KDN 0450/83 ISSN 0126/5539

PERSATUAN GEOLOGI MALAYSIA

WARTA GEOLOGI

NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MALAYSIA

Jil. 9, No. 5 (Vol. 9, No. 5) Sep–Okt 1983

KANDUNGAN (CONTENTS)

DIKELUARKAN DWIBULANAN

ISSUED BIMONTHLY

PERSATUAN GEOLOGI MALAYSIA
(GEOLOGICAL SOCIETY OF MALAYSIA)

Majlis (Council) 1983/84

Pegawai-pegawai (Officers)

Presiden (President)	:	Khoo Teng Tiong, Jabatan Geologi, Universiti Malaya, Kuala Lumpur
Naib Presiden (Vice-Paesident)	:	Leong Khee Meng, Petronas-Carigali, P.O. Box 12407, Kuala Lumpur
Setiausaha Kehormat (Honorary Secretary)	:	Mohamad Ali Hasan, Jabatan Geologi, Universiti Malaya, Kuala Lumpur
Penolong Setiausaha Kehormat (Honorary Assistant Secretary)	:	Koh Tuck Wai, Petronas-Carigali, P.O. Box 12407, Kuala Lumpur
Bendahari (Honorary Treasurer)	:	Gan Ah Sai, Geological Survey Malaysia, Ipoh, Perak
Pengarang (Editor)	:	Teh Guan Hoe, Jabatan Geologi, Universiti Malaya, Kuala Lumpur
Presiden Yang Dahulu (Immediate Past President)	:	Mohd. Ayob, Petronas, P.O. Box 12444, Kuala Lumpur
Ahli-ahli Majlis, 1983-85 (Councillors, 1983-85)	:	Andrew Spykerman, Malaysia Mining Corp., P.O. Box 10300, Kuala Lumpur
		Choo Mun Keong, Malaysia Mining Corp., P.O. Box 10330, Kuala Lumpur
		Syed Sheikh Almashoor, Jabatan Geologi, Universiti Kebangsaan Malaysia, Bangi, Selangor
		Yeap Ee Beng, Dept. of Geology, Universiti Malaya, Kuala Lumpur
Ahli-ahli Majlis, 1983-84 (Councillors, 1983-84)	:	John Kuna Raj, Dept. of Geology, Universiti Malaya, Kuala Lumpur
		Khoo Kay Khean, Geological Survey Malaysia, Kuala Kangsar, Perak
		Michael Leong, Petronas, P.O. Box 12444, Kuala Lumpur
		Yeoh Gaik Chooi, Esso Production Malaysia Inc., P.O. Box 10857, Kuala Lumpur
Juruodit Kehormat (Honorary Auditor)	:	Peter Chew

*****

Published by the Geological Society of Malaysia, Dept. of Geology, University of Malaya, Kuala Lumpur 22-11 (Tel. 03-577036) -
15 March 1984.
Printed by Art Printing Works Sdn. Bhd., 29 Jalan Riong, Kuala Lumpur.

CATATAN GEOLOGI
(GEOLOGICAL NOTES)

A FAULTED HOLOCENE PLATFORM IN LANGKAWI

TJIA, H.D., Universiti Kebangsaan Malaysia, Bangi, Selangor.

Pulau Ular off the southwest point of Langkawi's main island consists of three low hills and a sea stack, all standing on a low and smooth abrasion platform (Fig. 1). Tha major part of the island consists of yellowish (metamorphosed) mudstone and siltstone which is stratigraphically overlain by grey siltstone that outcrops in the southernmost hill. Foliation is subparallel to bedding and generally strikes 60°, dipping 10°-15° towards southeast. Jones (1966) has shown on the geological map that the Pulau Ular rocks belong to the Upper Devonian-Carboniferous Singa Formation. On Pulau Ular, zones reaching thicknesses of 4 m are made up of slump folds and other products of soft-sediment deformation.

The abrasion platform stays above high tide level, and even during spring tide on 2 March 1983, the platform was still 0.4-0.6 m above sea level. Nevertheless, this platform is almost free from debris except for a narrow, half a metre high ridge of coquina and coral fragments, suggesting that storm waves occasionally sweep across the platform. Such waves could be generated by westerly winds, since to the west of the Langkawi islands lies an open stretch of the Strait of Malacca.

The platform very probably defines the wave base of sea level that left notches in the hill sides approximately 1½ metre higher. Such a notch is especially clear along the northwest side of the central hill. According to the Holocene sea level curve of stable Peninsular Malaysia (see Tjia, *et al.*, 1977), sea level was 1½ to 2 m above present high tide during two periods, that is, between 2500 - 3000 B.P. and between 4000 - 5400 B.P. The smooth surface of the platform without indication of weathering strongly suggests that this appearance has been achieved during the younger period of submergence (2500 - 3000 B.P.).

Along the base of the central hill (see Fig. 1) and clear across the platform runs a 240° striking fault that dips steeply towards northwest. The fault is marked by a fracture zone, usually less than 40 cm wide, but locally up to 80 cm wide, that has straight and irregular borders on its south and north side, respectively. The fault depressed the smooth platform surface to its north by 10 cm relative to the surface to its south. Local variations do occur (see Fig. 1) but the general appearance is that of a normal fault downthrowing to the north. A similarly striking normal fault cuts across the southern hill and interrupts two old reverse fault zones. From the air, a few long faults parallel in strike to the above-described normal faults were also seen in other parts of Pulau Ular, suggesting that this fault strike is regional.

Until now there has not been shown evidence for regional compressional phenomena of Cenozoic age in tectonically stable

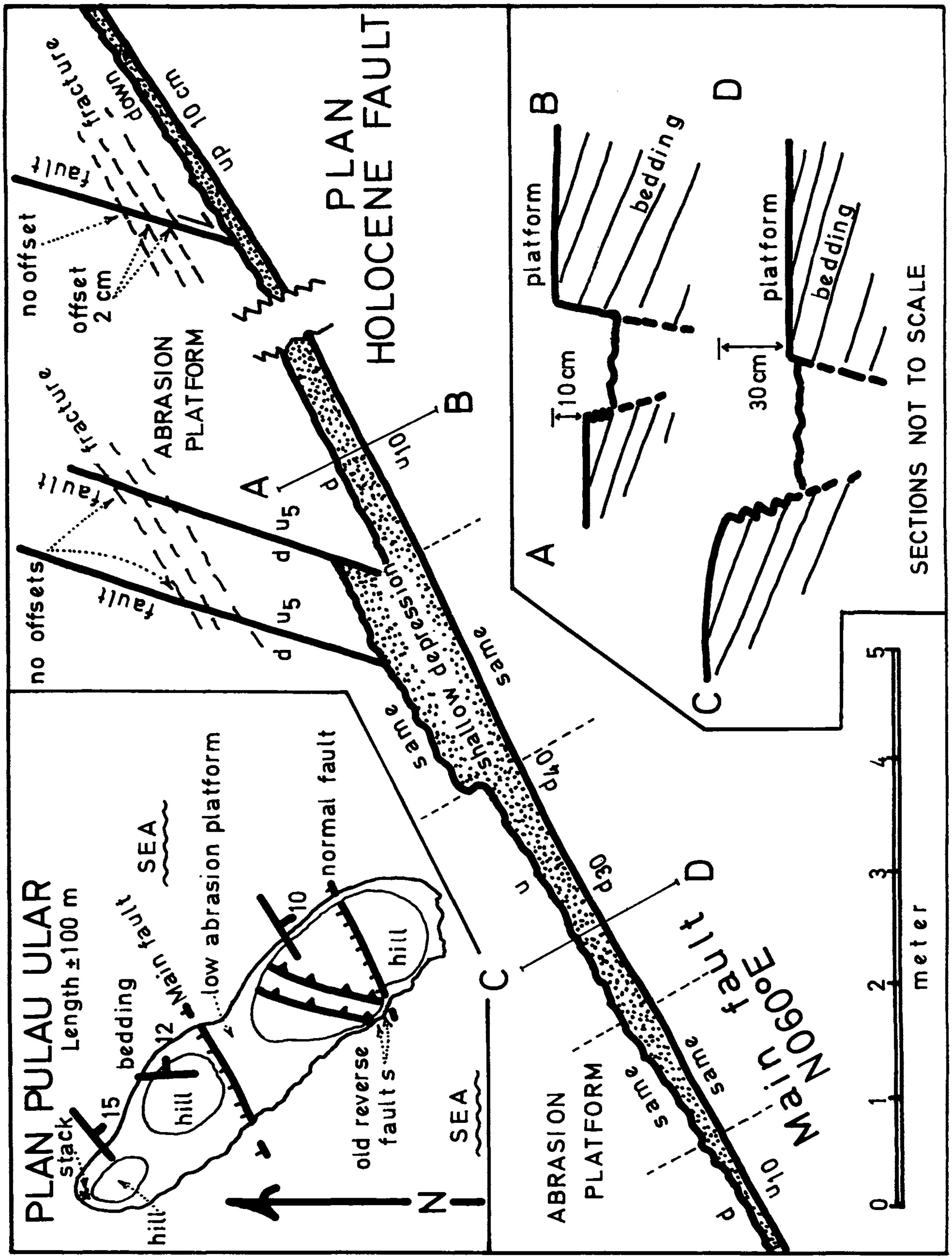


Fig. 1. The central segment of the Holocene fault in the abrasion platform of Pulau Ular. Along some of the NNE-striking faults right lateral displacement of 2 cm of crossing fractures are clear, but the same faults may not offset other fractures. Abbreviations: d = downthrow, u = upthrow, u_{10} = 10 cm upthrow relative to the abrasion surface across the fault.

Peninsular Malaysia. Faults cutting Tertiary (Batu Arang, Selangor) and Quaternary deposits (see Raj, 1979) are all normal faults. Displacement along those faults may be solely due to gravity acting on existing zones of weakness.

The normal fault displacement on Pulau Ular very probably took place within the last few thousand years (basing on the age of the abrasion platform) and occurred along an existing zone of weakness. The Langkawi islands are located near the edge of the Sunda craton, and in that position the area may have experienced or is experiencing slight warping. In other words, normal faulting in an area of upwarp is a manifestation towards a new state of crustal equilibrium.

References

Jones, C.R., (1966). West Malaysia 1 : 63,360 geological, Sheet 150, Pulau Langkawi. Geological Survey HQ, Ipoh.

Raj, J.K., (1979). A Quaternary fault in Peninsular Malaysia. Warta Geologi, vol. 5 (1), p. 3-5.

Tjia, H.D., S. Fujii and K. Kigoshi, (1977). Changes of sea-level in the southern South China Sea area during Quaternary times. United Nations ESCAP, CCOP Tech. Publ., No. 5, p. 11-36.

Manuscript received 15 March 1983.

Occurrence of a thick intraformational conglomerate horizon within the Semantan Formation (Triassic) near Temerloh, Pahang.

METCALFE, I. and CHAKRABORTY, K.R., Department of Geology, University of Malaya.

Triassic sedimentary rocks are widely distributed in the Karak - Temerloh area, Pahang. These rocks were divided by Jaafar (1976) into two formations, a Middle to Upper Triassic Semantan Formation and an Upper Triassic Kaling Formation.

The Semantan Formation (Jaafar, 1976, 1980) comprises an interbedded sequence of mudstone and tuff with rare limestone lenses developed near the base and near the top of the formation. Rare carbonaceous chert lenses and arenaceous sandstones also occur in the sequence. Intraformational conglomerates within the Semantan Formation were not reported by Jaafar (1976, 1980). However, thin conglomerate beds have been noted in the formation by Loganathan (Pers. comm) in Negri Sembilan and the authors have also noted thin conglomerate horizons in the Semantan Formation of the Sungei Manchir area. Details of the sections studied near Sungei Manchir will be published separately.

The Upper Triassic Kaling Formation comprises predominantly sandstone with subordinate conglomerate, shale and rhyolitic tuff and is distributed as a narrow belt running NNW-SSE a few miles east of Karak.

New exposures of the Semantan Formation along the new Mentakab - Temerloh By-Pass have been studied by the authors and details (including logs of sections) of the major part will be published separately. This note reports the occurrence of an unusually thick conglomerate horizon 3.8 km from the Pahang River Bridge end of the By-Pass (see Fig. 1). This conglomerate horizon is 92+ m in thickness, the upper two meters being transitional in nature and passing up into tuff and mudstone interbeds typical of the major part of the Semantan Formation. The base of the unit is not exposed but it is apparently underlain by interbedded tuff and mudstone. The beds have a consistent strike of 335^{o} and dip between 25^{o} and 30^{o} South Westerly. Lithologically the unit is made up of multiple conglomerate beds, many of which show grading (fining upwards). There are also several discontinuous tuff beds up to 0.5 m in thickness, some of which are also normally graded. Clasts within the conglomerate range from a few mm to 30 cm but are generally of pebble size. Compositionally they are predominantly tuff and mudstone of the Semantan Formation. Pebbles of quartzite and vein quartz are also observed. The pebbles of the conglomerate beds show a crude preferred orientation sub-parallel to the bedding. The precise stratigraphic position of the conglomerate unit is not known but it appears to lie in the lower part of the Semantan sequence exposed in the By-Pass and is therefore likely to be of Middle Triassic age.

Metcalfe *et al.* (1982) have showed that the typical rhythmically interbedded tuffs and mudstones of the Semantan Formation were deposited by turbidity currents or by mass flow mechanisms. The conglomerates reported here may represent proximal turbidites or may

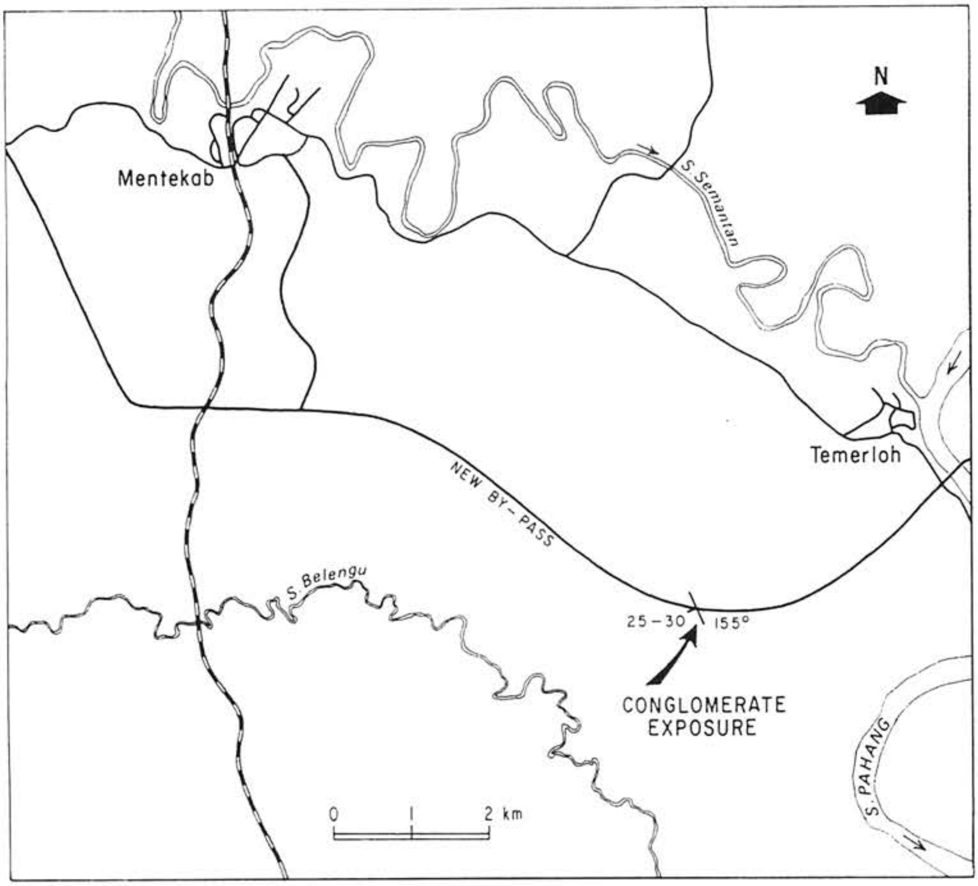


Fig. 1. Sketch map showing the location of the conglomerate unit.

be the result of mass flow near to the source. This source was probably one of the number of volcanic islands which formed an Island Arc chain at that time (Metcalfe *et al.* 1982).

Acknowledgements

The receipt of University of Malaya Research Grants Nos. F142/77 (I.M.) and F28/78 (K.R.C.) are gratefully acknowledged.

References

Jaafar Bin Ahmad, 1976. The geology and mineral resources of the neighbhourhood of Karak and Temerloh, Pahang. Geol. Surv. Malaysia Mem. 15.

Jaafar Bin Ahmad, 1980. The geology and mineral resources of the Sungai Teris area, Pahang. Geol. Surv. Malaysia Mem. 18.

Metcalfe, I., Sivam, S.P. and Stauffer, P.H., 1982. Stratigraphy and sedimentology of Middle Triassic rocks exposed near Lanchang, Pahang, Peninsular Malaysia. Bull. Geol. Soc. Malaysia, 15, 19-30.

Manuscript received 7 Jun 1983

PERHUBUNGAN LAIN (OTHER COMMUNICATIONS)

GROUNDWATER RESOURCES IN MALAYSIA

YONG, S.K., Department of Geology, University of Malaya.

Summary

The importance and use of groundwater in relation to development needs, climate and geologic structure of Malaysia are discussed. The occurrence, distribution, supply, groundwater movement, exploration, extraction, groundwater quality, pollution and control are reviewed. The management, legislation and future development trend of the resource are noted.

Introduction

The understanding of groundwater hydrology is important to the development of water supply and to construction engineering in Malaysia. Groundwater constitutes a portion of the earth's hydrologic cycle. Precipitation incident on the earth's surface forms surface runnoff as overland flow, channel flow or stream flow that eventually leads to the ocean or remains in lakes and reservoirs. The rest of the precipitation is intercepted by surface vegetation or infiltrate into the ground as soil moisture or deeper to form groundwater. The surface and subsurface water return to the atmosphere in the process of evaporation and evapo-transpiration by vegetation.

Climate

Peninsular Malaysia, Sabah and Sarawak lie in the same latitude and are subjected to the movement of the same air masses and therefore have almost identical climate. Some local variations in temperature and rainfall are evident due to elevation or proximity to the sea but the areas are tropical, have heavy rainfall and a high uniform temperature throughout the year. Sarawak and Sabah have a slightly higher temperature and higher rainfall than the peninsula.

The year is divided into two seasonal monsoons, both are hot and wet. The major difference between the two monsoons is the direction from which the rains arrive. The more robust is the North-east Monsoon from early November to late February. Strong and regular winds sweep southwards at a rapid pace. South-west Monsoon is from May to August and is slightly milder.

The annual mean rainfall in the peninsula is just over 2540 mm (100 inches) with precipitation primarily during the South-west Monsoon. In Sabah and Sarawak it is about 3810 mm (150 inches) with precipitation primarily during the North-east Monsoon. The west coast of the peninsula is wettest during the South-west Monsoon but is driest during the North-east Monsoon. The east coast is driest during the South-west Monsoon when drought occurs.

Temperatures in the peninsula, Sabah and Sarawak are similar. It varies in the range from 21 to 32 degrees Centigrade in the coastal areas and varies in the range from 13 to 27 degrees Centigrade in the mountainous areas.

Water resources in Malaysia

In spite of the heavy average annual rainfall, the total water resources in the country are only moderate due to high potential evaporation of about 1500 mm (59 inches). Although the total surface area water resource may appear to be plentiful yet not all the water is available for use. Approximately 65% of this is estimated to run off to the sea and about 25% is utilised for hydroelectric purposes, fisheries, channel maintenance and pollution abatement. Thus only about 10% is available for development for other uses including consumption (Pang, 1981).

It is observed that in general Malaysia is not handicapped by a lack of water resources but is concerned with achieving the optimum use of those resources at the lowest cost and with due regard to ensuing their long-term availability. Hence the need for a national water policy was recognised (Country Report, 1976).

The availability and quality of surface water is being affected by the increasing pollution from industrial and agricultural wastes and by changes in landuse in land development and deforestation. There is an increase in demand for water supply due to population and industrial growth. Kedah and Perlis suffer continuous economic losses due to crop failure because of droughts. Cloud seeding and irrigation are carried out. Water rationing is a recurrent problem in the Klang Valley. Kelantan, Sabah and Sarawak have inadequate surface supply problems.

The National Water Resources study was started in 1979 in view of the competing use of surface water by industries, agriculture and domestic sectors and the need of integrated water resource development and management. Constitutional, legal aspects, and conflict among water-users will be studied. (Fourth Malaysia Plan, 1981).

The Water Resource Management Study (1970 - 1980) was completed for Klang Valley, Pahang Tenggara, Kedah and Perlis and included an assessment of future water supply requirements up to the year 2000.

Water supply project for Sg. Semenyih was initiated in 1981 with a similar plan for Sg. Batu to meet the domestic and industrial water supply requirements of Klang Valley. Similar studies were carried out for southern coast of Trengganu, Malacca, Negri Sembilan and northern Johore.

A National Rural Water Study was initiated in 1981 to produce a master plan for rural water supply development up to 1990 nationwide. Preliminary findings of the on-going National Water Resources Study indicate that the potential surface water yield cannot meet the annual water demand in the states of Perlis, Kedah, Penang island and Malacca (Progress Report, 1981). Therefore the development of groundwater resource as an alternative or supplement source of water supply is necessary.

Occurrence and geologic structure

Groundwater occurs in certain geologic areas where the physical properties affect the amount of groundwater stored and the ease of extraction. These properties are porosity (the ratio of volume of spaces in a material to the total volume of the material) and permeability (the speed of water moving through the material depending on the grain size, shape, uniformity and packing). In groundwater studies rock materials are divided into unconsolidated and indurated rock materials. Unconsolidated materials are alluvium, clay, silt and sand that form aquifer (water-bearing rock strata that yields significant amount of water economical for extraction in form of wells) because of high porosity, high permeability and absence of cementing materials in the pore spaces. Indurated materials like sedimentary rocks, igneous rocks and metamorphic rocks have low permeability except when fractured. The Kuala Lumpur Limestone Formation bedrock is a good aquifer with joints and fractures formed and later enlarged as the limestone dissolves in carbonic acid formed by gaseous carbon dioxide dissolving in rainwater which then percolates into the ground.

In the peninsula the most promising areas are found within the Quaternary alluvium located in the coastal alluvial plains especially in the downstream areas of large river basins such as Kelantan, Trengganu, Pahang, Selangor and Perak. The carbonate rocks also constitute important aquifers but their distribution is more localised. In Sabah, over three quarters of the land are underlain by sedimentary and volcanogenic-sedimentary rocks. Igneous rocks occur in the north around Mount Kinabalu while the eastern half of Sabah is underlain by Tertiary sedimentary rocks of interbedded sandstone, shale, mudstone and some slate. It is the sandstone in the upper sedimentary basins that provide the only important aquifers. Geologically Sarawak can be divided into two distinct regions - western Sarawak and central-northern Sarawak. In western Sarawak the main rock types are shale, sandstone and conglomerate with volcanic rocks while in central-northern Sarawak, the main rock types are quartzitic sandstone, greywackes, siltstone, phyllite and slate. Based on studies carried out so far, potential aquifers are mainly found in the sand layers in areas which are underlain by unconsolidated materials (Pang, 1981).

Progress of groundwater investigation

Groundwater investigation seeks to determine the presence of groundwater, the volume of supply and the rate at which the supply can be removed from the ground.

The first hydrogeological investigation was started in 1903 by the present Geological Survey Department of Malaysia. Studies on Labuan, Sabah were conducted in 1940 and on the coastal belt of the peninsula completed in 1958 by the United Nations Technical Aid Assistance. The German Hydrogeological Mission in Malaysia was formed in 1973 in cooperation with the Geological Survey to initiate a systematic and scientific investigation of groundwater in areas of water shortage and to enlarge the infrastructure of the hydrogeological section and enrich the technical know-how of the Geological Survey staff. Between 1974 and 1977, a systematic regional investigation was conducted in Kelantan, Trengganu, Pahang and Perlis in connection with the Public Works Department water supply programme to meet the domestic, industrial and agricultural needs of the states. The hydrogeological map of Peninsular Malaysia is published in 1975 by the Geological Survey as a step towards the systematic assessment of the groundwater potential in the country and to aid in the planning of groundwater utilisation. Investigations were also carried out in Sabah and Sarawak. The country's first international conference on groundwater organised by Australia Groundwater Consultants was held in Kuala Lumpur in 1981.

Groundwater quality

Groundwater fit for human consumption is potable free of dissolved minerals (iron, manganese, chloride, sulphate, fluoride, nitrate and bicarbonate), dissolved or suspended solids, trace elements (arsenic, barium, cadmium, lead, chromium and selenium), dissolved gases (carbon dioxide and hydrogen sulphide produced by decaying organic matter) and bacteria and other organisms (Sekarajasekaran, 1972).

Iron and manganese are distasteful and produce deposits. Iron stains and chlorides have noticeable taste and not suitable for irrigation purpose. Fluorides reduce tooth decay but excessive concentration produce dental fluorosis and may affect bone structure. Sulphate in high concentration produces laxative effects. Nitrate often present due to contamination from human wastes and or agricultural products produces at high concentration, cyanosis in babies under 6 months old (blue babies). High dissolved solids usually indicate that water will produce problems of taste, corrosion and possibly medical danger. Extreme pH values may indicate corrosion difficulties. Trace elements are toxic at very low concentration.

Significant dissolved chemicals in surface water can be removed by absorption and reaction with ground chemicals. However detergents resist removal and infiltrate up to one metre deep in the ground. Biodegradable materials although removed by absorption and chemical action cannot be acted by biological organisms which are usually removed in from three to ten metres passage through uniform soil or fine sand.

Excessive oxygen content in water can be treated by aeration by aeration oxygenation. Dissolved mineral iron is precipitated by oxygen and the precipitate is separated by filtration. Calcium and magnesium bicarbonates causing temporary hardness are removed by boiling while calcium and magnesium sulphates and chlorides causing permanent hardness cannot be removed. Organic materials are oxidised by oxygen and chlorine and dissolved. Very low suspended solid and low bacterial content can be treated by free residual chlorination.

Unpotable groundwater can only be used in non-food processing industries.

With reference to limestone calcium carbonate distributed locally in the country, the groundwater quality is (i) chemically low dissolved solid of calcium carbonate less then 350 ppm, (ii) chlorine and sulphate dissolved salts derived from rain, (iii) poor bacteriological filtering qualities - limestone is particularly susceptible to pollution and (iv) chemical quality of confined water is excellent especially at intake area for an open system whereas chloride and sulphate concentrate in a close system.

Based on exploration studies the country's groundwater quality at various exploration locations range from potable to unpotable limits. The potable limit for iron is 0.3 ppm and chloride is 8 to 30 ppm. The concentration of sodium chloride is high in the coastal areas due to seawater intrusion. Groundwater in the country is used for various purposes such as domestic consumption, industries, irrigation, livestock and aquaculture.

Groundwater pollution and control

Sources of groundwater contamination and pollution are domestic and urban sewage; industrial wastes (organic wastes, mining, oil and chemical industries); solid and semisolid. Degradation of groundwater arises from development, use and refuse of water effects (interchange between aquifers due to improperly constructed, defective or abandoned wells); overdraft condition (seawater intrusion, upward or lateral diffusion of connate saltwater and or juvenile water due to overpumping);

contamination from the surface due to improperly constructed wells; natural causes (inflow and or percolation of juvenile water from highly mineralised speings and streams); and other causes (accelerated erosion and floods).

Pollution control should consider the effects of mining, sewage and refuse disposal, surface water pollution by industrial and agricultural effluents, acid rain occurrence and coastal seawater intrusion.

Mining pollution introduces substances causing physical and chemical changes and intercept or divert all or part of a water resource. These change the water quality and quantity and cause ecological damage (changes in the diversity of composition of biological community). Direct mining influences are hydraulic mining, dredging, water for cooling for machinery and processing water. Indirect influences are pumped mine water, percolation, leaching, groundwater interception affecting aquifers and spillages when mine embankment collapses.

Mining pollution can be controlled by monitoring and water control using certain mining techniques such as contour mining, erosion and infiltration control and treatment of polluted water.

Solid and semisolid refuse can pollute the groundwater. The refuse disposal system in the Klang Valley (Kuala Lumpur, Petaling Jaya, Shah Alam and Klang) is the sanitary landfill method - dumping refuse at disposal grounds (EPS, 1979). The wastes are levelled with tractors and then sprayed on by disinfectant and insecticides (izol, gamaxene, anti-malarial oil and dipthrox). The waste is covered by sand in layers obtained from mining areas by contract. The disposal sites are former mining grounds, river banks and swampland (Salak South, Jinjang, Sungei Way, Shah Alam; Jalan Tepi Sungei, Klang; Klang; and Kapar, Klang respectively). These are all potential groundwater and surface water pollution susceptible areas. Groundwater or rainwater may dissolve the finely suspended solid matter and microbial waste and the leachate produced may leave disposal site in form of a spring or it may percolate down through the soil water under and around the landfill. This is especially so with food waste deposited on the landfill site. Poisonous compounds present in the leachate once reached the groundwater beneath a landfill can be carried over long distances and pollute streams and drinking water supplies eventually. Surface water pollution can be prevented by intercepting all surface drainage entering the landfill site and reroute these waters around the landfill and by collecting and treat all surface water which have passed through the site. The rerouting method is easier. Sewage should be properly treated and disposed. Pollution preventive measures should include location of industries considering natural protection, direction of the natural groundwater flow, evaluating consequences of a design project on the environment and groundwater (within the scope of an environmental impact assessment for a development project), create a network of observation wells at large water intakes and industrial objects to establish groundwater pollution and study their self-treatment, correct for long-term prediction of spreading the polluted groundwater in aquifer and substantiate the necessity of special protective measures (Goldberg, 1977).

Management, legislation and future development of groundwater resources

The groundwater potential of Malaysia may not be as extensive as a number of countries of similar geographical location. In order to achieve an optimum use of this valuable resource which is renewable but limited, a proper management of this resource should be instituted.

Proper management includes planning, implementation, control and evaluation. Planning and forecasting is to anticipate future demands and to set a goal to meet these demands. A course of action to achieve the goal is established based on development trends over a period of years expressed in real figures involving statistical methods. The plan should relate to the country's various economic sectors and its investment programme. Environmental protection and multi-purpose development of the resource are also considered. The plan should be legislated with a well-defined system of indicators used for control purposes later. Implementation of the plan begins on a regional basis with a view to integrate national information. Alternatives to courses of action should be open for option.

The plan is then acted on by administration of the methods and measures as stated in the plan. Problems of implementation like inadequate manpower and equipment in terms of quantity and quality should be resolved first.

The administration and implementation machinery on groundwater resource development of various government agencies such as Geological Survey Dept., Drainage and Irrigation Dept., Public Works Dept. and the Ministry of Health engaged in groundwater work with specific roles well-defined should be co-ordinated.

Proper implementation of this plan can be achieved by exercising proper controls. Control provides for guidance of the course of action that includes supervision and oversee with strict enforcement of regulatory legislation.

The last phase, evaluation is to assess the situation and progress of the course of implementation and control from time to time in order to ascertain the eventual achievement of the goal within a specific time-frame.

The existing legislation from 1935 to 1982 in direct or indirect relation to groundwater resource in Malaysia on the aspects of Federal-State government powers, groundwater management and development, environmental pollution and control, geological prospecting, sewage, water usage and supply are as follows:

1. Federal Consitution 1957 article 91. The National Land The National Land Council, 92. National development plan.
2. Town and Country Planning Act 1976
3. Environmental Quality Act 1974
4. Geological Survey Act 1974
5. National Land Code Act 1969
6. Land Conservation Act 1960
7. Water Supply 1955
8. Irrigation areas Federation of Malaya Ordinance 1953
9. Mining Federated Malay States Enactment Chapter 147
10. Water Federated Malay States Enactment 1935

Any adequate groundwater legislation should include:

1. A National Water Policy
2. Distribution of responsibility with respective government agencies and institution of co-ordination among these agencies
3. Control and ownership of water by Federal and or State government
4. Means of acquiring water rights e.g. action of law, concession, licence, registration, etc.
5. Restrictions on certain sources or users of water
6. Priorities between regions, uses and users and in relation to other natural resources e.g. minerals

7. Conditions of use (domestic, town, irrigation, agriculture, industries, ming and aquaculture)
8. Environmental protection of water resources
9. Participation of users and industries and other interested persons in water administration
10. Registration and classification of water, water-users and water rights
11. Evaluation and approval of new techniques for water use (Cano, 1977).

The future trend of groundwater resource development in the country may be influenced by the following factors:

1. Completion of the National Water Resource Study long-term plan for management and development
2. Set-up of a National Water Authority as an integral policy-making body
3. Legislation and amendment of laws on groundwater resource management and development
4. Production and training of groundwater resource personnel at various levels of research, investigation and technical work
5. Financial backing of groundwater resource undertakings
6. Research by institutions of higher learning on groundwater.

Conclusion

In view of the population growth, industrial and agricultural development, the importance of limited groundwater resource as an alternative or supplement source of water supply should be recognised and the status of groundwater compared with other sources of water supply should be defined. Legislation should be instituted and implemented with effective enforcement to manage, conserve and develop the resource in face of pollution or depletion problems for a long-term sustainable use. In order to achieve this, groundwater resource management and development should be in the mainstream of the country's national development plan.

References

Cano, Guillermo J., 1977. United Nations Water Conference 1977, Argentina.

Country Report, 1976. Malaysia to the United Nations Water Conference, Argentina.

Fourth Malaysia Plan (1981 - 1985), 1981. Government of Malaysia.

Environmental Protection Society Malaysia (E.P.S.), (1979). Klang Valley Rubbish Report.

Goldberg, V.M., 1977. Methods of Groundwater Protection from Pollution, United Nations Water Conference, Argentina.

Pang, Leong Hoon, Ir., 1981. Groundwater Planning and Development, Groundwater '81 Conference, Kuala Lumpur.

Progress Report, 1981. National Water Resources Study Malaysia 1981, Japan International Co-operation Agency.

Sekarajasekaran, A., 1972. Water Quality Management within existing legislation in Water Supply Engineering Course Proceedings (1977), University of Malaya, Kuala Lumpur.

Manuscript received 25 May 1983

******

GEOLOGI DAN TAMADDUN ISLAM
(GEOLOGY AND ISLAMIC CIVILISATION)

MOHAMAD Ali Hasan* dan AZIZAN Baharuddin**

Abstrak

Mulai sesi 1983/84 ini kesemua universiti tempatan akan mengadakan kursus-kursus "Tamaddun Islam" bagi semua pelajar, terutamanya bagi tahun pertama. Salah satu tujuan kursus ini diadakan ialah untuk memperkenalkan Sains Islam sebagai yang telah dihayati cara dengan segala kejayaannya di zaman pertengahan. Kursus ini berorientasikan pengetahuan bukan berorientasikan pendidikan. Kertas ini adalah bertujuan sebagai sumbangan kepada memperkatakan pencapaian dan hasil tamaddun Islam dalam sejarah manusia di bidang geologi. Antara lain ianya menyentuh mengenai kedudukan ilmu geologi di dalam pengelasan ilmu orang-orang Islam; falsafah di sebalik pengkajian ilmu tersebut di dalam Islam; Beberapa ayat Al-Quran yang berkaitan; tokoh-tokoh penting ahli-ahli geologi Islam serta karya-karya pokok mengenai geologi, dan akhirnya pengaruh ahli geologi Muslim ke atas dunia geologi keseluruhannya. Tulisan ini tidak mengakui meliputi keseluruhan bidang geologi Islam, akan tetapi hanya menyentuh beberapa aspek yang termaklum oleh penulis.

Abstract

Courses about the "Islamic Civilisation" most probably will be given to all students, especially the first year students in all the local universities starting this 1983/84 session. One of the aims of the course is to introduce Islamic science as practiced during the Middle Ages with all its achievements. These courses are knowledge oriented rather than education oriented. This paper is an attempt to discuss various accomplishments and the results of Islamic Civilisation in man's history in the field of geology. Some of the things that are being discussed include the position of geology in the classification of knowledge of the Muslim; the philosophy behind the discipline in Islam; various related verses of Al-Quran; prominent Muslim geologists and their findings, and lastly the influence of Muslim geologists in the overall geological worldview. This article is by no means a complete account of geology in the Islamic Civilisation but is merely touching on various relevant aspects which are familiar to the writer.

* Jabatan Geologi, Universiti Malaya
** Pejabat Dekan Sains, Fakulti Sains, Universiti Malaya

1. Pengenalan terhadap bidang geologi - takrif geologi: Kaitannya dengan bidang-bidang sains yang lain; Kedudukannya di dalam pengelasan ilmu orang-orang Islam.

1.1 Takrif geologi

Geologi berasal dari dua perkataan Grik (Yunani) iaitu - GEO dan LOGY. GEO bermakna bumi dan LOGY bermakna pengkajian atau pembelajaran. Jadi dari segi bahasanya, GEOLOGI bolehlah dimaksudkan sebagai satu ilmu (sains) yang mengkaji tentang bumi. Tidak hairanlah dahulu kita pernah menggunakan istilah 'kajibumi' untuk ilmu ini.

Pengkajian geologi meliputi berbagai aspek mengenai bumi, dari struktur dan kandungan keseluruhannya hinggalah kepada perkara-perkara yang dipelajari menerusi mikroskop. Ahli-ahli geologi meneliti kandungan dan struktur batuan, bahan-bahan mineral, tenaga serta sumber-sumber alam yang lain yang terdapat di bumi, dan juga proses-proses fizikal, kimia serta biologi yang telah dan akan berlaku di permukaan atau dalam bumi. Tidak ketinggalan juga, pengkajian geologi melibatkan kefahaman tentang asal usul bumi iaitu satu bidang yang juga disebut sebagai kosmologi, serta pembentukkannya dari semasa ke semasa. Dalam konteks yang lebih luas, ahli-ahli geologi juga mengkaji mengkaji mengenai bulan, bintang, matahari dan lain-lain planet dalam sistem suria ini khasnya.

Disiplin geologi ini bukan sahaja melibatkan perkara-perkara asas (misalnya teori dan prinsip-prinsip yang berkenaan), tetapi juga menekankan kepada kerja-kerja di makmal dan kerja luar (lapangan). Bumi luas yang terbentang ini merupakan makmal semesta bagi ahli-ahli geologi.

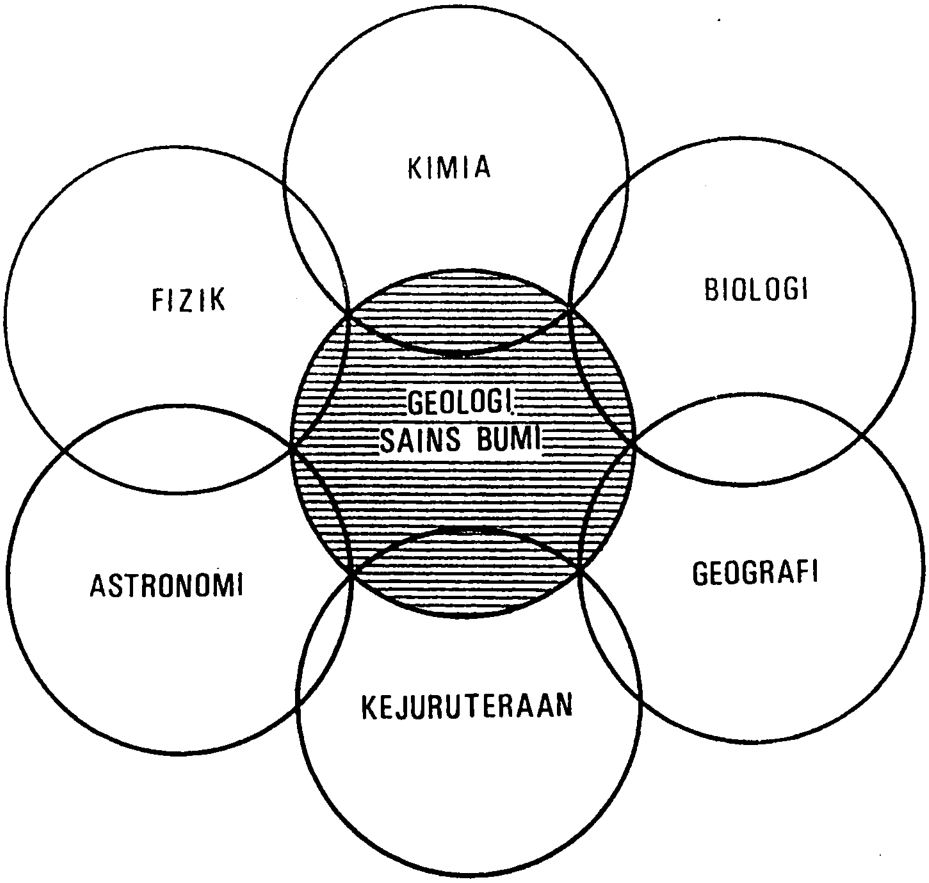
1.2 Geologi dan kaitannya dengan bidang-bidang sains yang lain

Geologi merangkumi berbagai disiplin, khususnya disiplin sains yang lain. Kemajuan geologi pada dasarnya bergantung juga kepada kemajuan disiplin-disiplin ini terutamanya kimia, fizik, biologi dan matematik. Rajah 1 menerangkan hubungan geologi dengan disiplin-disiplin sains yang lain. Pemusatan geologi di rajah ini menunjukkan bahawa disiplin geologi menggunakan pengetahuan asas disiplin-disiplin sains yang lain bagi menerangkan apa-apa fenomenon berkenaan dengan bumi.

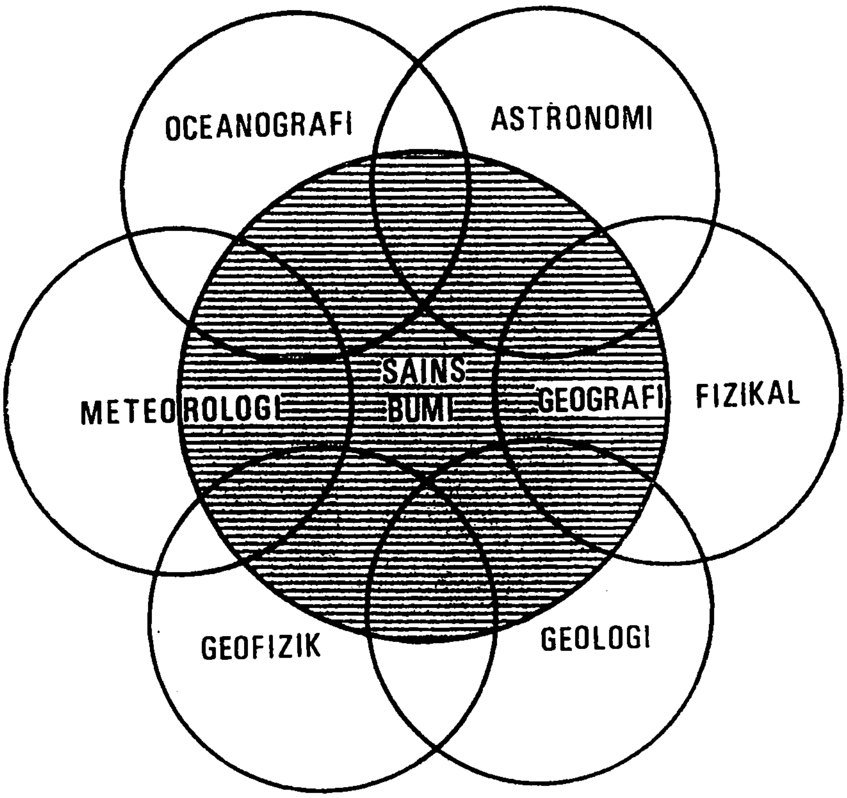
Pengetahuan geologi amat berguna bukan sahaja kepada seorang ahli geologi itu sendiri sahaja, tetapi juga berguna kepada jurutera, ahli pertanian, ahli geografi, jurukur, pengurus sumber-sumber alam dan lain-lain yang berkaitan dengan permukaan dan bawah bumi. Ini dapat dijelaskan dengan adanya berbagai pengkhususan di dalam geologi seperti mineralogi, petrologi, paleontologi, geologi struktur, geofizik, geokimia, geologi ekonomi, geomorfologi, hidrogeologi, geologi sejarah, geokronologi, geologi kejuruteraan, geologi petroleum, geologi persekitaran, astrogeologi, geologi isotop, mikropaleontologi, dan lain-lain.

1.3 Kedudukan geologi di dalam pengelasan ilmu orang-orang Islam dahulu

Di dalam sejarah Islam, ilmu geologi termasuklah di dalam bidang sains tabii yang termasuk pula di dalam kelas ilmu-ilmu falsafah. Ini ialah mengikut pengelasan kumpulah Ikhwan as-Safa (lihat Rajah 2).



Rajah 1. (a) Hubungan antara geologi dan bidang-bidang yang berkenaan.



Rajah 1. (b) Bulatan Sains Bumi

ILMU

(1) SAINS PROPEDENTIK (8)

- 1 membaca & menulis
- 2 tatabahasa, nahu
- 3 arithmetik simpan kira perdagangan
- 4 puisi
- 5 mekanik, azimat
- 6 perusahaan dan kraftangan
- 7 pertanian
- 8 sejarah

(2) SAINS KONVENSIONAL (6)

(3) SAINS FILOSOPIKAL (4)

- 1 matematik
- 2 logik
- 3 naturalisme* (sains tabii)
- 4 metafizik

* Sains tabii

1. bentuk, waktu, ruang dan pergerakan - prinsip-prinsip jisim
2. bumi dan langit
3. pertumbuhan dan pereputan
4. fenomena atmosfera
5. mineralogi
6. botani
7. zoologi

(mengikut Rosenthal, 1975: 55-58)

Rajah 2: Pengklasan Ilmu Kumpulan Ikhwan as-Safa

Dari pengelasan ini jelaslah bahawa geologi telah mungkin dikaji di bawah cabang (3.3) bumi dan langit (2) serta mineralogi (5). Kumpulan falsafah ini telah ditubahkan di Mesopotamia (Iraq) di dalam kurun kesepuluh. Mereka telah menulis lima puluh dua tritis yang mana tujuh belas telah membincangkan tentang pembentukan mineral, kejadian gempa bumi, fenomenon meteorologi dan lain-lain lagi. Pada keseluruhannya zoologi, botani dan mineralogi pula sering dikumpulkan ke dalam Sejarah Tabii (Arnold and Guilaume, 1968:333).

2. Falsafah di sebalik pengkajian ilmu Sejarah Tabii termasuk geologi di dalam Islam

2.1 Sejarah Tabii

Ahli sejarah tabii di dalam Islam telah mencuba untuk menyatukan ilmu-ilmu yang berasingan tentang susunan atau struktur tabii supaya menjadi prinsip-prinsip semesta yang mempunyai sifat kosmologi dan metafizik (Nasr, 1976). Pengkajian Sejarah Tabii juga bererti melihat tanda-tanda (ayat) Tuhan yang dijadikan khusus untuk manusia meneliti dan memahaminya. Di dalam konteks ini apa yang dilakukan oleh ahli-ahli sejarah tabii kristian semasa kurun kelapan belas dan kesembilan belas di Eropah, misalnya John Ray (Nasr, 1976:52), adalah mengikut apa yang dilakukan oleh ahli-ahli sains Muslim di kurun-kurun sebelumnya, iaitu alam tabii dikaji sebagai melihat 'bekas' atau kesan-kesan hasil ciptaan Allah S.W.T. dengan kebesarannya.

Sejarah tabii telah ditulis oleh penulis-penulis Islam di dalam berbagai-bagai bentuk. Ada yang di dalam bentuk ensiklopedia, seperti 'Uyun al-akhbar' (Maklumat-maklumat Paling Penting Sekali) oleh Ibn Gutaybah; atau bentuk kompendia kosmografi al-Quazwini dan al-Dimashiqi atau di dalam sejarah kosmografi oleh Masudi, sehinggalah ke bentuk sastera seperti yang ditulis oleh al-Jahiz dan di dalam bentuk penulisan falsafah seperti di dalam bentuk kitab Shifa (Buku Penyembuhan) oleh Ibn Sina. Sebahagian besar daripada buku-buku tersebut telah ditumpukan kepada bidang-bidang zoologi, botani, dan geologi. Pendekatan-pendekatan yang digunakan di dalam penulisan-penulisan ini juga berbeza, ada yang menekankan penggambaran yang terperinci tentang komponen-kompenen alam tabii tadi misalnya, dan ada pula yang ditulis di dalam bentuk yang simbolik serta kosmologi yang menerangkan aspek-aspek falsafah alam tabii tersebut.

Akan tetapi kesemuanya ingin menerangkan pertalian di antara bentuk-bentuk tabii dengan daya-daya dalaman yang ada di dalam diri manusia iaitu 'nafs' atau pun rohnya dan kepentingan bentuk-bentuk tadi di dalam menjadi penyata kepada ilmu tentang hakikat yang ada di sebalik dunia yang zahir iaitu hakikat yang bersifat metafizik dan moral.

Dengan perkataan lain, pengkaji alam tabii Muslim, di samping melakukan pengkajian yang berperihalkan tentang haiwan-haiwan, tumbuhan-tumbuhan dan batuan-batuan serta gunung-ganang, ingin juga mengetahui apa-apa pengajaran yang boleh dipelajari oleh manusia secara moral dan kerohanian (Nase, 1976:46)

Pada keseluruhannya tema yang mempengaruhi pengkajian sejarah tabii Islam ialah kepercayaan kepada ujudnya tiga (3) kingdom atau alam (mawalid) dan roh-roh yang menggerakkan setiap satu darinya. Ketiga-tiga alam ini ialah alam mineral/batuan, tumbuhan dan haiwan. Seperti orang-orang Islam yang juga telah mempercayai 'Konsep Rantai Hidupan' iaitu Tuhan telah menciptakan kesemua spesis atau alam (mineral, tumbuhan dan haiwan) dengan lengkap dan sempurna tiap-tiap satu darinya, dari yang serendah-rendah bentuk dan kekompleksannya sehinggalah kepada yang sehabis tinggi iaitu seorang wali, seperti kata Nasr, 'Segala yang diwujudkan akan sampai kembali kepada asalnya (Nasr, 1975:52)', ketiga-tiga alam ini telah diterangkan dengan cara bersistem oleh Ibn Sina di dalam kitabnya al-Shifa.

Apa yang menggerak dan menguasai keseluruhan dunia tabii ialah 'Roh Alam' yang mempunyai beberapa aspek dan manifestasi yang berlainan. Aspek-aspek yang berlainan inilah yang menentukan bentuk serta corak kehidupan setiap spesis di dalam ketiga-tiga alam yang disebutkan itu. Tiap-tiap dari yang diperlihatkan di Rajah 3. Tiap-tiap mineral, tumbuhan serta haiwan mempunyai beberapa fakulti dan setiap daripada mereka ini menjadi sempurna setakat mana fakulti-fakulti di dalam diri mereka tadi menjadi sempurna. Hanya manusia sahajalah yang mempunyai kesemua dari fakulti ini di samping fakulti aqliah/rasional (Al-nafs al-natiqah) yang menjadi ciri yang membezakannya daripada haiwan.

2.2 Beberapa ayat Al-Quran yang berkaitan dengan Geologi

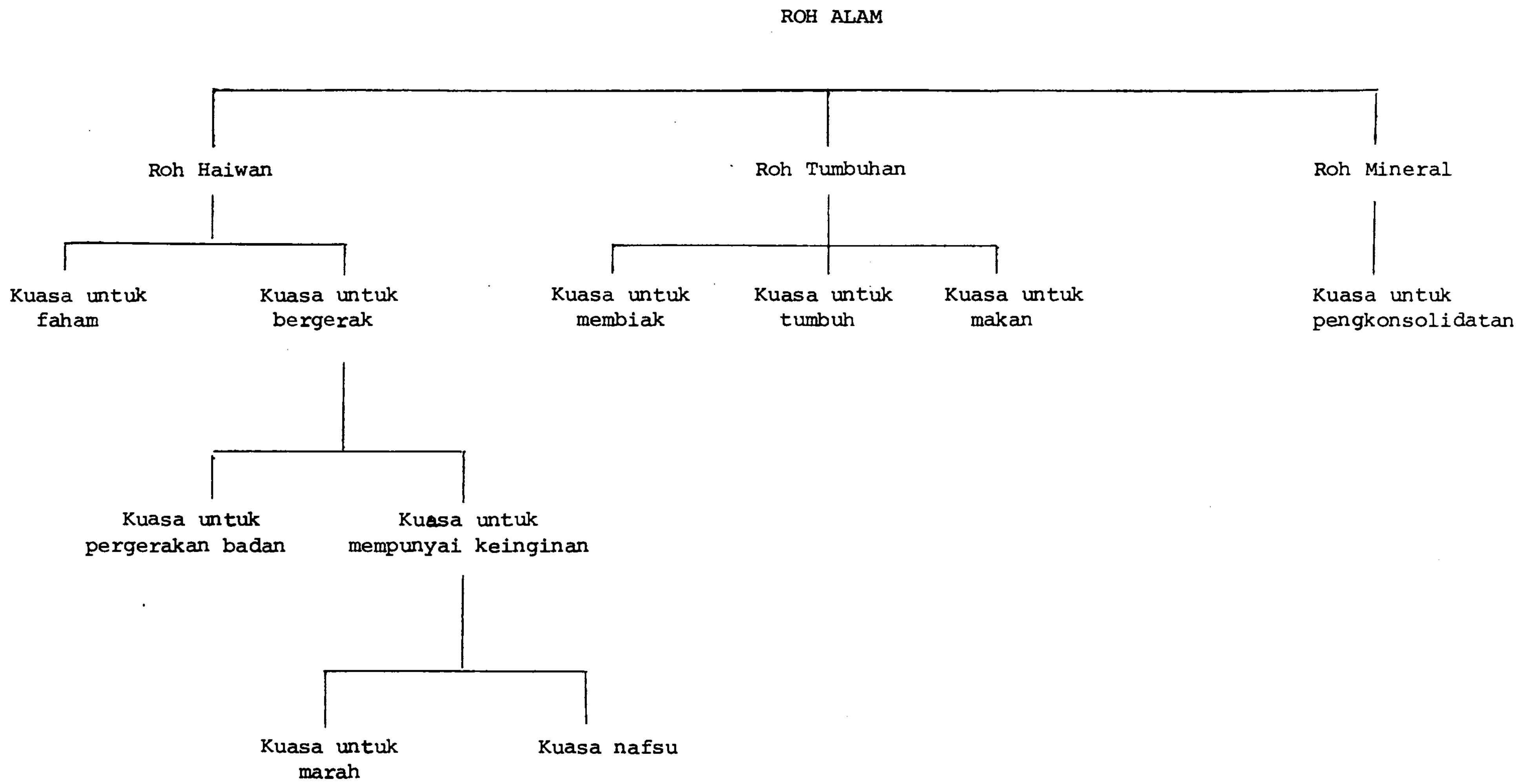
Sesungguhnya kepada ahli-ahli geologi Muslim apa yang mereka temui dan perhatikan berlaku semuanya menjadi kenyataan kepada apa yang telah pun diterangkan di dalam Al-Quran. Maka dengan ini, bidang Geologi seperti juga bidang-bidang lain semuanya menambahkan kekuatan iman mereka terhadap Allah S.W.T. (Rahman, A. 1981:132-138).

Di antara beberapa ayat Al-Quran yang berkaitan dengan geologi adalah seperti berikut.

1) tentang ketidakstabilan kerak bumi (27:61)
2) tentang Tuhan merubah bentuk permukaan atau lapisan dan kegunaan gunung-gunung kepada manusia sebagai sumber dan storan air (79:30-33)
3) fenomenon perlipatan kerak bumi serta pembentukan gunung-ganang (21:44), (51:48),(71:19-20) dan (27:88)
4) fungsi gunung-ganang sebagai agen yang menstabilkan kerak bumi (78:6-7), (88:19-20)
5) fungsi gunung (31:10)
6) warna-warni serts sifat kepada batuan dan mineral (35:27)
7) penggunaan besi (34:10-11), (57:25)
8) penggunaan tembaga (34:12), (18:96)
9) rujukan kepada mineral bernilai (22:23), (76:15-16), (55:22-23), (55:58-39)
10) sifat batuan (2:74), (17:50-51)
11) tentang gempa bumi dan gunung-ganang (11:82), (73:75), (7:171), (29:40)
12) kesemua yang berada di langit dan di bumi telah dijadikan Tuhan sebagai lambang kebesaranNya dan untuk kegunaan manusia. Tetapi manusia harus ingat peranannya yang sebenar di atas bumi dan tidak menyalahgunakan apa yang telah diciptakan olehNya (45:13), (31:20), (22:65)

3. Tokoh-tokoh geologi di dalam Islam, karya-karya pokok, serta sejarah geologi di dalam Islam serta pengaruhnya ke atas dunia geologi keseluruhannya

Ahli-ahli sejarah tabii sering membincangkan geologi terlebih dahulu daripada botani dan zoologi. Ini adalah kerana kedudukan



(mengikut Nasr, 1976 : 46)

RAJAH 3: Pengklasan Roh Alam

mineral sebagai bahan komponen yang asal sekali di dalam bidang-bidang tersebut.

Sebenarnya telah banyak idea serta cerapan-cerapan geologi yang dibuktikan di dalam kurun-kurun yang kemudian (khususnya selepas abad ketujuh belas oleh kerana geologi sebagai suatu sains hanya diakui telah muncul di dalam abad kelapan belas di barat), telah pun diketahui terlebih dahulu lagi oleh orang-orang Islam. Ini akan jelas dapat dilihat di dalam contoh-contoh yang akan diberikan.

James Hutton (1726-1797) yang merupakan tokoh geologi moden yang mula-mula sekali telah mengutarakan prinsip-prinsip seragamisme uniformitarianisme di dalam geologi. Beliau mengembangkan idea bahawa proses-proses yang menukarkan bentuk lapisan-lapisan bumi adalah sama sahaja pada masa yang silam, masa kini serta pada masa akan datang. Beliau juga mengatakan bahawa proses-proses yang merubah lapisan bumi tersebut beroperasi di dalam jangka waktu yang panjang. Lyell, (1797-1873) anak murid kepada Hutton, kemudian telah menambah lagi dengan mengatakan bahawa fosil-fosil yang berlainan yang didapati di dalam lapisan-lapisan yang berlainan adalah dalil kepada perubahan spesies yang telah berlaku. Kedua-dua inilah yang telah dipinjamkan atau yang telah mempengaruhi Darwin di dalam mereka teori evolusinya, yang secara ringkas mengatakan bahawa spesies akan tetap berubah oleh kerana evolusi akan tetap berlaku melalui pemilihan alam tabii. Walaupun ramai ahli sejarah sains (tabii) boleh mengatakan bahawa Darwin tidak pernah menidakkan kewujudan tuhan, tetapi pada hakikatnya, implikasi dari teori tersebut ialah Tuhan tidak penting lagi di dalam kehidupan makhluk-makhluknya, di samping Ianya bukan lagi menjadi Pencipta bagi segala-gala yang wujud di atas muka bumi ini.

Sebaliknya bagi ahli-ahli geologi Islam yang telah pun berkecimpung dan mewujudkan bidang yang diberi nama geologi itu terlebih awal lagi, Tuhan tidak pernah dipisahkan daripada fenomenon-fenomenon tabii. Maka dengan itu mereka tidak perlu menimbulkan hipotesis-hipotesis seperti semenjak dari pertengahan abad kesembilan belas, telah galak dianggap sebagai fakta-fakta sains, walhal pada hakikatnya ia hanyalah merupakan cara-cara manusia sekular menutupkan kekosongan yang terbit hasil dari mereka membuangkan konsep Perciptaan Tuhan dari alam tabii (Nasr, 1976:51).

Penulisan orang-orang Islam tentang geologi menunjukkan satu kefahaman yang terang dan jelas tentang sifat beransur-ansur perubahan-perubahan geologi, transformasi-transformasi yang telah berlaku di permukaan bumi termasuklah penukaran tanah daratan kepada laut dan laut kepada darat, kepentingan mala-petaka seperti gempa bumi di dalam merubah bentuk permukaan bumi serta kepentingan jenis-jenis batuan sebagai suatu rekod sejarah geologi bumi (Nasr, 1975:51).

Pengkaji-pengkaji geologi Islam telah mengetahui juga tentang asal-usul fosil sebagai peninggalan-peninggalan binatang-binatang laut yang telah terbatu, yang sekarangnya daratan, tetapi dahulu kala lautan. Maklumat ini telah ditulis oleh Ikhwan al-Safa di dalam salah sebuah daripada epistel mereka (Nasr, 1978). Manakala di dunia Barat asal usul fosil tersebut masih merupakan tandatangannya di dalam abad ketujuh belas.

Al-Biruni pula telah menyedari kepentingan catitan A catitan yang terkandung di dalam batuan-batuan iaitu beliau telah menulis bahawa,

".... kita terpaksa bergantung kepada rekod-rekod batuan dan

> peninggalan masa yang silam untuk merumuskan bahawa semua pertukaran ini sepatutnya telah berlaku di dalam masa yang panjang dan di dalam keadaan panas dan sejuk yang tidak diketahuk.", (Nasr, 1975:52).

Begitu juga ahli-ahli sains Islam telah mengetahui tentang fenomenon-fenomenon geologi lain yang penting seperti peluluhawaan, perbezaan-perbezaan di dalam darjah ketahanan gunung-ganang yang berlainan kepada proses peluluhawaan tersebut, pengumpulan pasir yang diakitatkan oleh air dan angin di dalam tindakan mereka yang terus menerus ke atas batuan-batuan. Mereka juga faham bagaimana batuan endapan telah terbentuk melalui proses-proses ini.

Ahli-ahli geologi Muslim juga mempunyai minat yang mendalam tentang air di bawah tanah (air tanah) dan sistem-sistem air. Minat ini jelas kelihatan di Parsi (kini Iran) umpamanya di tempat orang-orang Islam telah mewarisi sebuah sistem pengairan (dikenali sebagai qanat) yang luas, dari orang-orang Sassanid (Nasr, 1976:52). Minat ini juga dapat dilihat di banyak tempat di Andulasia (Immanuddin, 1965:75-76).

> "Akan tetapi, ahli-ahli sains Muslim tidak pernah berasa puas hati dengan penggunaan sistem ini di dalam bidang pertanian sahaja. Mereka juga memerlukan pengkajian-pengkajian sains yang berkaitan dengan hidrologi dan geologi. Al-Karaji misalnya telah menyatukan ilmu dan amali di antara berbagai-bagai disiplin, termasuklah matematik sehinggalah geologi. Sifat ini memanglah merupakan salah satu dari ciri-ciri sains Islam", (Nasr, 1976:52).

3.1 Mineralogi

Sains mineral merupakan satu cabang ilmu geologi yang mendapat perhatian dari Al-Quran, Ahli-ahli geologi Muslim telah mendapat galakan darinya (Al-Quran). Dari Al-Quran terdapat beberapa ayat yang secara langsung berkaitan dengan mineralogi, misalnya warna-warna yang menjadi sifat mineral dan batuan (35:27), penggunaan besi (34:10-11 dan 57:25); memperkatakan hal-hal tembaga (34:12 dan 18:96); rujukan kepada mineral bernilai (22:23); (76:15-16), (55:22-23) dan (55:58-59).

Kalangan ahli mineralogi Islam adalah seperti berikut:- Al-Kindi, Al-Jahiz, Nasr Ibn Yakin Al-Dinawari, Muhammad Ibn Zakariyya Al-Razi, Mohd Ibn Ahmad Al-Tamimi, Ibn Sina, Al-Biruni, Maslamah Ibn Waddah Al-Qurtubi, Al-Majriti, Abdul Abbas Al-Tifashi, Nasr Al-Din Al-Tusi, Abdul Qasim Al-Qazani, Qazwini, Hamdallah Mustaawfi, Shams Al-Din Al-Akfami, Ibn Al-Akhir, Ibn Al-Jawzi dan Daud-Antaki, (Rahman, A., 1981: 139-142).

Di dalam Islam, mineralogi mempunyai kaitan yang amat rapat dengan kimia, kaji logam serta perubatan. Hasil-hasil kerja yang berkaitan dengan mineralogi selalunya merupakan lapideri dengan banyak juga rujukan kepada petrografi dan kajilogam. Perkataan 'hajar' (batu) sering digunakan sebagai tajuk kepada berbagai-bagai lapideri dan juga merujuk kepada "Batu Ahli Falsafah" dan oleh yang demikian merupakan satu istilah petrografi dan kimia (Nasr, 1976:53).

Banyak karangan yang penting tentang mineralogi dan bidang-bidang yang berkaitan telah sampai kepada orang-orang Islam dari orang-orang Parsi, India dan Grik. Karangan-karangan yang telah ditulis oleh ahli-ahli sains dan sarjana-sarjana Muslim tentang mineralogi serta bidang-bidang yang berkaitan telah bermula di dalam abad kesembilan Masehi, dengan dua karya oleh ahli falsafah dan ahli sains bernama Al-Kindi. Beliau telah mengarang "Risalah Fi anwa' al-jawahir al-thaminah wa ghayriha" (Huraian Mengenai Berbagai-bagai Batuan Permata Yang Bernilai Dan Jenis-jenis Batuan Yang Lain) dan "Risalah fi anwa' al-hijrah wa'l jawahir" (Huraian Mengenai Berbagai bagai Jenis Batuan Dan Batu Permata). Al-Kindi juga telah menulis satu karangan yang paling mengenai bidang kajilogam dan seni membuat pedang. Karya-karya ini telah diikuti oleh yang lain-lain (iaitu tentang batuan dan mineral) seperti yang telah ditulis oleh al-Jahiz, Nasr ibnu Ya'qub al-Dinawari, ahli falsafah dan tabib Muhammad ibnu Zakariyya al-Razi. Ikhwan al-safa pula telah menulis tentang mineralogi di dalam salah satu daripada epistal mereka, dan Muhammad ibnu al-Tamini telah menulis "Kitab al-Murshid" (Buku Panduan). Ia merupakan sebuah kitab yang utama tentang mineral-mineral, batuan-batuan dan logam dan selalu dirujuk oleh penulis-penulis selepasnya, (Nasr, 1976:53).

Akan tetapi, karangan-karangan yang terpenting sekali di dalam bidang geologi umumnya ialah yang telah dihasilkan oleh Ibnu Sina dan Al-Biruni. Di dalam bukunya al-Shifa (Buku Tentang Penyembuhan), Ibnu Sina telah membincangkan dengan panjang lebar tentang proses-proses pembentukan dan keterangan logam-logam dan mineral-mineral serta pengelasan masing-masing. Di dalam bukunya yang kedua iaitu kitab Ganun (Kitab Kanun), beliau ada juga membincangkan tentang mineral-mineral.

Al-Biruni pula telah menulis "Kitab al-jamahir fi marifat al-jawahir" (Buku Tentang Berbagai Ilmu Mengenai Batu-Batu Permata Berharga) yang dianggap sebagai karangan orang-orang Muslim yang terbaik atau terpenting sekali di dalam bidang ini. Di dalam karangan yang unik ini al-Biruni telah menggabungkan pendekatan-pendekatan falsafah, mineralogi, fizik dan perubatan mengenai batuan-batuan. Dia juga telah memberikan berat spesifik mineral-mineral tadi. Al-Biruni juga telah membuat cerapan geologi yang terpenting yang pernah dibuat oleh ahli geologi Muslim. Melalui cerapannya, beliau telah dapat mengenal-pastikan, Dataran Genges (India) sebagai satu mendapan enapan. Setelah mengkaji dengan meluas segala aspek negeri India termasuk persekitaran tabiinya, al-Biruni telah menulis di dalam bukunya yang berjodol "Tahqiq Malil-hind" (India). Antara kandungannya adalah lebih kurang seperti berikut:-

> "Satu daripada dataran-dataran di India iaitu yang disempadani di selatannya oleh Lautan India dan di tiga tepian oleh gunung-gunung yang tinggi, yang daripadanya mengalir air. Tetapi jika anda melihat tanah (dataran) di India dengan mata anda sendiri dan memikirkan keadaannya, jika anda memikirkan tentang batuan-batuan bulat yang didapati di dalamnya tidak kira berapa dalam kita mengorek tanah tersebut, batuan-batuan yang besar ukurannya berada berhampiran dengan gunung-ganang di tempat sungai-sungainya mempunyai arus yang deras, sementara semakin jauh dari gunung-ganang tempat sungai-sungainya mengalir lebih perlahan, batuan-batuannya lebih kecil dan kelihatan hancur (halus) di dalam bantuk pasir dengan sungai-sungai tadi mula bertakung berhampiran dengan kuala di tepi laut. Jika anda memikirkan kesemuanya ini, anda tidak akan gagal berfikir bahawa India pada suatu masa dahulu adalah sebuah laut, yang dengan perlahan-lahan telah ditimbuni oleh lanar dari sungai-sungai" (Nasr, 1976)."

Al-Biruni juga mendapati bahawa alam ini bukanlah bersifat abadi tetapi senantiasa bertukar dan menganggap bahawa tidak mungkin untuk seseorang menentukan umurnya dengan tepat. Mungkin katanya umur bumi ini berjuta-juta tahun lamanya (berbanding dengan 6000 tahun yang dikatakan ahli-ahli teologi Kristian dalam abad keenam belas). Dia bersetuju dengan Aristoteles bahawa pada asalnya mungkin bumi ini berada di dalam bentuk cecair. Dia menganggap ia bulat, walhal ketika itu hampir seluruh dunia yang lain menganggapnya leper, dan menyedari akan teori geosentrik (bumi sebagai pusat alam). Teori-teori al-Biruni mengenai umur dunia yang lama, berasal dari cerapan geologinya tentang transformasi geologi yang merujuk kepada zaman-zaman perubahan yang panjang, iaitu bumi kita ini sudah tua usianya (lebih daripada 416 juta-juta tahun menurut sains moden). Beliau membandingkan peninggalan-peninggalan batuan dan fosil yang ditemuinya di dataran-dataran Arabia, Jurjan dan Khwarizun di sepanjang laut Caspian dan membuktikan kewujudan laut di tempat-tempat ini pada suatu masa yang silam walaupun tidak ada rekod-rekod sejarah mengenainya (Hakim Mohamad Said Ansar Zahid Khan, 1981:154-155).

Al-Biruni juga telah mengukur lilitan bumi dengan menggunakan kaedah trigonometri. Ini diterangkannya di dalam "Kitab al-Asturlab", dan telah juga menulis risalah-risalah khas "Maqalah fi Istikhraj qadr al-arb ba rasad inhitat al-ufq an qalil al-jibal" mengenai aspek-aspek geodesi. Malah al-Biruni sekarang dianggap sebagai peneroka (bapa) geodesi. (Hakim Mohamad Said Ansar Zahid Khan, 1981:165).

Dalam zaman yang sama dengan al-Biruni, pengkajian mineralogi juga telah muncul di Maghrib (Afrika Utara) di dalam akhir abad kesepuluh dan kesebelas, yang pada ketika itulah Maslamah ibnu Waddah al-Qurtubi al-Majriti telah menumpukan satu bahagian yang besarnya kepada mineral di dalam "Rawdat al-hada ig wa ri yad al-haqa iq" (Taman-taman di antara Taman-taman dan Padang Kebenaran). Al-Masudi (951 M) di dalam bukunya yang telah diterjemah kepada bahasa Inggeris sebagai "Meadows of Gold" (Padang-padang Emas) telah menerangkan fenomenon gempa bumi dan perairan Laut Mati. Ahli sufi Andalusia yang mashyur iaitu Ibnu Arabi juga telah menumpukan perhatian terhadap mutu-mutu esoterik batuan di dalam bukunya "Tadbirat al-ilahiyyah fi islah mamlukat al-insaniyyah" (Cara-cara Tuhan Memperbaiki Keadaan Manusia).

Kerja-kerja di dalam bidang mineralogi telah disambung di dalam abad kedua belas dan ketiga belas dengan karangan-karangan yang telah dibuat oleh sarjana-sarjana Islam seperti Abu'l-Abbas al-Tifashi. Nasir al-Din al-Tusi dan Abu' l-Qasim al-Qasani. Begitu juga penyusun-penyusun ahli-ahli kosmografi yang berikutnya seperti al-Qazwini, Hamdallah Mustawfi, Shams al-Din al-Akfani, ibnu al-Athir, ibnu al-Jawzi dan Daud al-Antaki, kesemuanya telah menumpukan sebahagian daripada penulisan mereka kepada mineralogi (Nasr, 1976:54).

Setelah dunia Islam terbahagi kepada beberapa empayar, kerja-kerja di dalam bidang ini berterusan dan selalunya mempunyai sifat tempatan tetapi masih lagi berdasarkan sumber-sumber sebelumnya. Di dalam abad kelima belas ahli sains Parsi yang tinggal di India iaitu Muhammad ibnu Mansur Shirazi telah menulis di dalam bahasa Parsi sebuah buku mengenai batu-batu berharga, dan di dalam abad kelapan belas Syakh Ali Hazin yang telah berpindah ke India telah menyambung tradisi itu.

Di Maghrib, Imam Ahamad al-Maghribi telah menulis tentang perkara yang sama. Tradisi ini, iaitu mengaitkan mineralogi, kimia dan perubatan telah berterusan hingga ke hari ini di dalam bentuk perubatan desa di dalam penggunaan barang-barang kemas, dan di dalam aspek-aspek kehidupan seharian.

Penulisan tentang mineral oleh para ahli sains Muslim telah juga menarik minat orang-orang di Barat. Yang sangat tertarik hati terhadapnya ialah Raja Alfonso X elsabio di Castile. Beliau telah menulis lapideri mengikut model orang-orang Islam (Schacht and Bosworth, 1974:453).

Lapideri-lapederi Muslim ini adalah berdasarkan sebuah pandangan alam yang berbeza dari sains moden dan tidak boleh difahami jika hanya dilihat dari perspektif sains yang kuantitatif semata-mata. Di dalam karya-karya ini aspek-aspek kualitatif batuan tersebut sama juga penting dan nyatanya dengan aspek-aspek kuantitatifnya.

Menurut Nasr (1979:54), sains dengan sifat-sifat benda tidak terkongkong kepada pemikiran orang-orang Islam terhadap apa yang diukur sahaja, walaupun ini merupakan salah satu aspek yang sangat penting. Bahkan sains tentang sifat-sifat benda (ilmu khawass al-ashya) yang sangat berkait rapat dengan mineralogi, adalah berdasarkan kepada fahaman tentang kenyataan yang menganggap bahawa aspek-aspek di luar dan di dalam, yang dapat dilihat dan yang tersembunyi, tiap-tiap benda, semuanya adalah nyata dan bertindak bersalingan antara satu sama lain dan dengan manusia di dalam sebuah alam yang senantiasa dihidupkan oleh Tuhan.

3.2 <u>Kosmogoni, Kosmologi</u>

Orang-orang Islam juga telah mula-mula menerangkan tentang sejarah pembentukan bumi (kosmogeni) di dalam tritis kasmografi, misalnya. Mengikut sains, proses pembentukan bumi boleh dibahagikan kepada beberapa tahap bermula dari masa matahari serta planet-planet lain berada di dalam bentuk nebula sehinggalah kepada kemunculan benda-benda hidupan di dalam laut dan kemudian daratan. Besar kemungkinannya ahli sains Islam juga mengetahui tentang hakikat ini kerana di dalam Al-Quran sendiri sudah ada petanda-petanda yang terang dan jelas mengenainya. Contoh-contoh ayat yang penting ialah:

(1) Sesungguhnya Tuhan kamu ialah Allah yang telah menciptakan langit dan bumi dalam enam (6) masa, lalu Dia bersemayam di atas 'arasj." (Al-A'raq 7:54).

(2) "Allah yang menciptakan bumi dan langit yang tinggi" (Taha 20:4), dan

(3) "(Tuhan) yang menciptakan langit dan bumi dan apa yang ada di antara kedua-duanya di dalam enam masa, kemudian, Dia bersemayam di atas 'arasjnya ..... (Al-Furqan 25:59).

Jadi, di dalam konteks ini dapatlah dikatakan bahawa orang-orang Islam telah mendahului teori asal-usul bumi yang moden.

3.3 <u>Perlombongan</u>

Sektor perlombongan dan kuari juga telah lebih dahulu diterokai oleh orang-orang Islam sebelum zaman perindustrian. Perlombongan yang biasa diketahui adalah lombong-lombong yang didapati di Sepanyol. Hasil-hasil dari lombong-lombong tersebut termasuklah emas, perak, tembaga, besi dan raksa. Industri perlombongan ini telah diperbaiki oleh orang-orang Islam setelah terbiar di bawah pemerintahan orang-orang Goth. Idrisi, ahli geografi Islam yang termashyur telah pernah melawat ke beberapa lombong dan menulis tentangnya di dalam abad kedua belas (Immamuddin, 1965:102).

Kuari-kuari di Sepanyol juga kaya dengan batuan marmar dan batuan lain yang digunakan untuk binaan bangunan-bangunan. Di Cazalla di Elvira, sejenis marmar putih yang lembut boleh didapati. Ia telah digunakan untuk membuat bekas-bekas, patung-patung dan lain-lain. Lain-lain marmar termasuklah bertompok, merah dan kuning.

4. Kesimpulan

Pada keseluruhnya, sumbangan dan pengaruh ahli-ahli geologi Islam tidak dapat dilupakan begitu sahaja. Sumbangan-sumbangan yang nyata termasuklah bidang-bidang geologi khususnya, seperti mineralogi. Pakar-pakar terpenting geologi Islam ialah Al-Biruni, Ibnu Sina, Al-Kindi dan Ikhwan al-Safa.

5. BIBLIOGRAFI

1) AL-QURAN

2) Arnold, T and Guillaume, A., (1968). "The Legacy of Islam", Oxford University Press.

3) Hakim Mohd. Said Ansar Zahid Khan, (1981). "Al-Biruni", Hamdard Academy, Hamdard Foundation, Pakistan.

4) Immamuddin, S.M., (1965). "Some Aspects of Social, Economic and Cultural History of Muslim Spain", E.J. Brill, Leiden.

5) Nasr, S.H., (1968). "Science and Civilisation in Islam", Harvard University Press, Mass.

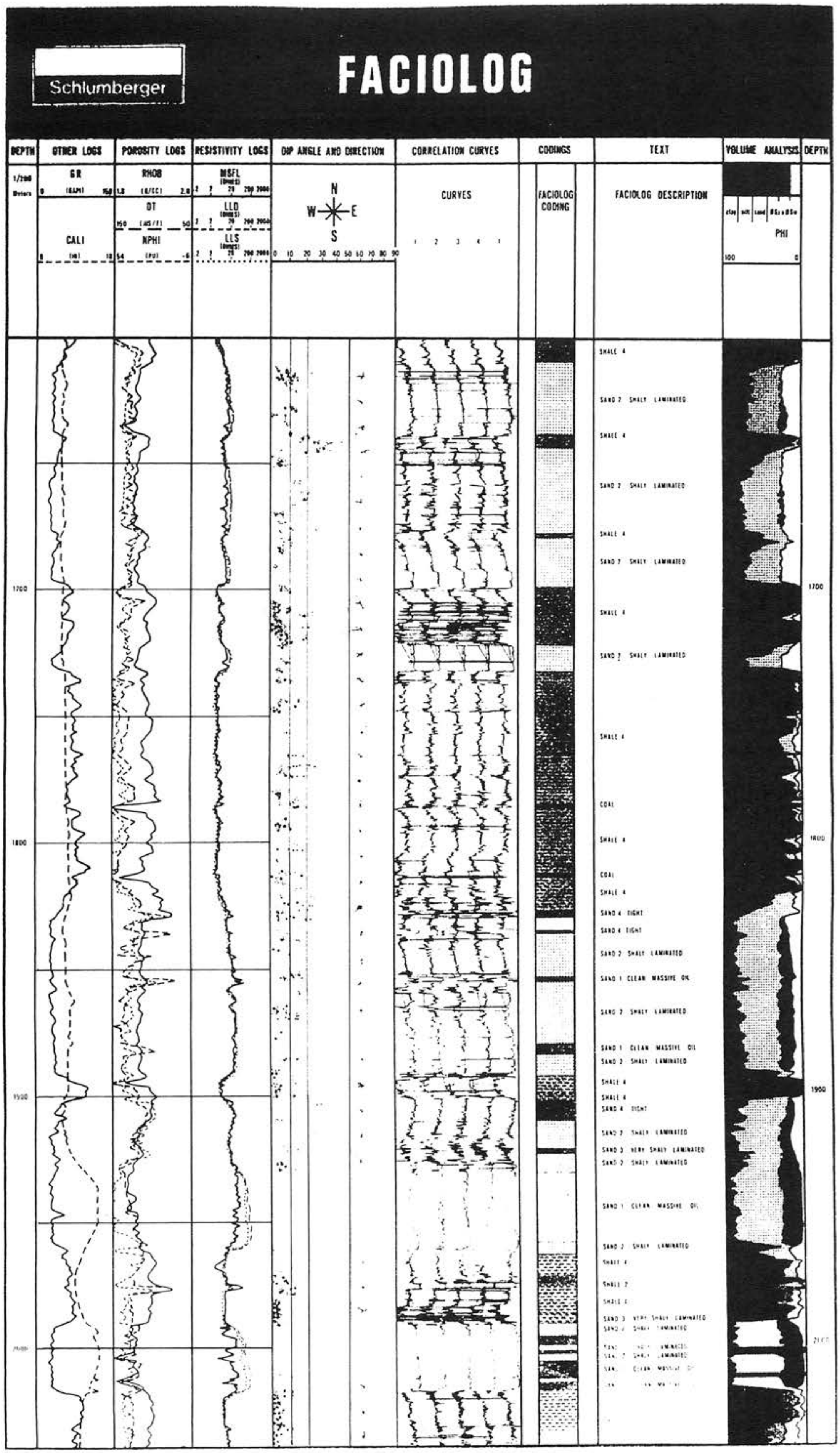
6) Nasr, S.H., (1978). "An Introduction to Islam Cosmological Doctrines", Thames and Hudson.

7) Rahman, Azfalur, (1981). "Quranic Sciences", Pustaka Nasional, Singapore.

8) Rosenthall, F., (1975). "The Classical Heritage in Islam", Routledge Kegam Paul, London.

9) Schacht, J. and Bosworth, (1974). "The Legacy of Islam", Oxford Clarendon Press.

Manuskript diterima 5 Mei 1983



Wireline logging data is finding wider applications in sedimentology. This began with the study of log curve shapes to identify different depositional sequences. Recent developments have led to the use of logs to identify "electrofacies"—that is, a set of log responses that characterizes a sediment and distinguish it from others. The objective is to associate a certain type of lithofacies defined by core data with a set of log responses so that such a lithofacies can be identified in other wells without core data. This can also be used to guide the choice of interpretation model and in well to well correlations.

PERTEMUAN PERSATUAN
(MEETINGS OF THE SOCIETY)

WORKSHOP ON STRATIGRAPHIC CORRELATION OF THAILAND AND PENINSULAR MALAYSIA - A REPORT

Plans for holding the Workshop were first mooted as far back as June 1981. It was only now, after several unsuccessful attempts, that the Workshop was finally realized and held at Haadyai, Thailand in the Lee Gardens Hotel from the 8th to the 10th of September 1983.

The Workshop was organized jointly by the Geological Society of Thailand (G.S.T.) and the Geological Society of Malaysia (G.S.M.) in cooperation with the Ministry of Science, Technology and Energy of Thailand, Department of Mineral Resources of Thailand, Geological Survey of Malaysia, Association of Geoscientists for International Development, Prince of Songkhla University, Chulalongkorn University and the University of Malaya.

This Workshop was an attempt to bring together geoscientists who either work or are interested in the areas in order that they can for the first time focus their attention on the stratigraphic and related problems of the border areas between the two countries. The objectives of this Workshop were:

1. To review current knowledge of the stratigraphy of the two countries.
2. To establish, as far as possible, the formal stratigraphic units, their regional aspects, and sequences in the border areas.
3. To attempt the correlation of stratigraphy of the two countries.
4. To acquaint geoscientists of the region with the stratigraphy of Thailand and Peninsular Malaysia.
5. To provide a venue for geoscientists and interested persons to exchange ideas and experiences.
6. To define research needs in the regional stratigraphy.

The first two days were devoted to key-note papers from each country covering the Palaeozoic, Mesozoic, Cenozoic/Quaternary stratigraphy and Magmatism/Metamorphism; followed by Tectonic/Geologic Evolution keynote papers. Supporting papers relating to stratigraphy were also solicited and slotted under the respective headings mentioned above. Other miscellaneous papers presented on the third day were related to various aspects of the border geology.

At the end of each day's presentation, a panel session and a workshop meeting was held to come out with problem-defining and decision-making conclusions regarding the stratigraphy of the two countries.

The opening ceremony of the Workshop saw a welcoming address by His Excellency the Governor of Songkhla and an opening address by Mr. Vija Sethaput, former Director-General of the DMR. The Workshop was attended by about 120 geoscientists from Thailand, 25 from Malaysia and also participants from Singapore, Australia and Indonesia.

A buffet dinner, hosted by the Rector of the Prince of Songkhla University and the GST was given on the evening of the first day. A farewell dinner, hosted by GSM was given on the third day.

A 383 page volume of the proceedings of the Workshop containing the technical papers was distributed to each participant on registration. A second volume containing late papers and Workshop discussions will be printed for distribution soon. All together, a total of 28 technical papers were presented.

A post-Workshop field trip to the Songkhla and surrounding area was held on the fourth day. Two other field trips to Phuket and Langkawi were cancelled due to poor response. The following was the programme of the Workshop:

Workshop on stratigraphic correlation of Thailand and Malaysia
8-10 September, 1983.

Program

Thursday; 8 September, 1983.

8.00 - 8.30	: Registration	
8.30 - 9.00	: Opening ceremony	
	Master of ceremony	: Chongpan Chonglakmani
	Welcoming address	: The Governor of Songkhla
	Report of the Workshop	: Sangad Bunopas
	Opening address	: Vija Sethaput
Subject	: Paleozoic stratigraphy	
	Chairman	: K.K. Khoo
	Rapporteur	: M.A. Hasan
9.00 - 9.40	: The Paleozoic sedimentary rocks of Peninsualr Malaysia-Stratigraphy and correlation : Foo Khong Yee	
9.40 - 10.00	: Stratigraphy of the Tarutao and Machinchang Formation : to be read by B.K. Tan	
10.00 - 10.30	: Coffee Break	
	Chairman	: C. Khantaprab
	Rapporteur	: Yeow Yew Heng
10.30 - 11.00	: Paleozoic succession in Thailand : S. Bunopas	
11.00 - 11.30	: Correlation of the Ordovician of Tarutao Island (Thailand) and Langkawi Islands (Malaysia) : T. Wongwanich, D. Wyatt, B. Stait and C. Burrett	
11.30 - 11.50	: Middle Paleozoic Rocks in Peninsular Thailand : W. Tantivanich, L. Raksaskulwong and N. Manthajit	
11.50 - 13.30	: Lunch	
Subject	: Mesozoic stratigraphy	
	Chairman	: S. Bunopas
	Rapporteur	: Wan Fuad
13.30 - 14.00	: Mesozoic stratigraphy in Peninsular Malaysia : Khoo Han Peng	
14.00 - 14.30	: Marine Mesozoic stratigraphy of Thailand : C. Chonglakmani	
14.30 - 15.00	: Continental Mesozoic stratigraphy of Thailand : N. Sattayaruk	
15.00 - 15.30	: Coffee Break	

Subject	: Panel discussion on Paleozoic & Mesozoic Stratigraphy of Thailand-Malaysia Chairman : Aw Peck Chin Rapporteur : Yeap E.B. Panelists : Speakers of the above sessions
18.30	: Reception Buffet

Friday; 9 September 1983.

Subject	: Cenozoic stratigraphy Chairman : Foo Khong Yee Rapporteur : S.S. Almashoor
9.00 - 9.40	: Cenozoic stratigraphy of Peninsular Malaysia : T. Suntharalingam
9.40 - 10.30	: Reviews of the Cenozoic stratigraphy of Thailand: P. Chaodumrong and N. Thiramongkol
10.30 - 11.00	: Coffee Break
Subject	: Cenozoic stratigraphy (cont.) Chairman : T. Thanasuthipitak Rapporteur : A.S. Gan
11.00 - 11.20	: A short note on Quaternary geology of the Haad Yai-Songkhla area, Southern Thailand : H. Sawata, G. Trebuil, A. Tanchotikul and R. Darnsawasdi
11.20 - 11.45	: The coastal alluvial plain of Kelantan - Its hydrogeological significance : Ismail M. Noor
11.45 - 13.15	: Lunch
Subject	: Igneous and metamorphic rocks Chairman : P. Nutalaya Rapporteur : Khoo Han Peng
13.15 - 13.40	: Review of felsic plutonic rocks of Thailand: V. Pisutha-Arnond, P. Charusiri and W. Pongsapich
13.40 - 14.05	: A review of plutonic rocks with intermediate-ultrabasic compositions and volcanic rocks : Y. Panjasawatwong and W. Yaowanoiyothin
14.05 - 14.30	: Reviews of metamorphic rocks of Thailand : P. Charusiri, S. Vedchakanchana, and W. Pongsapich
Subject	: Geologic evolution of the Thai-Malay Peninsula
14.30 - 15.10	: Geologic evolution of Peninsular Malaysia : 1) T.T. Khoo and 2) B.K. Tan
15.10 - 15.40	: Coffee Break
Subject	: Geologic evolution of the Thai-Malay Peninsula (cont.) Chairman : Leong Khee Meng Rapporteur : K.K. Khoo
15.40 - 16.10	: Mineralization pattern of the northwest part of Peninsular Malaysia : E.B. Yeap
16.10 - 16.15	: Facies and stratigraphy of the Lower - Lower Middle Permian strata of the Petchabun fold belt in Central Thailand to be read by C. Chonglakmani
16.15 - 16.35	: Tectonic and geologic evolution of Thailand : S. Bunopas and P. Vella
16.35 - 17.30	: Discussion on papers presented

Plate 1: Khoo Han Peng delivering paper on Mesozoic Stratigraphy

Plate 2: Palaeozoic Correlation Group meeting

Saturday; 10 September 1983.

9.00 - 10.20 : Geologic history of the Thai-Malay Peninsula - A panel discussion
Chairman : T. Suntharalingam
Rapporteur : E.B. Yeap
Panelists : T.T. Khoo, B.K. Tan
S. Bunopas, C. Chonglakmani

10.20 - 10.50 : Coffee Break

Subject : Aspects of geology and mineral resources of the border area
Chairman : W. Pongsapich

10.50 - 11.15 : Mineralogy and geochemistry of pegmatitic cassiterites from Gunung Jerai, Kedah : Wan Fuad Wan Hassan
11.15 - 11.35 : The Wang Phar wolframite Mine (South Thailand) : Tan Say Biow
11.35 - 11.55 : Geology and mineral resources of Songkhla Province, Thailand : T. Pungrassami
11.55 - 13.30 : Lunch

Subject : Aspects of geology and mineral resources of the border area (cont.)
Chairman : Pakdi Thanvarachorn

13.30 - 13.50 : SIR A - A shuttle imaging radar strip over south Thailand and northeast Peninsular Malaysia : B.N. Koopmans and S. Muenlek
13.50 - 14.10 : Geoelectrical survey at the Phuket Mining Co., Ltd., Tumbon Lidon, Changwat Yala : D. Phongsmas
14.10 - 14.35 : Regional gravity surveys in Peninsular Malaysia - with special emphasis on Northwest Peninsular Malaysia : M.H. Loke and C.Y. Lee
14.35 - 15.00 : Hydrologic and hydrogeologic characteristics of North-western Peninsular Malaysia : Mohamad Ali Hasan
15.00 - 15.30 : Coffee Break

Chairmen : T.T. Khoo, Prinya Nutalaya
K.K. Khoo, Sangad Bunopas

15.30 - 15.50 : Geology of Haad Yai and its environs : Thongchai Pungrassami
15.50 - 16.50 : Open discussion Conclusion & Recominendate
16.50 - 17.00 : Closing ceremony
18.30 : Farewell Dinner

Sunday; 11 September 1983.

6.00 - 18.00 : Post workshop field trip in Songkhla area

K.K. Khoo

******

Stratigraphic Correlation of Thailand and Malaysia Workshop
Geology of Songkhla and its environments Field Trip - 11 September 1983

A rather multinational group of Workshop participants made up of Y. Nakashima, D. Djunuddin, S. Johari, B. Stait, C.K. Burton, G. Knox, M.J. Newport, J. Kheokas, N. Kheokao, T. Sirinawin, V. Sethaput, Y.H. Yeow, A.S. Gan, B.K. Tan and T.T. Khoo participated in the field trip. It was ably led by Mr. Thongchai Pungrassami of the Prince of Songkhla University, Hatyai. The itinerary was as follows:

Stop 1. Highway 43 Quaternary gravel beds (about 8 km from town) unconsolidated pebble, sand, silt, clay, pebbles of sandstone and few quartz, 5 - 15 cm in size.

Stop 2. Thung Pho Mine (about 20 km from town). Carboniferous sandstone and shale are intruded by late Triassic to early Jurassic granitic stock. Cassiterite disseminations occur in the cupola of fine- to medium-grained leucogranite which is intensely altered by pneumatolytic process. Kaolinization and sericitization can be seen in granite. Torbernite is locally found along fractures.

Stop 3. Khao Mi Kiat Triassic conglomerate (km 9.5 from Ban Khlong Ngae junction, south of Highway 42). Conglomerate exposes as cliff, ca. 30 m alternating with sandstone, siltstone, and shale. Cross-bedding and graded bedding can be seen.

Stop 4. Daonella fossil locality (km 14 from Ban Khlong Ngae on Highway 42). Exposure of thin-bedded alternating sandstone, siltstone, and shale. Fossils of Daonella are preserved in shale.

Stop 5. Lunch at Ban Pak Bang, Amphoe Thepa, a fishery village about 13 km east of Amphor Chana.

Stop 6. Carboniferous interbedded argillite and chert. Along Highway 408 to Songkhla town, on the left (west) of the road.

Stop 7. Khao Kao Seng granite (Late Triassic to early Jurassic). On the right (east) of the Highway 408, a quarry exposure of medium- to coarse-grained porphyritic biotite granite.

Stop 8. Khao Noi (a hill 60 m from sea level). View of Samila Beach, sand accretion growing northwestward by longshore current.

Stop 9. Samila Beach.

Stop 10. Nam Noi granite quarry (11 km from Hat Yai). Hornfel xenolith ca. 30 cm in length and 3-4 m in width is enclosed by medium-grained biotite granite.

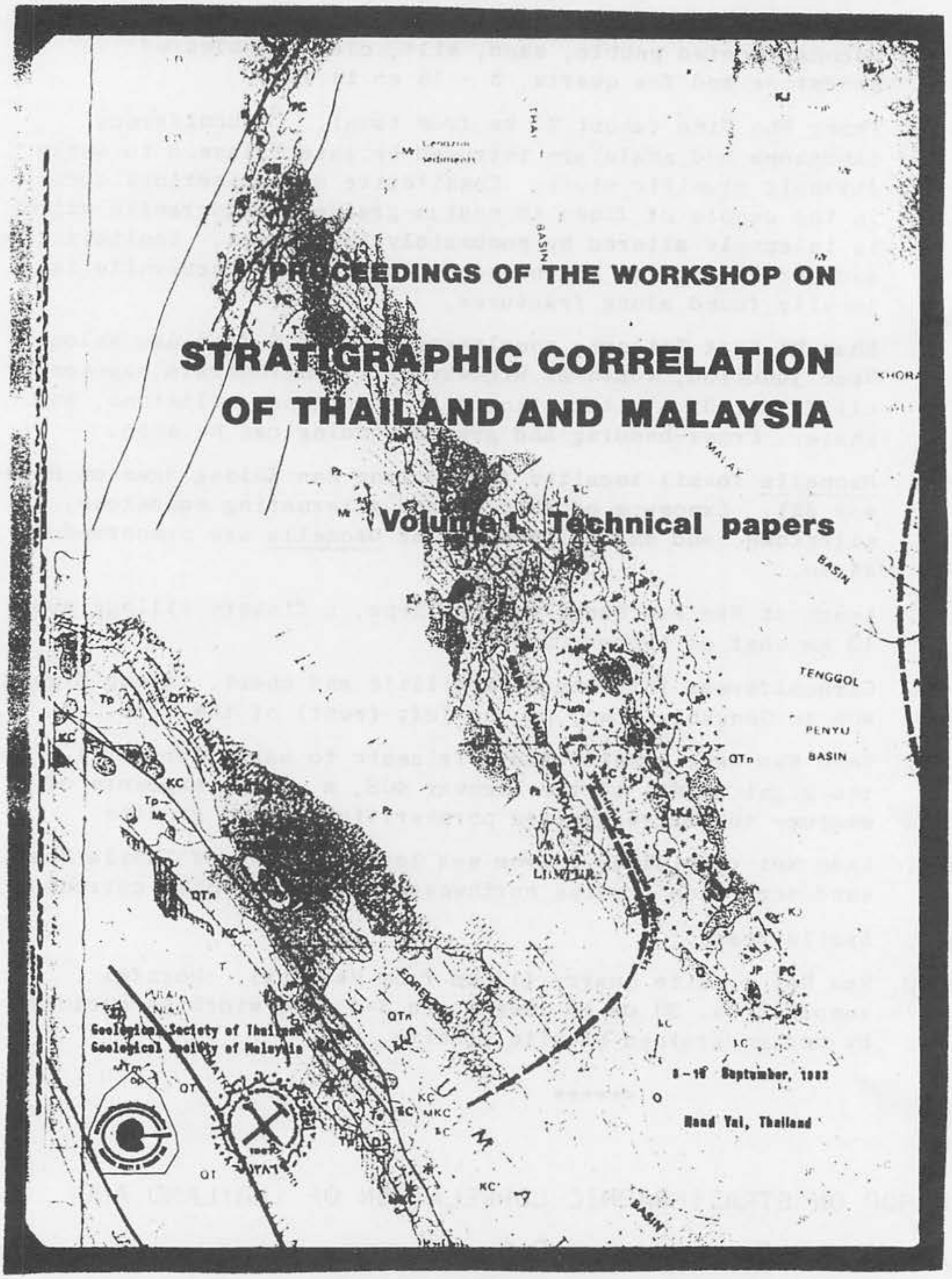
******

WORKSHOP ON STRATIGRAPHIC CORRELATION OF THAILAND AND MALAYSIA - ABSTRACTS OF PAPERS

The Palaeozoic Sedimentary Rocks of Peninsular Malaysia - Stratigraphy and Correlation

Foo Khong Yee, Geological Survey of Malaysia, Ipoh, Perak, Malaysia

A well-represented sequence of Palaeozoic rocks ranging in age from Cambrian to Permian is found in Peninsular Malaysia. Two sedimentation regimes are recognized based on their different periods of initial sedimentation; a western regime to which Lower Palaeozoic



The above Proceedings is obtainable from:

The Assistant Secretary,
Geological Society of Malaysia,
University of Malaya,
Kuala Lumpur

at M$12.00 for members and M$25.00 for non-members.

strata are confined and where a conformable Cambrian-Permian succession is evident in the Langkawi, Perlis and Kedah area and an eastern regime where Carbo-Permian strata crop out in the central and eastern parts of the peninsula.

On the basis of their stratigraphic record and characteristics the western regime is subdivided into the northwestern zone and western zone and the eastern regime into the central zone and eastern zone. Representative lithostratigraphic units of the northwestern zone are the Machinchang formation, Setul formation, Mahang formation, Kubang Pasu formation and the Chuping limestone. Those of the western zone are represented by the Baling group, Bentong group, Kinta limestone, Kati formation, Kenny Hill formation, Dinding schist, Hawthornden schist and Kuala Lumpur limestone; those of the central zone by the Raub group, Kepis formation and Taku schist and those of the eastern zone by the Kuantan group.

The earliest sedimentation began during Late Cambrian in the western regime and sedimentation was more or less continuous till the Permian in the northern part of the regime. An unconformity has been reported separating Upper Palaeozoic Kenny Hill formation from the Silurian Kuala Lumpur limestone and Hawthornden schist in the southern part of the regime. In the eastern regime, shallow marine sedimentation commenced in Early Carboniferous and probably continued uninterrupted till Late Permian. However, the central zone of the regime differed from the eastern zone in the accumulation of abundant volcaniclastics in the later stages of sedimentation while the eastern zone remained tectonically more stable and was characterized by more clastic sedimentation. Uplift of the eastern zone took place towards the end of the Permian whereas sedimentation continued in the tectonically unstable central zone into the Mesozoic.

******

Stratigraphy of the Tarutao and Machinchang Formations

Lee, C.P., Department of Geology, University of Malaya, Kuala Lumpur, Malaysia

The Cambro-Ordovician Tarutao and Machinchang Formations each consists of about 3000 m of predominantly clastic deposits which are part of the miogeosynclinal shelf sediments of the southern Yunnan-Malayan Geosyncline. These two equivalent formations have no known base and each can be differentiated into three members (i.e. lower, middle and upper) with the middle member further subdivided into three submembers.

The lower member (450 m+ in Tarutao; 1620 m+ in Langkawi) is a coarsening upward sequence of rhythmically interlayered graded siltstones and mudstones interbedded with thicker bedded clayey sandstones. Rare cross-bedding, small load structures, ripple marks, slumped bedding and small burrows are found in this member. This member is interpreted to be an offshore shelf deposit affected by occasional storms.

The middle member consists of abundantly cross-bedded, medium to thick beds of coarse to fine sandstones, conglomerates and rare coarse acid tuffs and fine heavy mineral bands in its lower submember (500 m+ in Tarutao; 575 m in Langkawi) which is interpreted as

estuarine channel lag deposits cutting upper shore face deposits. The middle submember (700 m+ in Tarutao; 340 m in Langkawi) is of thin to medium, wavy-bedded, fine to medium grained cross-bedded sandstones with occasional pebbly, argillaceous and fine tuffaceous intercalations. It is interpreted as an upper estuarine facies. The upper submember (750 m in Tarutao; 700 m+ in Langkawi) is of fine to very fine grained, thick straight-bedded sandstones with thin to thick intervals of very fine acid tuffs and is increasingly arqillaceous up-section. The sandstones are usually parallel laminated or low angle planar cross-bedded with occasional heavy mineral and fragmentary trilobite and brachiopod fossil bands. This submember is interpreted as upper shore face to beach deposits belonging to a series of barrier-beach complexes.

The upper member (575 m in Tarutao; 420 m in Langkawi) is a fining upward sequence of siltstone, mudstone (some tuffaceous) and very fine sandstone with minor thin limestone intercalations. Trilobite and brachiopod fossils of Uppermost Cambrian to Lowermost Ordovician age and various types of shallow-marine trace fossils are present in this member. It is interpreted as an open back-barrier lagoon deposit. It grades upwards into the shelf limestones of the Setul and Thung Song Formations.

The overall interpretation of the facies sequence is that of a high-destructive, wave-dominated delta which had built over an offshore shelf deposit to produce a series of barrier-beach sands aligned parallel to the shore line with subdued channel sands cutting across them.

******

Paleozoic Succession in Thailand

Sangad Bunopas, Department of Mineral Resources, Bangkok 10400, Thailand.

The whole sequence of Paleozoic rocks which mainly of marine origin are outcropping outside the Khorat Plateau, both in Shan-Thai and Indochina microcontinents, or cratons. The Cambrian and Ordovician outcrops are closely associated with the Precambrian in the Western Belt, on the Shan-Than cratonic fragment. The total thickness of Cambro-Ordovician sandstone and limestone exceeds 1,600 m.

Silurian-Devonian rocks are differentiated into several facies belts from west to east. Fossiliferous carbonate shelf facies and continental derived clastic shale and snadstone of graptolite-tentaculite facies conformably overly Ordovician limestone and conformably underly Upper Paleozoic rocks outcrop in the lower Peninsula and west of the Western Mountains from Kanchanaburi to Mae Hong Son. East of the Western Mountains, the eastern Gulf, and in the Sukhothai Fold Belt, three facies belts are recognised; from west to east, 1, back-arc basin facies consisting of graptolitic black shale and bedded chert and occasional limestone are found at Fang, Lampang, east Kanchanaburi, Rayong, and Yala in the south Peninsula; 2, volcanic arc facies consisting of metavolcanics and metaagglomerate and fine grained tuffs crop out at Chiangrai, Lampang, Tak, Nakhon Sawan in north and western Thailand, at Rayong in the eastern Gulf *and probably at south Narathiwat in the Peninsula; 3, fore-arc, chiefly the arc-trench gap deposits consisting of marble, and bedded cherts occur at Sukhothai and Nakhon Sawan, and Rayong-Chantaburi in the eastern Gulf, and the trench facies consisting of flysch-like low grade metasediments are found at Nan, immediately west of the Pha Som Ultramafic Belt. Silurian-Devonian rocks at Loei which are the oldest Paleozoic outcrops of Indochina Craton on the Thai side consist of shelf sandstone, shale and limestone.*

Carboniferous rocks in the Sukhothai Fold Belt consist of varying lithologies and thickness from west to east in the West, the North, the eastern Gulf, and the Peninsula. At places marine shelf sedimentation continued in the west and flysch type sediments in the east, but with local unconformities. In the middle part of the fold belt pronounced unconformities on the Silurian-Devonian rocks are overlain by thick volcanic agglomerates and possibly marine red-beds underlying Lower Permian limestone. Carboniferous volcanic rocks are relatively rarer than in the Silurian-Devonian sequence and are represented by agglomerate and tuffaceous rocks with minor shallow acid to basic intrusive rocks near Phrae. West of the Western Mountains, west of the eastern Gulf and west of the Peninsula passive continental margin sediments continued into Carboniferous period and consisted of shale sandstone and minor chert beds, but local paralic red-beds occur. The mainly Carboniferous to Lower Permian pebbly mudstones occur further to the west. Carboniferous sediments which are fossiliferous in the upper part occur in the environs of Loei and Phetchabun and are thicker from east to west, changing from massive limestones to a more sandy shaly limestone facies.

Permian rocks are dominantly limestones. The limestones are possibly of different ages in the Western Mountains, the Sukhothai Fold Belt and the Loei Fold Belt. The Permian in the Sukhothai Fold Belt contains minor tuffaceous rocks. The Permian sequence in all areas are mainly Lower to Middle Permian. The early Upper Permian rocks, mainly shale, sandstone and thin limestone are found at places in Lampang, in the Sukhothai Fold Belt, and in the Loei Fold Belt at Loei and Phetchabun.

******

The Ordovician System in Southern Thailand and Northern Malaysia

Wongwanich, T., Geological Survey Division, Department of Mineral Resources, Bangkok 10400, Thailand; Wyatt, D., Stait, B., Burrett, C., Geology Department, University of Tasmania, Box 252C, Hobart, Tasmania, Australia, 7001.

A Middle-Upper Tremadocian trilobite fauna is found in the upper two member (T3-T4) of the siliciclastic Tarutao Formation of Tarutao Island (Thailand) and the T3 member may young towards the south of the island. Six carbonate units can be recognised in the conformably overlying Thung Song Formation. These units display a gradual deepening of the environment of deposition from peritidal in the Upper Tremadocian (Middle Ibexian) and Lower Argningian (Upper Ibexian) to open subtidal in the Middle Areningian (Lower Whiterockian). At least two of the lithological units can be recognised in Satun

Province (Thailand) and all of them occur to the west of the Gunong Raya Granite, Langkawi Islands (Malaysia) where they are metamorphosed to marble.

To the east of the Gunong Raya Granite the remaining 1100 m of the Lower Setul Limestone can be divided into 9 lithological units ranging in age from Tremadocian-Llanvirnian (Ibexian-Lower Whiterockian). The Lower 8 units represent peritidal conditions and only in the ninth is there evidence of basinal deepening. This last (105 m thick) unit may be of Llandilian (Upper Whiterockian) age or even younger and is overlain by the Silurian Lower Detrital Member. Biostratigraphic equivalents of the Lower Setul Limestone occur in peritidal dolomicrites in central and southern Thailand but no definite Llandeilian-Caradocian (Mohawkian) or Upper Ordovician fossils have yet been found in carbonates in central or southern Thailand or in Malaysia.

Mapping of individual carbonate units is recommended in order to delineate formations that are suitable and unsuitable for commercial exploitation especially those of potential significance to the cement manufacturing industry.

******

The Upper Palaeozoic Pebbly Rocks in Southern Thailand

W. Tantiwanit, L. Raksaskulwong, N. Mantajit, Department of Mineral Resources, Rama VI Road, Bangkok, Thailand.

The pebbly rocks in Thailand have been found widely distributed in the marine Kaeng Krachan Formation. Stratigraphically, the Kaeng Krachan Formation can be correlated to the Mergui Series and the Singa Formation of Burma and Malaysia respectively. They are typically exposed along the western part of the Thai Peninsula. The formation consists mainly of pebbly mudstones, laminated mudstones and turbidites. Being a significant features of the formation, the laminated mudstone is characterized by showing well-developed fine lamination with numerous scattered clasts which vary from pebble to boulder size. The composition of the clasts includes quartzite, limestone, granite and possible gneissic granite. In some localities they show an alternation of very fine grained layers and relatively coarser grained, poorly sorted layers with a number of clasts that show dropstone-like structure. The pebbly mudstones found associated with the laminated mudstone is petrographically characterized by being poorly sorted and containing clasts of granite, possible gneissic granite, slate, quartzite and limestone. Stratification is usually absent or indistinct in the pebbly mudstone, but is well-defined at Ko Pi Pi, south of Phuket Island. The size of clasts varies from pebble to boulder and the shape of the clasts ranges from subangular to well rounded. The number of subangular clasts is greater than that of subrounded and well rounded types. A few well polished and facetted cobbles have been collected. This pebbly mudstone is much like the rocks described as diamictite which are found in the Gondwana System in Australia, S. Africa, Brazil, Antarctica and India.

Turbidites in the Kaeng Krachan Formation clearly show load casts, graded bedding and slump structures. The formation is conformably overlain by the Permian Ratburi Limestone and contains *bryozoan and brachiopod fossils of lower Permian age near the top and some brachiopods considered to be upper Carboniferous age in the lower part. However, the base of the formation is still not known. These pebbly rocks are obviously of marine origin, and on the basis of the stratigraphy range from upper Carboniferous to lower Permian.*

In this paper the stratigraphy of various localities where the pebbly rocks have been found such as Kaeng Krachan, Takua Pa, Phang Nga, Ko Yao Noi, Krabi and Phuket Island are briefly discussed. In the light of the field evidence, stratigraphy and petrographical data, three major origins of the pebbly rocks in southern Thailand are feasible: (1) Turbidity current and slump deposits: (2) Ice rafted deposits: and (3) Tillite deposits. If they are glaciogenic, the glacial marine environment, particularly the distal glacial marine environment including the continental shelf and slope, would have played an important role in their deposition.

******

The Marine Mesozoic Stratigraphy of Thailand

Chongpan Chonglakmani, Geological Survey Division, Department of Mineral Resources, Bangkok 10400, Thailand.

The marine Mesozoic sediments are distributed extensively in Thailand. They consist of Triassic and Jurassic strata the latter of which is relatively more limited in distribution. The Triassic sequence has been recorded from Northern, Northwestern, Westcentral, Southeastern and Southern Thailand. Biostratigraphic subdivision based upon bivalves and ammonoids in the Lampang area proves the existence of Upper Griesbachian, Lower and Upper Anisian, Upper Ladinian, Lower-Upper Karnian, and Lower Norian sediments in Northern Thailand. The Jurassic sequence is only known in Northwestern, Westcentral and Southern regions. The ammonites and foraminiferas recorded from this sequence suggest that the marine sedimentation was almost complete from Lower to Upper Jurassic.

******

Review of the Continental Mesozoic Stratigraphy of Thailand

Nares Sattayarak, Mineral Fuels Division, Department of Mineral Resources, Bangkok 10400, Thailand.

The continental Mesozoic redbeds are widely distributed throughout the country, especially in the Khorat Plateau, from which the group's name was obtained. The rocks are predominantly red clastic, i.e., sandstone, siltstone, claystone, shale and conglomerate. The Khorat Group rests unconformably on older rocks, generally of Paleozoic age, but occasionally it overlies the Permo-Triassic igneous rocks and/or Lower to Middle Triassic sedimentary rocks.

The Khorat Group was previously reviewed in Thai by Nakornsri (1975) and in English by Kulasing (1975) and Ramingwong (1978). This paper is an attempt to update the knowledge so far reported about the Khorat rocks and theri equivalents.

******

Cenozoic Stratigraphy of Peninsular Malaysia

T. Suntharalingam, Geological Survey of Malaysia

The Cenozoic underlies slightly more than 20 percent of the land area of Peninsular Malaysia of which the majority of the sediments are Quaternary age (Figure 1). The Cenozoic in Peninsular Malaysia has been relatively stable tectonically with activity confined to epeirogenic uplift and tilting, some fault movements and localised gentle downwarps.

The known Cenozoic deposits vary in thickness but an average thickness of 10,000 m has been noted for sediments in the Malay Basin (DuBois, 1980). The offshore deposits are also included for discussion and correlation in view of their economic importance. Figure 2 gives the Cenozoic correlation chart for Peninsular Malaysia.

The Tertiary rocks are distributed either as isolated lacustrine basins between the Main Range and the west coast or underlie the Quaternary deposits in the lowlying coastal and offshore areas. Localised granitic and basaltic rocks of Tertiary age have also been mapped. The Quaternary deposits however consist mainly of unconsolidated to semi-consolidated gravel, sand, clay and silt occupy the coastal terrains and floors of some of the inland valleys. Besides these sediments there are basaltic lava flows, ash deposits, laterite and bauxite of Quaternary age.

******

A Review of the Tertiary Sedimentary Rocks of Thailand

Pol Chaodumrong, Sathien Snansieng, Geological Survey Division, Department of Mineral Resources, Thailand; Yongyuth Ukakimapan, Somkiet Janmaha, Surawit Prapidtan, Mineral Fuels Division, Department of Mineral Resources, Thailand; Nawee Sae Leow, Department of Geology, Chulalongkorn University, Thailand.

Tertiary sedimentary rocks in Thailand were previously reviewed by Nutalaya (1975), Bunopas (1976), Gibling and Ratanasthien (1980), Snansieng and Chaodumrong (1981), and Sae Leow (1982). In this present review the paper is divided into three parts, i.e., the general review of the Tertiary rocks of Thailand, the review of previous works, and the stratigraphic details of some Tertiary basins.

There are many small intermontane basins and some larger regional basins with Cenozoic sedimentary deposits in Thailand (Fig. 1). Some large basins consist of a connected set of sub-basins.

Tertiary sedimentary rocks are known in isolated basins of limited extents in 6 main regions. In the northern and the western part of Thailand, the Tertiary sediments consist predominantly of lacustrine and fluviatile carbonaceous shale, coal bed, oil shale, claystone, sandstone and fresh water limestone. In the central basin of Thailand, the area is located within a broad structural depression which was filled by non-marine strata of several thousand feet thick. They are overlain by deltaic sediments of Pleistocene age. In the peninsular Thailand, isolated Tertiary basins contain fossiliferous marine limestone and marlstone with interbedded sandy *shale, carbonaceous shale and coal bed. In the Gulf of Thailand, the sediments are predominantly alternating beds of sand and shale with some lignitic layers. These sediments were laid down under the deltaic and fluviatile conditions in the northern part of the basin, while marine incursions were from the south. In the Khorat Plateau, the uppermost part of the Maha Sarakham Formation may represent some upper Cretaceous to lower Tertiary sediments in enclosed basins.*

Tertiary basins are mainly fault - bounded grabens and/or half grabens formed by reactivation of basement structures. The shape and trend of the basins are elongated following the regional strike of the older formations, which were also controlled by subsequent faulting. The Tertiary strata rest unconformably on Mesozoic and older rocks and are commonly overlain unconformably by Quaternary, coarse terrigenous strata (Mae Taeng Group). Palynological analyses of well cuttings in the Gulf of Thailand indicate a major unconformity in late Miocene age. This unconformity is also found in the central basin of Thailand and can be traced to the Sundaland area of Southeast Asia.

Paleontological studies of fauna and flora from some of the Tertiary sequences in the Northern Thailand indicated that their ages range from upper Eocene to Pliocene. In the Gulf of Thailand, palynological studies indicated that the oldest rock is Oligocene. Five floral zones were found. Although in most of the studies, the fossils were taken from a limited stratigraphic interval but they represent the age range of each basin. Table 1 shows the summary of the age of rocks in the Thai Tertiary basins.

The topographic elevation of the Tertiary basins, varies from below sea level in the Gulf, to just above the sea level at Krabi basin in the south, to 1000 m above the mean sea level at Boluang basin, in the North. These elevation differences are probably the result of subsequent tectonic movements.

The thickness of Cenozoic strata in Northern Thailand is nearly 3000 meters thick as indicated by drilled holes. Results of geophysical survey suggested that the sediments in the Central basin may reach the thicknesses of 7000 meters in Phitsanulok basin and 3500 meters in the Chao Phraya basin. In the Gulf of Thailand, the study of the seismic and exploration wells data indicated that the Tertiary sequences are up to 8000 meters or more in thickness.

Coal beds are common in the Tertiary basins. Coals occur as seams up to 35 meters thick. They are interbedded with massive mudstone/claystone. Seven coal mines (lignite to high volatile C bituminous) were exploited in five basins. Natural gas is being piped from the Gulf of Thailand. Petroleum is found in the Phitsanulok basin and in Fang basin. Major oil shale deposits are found in the Mae Sot basin and diatomite deposits are in the Lampang basin.

******

A Short Note on Quaternary Geology of the Haad Yai - Songkhla Area, Southern Thailand

SAWATA, Hideho, TANCHOTIKUL, Anong, DARNSAWASDI, Rotchanatch, Geological Research Project, Prince of Songkhla University, Thailand; TREBUIL, Guy, Natural Resources Faculty, Prince of Songkhla University, Thailand.

Land and fresh water shells from one limestone cave deposit on the west coast of Songkhla Lagoon, marine shells from a bed 7 m below present ground surface of the Songkhla Great Spit and a piece of half-carbonized wood from an open pit tin mine west of Haad Yai city were collected and dated by ^{14}C method. Shells were identified of their genera and species and their living environments were suggested. These samples range in their age from 4,860 + 270 yr B.P. to 6,720 + 130 yr B.P. Old maps of the area prepared during the time from 1,638 to 1,896 A.D. were collected and studied together with present maps, airphotographs and satellite imagery. Conclusively it is presumed that the Songkhla Great Spit did not exist at its present location approximately 5,000 years ago but already existed in or before 1638 nearly at present location.

******

Reviews of Felsic Plutonic Rocks of Thailand

W. PONGSAPICH, V. PISUTHA-ARNOND, P. CHARUSIRI, Department of Geology, Faculty of Science, Chulalongkorn University, Bangkok 10500, Thailand.

Felsic plutonic rocks have been the main object of interest and research activities among geologists who work in Thailand for decades. The prime reason for this interest inevitably depends much upon the close association of valuable tin and tungsten mineral as well as other economic minerals such as, fluorite and barite with the felsic plutonic rocks. The felsic plutonic rocks exposed in Thailand are just a portion of an arcuate belt of Southeast Asia batholithic intrusions (Figure. 1). This batholithic belt, which is over 2,500 km long, runs from Indonesia in the south through the Thai-Malay Peninsula into the Shan State of eastern Burma and into northeastern Thailand and western Laos (Garson and others, 1975) then veers northeastward through Yunnan, Kwangsi, and Kwangtung of South China (Burton, 1969). In Thailand the granitic rock concentrates mainly along the western part and the Peninsular Thailand. Subordinate numbers of small and scattering masses are, however, found along the western flank of Khorat plateau and along the eastern Gulf of Thailand.

In the early days, the granitic rocks of Thailand have been primarily classified into younger Cretaceous granite and older Triassic granite by Brown and others (1951). Later an addition of Carboniferous granite was reported by Burton and Bignell (1961) which subsequently was adopted by Javanaphet (1969) in his compilation of the geologic map of Thailand. In the early 70's, the Precambrian granite (orthogneiss), was believed to exist along the high grade metamorphic terrain of inferred Precambrian age. Von Braun (1969) and Baum and others (1970) suggested from their geologic mission in the northern part of Thailand that the plutonic emplacements were linked closely to the major orogenic episodes in Precambrian, Carboniferous, Triassic, and also late Cretaceous - Tertiary. During the last decade enormous radiometric age data of the granitic rocks have been produced all over the country (Snelling and others, 1970; Besang and others, 1975; Teggin, 1975; Garson and others, 1975; Bignell, 1972; von Braun and others, 1976; Beckinsale and others, 1979;

Ishihara and others, 1980; Nakapadungrat, 1982). It is clearly illustrated from figure 2 that among those granitic rocks, the Triassic granites are by far the dominant phases exposed in this region.

Mitchell (1977) and Hutchison (1978) have recognized and defined the granitic rocks in Malaysia and Thailand into three main parallel belts namaly, the Eastern, the Central, and the Western Granitic Belts.

The Eastern Granitic Belt includes the Belitung Island, the eastern Malaysia, the eastern Thailand and possibly small plutons on the western flank of the Khorat Plateau. It is characterized by plutonic rocks ranging from gabbro through quartz diorite, granodiorite, adamellite to granite with their ages ranging from Permian to early Triassic especially in Malaysia. Recently Mahawa (1982) has also included the Tak Batholith of Triassic age into this eastern belt (Figure 1).

The Central Granitic Belt consists of the Banka, the Singkep, and the Tuju islands of Indonesia, the Main Range of Malaysia, the Peninsular, the Central, and the Northwestern Thailand. This belt covers at least three - fourth of the granitic rocks of Thailand. It is characterized principally by mesozonal porphyritic biotite granites of Triassic age, usually associated with highly folded Paleozoic metasediments.

The Western Granitic Belt comprises the Peninsular Thailand and Burma, and the western Shan States. It is characterized chiefly by high level adamellites, granites and granitic pegmatites of Cretaceous to Eocene ages.

******

Igneous Rocks of Thailand: A Review of Plutonic Rocks with Intermediate-ultrabasic Compositions and Volcanic Rocks

Y. PANJASAWATWONG, W. YAOWANOIYOTHIN, Department of Geological Sciences, Chiang Mai University, Chiang Mai, Thailand.

Igneous rocks in Thailand consist mainly of plutonic, volcanic and volcaniclastic rocks. Hypabyssal rocks are known in some localities. Mafic and ultramafic rocks and their associates are present in the northern highlands, the eastern coast and the peninsula. Very few records of volcanic and volcaniclastic rocks have been reported in the peninsula. Amongst the igneous rocks, volcanic rocks appear to be ambigously classified by many workers since the geochemical data are rare.

Reviews of igneous rocks of Thailand were previously made by Natalaya (1973), Thanasuthipitak (1978) and Bunopas (1981). At present, the last review is generally up to date. The aim of this paper is to review igneous rocks other than granites and related rocks based on recently available information since 1981. The rocks presented here include syenite and volcanic rocks in some localities. The reviews carried out by Nutalaya (1973), Thanasuthipitak (1978) and Bunopas (1981) will be briefly discussed.

******

Reviews of Metamorphic Rocks of Thailand

W. PONGSAPICH, P. CHARUSIRI, S. VEDCHAKANCHANA, Department of Geology, Faculty of Science, Chulalongkorn University, Bangkok 10500, Thailand.

Regional dynamothermal metamorphic rocks in Thailand are considerably limited or restricted both in spatial distribution and in stratigraphic units. A major zone or belt of metamorphism concentrates along the western moutain range of the country starting from Changwat Mae Hong Son and Changwat Chiang Rai, two northernmost provinces, and it extends down southerly through the western part of Changwats Chiang Mai, Lampang, Lamphun, Tak, Kamphangphet, Nakhon Sawan, Uthai Thani, Kanchanaburi, then it pinches out in Changwat Prachuab Khirikhan (Figure 1). The metamorphic rocks cropped out again in Thai Peninsula just to the south of Changwat Surat Thani and they extend to the Thai-Malaysian border. Two minor separate belts of metamorphic rocks are located, one in Uttaradit area and the other in the eastern portion of the country.

These metamorphic rocks are tentatively divided into two portions. The first group belongs to the inferred Precambrian age which is characterized by high grade metamorphic rocks and anatexites, the other belongs to the Lower Paleozoic (Cambrian-Devonian) and is characterized by low grade metamorphic rocks. However, it should be noted that not all rocks of the Lower Paleozoic age were subjected to the metamorphic events.

******

Geological Evolution of Peninsular Malaysia

T.T. KHOO and B.K. TAN, Department of Geology, University of Malaya, Kuala Lumpur

Peninsular Malaysia can be divided into 3 longitudinal belts, Western, Central and Eastern, each of which has its own distinctive characteristics and geological development. The Western Belt can be subdivided into a northwest sector and a Kinta-Malacca sector. The northwest sector is underlain by clastics, limestones and minor volcanics. The time of the Langkawi folding phase of Koopmans (1965) is revised from Devonian to mid-Permian and this phase is not only confined to southeast Langkawi but covers the whole of Langkawi and Terutao area and extends southeast into mainland Kedah forming a northwest trending belt called the Patani Metamorphics. There is some evidence for a Devonian phase of folding and uplift as well but evidence for it is not strong. The post mid-Permian saw deposition of carbonates and clastics in this sector and the whole region was uplifted by the culminating late Triassic orogenic event which affected the whole of the peninsula. In the Kinta-Malacca sector, there was deposition of argillaceous and calcareous sediments in the early Palaeozoic followed by more limestone deposition in the Kinta region but by clastics in the Kuala Lumpur area. There is evidence foa a post-Silurian event of folding and metamorphism in the Kuala Lumpur area, possibly Devonian. In the Kinta region there is scant evidence to date this tectonic event. There is no known Mesozoic sediment in this sector.

The Central Belt is underlain predominantly by Permian-Triassic clastics, volcanics and limestones. Pre-early Devonian deposition of coarse clastics, argillaceous sediments chert and other rock types occur in the marginal belt forming the foothills of the Main Range Granite. Ultramafic bodies were emplaced in this foothills belt and the whole belt was regionally metamorphosed probably during the Devonian. The Taku Schists and adjacent areas occupy the northern part of the Central Belt and it exposes mainly schists, amphibolites and phyllites. The regional metamorphic rocks adjacent to the Taku; Schists include the Triassic. Rocks assemblage inside the Taku Schists has little similarity to those of the Permian-Triassic outside and it is possible that they represent pre-Permian rocks. The Taku Schists and adjacent areas suffered uplift, recumbent style folding and regional metamorphism during the late Triassic. In the rest of the Central Belt, this late Triassic orogenic uplift also terminated marine sedimentation. Continental deposition began soon after and continued up to the early Cretaceous. During the late Cretaceous, the continental deposits were uplifted and gently folded.

The Eastern Belt is largely underlain by Carboniferous and Permian clastics and volcanics. A phase of regional metamorphism, folding and uplift probably occurred in the late Palaeozoic (Permian?) followed by deposition of an older series of continental deposits such as the Murau and Redang conglomerates. The pan-peninsula late Triassic orogenic event uplifted the Eastern Belt. This was followed by deposition of a younger series of continental deposits which are only gently dipping and probably they were uplifted in the late Cretaceous.

Significant plutonic acid magmatism occurred during the early Permian, late Permian/early Triassic and the late Triassic in the Western Belt, late Triassic and late Cretaceous in the Central Belt and late Permian/early Triassic and late Triassic in the Eastern Belt. Volcanism occurred in all 3 belts. In the northwest sector of the Western Belt, acid volcanism occurred during the late Cambrian and Ordovician. In the Central Belt significant acid to andesitic volcanism occurred in the Permian and Triassic. In the Eastern Belt Carboniferous-Permian acid volcanism was widespread. After the cratonization of the peninsula, volcanic activities continued to be manifested in the late Mesozoic, early Tertiary and Pleistocene in the Central and Eastern Belts. The later volcanic activities tend to be basic.

Various models have been proposed to explain the 3 fold division of the peninsula and their geological features. Models involving both eastward and westward subduction at the foot of the Main Range and collision have been suggested. An aborted rift model interpreting the Central Belt to be an aborted graben has also been proposed. The suggestion that the Foothills Formation rocks include ophiolites and tectonic melange has yet to be substantiated by field evidence. The margins of the belts are not sharp or easily delineated. Various interpretations have been suggested for the boundaries of the three belts. Sedimentological and structural characteristics of the rocks adjacent to the margins of the belts can be best explained by vertical movement along northsouth striking faults. The tectonic reconstruction of the peninsula has been and will continue to be a subject for speculation. Many of the tectonic *schemes proposed depend on a great deal of assumptions and some of the desirable features required by these schemes appear to be lacking or possibly yet to be uncovered. The geological evolution of the peninsula needs to be considered together with the adjacent regions including onshore and offshore Thailand and Indonesia and advances in the geology of these regions can contribute to a better understanding of Peninsular Malaysian geology.*

Since the 1970s there has been a rapid increase in the geological knowledge of Peninsular Malaysia both onshore and offshore. This increase has been made possible by the expansion of activities of the Geological Survey, local universities and the petroleum and mining industries. During this period there has also been much progress in the advancement of geological knowledge of the Southeast Asian region and the science of geology itself has witnessed much development and growth in knowledge and theories. Under these favourable conditions it would appear that efforts to reconstruct the geological evolution of Peninsular Malaysia would have been made easier. However, the opposite is nearer to the truth. More knowledge has put restraints on many tempting generalizations which one would have boldly made and in fact more knowledge has often begged for even more knowledge. Under these circumstances, this paper will give an account of the essential features of the Peninsular Malaysian geology and followed by discussions on the geological evolution (mainly tectonic) including those proposals made by various authors earlier.

******

Mineralization Patterns of North-West Peninsular Malaysia

YEAP Ee Beng, Department of Geology, University of Malaya, Kuala Lumpur.

North-west Peninsular Malaysia including the Langkawi Islands is characterised by a diversity of rocks which range in age from Cambrian to Tertiary. Five distinct centres of mineralization associated with acid magmatism can be recognised. The mineralization centres on the Langkawi Islands and in the Jerai-Semiling Area, Kedah are associated with stock-like presumably high level granitic intrusions. Skarn type sulphide and scheelite mineralization is prevalent on the south-east Pulau Langkawi and the surrounding islands. Bismuth (Bi) and copper (Cu) in the skarn had been mined in south-east Pulau Langkawi for a short period in the past. Other associated metals in these skarn include lead and zinc. Scheelite some of which is Mo-rich is found in several localities of the skarn rocks located largely at the granite contacts while scattered quartz-tourmaline-wolframite veins are found inside the granite. South-east Pulau Langkawi and the surrounding islands appear to hold good potential for pyrometasomatic scheelite and Cu-Bi deposits.

The Jerai-Semiling area is presently regarded as a Sn-Ta-Nb-Fe mineralization centre associated with the granitic Jerai massif. Economic tin deposits are alluvial in nature; containing in addition significant Ta-Nb minerals. The alluvial cassiterite and Ta-Nb minerals have been related to acid pegmatites veins and dikes commonly found in the south and west of the Jerai area. In situ cassiterite has been found in magnetite-hematite ore, pegmatite, hornblende granite,

quartzite and various types of calc-silicate rocks. Mineable iron ore deposits largely consist of residual concentrations of secondary hematite with varying amount of magnetite. The original economic iron ore deposits are interpreted as pyrometasomatic magnetite (minor hematite) deposits which had replaced calc-silicate rocks and are usually located at contacts of granite and pegmatites with other rock types. Bands, lenses and disseminations of sulphides consisting of chalcopyrite, monoclinic pyrrhotite, pyrite and arsenopyrite are found quite commonly in the schist and calc-silicate rocks of the Jerai area. The Jerai area is believed to hold potential for primary Sn-Fe skarn type (magnetite-cassiterite) and cassiterite-sulphide replacement type deposits.

The mineralization centres at Gunong China-Kaki Bukit Area, Perlis and Sintok Area, Kedah are associated with the distal parts of two elongated granitic batholiths which had extended southward from Thailand into Peninsular Malaysia. The source of the cassiterites in the famous cave mines and other gravel pump mines in the general area of Kaki Bukit is from the Gunong China granite. Evidence indicates that these original primary sources at Gunong China were in the form of quartz-tourmaline-cassiterite veins. Abundant psuedomorphs of hematite after pyrite in the semi-hard cave alluvium indicates the presence of abundant sulphides, mainly pyrite in the original source area. Lead and zinc sulphides have been reported to occur in the limestone hills of Kaki Bukit Area.

The Sintok Area, Kedah had been famous for its Sn-W mineralization especially at Bukit Kachi where substantial cassiterite and wolframite were mined from numerous greisen bordered veins of significant depth. The Bukit Kachi mineralization is quite intense and are largely exocontact and consists of several parallel veins cutting tourmaline schist.

Griesenized economical endocontact cassiterite mineralization, but of lesser intensity, has been found at several localities. Diffuse exocontact cassiterite mineralization in the schist at numerous localities within 2 km of the granite contacts has given rise to eluvial tin deposits which had been worked by ground sluicing (lampang) in the past and these together with the endocontact mineralization had contributed to the thin but rich gravelly to bouldery placer deposits in the Sungai Sintok and Sungei Badak drainage systems.

The fifth mineralization centre is located in the general area of Klian Intan, Perak and Baling, Kedah. This centre is associated with the northern extension of the Bintang Range Batholith where multiple phase granitic intrusions have been mapped. Alluvial tin is being mined in around Baling and Kroh, Kedah while near Kroh and in Klian Intan (Perak) parallel sheeted and stockwork veins cutting the metasediments are being mined by open-cut methods. Alluvial tin and float barite ores had been located in the Sungei Pong area which is approximately 15 km south of Kroh.

******

Tectonic and Geologic Evolution of Thailand

Sangad BUNOPAS, Geological Survey Division, Department of Mineral Resources, Bangkok 10400, Thailand; Paul VELLA, Department of Geology, Victoria University of Wellington, Wellington, New Zealand

Thailand consists of Shan-Thai and Indochina Microcontinents.

In the early stage of their evolution (Archeotectonics), Shan-Thai and Indochina were cratonic fragments of Gondwana Australia in the Southern Hemisphere during the Precambrian to Lower Paleozoic.

During Middle Paleozoic to Lower Triassic (Paleotectonics), Shan-Thai and Indochina were rifted and drifting in the Paleotethys. Paleomagnetic and Paleontologic data suggest that Shan-Thai move from a low latitude Southern Hemisphere to a low latitude Northern Hemisphere position, while rotating nearly 180 degrees in the horizontal plane, in the time between early Carboniferous and early Triassic. During the Middle Triassic Shan-Thai sutured nearly simultaneously to Indochina and to South China, the continen-continent collision being a part of the Indosinian Orogeny and Indochina tended to underthrust Shan-Thai.

After the collision (Mesotectonics), mountains arose along the suture, particularly along the overthrusting Shan-Thai margin, and at the same time granites were intruded to high levels in the sediments, and extensive rhyolites were extruded on the land surface. Erosion of the mountains produced mollasse deposits (mostly alluvial plain red-beds) which occur on both sides of the suture, but are most fully developed in the Khorat Basin that formed on the underthrusting west side of the Indochina continent.

Rifting of continental Southeast Asia and the opening of the Gulf of Thailand by tensional regime during late Cretaceous to Tertiary mark the Neotectonics stage of Thailand with subsequent rapid uplift of the present mountains during the Quaternary.

******

Mineralogy and Geochemistry of Pegmatitic Cassiterites from Gunung Jerai, Kedah.

WAN FUAD Wah Hassan, Jabatan Geologi, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia.

In the Gunung Jerai are, Kedah, cassiterites together with Columbite-tantalites are found associated with pegmatites of probably Upper Carboniferous age.

The mineralogy of the heavy mineral assemblages found in the area is rather different from those found in other Malaysian tin-fields, with the exception of Bakri Area. In the Gunong Jerai concentrates, gahnite, green monazite, columbite-tantalite and other common minerals in addition to cassiterites, are rather common. The mineralogy and geochemistry of the cassiterites show marked fifferences: they have a strong magnetic property, rather low specific gravity and showing peculiar crystal shapes.

Polished section study of the magnetic cassiterite grains under reflected light microscopy and electron microprobe showed that these magnetic cassiterites contain high amount of niobium and tantalum which are found in two forms a, as separate exsolved columbite-tantalite phase within the grain, and b, as solid-solution within the cassiterite crystal lattice.

******

The Wang Phar Wolframite Mine (South Thailand)

TAN Say Biow, Petronas-Carigali, P.O. Box 2407, Kuala Lumpur, Malaysia.

The Wang Phar tungsten mine is located west-southwest and 32 km by road from Haad Yai, South Thailand. On a regional scale this mine is situated on the eastern slopes of a north-south trending granite range overlooking a vast flat-lying plain.

The oldest rocks occuring in and around the Wang Phar mine consist of a suite of metamorphosed sedimentaries of Palaeozoic age. Within the mining lease, the dominant rock-type of this suite of rocks is a weathered pale grey phyllite which is seen to underly the foothills and valley floors. The phyllite is substantially deformed and steeply dipping with erratic dip directions and strikes. Towards the west, the country rocks have been thermally metamorphosed by a granite intrusive into a hard and massive dark-gray argillite.

The granite body which intrudes the phyllite and agillite occupies the entire western portion of the area and of probable Triassic in age. An important consequence of this granite emplacement is the formation of hydrothermal vein systems brought about by ore-forming agents liberated during the consolidation of the granite magma and which were concentrated on the granite cusps immediately beneath the invaded rocks. The vein systems did not penetrate into the country rocks because the argillite provided an effective impounding body which blocked the passage of the mineralising solutions.

The mineralised veins are essentially greissens consisting of quartz, muscovite as the main components followed by lesser proportions of tourmaline, topaz and the ore-minerals wolframite, cassiterite, scheelite and sulphides. The most important ore-mineral found in the veins is wolframite which is present in significant amounts in some of the veins to be economically exploited.

The mineralised veins occuring in the Wang Phar area vary in thickness from about 2 cm to a maximum width of about 1.2 m, frequently pinching and swelling along the way. The bigger veins may extend for about 200 m along strike, often petering out at the granite-argillite contact or disappearing beneath the argillite. All the veins have very steep dips and on the whole are westerly dipping though they may bend and dip to the east at very localised spots. Down-dip extensions of the veins vary according to the size of the veins, with some of the prominent ones extending down to at least 90 m from surface.

The wolframite occurs commonly as greyish-black well-formed crystals and as large aggregates in the vein, often in close association with muscovite. There appears to be a general enrichment *of wolframite in places along the vein where the muscovite content is increased.*

The Wang Phar tungsten deposits comprise five different localities where significant vein developments are exposed on the surface. They are Kuen Mai Phai, Kuen Lang, Khog Yang, Klong Kung Lang and Klong Kung. Of these five places, only three namely Kuen Leng, Khog Yang and Klong Kung have underground tunnel workings.

Kuen Leng has the most extensive underground workings, totalling about 2 km of tunnels and with adits driven at 50 m, 80 m and 120 m elevations above sea-level. At this place, five significant mineralised veins have been worked and the average grade of ore determined from actual production is about 0.7-0.9 % WO_3. Cassiterite and scheelite are also recovered but constitute only 1 % and 0.2-0.3 % of the final heavy concentrates from the treatment plant respectively.

******

Geology and Mineral Resources of Songkhla Province, Thailand.

Thongchai PUNGRASSAMI, Department of Mining Engineering, Prince of Songkhla University, Haad Yai, Songkhla 90112.

Conglomerate, sandstone, siltstone, shale, mudstone, limestone, and their metamorphic equivalents ranging in age from Cambrian to Triassic, are found in Songkhla Province. Of these the rocks of Carboniferous and Triassic ages are most abundant. Granite intrusions of late Triassic to early Jurassic age are found. Pegmatite, aplite, and quartz veins locally cut the granites and sedimentary rocks. Cassiterite is the most important ore mineral mined. Wolframite, barite, manganese, glass sand, heavy clay, crushed stone, gravel, and construction sand are occasionally produced.

******

SIR-A - A Shuttle Imaging Radar Strip over South Thailand and Northeast Peninsular Malaysia.

B.N. KOOPMANS, ITC. P.O. Box 6, Enschede, Netherlands; S. MUENLEK, Economic Geology Division, Department of Mineral Resources, Bangkok 10400, Thailand.

A study was undertaken to evaluate a visual geological interpretation of side-looking radar images of the second Space Shuttle mission. The images were obtained by synthetic aperture radar in the L-band, over a strip 50 km wide between Takua Pa (Thailand) and Dungun (W. Malaysia). The interpreted radar geological map was compared with available Landsat MSS. It was attempted to correlate the structural features in the sedimentary rocks from both sides of the border. A lineament analysis was made from the radar images. Some differentiation could be made between different igneous intrusive bodies on the basis of their joint and fault patterns.

******

Geoelectrical Survey at the Phuket Mining Co. Ltd., Tumbon Lidon, Changwat Yala.

Dhanintr PHONGSMAS, Department of Physics, Faculty of Science, Prince of Songkhla University, Haad Yai, Thailand.

Geoelectrical survey was carried out at the Phuket Mining Co. Ltd. Tumbol Lidon Changwat Yala covering an area of 1.5 Square kilometres. The array contain 68 measuring points, arranged in the grid 100 X 100 square metres. The Wenner configuration was spread nearly in the north-south direction approximately parallel to the general structure found at the mine. To check the lateral inhomogeneous medium the Carpenter and Haabergam's method was used. To smoothing of field data was done by the computer. The average lateral inhomogeneous index of this area is about 1.0. This figure shows that the ground medium is roughly homogeneous. The field date, after they were analysed by Tagg's method, were fed into the computer to calculate and to draw the theoretical curve which should match the field curve. All data were analysed by the same method, and the geoelectrical layers were determined at every measuring point. The geoelectrical contours of bedrocks were drawn. The main structure was interpreted as follows: the bedrocks are composed of granite and limestone. They were located at the 45,000 ohm-feet contour line. Probable fracture zone is shown by the aprupted change in the gradient contour. When the geoelectrical data of the measuring points were compared with the geological information from the bored hole nearby the geologic cross-section was drawn to show the geologic structure in the area. After six cross-section lines were drawn in the surveying area, the resistivity table was made.

	Resistivity ohm-feet
The westhering layer	215-3299
Clay with fine and coarse sand	400-45600
Laterite	1965-45600
Alluvium, decomposed schist and shale	13-564
Porous limestone	1000-7800
Hard limestone	6162-34425
Decomposed granite	529-7029
Granite	76440-280

******

Hydrologic and Hydrogeologic Characteristics of Northwestern Peninsular Malaysia

MOHAMAD Ali Hasan, Department of Geology, University of Malaya, Kuala Lumpur 22-11, Malaysia.

The North Western section of Peninsula (especially Kedah) has been considered as the main'rice bowl' area of Malaysia. Large percentages of the land areas are used for padi cultivation. For padi, being basically a water dependent crop, the availability of water is very important. Of late, water shortages and droughts have been quite common to these areas. As such an understanding of the hydrologic and hydrogeologic characteristics of the area could perhaps help in bettering of the planning and managing of the 'water crises' of the region.

This short paper attempts to assemble and synthesise the available hydrologic and hydrogeologic data of the northwestern peninsular area and to summarise existing trends and characteristics of the region.

******

Geology of the Tarutau Islands

Thongchai PUNGRASSAMI, Department of Mining Engineering, Peince of Songkhla University, Haad Yai, Thailand.

The Tarutau Islands consist of lower Paleozoic strata: the Tarutau Formation and the Thung Song Formation. The former is of Cambrian-Ordovician age and the latter is of Ordovician in the surveyed area.

The Tarutau Formation is mapped in 4 members: the T1, T1, T3 and T4 being characterized by red clastic facies. The formation is of shallow marine sediments with thickness of more than 3,100 meters. It is composed of conglomerate, sandstone, shale, limestone and rhyolitic tuff. Fossils of brachiopods, trilobites, conodonts and trace fossils and found in this formation.

The Thung Song Formation is divided into the S1, S2, S3, S4 and S5 Members with a total thickness of 1,500 meters, being characterized by limestone facies. It is composed of alternating limestone and shale sequences, limestone, shale, sandstone and siltstone. Fossils of gastropods, trilobites, cephlopods, brachiopods, crinoids conodonts and burrows are found. The formation represents platform margin to slope facies.

A NNW-SSE trending asymmetric anticline occurred in the southwestern portion of the Tarutas main island. Four major longitudinal faults divide the islands into five structural units.

Various primary sedimentary structures, especially cross-bedding can be seen in both formations.

******

Mesozoic Stratigraphy in Peninsula Malaysia

KHOO Han Peng, Geological Survey Malaysia, Ipoh, Perak, W. Malaysia.

The Mesozoic system is exposed in two separate belts in Peninsula Malaysia, one at the northwestern extremity and the other from north to south along the axial region. Chronostratigraphically it is subdivided into two sequences, namely a largely Triassic flysch sequence and an Upper Mesozoic molasse sequence.

At the northwestern belt the Kodiang Limestone is a time equivalent of the Semanggol Formation which is exposed in three separate outcrops that are homotaxial and show good lithostratigraphic correlation.

Along the axial belt there are differences in nomenclature even for connected extensions of the same unit as a result of isolated work eventually merging together. At the northern portion for example the Jelai Formation, Kerdau Formation, Gua Musang Formation, Gunong Rabong Formation, Telong Formation and Aring Formation are overlapping and can be reduced essentially to the Aring and Telong Formations. At the central part what has been referred to as the Kerdau Formation, Lipis Group, Semantan Formation, Kaling Formation, Jelai Formation and Gua Musang Formation are now more commonly known as the Semantan and Kaling Formations. In the south where the Gemas Formation, Tenang Beds, Jurong Formation and Jelai Formation has been used for different and overlapping parts of the same continuous unit, the Gemas Formation is now preferred. The Semantan, Gemas and Semanggol are homotaxial with the Telong a time equivalent.

Among the continental sequences the Gagau Group, Tembeling Group, Ulu Endau Beds, Tebak Formation (Kluang) and Panti Sandstone are homotaxial and have good lithostratigraphic correlation with each other as well as with the nonfossiliferous Koh Formation, Bertangga Sandstone, Ma'okil Formation and Saiong Beds.

******

COMPACT COURSE ON EXPLORATION GEOCHEMISTRY

The Society organised the above course on Tuesday 13 September 1983 to Thursday 15 September 1983, daily from 5.00 p.m. to 7.00 p.m., at the Department of Geology, University of Malaya, Kuala Lumpur. It was attended by 50 participants.

The Course Lecturer was Dr. W.K. Fletcher, UN Expert at SEATRAD, on leave from Department of Geological Sciences, University of British Columbia, Vancouver, B.C. Canada where he is an Associate Professor. He is also author of Handbook of Exploration Geochemistry Volume 1 - Analytical Methods in Geochemical Prospecting.

<u>Course Outline</u>

Lecture 1: Introduction - media collected - regional vs. detailed surveys - element mobility - mechanical vs. hydromorphic dispersion - African and Australian case histories - pathfinders and element associations - American - Puerto Rican - Canadian case histories. 24 slides.

Lecture 2A: Background - threshold - contrast - factors influencing background - geology with examples from Canada, Africa and Brasil - climate and soils with examples from U.K. and Zambia - pH with example from Canada - contamination example from Canada. 30 slides.

Lecture 2B: Calculation of thresholds - normal and lognormal distributions - partitioning using probability plots - some examples - regression analysis in estimation of background - some hazards in methods based on correlation matrix. 30 slides.

Lecture 3: Distribution of metals in soils and sediments - mineral stability - element mobility - Eh/pH - adsorption - hydrous oxides - organic matter - metal speciation - identification of hydromorphic anomalies - maximizing anomaly contrast - false anomalies. 25 slides.

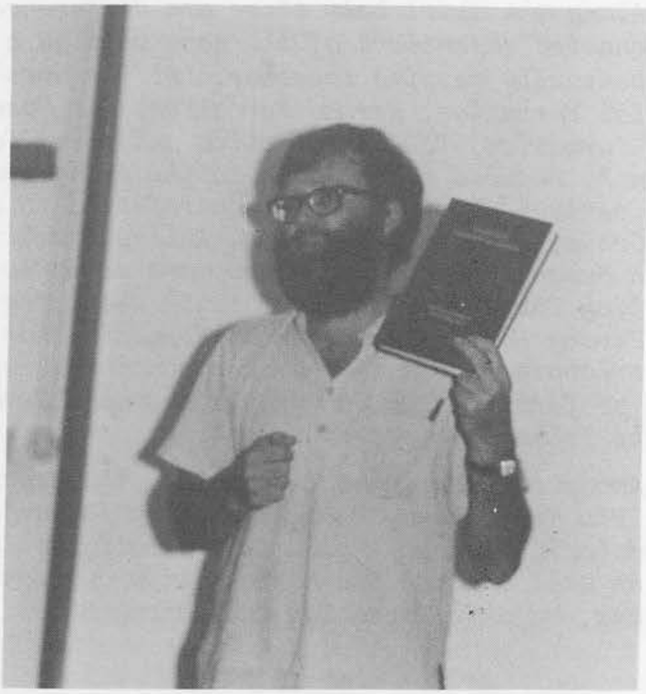
COMPACT

COURSE

ON

EXPLORATION

GEOCHEMISTRY



GSM pix by G.H. Teh

Lecture 4: Analysis of samples - sample preparation - size fractions - examples from U.S.A., Spain, Australia, Saudi Arabia - heavy minerals - paramagnetic fraction - sample decomposition techniques - strong decompositions - influence mineralogy - partial extractions - reaction surfaces - selective extraction - sulphides - hydrous oxides - sequential extraction schemes - example in lake sediments. 30 slides.

Lecture 5: Soil profile effects - tropical soil catenas - examples from Zambia - effect on element distribution - leaching of metals - leached caps - application of pathfinders - evaluation of ironstones - examples from Namibia, Puerto Rico, Australia and French Guiana - factors to record during soil surveys - orientation surveys. 35 slides.

Lecture 6: Drainage surveys - basic premise - waters vs. sediments - survey scales - mechanical vs. hydromorphic transport - precipitation barriers - anomaly contrast - downstream dilution - examples from B.C. - heavy minerals - hydraulic equivalence - environmental factors - lake sediment surveys - control of sampleing - orientation surveys. 35 slides.

G.H. Teh

******

BERITA PERSATUAN
(NEWS OF THE SOCIETY)

WE APOLOGISE FOR THE LATE PUBLICATION OF THIS ISSUE OF WARTA GEOLOGI.

THE DELAY IS DUE TO UNFORESEEN CIRCUMSTANCES RELATING TO EDITORIAL PROCEDURES AND GUIDELINES BEYOND THE CONTROL OF THE EDITOR.

EDITOR

GEOSEA V - PROGRESS REPORT

Papers

Up to 1st November 1983, 132 titles have been received. Up to 3rd November 1983, 41 abstracts of papers have been received. 22 papers have been accepted for presented.

Keynote papers have been solicited from Prof. J. Watson, FRS, Prof. R.W. Hutchinson and Prof. W.S. Fyfe, FRS. Review papers have been solicited from GEOSEA core countries of PNG, HK, S'pore and Malaysia.

List of papers submitted up to 1st November 1983 will be sent to all members of Society and all those who respond by 10th November 1983.

Training Courses

The following courses are on:-

a) CCOP - ASCOPE - GEOSEA Course on Carbonate Diagenesis. Instructor: Prof. R.G.C. Bathurst. 3 days, most probably 4-6 April 1984.

b) SEATRAD-GEOSEA Course on Geochemical Exploration in Tropical Terrain. Instructor: Prof. K. Fletcher. Duration: 5 days. Venue: SEATRAD and Bujang Melaka. Dates: 3-7 April 1984 (ideally).

c) Alluvial Deposit Evaluation Course. Instructors: From MMC. Probably 2 days.

The state of the other courses are as follows:-

d) Granite Course - response so far not encouraging.

e) Plate Tectonics - Concept & Development - good response. Dr. Buffetaut (Paris) will give lectures on palaeotological aspects.

f) Sulphide Mineralogy - poor response. Instructor available - Prof. G. Moh (Germany).

g) AMF-GEOSEA Course on Coal - exploration and evaluation. Pending.

h) AMF-GEOSEA Course on Uranium-exploration and evaluation. Cancelled.

i) 1 day course on District Analysis as a Mechanism for Target Generation in Tin Exploration by Prof. R. Taylor (Australia). Will test response in Second Circular before further action.

j) USM Course on Geophysics. Cancelled.

Field Trips

The following trips will have to be on from the response shown:

1) Kota Kinabalu - Tawau, Sabah
2) Lupar Line - Bau, Sarawak
3) NW Peninsular Malaysia
4) Kuala Lumpur Tin Field
5) Eastern Belt, Peninsular Malaysia.

Publicity

News of GEOSEA V has appeared in the following publications besides Society's.

1) Episodes, Newsletter of IUGS, every issue this year
2) AGID News
3) IMM Newsletter
4) GEOTIMES
5) Ministry of Science & Technology Bulletin
6) Jurutera Galian, IME Newsletter
and others.

The Episodes will carry a feature article on GEOSEA V in early 1984 to focus on the Congress and our efforts in technical cooperation with fellow developing-countries by the training courses.

Airfares

Efforts are being made to get MAS as official carrier by giving substantial discounts for fares.

Second Circular

Plan to be out in early December.

******

TRAINING SEMINAR ON GEOLOGICAL/GEOTECHNICAL PROBLEMS OF URBAN CENTRES

March 27-31, 1984

Organized by: University of Malaya

In collaboration with:

a) UNESCO
b) Southeast Asia Regional Network of Geosciences
c) Geological Society of Malaysia
d) Association of Geoscientists fof International Development
e) Asian Institute of Technology

Introduction

The ever increasing populations in towns and cities have led, and will continue to lead, to increasing demands on the natural environment through the lateral and vertical growth of these urban centres. Constraints of the natural environment have led to several problems of a geological/geotechnical character that affect the growth of these urban centres. These problems, including those arising from ground subsidence, stability of cuts and embankments, flooding, waste disposal, coastal erosion and earthquakes, are of particular significance in S.E. Asia where large populations are often concentrated in urban centres of small areal extents. The growth of these urban centres thus requires that these geological/geotechnical problems be not only identified and defined, but also be analyzed and hopefully solved. There is furthermore, the need for the proper planning and utilization of, construction materials and land and water resources within, and close to, these urban centres so as to allow for a better standard of living and to allow for the development of the region as a whole. There is thus an urgent need, for applied and fundamental research, for the exchange of ideas, information and experiences, and for education and training, on these geological/geotechnical problems of urban centres, and on the planning and management of natural resources of urban centres in S.E. Asia.

Training seminar on geological/geotechnical problems of urban centres

This training seminar is aimed at providing participants with a knowledge of the main geological/geotechnical problems of urban centres and will be based on a series of lectures and practicals that will include discussions of case histories of some of these problems. Methods of detection and site investigation will also be discussed together with remedial measures for some of these geological/ geotechnical problems. The following topics will be covered:-

1. Urban centres over subsurface karst - including discussions on problems associated with cavities in, and the irregular topography of, subsurface limestone bedrock.
2. Urban centres over unconsolidated deposits - including discussions on foundations, ground subsidence and groundwater.
3. Stability of cuts and embankments in urban centres - including discussions on mechanisms of failures of existing slopes, analytical methods and remedial measures.
4. Hydrology and urban centres - including discussions on water supply, flooding, flood mitigation and water resources planning and management.
5. Earthquakes and urban centres.
6. Other geological/geotechnical problems of urban centres - to include discussions on waste disposal and management, construction materials, land reclamation, coastal erosion and sedimentation and urban landuse planning.

Date and venue

27th to 31st March, 1984 at the Department of Geology, University of Malaya, Pantai Valley, Kuala Lumpur, Malaysia.

Medium of instruction

English

Seminar fee

US$100

Teaching staff

The training seminar will be taught by well experienced professional staff from the University of Malaya and the Asian Institute of Technology. Practicing engineers experienced with Southeast Asian situations and international experts will also be involved in the training seminar.

Participants

Geologists, civil engineers, hydrologists, environmental specialists, urban geographers, soil scientists, landscape architects, city planners - from government, industry and academic institutions. Course enrollment will be limited.

******

LANDPLAN II - WORKSHOP ON ROLE OF GEOLOGY IN PLANNING AND DEVELOPMENT OF URBAN CENTRES IN SOUTHEAST ASIA

April 2-5, 1984

Organized by:

a) Geological Society of Malaysia
b) Association of Geoscientists for International Development
c) Geological Society of Thailand

In collaboration with: International Union of Geological Sciences

Venue: Kuala Lumpur, Malaysia

Landplan II - Workshop on role of geology in planning and development of urban centres in Southeast Asia

This workshop is aimed at not only providing a forum for communication and exchange of ideas and experiences, but also identifying areas for research and working out research projects on the role of geology in the planning and development of urban centres in S.E. Asia. The workshop is thus aimed at initiating inter-disciplinary and inter-nation cooperation towards the identification and definition, and the analysis and solution of some of the geological-geotechnical problems that are common to many of the urban centres of S.E. Asia. It is finally envisaged that the workshop will formulate specific research proposals not only on the geological/geotechnical problems of urban centres in S.E. Asia but also on the role of geology in the future planning and development of urban centres in S.E. Asia.

Workshop programme

April 2-3, 1984.

Presentation of keynote papers, country papers and related papers on the role of geology in the planning and development of urban centres in S.E. Asia.

April 4-5, 1984.

Discussions on formulating research proposals on the role of geology in the planning and development of urban centres in S.E. Asia.

Registration fee

US$50

Language

The official language of the Workshop is English.

Participants

Geologists, civil engineers, hydrologists, environmental specialists, urban geographers, soil scientists, landscape architects, city planners - from government, industry and academic institutions.

Workshop venue

Department of Geology, University of Malaya.

Correspondence

Dr. J.K. Raj,
Organizing Secretary,
Training Seminar and LANDPLAN II - Workshop,
Geology Department,
University of Malaya,
Kuala Lumpur 22-11,
Malaysia.

******

KEAHLIAN (MEMBERSHIP)

The following applications for membership were approved:

Full Members

Michael G. Waddell, Earth Sciences and Resources Institute, Byrnes Center, University of South Carolina, Columbia, SC. 29208, USA.

Liaw Kim Kiat, Geological Survey Malaysia, Sarawak.

William H. Kanes, Earth Sciences and Resources Institute, University of South Carolina, SC 29208, USA.

Engku Nasir Syed Mohamad, Projekon Sdn. Bhd., No. 11, Jalan SS2/67, Petaling Jaya, Selangor.

Noral Hadi Yusof, Projekon Sdn. Bhd., No. 11, Jalan SS2/67, Petaling Jaya, Selangor.

Student Members

Ramly Manja, Department of Geology, University of Malaya, Kuala Lumpur.

Mohd. Shahrin Mohd. Dom, Department of Geology, University of Malaya, Kuala Lumpur.

Yusof Sarangit, Department of Geology, University of Malaya, Kuala Lumpur.

Mohsin Hj. Abdul Rashid, Department of Geology, University of Malaya, Kuala Lumpur.

Ridzuan Ahmad Idrus, Department of Geology, University of Malaya, Kuala Lumpur.

Mohamad Yusof Talif, Department of Geology, University of Malaya, Kuala Lumpur.

Wang Hui Kuen, Department of Geology, University of Malaya, Kuala Lumpur.

Toh Kang Sai, Department of Geology, University of Malaya, Kuala Lumpur.

Ahmad Mohd. Jais, Department of Geology, University of Malaya, Kuala Lumpur.

Jasmi Ab. Talib, Department of Geology, Universiti Kebangsaan Malaysia, Bangi, Selangor.

Joanes Muda, Department of Geology, Universiti Kebangsaan Malaysia, Bangi, Selangor.

Associate Members

Hugh A. Smith, Rockfall Asia Sdn. Bhd., Jalan Pengisir 15/9, Shah Alam, Selangor.

Cheong Kong Fuat, Koperatif Bersatu Bhd., 49A, Jalan SS2/64, Sungai Way-Subang.

Dorffer Daniel, Gearhart (Malaysia), Suite 708, Wisma Lim Foo Yong, 86 Jalan Raja Chulan, Kuala Lumpur.

Institutional Members

Australian Mineral Ventures Library, P.O. Box 303, West Perth, Western Australia 6005 (Mrs. Kerry Smith).

Schlumberger Overseas S.A.. 3rd Floor, Wisma Bunga Raya, 152 Jalan Ampang, Kuala Lumpur 04-07. (Mr. Maria-Sube - LAS).

******

PERTUKARAN ALAMAT (CHANGE OF ADDRESS)

The following member has informed the Society of his new address:

Mohd. Hatta Abd. Karim, Ibu Pejabat Jabatan Kerja Raya, Cawangan Bekalan Air (Tingkat 6), Jalan Mahameru, Kuala Lumpur.

R. Hillen, CCOP Project Office, 41 Sukhumvit Soi 4, Bangkok 11, Thailand.

Dennis Taylor, 106 Duffy Street, Ainslie, A.CT, Australia 2602.

Ida Suzaini, OMRD (Geological Section), P.O. Box No. 5, Ranau, Sabah, Malaysia.

Chue Hang Cheong, Kumpulan Pantai Sdn. Bhd., 195, Jalan Sungei Besi, Kuala Lumpur 07-02, Malaysia.

C.K. Burton, BP Minerals, 456 Alexandra Road, 09-00NOL Building, Singapore 0511.

V.T. Pun, c/o Ravenshoe Tin Dredging Limited, P.O. Box 9, Mount Garnet, North Queensland, 4872, Auatralia.

Mohamed Shah Abdullah, No. 1, Jalan 4/4J, Shah Alam, Selangor.

Buddhadeb Biswas, D.Sc., 903, Ranch Estates Place, NW, Calgary, Alberta, T3G1M5, Canada.

Glenn L. Shepherd, Occidental Eastern Inc., P.O. Box 511, Guangzhou, China.

******

PERTAMBAHAN BARU PERPUSTAKAAN (NEW LIBRARY ADDITIONS)

The following publications were added to the Library:

1. Seatrad bulletin, vol. IV, no. 2, 1983.
2. Indian geoscience abstracts, 1974 (1981).
3. Chronique de la recherche miniere no. 471 & 472, June, 1983.
4. IME Bulletin no. 11 & 12, 1983.
5. Geophysical Research Bulletin, vol. 21, no. 2, 1983.
6. Stratigraphy and palaeontology in W. Sichuan & E. Xizang, China, Parts 1 & 2.
7. IMM Bulletin 917, 920, 921, 922, 923, 924, 1983.
8. Records of the Geological Survey of NSW, vol. 21, pt. I & II, 1983.
9. Journal of geosciences, Osahia City Univ., vol. 26, 1983.
10. Berliner Geowissenschaftliche Abhandlungen, Band. 38-43, 1982.
11. Geosurvey Newsletter, vol. 15, nos. 7-12, 1983.
12. Geological literature of USSR, Bibliographical yearbook for 1978 year, vols. I & II.
13. Journal of the Geological Society, vol. 140, part 4 & 6, 1983.
14. Journal of Stratigraphy, vol. 7, no. 2, 1983.
15. Acta Palaeontologia Sinica, vol. 22, no. 3 & 4, 1983.
16. Resources Asia, Sept. 1983.
17. Palaeontologia Sinica, whole no. 162, new series, no. 18, 1982.
18. American Museum Novitates nos. 2749 (1982), 2759 & 2761 (1983).
19. Bulletin of the Americal Museum of Natural History, vol. 174, Art. 3, 1983.

******

BERITA-BERITA LAIN
(OTHER NEWS)

JAWATANKUASA ISTILAH GEOLOGI DEWAN BAHASA PUSTAKA

One of the resolutions of the "Workshop on the use and implementation of Bahasa Malaysia in the field of Geoscience" (see WARTA GEOLOGI Vol. 9 No. 2, pp 63-74) was the completion and coordination of terminologies in the field of Geoscience.

As a result, a Committee on Geological Terms was set up by Dewan Bahasa dan Pustaka with representatives of the various institutions of higher learning and other government bodies involved in Earth Science.

The members making up this committee, the majority of whom are GSM members, comprise:

Dr. Wan Fuad Wan Hasan, UKM (Chairman)
Encik Mohamad Ali Haji Hasan, UM (Vice-Chairman)
Encik Samsudin Haji Taib, UM
Dr. Teh Guan Hoe, UM
Puan Zaiton Harun, UKM
Encik Juhari Mat Akhir, UKM
Encik Abdul Aziz Husin, UTM
Puan Siti Zauyah Darus, UPM
Encik P. Loganathan, Jab. Peny. Kajibumi
Encik Mohd. Shahid Ayub, PUSPATI
Encik Hila Ludin Abu Hazim, PETRONAS
Encik Abd. Kahar Haji Yaakob, DBP (Secretary)
Encik Mohd. Zain Mohd. Amin, DBP
Encik Mohd. Nor Ab. Ghani, DBP

The Committee commenced work in June 1983 and hope to bring out the Geological Terms in Bahasa Malaysia early 1984.

Meanwhile DBP has also received geological terminologies from a number of experts in the various fields of Earth Science.

G.H. Teh

******

BOOK LAUNCHING - ECONOMIC DEPOSITS AND THEIR TECTONIC SETTING BY CHARLES S. HUTCHISON

A light meal was held by Macmillian Publishers (M) Sdn. Bhd. at Bilik Wau, Rumah Universiti (Universiti Malaya) on 1 October 1983 to launch C.S. Hutchison's book titled "Economic Deposits and their Tectonic Setting".

The comprehensive textbook covers a broad spectrum of economic geology, including ores, fuels and sedimentary deposits. The emphasis is placed on integrating the different kinds of economic geological deposits with the concepts of plate tectonics.

In the core of the book, ore deposits are described and classified according to their tectonic setting. The geology of the deposits, rather than their detailed petrology, is stressed and wherever appropriate, the processes of ore concentration and deposition are related to the concepts of plate tectonics. Discussion of petroleum and natural gas is taken from source rocks, through oil maturation and migration, to trapping and reservoir configurations. Coal is described with emphasis on regional environment of deposition, and maturation into ranks. Uranium ore is discussed in relation to tectonic setting, for example, Archaean placers, batholith-related and low-temperature hydrothermal sedimentary deposits. Sedimentary-type economic deposits such as evaporites and phosphorites are also included.

In an appendix, the various commodities are tabulated with details of their world share of annual production, major commercial uses and cross-references to geological descriptions. A comprehensive list of references is provided, making the book useful for the graduate and professional geologist as well as for undergraduates.

Charles S. Hutchison is currently Professor of Applied Geology at the University of Malaya, Kuala Lumpur, Malaysia. He has also been a Visiting Professor at both the University of Kansas and Cornell University, USA. As well as having had published over 65 papers and articles on geology, tectonics and petrology of volcanic and plutonic rocks in Southeast Asia, he is the co-editor of Geology of the Malay Peninsula and the author of Laboratory Handbook of Petrographic Techniques.

G.H. Teh

GEOLOGY AND GEOTECHNICS OF THE QUATERNARY SEDIMENTS

August - October 1984

Asian Institute of Technology, Bangkok, Thailand.

Aims

Many of the world centres of population and engineering construction are situated on geological materials deposited or modified in the Quaternary period. The nature and geotechnical properties of Quaternary formations have given rise to problems in engineering design, foundation construction, groundwater management, flood protection and land reclamation and so forth. The geotechnical engineer working in areas of Quaternary geology must be aware of the particular geological characteristics of these areas in order to undertake his work properly while the geologist, perhaps specialised in Quaternary geology, should be aware of the particular geotechnical problems posed by these materials in order to offer useful advice to the engineer.

The course on Geology and Geotechnics of the Quaternary Sediments seeks, in an eight week period, to blend together the essence of Quaternary geology and the geotechnics relevant to engineering projects in this geological environment. The course is given as two basic streams of training, one geological and the other geotechnical, given together so that the relationships between gwology and geotechnics are clearly demonstrated.

In such a short course the emphasis will be placed on practical rather than theoretical aspects. The student will receive four lectures per day and afternoon laboratory and field practicals and excercises. Visits to appropriate engineering works in the Quaternary geological environment are planned together with some whole day weekend excursions to areas of Quaternary geology.

Teacher will be outstanding professionals in the field of applied Quaternary geology and geotechnics. The course will include lectures on soil mechanics, groundwater mechanics, foundation engineering, construction materials, land reclamation, Quaternary sedimentary environments and deposition, hydrogeology, techniques for determining stratigraphy, mapping, geophysics, aerial photograph interpretation, earthquake engineering and engineering geology and site investigation. Full use will be made of the excellent laboratory facilities at the Asian Institute of Technology.

Students will be resident at the Asian Institute of Technology. Some special attention will be given to the particular problems associated with the Quaternary sediments on which the City of Bangkok stands.

Course Organizers

Prof. D.G. Price, Dept. of Mining Engineering, Delft University of Technology, Netherlands.
Dr. Prinya Nutalaya, Asian Institute of Technology, Thailand.
Ir. R. Hageman, Director, Geological Survey of the Netherlands.
Dr. E. Oele, Geological Survey of the Netherlands.

Place and Date

The course will be held at the Asian Institute of Technology (AIT) 42 km north of Bangkok, the capital of Thailand. The course will run for eight weeks from August to October 1984.

Tuition and Fees

The tuition and fees are US$1200 (or Baht 27,600) which will include one set of the course notes and transportation on field trips.

Teaching Staff

The course will be taught by well experienced professional staff. These will be from AIT, from the United States and, from the Netherlands, staff from the Geological Survey, the National Laboratory for Soil Mechanics, the Delft University of Technology, the Free University in Amsterdam and the International Training Centre (ITC). Personnel from the Geotechnical and Transportation Engineering Division in AIT will provide general backing for laboratory and field studies.

Participants

The aim of the course is to teach those younger scientists (not over 35) with a solid background, outstanding academic record and at least three years of work experience in geotechnical studies beyond the completion of their B.Sc. degree. It is anticipated that 30 participants will be selected and that some geoscientists and engineers will receive scholarships which will cover the fees for the eight week course and may include roundtrip airfare to and from Bangkok.

Course participants should have a B.Sc. or equivalent in geology, geophysics, physics, mining or civil engineering and at least three years of practical experience in applied geology or geotechnical engineering. They must be presently employed in positions where geology and/or engineering is used in their daily work. The course enrollment will be limited to 30 participants, comprising approximately 20 from Asia and the Pacific, 5 from Africa, and 5 from Latin America. Selection will be made by the Organizers.

Participants should bring a scientific calculator with them.

Scholarships

Some travel grants and scholarships are available for outstanding students from developing countries. Applications for the scholarships should be directed to Dr. Prinya Nutalaya - Course Director, AGID-AIT G.P.O. Box 2754, Bangkok 10501, Thailand.

Accommodation and Facilities

Accommodation is available at the AIT Center. The AIT Center is a conference facility and is equipped with a bookstore, dining room, post office, bank, barbershop, etc. There are 60 first class air-conditioned double guestrooms in the AIT Center hotel together with a swimming pool, tennis courts, and a nine hole golf course.

The cost for room is US$11 per day for single occupancy or US$15 per day for double occupancy.

Correspondence

All correspondence regarding the short course should be addressed to:

Dr. Prinya Nutalaya
AGID, Asian Institute of Technology, G.P.O. Box 2754,
Bangkok 10501, Thailand.

Telex: 84276 TH
Cable: AIT BANGKOK
Tel. : 5239300-13 Ext. 190

******

"MANAGEMENT TRAINING FOR SENIOR GEOLOGISTS"

17th - 26th September, 1984

Venue: Australian Mineral Foundation, Glenside, South Australia.

The Course Objective

Lectures, discussion and practical problems over 9 days are used to stress concepts and obligations involved in the interaction of senior geologists with upper management, field personnel and government.

Course Outline

1. Defining of objectives: commodity selection, minimum size and grade determination; analysis of risk; influence of location; financial objectives.

2. Generation of targets: regional, district and mine analysis techniques; use of genetic models; creative thinking; effect of economic and technological developments.

3. Programme organization: selection of search and evaluation techniques; co-ordination of resources (personnel, research, techniques and funds); budgeting and accounting procedures.

4. Evaluation of prospects: reliability of drilling, logging, sampling, estimation of reserves and testing procedures; feasibility studies and environmental impact surveys.

5. Laws, contracts, negotiations: state and federal laws controlling mining activity; contracts for drilling and servicing; negotiations for tenure including purchase, options, leases, joint ventures and farm-outs.

6. Communications and personnel management preparation of maps and reports for internal reporting and for governmental bodies; management principles; personnel training and motivation.

7. Ten minute formal reports will be required from each participant on a project with which they have been personally involved. The report should be as a presentation to a Budget Committee requesting financial support for the project or its relinquishment. The emphasis must be on economic factors and not on technical aspects of projects or geological models developed. Consider your recommendations in the light of the corporate plans of the organization concerned and the economic climate that is expected tp prevail. A 100-word abstract of a proposed presentation should accompany the course application.

Course Duration

A nine-day residential course is planned commencing with registration and an orientation dinner at 6.30 p.m. on Sunday 16th September, 1984, at Australian Mineral Foundation, Conyngham Street, Glenside, South Australia. The programme includes evening sessions. Time will be set aside for recreation during the course including one full day.

Course Venue and Accommodation

The course will be held at Australian Mineral Foundation, Conyngham Street, Glenside, South Australia, with accommodation at the nearby Adelaide Granada Inn. All candidates will be required to reside in the motel, including Adelaide residents.

The Course Leader

The course leader is Emeritus Professor Willard C. Lacy, former Foundation Professor of Geology at James Cook University of North Queensland. Professor Lacy received his doctorate degree from Harvard University.

Candidates

Applications for the course will be accepted in the order in which they are received at AMF in Adelaide. Closing date for applications is 31st May, 1984. A maximum of 21 candidates will be accepted for the course. As the programme has been designed to meet a specific industry need at a particular experience level the AMF Director reserves the right to reject any application, if, after consultation with an appropriate senior manager in the applicant's organization it is felt that the applicant may have experience far exceeding the pre-requisites of this course.

Eligibility and Pre-requisites

Applications will be accepted from:

a) Explorationists and mining geologists with approximately ten years experience with mining companies in Australia or overseas.

b) Staff in state and federal government departments concerned with geological operations.

c) Staff of tertiary schools of geology and geophysics.

Course Fee

The total course fee is $A2,200 which includes all accommodation and meal charges. The total course fee is required with your application.

******

MINERAL PROCESSION AND EXTRACTIVE METALLURGY

Kunming, People's Republic of China

14-20 October, 1984.

"Modern plant equipment and practice in non-ferrous metallurgy" is the broad theme of the joint international conference Mineral Processing and Extractive Metallurgy, organized by the Institution of Mining and Metallurgy and the Chinese Society of Metals, which is to be held in Kunming, Yunnan Province, People's Republic of China, from 14 to 20 October, 1984.

The Organizing Committee will welcome the submission of abstracts (200 - 300 words) of papers intended for publication in the preprinted volume of papers, which will be distributed to conference registrants in September, 1984, and for presentation at the technical sessions.

Abstracts, in English, should be sent to the Conference Office, Institution of Mining and Metallurgy, 44 Portland Place, London W1N4BR, England.

Papers accepted for publication and presentation will be divided equally between mineral processing and extractive metallurgical subjects. It is envisaged that plenary and simultaneous sessions will be held. The Organizing Committee will welcome, in particular, the submission of abstracts on such topics as the problems that arise in the implementation of changes in practice, techniques, etc., in existing plants, innovative equipment and technology, pyro-and hydrometallurgy, energy and environmental factors, and the treatment of complex ores.

******

INTERNATIONAL SYMPOSIUM ON THE GEOLOGY OF TIN DEPOSITS

Nanning City, Guangxi Zhuang Autonomous Region, China.

25 October - 5 November 1984 (to be confirmed)

Organized by: The Chinese Academy of Geological Sciences and the ESCAP Regional Mineral Resources Development Centre under the joint sponsorship of the Ministry of Geology and Mineral Resources, People's Republic of China and the United Nations Economic and Social Commission for Asia and the Pacific.

China, which has a history of over 1000 years of tin mining, has during recent decades significantly expanded and modernized its tin mining industry and is taking its place as one of the important producers in the Southeast Asian tin belt. To assist in better understanding of tin development in the region and the world, the Government of the People's Republic of China has invited ESCAP to join with it in organizing a symposium on the geology of tin deposits.

The symposium is designed to provide an opportunity for a number of specialists from countries with tin production or potential in the ESCAP region and other regions to meet with their Chinese colleagues to exchange information, experience and views on the study and investigation of tin deposits and tin mineralization and to familiarize themselves with some of the major tin deposits of Chine, both placer and primary.

The symposium will include a series of lectures by specialists and the presentation of country papers based on experience in the region. Meetings will be held at Nanning City and field trips will be organized in the neighbouring areas. There will also be a study tour of the Daching tin deposits, about 300 km north of Nanning. Nanning is located some 400 km west of Guangzhou (Canton).

Participants

About 100 participants are expected to take part in the Symposium, some 60 from China, 20 from developing countries in the ESCAP region, and 20 from other countries. A number of these will be international experts who will be invited to present background papers.

The Regional Mineral Resources Development Centre expects to be able to assist in covering the expenses of key participants from the ESCAP region with support provided by the United Nations Development Programme, the Government of the People's Republic of China and other sources. Participants from developed countries and from other regions will be expected to arrange to cover their own expenses for travel and accomodation.

The number of participants is limited by facilities, and all participants must make application to and receive invitations from ESCAP/RMRDC or the People's Republic of China. Participants who request RMRDC support should apply through official government channels of their country.

The symposium will be in English with facilities for simultaneous translation into and from Chinese.

Topics of the Symposium

A. Geology of Tin Deposits

1. Description of typical tin deposits
2. Geological setting of tin deposits
3. Mechanisms and patterns of tin mineralization
4. Genetic types of tin deposits
5. Assiciated ore deposits

B. Tin Exploration and Surveys

1. Geological, geochemical, geophysical and analytical techniques in the study of tin deposits
2. Exploration strategies
3. Sample preparation methods
4. Analysis techniques (chemical and other)
5. Country papers on tin exploration and prospecting

Presentation of Papers

All participants will be expected to submit papers based on their experience and related to the above topics. The sponsors in China will responsible for the selection and collection of papers from Chinese participants and from international experts invited by the Government. ESCAP/RMRDC will be responsible for papers from participants in the ESCAP region.

Titles and abstracts on the order of 500 words (2 typed pages) should be submitted to the appropriate point of contact (see below) before 31 May 1984. Completed manuscripts must be submitted by 15 August in order to be included in the symposium.

Abstracts will be circulated to all participants in advance of the symposium, and the proceedings including all accepted papers will be published in both Chinese and English after the Symposium.

Information

For further information, and submission of applications and abstracts please contact either:

Mr. Zhang Sihui, Deputy President,
Chinese Academy of Geological Sciences,
Baiwanzhuang Road,
Fuchengmenwai,
Beijing,
CHINA.

or

Co-ordinator,
Regional Mineral Resources Development Centre,
P.O. Box 19,
Bandung,
INDONESIA.

******

KURSUS-KURSUS LATIHAN (TRAINING COURSES)

A bracketed date (Mar-Apr 1983) denotes entry in that issue carried additional information.

January 1984-March 1984

Remote sensing application and digital image processing (Enschede, The Netherlands). Certificate courses on techniques for national resources surveys, organized annually by the International Institute of Aerial Surveys and Earth Sciences (ITC). Sponsored by Unesco, English. For information: ITC Student Affairs Office, P.O. Box 6, 7500 AA Enschede, The Netherlands.

January 16-July 13, 1984

Post-experience courses on water resources technology in developing countries (Birmingham, U.K.). For information: Dr. N.T. Kettegoda, Dept. Civil Engineering, University of Birmingham, Box 363, Birmingham, U.K. B15 2TT.

February 1984 - March 1984

Geochemical prospecting techniques (Tervuren, Belgium). Annual course sponsored by the Royal Museum of Central Africa and UNDP. French. For information: Musée royal de l'Afrique centrale, Steenveg op Leuven, 13, B-1980 Tervuren, Belgium.

February 1984 - November 1984

Photointerpretation applied to geology and geotechnics (Bogota, Colombia). Course organized by the Interamerican Centre of Photointerpretation (CIAF) in cooperation with ITC and Unesco. Spanish. For information: Academic Secretariat of the CIAF, Apartado Aereo 53754, Bogota 2, Colombia.

February 15 1984 - December 15 1984

Geothermics (Pisa, Italy). Certificate course organized annually by the Istituto Internazionale per le Ricerche Geotermiche and sponsored by Unesco, UNDP and Italy. English. For information: Dr. Mario Fanelli, Istituto Internazionale per le Ricerche Geotermiche, Via Buongusto 1, 56100 Pisa, Italy. Telephone (050) 41503 or 46069.

March 5 - 30 1984

Geological and hydrological hazards (Denver, Colorado, USA). Training course for foreign scientists organized by the U.S. Geological Survey. English. For information. Training Section, Office of International Geology, U.S. Geological Survey, National Center, M/S 917, Reston, VA 22092, USA.

March 1984 - April 1984

Mineral exploration (Paris, France). Short course based on a simulation method organized annually by the Ecole Nationale Superieure des Mines and sponsored by Unesco. French. For information: Prof. H. Pelissonnier, Ecole des Mines, 60 Bd Saint Michel, 75272 Paris, Cedex 06, France.

April 23 - May 25 1984

Applications in geologic and hydrologic exploration and planning (Sioux Falls, South Dakota, USA) International Workshop. For information: Chief, Training and Assistance, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD57198, USA. Telephone: (605) 594-6114.

May 28 - June 29 1984

Remote sensing: geologic applications (Flagstaff, Arizona, USA). Advanced training program for foreign scientists organized by U.S. Geological Survey. English. For information: U.S. Geological Survey Training Center, 917 National Center, Reston, Virginia 22092, USA.

July 1984

Regional geochemical exploration in tropics (Recife, Brazil). 3-week workshop. For information: Prof. Arao Horowitz, Coordenador do Programa de Mestrado em Quimica, Univ. Federal de Pernambuco, Cidade Universitaria, 50000 Recife, Brazil.

July 1984 - August 1984

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. Spanish. For information: Prof. T. Monseur, Departamento de Geologia y Geoquimica, Facultad de Ciencias, Universidad Autonoma de Madrid, Canto Blanco, Madrid 34, Spain.

September 1984 - November 1984

Geothermal energy (Kyushu, Japan). Annual short course organized by the Government of Japan and sponsored by Unesco. English. For information: Japan International Cooperation Agency (2nd Training Division, Training Affairs Department), P.O. Box 216, Shinjuku Mitsui Building, 2-1 Nishi-shinjuku, Shinkuku-ku, Tokyo 160, Japan.

September 1984 - November 1984

Mining 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. English. For information: ITC (ME), 3 Kanaalweg, 2628 Delft, The Netherlands.

October 1984 - November 1984

Tectonics, seismology and seismic risk assessments (Potsdam, G.D.R.). One month training course organized annually by East German Academy of Sciences in collaboration with Unesco. English. For information: Prof. Dr. H. Kautzleben, Director, Central Earth's Physics Institute, Academy of Sciences of the German Democratic Republic, Telegraphenberg, DDR 1500 Potsdam, G.D.R.

October 1 - November 2, 1984

Remote sensing: Geologic applications (Flagstaff, Arizona, USA). Advanced training program for foreign scientists organized by U.S. Geological Survey. English. For information: U.S. Geological Survey Training Center, 917 National Center, Reston, Virginia 22092, USA.

October 1984 - September 1985

Fundamental and Applied Quaternary Geology (Brussels, Belgium). Annually organized training course leading to a Master's degree on Quaternary Geology by the Vrije Universiteit Brussel (IFAQ) and sponsored by Unesco. English and French. For information: Prof. Dr. R.

Paepe, Director of IFAQ, Kwartairgeologie, Vrije Universiteit Brussel, Pleinlaan 2, B-1050, Brussels, Belgium.

*****

KALENDAR (CALENDAR)

A bracketed date (Mar-Apr 1983) denotes entry in that issue carried additional information.

1984

March 18 - 25 : Land subsidence (3rd International Symposium), Venice, Italy. Sponsored by IAH. (A. Ivan Johnson, 3rd International Symposium on Land Subsidence, Woodward-Clyde Consultants, 7600 East Orchard Road, Englewood, Co. 80111, USA).

March 19 - 23 : Offshore Mineral Resources (2nd International Seminar), Brest, France, Languages: French and English (Mr. Louis Galtier, Association Germinal, B.P. 6009, 45060 Orleans, Cedex, France).

March 25 - 29 : Soil salinity under irrigation - processes and management (International Meeting), Bet Dagan, Israel. Sponsored by ISSS and Israel Society of Soil Science. (Dr. B. Yaron, P.O. Box 3054, Tel-Aviv 61030, Israel).

March 26 - 30 : Computer applications in the mineral industries (18th International Symposium), London, U.K. Organized by the Institution of Mining and Metallurgy. (The Conference Office, Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, UK).

March 26 - 30 : Recent advances in mineral science and technology (International Conference), Johannesburg, South Africa. Sponsored by the South African Council for Mineral Technology. (The Conference Secretary (C.25), Mintek, Private Bag X3015, Randburg, 2125 South Africa) (May-Jun 1983).

March 27 - 31 : Landplan II - Geoscience applied to urban problems in SE Asia (Workshop), Kuala Lumpur. (Organizing Secretary, Landplan II, Dept. of Geoology, University of Malaya, Kuala Lumpur 22-11, Malaysia).

April 9 - 13 : Geology, Mineral and Energy Resources of Southeast Asia (GEOSEA V), Kuala Lumpur, Malaysia. Sponsored by Geological Society of Malaysia. (T.T. Khoo, Dept. of Geology, University of Malaya, Kuala Lumpur 22-11, Malaysia).

April 12 - 13 : Diagenesis and low-temperature metamorphism (Meeting), Bristol, U.K. (D. Robinson, Department of Geology, The University, Queen's Building, University Walks, Bristol BS8 1TR, U.K.).

May 10 - 12 : Mineralisation in volcanic processes (Geological Society and Volcanic Studies Group Joint Meeting), Aberystwyth, Wales, U.K. (Geological Society, Burlington House, Piccadilly, London W1V OJU, UK).

May 14 - 18	:	Geomechanics (4th Australia-New Zealand Conference), Perth, Western Australia. (The Conference Manager, 4th A.N.Z. Geomechanics Conference, The Institution of Engineers, Australia, 11 National Circuit, Barton, ACT 2600, Australia).
May 20 - 23	:	Industrial minerals (6th International Congress), Toronto, Canada. (B.M. Coope - Editor, Industrial Minerals, 45/46 Lower Marsh, London SE1, UK).
May 21 - 23	:	Aggregates (International Symposium), Nice, France. Sponsored by IAEG. Languages: English and French. (M. Louis Prime), L.C.P.C., 58 boulevard Lefebvre, 75732 Paris Cedex 15, France).
May 21 - 23	:	Climate: Present, past and future (Symposium), New York, N.Y., USA. Sponsored by Columbia University in honour of Rhodes W. Fairbridge. (John E. Sanders, Dept. of Geology, Columbia University, 606 West 120 Street, New York, NY 10027, USA).
May 21 - 23	:	Groundwater resource utilization and contaminant Hydrogeology (International Symposium), Montreal, Quebec, Canada. Sponsored by Canadian National Chapter of IAH and CWWA. Languages: English and French. (Mr. H. Sommelet, Geomines Ltd., 1010 Sherbrooke St. W., Suite 2202, Montreal, Quebec, Canada H3A 2R7).
June 5 - 11	:	Geology of the Himalayas (International Symposium), Chengdu, China. Field excursion to Tibet. Languages: Chinese and English. (Mr. Li Tingdong, Secretary-General of the Organizing Committee, c/o Chinese Academy of Geological Sciences, Baiwanzhuan, Beijing, P.R. China).
June 6 - 9	:	Interpraevent (Interdisciplinary Symposium on mountain rivers, torrents, snow avalanches, slope stability, etc.) Villach, Austria. (Interpraevent 1984, Postfach 134, A-9501, Villach, Austria).
June 15 - 17	:	Sedimentology of nearshore and shelf sands and sandstones (Research Symposium), Calgary, Canada. (R. John Knight, Petro-Canada, P.O. Box 2844, Calgary, Alberta, Canada T2P 3E3).
June 18 - 23	:	7th International Peat Congress, Dublin, Ireland. Study tours and post-congress tours. (International Peat Congress, c/o Bordna Mona, Lower Baggot Street, Dublin 2, Ireland).
June 20 - 23	:	Geomembranes (International Conference), Denver, Colorado, USA. Conference to precede the Impermeable Barriers for Soil and Rock Symposium. (A. Ivan Johnson, Woodward-Clyde Consultants, P.O. Box 4036, Denver, Co. 20204, USA).
June 23 - 26	:	Practical applications of groundwater geochemistry (Workshop), Banff, Alberta, Canada. (Dr. E.I. Wallick, Alberta Research Council, 5th Floor, Terrace Plaza, 4445 Calgary Trail South, Edmonton, Alberta, Canada T6H 5R7).

June 23 - 30 : Melanges of the Appalachian Orogen (Penrose Conference), Newfoundland. (B. Lorenz, Department of Earth Sciences, Memorial University, St. Johns, Newfoundland, Canada A1B 3X5)

June 24 - 27 : Codata (9th International Conference), Jerusalem, Israel. (The Secretariat, 9th International CODATA Conference, 122 Hayarkon Street, P.O. Box 3054, 61030 Tel Aviv, Israel)

June 26 - 28 : Deep structure of the continental crust (International Symposium), Ithaca, N.Y., USA. (Muawia Barazangi, Department of Geological Sciences, Cornell University, Ithaca, NY 14853, USA).

July : Volcanic Soils (International Panel) Tenerife, Canary Islands. (M.E. Fernandez Caldas, Dpto, de Edafologia, Univ. de la Laguna, Tenerife, Islas Canarias, Spain)

August : Mapping of the soil-water balance (Meeting), Budapest, Hungary. (Dr. W.G. Sombroek, ISSS, International Soil Museum, 9 Duivendaal, POB 353, 6700 A.J. Wageningen, The Netherlands)

Aug 4 - 14 : 27th International Geological Congress, Moscow, USSR. (N.A. Bogdanov, General Secretary, Organizing Committee of the 27th IGC, Staromonetny per. 22, Moscow 109180, USSR)

Aug 9 - 18 : Crystallography, (13th General Assembly and International Congress), Hamburg, F.R.G. (E.E. Snider, American Crystallographic Association, 335 East 45th Street, New York, NY 10017, USA).

Aug 24 - 30 : 6th International Palynological Conference, Calgary, Canada. Sponsored by ICP, CAP, CSPG, the University of Calgary, and Arctic Institute of North America. Pre- and post-Conference excursions. (L. Kokoski, Conference Office, Faculty of Continuing Education, Education Tower Room 102, Calgary, Alberta, Canada T2N 1N4)

Aug 27 - 31 : Water movement in heavy clay soils (Meeting), Wageningen, Netherlands. (Dr. W.G. Sombroek, ISSS, International Soil Museum, 9 Duivendaal, POB 353, 6700 A.J. Wageningen, The Netherlands)

Sept 3 - 8 : Caledonide Orogen, (IGCP Project 27, Working Group Meeting), Edinburgh, Scotland. Pre-Meeting excursions in Ireland, Scotland, England and Wales. (A.L. Harris, The University of Liverpool, Jame Herdman Laboratories of Geology, Brownlow Street, P,O. Box 147, Liverpool L69 3BX, UK)

Sept 10 - 14 : Titanium (5th International Conference), Munich, F.R.G. (Deutsche Gesellschaft fur Metallkunde EV, Adenauerallee 21, D-6370 Oberursel 1, F.R.G.)

Sept 16 - 22 : Landslides (4th International Symposium), Toronto, Canada. Sponsored in part by IAEG (Mr. J.L. Seychuk, Chairman, Organizing Committee, ISL/84, P.O. Box 370, Station A, Rexdale, Ont., Canada M9W 5L3)

Oct 1 - 5	: Remote sensing of environment (18th International Symposium), Paris, France. (Environmental Research Institute of Michigan, P.O. Box 8618, Ann Arbor, MI 48107, USA)
Oct 14 - 20	: Mineral processing and extractive metallurgy. (International Conference), Kunming, P.R. China. (The Secretary, Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, UK)
Oct 31 - Nov 7	: Seismology and physics of the earth's interior (Regional Assembly of the International Association) Hyderabad, India. (Organizing Committee, IASPEI Regional Assembly, National Geophysical Research Institute, Hyderabad 500 007, India)
Nov/Dec	: Land evaluation for soil erosion hazard assessment (Meeting), Enschede, Netherlands. (Dr. W.G. Sombroek, ISSS, International Soil Museum, 9 Duivendaal, POB 353, 6700 A.J. Wageningen, The Netherlands)
Nov 5 - 8	: Geological Society of America (Annual Meeting), Reno, USA. (S.S. Beggs, Geological Society of America, P.O. Box 9140, 330 Penrose Place, Boulder, Co. 80301, USA)
Nov 19 - 22	: 12th World Mining Congress, New Delhi, India (Organizing Committee, Institute of Engineers, 8 Gokhale Road, Calcutta 700 020, India)
Nov 20 - Dec 5	: Late Quaternary Sea-Level Changes (International Symposium and Field Meeting), Argentina and Chile. IGCP - 200 and INAUA Commission on Quaternary Shorelines. (Prof. Dr. Enrique Schnack, Centro de Geologia de Costas, C.C. 722, Correo Central, ARG-7600, Mar del Plata, Argentina)
Dec 2 - 5	: Future petroleum provinces of the world (AAPG W.E. Pratt Memorial Conference), Phoenix, Ariz., USA. (AAPG, P.O. Box 979, Tulsa, OK 74101, USA)
Dec 2 - 6	: Society of Exploration Geophysicists, (54th Annual Meeting), Atlanta, Georgia, USA. (J. Hyden, SEG, Box 3098, Tulsa, Oklahoma 74101, USA)

1985

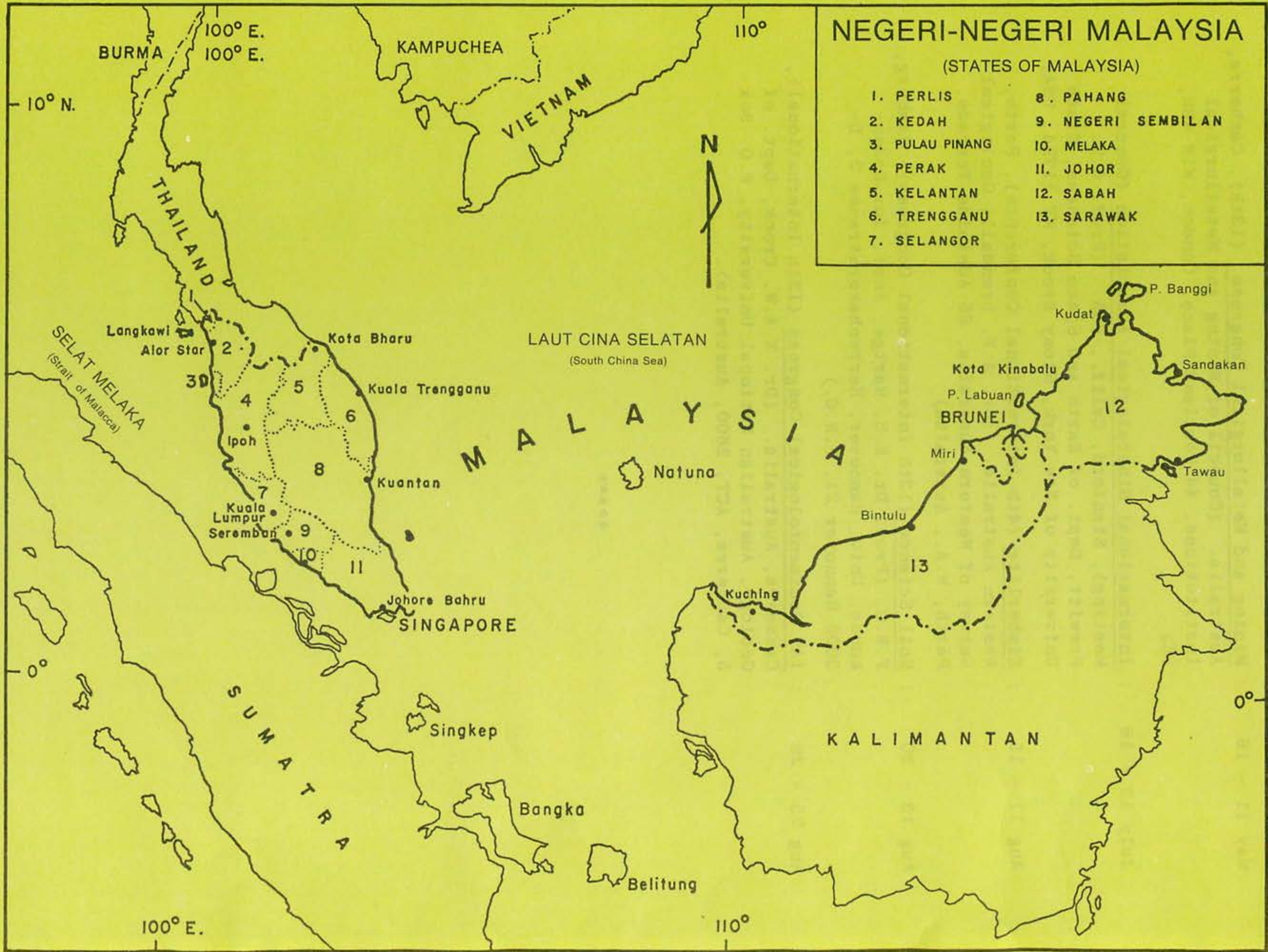
January	: International Association of Hydrogeologists (International Congress), Tucson, Arizona, USA. Sponsored by IAH and AGU. (Eugene S. Simpson, Dept. of Hydrology and Water Resources, College of Earth Sciences, The University of ARizona, Tucson, AZ 85721, USA)
January	: Acid-Sulphate Soils (meeting), Dakar, Senegal. (Dr. W.G. Sombroek, ISSS, International Soil Museum, 9 Duivendaal, POB 353, 6700 A.J. Wageningen, The Netherlands)
Feb 11 - 14	: Asian Mining '85 (2nd Conference), Manila, Philippines. (Meeting Secretary, The Institute of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, UK)

April 10 - 12	: Forum on the Geology of Industrial Minerals, ann. mtg. Tucson, Ariz. (H. Wesley Peirce, Arizona Bureau of Geology & Mineral Technology, 845 N. Park Ave. Tucson 85719. Phone 602/621-7906)
June	: Tunnelling (4th International Symposium), Brighton, UK. (The Secretary, Institute of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, UK)
June 9 - 15	: Water Resources (5th World Congress), Brussels, Belgium. (Dr. L.W. Debacker, c/o Brussels International Conference Centre, Parc des Expositions, Place de Belgique, B-1020 Brussels, Belgium)
July 28 - Aug 2	: 8th International Clay Conference, Denver, Colorado. Sponsored by AIPEA. (Dr. A.J. Herbillon, Groupe de Physico-Chimie Minerale et de Catalyse, Univ. Catholique de Louvain, Place Croix du Sud 1, B-1348 Louvain-la-Neuve, Belgium)
Aug 19 - 23	: Sixth Gondwana Symposium. Columbus, Ohio, USA. Sponsored by IUGS and Geological Society of America. (D. Elliott, Inst. of Polar Studies, Ohio State University, 103 Mendenhall, 125 South Oval Mall, Columbus, Oh 43210, USA)
Sep 8 - 13	: Hydrogeology in the service of man (18th IAH Congress - International Symposium), Cambridge, UK. (J. Day, Hydrogeology Unit, Maclean Building, Crowmarsch Gifford, Wallingford, OX10 8BB, UK)
Sept 9 - 13	: Fossil and living brachipods (Meeting), Brest, France. (Congres Brachiopodes, Univ. Bretagne occidentale, Laboratoire du Paleozoique - 6, av. Le Gorgen 29283 Brest Cedex, France)
Sept 15 - 21	: Geomorphology, resources, environment and the developing world (International Conference), Manchester, UK. (Prof. Ian Douglas, School of Geography, University of Manchester, Manchester M13 9PL, UK)
Sept 22 - 28	: Chemrawn IV: Chemistry and resources of the global Ocean (Meeting), Woods Hole, Mass., USA. (Prof. G. Ourisson, Centre de Neurochimie, Universite Louis Pasteur, 5 rue Blaise Pascal, F-67084 Strasbourg, France)
Sept 22 - 26	: High heat production granites, hydrothermal circulation and ore genesis, mtg. St. Austell, Cornwall. (Institution of Mining & Metallurgy, 44 Portland Place, London W1N 4BR. Phone: 01-580 3802. Tel-ex. 261410)

1986

May 11 - 16	:	Mining and Metallurgical Congress (13th), Canberra, Australia. (Council of Mining and Metallurgical Institutions, 44 Portland Place, London, W1N 4BR, UK)
July 13 - 18	:	International Mineralogical Association (General Meeting), Stanford, Calif., USA. (Prof. C.T. Prewitt, Dept. of Earth and Space Sciences, State University of New York, Stony Brook, NY 11794, USA)
Aug 11 - 15	:	Kimberlite (4th International Conference), Perth, Western Australia. (Dr. A.F. brendall, Geological Survey of Western Australia, 66 Adelaide Terrace, Perth, W.A., Australia)
Aug 13 - 20	:	Soil Science (13th International Congress), Hamburg, F.R.G. (Prof. Dr. K.H. Hartge, Inst. fur Boden-kunde, Univ. Hannover, Herrenhaserstrasse 2, D-3000 Hannover 21, F.R.G.)
Aug 25 - 29	:	IAS Sedimentological Congress (12th International), Canberra, Australia. (Dr. K.A.W. Crook, Dept. of Geology, Australian National University, P.O. Box 5, Canberra, ACT, 2600, Australia).

*****



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
100° E.
100° E.
10° N.
KAMPUCHEA
VIETNAM
110°
N
THAILAND
Langkawi
Alor Star
Kota Bharu
Kuala Trengganu
Ipoh
Kuantan
Kuala Lumpur
Seremban
Johore Bahru
SINGAPORE
SELAT MELAKA
(Strait of Malacca)
LAUT CINA SELATAN
(South China Sea)
MALAYSIA
Natuna
P. Banggi
Kudat
Sandakan
Kota Kinabalu
P. Labuan
BRUNEI
Miri
Tawau
Bintulu
Kuching
KALIMANTAN
0°
SUMATRA
Singkep
Bangka
Belitung
100° E.
110°