

## PERSATUAN GEOLOGI MALAYSIA

# WARTA GEOLOGI

## NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MALAYSIA

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DIKELUARKAN DWIBULANAN  
ISSUED BIMONTHLY

PERSATUAN GEOLOGI MALAYSIA  
(GEOLOGICAL SOCIETY OF MALAYSIA)

Majlis (Council) 1979/80

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Address of Society: Geological Society of Malaysia  
c/o Dept. of Geology  
University of Malaya  
Kuala Lumpur 22-11, Malaysia.

## CATITAN GEOLOGI (GEOLOGICAL NOTES)

Titanaugite from Bukit Kemuning, Kemaman, Trengganu, Peninsular Malaysia.  
S. CHANDRA KUMAR, Jabatan Geologi, Universiti Malaya, Kuala Lumpur.

Hornfelsed xenoliths of variable sizes are common in a small stock-like body of gabbroic rocks exposed on Bukit Kemuning, Kemaman, Trengganu (Fig. 1). Along the western edge of the gabbroic body, close to its contact with Lower Carboniferous regionally metamorphosed sediments, virtually every outcrop of gabbro is clogged with xenoliths.

The xenoliths represent a wide variety of rock types amongst which are banded basic granular hornfels containing an unusual vividly pleochroic titanaugite. The mineral is almost always fine-grained and forms granoblastic aggregates segregated into layers which alternate with felsic bands. Some samples are virtually monomineralic comprising more than 90% of the titanaugite alone. In such rocks the layering is barely visible as the felsic bands become very narrow and discontinuous. The leucocratic layers are usually a cloudy cryptocrystalline mass of altered plagioclase which finger into the adjacent pyroxene-rich bands. Rare garnet and calcite may be associated with these felsic layers. Advanced alteration of plagioclase appears to be characteristic of these titanaugite-rich rocks. Amphibole, sphene and biotite occur in variable amounts. Like the titanaugite they are also strongly coloured and pleochroic. Apatite is a common accessory.

The titanaugite from the banded basic granular hornfels is a mineral of special interest because of its distinct chemistry (Table 1, no. 1) and association. This conspicuous clinopyroxene with pleochroic scheme  $\alpha = \beta = \text{lilac}$ ,  $\gamma = \text{greenish yellow}$ , is always optically positive. However, the 2V is highly variable generally between 32 and 47 while some sections even appear pseuduniaxial. Powder X-ray diffraction data of the extracted mineral are presented in Table 2. Similar metamorphic titanaugite described in the literature (Coulson, 1930; Tilley and Harwood, 1931; Dixon and Kennedy, 1933; Sadashivaiah, 1950; Sabine, 1975) are unique in their constant association with calcareous sediments thermally metamorphosed by gabbroic magma. The Kemuning titanaugite is almost identical in chemistry to the mineral described by Tilley and Harwood (1931), (see Table 1, no. 2) from a dolerite-chalk contact at Scawt Hill, Co. Antrim, N. Ireland. The four analyses of metamorphic titanaugites associated with basic intrusives are distinct from titanaugites of igneous paragenesis (cf. Deer, *et al.*, 1978, p. 319-320) by their exceptionally high alumina content (9.5 to 14.29 wt.%) and low silica values (37.52 to 40.36). In this respect it is noteworthy that a metamorphic titanaugite from calcareous hornfels associated with a granitic intrusion considered by Kuno (1960) to be similar to the species from Aberdeenshire, Scotland (Dixon and Kennedy, 1933) and Rajputana, India (Coulson, 1930) is in fact somewhat different.  $\text{Al}_2\text{O}_3$  and  $\text{SiO}_2$  contents of this mineral cannot be distinguished from those of the igneous titanaugites. Alternatively, the species described by Kuno may be better classified as a titanium-rich fassaite while the Kemuning metamorphic titanaugite and similar minerals may be considered titanium-rich, silica-poor fassaite.

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- Tilley, C.E., and Harwood, H.F., 1931. The dolerite-chalk contact of Scawt Hill, Co. Antrim. The production of basic alkali-rocks by the assimilation of limestone by basaltic magma. Min. Mag., 22, 439 - 468.

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Table 1. Chemical compositions of metamorphic titanite

	1	2	3	4	5
SiO <sub>2</sub>	40.36	40.28	37.52	39.9	45.50
TiO <sub>2</sub>	3.98	3.85	5.72	5.2	2.47
Al <sub>2</sub> O <sub>3</sub>	10.03	10.30	14.29	9.5	6.89
Fe <sub>2</sub> O <sub>3</sub>	5.43	5.35	4.43	3.9	3.24
FeO	6.38	7.92	7.12	12.9	3.88
MnO	0.21	-	0.14	0.25	0.08
MgO	8.11	7.78	6.72	4.6	11.81
CaO	23.23	23.57	24.06	22.7	25.95
Na <sub>2</sub> O	0.46	0.36	0.09	0.55	0.12
K <sub>2</sub> O	0.08	tr	tr	-	0.04
H <sub>2</sub> O <sup>+</sup>	-	0.19	0.00	0.20	0.58
H <sub>2</sub> O <sup>-</sup>	-	-	-	-	0.11
L.O.I.	1.54	-	-	-	-
Total	99.81	99.60	100.20	99.70	100.67

## Number of ions on the basis of six O

	1	2	3	4	5
Si	1.577	1.565	1.443	1.581	1.713
Al	0.423	0.435	0.557	0.419	0.287
Al	0.039	0.037	0.091	0.024	0.020
Ti	0.117	0.112	0.165	0.154	0.070
Fe <sup>3+</sup>	0.160	0.156	0.128	0.116	0.090
Mg <sup>2+</sup>	0.472	0.450	0.385	0.271	0.662
Fe <sup>2+</sup>	0.209	0.257	0.229	0.427	0.122
Mn	0.007	-	0.005	0.008	0.002
Ca	0.973	0.981	0.992	0.963	1.046
Na	0.035	0.027	0.006	0.042	0.009
K	0.004	0.000	0.000	-	0.000
Mg <sup>3+</sup> (Fe <sup>2+</sup> +Fe <sup>2+</sup> +Mn)	25.9	24.4	22.1	15.2	34.4
Ca	53.4	53.2	57.0	53.9	54.42

1. Titanite, banded basic granular hornfels (sample KE9A) Bukit Kemuning, Kemaman\*.
2. Titanite, dolerite-chalk contact rock, Scawt Hill Co., Antrim, N. Ireland (Tilley and Harwood, 1931).
3. Uniaxial titanite, hornfels xenolith, Haddo norite, Schivas, Aberdeenshire, Scotland (Dixon and Kennedy, 1933).
4. Titanite, dolerite-chalk contact rock, Carneal plug, Ballyvallah Bridge Co. Antrim, N. Ireland (Sabine, 1975).
5. Titanite, calcareous hornfels in schistose granite, Sasaki-zima, Japan (Kuno, 1960).

\* Analyst S. Chandra Kumar. All elements by XRF except Na and K by AAS. Fe<sub>2</sub>O<sub>3</sub> by titration.

Table 2. Powder X-ray diffraction data for the Kemuning metamorphic titanite

(CuK $\alpha$ )2 $\theta$ obs	d( $\text{\AA}$ )	I	(CuK $\alpha_1$ )2 $\theta$ obs	d( $\text{\AA}$ )	I
18.89	4.69	10	41.95	2.15	24
19.96	4.44	11	42.40	2.13	24
27.67	3.22	53	42.87	2.11	20
29.87	2.99	100	44.45	2.04	23
30.20	2.96	54	49.56	1.84	11
30.78	2.90	16	52.36	1.75	25
33.00	2.71	8	56.65	1.62	19
35.02	2.56	52	57.05	1.61	13
35.15	2.55	53	58.95	1.57	7
35.62	2.52	65	59.85	1.54	15
38.95	2.31	17	60.45	1.53	11
40.42	2.23	9	65.50	1.42	15
			66.38	1.41	10

2 $\theta$ obs in degrees: CuK $\alpha$   $\lambda$  = 1.5418

CuK $\alpha_1$   $\lambda$  = 1.54050

d( $\text{\AA}$ ) - interplanar spacing in Angstrom

I - relative intensity based on arbitrary scale as determined from peak heights on diffractogram.

Potassium bromate was used as the internal standard.

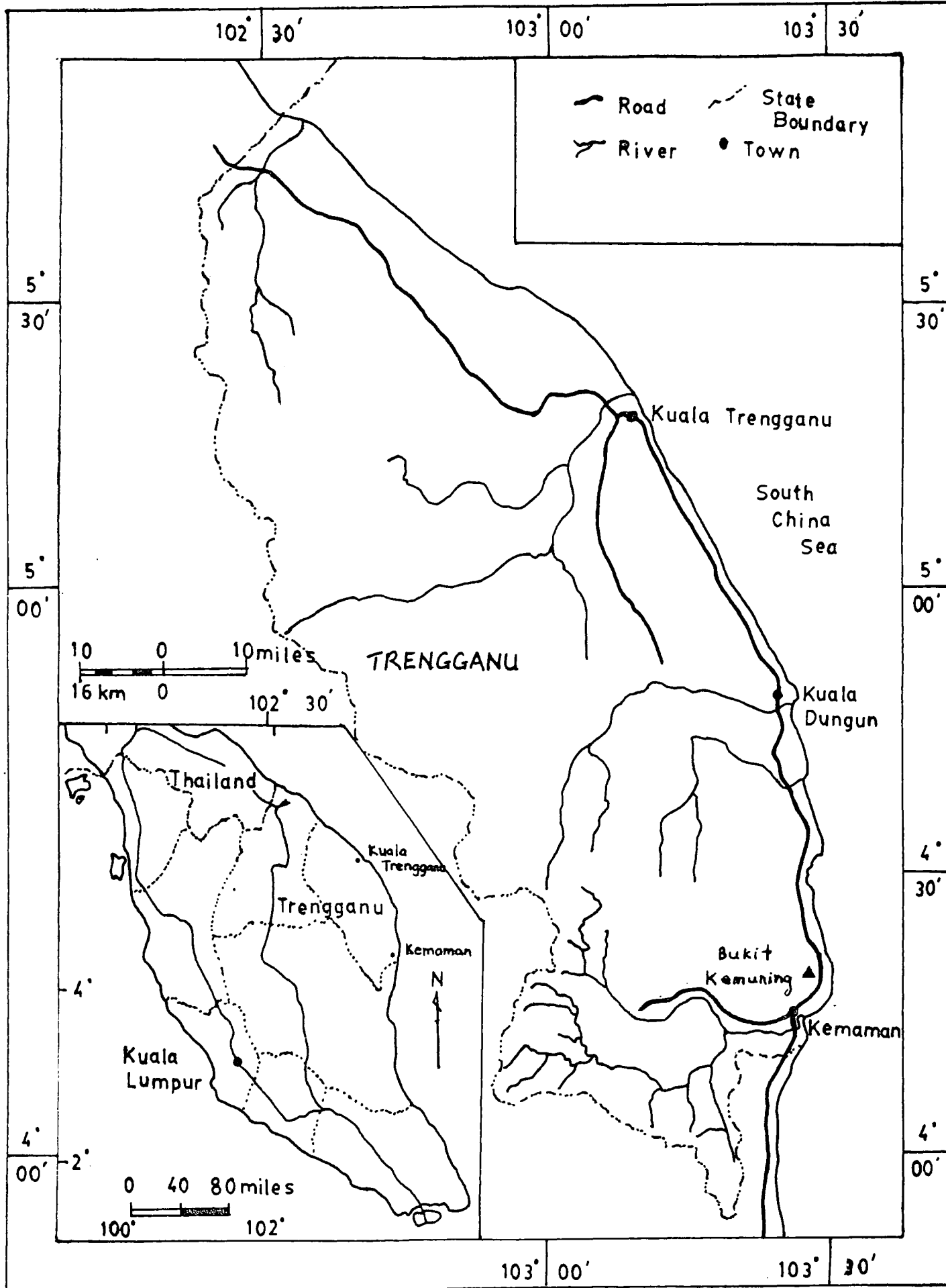


Fig. 1. Map showing location of Bukit Kemuning.

## MESYUARAT PERSATUAN ( MEETINGS OF THE SOCIETY )

Forum: Role of Geologists in National Development

The above forum was held at 5.00 p.m. on 7th January 1980 at the Dept. of Geology, University of Malaya. Members of the panel, consisting of distinguished geoscientists representing the main professions which have in the past provided the main avenues of employment for local graduates, were

1. En. S.K. Chung, Director-General, Geological Survey of Malaysia.
2. En. Eric Toh, Project Manager for Pahang Tenggara, Conzinc Riotinto.
3. En. J.H. Armitage, Exploration Manager, Esso Production Malaysia Inc.
4. En. L.S. Goh, Geologist, Sarawak Shell Bhd.
5. Prof. C.S. Hutchison, Head, Geology Dept., University of Malaya.
6. Dr. C. Samz, Assoc. Prof. (Geophysics), Universiti Sains Malaysia.
7. Dr. Ahmad Jantan, Head, Geology Dept., Universiti Kebangsaan Malaysia.

Dr. B.K. Tan, the Society President, chaired the meeting, which was attended by about 100 people and lasted for about 2 hours. Panel members delivered short presentations on the role of geologists and type of training provided in their various organisations besides touching on the employment situation for new graduates in the near future. A brief report incorporating other points and discussion follows:

En. S.K. Chung emphasized the role of the Survey geologists besides touching on the difficult working conditions in the field. Basically he felt that Survey geologists are poorly paid. Recruitment, however, is not handled by his department but by the Public Services Department (PSD).

En. Eric Toh painted a very gloomy picture of the present state of the country's mining industry. Restrictions of Federal and State Governments on mining land and the equity participation were listed as the main causes. As such, employment opportunities in the mining section are very dim for the moment.

En. J.H. Armitage declared that long-term planning by his company is restricted by short-term contracts in the petroleum industry. As a result, there is a slow down in the recruitment of fresh or experienced graduates and at the same time the racial composition will have to meet National Policies.

En. L.S. Goh spoke at some great length on the role of the geologist in the set-up of his company. He indicated the keenness of his organisation to take in fresh graduates.

Prof. C.S. Hutchison emphasised that although there are pure and applied geology streams at his University, the undergraduates are, nevertheless, given an all round geology course. To uphold the standard of our graduates he stressed the importance of having external examiners.

Dr. C. Samz, reported that although his University produced very few geophysicists annually, the graduates are well absorbed by the Geological Survey and oil companies.

Dr. Ahmad Jantan enlightened the gathering on the new structure of the geology courses at his University. With the setting up of the UKM campus at Kota Kinabalu, more places are available for students and at the same time tutors are also required.

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## R.C. Selley: Subsurface Facies Analysis

Several dozen members of the Society assembled at 5.30 p.m. on February 20th in the Geology Lecture Hall at the University of Malaya to hear Dr. R.C. Selley present a talk on "Subsurface facies analysis". The size of the audience was gratifying, considering that examinations were over and the university students therefore already scattered.

Dr. Selley, Reader at Imperial College in London and consultant in petroleum Geology, is well known for his studies in Libya and his books "Ancient Sedimentary Environments" and "An Introduction to Sedimentology". In his talk he reviewed the methods one can use to interpret the facies or environment of sediments in the subsurface, in particular (1) geophysical well logs and (2) critical diagnostic substances.

Two types of geophysical logs are used to interpret facies in the absence of core data. These are the SP (self-potential) and gamma logs, both of which give profiles more or less indicating grain size in clastic rocks. The SP log does this because the response is related to permeability, which in turn is related to grain size; the gamma log response is mainly dependent on the potassium percentage, which is related to clay mineral content and thence to grain size. In neither case is the relationship to grain size direct or unequivocal, and problems often do appear. One problem is with very coarse rocks containing abundant lutite clasts, whose clay mineral content may give a gamma log response suggesting a fine-grained sediment. The use of both logs together will often identify such unusual situations.

Where actual samples (cores or even cuttings) are available, two critical substances can give a quick diagnosis of environment for sandy sediments. These critical substances are glauconite, an exclusively marine product, and carbonaceous detritus, implying rapid sedimentation without much winnowing. The presence or absence of these two then allows quick placing of the sands into one of four classes:

1. GLAUC., CARB. DET. both present : 'Dumped' marine sands (submarine channel and fan)
2. GLAUC., no CARB. DET.: Winnowed marine sands (marine shelf sands - barrier, bar, or shoal)
3. CARB. DET., no GLAUC.: 'Dumped' non-marine sands (fluvial, lacustrine, or deltaic)
4. no GLAUC., no CARB. DET. : Winnowed non-marine sands (eolian?)

Obviously interpretations based on negative criteria are somewhat dangerous, and the speaker pointed out that assignments to the fourth category above must be considered especially doubtful.

Dr. Selley's talk was characterized by the same clarity, simplicity of expression and lucid organization as are seen in his useful books. After some questions from the floor, Mr. Leong Khee Meng of Petronas, a former student of Dr. Selley's at Imperial College, proposed a vote of thanks to the speaker for his interesting presentation.

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## BERITA PERSATUAN (NEWS OF THE SOCIETY)

Officers of the 1980/81 Council

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 (Vacant)  
 Immediate Past President: Tan Bock Kang, Jabatan Geologi, Universiti Malaya.

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Geology of North-west Peninsular Malaysia Seminar and Presidential Address

The above-mentioned events will be held on Friday, 25 April, 1980 in Rumah Universiti, Universiti Malaya, Kuala Lumpur. They will be followed by the Annual General Meeting at 5.00 p.m.

The programme for the day is as follows:

## S E M I N A R

- 0845 - 0915 : The Patani Metamorphics terrain - T.T. Khoo (Universiti Malaya).  
 0915 - 0945 : Hydrogeology of Kedah/Perlis - Ismail Noor and Tan Boon Kong (Universiti Kebangsaan Malaysia).  
 0945 - 1015 : Some magnetic studies of the Rest House area, Kedah Peak - Lim Beng Kung (Geomex).  
 1015 - 1045 : Tea.  
 1045 - 1115 : The Machinchang - Setul transition in Langkawi and Tarutao - C.P. Lee (Universiti Malaya).  
 1115 - 1145 : Some aspects of the stratigraphy and structure of the upper part of the Machinchang Formation and the lower part of the Setul Formation - Y.H. Ong and P.C. Aw (Geological Survey Malaysia).

- 1145 - 1215 : The Singa Formation: is it a glacial deposit? - P.H. Stauffer (Universiti Malaya).
- 1215 - 1415 : Lunch and Prayers.
- 1415 - 1445 : Stratigraphy and structure of islands off Gunung Jerai and the Merbok estuary area - W.Y. Foo (Petronas) and T.T. Khoo (Universiti Malaya).
- 1445 - 1515 : Sedimentology of the Kubang Pasu Formation, Kedah - Ahmad Jantan (Universiti Kebangsaan Malaysia).
- 1515 - 1545 : Late Permian and Early Triassic conodonts from the Kodiang Limestone Formation, Kedah - S.S. Yii and I. Metcalfe (Universiti Malaya).
- 1545 - 1645 : PRESIDENT ADDRESS: Structures in Peninsular Malaysia - facts and factasies - B.K. Tan (Universiti Malaya).
- 1645 - 1700 : Tea.
- 1700 - : ANNUAL GENERAL MEETING.

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#### Annual General Meeting

The Annual General Meeting of the Geological Society of Malaysia will be held at 5.00 p.m. on Friday, April 25th 1980 in Rumah Universiti, University of Malaya, Kuala Lumpur. Tea will be served at 4.45 p.m.

The agenda is as follows:

1. Confirmation of minutes of previous meeting.
2. Matters arising.
3. President's Report.
4. Hon. Secretary's Report.
5. Hon. Assistant Secretary's Report.
6. Editor's Report.
7. Treasurer's and Auditor's Reports.
8. Announcement of New Council.
9. Election of Hon. Auditor.
10. Any other business.

Members wishing to request for items for discussion to be included in the Agenda are reminded that such requests have to be received by the Secretary at least seven days before the meeting.

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#### Proposed field trip to Pulau Tarutao

Plans are being finalised with the Geological Society of Thailand, Dept. of Mineral Resources, Thailand and the Geological Research Project at Haadyai for this field trip. At the moment the itinerary is as follows:

- March 30th - K.L. to Alor Star, overnight at Alor Star.  
 March 31st - Alor Star to Thai border and take a boat from Satun  
 to Tarutao Island. Night at Tarutao Island.  
 April 1st - Geological visit around Tarutao Island. Night  
 at Tarutao Island.  
 April 2nd - Geological visit in the morning around Tarutao  
 Island. Return to mainland and Haadyai or Alor Star.  
 End of trip.

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Seminar on Industrial Minerals : Preliminary announcement

The Society intends holding the above seminar sometime in July 1980.

Those who wish to present papers should write to:

The Organising Secretary  
 GSM Seminar on Industrial Minerals  
 c/o Dept. of Geology  
 Universiti Malaya  
 Kuala Lumpur 22-11, Malaysia.

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Editor's Note

Many of you would have realised that the last two issues of the Warta Geologi have had no back covers! The reason being that stocks of our purple-coloured covers are almost exhausted.

As a stroke of good timing (very much unforeseen) we start the 1980s with a new colour and slightly re-designed front cover for our newsletter.

Will this facelift be incentive enough to motivate you members to contribute to the Warta Geologi, especially the section on 'geological notes'? I know of one, a regular contributor, who has succumbed. We are dangerously low on such contributions and we hope members will make good use of this avenue in the newsletter to get their discoveries or anything geologically interesting dissipated in quick time. Remember that 'geological notes' published in the Warta Geologi are refereed and should not be slighted.

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New Library Additions

The following publications were added to the Society's collection:

1. Late Pleistocene stratigraphy of the area around Muhos, North Finland by P.L. Gibbard, 1979.
2. Berliner Geowissenschaftliche Abhandlungen Band 6-12, 14.
3. IMM Transactions/Section C, vol. 88, 1979.
4. IMM Bull. 877, 1979 & 878-879, 1980.
5. National Library Singapore, adult reference collections, accessions

- list, Nov, 1979 and Jan, 1980.
6. Acta Palaeontologica Sinica, vol. 18, no. 5, 1979.
  7. Acta Stratigraphica Sinica, vol. 3, no. 3, 1979.
  8. Grondboor and Hamer, nos. 2-6, 1979.
  9. Commonwealth Geological Liaison Office, no. 12, 1979 and no. 1, 1980.
  10. Bulletin of the American Museum of Natural History, vol. 164, article 2, 1979.
  11. American Museum Novitates, no. 2688, 1979.
  12. Stability of stratigraphical nomenclature by J.D. Lawson. Newsl. Stratigr. 7(3), 159-165, 1979.
  13. Fossils and lithostratigraphy by J.D. Lawson. Lethaia, vol. 12, 189-191, 1979.
  14. IMM Transaction/Section B, vol. 88, 1979.
  15. Procedure of the long-term forecast of oil exploration and production (in Russian).
  16. Geological structures and petroleum potential of northern Africa, near and Middle East (in Russian).
  17. Bibliography Yearbook for 1973 year, vols. I & II, (in Russian).
  18. Short notes on fossil locality of Pleistocene crabs and cuttlefish bones, Sg. Kolok, SE Thailand.
  19. Annual Report: Inst. of Geoscience, The University of Tsukuba, no. 5, 1979.
  20. Memoirs of the Ehime University, v. viii, no. 4, 1979.
  21. 9th International Congress of Carboniferous stratigraphy and geology, 1979: 9 papers.
  22. Jour. Fac. Science, The University of Tokyo, vol. 20, no. 1, 1979.
  23. Palaeontologica sinica, new series B, no. 15, 1979.
  24. Cambrian mineral deposits in China and the bio-environmental contral hypothesis by Lu Yen Hao, 1979.
  25. On a study of the Subera Siaian Stromatolites from Jixian County, north China by Tianjin. Inst. of Geology & Mineral, Nat. Bureau of Geology, 1979.
  26. Magnetostratigraphic polarity units - a supplementary chapter of the ISSC International Stratigraphic Guide, 1979.
  27. International subcommission on stratigraphic classification of IUGS commission on stratigraphy. Circular no. 59, 1980.
  28. Commonwealth Geol. Liaison Office, newsletter no. 2, 1980.
  29. SEATRAD Library, acquisition list, Feb, 1980.
  30. SEATRAD Library, list of periodicals.
  31. Bulletin of the National Science Museum, series C, vol. 5, no. 4, 1979.

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### Membership

The following persons have joined the Society:

#### Full Membership

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13. A.P. Whittle, Esso Production, Kuala Lumpur.
14. R.L. George, Gaffney, Cline & Assoc., 21A Goldhill Plaza (Podium Block), Singapore 1130.
15. Foo Ban Nyen, FBN Minerals, 2 Jln SS23/6, Damansara Jaya, P.J.

#### Student Membership

1. Low Far Nam, Jabatan Kejuruteraan Petroleum, Universiti Teknologi Malaysia, Kuala Lumpur.
2. Zaidi Yaacob, - same -
3. Abd. Halim b. Che Abas, - same -
4. Mohamed Wahid Kario, - same -
5. Abdullah Kasim, - same -
6. Ab. Wahab Ngah, - same -
7. Mohamad Abdullah, - same -
8. Mohd. Hata Sukiran, - same -
9. Ridzuan Ali, - same -
10. Ismail Abdul Razak, - same -
11. Koh Lee Song, - same -
12. Md. Padzil Hasan Ahmad, - same -
13. Mohd. Rashid Abd. Ghani, - same -
14. Munabir Sahri, - same -
15. Mohd. Nasir Haji Abdul Rahman, - same -
16. Ng Kim Seng, - same -
17. Shubli Adnan, - same -
18. Lee Chih Chiang, - same -
19. Samsuddin Selamat, - same -
20. Hareesh B.K. Pillai, - same -
21. Mohd. Zazali Salim, - same -
22. Muhammad Ekrami Daud, - same -
23. Raif Muslim, - same -
24. Mahbob Haji Abdul Manan, - same -
25. Ahmad Dalimi Kaser, - same -
26. Zainal Din, - same -
27. Wan Zakaria Wan Taib, - same -
28. Md. Wakif Sukahar, - same -
29. Samsudin Mohamed Yusoff, - same -
30. Mohd. Norani Abd. Rahman, - same -
31. Mohd. Anuar b. Mohd. Yusof, Jabatan Geologi, Universiti Kebangsaan Malaysia, Kuala Lumpur.
32. Zulkifli Mohd. Yusoff, - same -
33. Zakaria Mohamad, - same -

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#### Change of Address

The following members have informed the Society of new addresses as indicated:

1. J.G.Wilson, P.O. Box 365, Fyshwick, ACT 2609, Australia.
2. Clive R. Jones, 6 Scholars Close, St Peters Avenue, Caversham, Reading RG4 7DN, England.

3. Md. Shahid Ayub, Robert Menzies College, P.O. Box 145, North Ryde, NSW 2113, Australia.
4. Abdullah bin Haji Mohd. Salleh, Pejabat Penyiasatan Kajibumi, Perak Utara, Bukit Kerajaan, Kuala Kangsar, Perak.

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#### BERITA-BERITA LAIN (OTHER NEWS)

##### International Course on Applied Mineral Economics for Developing Countries

The International Course on Applied Mineral Economics for Developing Countries, sponsored by AGID in cooperation with the Government of State of Paraiba and Companhia de Pesquisa de Recursos Minerais (CPRM), will be held at Joao Pessoa, Paraiba, Brazil, from September 10 - 26, 1980, in Joao Pessoa's Tambau Hotel.

The objectives of the Course are: to stimulate a rational view of the importance of mineral resources in each country, their economics and evolution in order to respond to the increasing demands of the national economy; to prepare professionals involved in teaching or practicing in mineral economics in Government or private enterprises in techniques and strategies towards the development of mineral resources.

A total of fifty participants are expected to join the course. The preliminary composition of the participants is: 15 - from Central and South America, 10 - from Brazil, 10 - from Africa, and 15 - from Asia.

Course participants should have a Bachelor degree and must be involved in teaching or practicing of mineral economics. The programe will include lectures, case studies on selected metals and minerals and presentation of individual projects.

The Course is divided into: (1) Opening Forum, (2) Lectures on Applied Mineral Economics theory and practice, (3) Case studies on metallic and industrial mineral economics, (4) Individual projects of interest of participants and their countries:

- (1) Opening Forum:
  - (a) Mineral Economics of Brazil
  - (b) Mineral Economics of Northeastern Brazil.
- (2) Lectures on Applied Mineral Economics:
  - (a) The Economics of Mineral Supply
  - (b) Mineral Investment Decision Techniques
  - (c) Operational Investment Issue
  - (d) Optimizing Mine Development Decision Variable
  - (e) Exploration Economics and Strategies
  - (f) Risk Analysis Techniques and their Application
  - (g) Mineral Marketing and Trade
  - (h) Mineral Supply
  - (i) Transnational Resource Exploration Corporations
  - (j) National Mineral Policies in Developing Countries.
- (3) The Proposed Case Studies to be discussed are:
  - (a) Iron Ore
  - (b) Manganese Ore
  - (c) Copper
  - (d) Lead and Zinc

- (e) Tungsten
- (f) Gold and precious stones
- (g) Tin
- (h) Aluminium
- (i) Industrial Minerals

- (4) The program will also include presentation of individual projects by the participants. Such projects, as background papers, should be submitted before June 30.

The tuition fee is US\$200 and will include one Set of the Course notes and transportation to field trips. Accommodation is available at Tambau Hotel, single room rates about US\$25 per night. Teachers from abroad will be invited to conduct lectures and debates on background paper. Case-studies will be analysed by specialists in the various mineral substances.

Grants for travel, tuition fees and living expenses are available. Application forms are obtainable from the Hon. Secretary, Geological Society of Malaysia. A short resume of professional life is required for selection of the course participants, who should submit their application forms before April 30, 1980.

All other correspondence regarding the course should be addressed to: Dr. Eliseu D'Angelo Visconti Neto, CPRM/DAF  
President of Organizing Committee  
Ave. Pasteur no. 404 - Rio de Janeiro  
22.292, Rio de Janeiro, Brazil.

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#### 1981 AAPG Convention in San Francisco

The American Association of Petroleum Geologists and the Society of Exploration Geophysicists are sponsoring a research symposium session titled "Geological and Geophysical Rationale Related to the Deliberate Search for the Subtle Trap (Stratigraphic, Unconformity and Paleogeomorphic)" as part of the Convention.

Papers should be on geophysical or geological studies which will shed light on ancient environments that favour the formation of subtle hydro-carbon traps together with open discussions on how these traps may be searched for and delineated.

Anyone interested in presenting a paper should write to the following address: Michel T. Halbouty  
The Halbouty Center  
5100 Westheimer Road  
Houston, Texas 77056, USA.

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#### Sapphire-bearing Denchai Basalt of Thailand dated as Late Miocene

The Denchai basalt of northern Thailand consists of seven flows extruded during an interval (or intervals) of reversed polarity of the Earth's magnetic field, accordingly to a paper by Sandra M. Barr and Alan S. MacDonald, formerly of Chiangmai University, Thailand. (Palaeomagnetism, age and geochemistry of the Denchai basalt, northern Thailand: Earth and Planetary Science Letters 46, 1979, 113-124). The basalt



covers about 70 km<sup>2</sup>, and a sample of the top flow has been dated by the K-Ar method in the Institute of Geological Sciences, London, at 5.64 ± 0.24 Ma. The basalt changed from "hawaiite" (transitional to continental tholeiite) to true hawaiite and then to basanite. Sapphire and zircon mined from "gravel" deposits on the basalt are probably derived from the basanite.

Elsewhere in Indochina, in the Chantaburi (SE Thailand) and Pailin (SE Cambodia) areas, the source of sapphire, ruby, and zircon, is very undersaturated basanites and nephelinites. Spinel lherzolite nodules in the Denchai basalt, the authors suggest, were carried up from depths of 50 km or so.

The authors conclude that these alkali basalts, together with the other widespread late Cainozoic basalts of Indo-China, are probably "an expression of complex tectonic phenomena", possibly associated with tension arising from the opening of the Andaman Sea, rotation of parts of South-east Asia, opening of the South China Sea, and interactions between the Indian and Eurasian plates.

Since late Cainozoic basalts occur elsewhere around the South China Sea, (e.g. Kuantan, Malaysia) it would be interesting to know whether any trace of volcanic activity of this age is recorded in offshore oil-wells in the Thai and Malayan basins.

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#### Finding oil or gas - the odds

The odds of finding a really large oil or gas field in the U.S. through wildcat drilling are 1,820 to one according to a study just completed by the American Association of Petroleum Geologists.

John J. Amoruso, a Houston consultant and independent, chaired the special AAPG committee that compiled the study. The study covered the last decade, 1969 - 78, when the oil industry drilled 54,610 new field wildcats.

AAPG defined new field discoveries in four categories and assigned letters A through D to them with "A" designated as a new field discovery with ultimate recovery of 50 million barrels of oil or more than 300 billion cubic feet of gas. (North Slope of Alaska discoveries were not included in the study).

"Of the total wells drilled only 30 received the "A" designation," said Amoruso, "and only 933 were recorded as significant - that is with estimated recovery of more than one million barrels of oil or more than 6 billion cubic feet of gas."

AAPG defined "B" discoveries as capable of recovering from 25 to 50 million barrels of oil or from 150 to 300 billion cubic feet of gas. "C" was graded from 10 to 25 million barrels of oil or 60 to 150 billion cubic feet of gas, and "D" from one to 10 million barrels of oil or six to 60 billion cubic feet of gas.

Of the total new field wildcat wells drilled during the decade the

16 largest oil companies drilled 5,752 or 10.5 percent while all other operators drilled 48,585 or 89.5 percent.

Ranked according to lease revenue, the 16 largest companies used in the study were: Exxon, California Standard, Mobil, Gulf, Texaco, Indiana Standard, Atlantic Richfield, Shell, Continental, Phillips, Getty, Ohio Standard, Union of California, Sun, Marathon and Cities Service.

Amoruso said that current estimates of the reserves found in significant fields (A-D) by the decade of drilling are 2.8 billion barrels of oil and 41.3 trillion cubic feet of gas. Domestic production (excluding Alaska) during 1969-78 was 31.4 billion barrels of oil and 210 trillion cubic feet of gas.

The study showed that the 16 largest companies discovered 1.5 billion barrels of oil (53.7 percent of the total), 16.6 trillion cubic feet of natural gas (40.3 percent of the total).

All other operators discovered 1.3 billion barrels of oil (46.3 percent of the total), and 24.7 trillion cubic feet of gas, (59.7 percent of the total).

According to the Bureau of Census data for the five-year period, 1973-1977, the 16 largest companies accounted for about 60 percent of industry expenditures for geological geophysical information and lease acquisition, and paid for about 35 percent of the costs of all exploratory drilling.

All other operators accounted for 65 percent of the cost of all exploratory drilling in the U.S. over the five-year period. AAPG's study drew the inference that the large oil companies explore for oil and gas and buy leases at levels proportionate to their share of total U.S. production, but when it comes to exploratory drilling these companies account for only about one-third of all money spent.

The largest companies spent more than twice as much on pre-drilling exploration, such as seismographic and other exploration techniques. Other operators spent twice as much for actual drilling. The larger companies concentrate exploration and drill wildcats on high cost, high risk, deeper and potentially more rewarding prospects than the average of those drilled by all other operators.

Total cost of all exploration and wildcat drilling for the decade amounted to \$34.4 billion.

"Only 933 wells were listed by AAPG in the significant A to D categories, representing less than two percent of the total wildcats drilled," said Amoruso.

(AAPG News, Jan 21, 1980)

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Fourth Industrial Minerals International Congress

Atlanta, Georgia, USA. 28th, 29th, 31st May 1980.

The programme will include aspects of mineral markets, forecasting methods, energy, energy conservation, processing, exploration, the mineral

potential of the developing nations, and environmental considerations. The meeting will cover:

1. Kaolin and future
2. Markets for flint clays, minerals sands, rare earths and mica
3. Iron ore as an industrial mineral
4. Processing silica sand to a glass-grade
5. Energy conservation in mineral processing
6. Satellites as exploration tools for industrial minerals
7. Market forecasting, resources and reserves, risk philosophies
8. Industrial minerals in some developing countries (Venezuela, Nigeria, Kenya, and the Yeman)
9. Desulphurization using lime
10. A variety of 'mini-sessions' on topics current at the time of the meeting.

Pre- and post-congress tours have been arranged to visit producers of kaolin, iron oxide and barite (Georgia); lithium/feldspar/mica/silica sand (North Carolina); and mineral sands/phosphate rock/clays (Florida).

The Congress has been designed to retain its international and commercial flavour established at the three previous meetings - London (1974), Munich (1976), and Paris (1978) - and once again should provide an excellent meeting place for those interested in industrial minerals.

For further details contact: Industrial Minerals  
708 Third Avenue, 23rd Floor  
New York, New York 10017, USA.

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International Conference on Applied Mineralogy in the Mineral Industry

Johannesburg, 24th - 26th June, 1981

Organised by the National Institute for Metallurgy (South Africa) and the Geological Society of South Africa in collaboration with the Chamber of Mines of South Africa and the South African Iron and Steel Industrial Corporation Ltd., the conference will cover the complete spectrum of mineralogical activity in the exploitation of base metals, precious metals, carbonaceous materials, and base minerals (including building and construction materials and industrial minerals), in the area of geological and geochemical exploration, ore characterization and exploratory metallurgical testing, mining, grade control and metallurgical-plant operation, refining, and utilization. Also included will be investigations of refractories, ceramics, cement, slags, inclusions in iron, steel, and sinter coke, and various non-metallic inorganic crystalline materials used during industrial processes.

1. Titles and short abstracts by 31st March, 1980.
2. Extended abstracts by 1st June 1980.
3. Full papers by 20th December 1980.
4. The language of the conference will be English.

Contributors will be notified by 31st July 1980, if their contributions have been accepted.

All enquiries and submissions should be sent to

The Conference Manager  
 ICAM 81  
 National Institute for Metallurgy  
 Private Bag X3015  
 Randburg  
 2125 South Africa.

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### Mineralogy Word Puzzle

The puzzle contains names of minerals. The required words can be found either horizontally, vertically or diagonally in the puzzle. Some of the words are arranged with the letters in reverse, e.g. 'lapo' should read 'opal'. The 'ite' of a mineral ending in 'ite' is not included in the puzzle, e.g. 'kyanite' would appear as 'kyan' in the puzzle.

Clues are also given for the hidden minerals. Answers will be given in the next issue of the Warta Geologi.

V	O	R	A	V	U	C	D	P	E
S	P	V	P	A	K	U	K	N	P
R	H	Y	N	F	U	E	I	Y	S
E	E	M	R	S	Y	L	X	Z	O
H	N	O	S	O	A	X	I	N	M
T	A	Q	T	M	M	R	R	O	C
I	C	J	R	R	Q	O	Q	B	L
W	V	U	O	Z	N	O	R	B	B
S	O	B	W	E	J	U	L	P	D
T	T	I	V	M	C	R	Y	T	H

### Clues

1. The Kung-fu fighter (4 + ite).
2. The 'kapak' hit man from Kelantan (4 + ite).
3. The age counsellor of the Carbonate Mafia (6 + ite).
4. The fair lady of the Feldspathoid Family (4 + ite).
5. The Greek deceiver (6 + ite).
6. The horse-racing punter (5 + ite).
7. The Leader in fiery form (9 + ite).
8. Member of the Pyroxene Family who won a Games medal (5 + ite).
9. The Russian noble in the pomegranate orchard (6 + ite).
10. Turamali, the Ceylonese Rolling Stone.

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Calendar1980

- Mar 4 - 6 : Petroleum Geology of the Continental Shelf of North-West Europe, London, U.K. Miss I. McCann, Conference Officer, London, W1M 8AR, U.K.
- Mar 24 - 28 : AAPG Petroleum Reservoir Fundamentals School. AAPG Education Dept., P.O. Box 979, Tulsa, Okla. 74101, USA.
- Apr 7 - 11 : International Symposium on Landslides 'ISL 1980', New Delhi. Dr. R.K. Bhandari, Organizing Secretary, ISL 1980, P.O. Central Road Research Inst., New Delhi, 110002, India.
- Apr 10 - 15 : 8th International Geochemical Exploration Symposium, Hannover, Fed. Rep. Germany. Dr. H. Gundlach, Organising Committee, 8th International Geochemical Exploration Symposium, P.O. Box 51 01 53, D-3000 Hannover 51, F.R.G. (Jul-Aug 1978).
- May 12 - 14 : Conference on Soil Science and Agricultural Development in Malaysia. Secretary, Executive Committee, Conference on Soil Science and Agricultural Development, P.O. Box 2644, Kuala Lumpur, Malaysia (Jul-Aug 1979).
- May 12 - 16 : International Archaean Symposium, Perth, Australia. Sponsored by IGCP Archaean Geochemistry project and Geological Society of Australia. (J.A. Hallberg, Archaean Symposium, CSIRO, Division of Mineralogy, Private Bag, Wembly, Australia 6014.
- May 27 - 28 : Ninth Annual Convention of the Indonesian Petroleum Association. Indonesia Petroleum Association, Lecture Committee, Jalan Menteng Raya 3, Jakarta, Indonesia. (Sep-Oct 1979).
- May 27 - 30 : National and International Management of Mineral Resources. The Secretary, Institute of Mining and Metallurgy, 44 Portland Place, London, W1N 4BR, U.K. (Mar-Apr 1979).
- May 28 - 30 : 4th Industrial Minerals International Congress, Atlanta, U.S. Details from Metal Bulletin Congresses Ltd., Park House, Park Terrace, Worcester Park, Surrey KT4 7HY, U.K.
- Jun 2 - 4 : Conference on application of rock mechanics to cut and fill mining. Prof. Ove Stephansson, Dept. of Rock Mechanics, University of Lulea, S-951 87 Lulea, Sweden. (Nov-Dec 1979).
- Jun 3 - 5 : IVth International Precious Metals Conference, Toronto. Details from International Precious Metals Institute, Polytechnic Institute of New York, 333 Jay Street, Brooklyn, NY 11201, USA.
- Jun 25 - 27 : Fore-Arc Sedimentation and Tectonics in Modern and Ancient Subduction Zones, London, U.K. J.K. Leggett, Dept. of Geology, Imperial College, Prince Consort Road, London, SW7 2AZ, U.K.
- Jun 29 - : Fifth International Palynological Conference, Cambridge, England, U.K. Conference with field excursions. (Mrs. G.E. Drewry, Dept. of Geology, Sedgwick Museum, Downing Street, Cambridge, CB2 3EQ, England).
- Jul 4 - 7 : General meeting of the International Mineralogical Association (IMA), Orleans, France. Scientific and poster sessions, field excursions. (Secretariat de la 12eme

- Assemblee Generale de l'IMA, B.R.G.M., BP 6009, 45018, Orleans, Cedex, France).
- Jul 7 - 17 : 26th International Geological Congress, Paris, France. Paul Sangnier, Secretaire General du 26eme C.G.I., Maison de la Geologie, 77-79 rue Claude-Bernard, 75005, France. (Nov-Dec 1977).
- Jul 14 - 24 : International Symposium on water-rock interaction, Edmonton, Alberta, Canada. Sponsored by IAGC and the Alberta Research Council. (B. Hitchon, Alberta Research Council, 11315, 87th Avenue, Edmonton, Alberta, Canada T6G 2C2).
- Jul 29 - : Second European Conodont Symposium (ECOS II), Austria and  
Aug 10 : Czechoslovakia. Symposium with pre- and post-symposium field trips co-sponsored by the Geological Survey of Austria and Geological Survey of Czechoslovakia. (ECOS II, Geological Survey of Austria, P.O. Box 154, Rasumofskygasse 23, A-1031, Vienna, Austria).
- Sep 6 : Congress on Science and Technology in Resource Development. Secretary, Jubilee Science Congress, c/o Malaysian Scientific Association, P.O. Box 911, Kuala Lumpur. (Nov-Dec 1979).
- Sep 8 - 13 : World Conference on Earthquake Engineering, Istanbul, Turkey, A. Gurpinar, Secretary, 7 WCEE, Yuksel Caddesi 7/B, Ankara, Turkey.
- Sep 17 - 19 : Eurotunnel '80, Basle, Switzerland. Conference on Tunnelling in Europe. (Secretary, Institute of Mining and Metallurgy, 44 Portland Place, London, W1N 4BR, U.K.).
- Oct 5 - 8 : Complex sulphide ores, Rome, Italy, Organised by IMM in association with Consiglio Nazionale delle Ricerche (Laboratorio per il Trattamento del Minerals). The Secretary, IMM, 44 Portland Place, London W1N 1BR, U.K.
- Oct 6 - 13 : Workshop on Age Dating by the Unesco Geosciences Network. Prof. B.K. Kim, Executive Secretary, Geosciences Network, Seoul National University, Seoul, South Korea.
- Oct 13 - 17 : Second International Conference of Scientific Editors, Amsterdam, Holland. (J.L. Heller, U.S. Geological Survey, MS 303, Box 25046, Federal Center, Denver, Colorado 80225, USA).

### 1981

- Mar 29 - : International Conference on Arid Soils-Properties,  
Apr 4 : Genesis and Management, Jerusalem, Israel. International Conference on Arid Soils - Properties, Genesis and Management, P.O. Box 3054, 122 Hayarkon St., Tel Aviv, Israel. (May-Jun 1979).

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