986
6. Standardization and metrication of drilling data for unconsolidated ground in Southeast Asia by Eric Goh & H. Hussin, 1986
7. Geophysical Research Bulletin, vol. 25, no. 2, 1987
8. CCOP/SOPAC: proceedings of the 14th session, 1985
9. Commonwealth Science Council Newsletter, Jul-Aug. & Sept-Oct, 1987
10. Seatrad Bulletin, vol. viii, no. 2 & 3, 1987
11. Books about Singapore, 1987
12. Episodes, vol. 10, no. 3, 1987
13. Chronique de la recherche miniere, no. 488, 1987
14. Seatrad Centre, Annual Report, 1986
15. Annales Academiae Scientiarum Fennicae, nos. 145 & 146, 1987
16. SOPAC News, vol. 5, no. 2, 1987
17. Institution of Mining & Metallurgy, Section A, Oct. 1987
18. Geochimica Brasiliensis, vol. 1, no. 1, 1987
19. Southeast Asia Tin Research & Development Centre, Tenth Anniversary 1977-1987
20. PUKR-2 (version 2-0) - A system for filing, editing of borehole data and calculating universal Kriged point estimates in 2-dimensional configuration designed for micro-computers with BASIC language capabilities by Eric K.H. Goh, 1987

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GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATIONS
Back Issues Available

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Bulletin 17 (1984). 371 p. A collection of papers on geology. Edited by G.H. Teh. Price: M$35.00 (US$17.00). (US$14.00).

Bulletin 18 (1985). 209 p. Special Issue on Petroleum Geology. Edited by G.H. Teh & S. Paramananthan. Price: M$30.00 (US$17.00).

Bulletin 19 (1986). 652 p. GEOSEA V Proceedings Vol. I. 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 Bulletins 19 & 20: Members—M$50.00 (US$21.90). Non-members—M$125.00 (US$53.20).

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

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

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

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

PACKAGE DEAL 1: Bulletin nos. 1–8 + Field Guide 1
- Student Members : M$10.00 (US$5.60)
- Members : M$20.00 (US$10.00)
- Non-Members : M$40.00 (US$19.00)

PACKAGE DEAL 2: Bulletin nos. 9–12
- Student Members : M$30.00 (US$14.50)
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PACKAGE DEAL 3: Bulletin nos. 13–17
- Student Members : M$60.00 (US$28.00)
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PACKAGE DEAL 4: Bulletin nos. 1–17 + Field Guide 1
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Geological Society of Malaysia
c/o Dept. of Geology
University of Malaya
59100 Kuala Lumpur
Malaysia

BERITA-BERITA LAIN
(OTHER NEWS)

DAFTAR ISTILAH GEOLOGI DI AMBANG PENERBITAN

Zuraki Daud, Dewan Bahasa & Pustaka.

Manuskrip *Daftar Istilah Geologi* dihantar ke Bahagian Penerbitan pada pertengahan bulan Julai 1987. Ia dijangka diterbitkan pada tahun 1988.

Mengikut perancangan asalnya daftar ini sepatutnya diterbitkan pada akhir tahun 1986. Kelewatan ini disebabkan oleh beberapa masalah yang timbul di peringkat penyediaan manuskrip bersih. Punca utamanya ialah kerapnya berlaku pertukaran pegawai projek bidang berkenaan. Kekerapan ini menyebabkan terencatnya perancangan asal yang digalurkan oleh pegawai projek pertama. Sehingga kini jawatankuasa istilah Geologi telah ditangani oleh tujuh orang pegawai projek dan tiga orang setiausaha. Banyak orang banyaklah pula ragamnya.

Walau macam mana pun syukurlah, akhirnya dalam jangka masa yang agak lama iaitu kira-kira 4 tahun siap juga manuskrip *Daftar Istilah Geologi*. Apabila terbitnya daftar istilah ini nanti diharapkan akan terhindarlah alasan mengapa kita perlu menggunakan bahasa asing dalam laporan tahunan dan sebarang warta Geologi.

Terbitnya daftar ini hendaklah dijadikan titik mula bagi pakar Geologi sama ada di universiti tempatan atau di jabatan kerajaan, atau badan berkanun untuk mengorak langkah untuk menjunjung dan mendaulatkan bahasa ibunda. Buktikanlah kepada dunia bahawa bahasa ibundamu waja, padu dan jitu. Sebarkanlah berita atau ilmu Geologi dalam bahasa ibundamu, kelak anak-anakmu akan menyanjungi dan menghormatimu. Ketahuilah wahai pakar-pakar Geologi, bahawa sesungguhnya bahan rujukan ilmu bidangmu tidak pernah diterbitkan atau terlalu kurang diterbitkan. Kepada siapa hendak diharapkan, jangan dinanti manusia dari bumi jauh untuk melahirkan hasil-hasil tulisan dalam bidangmu. Bertindaklah demi kepentingan bangsamu.

Akhirnya kalam kami di Bahagian Peristilahan mengucapkan ribuan terima kasih kepada pakar-pakar Geologi dari universiti-universiti tempatan, badan-badan kerajaan dan badan berkanun yang bertungkus lumus untuk menyedia, menggubal, mengesah dan menyemak manuskrip *Daftar Istilah Geologi* ini, terutama kepada Dr. Wan Fuad W. Hassan (UKM) dan Encik P. Loganathan (Jabatan Kajibumi Seremban) yang selalu mengikuti setiap jejak dalam detik-detik penerbitan istilah Geologi ini.

Tidak lupa juga diucapkan berbanyak-banyak terima kasih kepada Persatuan Geologi Malaysia (PGM) yang telah menjadi pendorong ke arah tertubuhnya Jawatankuasa Istilah Geologi ini.

Sumber: *Berita Peristilahan: Bil 5, Ogos 1987*

Kiriman: Mohamad Ali Hasan

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'ISRADEMT'

INTERNATIONAL SYMPOSIUM ON RESEARCH AND DEVELOPMENT IN EXTRACTIVE METALLURGY OF TIN AND RELATED METALS

17-21 October 1988, Ipoh, Malaysia

Organized by the School of Materials and Mineral Resources Engineering, Universiti Sains Malaysia, Ipoh, Malaysia

In association with the Southeast Asia Tin Research and Development Centre, Ipoh, Malaysia

Sponsored by The Institute of Mineral Engineering Malaysia and The Institution of Engineers of Malaysia.

Objective

This international symposium will cover the research and development work carried out in the recent years in the fields of both primary and secondary extraction of tin and other related metals with a view to meet increased efficiency, higher throughputs and reduced costs. This programme will encourage the exchange of ideas among academicians, researchers and practising engineers and metallurgists, offering an assessment of current production processes, alternative extractive routes and future directions from a comparative world perspective.

Symposium Themes

The symposium will focus its attention on topics such as following:

* Mineral Processing (Gravity, Heavy Media, Flotation, Magnetic and Electrostatic Separation).
* Pyrometallurgical Processing (Smelting and Refining)
* Hydrometallurgical Processing (Extraction and Refining)
* Tailings Treatments
* Recent Technologies of Tin Extraction
* State of the Art Plant Practices
* Other Related Topics

The symposium will consists of invited lectures, panel discussion on specific topics of tin extraction, technical field trips to various industrial plants and social functions which will include a Welcoming Reception, Symposium Luncheon and Dinner.

Venue and Date

The symposium shall be held at The Royal Casuarina Hotel, Ipoh, Perak, Malaysia from 17-21 October 1988.

Call for Papers

High quality papers are sought from interested authors and intending delegates. Abstracts of paper, of not more than 250 words in English, should be mailed to Dr. V.N. Misra, Technical Programme Chairman, ISRADEMT, c/o School of Materials and Mineral Resources Engineering, Universiti Sains Malaysia, Perak Branch Campus, Jalan Bandaraya, 30000 Ipoh, Perak, Malaysia.

Registration

Fifth symposium on tin/tungsten granites in Southeast Asia and the Western Pacific (IGCP Project 220), Japan and Korea October 14 - 23, 1988

Invitation

The organizing committee invites you to attend the Fifth International Symposium on Tin/Tungsten Granites in Southeast Asia and the Western Pacific to be held in Japan and Korea in October 1988.

The symposium will be held at Shimane University, Matsue, Japan.

A pre-symposium field conference will visit late Cretaceous granites in Southwest Japan and a post-symposium field conference will visit tungsten deposits in Korea.

Aims and Topics

The IGCP project 220 'Correlation and Resource Evaluation of Tin/Tungsten Granites in Southeast Asia and the Western Pacific Region' will complete its scheduled five year-term in 1988. Thus this symposium will review all previous activities concerning the Project and to discuss possible future directions.

The field conference will provide participants with the opportunity to observe typical arc plutonism in Southwest Japan and to examine world famous tungsten deposits in Korea.

The symposium will deal with tectonic, petrogenetic, geochemical, and metallogenetic aspects of granitoids, especially, of tin/tungsten mineralized granites and also with techniques of exploration and resources evaluation of tin/tungsten deposits.

The topics will include:

1. Exploration and evaluation of tin/tungsten deposits related to felsic plutonism
2. Genesis of tin/tungsten ore deposits
3. Geotectonics, granite types and mineralization
4. Mechanisms of granite emplacement
5. Genesis of granitoids and tin/tungsten ore fluides.

Other topics consistent with aims of the project will be welcome.

Program Outline

14 October, evening	: Assemble in Osaka
15 - 16	: Pre-symposium field conference (Southwest Japan, from Osaka to Matsue)
17 - 19	: Symposium (Matsue)
20	: Travel from Matsue to Pusan (Korea) by bus and ferry) Overnight onboard ferry
21 - 23	: Post-symposium field conference from Pusan to Seoul
24 morning	: Break up in Seoul.

Language

The official language will be English.

Costs

a. Pre-symposium field conference (transportation from Osaka to Matsue, accommodation for two overnights 14 and 15 October, and all meals from breakfast on 15 until lunch on 16) US$200

b. Symposium registration fee US$100

c. Accommodation and meals in Matsue will cost approximately US$80 per person per day approximately US$240

d. Transportation from Matsue to Pusan by bus and ferry approximately US$100

e. Post-symposium field conference in Korea (transportation, accommodation for 3 overnights from 21 to 23 and all meals) approximately US$200

Correspondence

All enquiries and correspondence should be addressed to:

a. Pre-symposium field conference and symposium: Dr. Shigeru Iizumi, Geology Department, Shimane University, 1,060 Nishiikawatsu, Matsue, Japan 690

b. Post-symposium field conference: Mr. Kim Jong Hwan, Korea Institute of Energy and Resources, 219-5 Garibong-Dong, Guro-Gu, Seoul, Korea 150-06.

Further details

Contact Mr. Teoh Lay Hock, Chairman, National Working Group, IGCP Project 220, P.O. Box 11110, 50736 Kuala Lumpur, Malaysia.

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SECOND INTERNATIONAL CONFERENCE ON GOLD MINING - GEOLOGY, FEASBILITY, MINING, EXTRACTION - NOVEMBER 7, 8, 9, 1988 VANCOUVER, BRITISH COLUMBIA, CANADA

Extensive interest has recently developed in gold mining throughout the world. This conference is the first to deal with the overall program of the location of gold deposits through to mining extraction, easte disposal and reclamation. World recognized specialists will be Keynote speakers. Numerous case examples will be featured.

Technical displays will be featured.

The conference will be of interest to the following:-

- Mining Companies
- Exploration Companies
- Government Mining and Regulatory Dept.
- Consulting Engineers and Geologists
- Testing, Monitoring and Blasting specialists
- University Staff
- Mining Research Agencies
- Mine and Plant Suppliers
- Financial Agencies
- Brokerage Houses

Special technical sessions will emphasize the following areas of interest:

- Geology of gold deposits
- Geochemistry of gold deposits
- Exploration
- Feasibility studies
- Mine evaluation
- Mine design
- Mine development
- Mining methods
- Gold mineralogy
- Extraction and processing
- Leaching
- Waste disposal
- Environmental control
- Mine reclamation
- Opportunities for gold mining in lesser developed countries.

Conference Advisory Organizations

- Society of Mining Engineers of AIME
- B.S. and Yukon Chamber of Mines
- B.C. Mining Association
- B.C. Dept. of Mines and Petroleum Resources.

The official language of the conference is English.

For further information

Coordinator - Gold Mining Conference, P.O. Box 91651, West Vancouver, B.C. Canada V7V 3P/. Tel: (604) 922-3717.

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SILVER - EXPLORATION, MINING AND TREATMENT

An international conference, organized by the Institution of Mining and Metallurgy in association with the Camara Minera de Mexico and the Silver Institute - is to be held in Mexico City from 21 to 24 November, 1988

In addition to the conference technical sessions, at which there will be simultaneous translation into English and Spanish, field/plant visits will be made to silver operations in Mexico. A programme of local sightseeing tours will be organized for registrants and accompanying persons.

The Organizing Committee will welcome the submission of abstracts of papers intended for publication in the preprinted volume of papers (*Silver - exploration, mining and treatment* - to be published in September-October 1988) and presentation at the technical sessions. Abstracts in English (250-300 words), should be submitted to The Conference Office, The Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, England.

All enquiries in connection with the conference should be addressed to The Conference Office, The Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, England. Tel: 01 580 3802; Telex: 261410 IMM G.

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SHAFT ENGINEERING - INTERNATIONAL CONFERENCE

5-7 June, 1989, Harrogate, England
Organized by The Institution of Mining and Metallurgy in association with The Institution of Civil Engineers and The Institution of Mining Engineers

Papers

This conference, in addition to providing a major state-of-the-art review of the subject, will cover a wide range of shaft engineering problems such as small shafts for sewerage schemes, mine access and ventilation shafts, pressure shafts for hydroelectric schemes, offshore shafts and special prupose shafts such as those for radioactive waste repositories.

In order to ensure that the conference has wide international scope, the Organizing Committee includes representatives from Europe, North America, South Africa, India, Australia and China. The conference will provide a unique opportunity for those concerned with shaft design and construction to become acquainted with worldwide practice in civil and mining engineering.

The Organizing Committee will be pleased to consider papers that deal with any aspect of shaft engineering including the following:

* investigation
* hydrogeological aspects
* shaft-lining design and construction techniques
* geotechnical processes (freezing/grouting/dewatering)
* shallow shafts for civil engineering
* high-pressure shafts for hydroelectric and energy storage schemes
* mine access and ventilation shafts
* shaft requirements for nuclear waste repositories
* offshore shafts
* case histories

KURSUS-KURSUS LATIHAN & BENGKEL-BENGKEL (TRAINING COURSES & WORKSHOPS)

1988

June 1988
SEDIMENT TECHNOLOGY (Ankara, Turkey). An annual four-week Unesco-sponsored postgraduate course. For information: Dr. Ergun Demiroz, DSI Teknik Arastirma ve Kalite Kontrol, Dairesi Baskanligi, 06100 Ankara, Turkey.

June 1988 - August 1988
TECHNIQUES OF HYDROLOGIC INVESTIGATIONS (Washington, D.C. and Denver, Colorado, USA). Annual training course for international participants. For information: Office of International Hydrology, Water Resources Division, U.S. Geological Survey, 470 National Center, Reston, Virginia 22092, USA.

July 1988 - August 1988
SUMMER COURSE ON EARTH SCIENCES: CRYSTALLOGRAPHY, MINERALOGY, METALLOGENY (Madrid, Spain). Annual course organized by the Department of Geology and Geochemistry of the Universidad Autonoma de Madrid and sponsored by Unesco. Language: Spanish. For information: Prof. T. Monseur, Departamento de Geologia y Geoquimica, Facultad de Ciencias, Universidad Autonoma de Madrid, Canto Blanco, Madrid 34, Spain.

September 1988 - July 1989
PETROLEUM EXPLORATION GEOLOGY (Headington, Oxford, UK). An annual diploma course designed by Oxford Polytechnic to prepare post-graduate geologists for the duties of geologists in oil exploration teams. For information: M. Hoggins, Department of Geology and Physical Sciences, Oxford Polytechnic, Headington, Oxford OX3 OBP, U.K.

September 1988 - August 1989
MINERAL EXPLORATION AND EXPLORATION GEOPHYSICS (Delft, The Netherlands). Annual diploma courses organized by the International Institute for Aerial Survey and Earth Sciences and sponsored by Unesco. Language: English. For information: Student Registration Office, ITC (ME), P.O. Box 6, 7500 AA Enschede, The Netherlands.

October 1988 - November 1988
TECTONICS, SEISMOLOGY AND SEISMIC RISK ASSESSMENTS (Potsda, East Germany). One-month training course organized annually by East German Academy of Sciences in collaboration with Unesco. Language: English. For information: Prof. Dr. H. Kautzleben, Director, Central Earth's Physics Institute, Academy of Sciences of the German Democratic Republic, Telegraphenberg, DDR-500 Postdam, German Democratic Republic.

October 1988 - July 1989
ENGINEERING HYDROLOGY (Galway, Ireland). Annual diploma and post-graduate courses organized by the Department of Engineering Hydrology, University College Galway, Ireland. Sponsored by Unesco-IHP and the World Meteorological Organization. For information: Prof. J.E. Nash, Department of Engineering Hydrology, University College Galway, Galway, Ireland.

October 1988 - September 1989
HYDRAULIC ENGINEERING AND HYDROLOGY (Delft, The Netherlands). Diploma courses organized annually by the International Institute for Hydraulic and Environmental Engineering and sponsored by Unesco for professionals from developing countries. Language: English. For information: International Institute for Hydraulic and Environmental Engineering (IHE), Oude Delft 95, P.O. Box 3015, 2601 DA Delft, The Netherlands.

October 1988 - September 1990
FUNDAMENTAL AND APPLIED QUATERNARY GEOLOGY (Brussels, Belgium). Annually organized training course leading to a Master's degree in Quaternary Geology by the Vrije Universiteit Brussel (IFAQ) and sponsored by Unesco. Language: English. For information: Prof. Dr. R. Paepe, Director of IFAQ, Kwartairgeologie, Vrije Universiteit Brussel, Pleinlaan 2, B-1050, Brussels, Belgium.

October 1988 - September 1990
GEOLOGICAL EXPLORATION METHODS (Nottingham, U.K.). Two-year M.Sc. course starting every other year with emphasis on applied methodology, date acquisition and interpretations. For information: Dr. M.A. Lovell, Department of Geology, University of Nottingham NG7 2RD, U.K.

1989

May 1989
HYDROLOGY OF FRACTURED ROCKS (Montpellier, France). Annual three-week post-graduate course sponsored by Unesco. For information: Professeur C. Drogue, Laboratoire d'Hydrogeologie, Universite des Sciences et Techniques du Languedoc, Place Eugene Bataillon, 34060 Montpellier, France.

August 1989 - June 1991
SOIL SCIENCE AND WATER MANAGEMENT (Wageningen, The Netherlands). A 2-year M.Sc. course organized by Agricultural University Wageningen. Course starts every other year. Language: English. For information: The Director of Studies of the M.Sc. Course in Soil Science and Water Management, P.O. Box 37, 6700 AA Wageningen, The Netherlands.

August 1989 - October 1989
GEOCHEMICAL PROSPECTING METHODS (Prague, Czechoslovakia). Certificate course organized every second year by the Geological Survey of Czechoslovakia and sponsored by Unesco, IAGC and Czechoslovakia. Language: English. For information: GEOCHIM Unesco CSSR, Geological Survey of Prague, Malostranske nam. 19, 11821 Prague 1, Czechoslovakia.

September 1989 - October 1989
GROUNDWATER TRACING TECHNIQUES (Graz, Austria). Five-week course organized every other year by the Institute of Technical Geology, Petrography and Mineralogy and sponsored by Unesco. Language: English. For information: Institute of Technical Geology, Petrography and Mineralogy of the University of Technology, Rechbauerstrasse 12, A-8010 Graz, Austria.

KALENDAR (CALENDAR)

1988

May 30 - June 3, 1988
INTERACTION BETWEEN GROUNDWATER AND SURFACE WATER (International Symposium), Lund, Sweden. (Prof. Dr. G. Lindh, Lund Inst. of Technology, S-22007 Lund, Sweden).

May 31 - June 4, 1988
SEISMIC ANISOTROPY IN THE EARTH'S CRUST (AGU Chapman Conference), Berkeley, Calif., USA. (AGU Meetings, 2000 Florida Av, NW., Washington, D.C. 20009, USA).

June 1-5, 1988
CASE HISTORIES IN GEOTECHNICAL ENGINEERING (2nd International Conference and GSA Penrose Conference), St. Louis, Missouri, USA. (Shamsher Prakash, Room 308, Department of Civil Engineering, University of Missouri, Rolla, MO 65401, USA).

June 5-10, 1988
ENERGY '88 (2nd International Congress), Tiberias, Israel. Language: English. (Miriam Malz Exhibition Services Ltd., 30 Hey B'iyar Street, 62988 Tel-Aviv, Israel).

June 21-24, 1988
FLUID FLOW, HEAT TRANSFER AND MASS TRANSPORT IN FRACTURED ROCKS (4th Canadian/American Conference), Banff, Alberta, Canada. (Dr. Claude M. Sauveplane, ARC, P.O. Box 8330, Station F, Edmonton, Alberta, Canada T6H 5X2).

July 9-15, 1988
MINERALS AND EXPLORATION AT THE CROSSROADS (Annual Conference Australasian Institute of Mining and Metallurgh), Sydney, NSW, Australia. (Bicentenary Conference, c/o The Aus IMM, P.O. Box 122, Parkville, Victoria 3052, Australia).

July 10-15, 1988
LANDSLIDES (5th International Symposium), Lausanne, Switzerland. (C. Bonnard, P.O. Box 83, CH-1015, Lausanne 15, Switzerland).

July 11-16, 1988
GEOCHEMICAL EVOLUTION OF THE CONTINENTAL CRUST (IAGC Conference), Sao Paulo, Brazil. Language: English. (Dr. A.J. Melfi, Institute of Astronomy and Geophysics, University of Sao Paulo, C.P. 30627, Sao Paulo 01000, Brazil).

July 18-20, 1988
RADIOLARIA (International Conference), Marburg, F.R.G. (Prof. Dr. R. Schmidt-Effing, Interrad - Conference, Department of Geosciences, Philipps Universitat, Lahnberge, D-3550 Marburg, Federal Republic of Germany; or Dr. J.R. Blueford, U.S. Geological Survey, 345 Middlefield Road, MS 144, Menlo Park, Ca. 94025, USA).

July 18-22, 1988
GONDWANA (7th International Symposium), Sao Paulo, Brazil. Co-sponsored by IUGS (A.C. Rocha-Campos, Instituto de Geosciencias, Universidade de Sao Paulo, C.P. 20899, Sao Paulo, SP, Brazil).

July 25-29, 1988
FOSSIL CNIDARIA (5th International Symposium), Brisbane, Australia. (Dr. J.S. Jell, Department of Geology and Mineralogy, University of Queensland, St. Lucia, Queensland 4067, Australia).

July 25-29, 1988
OSTRACODA AND GLOBAL EVENTS (10th International Symposium), Aberystwyth, Wales, U.K. (Dr. R.C. Whatley, Micropalaeontology Division, Department of Geology, University College of Wales, Aberystwyth, Dyfed SY23 3DB, Wales, U.K.)

July 30 - August 4, 1988
SEDIMENTOLOGY RELATED TO MINERAL DEPOSITS (IAS International Symposium), Beijing, P.R. China. Co-sponsored by IGCP 219 and 226. Language: English. (Dr. Wang Shousong, IAS International Symposium, c/o Institute of Geology, Academia Sinica, P.O. Box 634, Beijing, P.R. China).

August 1988
GEOLOGICAL MAPS OF THE WORLD (3rd Exhibition), Edinburgh, Scotland. (Mr. D.H. Land, Hon. Secretary, Edinburgh Geological Society, c/o British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA, Scotland, UK).

August 9-12, 1988
ORDOVICIAN SYSTEM (5th International Symposium), St. John's, Newfoundland, IUGS Subcommission on Ordovician Stratigraphy and IGCP 216. (Dr. C.R. Barnes, ISOS, Department of Earth Sciences, Memorial University, St. John's, Newfoundland, Canada A1B 3X5).

August 14-19, 1988
THE ORIGIN AND EVOLUTION OF ANORTHOSITES AND ASSOCIATED ROCKS (GSA Penrose Conference), Chugwater, Wyoming, USA. (B. Ronald Frost, Department of Geology, University of Wyoming, P.O. Box 3006 University Station, Laramie, WY 82071, USA).

August 28 - September 2, 1988
INTERNATIONAL PALYNOLOGICAL CONGRESS (7th), Brisbane, Australia. (Dr. John Rigby, Conventions Department, P.O. Box 489, G.P.O., Sydney, NSW 2001, Australia).

August 28 - September 2, 1988
CLAY (AIPEA 9th International Conference), Strasbourg, France. (Dr. Helene Paquet, 9th International Clay Conference, Institut de Geologie, 1 rue Blessig, F-67084 Strasbourg Cedex, France).

August 29 - September 2, 1988
GEOCHEMISTRY AND COSMOCHEMISTRY (European Association of Geochemistry International Congress), Paris, France. (Pr. C.J. Allegre, Laboratoire de Geochimie et Cosmochimie, 4 place Jussleu, Tous 14-15, 3 eme etage, 75252 Paris Cedex, France).

September 5-9, 1988
PETROLOGY AND GEOCHEMISTRY OF GRANULITES AND RELATED ROCKS (International Workshop), Clermont-Ferrand, France. (Drs. D. Vielzeuf and Ph. Vidal, Departement de Geologie, 5 rue Kessler, 63038 Clermont-Ferrand, France).

September 5-9, 1988
FISSION TRACK DATING (6th International Congress), Besancon, France. (Laboratoire de Microanalyses nucleaires, UER Sciences et Techniques, La Bouloie, Route de Gray, 25030 Besancon Cedex, France).

September 5-9, 1988
GEOSTATISTICS (3rd International Congress), Avignon, France. Languages: English and French. (Geostat Congress 1988, Centre de Geostatistique, 35 rue Saint-Honore, 77305 Fontainebleau, France).

September 5-10, 1988
FAN DELTAS (International Workshop), Calabria, Italy. Sponsored by IAS. (Dr. Albina Colella, Dipartimento di Scienze della Terra, Universita della Calabria, 87030 Castiglione Cosentino SC. (CS), Italy).

September 6-10, 1988
GEOCHEMISTRY AND MINERALIZATION OF PROTEROZOIC MOBILE BELTS (International Symposium), Beijing, P.R. China. Partly co-sponsored by IGCP-217 and IGCP National Committee of China. Languages: English and Chinese. (Prof. Sun Dazhong, Tianjin Institute of Geology and Mineral Resources, CAGS, No. 4, 8th Road, Dazhigu, Tianjin 300170, P.R. China).

September 7-10, 1988
ASIAN MARINE GEOLOGY (International Conference), Shanghai, P.R. China. Co-sponsored by IUGS Commission for Marine Geology. (Prof. Wang Pinxian, Department of Marine Geology, Tongji University, Shanghai 200092, P.R. China).

September 19-23, 1988
ENGINEERING GEOLOGY AS RELATED TO THE STUDY, PRESERVATION OF ANCIENT WORKS, MONUMENTS AND HISTORICAL SITES (IAEG International Symposium), Athens, Greece. Languages: English, French, and Greek. (Greek Committee of Engineering Geology, 1988 Symposium Secretariat, P.O. Box 19140, GR-117 10 Athens, Greece).

September 20-22, 1988
BARITE (Symposium), Kutna Hora, Czechoslovakia. (Geological Survey /UUG/Symposium Barite, Malostranske nam. 19, 118 21 Praha 1, Czechoslovakia).

September 20-23, 1988
METAMORPHISM AND CRUSTAL EVOLUTION (International Symposium), Changehun, P.R. China. Languages: English and Chinese. (Yan Hongquan, Changchun College of Geology, Changchun, Jilin, P.R. China).

September 25-28, 1988
MEDITERRANEAN BASINS (AAPG European Geological Conference & Exhibition), Nice, France. (AAPG Convention Department, Box 979, Tulsa, Ok 74101, USA).

September 26-29, 1988
THE APPLICATION OF GEOLOGY IN THE DEVELOPING COUNTRIES (International Conference), Nottingham, U.K. Co-sponsored by AGID. (Conference Secretariat, Dept. of Geology, University of Nottingham, Nottingham, NG7 2RD, U.K.).

October 1988
COAL RESEARCH (International Conference), Tokyo, Japan. (Dr. W.G. Jensen, International Committee for Coal Research, Bte 11, B-1150 Brussels, Belgium).

October 1-3, 1988
NEOTECTONICS (INQUA Colloquium), Orleans, France. (J. Fourniguet, BRGM/SGN, B.P. 6009, 45060 Orleans Cedex 2, France.

October 11-17, 1988
GEOLOGY '88, CHINA (International Exhibition), Beijing, P.R. China. (M.C. Morley-Hall, SHK International Services Ltd., 3/F Prince Rupert House, 64 Queen Street, London EC4R 1AD, England, UK).

October 12, 1988
HYDROTHERMAL PROCESSES IN VOLCANIC TERRANES (Joint Meetings: Geological Society of London and Mineralogical Society of Great Britain), Cardiff, Wales, U.K. (Dr. R.E. Bevins, Department of Geology, National Museum of Wales, Cardiff CF1 3NP, UK).

October 23-28, 1988
MINE WATER (3rd International Congress), Melbourne, Australia. (Australasian Institute of Mining and Metallurgy, P.O. Box 122, Parkville, Victoria 3052, Australia).

October 30 - November 3, 1988
SOCIETY OF EXPLORATION GEOPHYSICISTS (Annual Meeting), Anaheim, California, USA. (Society of Exploration Geophysicists, P.O. Box 3098, Tulsa, Ok. 74101, USA).

October 31 - November 3, 1988
GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Denver, Colorado, USA. (Meetings Department, GSA, P.O. Box 9140, Boulder, Co. 80301, USA).

November 1988
GLOBAL GEOSCIENCE TRANSECTS (ICL Symposium and Workshops), Belem, Brazil. (J. Monger, Geological Survey, 100 W. Pender Street, Vancouver, B.C., Canada V6B 1R8).

November 10-14, 1988
EXPLORATION AND DEVELOPMENT OF GEOTHERMAL RESOURCES (Meeting), Kumamotu and Beppu, Japan. (Geothermal Research Society, c/o Geological Survey of Japan, 1-1-3 Higashi, Yatabe, Tsukuba, Ibaraki 305, Japan).

November 21-24, 1988
SILVER-EXPLORATION, MINING AND TREATMENT (Conference), Mexico City. (IMM Conference Office, 44 Portland Place, London W1N 4BR, U.K.).

1989

January 1989
SOIL MECHANICS AND FOUNDATION ENGINEERING (12th International Conference), Rio de Janeiro, Brazil. (XII ICSMFE, Caixa Postal 1559, 20000 Rio de Janeiro, PJ, Brazil).

January 15-27, 1989
OMAN OPHIOLITE-STRUCTURE-PETROLOGY-STRATIGRAPHY (International Symposium), Muscat, Sultanate of Oman. (Secretary, Hilal Azry, Ministry of Petroleum and Minerals, P.O. Box 551, Muscat, Oman).

February 8-11, 1989
MODEL OPTIMIZATION IN EXPLORATION GEOPHYSICS (7th International Seminar), Berlin. (Institut fur Geophysikalische Wissenschaften, Mathematische Geophysik, Freie Universitat Berlin, Podbeilskiallee 60, D-1000 Berlin 33, Federal Republic of Germany).

Febraruy 28-March 3, 1989
APPLICATION OF COMPUTERS AND OPERATIONS RESEARCH IN THE MINERAL INDUSTRY (21st International Symposium), Las Vegas, Nev., USA. (Society of Mining Engineers, Caller No. D, Littleton, Co. 80162-5002, USA).

March 28 - April 9, 1989
SILURIAN SYSTEM (International 'Murchison' Symposium), Keele, Staffs., U.K. Co-sponsored by the IUGS Subcommission on Silurian Stratigraphy. (Dr. M.G. Bassett, National Museum of Wales, Cathays Park, Cardiff CF1 3NP, Wales, UK).

May 17-18, 1989
GOLD IN EUROPE (International Conference), Toulouse, France. (R.P. Foster, Department of Geology, University of Southampton, Hants, SO9 5NH, U.K.).

June 26-29, 1989
ENGINEERING GEOLOGY IN TROPICAL TERRAINS (International Conference), Selangor Darul Ehsan, Malaysia. Co-sponsored by IAEG. (Secretariat, International Conference, Dept. of Geology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor Darul Ehsan, Malaysia).

July 9-19, 1989
INTERNATIONAL GEOLOGICAL CONGRESS (28th), Washington, D.C., USA. (International Geological Congress, P.O. Box 1001, Herndon, Va. 22070, USA).

July 27-August 1, 1989
WATER-ROCK INTERACTION (6th International Symposium), Bath, U.K. (Dr. W.M. Edmunds, Hydrogeology Group, BGS, Maclean Building, Crowmarsh Gifford, Wallingford, Oxfordshire, OX10 8BB, U.K.).

August 14-16, 1989
PRECAMBRIAN GRANITOIDS: PETROGENESIS, GEOCHEMISTRY AND METALLOGENY (IGCP 217 and 247 Symposium), Helsinki, Finland. (Precambrian Granitoids Symposium, Department of Geology, University of Helsinki, P.O. Box 115, SF-00171 Helsinki, Finland).

September 3-9, 1989
GEOMORPHOLOGY (2nd International Conference), Frankfurt/Main, F.R.G. (Prof. Dr. Arno Semmel, Institut fur Physische Geographie, Universitat Frankfurt, Senckenberganlage 36, Postfach 11 19 32, D-6000 Frankfurt/Main, F.R. Germany).

September 4-8, 1989
NON-METALLIC MINERALS (2nd World Congress), Beijing, P.R. China. (Prof. Xu Changyou, Wuhan University of Technology, Wuhan, Hubei Province, P.R. China).

September 14-19, 1989
EDITING IN THE 90'S (Joint CBE, EASE, AESE Meeting), Ottawa, Ontario, Canada. (Barbara Drew, Research Journals, National Research Council of Canada, Ottawa, Ontario, Canada K1A 0R6).

September 17-24, 1989
ENERGY (14th World Congress), Montreal, Quebec, Canada. (World Energy Conf., 34th St. James's Street, London SW1A 1HD, UK).

October 2-4, 1989
GEOCHEMICAL EXPLORATION (13th International Symposium), Rio de Janeiro, Brazil. Co-sponsored by AEG. (Organizing Committee, 13th IGES, P.O. Box 2432, 20010 Rio de Janeiro, Brazil).

October 2-4, 1989
FLUVIAL SEDIMENTOLOGY (4th International Conference), Barcelona, Spain. (C. Puigdefabregas, Servei Geologic de Catalunya, carrer Diputacio 92, 08015 Barcelona, Spain).

October 29 - November 2, 1989
SOCIETY OF EXPLORATION GEOPHYSICISTS (Annual Meeting), Dallas, Texas, USA. (Convention Assistant, SEG, P.O. Box 3098, Tulsa, Ok. 74101, USA).

November 9-12, 1989
GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), St. Louis, Missouri, USA. (Meetings Department, GSA, P.O. Box 9140, Boulder, Co. 80301, USA).

1990

August 1990
INTERNATIONAL ASSOCIATION ON THE GENESIS OF ORE DEPOSITS (8th Symposium), Ottawa, Canada. (Dr. R.W. Boyle, Geological Survey of Canada, 601 Booth Street, Ottawa, Canada K1A 0E8).

August 12-18, 1990
INTERNATIONAL MINERALOGICAL ASSOCIATION (15th Meeting), Beijing, China. (Prof. Huang Yunhui, Institute of Mineral Deposits, Chinese Academy of Geological Sciences, Baiwanzhuang Rd. 26, Fuchengmenwai, Beijing, China).

GEOLOGICAL SOCIETY OF MALAYSIA PUBLICATIONS

General Information

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

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

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

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

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

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

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

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

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

Script Requirements

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

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

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

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

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

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

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

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

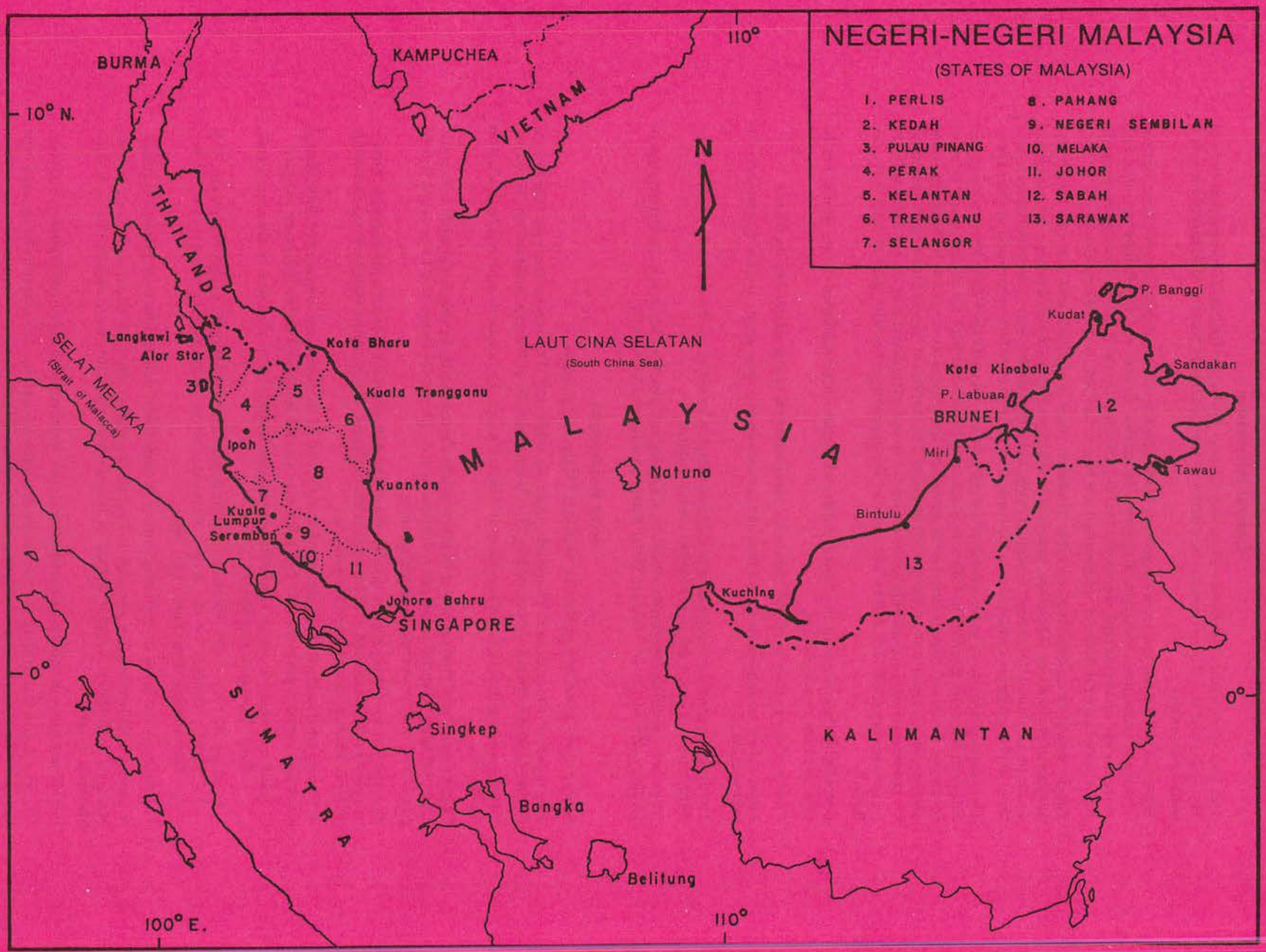
The name of the book or publication must be underlined and will be later printed in italics.

A concise and informative abstract in English is required for each paper written in Bahasa Malaysia or English. A paper written in Bahasa Malaysia must have an abstract in Bahasa Malaysia as well.

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

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

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


NEGERI-NEGERI MALAYSIA
(STATES OF MALAYSIA)
1. PERLIS
2. KEDAH
3. PULAU PINANG
4. PERAK
5. KELANTAN
6. TRENGGANU
7. SELANGOR
8. PAHANG
9. NEGERI SEMBILAN
10. MELAKA
11. JOHOR
12. SABAH
13. SARAWAK
BURMA
KAMPUCHEA
VIETNAM
THAILAND
10° N.
110°
N
LAUT CINA SELATAN
(South China Sea)
SELAT MELAKA
(Strait of Malacca)
Langkawi
Alor Star
Kota Bharu
Kuala Trengganu
Ipoh
Kuantan
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Singkep
Bangka
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