

PERSATUAN GEOLOGI MALAYSIA

WARTA GEOLOGI

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CATATAN GEOLOGI

Geological Notes

Composition of colour zoned garnet from the Redang aureole

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Abstract: Colour zoned garnet porphyroblasts from a garnet-biotite hornfels in the Redang aureole show concentric pale and red rings. The garnet is almandine with the pale zones having slightly elevated spessartine and grossular molecules compared to the pyrope molecule. The red zones are higher in pyrope molecule but more depleted in spessartine and grossular molecules combined.

Contact metamorphism of rocks adjacent to high level granitic plutons occurs throughout the Eastern Belt of Peninsular Malaysia. The pelitic rocks in the contact metamorphic aureoles have developed andalusite, cordierite, sillimanite and more rarely garnet. The Redang aureole (Fig. 1) is one of the places where garnet has developed in contact metamorphosed pelitic rock. In this note the results of a study of the composition of garnet in a garnet-biotite hornfels in the Redang aureole will be discussed.

The Redang aureole developed in Upper Palaeozoic rocks adjacent to the Redang granite which has a tonalitic margin exposed at the northern tip of Pulau Pinang, a small island south of the main Pulau Redang (Fig. 1 and Khoo *et al.*, 1988). A few metres away from the tonalitic contact the pelitic rocks have several narrow bands or lenses of a garnet-biotite hornfels.

The garnet occurs as porphyroblasts up to 1 cm across. About 20–30% of the rock is garnet which occurs in a much chloritized biotite-quartz groundmass with accessories such as apatite. In thin section the garnet shows concentric colour zones, pale cores surrounded by a red ring which is in turn surrounded by a pale ring. The whole grain is, however, isotropic under cross-polars.

The compositions of several garnet grains in Specimen R4 were analysed using the microprobe (Table 1). The garnets analysed show that they are very almandine rich with high FeO.

One of the smaller colour zoned garnet porphyroblasts was studied in detail with 12 spot analyses made along traverse XY across the grain (Fig. 2). In addition 3 spot analyses of the pale zone not along XY were also made. The results of the FeO, MgO, MnO and CaO analysed are tabulated in Table 2.

From the analysis, it is clear that the zoned garnet has only minor amounts of pyrope, spessartine and grossular molecules as indicated by the contents of MgO, MnO and CaO respectively. The results also show that in the red zone, the pyrope molecule is slightly elevated compared to the spessartine and grossular molecule combined. In the pale zone, the spessartine and grossular molecules are elevated but the pyrope molecule is depleted.

In conclusion, the mineralogy shows a hornblende hornfels grade of metamorphism has been achieved and the colour zonation of the garnet is caused by the amount of the pyrope molecule and spessartine/grossular molecules present.

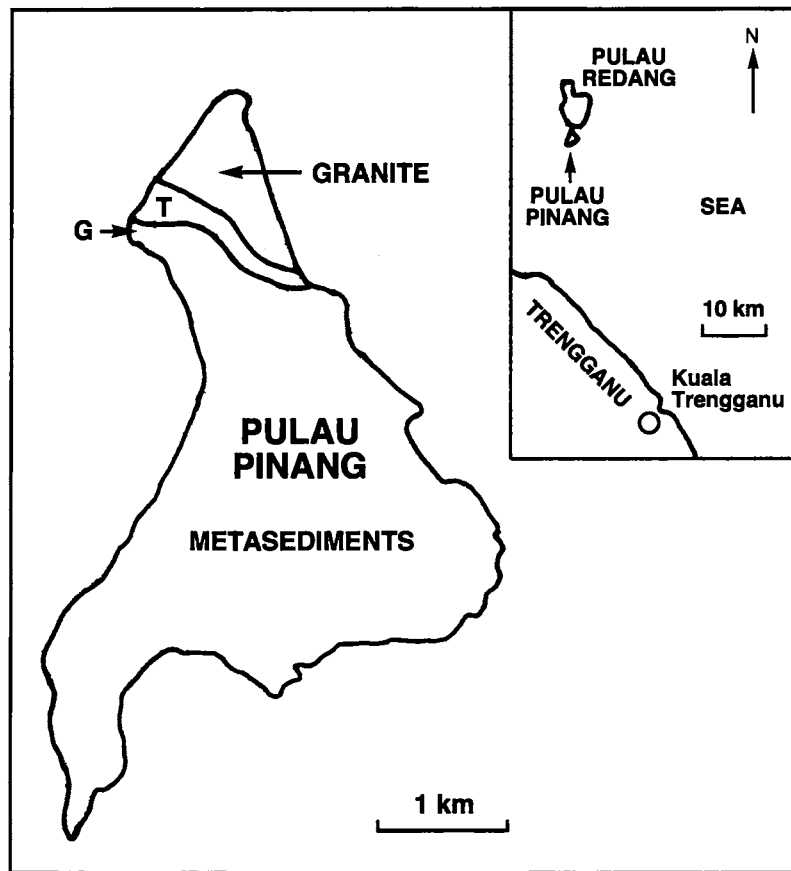


Figure 1. Location of the Redang aureole. T, tonalitic margin; G, garnet-biotite hornfels.

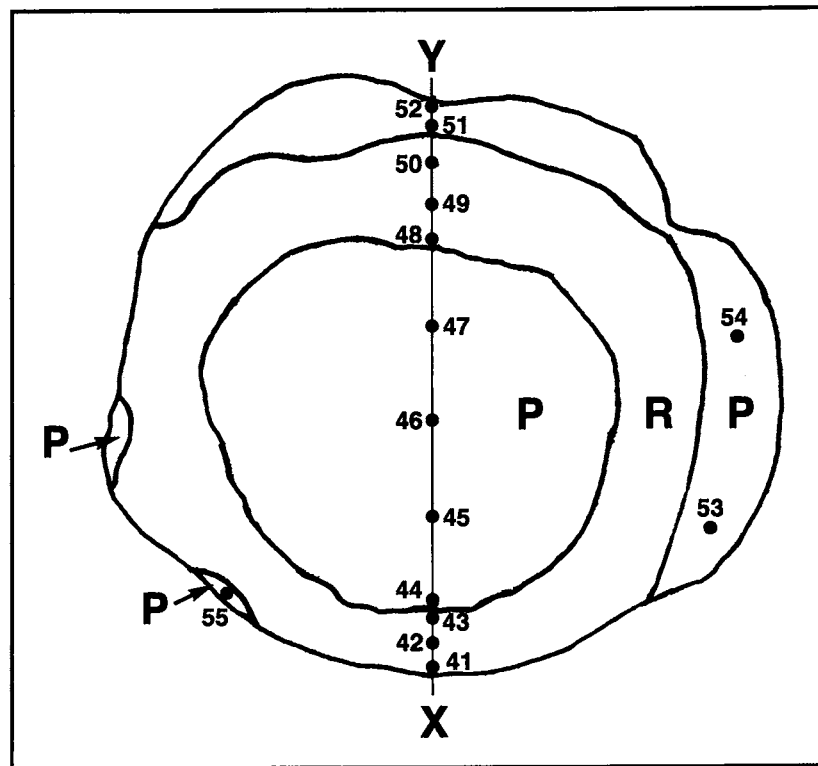


Figure 2. Colour zoned garnet in Specimen R4, garnet-biotite hornfels. P, pale zone; R, red zone; XY, section analysed; 49, 50, etc., spots analysed. Grain about 1 mm across.

Table 1. Composition of garnet porphyroblasts in Specimen R4, a garnet-biotite hornfels from the Redang aureole, Pulau Redang. All Fe₂O₃ analysed as FeO.

| Oxides | 1 | 2 | 3 | 4 | 5 |
|--------------------------------|--------|--------|--------|-------|--------|
| TiO ₂ | 0.06 | 0.03 | 0.02 | 0.05 | 0.05 |
| SiO ₂ | 35.90 | 36.22 | 36.11 | 35.61 | 36.22 |
| Al ₂ O ₃ | 20.39 | 20.36 | 20.54 | 20.55 | 20.07 |
| FeO | 42.76 | 41.93 | 41.79 | 41.61 | 42.21 |
| MnO | 0.31 | 0.26 | 0.22 | 0.28 | 0.63 |
| MgO | 0.94 | 0.93 | 0.90 | 0.87 | 0.70 |
| CaO | 0.23 | 0.66 | 0.56 | 0.65 | 0.56 |
| Na ₂ O | 0.03 | 0.00 | 0.02 | 0.00 | 0.00 |
| K ₂ O | 0.01 | 0.02 | 0.00 | 0.00 | 0.00 |
| Total: | 100.63 | 100.41 | 100.15 | 99.62 | 100.43 |

Table 2. Microprobe analysis of a zoned garnet in a garnetiferous hornfels from the Redang aureole, Pulau Pinang, Pulau Redang. Points 48 and 51 are at the zonal boundaries. Oxides in percent. Points 41–52 are in a traverse across grain. Points 53–55 are selected pale areas not on the traverse. All Fe₂O₃ assumed to be FeO.

| Point | FeO | MgO | MnO | CaO | Colour and Name of Zone |
|-------|-------|------|------|------|-------------------------|
| 41 | 42.18 | 1.22 | 0.06 | 0.00 | Red, A |
| 42 | 42.70 | 1.26 | 0.08 | 0.03 | |
| 43 | 43.07 | 1.11 | 0.06 | 0.02 | |
| 44 | 42.65 | 0.88 | 0.18 | 0.20 | Pale, B |
| 45 | 42.50 | 0.85 | 0.27 | 0.55 | |
| 46 | 42.28 | 0.80 | 0.24 | 0.69 | |
| 47 | 41.49 | 0.84 | 0.22 | 0.71 | |
| 48 | 43.39 | 0.84 | 0.17 | 0.07 | Red, A |
| 49 | 41.95 | 0.98 | 0.08 | 0.04 | |
| 50 | 42.97 | 1.03 | 0.06 | 0.00 | |
| 51 | 42.44 | 1.03 | 0.15 | 0.17 | Pale, C |
| 52 | 42.02 | 0.50 | 0.49 | 0.61 | |
| 53 | 42.01 | 0.43 | 0.83 | 0.60 | Pale, C |
| 54 | 41.57 | 0.33 | 0.78 | 1.22 | |
| 55 | 41.40 | 0.45 | 0.97 | 0.84 | |

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CHARLES S. HUTCHISON



| Point | PbO | MgO | MnO | CaO | Colour and Name of Zone |
|-------|-------|------|------|------|-------------------------|
| 41 | 42.10 | 1.22 | 0.28 | 0.00 | Peb. A |
| 42 | 42.70 | 1.28 | 0.28 | 0.02 | |
| 43 | 43.02 | 1.11 | 0.28 | 0.02 | |
| 44 | 42.00 | | | 0.20 | Peb. B |
| 45 | 42.20 | | | 0.28 | |
| 46 | 42.20 | | | 0.28 | |
| 47 | 41.89 | | | 0.00 | Peb. A |
| 48 | 40.20 | | | 0.00 | |
| 49 | 41.80 | | | 0.00 | |
| 50 | 42.77 | | | 0.00 | Peb. C |
| 51 | 42.84 | 0.03 | 0.08 | 0.17 | |
| 52 | 42.02 | 0.20 | 0.08 | 0.21 | |
| 53 | 41.27 | 0.21 | 0.10 | 0.22 | Peb. C |
| 54 | 41.11 | 0.40 | 0.21 | 0.24 | |

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CATATAN GEOLOGI

Geological Notes

Accounting for hidden flows associated with mineral production in Selangor, Malaysia

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Abstract: Total mineral production and hidden flows are useful to quantify the relative contribution of minerals towards environmental degradation. Analyses of these two parameters in the mining sector of Selangor reveal that the production of earth materials has contributed most to environmental degradation. Aggregate production is the second highest contributor and this is followed by sand and gravel and kaolin production. The contribution of silica, tin and gold production to environmental degradation is relatively insignificant.

INTRODUCTION

Accounting of material flows involves a systematic and holistic view of the materials flow cycle, through its extraction, production and final disposal, taking into account the wastage throughout this process. Such accounting provides a better picture of the impact of human activities on the environment (Brown *et al.*, 2000). It also facilitates the quest for better solutions to the problems of depleting natural resources and creation of excess waste. Materials flow studies have also been conducted for purposes of assessing resource efficiency and materials substitution, particularly for construction applications (Kelly, 1998; Wilburn and Goonan, 1998). Such material flow analyses allow for informed decision-making about the use of materials and the expected consequences of alternative decisions.

A method to chart material movement to provide an overview of the physical basis of industrial economies and derive indicators for sustainability has been developed by Adriaanse *et al.* (1997). This method accounts for both total material inputs and hidden flows of renewable and non-renewable resources in an industrialized nation's economic activities. It

also provides the best overall estimate of the potential environmental impact associated with the extraction and utilisation of natural resources. An adaptation of this method was used to chart non-renewable resources in the Langat Basin of Malaysia, to assess the health of its ecosystem (Pereira, 2000). The accounting of mineral flows in the basin revealed that despite an increase in production per capita, hidden flows associated with the extraction of minerals declined from about 30% of the total mineral production in 1980 to less than 10% in 1995. Thus, the overall efficiency of mineral resource extraction in the Langat Basin improved during this period, indicating a positive contribution of the minerals industry to the ecosystem health of the Langat Basin.

In charting material movement for non-renewable resources such as minerals, the boundary between nature and the economy is defined at the point when humans first extract or move minerals from natural sites. The extraction of minerals often requires removal of large quantities of overburden that can modify or damage the environment even though they are not of economic value. For instance, the washing of tailing sand results in the removal of fine material, which is eventually disposed

along the waterways. All such flows are part of the economic activity but do not enter the monetary economy as commodities. The flows that do not enter the monetary economy are referred to as hidden flows and are described as estimates of overburden or gangue removed during mineral extraction. In accounting mineral movement, hidden flows are separated from those that enter into the economy.

This paper traces trends in total mineral production in the state of Selangor, Malaysia. The hidden flows associated with mineral production are also charted, to determine the relative contribution of each type of mineral to environmental degradation as a result of its extraction.

MINERAL PRODUCTION IN SELANGOR

Negeri Selangor Darul Ehsan, located in the west coast of Peninsular Malaysia, is the most developed state in the country. The contribution of mining to the economy of Selangor has not been very significant compared to the non-mining sectors. In 1980, the mining sector contributed to about 11% of the total GDP valued at RM6,846 million (GOS, 1995). This was largely due to the contribution from the tin mining industry. The crash of the tin price in the mid-1980s further reduced the contribution of the mining sector to the economy to 2% in 1990, where the total GDP was valued at RM14,663 million. In the year 2000, the contribution of the mining sector stood at 0.6% of the total GDP, valued at RM32,510 million (GOS, 2000). Notwithstanding this, the mining sector is still important as it currently provides employment to nearly 2% of the work force in Selangor.

The minerals produced in the state of Selangor include both metallic and industrial minerals (Table 1). The main metallic mineral is tin. A small amount of gold was also produced prior to the 1990s. The industrial minerals extracted are aggregates, earth materials (including clays), sand and gravel, silica and kaolin. In terms of tonnage, construction materials such as aggregate, earth materials, and sand and gravel contribute more than 90% of the total minerals produced in Selangor.

Aggregates refer to crushed rock materials obtained from quarries, which are produced in various sizes. The main rock-types exploited as aggregates are granite and limestone. The bulk of the aggregates are utilised in the construction industry in Selangor. Between 1980 and 1987, the annual production rate of aggregates in Selangor was between 10–14 Mt (Table 1). The production dropped to about 4 Mt in the 1988–1989 period. After 1990, aggregate production increased by 25% annually, to a peak of about 42 Mt in 1996. In 1997, aggregate production dropped by about 40% compared to the previous year. Since then, production has increased at an annual rate of about 10% to 22 Mt in 1999.

Earth materials include material used for landfill, common clay, brick clay, plastic clay and fire clay. It excludes special clays such as kaolin, which is described later. The various types of clays are used for different purposes depending on its properties and the extent to which it can withstand high temperatures (GSD, 1996a). Ball clay and plastic clay are used in the manufacture of high quality whiteware, pottery, clay pipes and tiles, ceramics and other structural clayproducts. Common and brick clays are suitable for making building bricks while fireclay is essential for the manufacture of refractory products such as firebricks, refractory mortars and mixes, crucibles and castable materials, among others. The production trend of earth materials in Selangor is similar to that of aggregates, ranging from between 0.2–4 Mt annually (Table 1).

Sand and gravel are the basic materials used in the construction industry. About 40% of the mines in Selangor exploit sand from mine tailings while the rest extract sand from rivers. The production of sand and gravel increased periodically and the trend is similar to that of aggregates and earth materials. Since 1990, sand and gravel production has generally been in the range of 1–2 Mt per annum (Table 1).

Kaolin or "china clay" is a special kind of high quality clay material suitable for a variety of industrial applications. Premium grade kaolin is used as paper coating and the manufacture of fine tableware, porcelain bone china and electric insulators. Normal grade kaolin is

Table 1. Mineral production in Selangor, 1980–1999. Source: Minerals and Geoscience Department of Malaysia.

| Year | Tin (Mt) | Gold (Tonne) | Aggregates (Mt) | Earth Materials (Mt) | Sand & Gravel (Mt) | Silica (Mt) | Kaolin (Mt) |
|------|----------|--------------|-----------------|----------------------|--------------------|-------------|-------------|
| 1980 | 0.022 | 0.02 | *11.0 | *0.98 | 0.16 | 0.034 | 0.004 |
| 1981 | 0.021 | 0.02 | *13.6 | *1.04 | 0.21 | *0.015 | *0.003 |
| 1982 | 0.019 | 0.03 | *13.8 | *0.96 | 0.42 | 0.005 | 0.002 |
| 1983 | 0.015 | 0.02 | *12.3 | *1.06 | 1.23 | 0.011 | 0.003 |
| 1984 | 0.015 | 0.02 | *11.6 | *1.04 | 3.11 | 0.009 | 0.003 |
| 1985 | 0.013 | 0.01 | *12.4 | *0.83 | 0.67 | 0.003 | 0.003 |
| 1986 | 0.010 | 0.01 | *10.1 | *0.60 | 4.58 | 0.006 | 0.004 |
| 1987 | 0.012 | 0.07 | *11.3 | *0.20 | *2.21 | 0.028 | 0.005 |
| 1988 | 0.011 | 0.03 | 4.1 | 0.20 | 0.17 | 0.061 | 0.011 |
| 1989 | 0.014 | 0.03 | 4.8 | 0.42 | 0.72 | 0.089 | 0.003 |
| 1990 | 0.012 | 0.02 | 10.7 | 0.31 | 0.83 | 0.212 | 0.006 |
| 1991 | *0.007 | 0.02 | 18.6 | 0.33 | 1.12 | 0.178 | 0.004 |
| 1992 | *0.005 | nil | 16.3 | 1.89 | 1.09 | 0.110 | 0.002 |
| 1993 | 0.004 | nil | *30.5 | 1.18 | 1.65 | 0.125 | *0.004 |
| 1994 | 0.002 | nil | 36.9 | 1.31 | 1.83 | 0.125 | *0.007 |
| 1995 | 0.002 | nil | 36.7 | 2.71 | 1.23 | 0.004 | 0.009 |
| 1996 | 0.002 | nil | 42.3 | 4.34 | 1.36 | 0.015 | 0.010 |
| 1997 | 0.002 | nil | 17.4 | 3.85 | 3.62 | 0.030 | *0.009 |
| 1998 | 0.002 | nil | 19.1 | 1.25 | 1.55 | 0.021 | 0.008 |
| 1999 | 0.003 | nil | 22.2 | 1.13 | 1.20 | 0.019 | 0.005 |

* denotes estimated value

best suited as fillers and extenders in the ceramic, paper, paint and rubber industries. The production of kaolin in Selangor was highest in the 1996–1998 period at levels between 8,000 and –10,000 tonne (Table 1). This was attributed to the upgrading of facilities in the processing plants to make it integrated and capable of producing kaolin suitable for export to Taiwan and Korea (GSD, 1996a).

The production of tin concentrates has declined substantially since 1980 (Table 1). The tin mining industry used to be the major economic activity in Selangor prior to the 1970's.

The tin industry is now insignificant, with less than three mines operating at any one time, reworking tailings from dredges and old mines. The by-product of such operations includes gold, ilmenite, monazite, zircon, pyrite and silica. Tin concentrate is presently being imported into the country from Australia, China and Bolivia for smelting. Refined tin is exported to countries such as the Netherlands, Japan, USA and South Korea. Since 1996 the consumption of tin metal in Selangor has been higher than its production. The metal is being consumed in the solder, tinplate and pewter industries in the state (GSD, 1996b).

Table 2. Hidden flows associated with the production of one metric tonne of mineral. Values are modified from Adriaanse *et al.* (1997) to suit local conditions.

| Mineral Production | Overburden | Gangue |
|-----------------------|-------------------|---------|
| Aggregate | 5% | minimal |
| Sand and Gravel | minimal | 2% |
| Earth materials | 1 tonne/tonne | minimal |
| Kaolin | 3 tonne/tonne | 25% |
| Silica | 2 tonne/tonne ore | 10% |
| Tin/Gold Concentrates | 2 tonne/tonne ore | 10% |

TOTAL MINERAL PRODUCTION AND HIDDEN FLOWS IN SELANGOR

Total Mineral Production (TMP) is the sum of locally extracted minerals per capita that supports an economic activity within a defined area. In this case, the defined area is the state of Selangor. Hidden flows (HF) are associated with the extraction and processing of minerals. Hidden flows in Selangor, defined as estimates of overburden or gangue removed during mineral extraction, were obtained from the literature and modified based on field visits to extraction sites in the state (Table 2). The material removed is often transported by storm waters and cause siltation of rivers downstream of extraction sites. In most long-term extraction sites such as aggregate quarries and kaolin mines, silt traps are installed to mitigate this problem. However, the maintenance of silt traps is generally poor. Extraction sites for earth materials and sand and gravel mines, which are generally small short-term operations, commonly do not install silt-traps.

The contributors to the TMP of Selangor for the period of 1980–1997 are aggregates, earth materials, sand and gravel, silica, kaolin, tin and gold. Between 1980 and 1987, the TMP was between 7–10 tonne/capita (Table 3). In 1988, the TMP registered a drop to 2 tonne/capita. From 1989, the TMP of Selangor increased by about 30% annually up to 1996, to a maximum of 17 tonne/capita. In 1997, the TMP dropped by half to about 8 tonne/capita.

The overall trend of hidden flows between 1980–1999 is similar to that of the TMP during the same period. An examination of the data

shows that apart from one instance in 1997, hidden flows generally range between 6–14% of the TMP, at a value of less than 2.29 tonne/capita (Table 3). The highest value of 20% of the TMP was obtained in 1997 but the actual value of the hidden flow was 1.62 tonne/capita.

About 90% of the hidden flows in Selangor has been contributed by the production of earth materials and aggregates, with the former contributing about 50% and the latter about 40%. Hidden flows associated with the production of earth materials is higher than aggregates even though earth materials contributed less than 10% of the TMP whilst the contribution of aggregates generally exceeded 75%. Thus, the production of earth materials has contributed most to environmental degradation in Selangor while that of aggregates is second highest.

Hidden flows associated with the production of sand and gravel, kaolin and silica do not show any particular trend. They are less than 10% of the total hidden flows for any given year. Generally, hidden flows associated with sand and gravel production is twice as much as that of kaolin production. Hidden flows of silica production is negligible. With respect to environmental degradation in the mining sector, the third highest contributor is sand and gravel production, followed by kaolin production. Environmental degradation associated with silica production is relatively insignificant.

Hidden flows associated with the extraction of tin and gold have generally declined since the 1980s. From a maximum of 5% of the total

Table 3. Total mineral production (TMP) and hidden flows (HF) associated with the production of minerals in Selangor (units are in metric tonne/capita).

| Year | TMP | Earth Materials | Aggregates | Sand & Gravel | Kaolin | Silica | Tin/Gold | Total HF | % TMP |
|------|------|-----------------|------------|---------------|--------|--------|----------|----------|-------|
| 1980 | 8.6 | 0.69 | 0.39 | 0.002 | 0.009 | 0.0005 | 0.031 | 1.11 | 12.93 |
| 1981 | 10.0 | 0.70 | 0.46 | 0.003 | 0.006 | 0.0002 | 0.028 | 1.19 | 11.83 |
| 1982 | 9.7 | 0.62 | 0.44 | 0.005 | 0.004 | 0.0001 | 0.025 | 1.09 | 11.17 |
| 1983 | 9.0 | 0.65 | 0.38 | 0.015 | 0.006 | 0.0001 | 0.019 | 1.07 | 11.82 |
| 1984 | 9.3 | 0.61 | 0.34 | 0.037 | 0.005 | 0.0001 | 0.018 | 1.01 | 10.87 |
| 1985 | 7.9 | 0.47 | 0.35 | 0.008 | 0.005 | 0.0000 | 0.015 | 0.84 | 10.69 |
| 1986 | 8.3 | 0.33 | 0.27 | 0.050 | 0.006 | 0.0001 | 0.011 | 0.66 | 7.98 |
| 1987 | 7.1 | 0.11 | 0.29 | 0.023 | 0.008 | 0.0003 | 0.012 | 0.43 | 6.08 |
| 1988 | 2.3 | 0.10 | 0.10 | 0.002 | 0.016 | 0.0006 | 0.010 | 0.21 | 9.53 |
| 1989 | 2.9 | 0.20 | 0.11 | 0.007 | 0.004 | 0.0008 | 0.014 | 0.33 | 11.59 |
| 1990 | 5.5 | 0.14 | 0.24 | 0.008 | 0.008 | 0.0019 | 0.011 | 0.40 | 7.36 |
| 1991 | 8.8 | 0.14 | 0.41 | 0.010 | 0.005 | 0.0016 | 0.006 | 0.57 | 6.43 |
| 1992 | 8.1 | 0.79 | 0.34 | 0.009 | 0.003 | 0.0009 | 0.004 | 1.14 | 14.12 |
| 1993 | 13.4 | 0.47 | 0.61 | 0.013 | 0.005 | 0.0010 | 0.003 | 1.10 | 8.22 |
| 1994 | 15.4 | 0.50 | 0.71 | 0.014 | 0.008 | 0.0010 | 0.002 | 1.23 | 7.97 |
| 1995 | 15.0 | 1.00 | 0.68 | 0.009 | 0.010 | 0.0000 | 0.002 | 1.68 | 11.25 |
| 1996 | 16.9 | 1.53 | 0.75 | 0.010 | 0.011 | 0.0001 | 0.001 | 2.29 | 13.51 |
| 1997 | 8.4 | 1.30 | 0.29 | 0.024 | 0.009 | 0.0002 | 0.001 | 1.62 | 19.27 |
| 1998 | 7.1 | 0.41 | 0.31 | 0.010 | 0.007 | 0.0001 | 0.001 | 0.73 | 10.25 |
| 1999 | 7.7 | 0.35 | 0.35 | 0.008 | 0.005 | 0.0001 | 0.002 | 0.71 | 9.25 |

hidden flow in 1988, the contribution of tin and gold production to environmental degradation is presently negligible.

CONCLUSIONS

In accounting mineral flows, total mineral production and hidden flows are useful to quantify the relative contribution of each mineral towards environmental degradation. In the case of the mining sector in Selangor, the production of earth materials has contributed most to environmental degradation while aggregates production is the second highest contributor. The third and fourth highest contributors are sand and gravel and kaolin production, respectively. The contribution of silica, tin and gold production to environmental degradation is relatively insignificant. About 90% of the hidden flows in Selangor has been

contributed by the production of earth materials and aggregates, indicating that these two minerals are the biggest contributors to environmental degradation in the mining sector of Selangor.

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Manuscript received 5 December 2002

PERTEMUAN PERSATUAN

Meetings of the Society

Ceramah Teknik (Technical Talk)

Technical Talks by Shuji Yoshida

Laporan (Report)

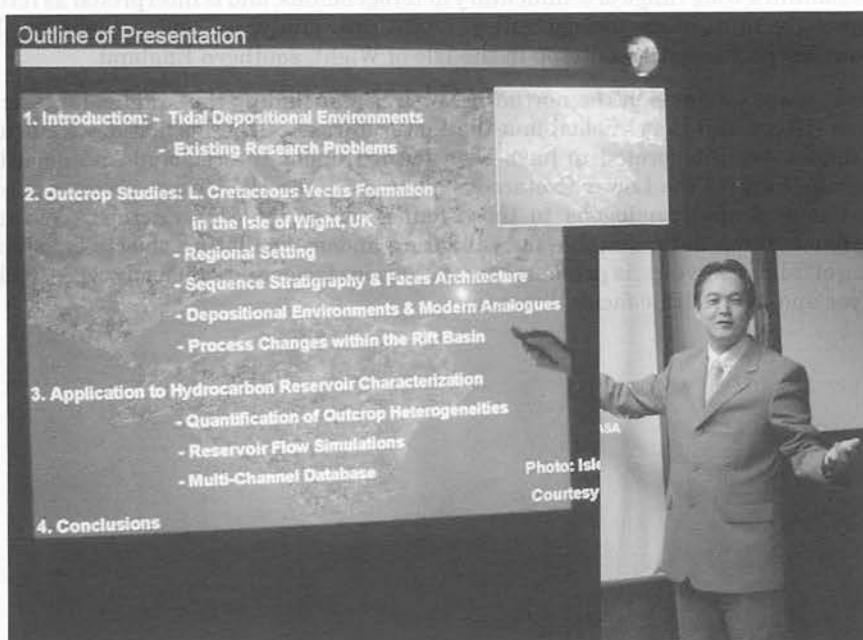
Dr. Shuji Yoshida of the Institute for Energy Research, University of Wyoming, USA, presented 3 interesting and well illustrated talks for the benefit of GSM members on the 17 and 18 December 2002.

The first 2 talks (Talks 1 & 2) held on 17th December at the Nikko Hotel, Jalan Ampang, commenced at 10.00 am and was hosted jointly by PETRONAS and the Society.

The next day, 18th December 2002, Dr. Yoshida was kind enough to give 2 talks (Talks 1 & 3) to GSM members at the Geology Department, University of Malaya, commencing at 4.45 pm.

This is Dr. Yoshida's second round of talks to the Society and judging from the good turnout at the talks, Dr. Yoshida has proved to be a popular speaker.

Abdul Hadi A.R.



Talk 1**Comparative studies of outcrop and modern analogues for characterizing subsurface tidal sandstone reservoirs: sequence stratigraphy, facies analysis and modeling — a multidisciplinary approach**

SHUJI YOSHIDA, HOWARD JOHNSON, ANN MUGGERIDGE, MATTHEW JACKSON, ALLARD MARTINIUS AND RICHARD DIXON

Abstrak (Abstract)

In many parts of the world, tidal sandstone reservoirs host major hydrocarbon accumulations. They are particularly important in the northern North Sea (Norway/UK), Venezuela, Columbia, SE Asia, onshore US/Canada, Yemen and Egypt. However, their characterization and modelling are difficult. This is mainly because they contain a complex array of sedimentary heterogeneities (e.g., mud baffles) at various length scales, and we have very little knowledge on the dimensions and geometries of these heterogeneities. Moreover, unlike wave-dominated coastal settings, it is often very difficult to interpret depositional environment (e.g., tidal delta v.s. estuary) and reconstruct a palaeogeographic map in a tide-dominated setting from a series of 1-D subsurface data, and occasionally, even from outcrop data.

In 1997–1999, at Imperial College, we formed a multi-disciplinary team of reservoir geologists and engineers, and started a tidal sandstone reservoir analogue studies sponsored by the members of the FORCE (Forum for Reservoir Characterization and Reservoir Engineering) consortium. We used several tidal outcrops of the Lower Cretaceous in southern England to characterize these heterogeneities in a hierarchy of scales, viz; (1) sequence stratigraphic analysis (c. 10 m–100s m thick; a scale of entire depositional systems such as palaeovalley), (2) architectural element analysis (c. m–10s m; a scale of individual bars and channels), and (3) facies analysis (c. mm–1 m thick; a scale down to individual laminae). These outcrops contain a wide range of sedimentary heterogeneities, and is interpreted as recording a transgressive infill of an incised valley. As a case study, we will present the Lower Cretaceous Vectis Formation outcrop in the Isle of Wight, southern England.

Many giant oil fields in the northern North Sea, including the Middle Jurassic Beryl Formation (Bruce and Beryl fields) and the Lower Jurassic Tilje Formation (Heidrun and Asgard fields), are interpreted to have been formed under the regional and depositional setting comparable to the Lower Cretaceous outcrops in the UK. These reservoirs contain abundant mud drapes analogous to those found within the UK outcrops. A range of quantitative outcrop data, suitable for validating and/or populating objects for stochastic modelling of tidal reservoirs, is presented for the various facies and sand body types, including shale layer and heterolithic facies dimensions.

Talk 2

Responses of European estuarine incised valley systems to relative sea level rise: geomorphic implications for sequence stratigraphy and delineation of reservoir flow units — a review

SHUJI YOSHIDA, RON STEEL, KEN PYE, DAPHNE VAN DER WAL AND ROBERT DALRYMPLE

Abstrak (Abstract)

The implications or impact of geomorphological studies on sequence stratigraphic models have been discussed since the early 1990's for both fluvial systems and coastal/littoral systems. A similar review of such impact on estuarine systems, however, has not been fully incorporated, even though our knowledge of estuarine morphology and processes has improved greatly since the late 1990's. This improvement has come not least from the studies of geomorphologists and oceanographers on Holocene European estuaries, with the aid of increased processing capabilities for numerical modeling (e.g., Shennan and Andrews, 2000; Allen and Pye, 2000). For this reason, at Royal Holloway College, we (SY, KP and DW) reviewed existing sequence stratigraphic models of estuaries from a geomorphic point of view.

Coastal-estuarine geomorphologists have been testing the predictive applicability of sequence stratigraphic models for future estuarine evolution in response to ongoing global sea-level rise. Some of these recent studies suggest that the updip translation of facies/energy zones of an estuary system in response to sea level rise is more complicated than predicted by current sequence stratigraphic models. We will present four main issues based on studies of modern and ancient coastal-estuarine systems in Europe: (1) change in dominant processes, (2) shoreline and bathymetric changes, (3) sensitivity of estuaries to base level rise, (4) formation of peat and minerogenic strata.

Currently at Wyoming and Queen's Universities, we attempt to develop a series of 'process-oriented' sequence stratigraphic models as a tool for higher-resolution correlation and delineation of reservoir flow units, and for more realistic paleogeographic reconstructions. Previous sequence stratigraphic models emphasise the balance between accommodation space and sediment supply, but in an energy setting that is maintained throughout the relative sea level cycle (e.g., a wave-dominated coast/shelf). However, they tend to severely underestimate process changes that can have a significant impact on preserved geometries, facies and heterogeneities on a wide range of scales. We attempt to construct next-generation sequence stratigraphic models by a multi-disciplinary approach with geologists and geomorphologists, utilising modern, Quaternary and ancient tide-influenced deposits in a wide range of basin and paleogeographic settings around the world. This is undertaken with the help of our alliance universities, including the group led by Abdul Hadi A.R. at USM in Penang. This project is currently sponsored by Shell, BP, ExxonMobil, Statoil, ConocoPhillips, TotalFinaElf, Agip, Fortum, DONG and the Norwegian Petroleum Directorate, comprising the FORCE consortium.

Talk 3**Tidal and brackish-water signatures within the fluvio-estuarine sheet sandstone of the Upper Cretaceous Mesaverde Group in Utah, Colorado and Wyoming, USA: foreland basin analysis and nonmarine-marine correlations over 100s km of downdip transects**

SHUJI YOSHIDA AND RON STEEL

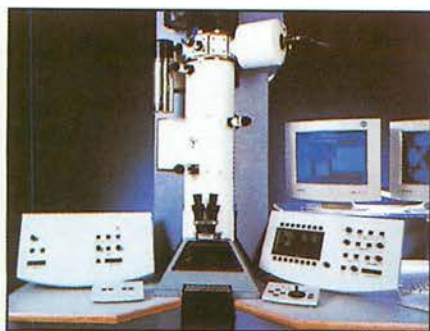
Abstrak (Abstract)

The Mesaverde Group is a second-order clastic wedge shed from the Sevier thrust belt, and contains two prominent sheet sandstones; the Castlegate Sandstone in Utah, and the Ericson Formation in Wyoming. They have been traditionally interpreted as of solely fluvial origin. However, detailed mapping utilizing outcrop photo panels and closely-spaced vertical sections have revealed that these units, at certain levels, also contain tidal sedimentary structures and a brackish-water ichnofauna. We propose that these amalgamated sheetsands contain high-frequency sequences with both fluvial and estuarine components. Although the entire sheetsand represents a time of lower regional A/S ratio, the upper (estuarine) part of individual high-frequency sequences represents transgressive penetration far back into the wedge during shorter periods of increased accommodation.

During the last decade the significance of tidal deposits have been increasingly recognized for giant hydrocarbon reservoirs (e.g., Jurassic Beryl, Cook and Tilje Formations in the North Sea). They were formerly misidentified as purely fluvial deposits. The difficulty of identifying tidal and brackish-water signatures within subsurface cores arises mainly due to (1) their low preservation potential, (2) scattered occurrence of genuine tidal indicators that may not be encountered by widely spaced wells, and (3) the close association of these deposits with genuine fluvial strata. In addition, tidally-influenced sandstone are difficult to identify on outcrops due to recent weathering effects which wash out mud drapes and leach shelly body fossils. We will present a diversity of tidal sedimentary structures and brackish-marine indicators from the outcrops of parts of the Castlegate and Ericson Sandstones.



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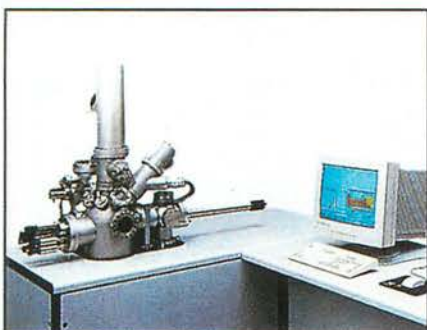
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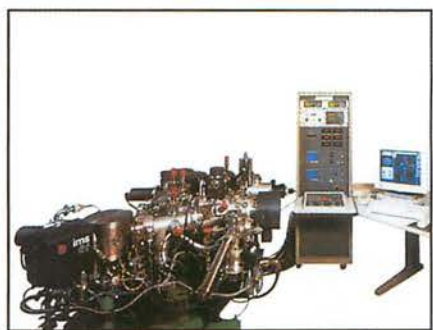
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- Vacuum Technology (Pumps, Leak Detectors, Components)
- Cytogenetic and Material Workstations
- Imaging Processing and Analysis (IA)

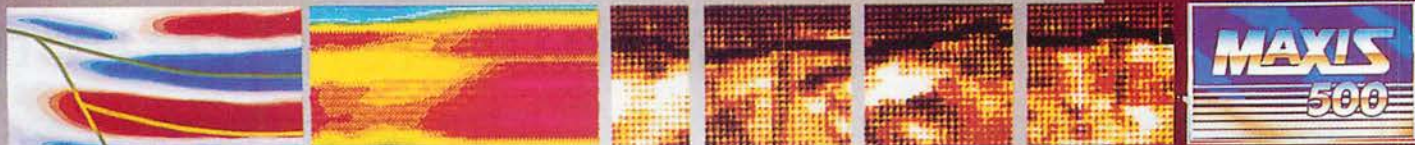


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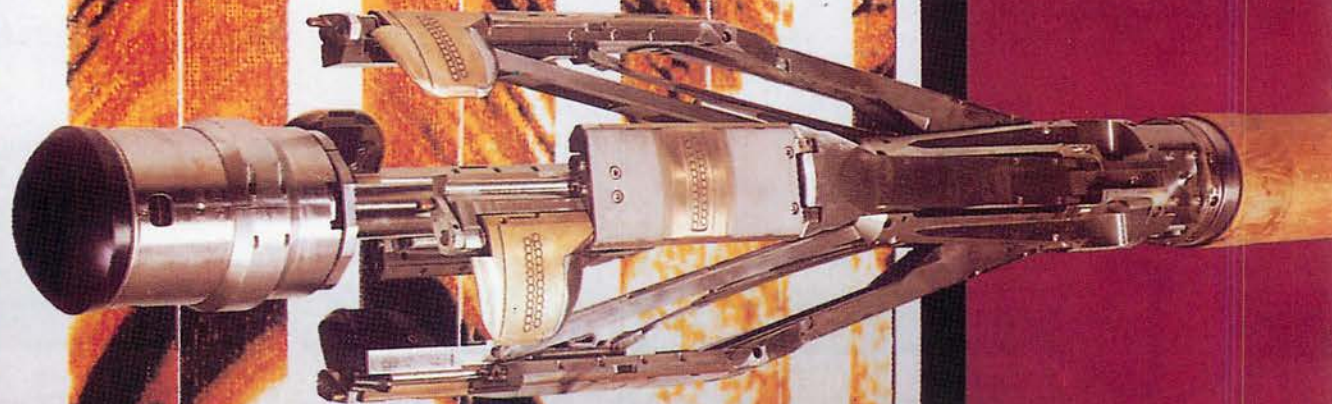
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BERITA-BERITA PERSATUAN

News of the Society

PETUKARAN ALAMAT (Change of Address)

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

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Lim Chee Keong No. 9, Jalan Anggerik Doritis 31/165, 40460 Kota Kemuning, Shah Alam. 2. Zahari Lambak Kumpulan Guthrie Berhad, Ladang Labu, 71900 Labu, Negeri Sembilan. | <ol style="list-style-type: none"> 3. Keith Richards Bryn Ash, 116 Albert Drive, Deganwy, Conwy, LL31 9YY, United Kingdom. 4. S.S. Subramaniam Suite 165-5-9, Wisma Mutiara, 165 Jalan Sungai Besi, 57100 Kuala Lumpur. |
|--|---|

GSM

CURRENT ADDRESSES WANTED

The GSM is seeking the addresses of the following members. Anyone knowing their new addresses please inform the Society.

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Sawsan Kamel Shariah 10, Jalan Taman Bukit Mewah 31, Taman Bukit Mewah, 43000 Kajang, Selangor D.E. 2. Mohd. Badzran Mat Taib Jabatan Mineral & Geosains Malaysia, Seberang Jalan Putera, 05150 Alor Setar, Kedah Darul Aman. 3. Sawsan Kamel Shariah 10, Jalan Taman Bukit Mewah 31, Taman Bukit Mewah, 43000 Kajang, Selangor D.E. | <ol style="list-style-type: none"> 4. David G. Bowen 7 Lyne Terrace, Penincui, Midlothian EH26 8HF, Scotland, U.K. 5. Yong Cheng Yeu Sg. Rusa, 96100 Sarikei, Sarawak. 6. Henry Stephen Wan 2866 Futree Garden, Miri-Bintulu Road, 98000 Miri, Sarawak. |
|---|--|

GSM

PERTAMBAHAN BAHARU PERPUSTAKAAN (New Library Additions)

The Society has received the following publications:

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Tin International, vol. 75, no. 9, 2002. 2. Earth Science Frontiers, vol. 9, nos. 1 & 2, 2002. 3. Acta Geoscientia Sinica, vol. 23, nos. 2-4, 2002. 4. Geoscience, vol. 16, nos. 1-3, 2002. 5. Journal of Shijiazhuang University of Economics, vol. 25, nos. 1-4, 2002. 6. AAPG Explorer, Oct, Nov & Dec 2002. 7. Monthly statistics on mining industry in Malaysia, Jul & Aug 2002. | <ol style="list-style-type: none"> 8. Annales Academiae Scientiarum Fennicae, no. 163, 2002. 9. Geoscience Journal, vol. 6, no. 3, 2002. 10. AAPG Bulletin vol. 86, no. 8, 2002. 11. SOPAC News, no. 2, 2002. 12. Geological Survey of Japan, vol. 53, nos. 2/3, 2003. 13. CCOP Technical Bulletin, vol. 31, 2002. 14. Mineralogia Polonica, vol. 30, nos. 1 & 2 (1999) and vol. 31, nos. 1 & 2 (2002). |
|--|--|

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- | | |
|---|--|
| <ol style="list-style-type: none"> 4. David G. Rowan 1 Lyle Terrace, Fennville, Michigan 49838 S.H., Sylvania, U.S. 5. Yang Cheng Yan Sq. Ruian, 85100 Sankai, Sarawak 6. Henry Stephen Wan 3888 Futuro Garden, Mini-Hintulu Road, 98000 Miri, Sarawak | <ol style="list-style-type: none"> 1. Rowan Kamel Sharieh 10, Jalan Taman Bukit Mewah 31, Taman Bukit Mewah, 43000 Kajang, Selangor D.E. 2. Mohd. Badrhan Slat Taib Jabatan Mineral & Geosains Malaysia, Seberang Jalan Puncak, 05150 Alor Setar, Kedah Darul Aman. 3. Rowan Kamel Sharieh 10, Jalan Taman Bukit Mewah 31, Taman Bukit Mewah, 43000 Kajang, Selangor D.E. |
|---|--|

BERITA-BERITA LAIN

Other News

OBITUARY



KHOO KAY KHEAN
29.1.1947 – 14.11.2002

Khoo Kay Khean (Jimmy to his friends) passed away peacefully on 14th November 2002 after a short illness. Jimmy was born in Penang where he had his primary and secondary education before he pursued his tertiary education at the University of Malaya in 1967. He was a long-serving Full Member of the Geological Society of Malaysia (GSM), having joined the Society in 1971, immediately after graduation with Honours in Applied Geology from the Geology Department, Kuala Lumpur. In the same year, he joined the then Geological Survey Department (GSD) of Malaysia (now known as the Minerals and Geoscience Department), serving his first assignment as a geologist in Ipoh. His first posting out of Ipoh was to Seremban where he headed the GSD office and undertook the geological and mineral resources mapping of the Kuala Pilah Topographic Map Sheet 103. After the completion of this map sheet in 1976, he served in various capacities and positions in GSD, including that of a Training Officer, responsible for the development of the training programme of GSD's staff, as well as being Editor-in-Chief of the Department's publications. In 2001, he was promoted to be the Director of the Corporate Affairs Section of the Minerals and Geoscience Department, a position he held until his untimely demise.

Jimmy also played a very active role in GSM serving the Society he loved for 10 years, from 1989 to 1998. He first served as its Assistant Secretary during the 1989/90 term and subsequently became its Secretary from 1990 to 1993. He then served as a Councilor from 1994 to 1997 and was elected GSM's Vice-President for the 1997/98 term. In 1996, he was the Organising Chairman of GSM's 10th Annual Conference

held in Kota Kinabalu, Sabah. He was always readily available to lend a hand to promote and participate in the Society's activities.

Although Jimmy was known for his outspoken views, he nonetheless made friends easily, having friends not only in Malaysia but also in Canada, Thailand, Japan, and Australia. He leaves behind his beloved wife, Gabrielle, and his three children, Josette, Joanne and Jason, and son-in-law, Anselm Fong, relatives and his numerous friends to mourn his loss. He will be missed but not forgotten. May his soul rest in peace.

P. Loganathan

KALENDAR (CALENDAR)

2003

January 6-10

10TH INTERNATIONAL SYMPOSIUM ON DEEP SEISMIC PROFILING OF CONTINENT & THEIR MARGINS, Taupo, New Zealand. (Contact: F. Davey. Tel: 6 44 577 1444; Fax: 64 4 570 4600; E-mail: seismix2003@gns.cri.nz; Website: www.gns.cri.nz/news/conferences/seismix2003/)

January 17-21

INTERNATIONAL CONFERENCE ON THE ROLE OF NATURAL RESOURCES AND ENVIRONMENT IN SUSTAINABLE DEVELOPMENT IN SOUTH AND SOUTHEAST ASIA (NESDA), National Museum, Shahbagh, Dhaka, Bangladesh. (Contact: Ms. Afia Akhtar, Convenor, NESDA & Vice President, AGID, Director, Geological Survey of Bangladesh, 153 Pioneer Road, Segunbagicha, Dhaka 1000, Bangladesh. Tel: 880-2-8322855 (O), 9337559, 9350412 (H); E-mail: <afia@agni.com>, <afia-nesda@yahoo.com> or <afia-agid@hotmail.com>; or Mr. Nehal Uddin, Member Secretary, NESDA, Deputy Director, Geological Survey of Bangladesh, 153 Pioneer Road, Segunbagicha, Dhaka 1000, Bangladesh. Tel: 880-2-9348318; E-mail: nehalu@btb.net.bd)

January 30-31

EDUCATION FOR A SUSTAINABLE AND SECURE FUTURE (National Conference). Ronald Reagan Building and International Trade Center, Washington, DC, USA. Sponsored by National Council for Science and the Environment. (Contact: Therese Cluck, 1707 H Street, NW, Suite 200, Washington, DC 20006. Tel: +1-202 530 5810; Fax: +1-202 628 4311; E-mail: conference@NCSEonline.org; Website: cnie.org/NCSEconference/2003conference/)

February 3-9

THE 8TH INTERNATIONAL CONGRESS ON PACIFIC NEOGENE STRATIGRAPHY, Chiang Mai, Thailand. (Contact: Benjavun Ratanasthien, Chairperson. E-mail: benjavun@geoll.geol.science.cmu.ac.th)

February 18-20

PALEOZOIC AND TRIASSIC PETROLEUM SYSTEMS IN NORTH AFRICA (Hedberg Research Conference of AAPG), Algiers, Algeria. (Contact: Debbi Boonstra, AAPG Education Department, Post Office Box 979, Tulsa, OK 74101-0979. Tel: +1-918 560-2630; Fax: +1-918 560-2678; E-mail: debbi@aapg.org; Website: www.aapg.org/)

March 27-30

NATIONAL EARTH SCIENCE TEACHERS ASSOCIATION (Annual Meeting), Philadelphia, Pennsylvania, USA. (Contact: NESTA, 2000 Florida Ave., N.W., Washington, D.C. 20009, USA. Tel: +1-202 462 6910; Fax: +1-202 328 0566; E-mail: fireton@kosmos.agu.org)

March 30 - April 2

SALT WATER INTRUSION IN COASTAL AQUIFERS: MONITORING, MODELING AND MANAGEMENT (2nd International Conference), Merida, Yucatan, Mexico. Workshops (27-29 March) precede the Conference, field trips (3-5 April) follow the conference. (Contact: Prof. Luis E. Marín, Sección de Hidrogeología y Sistemas Hidrotermales, Departamento de Recursos Naturales, Instituto de Geofísica, Universidad Nacional Autónoma de México, Mexico City, Mexico CP 04510. Tel: 52-555622-4212; Fax: 52-555-550-2486; E-mail: lmarin@tonatiuh.igeofcu.unam.mx; Website: www.igeofcu.unam.mx/swica2/)

April 6-11

EUROPEAN GEOPHYSICAL SOCIETY + AMERICAN GEOPHYSICAL UNION + EUROPEAN UNION OF GEOSCIENCES (Joint Assembly), Nice, France. (Contact: EGS office, Max-Planck-Str. 13, 37191 Katlenburg-Lindau, Germany. Tel: +49-5556-1440; Fax: +49-5556-4709; E-mail: egs@copernicus.org; Website: www.copernicus.org/EGS)

April 7-9

BRAIDED RIVERS (International Conference), Birmingham, UK. (Contact: Greg Sambrook Smith, School of Geography & Environmental Sciences, University of Birmingham, Birmingham, B15 2TT U.K. Tel: +44 (0)121

4158023; E-mail: g.smith.4@bham.ac.uk;
Website: www.cwr.bham.ac.uk/braid/)

April 14-17

URANIUM GEOCHEMISTRY, Nancy, France.
(Contact: Michel Cuney. Tel: 33 3 83 68 47 09;
E-mail: mcuney@persmail.uhp-nancy.fr)

April 28-30

SUBMARINE SLOPE SYSTEMS: PROCESSES, PRODUCTS AND PREDICTION (International Conference), University of Liverpool, Liverpool, UK. Sponsored by the Geological Society of London and International Association of Sedimentologists. (Contact: David Hodgson, Dept. of Earth Sciences, University of Liverpool, Liverpool, UK. Tel: +44 151 794 5141; E-mail: hodgson@liv.ac.uk; Website: <http://www.slope2003.net/>)

April 30 - May 2

WATER RESOURCES MANAGEMENT (2nd International Conference), Las Palmas, Gran Canaria. (Contact: Conference Secretariat, Water Resources03, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton SO40 7AA, UK. E-mail: shobbs@wessex.ac.uk; Website: www.wessex.ac.uk/conferences/2003/waterresources03)

May

INTERNATIONAL SYMPOSIUM ON KARST AND HARD ROCK FORMATIONS, Esfahan, Iran. (Contact: Dr. A. Afrasiabian, National Karst Study and Research Center, P.O. Box 15875-3584, Tehran, Iran. Tel: +98 21 7520474; Fax: +98 21 7533186)

May 11-14

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS AND SOCIETY FOR SEDIMENTARY GEOLOGY (SEPM) (Joint Annual Meeting and Exhibition), Salt Lake City, Utah, USA. (Contact: AAPG Conventions Dept., P.O. Box 979, Tulsa, OK 74119, USA. Tel: +1-918 560 2679; Fax: 1-918 560 2684; E-mail: convене@aapg.org; Website: www.aapg.org)

May 12-16

GEOFLUIDS IV (4th international conference on fluid evolution, migration and interaction in sedimentary basins and orogenic belts), Utrecht University, Utrecht, The Netherlands. Sponsored by Netherlands Institute of Applied

Geoscience TNO-National Geological Survey. (Contact: Ms. J.M. Verweij, P.O. Box 80015, 3508 TA Utrecht, The Netherlands. Tel: +31-30 256 4600; Fax: +31-30 256 46 05; E-mail: j.verweij@nitg.tno.nl; Website: www.nitg.tno.nl).

May 18-23

COASTAL SEDIMENTS '03 (5th International Symposium on Coastal Engineering and Science of Coastal Sediment Processes), Clearwater Beach, Florida, USA. (Contact: Darlene K. Gregory, Conference Secretariat. Tel: +1-361 939 9004; Fax: +1-361 939 9355; E-mail: dgregory@coastalsediments.net; Website: <http://www.coastalsediments.net/>)

May 18-24

GEOLOGY OF INDUSTRIAL MINERALS, "BETTING ON INDUSTRIAL MINERALS" (39th Forum), Sparks, Nevada, USA. Sponsored by the Nevada Bureau of Mines and Geology, Nevada Division of Minerals, and Nevada Mining Association. (Contact: Terri Garside, NBMG/MS 178, University of Nevada, Reno, NV 89557-0088; Tel: +1-775 784 6691, ext. 126; Fax: +1-775 784 1709; E-mail: tgarside@unr.edu; Website: www.nbmgs.unr.edu/imf2003.htm)

May 19-23

VII INTERNATIONAL SYMPOSIUM 'CULTURAL HERITAGE IN GEOSCIENCES, MINING AND METALLURGY: LIBRARIES-ARCHIVES-MUSEUMS' "Museums and their collections", Leiden, The Netherlands. (Contact: Dr. Cor F. Winkler Prins, Nationaal Natuurhistorisch Museum, Postbus 9517, 2300 RA LEIDEN, The Netherlands. Tel: +37.71.5687643; Fax: +31.71.5687666; E-mail: winkler@nmm.nl).

June 4-6

FLUID INCLUSIONS (17th Biennial European Current Research Conference), Budapest, Hungary. (Contact: Department of Petrology and Geochemistry, Budapest, Pázmány Péter sétány 1/C, Budapest H-1117, Hungary. Tel: +36-1 209 0555 ext. 8338; Fax: +36-1 381 2108; E-mail: ecrofi17@geology.elte.hu; Website: ecrofi17.geology.elte.hu/)

June 7-12

CLAY MINERALS SOCIETY (CMS) AND MINERALOGICAL SOCIETY OF AMERICA (MSA), "Classic Clay and Minerals" (Joint Meeting), Athens, Georgia, USA. (Contact:

Paul A. Schroeder, General Chairman, Department of Geology, University of Georgia, Athens, GA 30602-2501, USA. Tel: +1-706 542-2652; E-mail: schroe@gly.uga.edu; Website: <http://www.gly.uga.edu/>

June 8–13

ALLUVIAL FANS (International Conference), Sorbas, Almeria, Spain. (Contact: Martin Stokes, Department of Geology, University of Plymouth, Drake Circus, Devon PL4 8AA, UK. E-mail: alluvialfans@plymouth.ac.uk; Website: alluvialfans.net)

June 9–12

ORIGIN OF PETROLEUM, BIOGENIC AND/OR ABIOGENIC AND ITS SIGNIFICANCE IN HYDROCARBON EXPLORATION AND PRODUCTION (Hedberg Conference sponsored by the American Association of Petroleum Geologists and Institute of Petroleum), London, UK. (Contact: Debbi Boonstra, AAPG Education Dept., P.O. Box 979, Tulsa, OK 74101-0979; Fax: +1-918 560 2678; E-mail: debbi@aapg.org; Website: www.aapg.org/education/hedberg/london/index.html)

June 15–17

7TH ICOBTE — INTERNATIONAL CONFERENCE ON BIOGEOCHEMISTRY OF TRACE ELEMENTS, Uppsala, Sweden. (Contact: George R. Gobran. Fax: 46 (18) 67 34 30; E-mail: George.Gobran@eom.slu.se or ICOBTE7@slu.se; Website: <http://www.eom.slu.se>)

June 16–18

5TH INTERNATIONAL CONFERENCE ON THE ANALYSIS OF GEOLOGICAL AND ENVIRONMENTAL MATERIALS, Rovaniemi, Finland. (Contact: Website: <http://www.gsf.fi/geoanalysis2003>)

June 20–25

ROLE OF LIGHT ELEMENTS IN ROCK-FORMING MINERALS (International Symposium), Nové Mestona, Czech Republic. (Contact: Dr. Milan Novák, Chairman, LERM, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic. Fax: +420-5 412112; E-mail: mnovak@sci.muni.cz; Website: sci.muni.cz/~lerm/index.htm).

June 22–27

KIMBERLITE (8th International Conference), Victoria, British Columbia, Canada. (Contact: 8IKC, Conference, Secretariat, c/o Venue West Conference Services Ltd., 645 - The Landing, 375 Water Street, Vancouver, BC, Canada V6B 5C6. Tel: +1-604 681-5226; Fax: +1-604 681-2503; E-mail: 8IKC@venuewest.com; Website: www.venuewest.com/8IKC)

June 30 – July 11

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS (IUGG) (23rd General Assembly), Sapporo, Japan. (Contact: Dr. Kiyoshi Suyehiro, General Secretary of LOC XXIII General Assembly, Japan Marine Science and Technology Center (JAMSTEC), 2-15 Natsushima-cho, Yokosuka 237-0061, Japan. Fax: +81-468 66 5541; E-mail: IUGG_service@jamstec.go.jp; Website: www.jamstec.go.jp/jamstec-e/iugg/index.html)

July 8–10

CARBONATE SEDIMENTOLOGISTS (12th Bathurst Meeting), Dunham, UK. (Contact: Maurice Tucker or Moyra Wilson, Department of Geological Sciences, University of Durham, Durham DH1 3LE, U.K. Tel: +44-191 374 2524 or 2501; E-mail: M.E.Tucker@durham.ac.uk or Moyra.Wilson@durham.ac.uk; Website: www.dur.ac.uk/bathurst.2003/)

July 14–25

IGCP 450 MEETING AND FIELD EXCURSION (Proterozoic Sediment-hosted Base Metal Deposits of Western Gondwana: Intra and Intercontinental Correlation of Geological, Geochemical and Isotopic Characteristics, Southern Atlantic), Lubumbashi, D.R. Congo. (Contact: Dr. Jacques Cailteux, Organiser of the event, Groupe G. FORREST international, E.G.M.F., Lubumbashi, D.R. Congo. Fax: 243-23 42 275; Tel: 243-970 32 625; E-mail: egmf@forrestrdc.com)

July 23–31

INTERNATIONAL ASSOCIATION FOR QUATERNARY RESEARCH (INQUA) (16th Congress) "Shaping the Earth: A Quaternary Perspective", Reno Hilton, Reno, NV, USA. (Contact: Nick Lancaster, Desert Research Institute. Tel: +1-775 673 7304; E-mail: nick@dri.edu; Website: www.dri.edu/DEES/INQUA2003/inqua_home/htm)

July 30–31

GEODYNAMICS & METALLOGENY (International Conference), Ulaan Bataar, Mongolia. Organized by the Mongolian National Group of the International Association on the Genesis of Ore Deposits (IAGOD) and co-sponsored by IAGOD; post-conference expert fieldtrip 1–7 August 2003 to Oyu Tolgoy. (Contact: O. Gerel, E-mail: gerel@mtu.edu.mn)

August 9–21

FIELD CONFERENCE IN URUMQUI, CHINA, IGCP-473 annual field conference in Urumqui with excursion to Chinese Tianshan and Altay (Xinjiang). Sponsored by the International Association on the Genesis of Ore Deposits (IAGOD). (Contact: Prof. Mao Jingwen, CAGS Beijing. E-mail: jingwenmao@263.net; Website: www.nhm.ac.uk/mineralogy/cercams/index.htm)

August 10–13

GeoSciEd IV, Calgary, Canada. (Contact: Website: www.geoscied.org)

August 18–21

9TH INTERNATIONAL SYMPOSIUM ON THE ORDOVICIAN SYSTEM, 7TH INTERNATIONAL GRAPTOLITE, AND FIELD MEETING OF THE SUBCOMMISSION ON SILURIAN STRATIGRAPHY, San Juan City, Argentina. (Contact: ISOS: Guillermo L. Albanesi. E-mail: galbanesi@arnet.com.ar or Matilde S. Beresi. E-mail: mberesi@labocricyt.edu.ar; IGC-SSS field meeting: Gladys Ortega. E-mail: gcortega@arnet.com.ar or Guillermo F. Aceñolaza. E-mail: acecha@unt.edu.ar)

August 26–30

PRESENT STATE AND FUTURE EVOLUTION OF PALEOGENE STRATIGRAPHY, A symposium of the International Subcommission on Paleogene Stratigraphy, Leuven, BELGIUM. (Contact: Noël Vandenberghe, Dept. Geografie-Geologie, Afd. Historische Geologie, KU Leuven, Redingestraat 16, B-3000 Leuven Belgium. E-mail: noel.vandenberghe@geo.kuleuven.be; Website: www.uni-tuebingen.de/geo/isps/news)

August 29 – September 3

INTERNATIONAL GEOCHEMICAL EXPLORATION SYMPOSIUM (21st of the

Association of Exploration Geochemists), Dublin, Ireland. (Contact: Eibhlin Doyle, Secretary LOC. E-mail: eibhlindoyle@gsi.ie; Website: http://www.aeg.org/)

September 5–6

TERRANE PROCESSES AT THE PACIFIC MARGIN OF GONDWANA (International Conference), Cambridge, England. Sponsored by the British Antarctic Survey and the Geological Society. (Contact: Dr. Alan P.M. Vaughan, British Antarctic Survey, Cambridge CB3 0ET, England. Tel: +44-1223 221419; Fax: +44-1223 221646; E-mail: a.vaughan@bas.ac.uk)

September 7–11

ENVIRONMENTAL GEOCHEMISTRY (6th International Symposium), Edinburgh, Scotland, UK. (Contact: John Farmer, Dept. of Chemistry, The University of Edinburgh, Kings Buildings, West Mains Road, Edinburgh EH9 3JJ Scotland. E-mail: J.G.Farmer@ed.ac.uk; Tel: 0131-650-1000; Fax: 0131-650-4757)

September 8–12

ORGANIC GEOCHEMISTRY (21st International Meeting), Krakow, Poland. Sponsored by the European Association of Organic Geochemists. (Contact: IMOG 2003, Society of Research on Environmental Changes "Geosphere", Al. Mickiewicza 30, 30-059 Kraków, Poland. Fax: +48-12 623 78 28; E-mail: imog@imog.agh.edu.pl; Website: http://www.imog.agh.edu.pl)

September 8–12

INTERNATIONAL CONGRESS ON ROCK MECHANICS "Technology Roadmap for Rock Mechanics" (10th of the International Society for Rock Mechanics), Sandton (Gauteng-Johannesburg), South Africa. (Contact: Mrs. Karen Norman, The Conference Co-Ordinator, Technology Roadmap for Rock Mechanics, P.O. Box 61127, ZA-2107 Marshalltown, South Africa. Tel: +27-11 8341273 or 8341277; Fax: +27-11 833 8156 or 838 5923)

September 15–18

INDUSTRIAL MINERALS AND BUILDING STONES — IMBS 2003, Istanbul, Turkey. (Contact: Erdogan Yüzer, Maden fakültesi, Ayazaga Kampüsü, 80626 Maslak/Istanbul, Turkey. Tel/Fax: 90 212 285 61 46; E-mail: yuzer@itu.edu.tr)

September 15–19

GROUNDWATER IN FRACTURED ROCKS (International Conference of IAH), Prague, Czech Republic. (Contact: Jiri Krasny. E-mail: krasny@natur.cuni.cz)

September 17–19

SEDIMENTOLOGY (22nd Annual Meeting of the International Association of Sedimentology), Opatija, Croatia. (Contact: Davor Pavelic, IAS-2003, Institute of Geology, HR-10000 Zagreb, Sachsova 2, Croatia. Fax: +385 1 6144718; E-mail: dpavelic@yahoo.com; Website: www.igi.hr/ias2003)

September 21–24

AAPG INTERNATIONAL CONFERENCE EXHIBITION, "CROSSROADS OF GEOLOGY, ENERGY AND CULTURES", Barcelona, Spain. Sponsored by the American Association of Petroleum Geologists. (Contact: AAPG Convention Department, P.O. Box 979, Tulsa, OK, 74101-0979, USA. Fax: +1-918-560-2684; E-mail: convene@aapg.org; Website: www.aapg.org/)

September 22–26

1ST INTERNATIONAL CONFERENCE — GROUNDWATER IN GEOLOGICAL ENGINEERING, Ljubljana, Slovenia. (Contact: Slovene Committee of IAH, Andrej Juren, Kebetova 24, SI-1000 Ljubljana, Slovenia. E-mail: andrej.juren@siol.net or Nadja Zalar, E-mail: nadja.zalar@siol.net; Website: http://www.iah.org)

September 28 – October 3

SOCIETY OF EXPLORATION GEOPHYSICISTS (73rd Annual Meeting and International Exposition), Dallas, Texas, USA. (Contact: SEG Business Office, Tel: +1-918 497 5500; Fax: +1-918 497 5500; Fax: +1-918 497 5557; Website: seg.org/)

October 4–9

AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS (40th Annual Meeting), Glenwood Springs, Colorado, USA. (Contact: Tom Fails, 4101 E. Louisiana #412, Denver, CO 80246. Tel: +1-303 759 9733; Fax: +1-303 759 9731; E-mail: thomgeol@aol.com; Website: www.aipg.org/www.aipg.org/)

October 5–8

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (International Conference &

Exhibition), London, UK. (Contact: AAPG Convention Department, P.O. Box 979, Tulsa, OK 74101-0979, USA. Tel: +1-918 560 2679; E-mail: Website: www.aapg.org)

October 24–27

INTERNATIONAL SYMPOSIUM ON HYDROMETALLURGY — IN HONOR OF IAN RITCHIE, Vancouver, British Columbia, Canada. (Contact: Courtney Young. Fax: 406 496 4133; E-mail: cyoung@mtech.edu; Website: cms.tms.org)

November 2–5

GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Seattle, Washington, USA. (Contact: GSA Meetings Dept., P.O. Box 9140, Boulder, CO 80301-9140, USA. Tel: +1 303 447 2020; Fax: +1 303 447 1133; E-mail: meetings@geosociety.org; Website: http://www.geosociety.org/meeting/index.htm)

December 8–12

AMERICAN GEOPHYSICAL UNION (Fall Meeting), San Francisco, California, USA. (Contact: San Francisco, California, USA. (Contact: AGU Meetings Department, 2000 Florida Avenue, NW, Washington, DC 20009 USA. Tel: +1 202 462 6900; Fax: +1 202 328 0566; E-mail: meetinginfo@agu.org; Website: http://www.agu.org/meetings)

2004**January 14–16**

ASIAN MARINE GEOLOGY (5th International Conference), Bangkok, Thailand. (Contact: Thanawat Jarupongsakul, Department of Geology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand. Fax: +(662) 2185464-5; E-mail: thanawat@sc.chula.ac.th)

March 27 – April 4

NATIONAL EARTH SCIENCE TEACHERS ASSOCIATION (Annual Meeting), Atlanta, Georgia, USA. (Contact: NESTA, 2000 Florida Ave., N.W., Washington, D.C. 20009, USA. Tel: +1-202 462 69 10; Fax: +1-202 328 0566; E-mail: fireton@kosmos.agu.org)

April 18–21

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS AND SOCIETY FOR

SEDIMENTARY GEOLOGY (SEPM) (Joint Annual Meeting and Exhibition), Dallas, Texas, USA. (Contact: AAPG Conventions Dept., P.O. Box 979, Tulsa, OK 74119, USA. Tel: +1-918 560 2679; Fax: 1-918 560 2684; E-mail: convenc@AAPG.org; Website: www.aapg.org)

May 17-21

AMERICAN GEOPHYSICAL UNION AND CANADIAN GEOPHYSICAL UNION (Joint Meeting), Montreal, Canada. (Contact: AGU Meetings Department, 2000 Florida Avenue, NW, Washington, DC 20009 USA. Tel: +1 202 462 6900; Fax: +1 202 328 0566; E-mail: meetinginfo@agu.org; Website: <http://www.agu.org/meetings>)

June 27 - July 2

WATER-ROCK INTERACTION (11th International Symposium), Saratoga Springs, New York, USA. (Contact: Dr. Susan Brantley, Secretary General, Dept. of Geosciences, The Pennsylvania State University, 239 Deike Building, University Park PA 16802, USA. Tel: +1-814 863 1739; Fax: +1-814 863 8724; Website: www.outreach.psu.edu/C&I/WRI/)

July 4-9

INTERNATIONAL PALYNOLOGICAL CONGRESS (11th), Granada, Spain. (Contact: Technical Secretary. E-mail: eurocongres@eurocongres.es; Website: www.ugr.es/~bioveg/)

August 20-28

INTERNATIONAL GEOLOGICAL CONGRESS (32nd), "The Renaissance of Geology", Florence, Italy. (Contact: Ms. Chiara Manetti, Università degli Studi di Firenze, Dipartimento di Scienze della Terra, Via La Pira, 4, 50121 Firenze, Italy. Tel/Fax: +39-055 238 2146; E-mail: cmanetti@geo.unifi.it; To request the First Circular, send e-mail to: 32igc@32igc.org or visit the Congress Website: www.32igc.org)

August 27 - September 4

VLADIVOSTOK-2004 INTERIM IAGOD CONFERENCE (Metallogeny of the Pacific Northwest: Tectonics, Magmatism & Metallogeny of Active Continental Margins), Vladivostok, Khabarovsk, Magadan, Russian Far East, Russia. (Contact: Russian National IAGOD Group, Federal Far East Geological Institute, Far Eastern Branch of Russian

Academy of Sciences, 159, Prospekt 100-letiya, Vladivostok, 690022, Russia. Tel: 7(4232)31-87-50; Fax: 7(4232)31-78-47; E-mail: iagodconf@fegi.ru or fegi@online.marine.su; Website: <http://www.fegi.ru/IAGOD/index.htm>)

September 11-19

TECTONICS, MAGMATISM AND METALLOGENY OF ACTIVE CONTINENTAL MARGINS (Interim International Conference on Metallogeny of the Pacific Northwest), Vladivostok, Russia. Sponsored by the Russian Academy of Sciences and The Society of Economic Geologists. (Contact: Far East Geological Institute, Far Eastern Branch of Russian Academy of Sciences, 159, Prospekt 100-letiya, Vladivostok, 690022 Russia. Tel: +7(4232)31-87-50; Fax: +7(4232)31-78-47; E-mail: iagodconf@fegi.ru or fegi@online.marine.su; Website: <http://www.fegi.ru/IAGOD/>)

September 15-17

SEDIMENTOLOGY (23rd Annual Meeting of the International Association of Sedimentology), Coimbra, Portugal. (Contact: Rui Pena dos Reis, Universidade de Coimbra, Dpto. Ciências da Terra, Largo Marquês de Pombal, 3014 Coimbra, Portugal; E-mail: penareis@ci.uc.pt)

October 10-15

SOCIETY OF EXPLORATION GEOPHYSICISTS (74th Annual Meeting and International Exposition), Denver, Colorado, USA. (Contact: Debbi Hyer, 8801 S. Yale, Tulsa, OK 74137, USA. Tel: (+1-918) 497 5500; E-mail: dhier@seg.org; Website: meeting.seg.org)

November 7-10

GEOLOGICAL SOCIETY OF AMERICA (Annual Meeting), Denver, Colorado, USA. (Contact: GSA Meetings Dept., P.O. Box 9140, Boulder, CO 80301-9140, USA. Tel: +1 303 447 2020; Fax: +1 303 447 1133; E-mail: meetings@geosociety.org; Website: <http://www.geosociety.org/meetings/index.htm>)

December 13-17

AMERICAN GEOPHYSICAL UNION (Fall Meeting), San Francisco, California, USA. (Contact: AGU Meetings Department, 2000 Florida Avenue, NW, Washington, DC 20009 USA; Tel: +1 202 462 6900; Fax: +1 202 328 0566; E-mail: meetinginfo@agu.org; Website: <http://www.agu.org/meetings>)



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- Bulletins 19** (Apr 1986) & **20** (Aug 1986). GEOSEA V Proceedings Vols. I & II, Fifth Regional Congress on Geology, Mineral and Energy Resources of SE Asia, Kuala Lumpur, 9-13 April 1984. Edited by G.H. Teh & S. Paramanathan. Price for both Bulletins 19 & 20: Members: RM30.00; Non-Members: RM60.00.
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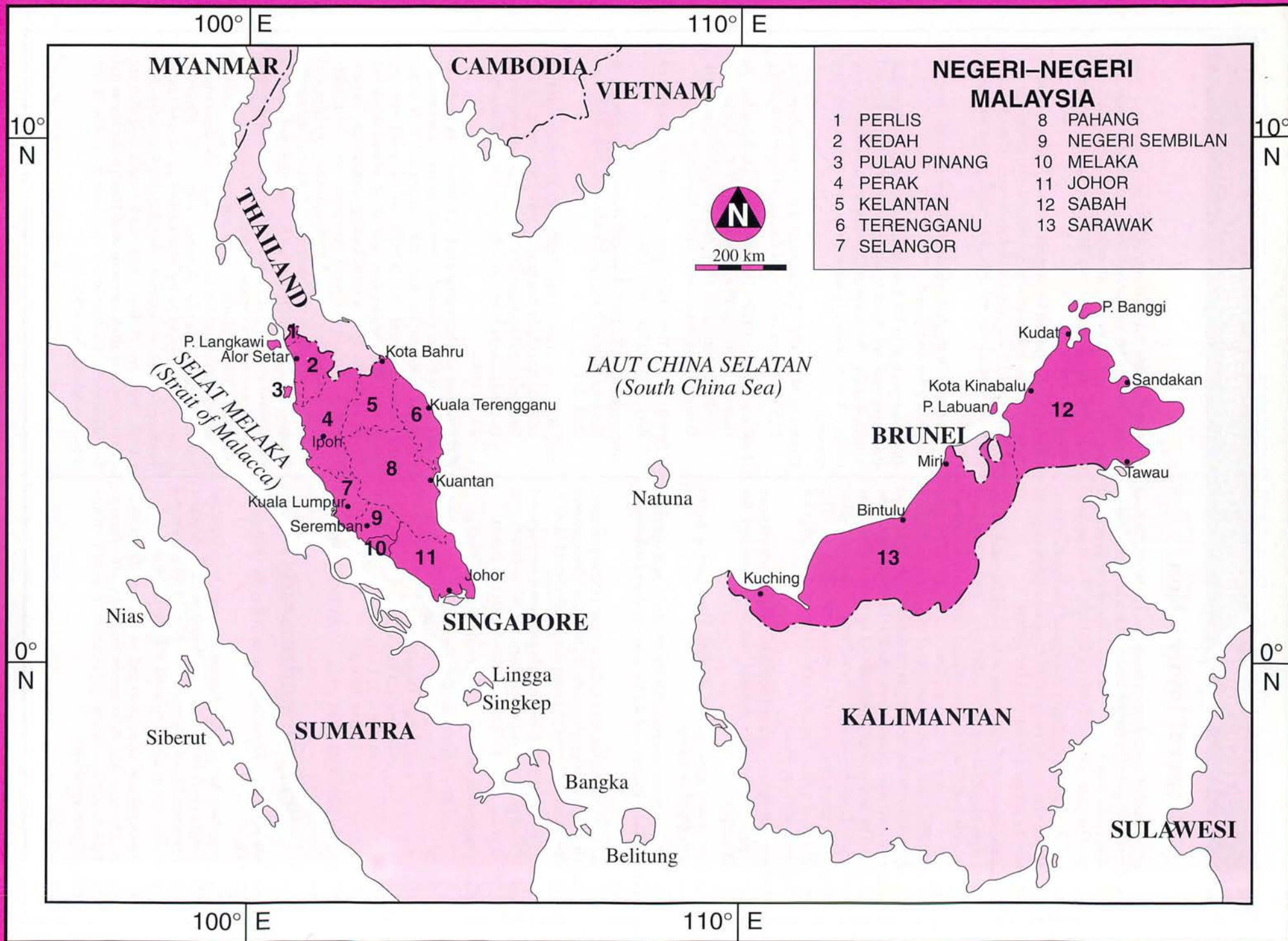
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