

GEOLOGICAL SOCIETY OF HONG KONG

# 香港地質學會

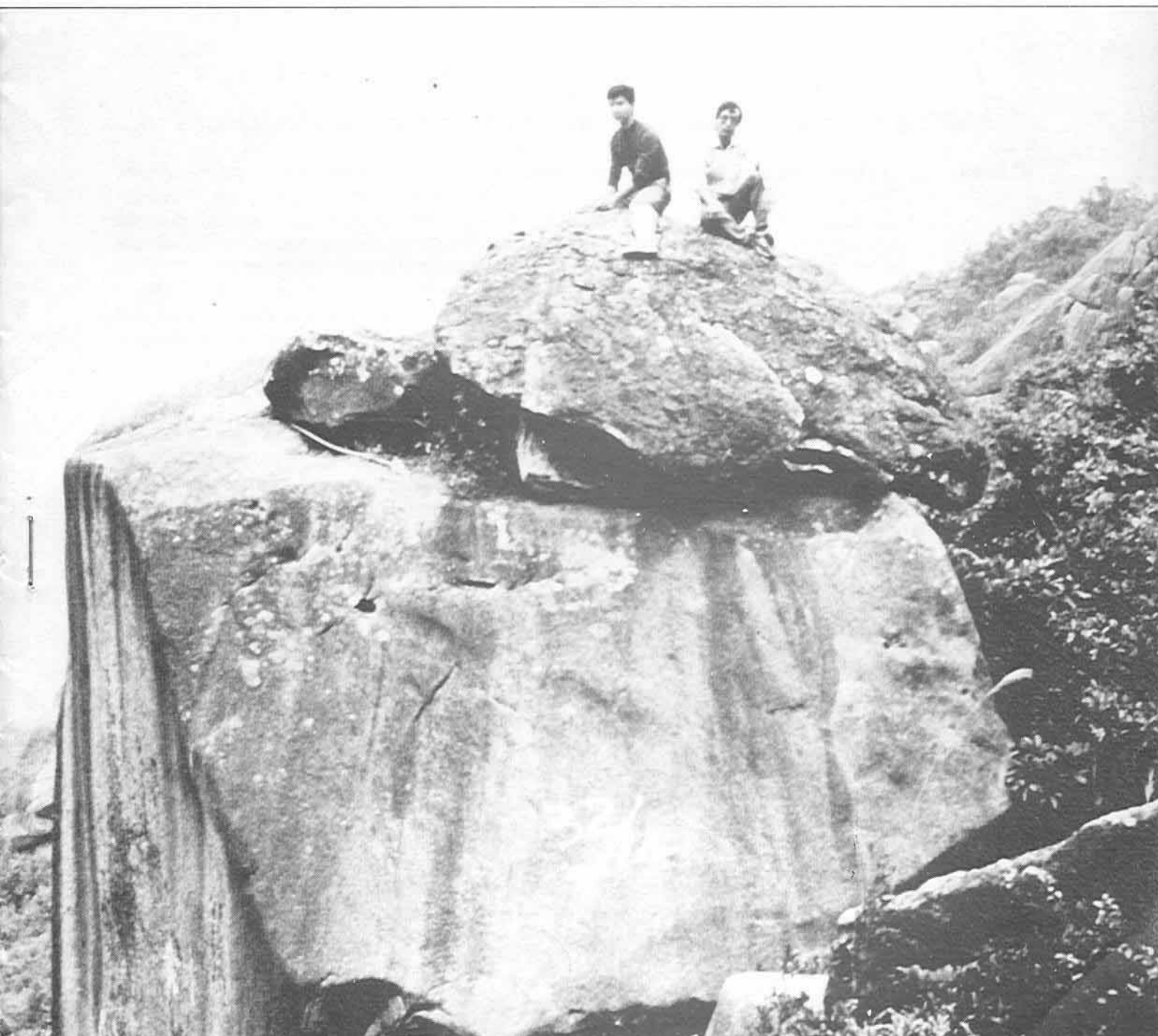
NEWSLETTER

通訊

第七卷 第二期

一九八九年六月

Vol. 7, Part II, June 1989



## GEOLOGICAL SOCIETY OF HONG KONG

		Office Tel. No.
General Committee: (1989 - 90)	Mr. M.J. Atherton (Chairman)	-- 3-638344 X793
	Mr. K.W. Lee (Vice-Chairman)	-- 5-8909211
	Dr. R.L. Langford (Secretary)	-- 3-667916
	Mr. E.P.Y. Chau (Editor)	-- 0-4750421 X211
	Mr. C.M. Lee (Treasurer)	-- 3-638344 X591
	Mr. H.S. Chan	-- 0-6056771
	Mr. H.M. Keung	-- 3-405916
	Mr. H.L. Law	-- 5-8392493
	Dr. R. Shaw	-- 3-7230441
	Mr. C.H. Tan	-- 5-8936988
	Mr. K.M. Wong	-- 3-325621
	Dr. D.R. Workman	-- 5-8592831
Marine Studies Group:	Mr. C. Dutton (Chairman)	
	Dr. R. Shaw (Secretary)	
Teachers Group:	Mr. H.M. Keung	

### NOTES FOR THE GUIDANCE OF CONTRIBUTORS TO THE NEWSLETTER

**General:** Typescripts, enquiries and all correspondence should be addressed to the Secretary, Geological Society of Hong Kong, C/o Dept. of Geography and Geology, University of Hong Kong. The Society does not assume copyright of material published in the Newsletter. Any other previous, current or expected future use of such material by the author must be stated at the time of submission.

Articles of a technical nature, as well as reports of interesting events, reviews and other topical items are welcome. Contributions must be short, although exceptions may be made at the discretion of the Society. Figures, tables, and half-tone plates must be kept to a minimum and must be all on separate sheets.

Typescripts must be accurate and in their final form. Two complete copies should be sent to the Secretary. Typescripts should be double-spaced, including references, on one side only of the paper only with a 2.5cm margin on each side. A4 paper is preferred. All pages should bear the author's name, and be numbered serially.

Send only photocopies of illustrations, retaining the originals until the Society asks for them. Originals should bear the author's name. Diagrams should be in black on tracing material or smooth white paper or board, with a line weight suitable for reduction. A metric scale should be included, and North Point (or where relevant, coordinates of latitude and longitude) on all maps. Avoid using fine proprietary symbols (e.g. Letratone) on figures that are likely to be reduced.

**References:** The author is responsible for ensuring that all references are correct. Unless the list of references is extensive, references should be given in full; where used, Journal abbreviations must comply with those in the List of Serial publications held in the Library of the Geological Society of London (Geological Society, 1978).

**Offprints:** The Society does not provide authors with free offprints of items published in the Newsletter, but will obtain quotations on behalf of authors of technical articles who may wish to purchase offprints from the printer.

# CONTENTS

Meeting Announcement	
Rock Cavern - Hong Kong	33
Forthcoming Field Excursions	
Discovery Bay	34
Meisha Beach	34
Kung Chau and Port Island	34
Meeting Reports	
The Buried Geology of Yuen Long	35
Seismicity of Daya Bay Region	41
Recent Fossil Finds in Hong Kong	42
Other Society News and Announcements	
Annual General Meeting - Draft Minutes	44
Treasurer's Report	44
Membership News	47
Subscriptions	47
Recent Publications on Hong Kong Geology	48
Discovery of an Ammonite Fossil near Yuen Long	49
Progress of the Engineering Geology Graduate Training Scheme of the Hong Kong Government	52
Conglomerate - fragments from various sources	
Sea-Level Changes: Current Perspectives	55
Pulsed Basin Evolution of the Northern Margin of the South China Sea	57
Nuclear Power Plants in Proximity to Active faults	58
Reports of Field Excursions	
Mai Po, San Tin and Pok Ta Hau	59
Northwest Guangdong	61
Discussion on "How safe is Daya Bay?"	65
Book Reviews	67
Booking and Reply Slips - inside back cover	

\* \* \* \* \*

CORRECTION - FROM HONG KONG POLYTECHNIC

Newsletter, v. 6 (1988), p. 55

The item (9) on the Department of Civil and Structural Engineering at Hong Kong Polytechnic should read:

"Currently employs two engineering geologists of senior lecturer grade to teach B.Sc. (Hons) degree and higher diploma and higher Certificate courses in Civil Engineering".





MEETING ANNOUNCEMENT

ROCK CAVERN - HONG KONG

A one day Seminar organised by the  
Institution of Mining & Metallurgy - HK Section

with the support of  
Hong Kong Institution of Engineers  
International Society for Rock Mechanics  
Institution of Geologists - HK Group  
Institute of Quarrying - HK Branch  
Geological Society of Hong Kong

FIRST NOTICE

Date and venue  
8th December 1989  
Hong Kong Arts Centre

Theme

A one day seminar to explore the theme of rock caverns and their potential in Hong Kong will be held under the auspices of the IMM in December 1989. The Seminar will briefly cover historical aspects and worldwide cavern usage and will address the questions: are local rock conditions suitable; how are caverns designed; what could be put into caverns in Hong Kong; where are the most attractive locations; how much would it cost; under what conditions can the rock cavern option be financially viable or economically worthwhile? Project planning, land matters, and statutory regulations will also be covered.

Programme

A panel of invited speakers, from both Hong Kong and overseas, will present various aspects of the theme, and participants will have the opportunity to contribute in the discussion sessions.

All participants will receive a copy of the book of proceedings, "ROCK CAVERN - HONG KONG", which will include the papers presented at the seminar plus other selected contributions.

Attendance

If you expect to attend please return the reply slip soon in order to reserve your place. The cost of the Seminar including a copy of the book of papers is likely to be about HK\$150. Please do not send any remittance at this time however.

## FORTHCOMING FIELD EXCURSIONS

### DISCOVERY BAY : SATURDAY 22 JULY

Dr R.L. Langford (Hong Kong Geological Survey) will lead a trip to look at dykes and granite at Discovery Bay. The first part of the trip will be to the east end of the golf course, where extensive rock slopes show the dykes, some of which may be composite. The site commands excellent views towards Hong Kong. The second part of the trip will be to the Phase IV development.

Transport to the top of the hill has been arranged with the contractor. The party will then walk down to the hill before returning to Hong Kong.

The cost will be \$20 each way on the Discovery Bay ferry. Assemble outside the ferry entrance on Blake Pier at 8.45 for 9.00 departure. Return should be between 2 and 3 p.m.

Those interested should contact Dr Langford (3-667916 work or 5-760234 home). Hip Hing Construction Ltd. have agreed to provide assistance and access, but will accept no liability. Please bring hard hats.

\* \* \* \* \*

### MEISHA BEACH : SUNDAY 23 JULY

We will travel by direct Citibus from Middle Road Terminal, Tsim Sha Tsui (behind YMCA) at 9 a.m. to Meisha beach (Club Med Hotel) via Sha Tau Kok. Returning at 3 p.m.

Meisha is a beautiful beach for swimming and walkers may explore the hinterland behind the beach and the granite cliffs beyond.

Meet: 8.45 a.m. at bus stop

Cost (return): Adults HK\$50. Children 2-15 yrs. HK\$30

Passport holder: Must obtain their own visa in HK before departure

Lunch & drink: Own arrangements

Booking to C.M. Lee CSE Polytechnic Hung Hom 3-638344 ext. 591, with cheque by Monday 10th July payable to Geological Society of Hong Kong. Booking slip inside back cover of this Newsletter.

\* \* \* \* \*

### KUNG CHAU (OFF TAP MUN) AND PORT ISLAND: SUNDAY 27 AUGUST

dep. Ma Liu Shui public ferry pier, 10 min. walk from University Station (KCR), at 9.30 a.m. Return there about 5 p.m. BRING FOOD AND DRINK.

COST \$45 (\$55 FOR NON-FAMILY GUESTS)

**\*\* BOOKING AND ADVANCE PAYMENT REQUIRED\*\***

- Booking slip inside back cover of this Newsletter.
- Enquiries: C.M. Lee 3-638344 ext. 591.

The Society's first landing on the small islet of Kung Chau, off the east coast of Tap Mun. A low tide of 0.4 m at 1.30 p.m. should give optimum conditions to explore. The island is said to be composed of tuffs, but there are pebbles of "Port Island" sedimentary rocks in a cave. Excellent exposures of outcrops of the latter on Port Island itself can be seen on a stopover there on the way back. If anyone wants to spend longer on Port Island, it should be possible to do so while others are visiting Kung Chau, by calling at Port Island first.

Good conditions for swimming, snorkelling and rocky-shoreline ecology at both places.

\* \* \* \* \*

## REPORTS OF RECENT MEETINGS

### LECTURE BY DR D.V. FROST : THE BURIED GEOLOGY OF YUEN LONG

On 19 April, at the Hong Kong Institution of Engineers, Dr D.V. Frost of the British Geology Survey, on secondment to the Geotechnical Control Office for a special study of the bedrock geology of the Northwest New Territories, gave a progress report on his work. This was a special joint meeting of the Combined Geotechnical Discipline of HKIE and the Geological Society, and the HKIE conference room was packed.

The following is a summary of the subject matter on which Dr Frost based his talk, as kindly supplied by him.

#### INTRODUCTION

It is only some ten years ago that marble was first discovered in a borehole in the north west New Territories, beneath a thick cover of superficial deposits which mask the complex solid geology of the area. This area is earmarked for new-town development proposing tower blocks up to 30 storeys high. As a result, hundreds of boreholes have been drilled for foundation and ground investigation purposes revealing rocks of the Carboniferous, Jurassic and Cretaceous periods. They have been folded, faulted and metamorphosed and eventually in the Tertiary period erosion of the younger rocks exposed Carboniferous marble at the surface. It suffered extensive karstification before a superficial cover of Quaternary muds, silts, sands and gravels stopped the process and protected the marble from further dissolution.

Development in this zone occupying some 60 sq. km and called the Designated Area, is carefully monitored by the Geotechnical Control Office of the Hong Kong Government. Funds were allocated in 1987 for a deep boring programme to locate the limits of the marble substrate and to construct a series of geological maps at a scale of 1:5000 to cover the area.

This two-year project is now at a half way stage and has located a structurally complex elongate basin from Tuen Mun in the south, through Yuen Long, & Lok Ma Chau to beyond the Chinese Border. The Carboniferous rocks, originally limestones, mudstones, siltstones, sandstones and conglomerates, have been converted into metasediments dipping steeply in places but generally to the north west. They are associated with Upper Jurassic volcanic rocks and Cretaceous intrusions of granites and granodiorites.

The dominant trend of the faulting and thrusting is parallel with the basin margins. This trend is interrupted and offset by a series of later NW-SE cross-faults probably of Tertiary age resulting in a complex marble sub-crop.

The upper part of the marble surface is an epikarst zone very irregular in profile showing numerous widened joint slots, overhangs and solution phenomena. The epikarst is some 20 m thick but underlain by further cavities to a maximum depth of about 80 m. Many of the cavities and joints are filled by sedimentary deposits.

REPORTS OF RECENT MEETINGS  
GENERALISED SUCCESSION OF THE DESIGNATED AREA

Recent	Fill or made ground	)
Quaternary	Pond & estuarine mud & peat	)
	Marine clays, silts, with shelly fauna	)
	Alluvial sands, silts and clays	)
	Alluvial gravels	)
Tertiary	Debris flow deposits	)
	Basaltic and doleritic intrusions	)
Cretaceous	Granites	)
Jurassic (Upper)	Volcanic ashes & tuffs	)
	(Lower) Sandstones with ammonites	)
Carboniferous	Metaconglomerates	)
	Metasiltstones & graphite schists	)
	Marble	)
Devonian	Sandstones & conglomerates	)

MARBLE & KARST

If limestone is heated to over 500°C and subjected to high pressures, most of the original sedimentary structures as well as faunal remains are destroyed. On cooling, the calcium carbonate recrystallises, the strength of crystallization resulting in a massive and extremely strong rock. This contrasts sharply with mudstones which develop a schistose texture. Any shaly or silty partings are streaked out into the typical marble patterns, making the identification of the original dip virtually impossible. Secondary minerals are introduced during the metamorphism such as tremolite, chlorite, sericite, and pyrite. Quartz and calcite veins are injected and intruded to complete the complex mozaic of marble texture.

To explain how the marble became so altered and why it is now riddled with cavities requires the introduction of the term KARST. It can be defined simply as a terrain with distinctive landforms and drainage arising from greater rock solubility in natural waters than elsewhere. Such a terrain can occur in a wide variety of climatic and tectonic settings.

When the calcium carbonate is exposed to rainwater - a weak carbonic acid - a complex solution process begins. The rock has already undergone a complex tectonic history and will contain a resultant pattern of fractures and joints in which the water will operate the dissolution process to the maximum effect. The cracks are accentuated into a pattern known in the UK as grikes (cracks) and clints (the remaining upstanding blocks of rock). A typical limestone pavement of this type is well exposed at Malham Cove in N. Yorkshire, England. The rate of dissolution will depend upon the purity of the limestone, its tectonic fabric, the water supply and the temperature.



Eventually the surface water in a limestone area finds its way down through the rock and travels underground in an ever increasing and widening cave system. The position at which the water or stream vanishes is defined as a "swallow hole", "swallet" or "pot hole" in the UK, but known as a "dolina" in Europe. Pot holes may develop in limestones which are only a few metres thick such as those in the Carboniferous Yoredale facies of north-east England.

Karst terminology originated in eastern Europe and many of the finest examples of the terrain can be seen in Yugoslavia. Here massive thick Cretaceous limestones and dolomites have a dominant NNW Dinaric trend giving an obvious "grain" to the region. Parallel to this trend are elongate, flat-bottomed, steep-sided depressions known as "poljes". The topography is considered to be a characteristic of late maturity in the erosion cycle, resulting from the enlargement and coalescence of smaller depressions such as dolinas by overall solution. A good example from the Lika region of Serbo - Croatia is the Kravsko Polje, some 15 miles long and 5 miles wide. The margins of this depression are faulted, and thrust-folded and associated with karst features known as "uvalas" - a form of hollow, intermediate in size between a dolina and a polje.

The most highly developed karst in the world occurs in China. In the south and west, over one third of the surface area is covered by carbonates with a total thickness of some 13,000 metres. Much of the overlying cover of Cretaceous and Tertiary red beds has been eroded resulting in three types of karst surfaces which are particularly well displayed in the Guilin region:

- (1) Pinnacle or stone forest
- (2) Cone or peak cluster (Fengcong)
- (3) Tower or peak forest (Fengling)

There are many variations of these types and an evolutionary sequence of the various forms is suggested. In the Guilin area the geologically complex structure comprising a series of anticlines and synclines bears little relationship to the karst topography of today. Tower karst was originally thought to be typical of hot, wet areas until Brook and Ford (1976) described similar features in the NW Territories of Canada which has a sub-arctic climate. Jennings (1982, 1987) believes that the tower karst is controlled by structure but the local evidence does not support this theory. It is possible that the karst pattern was initiated in the simpler structures of the overlying Cretaceous and Tertiary rocks and that this pattern is now superimposed on the underlying Carboniferous and Devonian carbonates.

#### YUEN LONG

Analysis of the borehole data in our local area has shown that the upper part of the marble surface contains many karst features. A rockhead contour map illustrates the irregularities of this surface and individual site examples show well-defined dolinas with a relief of some 40 m. (See Figs. on p.38).

The karst features are now choked by post Carboniferous sediments (paleokarst) and the process of dissolution has stopped. It could only start again if these superfcials are stripped-off such as



has occurred in the tin mining areas of Malaysia or if the water table is drastically lowered by overpumping, for example, as in some Chinese coal or mineral mines.

#### CAVES & CAVE DEPOSITS

Caves have long been famous for their picturesque stalagmites and stalactites but their importance is only just being realised in the way a slice of history is preserved which may be missing at surface elsewhere. The dating of cave sediments began using the usual order of superposition and perhaps the vertebrate content. Floral remains, pollen grains, etc. are usually rare except perhaps in the entrance areas. Radiocarbon dating can go back some 34,000 years but is liable to large errors. The ratio of Uranium 234 to Thorium 230 decay in calcite deposits of speleothems can cover the range 350,000 to 400,000 years B.P.

More recently the detrital remnant magnetisation of sediments has proved particularly useful. Many polar reversals occurred in the Tertiary - a particularly important event happened 730,000 years B.P.

Thermoluminescence (TL) and electron spin resonance methods of dating use defects in the crystal lattices of cave minerals to act as traps. In the case of TL, electrons from natural radiation are caught and give a measure of the natural radiation since the precipitation of the calcite.

Dating of caves in China shows a range in ages from the Pliocene (Tertiary) to late Pleistocene (Quaternary), the oldest occurring at the top of the hills and the youngest now at river level. The changes in water table levels are closely related to the tectonics of the area - a region of considerable instability as the south-east Asia plate moved northwards against the Tibetan plateau.

In Florida, where sinkholes are active and a serious problem in urban areas, only 6% of the carbonate has been dissolved. In Yuen Long nearly 50% of the marble is lost in the worst examples of dissolution and cavity formation. It is fortunate that the process here has ceased.

#### NEW TECHNIQUES

Although drilling is the most reliable method of ground investigation, many boreholes are required to give a true three-dimensional picture of the buried karst features. Cheaper alternatives to close density drilling have been tried, including geophysical methods e.g. gravity, magnetic, seismic, and tomographic. Radar scanning has been very successful in the shallow dry karst of the USA but in Yuen Long the depths involved are too great, the water table too high and the clay content of the overlying superficial rocks absorbs much of the energy of the electromagnetic conductivity before it can be reflected and refracted back to the surface receivers.

Gamma logs have been successfully run in several test holes and could be used as a cheap alternative to coring where a large number of holes are to be sunk.

The recrystallisation of the marble has destroyed most of the evidence as to its age. A new geochemical method of isotope dating using Uranium-Lead decay and the Lead 206/Lead 204 and Lead 207/204 ratios is being attempted.

CAVES & CAVE DEPOSITS

CONCLUSION

Some of the problems of Yuen Long and its hinterland have been solved. Much more is to be discovered before buildings on unfavourable sites are allowed to be constructed and yet be economically viable. Prediction of the buried karst structure is the ultimate goal. This may be possible if even deeper boreholes are sunk to ensure the overall Carboniferous sequence and its stratigraphy and structure is fully understood.

REFERENCES

Brook, G.A. and Ford, O.C., 1976. The Nahanni North Karst: A question mark on the validity of the morphoclimatic concept of karst development. Proc. 6th Int. Cong., Speleol. 2, 43-57.

Jennings, T.N., 1982. Karst of Northeastern Queensland reconsidered. Tower Karst Chillagoe Caving Club, Occasional Paper no. 4, pp. 13-52.

Jennings, T.N., 1987. Karst Geomorphology. Blackwell, Oxford.

NEW TECHNIQUES

Although drilling is the most reliable method of ground investigation, many boreholes are required to give a true three-dimensional picture of the buried karst features. Cheaper alternatives to close density drilling have been tried, including geophysical methods e.g. gravity, magnetic, seismic, and tomographic. Radar scanning has been very successful in the shallow dry karst of the USA but in Yuen Long the depths involved are too great, the water table too high and the clay content of the overlying superficial rocks absorbs much of the energy of the electromagnetic conductivity before it can be reflected and refracted back to the surface receivers.

Gamma logs have been successfully run in several test holes and could be used as a cheap alternative to coring where a large number of holes are to be sunk.

PALAEOONTOLOGISTS FROM THE NANJING UNIVERSITY  
: VISIT OF PROFESSOR DING YUANZHANG OF THE  
GUANGDONG BUREAU OF SEISMOLOGY

Prof. Ding, Honorary Member of our Society, visited Hong Kong from April 19th - 23rd at the invitation of the Hong Kong Institution of Engineers Nuclear Power Group to address the Group on the seismicity of the Daya Bay region. He also took the opportunity to address the Geological Society at the Royal Observatory on the evening of Friday 21st April on the same subject. The Royal Observatory meeting was followed by an excellent dinner at a nearby Beijing Restaurant attended by our guest, Prof. Ding, and some 15 members.

At both meetings Prof. Ding addressed the problem of supposed active faults at Daya Bay and made the following points:

The apparent new fault line 7 kms from the nuclear power plant shown on the 1986 Lithodynamics Map of China was due to Professor Ma Xing-yuen joining together several small previously known faults into what appeared to be a new fault line.

Different geologists have different ideas about active faults. e.g. Professor Liu Yixuan considered a fault active if it has shown movement since the beginning of the Neogene, i.e. in the past 25 million years; Professor Ma, if it had shown movement since the beginning of the Late Neogene (c. 10 million years); other scholars, since the beginning of the Quaternary, or even the Holocene.

The small faults in the Daya Bay region had been examined very carefully. Prof. Ding showed drawings of five sections across faults in which the covering soils were undisturbed. The soils were dated by spore-pollen analysis and stratigraphical correlations as being of mid-Pleistocene age, 700,000 - 150,000 years. Thus it is likely that there has been no surface movement of the faults since the mid-Pleistocene and the faults are not recently active and not capable of damaging the nuclear plant. There is no capable fault within 20 km radius of the nuclear power station.

Prof. Ding disagreed with the Royal Observatory figure of intensity VII for the 1918 earthquake which affected the site, and suggested that Intensity VI was more likely. Mr R. Lau of the Royal Observatory, who was at the meeting, agreed that intensity VI was quite possible.

Asked by Mr M. Atherton, Prof. Ding then turned his attention to the two small earthquakes near the fault line, one dated 1981. In his view they were too small and few to indicate that the fault was active, and in the case of the Daya Bay region, the actual position of the small earthquakes was inaccurate due to difficulties in locating the foci of small earthquakes.

Finally Prof. Ding stated that his surveys showed that the maximum possible intensity of an earthquake on the Daya Bay site during the next 100 years is VII. This figure included consideration of both local and distant earthquakes on land or in the South China Sea.

PALAEONTOLOGISTS FROM THE NANJING UNIVERSITY  
INSTITUTE OF GEOLOGY AND PALAEONTOLOGY :  
RECENT FOSSIL FINDS IN HONG KONG

Three palaeontologists from the Nanjing Institute of Geology and Palaeontology are currently in Hong Kong doing research at Hong Kong Polytechnic. On 25 April, they gave a progress report at a meeting of the Society, at the Polytechnic. The following is a report of the meeting by M.J. Atherton.

The three speakers addressed the meeting in turn, and afterwards there was a display of the fossils found by the team.

Mr Ho Guo Xiong stated that:

The Ammonoidea constitute the largest and in some aspects the most important major subdivision of the Cephalopoda. Little is known about the soft parts of the animal, because the subclass became extinct at the end of Cretaceous (65 my ago). Their shells are preserved in rocks ranging in age from late Early Devonian to Late Cretaceous and exhibit such rapid and varied changes in morphology, ornamentation and suture line that they are important index fossils for stratigraphical subdivision and correlation of the marine Late Palaeozoic and Mesozoic strata.

Based on the ammonites found from Ma Shi Chau, The Tolo Harbour Formation may be correlated with the Kuhfeng Formation in Guangdong and Jiangsu, the Dangchong Formation in Hunan, and the Wenbisha Formation in Fujian, and is of late Early Permian age.

The ammonite fauna collected from the Tolo Channel Formation at Fung Wong Wat, Nai Chung and Sham Chung, is similar to that found in southeast China (Guangdong, S. Hunan and S. Fujian), southern Xizang (S. Tibet) and Northwest Europe, and belongs to the Sinemurian stage of the Lower Jurassic.

Mr Chen Jin Hua stated that:

Devonian marine invertebrate fossils have been found, for the first time in Hong Kong at Sui Kau, northeast of Plover Cove, by a palaeontological survey team comprising C.M. Lee, G.X. He, J.H. Chen, S.Q. Wu, K.W. Lai, P.S. Nau and M.J. Atherton. The strata near Sui Kau were thought to belong to the Jurassic Repulse Bay Formation and Bluff Head Formation by Allen and Stephens (1971). More than a hundred specimens including bivalves, gastropods, ostracods and crinoids were collected from three beds in siltstones and mudstones there. Seven species of Bivalvia have been identified by Chen Jin Hua, who believes that the bivalve fauna in Sui Kau is comparable to that of the Yujiang Formation, Guangxi, South China and belongs to the Lower Emsian stage of the late Early Devonian (about 390 million years ago). This means that the marine fossil-bearing formation at Sui Kau may be older than the known formations in Hong Kong. It also provides important evidence to correlate the Devonian strata of Hong Kong with those of South China.

Permian Bivalvia of Hong Kong were formerly reported (undescribed) only as an undetermined species of the genus Aviculopecten (Ruxton, 1960). Now 12 species of 10 genera at least have been collected and identified from Ma Shi Chau, they indicate the age of Tolo Harbour Formation (the fossil-yielding formation) as belonging to the upper part of Lower Permian (about 255 million years ago).

Lower Jurassic bivalves have been discovered at localities extending from Sham Chung (Lee, 1984) and Nai Chung (Nau, 1986) to Fung Wong Wat and Ma Shi Chau (newly discovered by the team and Mr Nau respectively). About 30 species of Bivalvia have been obtained from these localities, they can be subdivided into several fossil zones. Some forms of them are valuable in palaeontological study because of the well-preserved internal structure of their shells.

Ms. Wu Shun Qing stated that:

Up to now, three different floras are known in Hong Kong. The first is of the Upper Permian from Centre Island Tolo Harbour. It belongs to Cathaysian flora and contains Gigantopterides and other Pteridophyta.

The second flora, the Lower Cretaceous from Ngong Ping Lantau, and Cheung Sheung Sai Kung, belongs to the southern floristic province of China and contains many Filices with small-sized pinnae, conifers with scale-like leaves and many Cycadophyles. The general aspect of this flora is equivalent to the Duoni Formation of eastern Xizang and the Wealden flora of western Europe.

The third is possibly Tertiary from East Ping Chau and contains Angiosperm flowers, Palmae leaves, Monocotyledoneae leaves and conifer shoots. In addition fossil insects were also found at this location.

M.J. Atherton

## OTHER SOCIETY NEWS AND ANNOUNCEMENTS

## DRAFT MINUTES OF THE ANNUAL GENERAL MEETING ,

16 MAY 1989

Ten members of the General Committee and nine ordinary members were present. The Secretary welcomed the members and explained that after the meeting there would be a slide show by C M Lee, W W S Yim and R L Langford. The evening would be concluded by a meal at the Sien Kung Lau Restaurant in Cameron Road.

1. **Minutes of the last meeting.** There was no discussion.
2. **Chairman's Report.** There were seven local trips and three China trips in the year. Meetings had included Prof Ding from the Guangdong Seismological Bureau and the palaeontologists working at the polytechnic. Although publication of the Newsletter had been delayed the situation was now changed. The Society has 290 members, of which 261 are resident. I feel that the next year will both interesting and active, and wish success to the new committee.
3. **Treasurer's report.** The accounts were presented for discussion, showing an income of \$66 833.75 and expenditure of \$120 086.60. Accumulated funds stood at \$162 951.42, compared with \$216 204.27 in the previous year. The excess of expenditure over income of \$53 252.85 was caused by income and payment for China trips falling in two years. A D Burnett asked if subscriptions covered Newsletter publication. M J Atherton said the Newsletter used to cost about \$8 000 against subscriptions of \$23 946.81. D R Workman added that the cost is now much less as much work is done by HKU. There is therefore no need to increase subscriptions, in spite of inflation, making the Society very good value for money. R L Langford asked if there were any ideas for spending some of the large accumulated funds of the Society, much of it the result of a very generous donation by S Hui some time ago. W W S Yim suggested plastic coated cards with geological time-scales be given to members, and offered to get details. D R Workman asked about the \$49 814.00 for printing and was told by C M Lee that it covered the Newsletter, Bulletin 3 and MSG Proceedings. R L Langford suggested that in future the



individual publications be presented separately in the accounts.

4. **Editor's report.** The general opinion was that the new Newsletter was very good. H M Keung asked about Chinese text and was informed that this would have to be provided by any author in camera ready form. A D Burnett was particularly pleased to see that the cover followed the style of earlier Newsletters, and suggested that the list of GSHK publications be put inside the back cover. D R Workman requested articles for publication, with an end of May deadline for the June issue. Following a question from W W S Yim he said that short articles could appear in the Newsletter or Bulletin or both, but long articles should be reserved for the Bulletin. W W S Yim suggested that the four issues of the Newsletter should be consecutively numbered.

5. **Secretary's report.** The General Committee held seven meetings during the year, and organized the following events; (May) Tai O - Sha Lo Wan; Shenzhen mineral baths; (July) Port Island; (August) Ping Chau; (September) lecture by Prof Brunsdon; Diamond Hill Quarry; (November) Daya Bay; (December) Northwest Guangdong; Sha Tau Kok - Mai Po; (January) Chinese research vessel; (February) Shek Ngau Chau; (March) Shek Au Chau; (April) Lectures by Dr Frost and Prof Ding. The proposed conference on seismic or structural geology was still being discussed. The library holding would have to be passed to GCO, where it would be available for all members to see.

4. **Election of Committee for 1988-89.** The Secretary introduced the new Committee, with the correct number standing as posts were available. No postal election had been necessary. The new General Committee are:

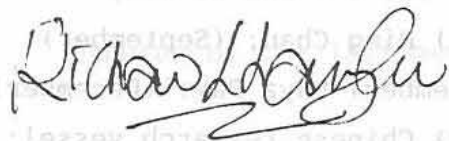
Chairman	M J Atherton
Vice-Chairman	K W Lee
Secretary	R L Langford
Editor	E P Y Chau
Treasurer	C M Lee
Committee	H S Chan, H M Keung, H L Law, R Shaw, C H Tan, K M Wong, D R Workman

5. **Any Other Business.** J M Nash asked if a trip to the Soko Islands could be organized, and R L Langford agreed to pursue this. W W S Yim asked if publications were going to the Government bookshop, and M J Atherton (Sales Director) said this would be pursued. A D Burnett said that Peter Allen

105,204.55	105,204.55
105,204.55	105,204.55
105,204.55	105,204.55
105,204.55	105,204.55

(Allen & Stephens) would visit at the beginning of June, and had been asked to talk to the Society. A D Burnett also noted that the IMM have asked the Society to support their proposed conference on underground space at the end of the year. H L Law asked if an honorary auditor could be found, and this request should go to the members. W W S Yim said that Prof Leatherman of the University of Maryland would give a talk to the MSG on Impacts of Future Sea-level Rise in Coastal Areas at 5pm on 17 May.

The meeting ended with a slide presentation showing some aspects of field excursions undertaken in the previous year, geological mapping on Lantau and amusing diversions. Slides were shown by C M Lee, R L Langford and W W S Yim. Most of the members present then retired to the restaurant.



(Dr R L Langford, Honorary Secretary)

### TREASURER'S REPORT

Statement of Income and Expenditure  
For the Year Ended 31st December 1988

	Income	Expenditure
	HK\$	HK\$
Subscription	23,946.81	899.75
Publications	3,586.49	100.00
Bank Interest	5,226.45	-
Conferences	2,110.00	2,726.35
Local Trips	9,260.00	5,710.00
China Trips	22,704.00	54,321.70
Newsletter & Printing	-	49,814.00
Stamps & Stationery	-	6,514.80
Donations	-	-
Total	<u>HK\$66,833.75</u>	<u>HK\$120,086.60</u>
Excess of Expenditure over Income		<u>HK\$53,252.85</u>
<u>Accumulated Funds HK\$</u>		
	31.12.87	31.12.88
	109,375.32	Bank Deposit Account 114,601.77
	101,835.45	Bank Current Account 40,634.15
	4,993.50	Petty Cash 7,715.50
	216,204.27	162,951.42*

(\* Included HK\$20,925 for the Geological Bureau of Guangdong Province)

RECENT PUBLICATIONS ON HONG KONG  
GEOLOGY AND ENGINEERING  
MEMBERSHIP NEWS  
PROBABLY NEAR YUEN LONG

The Society welcomes the following new members in 1989, additional to those named in the March issue of the Newsletter (to 31 May)

Mr Chan Tit Shan; Mr Chau Kwok Ping; Mr Stephen Chow Chan Ming; Mr Chun Kai Kwong; Mr John McN. Ferguson; Dr Donald V. Frost; Mr Fung For Yan; Mr Stuart T. Gilbert; Mr Dirk G. Hamer; Mr Leung King Wai; Mr Mak Wai Sum; Dr Ronald J. Neller; Mrs Jillian Rivers Rigg; Mrs Carol A. Smith; Mr Peter D. Stuckey; Mr Ian R. Wardall; Mr Wong Ka Ming; Dr Peter Yung Chiu Yin.

Student Members: Mr Chan Kit Chung; Mr Chu Yiu Fai; Mr Kung Pan Hung; Miss Florence Kwok Yee Ming; Mr Lam Tat Chuen; Miss Lee Suk Yee; Mr Tong Wong Tung Leung; Mr Wong Wai Ping; Mr Yau Tze Kee.

Jim Rhett, Overseas Member, has kindly sent the Society a copy of a new (1988) USGS map: Geologic Framework, Petroleum Potential and Field Locations of the Sedimentary Basins of China, by K.Y. Lee and C.D. Masters. This has been added to our Library collection.

Jim also writes: "should any members of GSHK ever visit Colorado I'd be pleased to show them the rich dinosaur track and fossil bone sites near Denver". He would be glad to correspond with GSHK members on this or any other aspect of American geology. His address is 1096 Adams Ave., Louisville, Colorado 80027, U.S.A.

SUBSCRIPTIONS FOR 1989 NOW OVERDUE

If you have not already paid your subscription for 1989, you are not reading your own copy of this Newsletter. If the reason for not paying your subscription is oversight, then please do so without delay. We can issue back numbers of the Newsletter on request while stocks last, but this cannot be guaranteed. Membership can be resumed any time upon payment of the subscription then due; it is not necessary to pay arrears for periods of lapsed membership.

\* \* \* \* \*

## RECENT PUBLICATIONS ON HONG KONG GEOLOGY AND GEOTECHNICAL ENGINEERING

We include here publications outside Hong Kong, or in Hong Kong in books, journals and magazines that may not come to the attention of all members. Readers are requested to inform the Editor of any such articles that they have written or that they know about, and if possible to supply a copy for the Society's library collection.

IRFAN T.Y. AND N.W. WOODS, 1988. The influence of relict discontinuities on slope stability in saprolitic soils. Proc. 2nd Int. Conf. on Geomechanics in Tropical Soils, Singapore, 12-14 December 1988, v. 1, pp. 267-276.

MALONE, A.W., 1988. The role of government in landslide disaster prevention in Hong Kong and Indonesia. Geotechnical Engineering (Journal of the S.E. Asian Geotechnical Society), v. 19, no. 2, pp. 227-252.

\* MCFEAT-SMITH, I., D.R. WORKMAN, A.D. BURNETT AND E.P.Y. CHAU, 1989. Geology of Hong Kong. Bull. Amer. Assoc. Engineering Geologists, v. 26, no. 1, pp. 17-107.

\* SWANSTON, D.N. AND R.L. SCHUSTER, 1989. Long-term landslide hazard mitigation programs: structure and experience from other countries. Bull. Amer. Assoc. Engineering Geologists, v. 26, no. 1, pp. 109-133 (Hong Kong, pp. 125-6).

\* Publications of the Association of Engineering Geologists can be obtained from the Association's Publications Office at 1040 New Hampshire Street, Lawrence, Kansas KS 66044, U.S.A. Single copies of the Bulletin are US\$15 each plus \$1 (USA) or \$2 (other countries).

SUBSCRIPTIONS FOR 1989 NOW OVERDUE

If you have not already paid your subscription for 1989, you are not reading your own copy of this Newsletter. If the reason for not paying your subscription is oversight, then please do so without delay. We can issue back numbers of the Newsletter on request while stocks last, but this cannot be guaranteed. Membership can be resumed any time upon payment of the subscription then due; it is not necessary to pay arrears for periods of lapsed membership.

\* \* \* \* \*

## DISCOVERY OF AN AMMONITE FOSSIL OF PROBABLE JURASSIC AGE NEAR YUEN LONG

D. Yuen

Dames & Moore (HK) on Secondment  
to the Geotechnical Control Office

Following an increasing number of reports of engineering, usually foundation, problems in the Yuen Long area caused by the difficult marble bedrock conditions, the Geotechnical Control Office (GCO) initiated in 1987 a programme of geotechnical "Studies and Work in the Northwestern New Territories". A major part of this programme which is still ongoing comprises a Geological Survey Project which has as its main objective the production of some fifteen 1:5 000 scale geology sheet maps of the affected area. This geological survey work is being undertaken from within the GCO by the employment of a consulting geological team whose staff is derived from both the UK British Geological Survey (BGS) and Dames & Moore (HK).

In February of this year during the course of undertaking field traverses in the region of Yuen Long (see location map) a rare fossil find was made, the important stratigraphy and mapping implications of which are still being discussed and assessed.

The actual locality of the find was south of Yuen Long town near the Tai Lam Country Park close to the end of Tai Tong Road (821120, 830350). At this location a sandstone bed forms low hills trending north eastwards from Yeung Ka Tsuen to Nam Hang bordering the granitic mountains of Tai Lam Country Park. The ammonite was found "in situ" in the rocky path leading to the top of the hill. It is preserved in yellowish brown, highly to moderately weathered, slightly metamorphosed fine grained sandstone. The discovery was notable as it is rare to find a fossil preserved so well in a metamorphosed rock, especially as the locality is quite near to the granite intrusion.

The fossil, which is clearly an ammonite, is some 6 cm in diameter and has strong straight ribs (2 cm long and 5 mm apart) which are well preserved, although the central chambers are indistinct (see plate). It was named *Arietites* sp. by Mr He Guo-xiong, Associate Professor of Nanjing Institute of Geology and Palaeontology, Academia Sinica, the geologist from

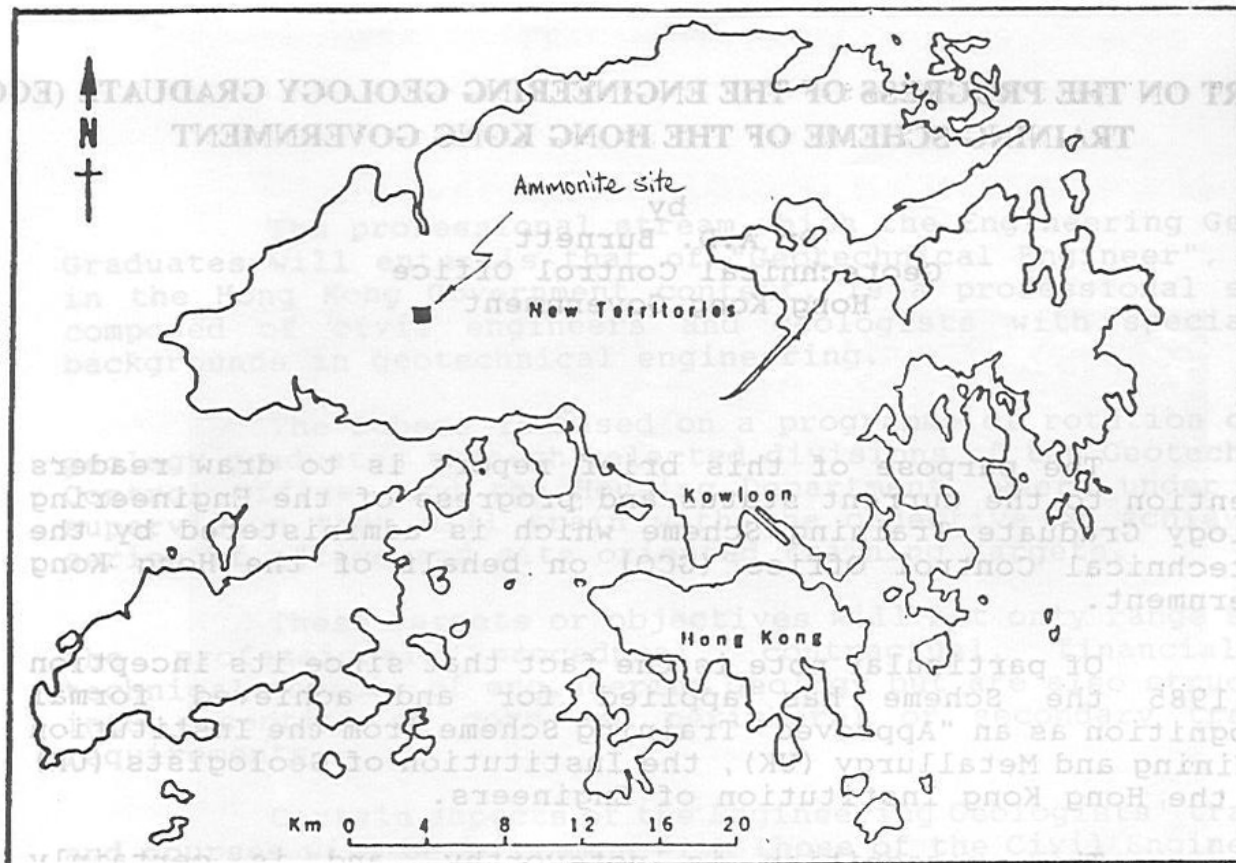
China visiting the Hong Kong Polytechnic. such is the interest and importance of this unique find from the western part of the territory that the specimen, which is numbered ( P116 ) in the GCO held Hong Kong Rock Collection, is shortly to be shipped to the UK where BGS palaeontologists will also examine it. Further searches of the area have unfortunately failed to find additional specimens.

A geological study of the locality was carried out a few years ago by Mr K.W. Lai as part of the 1:20 000 scale territorial geological mapping project and these rocks were then mapped as Jurassic Tsing Shan Formation. Later, the rocks were redesignated part of the Carboniferous Lok Ma Chau Formation (Mai Po Member). The present discovery of what appears likely to be Lower Jurassic sediments in the Yuen Long area thus also throws doubt on the classification of other sandstone crops hitherto considered to be of Carboniferous age.

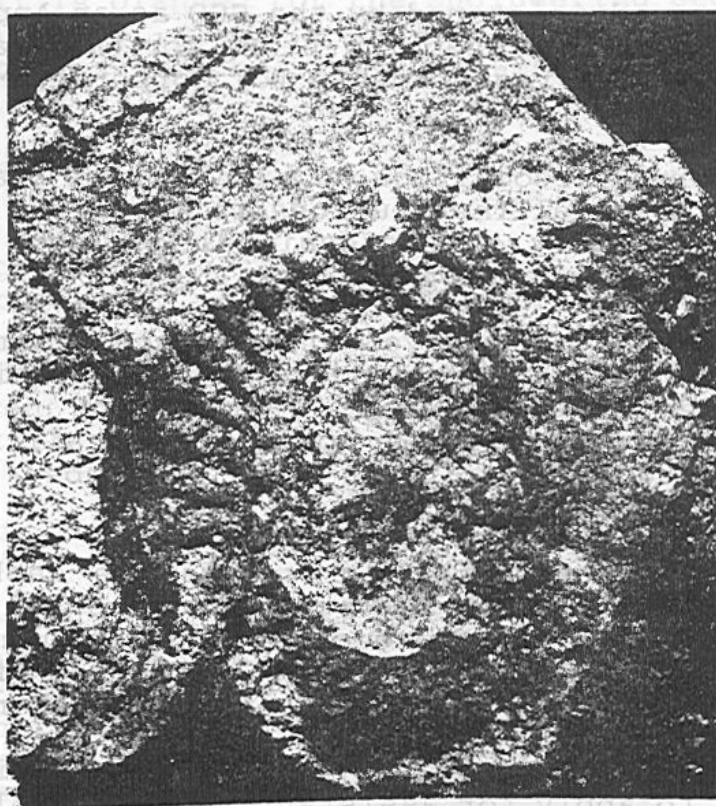
#### Acknowledgements

The author is grateful to Mr He Guo-xiang (Nanning Institute of Geology and Palaeontology) for his help in provisionally naming the fossil. Special thanks also to Miss N. Darigo (Dames & Moore), Dr D.V. Frost (British Geological Survey), Mr P.J. Strange and Mr K.W. Lai (Hong Kong Geological Survey) for the useful information and discussions concerning the geology of the fossil locality. Acknowledgement is made to the Director of Civil Engineering Services, Hong Kong Government, for the permission to publish this note.

Footnote Since this note was written, the specimen has been examined by Dr H. Ivemey-Cook, Palaeontologist at the British Geological Survey. Dr Ivemey-Cook writes: "Basically it is difficult to say more than 'indeterminate ammonite - probably Jurassic' as there is so little to go on. The ovoid shape is a problem, it is probably distortion in this very coarse matrix though there are some excentrically coiled ammonites in the Jurassic and others in the Cretaceous." He concludes that it is unlikely that anyone in Britain would be prepared to give it a generic name.



Location map



Fossil Ammonite, *Arietites* sp. in sandstone. Yuen Long.

# REPORT ON THE PROGRESS OF THE ENGINEERING GEOLOGY GRADUATE (EGG) TRAINING SCHEME OF THE HONG KONG GOVERNMENT

by  
Dr A.D. Burnett  
Geotechnical Control Office  
Hong Kong Government

The purpose of this brief report is to draw readers attention to the current status and progress of the Engineering Geology Graduate Training Scheme which is administered by the Geotechnical Control Office (GCO) on behalf of the Hong Kong Government.

Of particular note is the fact that since its inception in 1985 the Scheme has applied for and achieved formal recognition as an "Approved" Training Scheme from the Institution of Mining and Metallurgy (UK), the Institution of Geologists (UK) and the Hong Kong Institution of Engineers.

This recognition is noteworthy, and is certainly important for the trainees, as the institutions concerned probably represent the highest level of representation possible for engineering geologists in both the scientific and engineering professions, both at home and abroad. Clearly acceptance by each of these Institutions of the Engineering Geology Graduate Training Scheme as administered by the GCO as an Approved Formal Training Scheme is a major stepping-stone for the trainees toward fulfilment of the entry requirements for Corporate Membership of the Institutions.

This formal recognition of a government training scheme by three top Professional Institutions is certainly an important milestone in the history of professional geology, not only in Hong Kong but also internationally.

To date two EGG's have satisfactorily completed their course and another four are in process of being trained. During April advertisements were placed in Hong Kong newspapers and copied to about 60 universities world-wide, calling for young local geology graduates to fill the September 1989 intake vacancies in the Scheme.

The Scheme essentially involves the seeking out and recruiting of one or two Hong Kong citizens annually who have recently graduated overseas in geology and training them in an essentially geotechnical environment for a period of three years within government in general geology and engineering geology.

After the initial three year training period graduates will be eligible to apply for assistant professional grade posts in government but they will then have to obtain several years further of responsible experience before being capable of consideration for full professional status and before they can make application to be accepted into the three Institutions previously mentioned as full members.



SEA LEVEL CHANGES - CURRENT PERSPECTIVES

The professional stream which the Engineering Geology Graduates will enter is that of "Geotechnical Engineer", which in the Hong Kong Government context, is a professional stream composed of civil engineers and geologists with specialized backgrounds in geotechnical engineering.

The Scheme is based on a programme of rotation of the geology graduates through selected divisions of the Geotechnical Control Office, and the Housing Department, where under close supervision they will train with the objective of achieving a series of office and site oriented training targets.

These targets or objectives will not only range across the professional, procedural, contractual, financial and technical aspects of engineering geology but are also structured into essential or core and peripheral or secondary training requirements.

Certain aspects of the Engineering Geologists' training and courses will be in common with those of the Civil Engineering Graduate trainees and monitoring of training will be similar for both types of trainee; for example, trainees will keep up-to-date training records which will be signed by their training or course supervisors.

It is planned for the Engineering Geology Graduates to cover many of the detailed technical, financial and administrative aspects of the following series of broad subjects :

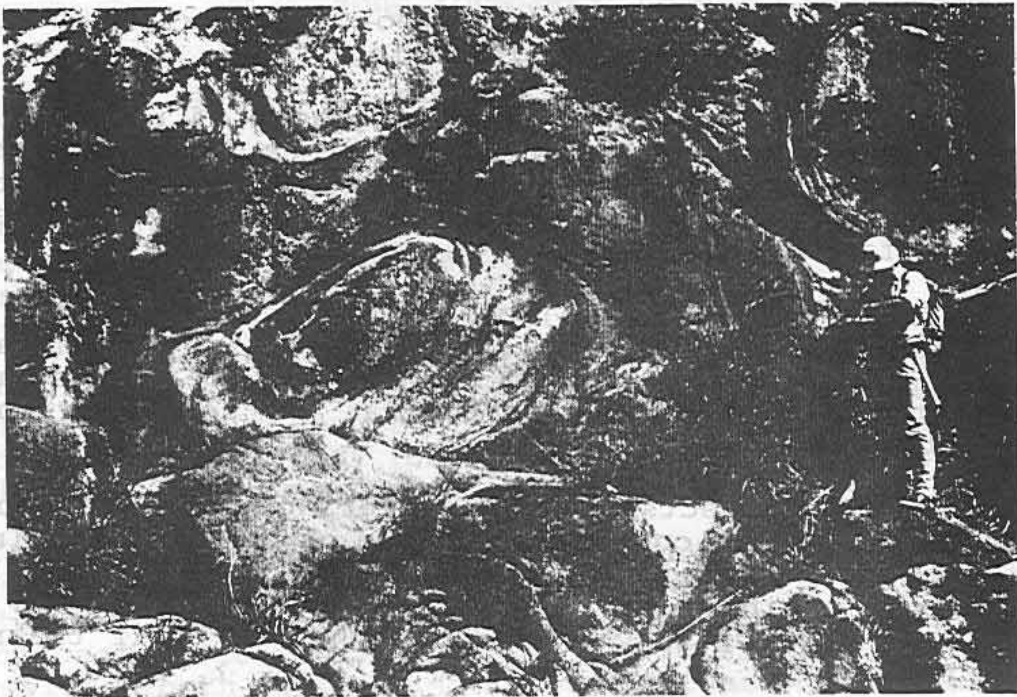
- |                                     |   |
|-------------------------------------|---|
| Engineering Geology                 | Construction Materials Resource Surveys   |
| Geological Surveying<br>(See plate) | Curation and Information Science          |
| Geophysics                          | Site Investigation and Laboratory Testing |
| Hydrogeology                        | Construction Site Experience              |
| Geotechnical Design                 | Geotechnical Engineering                  |

During the course of their training the Engineering Geology Graduates should thus cover the widest possible range of relevant training which the Hong Kong Government can offer. This training should indeed be comprehensive as the problem faced by the various geologists and geotechnical professionals in their various everyday job is certainly challenging in Hong Kong and it is anticipated that much of this experience will rub off onto the trainees.

Starting in 1975, altimeters on the Seasat and Skylab satellites made it possible to measure the position of the sea surface with extreme precision and thus to demonstrate the existence of undulations with very long wavelengths and with amplitudes of

REPORT ON THE PROGRESS OF THE ENGINEERING GEOLOGY GRADUATE (EGG) TRAINING SCHEME OF THE HONG KONG GOVERNMENT

The professional stream which the Engineering Geology Graduates will enter is that of "Geotechnical Engineer", which in the Hong Kong Government context is a professional stream



of the  
technical  
close  
having a  
stages  
cross  
of and  
uctured  
aining

geolog  
Conte  
super  
carrie  
the  
techni  
photo  
tratin

It is planned for the Engineering Geology Graduates to cover many of the detailed technical, financial and

Engineering Geology Graduate trainee mapping weathered Quartz Syenite at Tai Miu Wan, Clear Water Bay as part of a 1:5000 scale geological field mapping project which culminated in a partial map sheet and descriptive geological report.

Geological Surveying  
Geotechnical Design  
(See plate)

Site Investigation and Laboratory Testing  
Construction Site Experience

Geotechnical Design  
Geotechnical Engineering

During the course of their training the Engineering Geology Graduates should thus cover the widest possible range of relevant training which the Hong Kong Government can offer. This training should indeed be comprehensive as the problem faced by the various geologists and geotechnical professionals in their various everyday job is certainly challenging in Hong Kong and it is anticipated that much of this experience will run off into the training period. The training should be comprehensive as the problem faced by the various geologists and geotechnical professionals in their various everyday job is certainly challenging in Hong Kong and it is anticipated that much of this experience will run off into the training period.

## CONGLOMERATE - FRAGMENTS FROM VARIOUS SOURCES

### SEA LEVEL CHANGES : CURRENT PERSPECTIVES

Following is an extract from an article in 'Episodes', September 1988, by K. Suguio, L. Martin and J.-M. Flexor entitled "Quaternary Sea Levels of the Brazilian Coast: Recent Progress". We are grateful to the Editors of 'Episodes' for permission to reproduce it.

Until recent years, the ancient shorelines of regions regarded as stable were considered to be records of past global ocean levels. One of the goals of the two IGCP projects (61 and 200) on sea levels was to determine a worldwide eustatic curve for the Holocene. However, field observations conducted in many countries very quickly showed that this was not a realistic undertaking, and all specialists now accept that it is possible only to define local or regional, not global, curves. It is evident that coastal zones in different areas can be at the same time stable, submerged, or emerged and, consequently, there can be no general model of coastal evolution. Thus, so-called eustatic curves, such as that of Fairbridge (1961), cannot be used as models of relative sea-level variations over recent millennia.

#### Factors Governing Changes in Sea Levels

Reconstructions of ancient sea levels represent relative and not absolute positions, because relative sea-level changes (Fig. 1) are the result of widespread variation of sea level (eustasy), and of variations in the elevation of continents. The latter are mainly controlled by horizontal or vertical tectonic movements over time scales ranging from long-term to instantaneous (seismic), or by isostatic movements related to variations in the loading of land surfaces due to the formation and disappearance of ice caps, the erosion of continents and accumulation of sediments in sedimentary basins, and transgressions and regressions on continental shelves (hydro-isostasy).

Changes in the level of the ocean surface are also controlled by variations in the volume of oceanic basins as a consequence of plate tectonics (tectono-eustasy), and in the volume of water in oceans connected with glaciation and deglaciation (glacial-eustasy). Deformation of the continental geoid (the current reference surface) or of the ocean surface (geoidal-eustasy) also induce sea-level variations.

The height of the marine surface has oceanic and geophysical components. The former include tides, major currents and associated whirlpools, and slope variations due to wind pressure, water temperature and salinity. The total effect of these does not exceed 1 to 2 m, and thus is quite small compared to the enormous marine surface hollows and bumps caused by density heterogeneities within the Earth's interior. This geophysical component corresponds to the geoid, which is essentially the average sea level.

Starting in 1975, altimeters on the GEOS 3 and SEASAT satellites made it possible to measure the position of the sea surface with extreme precision and thus to demonstrate the existence of undulations with very long wavelengths and with amplitudes of

several dozen metres (up to 100 m to the south of India). The absence of correlation between these undulations and the surface on the one hand, and their amplitudes and wavelengths on the other, indicates that they may be attributed to density differences in the lower mantle, or even at the core-mantle interface. At shorter wavelengths, the marine geoid exhibits a highly varied spectrum of anomalies in elevation.

The geoid is an equipotential surface of the gravity field, determined by the forces of rotation and gravity that affect the planet Earth. These forces, and hence the geoid shape, vary as a function of core and mantle compositions, and of the relationship between asthenosphere and lithosphere. Several orbital phenomena and their interactions may also affect the geoid. According to Morner (1984) geoid surface modifications can occur rapidly (up to 10 mm/year), with gradients of several metres per kilometre. One milligal change in the force of gravity can deform the ocean surface by 3.3 m, and the surface of the Earth's crust by 1.7 m.

The ocean level at any given point on the crust is, thus, the instantaneous product of complex interactions between the surfaces of the ocean and the continent. Changes in the volume of oceans exert their effects on a global scale. Variations in the geoid surface and in continental levels also exert an influence on local and regional scales. It is not, therefore, surprising that inconsistencies exist among sea-level reconstructions for the same time period but at different points of the globe. This is particularly so for the past 7,000 years, prior to which the rate of glacio-eustatic rise was fast enough to mask effects due to local or regional factors.

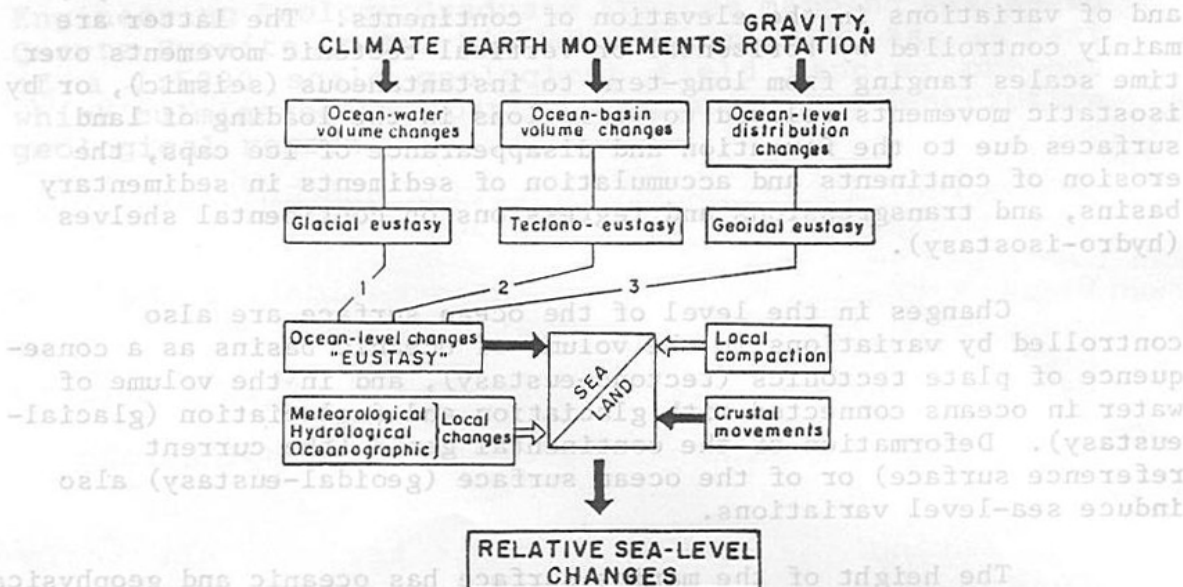


Figure 1: Mechanisms governing changes in sea level. After Mörner (1980).

Reference

Suguio, K., Martin, L. and Flexor, J.-M., 1988.

Quaternary Sea Levels of the Brazilian Coast:

Recent Progress. International Union of Geological Sciences, Episodes, v.11, no.3, pp.203-208.

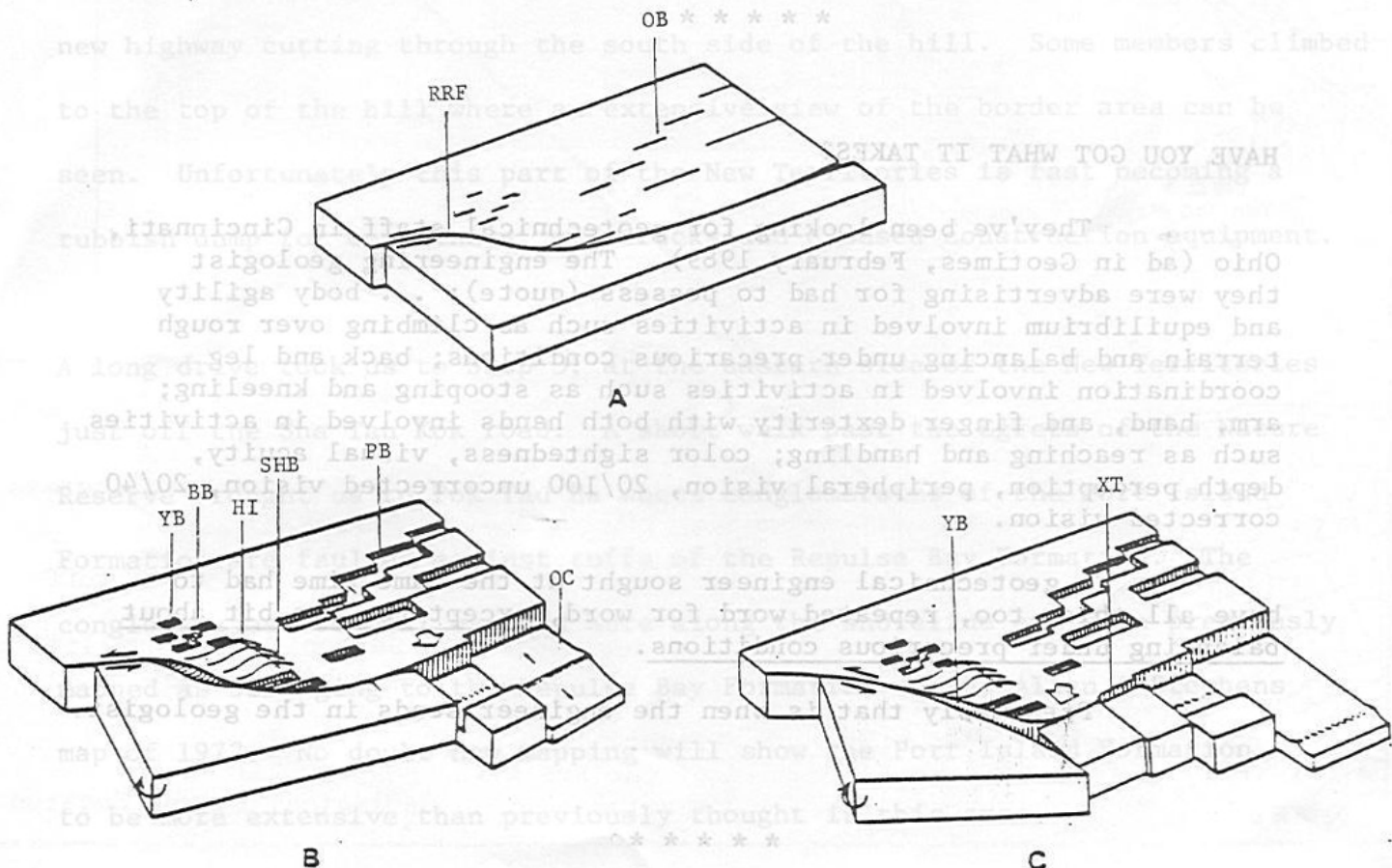
# PULSED BASIN EVOLUTION ON THE NORTHERN MARGIN OF THE SOUTH CHINA SEA

John D. Piggott and Ke Ru

The following is an Abstract of a paper presented at an International Symposium on the Geodynamic Evolution of Eastern Eurasian Margin in Paris in September 1988.

A synthesis of reflection seismic, subsurface well control, and available regional work suggests the basin evolution on the northern margin of the South China Sea can be resolved into three principal tectonically pulsed episodes: Late Cretaceous to Paleocene, Late Eocene to Early Oligocene, and Middle Miocene. Accompanying these three episodes were the resulting trends of the major basin boundaries and faults: to NE, to NE-EW, and to EW-NW; respectively. The NE trends originated from rifting along a NW extensional direction, whereas the NE-EW and EW-NW couples resulted from extension along Riedel shear and tensional components under a sinistral divergent wrench regime whose azimuth rotated clockwise. In each case, the influence of inherited crustal weaknesses was important.

Below is a schematic representation of these cumulative effects on the north margin of the South China Sea ( A: Late Eocene; B: Early Oligocene; C: Middle Miocene; RRF: Red River Fault; OB: older basins; YB: Yinggehai Basin; BB: Beibu Gulf Basin; SHB: Southeast Hainan Basin; PB: Pearl River Mouth Basin; OC: Oceanic crust; XT: Xisha Trough.).



## NUCLEAR POWER PLANTS IN PROXIMITY TO ACTIVE FAULTS

The Guangdong Nuclear Power Joint Venture Company (GNPJVC) is on record as stating that according to U.S. Nuclear Regulatory Commission (USNRC) Rules and Regulations there should not be any active faults (as defined) within an 8 km radius of a nuclear power plant. There has been a debate recently about whether such conditions might exist at Daya Bay.

However, a search of the 1973 version of the USNRC's "Reactor Site Criteria", including an appendix "Seismic and Geological Siting Criteria for Nuclear Power Plants", and a 1977 version of the appendix, and now a 1988 version of both, has failed to reveal the requirement referred to.

There are specific detailed requirements for geological investigations, seismic and geological design bases, and application to engineering design but nothing to say where a plant shall or shall not actually be built in the event of any active faults being identified.

Any readers who know anything further about this, please write in.

D.R. Workman

\* \* \* \* \*

HAVE YOU GOT WHAT IT TAKES?

They've been looking for geotechnical staff in Cincinnati, Ohio (ad in Geotimes, February 1989). The engineering geologist they were advertising for had to possess (quote): ... body agility and equilibrium involved in activities such as climbing over rough terrain and balancing under precarious conditions; back and leg coordination involved in activities such as stooping and kneeling; arm, hand, and finger dexterity with both hands involved in activities such as reaching and handling; color sightedness, visual acuity, depth perception, peripheral vision, 20/100 uncorrected vision, 20/40 corrected vision.

A geotechnical engineer sought at the same time had to have all this, too, repeated word for word, except for the bit about balancing under precarious conditions.

Presumably that is when the engineer sends in the geologist.

\* \* \* \* \*

## REPORTS ON PAST FIELD EXCURSIONS

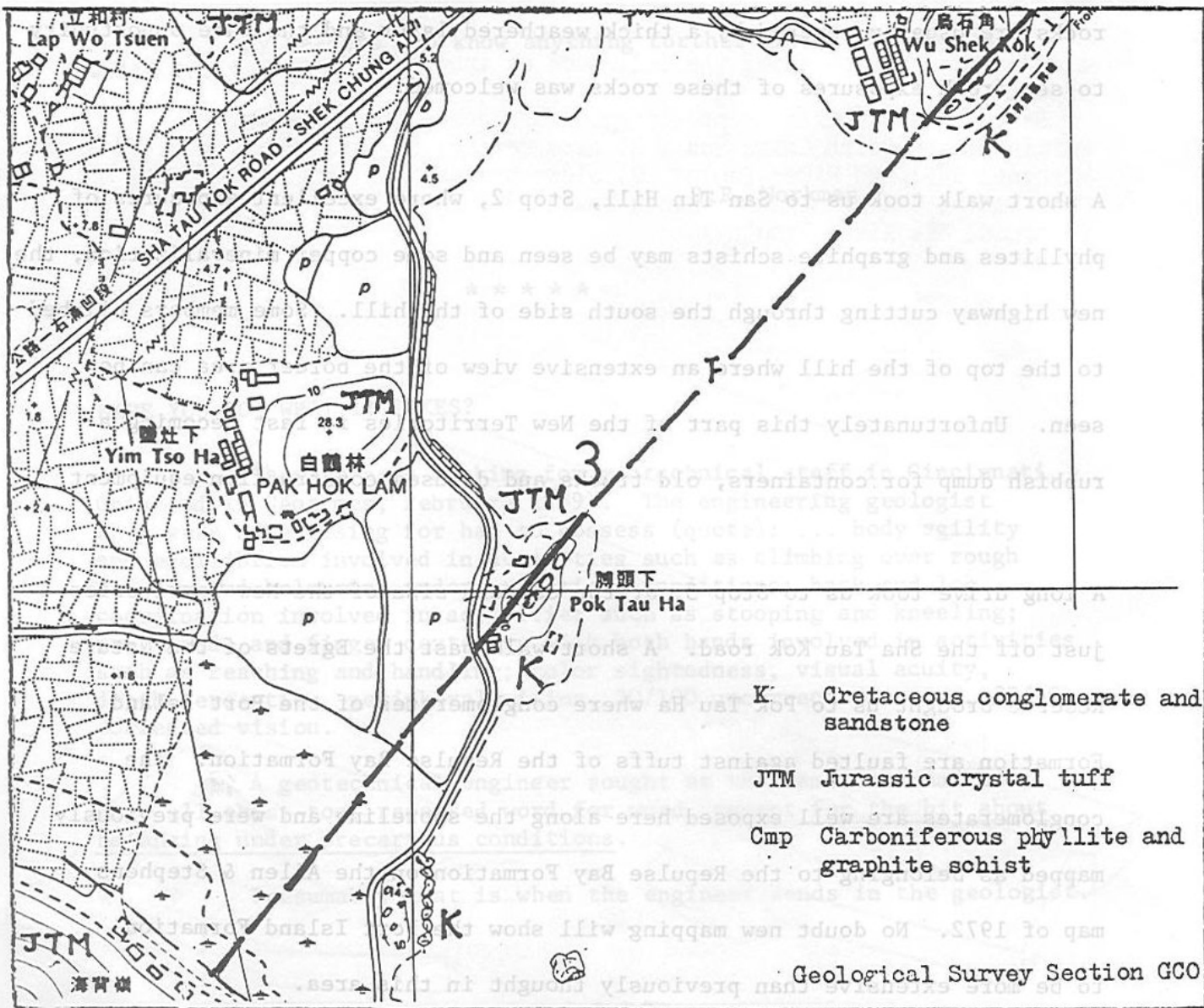
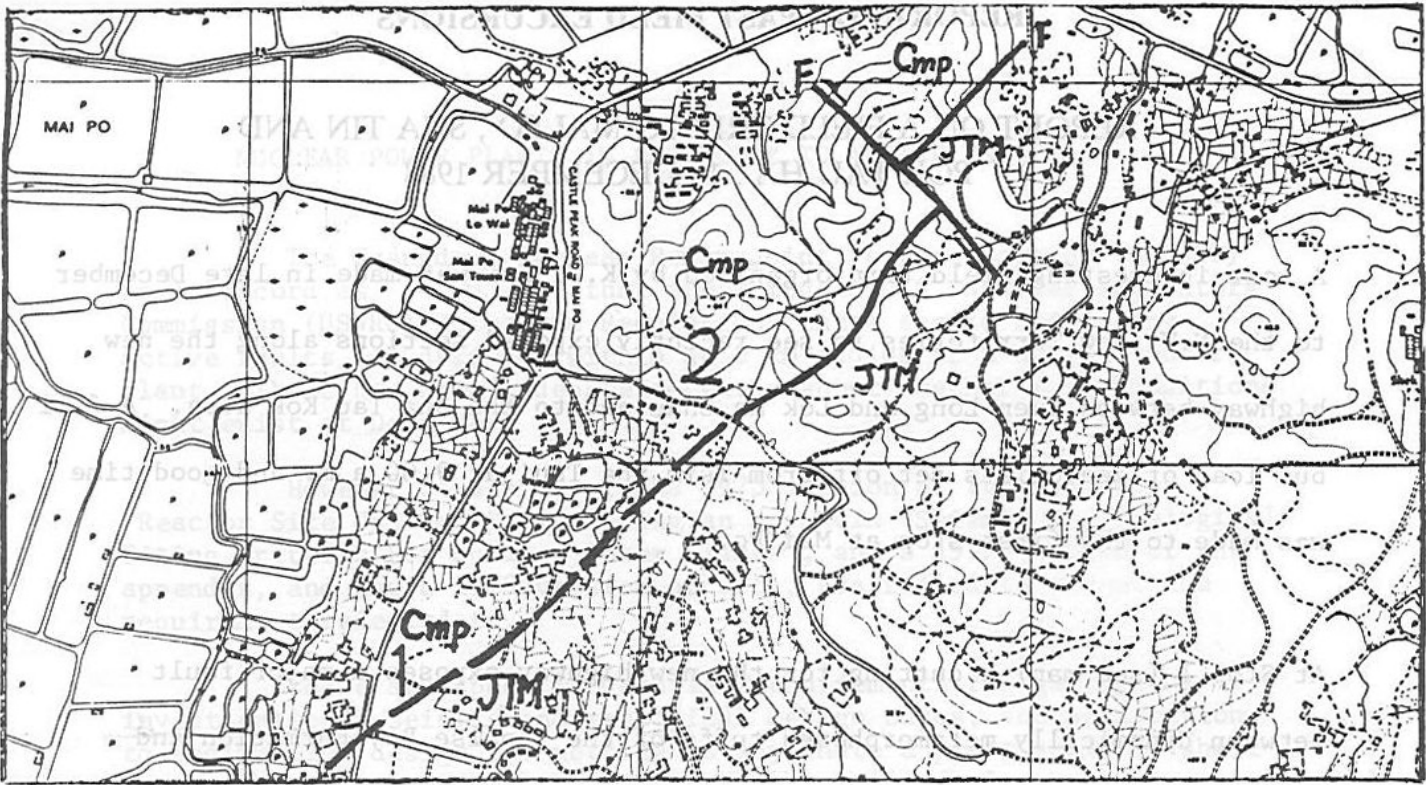
### REPORT ON A FIELD TRIP TO MAI PO , SHA TIN AND POK TAU HA , 18 DECEMBER 1988

A most interesting field trip organised by K.W. Lai was made in late December to the N.W. New Territories to see recently exposed sections along the new highway between Yuen Long and Lok Ma Chau and to the Sha Tau Kok area. A full bus load of geologists set off from Tsim Sha Tsui at 9.00 a.m. and good time was made to the first stop at Mai Po.

At Stop 1 (see map) a cutting for the new highway exposes a major fault between dynamically metamorphosed tuffs of the Repulse Bay Formation and carbonaceous phyllites and schists of the Lok Ma Chau Formation. Each these rocks are usually covered by a thick weathered layer and the rare opportunity to see fresh exposures of these rocks was welcomed.

A short walk took us to San Tin Hill, Stop 2, where excellent exposures of phyllites and graphite schists may be seen and some copper mineralization, the new highway cutting through the south side of the hill. Some members climbed to the top of the hill where an extensive view of the border area can be seen. Unfortunately this part of the New Territories is fast becoming a rubbish dump for containers, old trucks and disused construction equipment.

A long drive took us to Stop 3, at the eastern side of the New Territories just off the Sha Tau Kok road. A short walk past the Egrets of the Nature Reserve brought us to Pok Tau Ha where conglomerates of the Port Island Formation are faulted against tuffs of the Repulse Bay Formation. The conglomerates are well exposed here along the shoreline and were previously mapped as belonging to the Repulse Bay Formation on the Allen & Stephens map of 1972. No doubt new mapping will show the Port Island Formation to be more extensive than previously thought in this area.





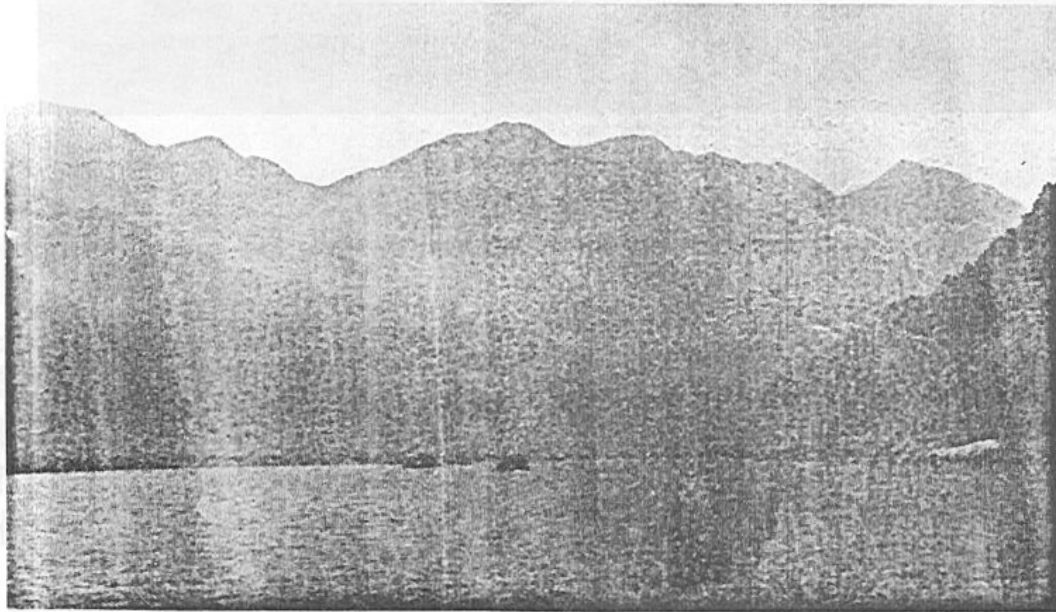
# 粵西北地質旅行紀實

李作明

一九八八年聖誕節期間，二十六位會員參加了我會和廣東省地質學會聯合組織的粵西北地質旅行。我們沿北江南段及小北江（連江）流域進行了地質岩溶地貌、黃金及黃鐵礦床、泥盆石炭紀灰岩及化石產地以及瑤族聚居地參觀訪問。

## 清遠北江飛來峽

從地質學角度來看，飛來峽是由距今三億六千萬年以前的泥盆紀地層所組成，當時飛來峽一帶是一片廣闊濱海環境，沉積了砂礫岩、砂岩、粉砂岩和頁岩，厚約二千餘米。後因歷次地殼運動上升成為山峰。到了現代，北江有多次改道和變遷，它曾先後在飛來峽的南北兩側作為主河道，後來才穿越幾百米的山體中央山峰而形成北江現今河道，類似我們曾參觀的西江肇慶羚羊峽改道歷史（照片一）。



照片一 清遠市北江飛來峽



照片二 新洲金礦

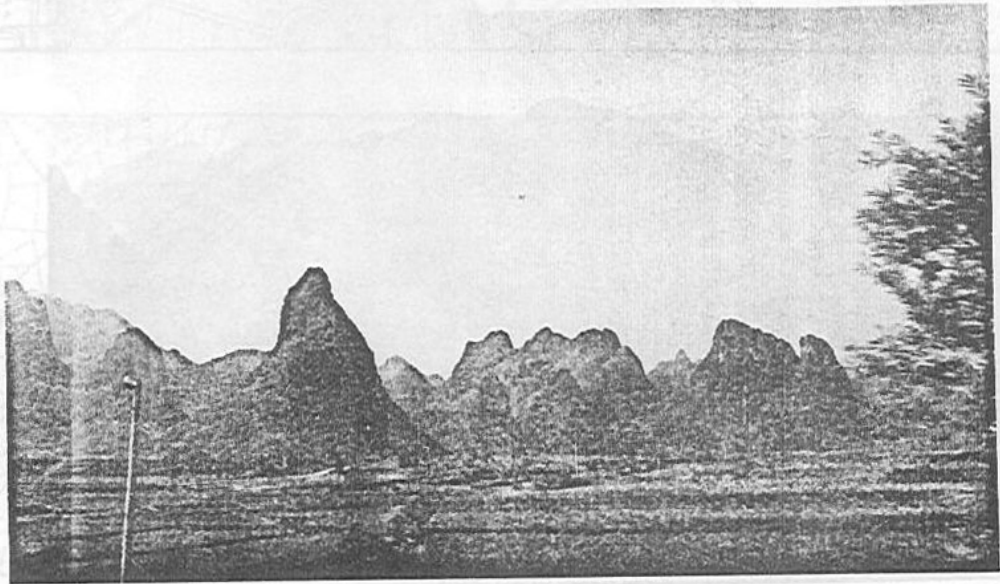
### 清遠市新洲金礦

新洲金礦位於清遠市以北約三十五公里，礦山面積約四平方公里。一九八二年農民根據砂金線索，用重砂法追索發現岩金（山金）。經地質隊普查，出露地層為震旦系淺變質片岩、石英片岩、泥盆系砂礫岩及砂頁岩等，礦區附近有燕山期花崗岩體。礦區位於緯向構造帶與北北東吳川—四會大斷裂的複合部位。

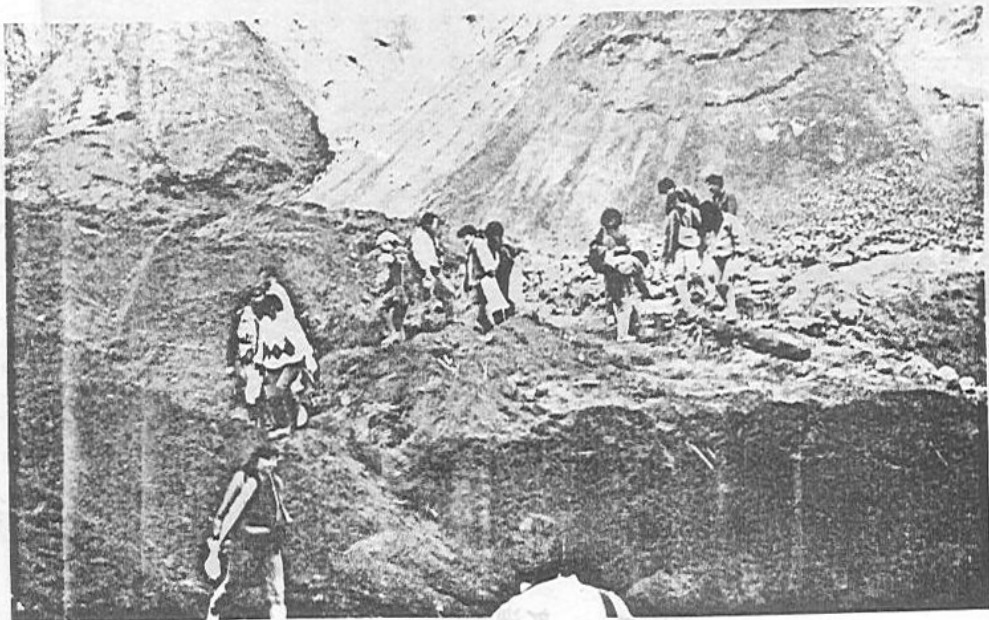
金礦富集於沿斷裂帶中北西西向、南北向及北東東向斷裂上，其中主要為I、II、III號金礦帶及其工業礦體。礦區由個體戶開採，茅蓬林立密集，開採及提煉水平低，回收率極低，使人甚為痛惜；附近河流也嚴重污染。

### 英德紅岩黃鐵礦

紅岩黃鐵礦區位於英德縣（照片三）以西約五十公里，由中泥盆統白雲岩及石灰岩組成近東西向槽形谷地。礦體為一大型黃鐵礦礦床。礦床長二千二百米，寬四百米，礦體約二十個。廖廉清工程師指出黃鐵礦賦存於東崗嶺組白雲岩中，受層位控制，富集不均勻，為層控礦床。（照片四）



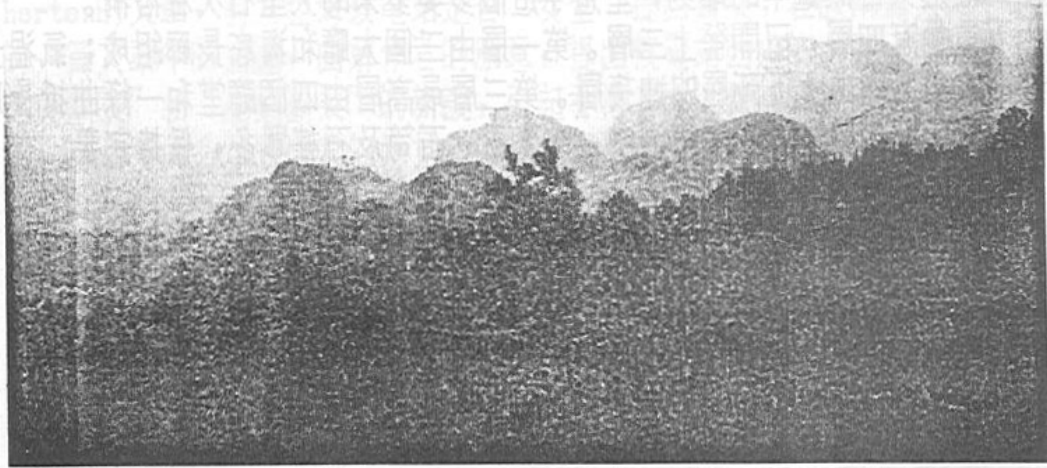
照片三 英德石灰岩峰林谷地，峰叢間多坡立谷盆地。



照片四 紅岩黃鐵礦山現場

### 喀斯特地貌

往瑤寨地區途中，一路發育着一大片獨特風格的石林地帶，沿途可觀賞美麗壯觀的峰林地貌，各種山峰千奇百怪；連南瑤族自治縣瑤寨三排的風景亦如美麗自然園畫在眼前。這裡是典型的岩溶（喀斯特）峰林地貌景觀（照片五）。



照片五 連南萬山朝瑤王岩溶連座峰——峰叢洼地型

### 小北江龍泉峽探奇

連江，又稱小北江，係廣東北江水系第一大支流，沿江多急流險灘。但此景已在改變中，因沿江建成了十多級蓄水堤壩，提高水位，便利通航和農業灌溉及水電建設。此外，景色獨特的漣川三峽乃是連江風景精華。

沿江主要是由泥盆石炭系石灰岩組成的岩溶喀斯特地貌（照片六）。



照片六 連江龍泉峽止的鐘乳石幔懸掛在斷崖上

### 英德寶晶宮溶洞

在陽山縣城東郊，南頤先生介紹該處泥盆石炭系灰岩地質構造，並觀察一早石炭世灰岩採石場，珊瑚石豐富，保存良好和完整，大家紛紛敲打收集稱心如意的化石標本。（照片七）

在英德縣，我們前往廣東省著名的石灰岩溶洞——寶晶宮。

寶晶宮是一處在七十年代末新發現的旅遊風景區和石灰岩溶洞位於英德縣城西南七公里的北江邊上。經過大自然億年的雕刻，塑造了這個多姿多采的大型石灰岩溶洞。

溶洞上下重疊有四層，已開發上三層。第一層由三個大廳和海底長廊組成；氣溫長年保持在18℃左右。第二層為上下兩層的連接層。第三層最高層由四個廳堂和一條曲折長廊組成；氣溫較底層明顯地高軟度。三層溶洞中，鐘乳石、石筍及石柱眾多，保持完善。



照片七 在連城東郊早石炭世石灰岩採石場採集珊瑚石

### 虎門公園銷煙地

行程最後一天早上，我們到廣東地質局地質博物館，參觀了陳列眾多的廣東省各類礦物、礦石、各時代的化石及各種岩石標本。

接著南下經東莞太平墟到虎門公園，參觀了鴉片戰爭紀念館和紀念碑，以及陳列的有關鴉片戰爭的資料和文物。公園內至今仍完整地保存著當年的兩個銷煙地。

傍晚抵深圳火車站，我們向帶隊的廣東省地質學會陳君拔副秘書長、南頤高級工程師及廖廉清工程師等告別，感謝他們熱誠的接待。

# 對大亞灣核電站地區所謂新發現的 “地震斷裂”和“能動斷裂”的看法

劉以宣

今年三月份的“香港地質學會會訊”和四月份的“香港工程師學會雜誌”曾分別刊登 M. J. Atherton 的文章，對大亞灣核電站是否“安全”提出質疑；在該兩篇文章中還引用作者在港的一篇文章中的插圖，曲解作者的原意，提出核電站西邊的水頭—西冲斷裂是新發現的“地震斷裂”和“能動斷裂”的新說，引起香港各方人士的關注。既然涉及到引用作者的插圖，有必要向公眾表達我的意見，以便據事實澄清一些問題。

## 一、水頭—西冲斷裂並非地震斷裂，亦非能動斷裂

水頭—西冲斷裂是發育於大鵬灣半島中部，亦是核電站西邊的一條斷裂，該條斷裂發育於中生代燕山三期花崗岩和下侏羅統地層中，走向北西  $30^\circ$ ，傾向南西，傾角  $70^\circ$ ，長約 4km，寬約 1-2m，斷層表現為硅化破碎和糜棱岩化，中生代為逆斷層。新生代活動跡象是斷裂兩側某些地段的地貌反差較強，斷層山脊、斷層崖地貌較明顯。推測晚第三紀以來有過活動，較近活動欠明顯的“微活動”斷裂。

作者（1984）對活動斷裂類型劃分為烈、強、中、弱和微等五類。它是指晚第三紀以來（距今 22.5 百萬年）曾經活動過的斷裂，再根據斷裂規模大小、活動程度以及與地震活動的關係而劃分的。一般來說地震斷裂及能動斷裂均是屬於活動斷裂，但反過來活動斷裂不一定是地震斷裂與能動斷裂，主要是在活動時間與強度上有區別。

**地震斷裂：**有著悠久的發展歷史，在第四紀以來有明顯活動，在近代該帶有過多次  $\geq 4.75$  級（有感地震）以上地震活動，而且現今儀器記錄到該斷裂的主體處的深部發生地震，稱為發震斷裂。地震時地震波在地表形成的斷層或破裂，稱為地震斷裂，有些發震斷層延伸至地表，地震時在地表產生位移，亦形成地震斷層。通常把沿帶有一系列  $\geq 5.75$  級地震規模較大的、具有一定長度和寬度的斷裂，稱為地震斷裂帶。

**能動斷裂 (capable fault)：**根據國際原子能機構 (IAEA) 所給予的定義，有下列一個或幾個特點的斷裂，稱為能動斷裂：1. 三萬五千年以來至少有過一次地表移動或過去五十萬年內有過重複性移動；2. 儀器記錄有強震活動性，且有足夠證據與斷裂活動直接有關；3. 有證據證實與上述 1. 或 2. 的斷裂有構造聯繫，具有潛在活動的斷裂。

顯而易見，據作者對活動斷裂和分類的概念，它與地震斷裂及能動斷裂的概念是有著較大的區別。作者在一篇文章中曾指出，烈、強和中等活動斷裂帶屬大的斷裂帶，歷史上多次發生 5.75 級以上強震，它們可能與能動斷裂相當，而弱活動與微活動斷裂則不是屬於能動斷裂，亦不完全是地震斷裂。按照地震斷裂與能動斷裂這一嚴格的概念，不但水頭—西冲斷裂不是該兩類斷裂，即使是微活動也是屬於晚第三紀以來推測有過活動的斷裂。如果把它說成是新發現的地震斷裂與能動斷裂，那顯然是混淆上述三類斷裂的概念，導致曲解作者的原意，造成與事實有較大的出入。

## 二、大亞灣核電站周圍四十公里的範圍內至今尚沒有足夠證據證實有能動斷裂存在

距大亞灣核電站南北面約20公里，分佈有北東向的深圳斷裂帶與海豐斷裂帶，該兩條斷裂帶亦總稱為蓮花山斷裂帶，一般人認為是中生代一條深大斷裂帶：該帶在近代曾發生多次5級左右的地震，故有些學者把它與能動斷裂相當。1983年以前作者曾把深圳與海豐斷裂帶分別稱為中弱與中等的活動斷裂，隨後在一些文章中先後把該兩條活動斷裂均歸為弱活動斷裂一類，其主要理由是：

1. 沒有找到足夠證據證實該帶有錯斷第四紀地層跡象，更沒有證據證實晚更新世以來有過多次地殼活動的證據。

2. 1911年5月海豐5.25級地震的震中，經考証是在紅海灣外，並不是在該帶上，因而蓮花山斷裂帶歷史僅發生四次左右4.75-5級左右的地震，並沒有發生過5.75級以上破壞性地震（強震），有些學者把該帶稱為地震帶的副帶。

據以上特點，我們認為蓮花山斷裂帶與能動斷裂的概念不完全相當。作者看來，距大亞灣核電站南部海域40公里左右，發育一條北東東向濱海斷裂帶（部分屬推測），該帶在東端南澎和西端廣洲灣附近，歷史上曾多次發生6.5級以上大地震，屬於作者分類中的強活動斷裂，該斷裂帶可與能動斷裂相當。它是華南沿海強震主要活動帶，現已知過去沿海強震並非產生在陸地上的北北東向斷裂系（它們屬中至弱活動斷裂），而是產生在濱海斷裂帶。因此濱海強活動斷裂對今後評價華南沿海城市的區域穩定性有重要意義，亦解除人們習慣對沿岸地帶的北北東-北東向斷裂系的活動性之憂慮；因主要強活動的地震帶距沿岸城市有40-80公里之遙，該帶中段及大部分區段歷史上地震活動性較弱或沒有地震活動，故對沿海城市的大型工程建設十分有利。

據美聯邦核管理委員會管理規程（10CFR 100附錄5），對核電站選址中地震地質方面的準則，一般要求能動斷裂距核電站選址達8公里以外，現今大亞灣核電站距南部海域的濱海強活動斷裂中段（該段歷史上活動性不强）約40公里，而南北距海豐與深圳弱活動斷裂達20公里。如果按作者的觀點把強活動與中活動斷裂帶視為與能動斷裂相當，那麼大亞灣核電站廠址已大大超過安全規範的要求，已超出能動斷裂距離達5倍以上；假設是把蓮花山弱活動斷裂視為能動斷裂，那亦超過安全規範要求的距離達2.5倍。

因此不管以哪一角度分析，核電站地區是區域穩定性較好的地區，這是經過廣大地質同行長期工作和多次學術探討所公認的。

### 參考文獻

M.J. Atherton, 1989, How 'safe' is Daya Bay? HONG KONG ENGINEER, APRIL, 1989, P.13;  
GEOLOGICAL SOCIETY OF HONG KONG NEWSLETTER, VOL.7, PART I, MARCH, 1989, P.14.

劉以宣, 1981, 華南沿海區域斷裂構造分析, 地震出版社

劉以宣、卓家倫, 1984, 從南海北部新構造運動特徵試論海洋環境地質的穩定性, 熱帶海洋, 3期, 頁55-63

(We hope to include an English-language article by Prof. Liu on this subject in our next issue - Ed.)

## BOOK REVIEWS

Following are short extracts from two extended reviews of a new textbook: 'Principles of Engineering Geology' by R.B. Johnson and J.V. DeGraff, published by John Wiley (1988). These reviews appeared in the Bulletin of the Association of Engineering Geologists, v. 26, no. 1, pp. 161-164.

- from a review by Kerry D. Cato, Texas A & M University:

Johnson and DeGraff have written a text straddling the Engineering Geology/Geotechnical Engineering fence. The book is well titled for indeed it does emphasize the principles of the subject rather than practical applications; there is more emphasis on the theory and various classifications and less on engineering case histories or problems associated with a particular geologic environment. This approach makes it an engineering geologic equivalent to the commonly used geotechnical engineering text, which stresses engineering principles, Fundamentals of Geotechnical Analysis, by Dunn, Anderson, and Kiefer...

Strong points: Instrumentation is perhaps the strongest subject dealt with in this book, a subject overlooked in many texts ...

Weak points: Detailed case histories are rare, but many examples are given for numerous subjects. Many times the authors seemed to stop short of completing a subject and direct the reader to an appropriate reference rather than elaborating on the direct application or case history in the text ...

This is an excellent text dealing with earth materials and instrumentation. Principles ... is appropriate for upper level undergraduates and graduates in geology who have had the geologic principles early in their academic careers, but have not had the opportunity to put these in an applications context. For engineering students this will provide a brief introduction to earth materials and supplement more specific texts in their curriculum....

- from a review by John W. Williams, San Jose State University:

.... the authors have set for themselves the goal of providing a text for the upper-division undergraduate and beginning graduate student in geology and civil engineering. Their goal is to provide a textbook on engineering geology rather than try to turn engineering students into geologists for geologists into engineers. In my opinion they have been able to accomplish this ....

Of particular interest was the book's final chapter on "Engineering Geology and Earth Processes" dealing with the "Safety, Risk, and Geologic Forecasting." These pages effectively, although briefly, cover several critical potentially hazardous geological processes and address the important question of what we can and should do about them.

This book does not cover comprehensively the increasingly large subfield of engineering geology-hydrogeology and hazardous waste. Johnson and DeGraff have elected to focus their attention on the more narrowly defined field of "classical engineering geology" stressing materials (soils and rock), their properties and uses, investigations, and instrumentation in contrast to the current more broadly defined field of engineering geology ...

Because of the topics selected and the comprehensiveness of the presentations, this book should become part of the practicing engineering geologist's library and will probably become an essential element in many engineering geology student's education.





BOOKING AND REPLY SLIPS

for details of these meetings, see pages 33-34.

REPLY SLIP

ROCK CAVERN - HONG KONG (P. Whiteside)

Institution of Mining & Metallurgy

Yan Hing Mining Co

Top Floor, Central Building

1-3 Pedder Street

Hong Kong

FAX 3-7234861

Tel 3-7213684

I expect to attend ROCK CAVERN - HONG KONG.

Name \_\_\_\_\_

Organisation \_\_\_\_\_

Address & Tel. \_\_\_\_\_

No. of places to be reserved \_\_\_\_\_

.....

Meisha Beach  
9 a.m. 23 July 1989

I wish to book \_\_\_\_\_ places for \_\_\_\_\_ adults and \_\_\_\_\_ children and enclose payment of \_\_\_\_\_.

Name \_\_\_\_\_

Address \_\_\_\_\_

Contact Nos. \_\_\_\_\_ office

\_\_\_\_\_ home

Send completed slip to C.M. Lee, Civil and Structural Engineering, Hong Kong Polytechnic, Hungghom, Kowloon. Cheques payable to Geological Society of Hong Kong.

.....

Kung Chau/Port Island  
27 August 1989

I wish to book \_\_\_\_\_ places at \$45 and \_\_\_\_\_ places at \$55, and enclose payment of \$ \_\_\_\_\_.

Name \_\_\_\_\_

Address \_\_\_\_\_

Contact tel. nos. \_\_\_\_\_ office

\_\_\_\_\_ home

Send completed slip to C.M. Lee, Civil and Structural Engineering, Hong Kong Polytechnic, Hungghom, Kowloon. Cheques payable to Geological Society of Hong Kong.



# GEOLOGICAL SOCIETY OF HONG KONG

## PUBLICATIONS

BULLETIN No. 1 (1984), 177 p., Ed. W.W.-S. Yim. Geology of Surficial Deposits in Hong Kong - a collection of 17 papers presented at a symposium at the University of Hong Kong in September 1983, dealing with general geology of the deposits (colluvial, alluvial and marine), investigation and sampling methods, weathering and erosion, landslides and prehistoric coastal development.

BULLETIN No. 2 (1985), 236 p., Ed. I. McFeat-Smith. Geological Aspects of Site Investigation - proceedings of a conference at the University of Hong Kong in December 1984, 17 papers dealing with geological site investigations for new towns, reclamations and tunnels, rock strength testing, drilling, problems of soil erosion, debris flows, joint and fault systems, seismological measurements in Hong Kong, current offshore practice in Hong Kong.

BULLETIN No. 3 (1987), 600 p., Ed. P.G.D. Whiteside. The Role of Geology in Urban Development - proceedings of a conference at the University of Hong Kong in December 1986, 12 papers on Hong Kong and 35 papers from 11 other countries dealing with geological aspects of urban planning and construction, landslides and other hazards, environmental management and groundwater resources.

MARINE GEOLOGY OF HONG KONG AND THE PEARL RIVER MOUTH (1985), 96 p., Eds. P.G.D. Whiteside and R.S. Arthurton. A collection of 12 papers presented at a Marine Studies Group seminar at the University of Hong Kong in September 1985.

MARINE SAND AND GRAVEL RESOURCES OF HONG KONG (1988), 221 p., Eds. P.G.D. Whiteside and N. Wragge-Morley. Proceedings of a Marine Studies Group seminar on Marine Sources of Sand held in Hong Kong on 4 December 1987.

ABSTRACTS No. 1, 79 p. Abstracts of papers presented at the meeting on Geology of Surficial Deposits in Hong Kong, September 1983 - OUT OF PRINT.

ABSTRACTS No. 2, 50 p. Abstracts of papers presented at the conference on Geological Aspects of Site Investigations, December 1984.

ABSTRACTS No. 3, 51 p. Extended Abstracts of papers presented at a meeting on Sea-level Changes in Hong Kong During the Last 40 000 Years, held at the University of Hong Kong in May 1986.

ABSTRACTS No. 4, 65 p. Abstracts of papers presented at the conference on The Role of Geology in Urban Development, December 1986.

ABSTRACTS No. 5, 56 p. Abstracts/Extended Abstracts of six papers presented at a meeting on Future Sea-Level Rise and Coastal Development, held at the University of Hong Kong in April 1988, plus general information and bibliography.

NEWSLETTER Published regularly, bi-monthly from November 1982 to November 1985, quarterly from March 1986.

Vol. 1 (7 issues) 1982-3; Vol. 2 (6 issues), 1984; Vol. 3 (6 issues), 1985;  
Vol. 4 (4 issues), 1986; Vol. 5 (4 issues), 1987.

Each Newsletter contains short technical articles in addition to Society and other news. A4 format; in English. with Chinese summary section.

### Prices (including postage in Hong Kong)

BULLETIN No. 1 HK\$60 (Members, \$40)  
BULLETIN No. 2 HK\$70 (Members, \$50)  
BULLETIN No. 3 HK\$130 (Members, \$100)

MARINE GEOLOGY HK\$30

ABSTRACTS No. 2 HK\$10  
ABSTRACTS No. 3 HK\$15  
ABSTRACTS Nos. 4 and 5 HK\$20

NEWSLETTER (Post free world-wide - surface mail)

Annual Institutional Subscription  
(4 issues; free to Members) HK\$100  
Individual issues HK\$ 25.  
Back numbers (as available,  
details on request) Vols. 1-3 HK\$ 10  
Vols. 4-6 HK\$20

Cover photograph: Transported boulders at Mt. Parker,  
Hong Kong Island (K.M. Wong)

A large granitic boulder is found rested upon by smaller size boulders of volcanic tuff on the valley side. These boulders, transported either by gravity or water-born movements, are common on the lower hillsides at northern Mt. Parker, Shaukiwan East, where the bedrock is mainly granite. The photo shows a latter movement of the volcanic tuff boulders which originate from the higher level volcanic tuff area of Mt. Parker in the south.

Publications are available from:  
The Secretary,  
Geological Society of Hong Kong  
C/o Dept. of Geography and Geology  
University of Hong Kong  
Hong Kong

ISSN 1010-335X