geological society of hong kong

NEWSLETTER

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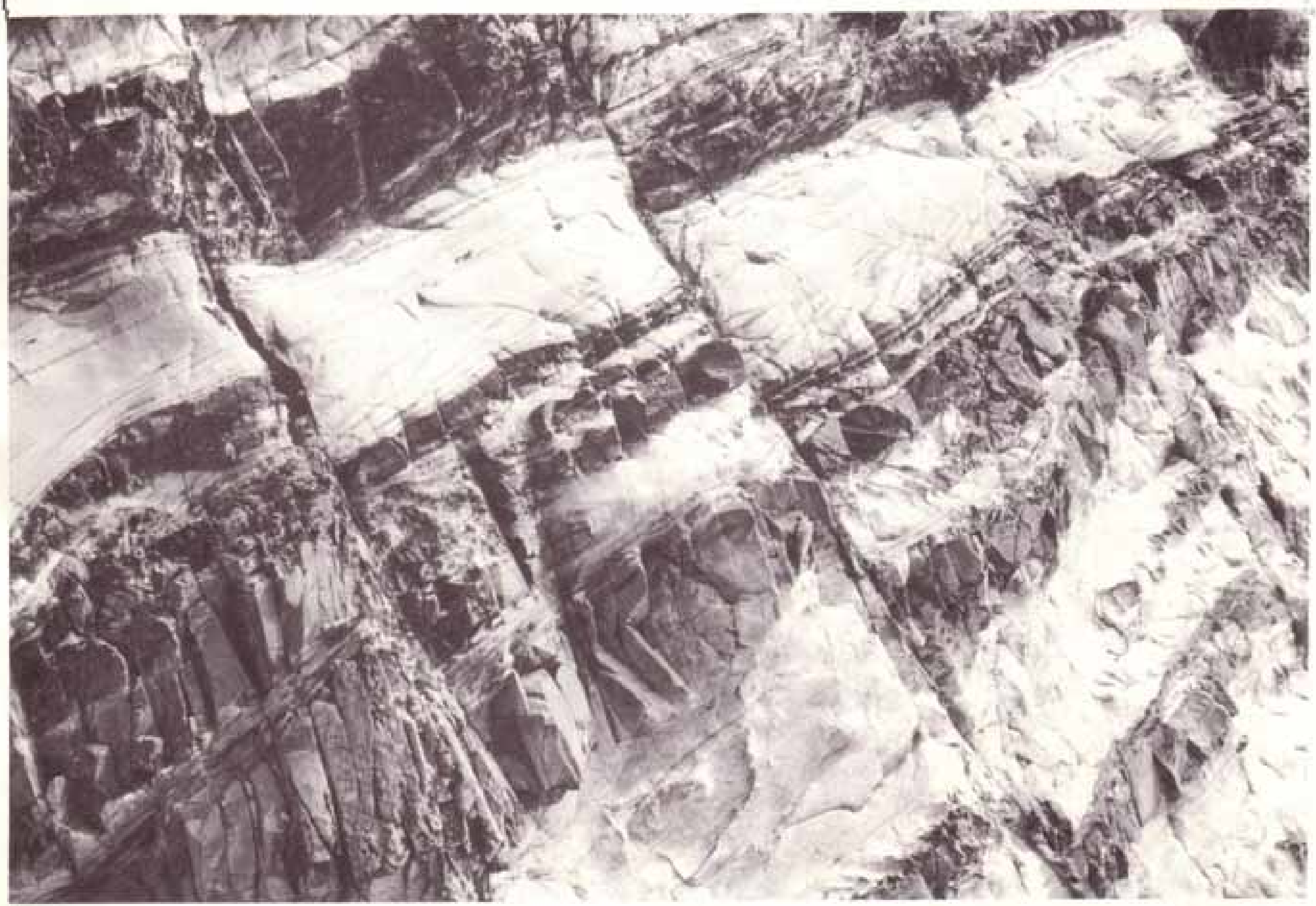

GEOLOGICAL SOCIETY OF HONG KONG

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Cover Photo : Faulted sequence of cross-bedded tuffaceous sands and chert-like fine ash tuffs in the Repulse Bay Formation at Lai Chi Chong, Tolo Channel. (Scale x 0.15)

STAFF OF THE GUANGDONG BUREAU OF GEOLOGY AND MINERAL RESOURCES VISIT HONG KONG

During the week of 6th to 12th October 1986, the Society hosted the first visit to Hong Kong by members of the staff of the Guagdong Bureau of Geology and Mineral Resources. The group was headed by Mr. SHU Cheng-man, the deputy director of the Bureau and Vice Chairman of the Geological Society of Guangdong. The other members were: Mr. PANG Cun-rui, Director of the Mineral Resources Department of the Bureau, Mr. LIU Gong-min, Director, and Mr. WANG Wen-xiou, Deputy Director of the Institute of Geological Science of Guangdong; Mr. ZHOU Shu-qiang, Chief Engineer of the Institute, Mr. NAN Yi, Senior Engineer of the Insitute, and Director of the Stratigraphy & Palaeontology Committee of Guangdong and Mr. CHEN Ting-guang, Senior Engineer of the Institute and Director of the Tectonics Committee of Guangdong.

On the morning of Monday 6th October, following their arrival, the visitors were welcomed at the University of Hong Kong. The group then visited the Geotechnical Control Office and in the afternoon, the Department of Civil & Structural Engineering, Hong Kong Polytechnic. The remaining days were occupied by field trips in the New Territories and several site visits, and a visit to Intrusion Prepakt (Far East) Ltd.

On the evening of October 6th, the seven guests gave lectures at a well-attended special meeting of the society at Hong Kong Polytechnic. Altogether there were eight presentations. A brief synopsis of each is included in this newsletter, taken from English texts supplied by the speakers. The full text of any of these texts can be borrowed from the society or from Mr. C.M. Lee on request.

This is believed to be the first meeting of the society reported in the local English-language press. The reason was that one of the talks (see below) dealt with the nuclear power plant project at Daya Bay. This was reported in the South China Morning Post in a bold-type item under the headline "Daya Bay an 'island of safety'".

At the meeting, the leader of the delegation, Mr. SHU Cheng-man, made a closing statement which included the following remarks:

> "This visit is the first academic exchange between the Guangdong Bureau of Geology and Mineral Resources and the Geological Society of Hong Kong. The main purpose is to exchange information and to promote mutual under-standing. I believe we will have the second, third and many more visits in future in order to further exchange information and to discuss problems of common concern and interest.
>
> Finally, I would like to extend, on behalf of the Guangdong Bureau of Geology and Mineral Resources, a warm welcome to the Hong Kong Geological Circle to organize another visit to Guangdong, and I am looking forward to seeing you in Guangzhou in the near future."

After his return to Guangzhou, Mr. Shu sent the Society the following letter:

"The visit of our observation group of Guangdong Bureau of Geology and Mineral Resources to Hong Kong has been a success. We have observed the general geology of Hong Kong and met many geologists of Hong Kong. We all enjoyed this visit very much which has been very rewarding and left us deep impression and many beautiful memories.

Thank you and the Geology Society of Hong Kong for the warmful hospitalities extended to us during our visit, and please extend our respect to Mr. C.M. Lee, the standing council member of the Society who has so kindly accompanied us all the time and has given us so much help during our stay in Hong Kong.

We are looking forward to seeing you and your colleagues in Guangzhou in the near future."

GENERAL SITUATION OF GEOLOGICAL WORK IN GUANGDONG PROVINCE

Shu Cheng-man

Guangdong Province has a land area of 206,000 square kilometres. The tectonic framework is extremely complicated, igneous activity has been very frequent, geological conditions have been most favourable for the formation of ores, and mineral resources are abundant and of a great variety.

Since 1978, geological work in Guangdong has entered a new stage of development in a harmonious and stable situation. With the introduction of remote sensing, mathematical geology and computer techniques, studies on metallogenesis and geological prospecting have made much headway. During this period, some new organizations including the Geological Research Institute, the Palaeomagnetic Laboratory, the Department of Remote Sensing Geology and the Computer Station have been set up in Guangdong.

Various kinds of all-provincial geological maps on small scale have been compiled and revised since the completion of regional geological mapping on the scale of 1:200,000 in 1973. The second round of 1:200,000 scale geochemical scanning has been in progress in recent years and about half of the province has been scanned to date. A volume of 'Regional Geology of Guangdong Province' with maps on the scale of 1:1,000,000 was approved for publication in 1984. An area of more than 10,000 square kilometres has been geologically mapped at the scale of 1:50,000.

Stratigraphy: The major stratigraphical sequences from Pre-Cambrian through Quaternary have been systematically established, and altogether 130 stratigraphic units have been distinguished.

Volcanic rocks: Stratigraphical units bearing volcanic rocks have been recorded for all geological periods from Sinian through Quaternary. Systematic studies have been undertaken on Mesozoic volcanic rocks in East Guangdong and on basalt in Hainan.

Granitoids: Occupying one third of the province in area and bearing intimate relationships with many kinds of important mineral resources, the granitoids in Guangdong constitute the major component part of the Nanling granites. A preliminary summation has been made on the genetic types, the evolutional regularities and the metallogenic model of the Nanling granites.

Metamorphic rocks: Research work has been carried out on the multiphase metamorphism in this province, and the tectonic background of metamorphism. Notably, the characteristic features of fracture metamorphism have been brought to light.

Regional mineral resources investigation: Minerogenetic prospect provinces for the major kinds of mineral deposits have been delineated. In the early 1960s, a number of large mineral deposits were discovered and the reserves of energy resources, non-ferrous metals, rare metals, rare earths, and mineral materials for chemical industry were increased by many times. A number of Mesozoic and Cenozoic gypsum and salt deposits and organic fuel deposits were discovered and assessed during the 1970s. In recent years, a number of porphyry metal deposits, precious metal deposits, and building material and industrial chemicals deposits have been discovered and evaluated.

Hydrogeology: The regional hydrogeological survey of Guangdong on a scale of 1:200,000 has been completed and a 1:500,000 scale hydrogeological map of Guangdong Province has been published. More than ten karst regions of hydrogeological complexity have been explored and investigated in some detail: research work has been conducted on the hydrogeological conditions of pore-fissure water in basalt terrains; water supply surveys have been carried out for a number of key cities, major ports, factories and mines. The geothermal resources of the province have been preliminarily ascertained. It is clear that there are major hot water resources of a medium to low temperature.

Engineering geology: Engineering geological investigations have been undertaken in relation to many key projects.

Geophysical prospecting, mainly aeromagnetic survey on various scales,has covered most of the province. An all-province aeromagnetic map on the scale of 1:500,000 has been compiled. Aeromagnetic surveys in Nanhai (South China Sea) and Beibu Bay have outlined potential areas for oil and gas. Subsequently, oil-and gas-bearing structures were delineated by employing marine gravimetric survey, marine geomagnetic survey and marine seismic survey.

A new round of 1:200,000 scale geochemical prospecting is under way at present over the whole province in coordination with the re-processing of panned concentrate data accumulated in the past. At the same time, 1:50,000 scale geochemical surveys have been undertaken in minerogenetic prospect areas and belts.

In recent years, some computer programmes relating to gravity, magnetic and geochemical prospecting and mathematical geology have been introduced or compiled by geologists in Guangdong. A pioneer application of mineralogical data storage and retrieval system was completed recently.

The application of remote sensing is still in the pilot stage. A department of remote sensing geology has been set up under the Guangdong Bureau of Geology and Mineral Resources. Image interpretation has been employed in structural geological mapping and in prognosis of mineral resources. A comprehensive investigation of Guangzhou city employing aerial remote sensing techniques has been carried out in recent years.

A BRIEF HISTORICAL REVIEW OF REGIONAL GEOLOGICAL RESEARCH IN GUANGDONG PROVINCE

Zhou Shu-qiong

The commencement of geological work in Guangdong can be traced as far back as the nineteenth century, at the end of which Ferdinand Von Richthofen, a German geologist, arrived in Guangdong and carried out investigations on several subjects including the red beds in Sanshui County close to Guangzhou, the limestone strata in Shaoguan area of northern Guangdong, and the Quren coalfield.

In the 1920s, the Geological Survey of Guangdong and Guangxi Provinces was set up in Guangzhou. Investigations on the geology along Guangzhou-Kowloon railway and other railway routes and on the geology and mineral resources of numerous areas were undertaken then and through the 1930s.

In the 1940's geological work suffered as a result of the war of Japanese aggression against China.

In the 1950s, systematic geological mapping on a scale of 1:200,000 was begun. This was completed in the early 1970s.

In the 1960s and 70s a large amount of work was done on all-provincial comprehensive studies, resulting in the compilation of geological maps, tectonic maps and minerogenetic maps on the scales of 1:500,000, 1:1,000,000 and 1:2,000,000 as well as a hydrogeological map at the scale of 1:200,000.

In the 1980s, attention has been directed to several new types of study. Urban and environmental geological work has been placed on the agenda. Our prime consideration is to restudy comprehensively all the data available, and to compile maps and documents relevant to urban development. Only on such a basis could we start the comprehensive urban geological investigation on a 1:50,000 scale comprising geology, mineral resources, hydrogeology, engineering geology, hazard geology, environmental geology and regional stability which are now in progress in Shenzhen and Guangzhou.

A BRIEF INTRODUCTION TO THE STRATIGRAPHY OF GUANGDONG PROVINCE

Nan Yi

A stratigraphic sequence from Sinian to Quaternary is exposed more or less completely within Guangdong territory. The province is divisible into five stratigraphic regions according to the distribution of lithofacies and lithological characteristics.

I. West Guangdong Region: marked by wide distribution of the Pre-Cambrian System and the Lower Palaeozoic Erathem.

II. North Guangdong Region: situated in the middle sector of the Nanling Mountains and marked by wide distribution of the Palaeozoic Erathem, with the Mesozoic and the Cenozoic Erathems distributed sporadically only in some inland fault basins.

III. Central Guangdong Region: the Pre-Cambrian in this region is similar to that in West Guangdong, whereas the Lower Palaeozoic is similar to that in North Guangdong. The Upper Palaeozoic is composed largely of neritic and littoral clastic deposits. The Mesozoic and the Cenozoic are developed more or less completely.

IV. East Guangdong Region: The Lower Palaeozoic is poorly developed, and the Upper Palaeozoic, which is marked by littoral clastic deposits, is developed only partly although it is distributed widely in this region. The Mesozoic, however, is most well-developed. The Cenozoic is distributed largely along coastal area.

V. Leiqiong Region: Leizhou Peninsula, Hainan Island and other islands in the South China Sea. Pre-Cambrian rocks are found in western Hainan Island and in the Xisha Islands, Lower and the Upper Palaeozoic strata are recognized only in central and southern Hainan. The Mesozoic and Cenozoic are widespread over the region.

GENERAL STRATIGRAPHIC OUTLINE

Pre-Cambrian

The Pre-Cambrian in Guangdong is divided into Lower Sinian and Upper Sinian. In West Guangdong, East Guangdong and Leiqiong regions, the Pre-Cambrian includes greenschist facies metamorphic rocks and ferruginous and phosphatic beds. In North Guangdong it comprises neritic phosphatic sandstone, shale and siliceous rocks.

Cambrian

Two sedimentary types are distinguishable. On the continent, The Cambrian is composed of neritic sandstone and shale containing sponges and brachiopods. In South Hainan, it consists of neritic phosphatic carbonate-sandstone and shale series. Lithology, fossil content and ore-bearing characteristics of this series are similar to those of Cambrian strata in Australia.

Ordovician

Three sedimentary types are recognizable. In North and Central Guangdong, the Ordovician is composed of black graptolitic shales of the Tremadocian-Caradocian stage. In West Guangdong, it consists of a neritic sandstone and shale series. The Ordovician System in southern Hainan has a transitional feature. The Lower and Middle Series are graptolite-bearing shale and carbonate rock series while the Upper Series is a sandstone and shale series containing brachiopods and bivalves.

Silurian

The Silurian occurs only in West Guangdong. The Lower-Middle Series consists of black graptolitic shales of Valentian to Wenlockian stage. The Upper Series is composed of neritic sandstone and shale. A suite of neritic sandstones and shales with carbonate intercalations containing Heliolites has recently been found in the central Hainan. This is approximately of middle to late Silurian age.

Devonian

With the exception of the Leiqiong Region where no reliable data are available, the Devonian System is distributed widely in Guangdong. After the Caledonian earth movements, the Devonian Sea transgressed eastward into Guangdong from Guangxi Province and gradually into Jiangxi and Fujian. Therefore, the carbonate rocks of this age are distributed largely in North and West Guangdong, while in Central and East Guangdong they pass into clastic deposits. The horizon of this clastic rock series gets higher and higher eastward accordingly.

Carboniferous

The Carboniferous System is widespread and is similar to the Devonian System in depositional characteristics. In recent years, there is a tendency to divide the Carboniferous into two Series. The Lower Series in West and North Guangdong is marked by the development of carbonate deposits. In Central and East Guangdong, however, the Lower Series is composed wholly of clastic rocks, with coal seams in places. The Lower Series in Hainan is similar to that in East Guangdong but no coal is found. The Upper Series is composed of carbonate deposits throughout Guangdong.

Permian

The Permian is an important coal-bearing series in Guangdong. No Permian rocks have been recorded in West Guangdong. The Lower Series in North Guangdong consists of carbonate rocks; in Central and East Guandgong there are clastic rocks with relatively good coals. The Upper Series in the western part of North Guangdong is composed of carbonate rocks with coal-bearing clastic rocks intercalated. In the eastern part of North Guangdong as well as in Central and East Guangdong, the Upper Series is dominated by clastic rocks and bears coal. In Hainan, the Lower Series consists of carbonate rocks whereas the Upper Series is composed of clastic rocks. In summary, the major Permian coal horizon in Guangdong is characterized by the fact that it gets stratigraphically higher westwards and northwards.

Triassic

The Triassic is distributed mainly in North Central and East Guangdong. In West Guangdong and Leiqiong it is not well-developed. The Lower Series comprises mainly carbonate rocks. In recent years, a suite of Early Triassic sandstones and shales containing flora has been discovered in eastern Hainan. The Middle Series is found only in North Guangdong. It comprises lacustrine-continental sandstones and shales. The Late Triassic Upper Series is another important coal-bearing sandstone-shale series (North, West and East Guangdong).

Jurassic

The Jurassic System is distributed mainly in Central and East Guangdong. The Lower Series consists of a neritic sandstone and shale sequence known as Jinji Formation which yields ammonoid Hongkongites-Arietites belonging to Hettangian to Sinemurian Stage (Early Jurassic). The Jingji Formation is not readily differentiated from the underlying Upper Triassic since the two are in conformable contact throughout the province. The Middle Series (Zhangping Group) which occurs only in East Guangdong is composed of lacustrine sandstones and shales. It often contains volcaniclastics. The Upper Series, distributed widely in Central and East Guangdong, but only sporadically in West Guangdong and Leiqiong is called Gaojiping Group. It consists of continental volcanics of intermediate-acidic composition with volcaniclastic intercalations and contains plant fossils. The age is Late Jurassic to Early Cretaceous.

Cretaceous

The Cretaceous System is widely distributed througout the province, largely in basins along major fracture zones. In recent years, a three-fold division of the Cretaceous System has been proposed. The Lower Series developed in Central and East Guangdong comprises acidic volcanics and pyroclastics and is divided into Gaojiping Group (the upper part) and the Guancaohu Group. The Middle Series in West and North Guangdong is composed of red argillo-arenaceous clastic rocks of inland lake facies. In Central Guangdong, it is composed of intermontane basin pyroclastics known as Baizushan Group. In East Guangdong, this Series changes into interior lake deposits bearing pyroclastics. The Upper Series in North, West and East Guangdong consists of red inland lacustrine argillo-arenaceous clastics which produce dinosaur remains and abundant dinosaur eggs. In Central Guangdong, the equivalent is the Sanshui Formation in which no dinosaur skeletons but only eggs have been found.

Tertiary

The Tertiary is rather widespread in Guangdong and often rests on the Cretaceous System in inherited basins. In West and East Guangdong, it comprises fluvio-laustrine red argillo-arenaceous clastics with oil shales and brown coal. In North Guangdong, the Tertiary comprises lacustrine red argillo-arenaceous clastics. In western Hainan and the Leizhou Peninsula, it consists of paralic-marine argillo-arenaceous clastics.

In recent years, a suite of Tertiary rocks several thousand metres thick has been identified by offshore drilling in the Pearl River Mouth Basin of Central Guangdong. A more or less complete stratigraphy for the Tertiary has been established on the basis of these data in combination with those obtained from the Sanshui Basin. On the whole, the Tertiary System in this region is composed of interfingering fluvio-lacustrine clastics and paralic-marine clastics.

Quaternary

The Quaternary System is widespread in Guangdong. Along the coast and in Leiqiong, marine Quaternary is well developed, whereas in the interior it is dominated by fluvial sediments. In Leiqiong, extensive sheets of basalt were erupted during the Pleistocene. Quaternary glacial sediments are recognized in northwestern Guangdong but they are only of limited distribution.

INTRUSIVE ROCKS IN GUANGDONG

Liu Gong-min

The total exposed area of plutons in Guangdong is some 80,000 km², covering more than one third of the land area. Plutonic activity occurred in Caledonian, Indosinian, Yanshanian and Himalayan stages, but it culminated in the Yanshanian.

Caledonian and Indosinian plutons are distributed chiefly in North and West Guangdong, also in Hainan; Early Yanshanian ones occur largely in North and West Guangdong while the late Yanshanian intrusions are concentrated in the central and the eastern parts of the province. It is thus apparent that intrusive rocks in Guangdong become generally younger eastwards and southwards.

Intrusive rocks in Guangdong include ultra-basic, basic, intermediate, acid and alkali rocks, with the acid rocks predominating.

On the basis of source material, granitoids in Guangdong can be grouped into two genetic types, namely the granitoids derived from the crust and the granitoids derived from the upper mantle.

The intrusive rocks in Guangdong are responsible for the formation of many endogenic mineral deposits. Especially the mineralization of Fe, Cu, Pb, Zn, W, Sn, Bi, Mo, U, Nb, Ta, and rare earth are intimately related to granitoids.

Caledonian Intrusive Rocks (c.427-345 Ma)

Only 9 Caledonian intrusions have been recorded, with a total exposed area of about 1600 km², which amounts to 2 per cent of the total exposed area of intrusive rocks in this province. They are distributed in the western and northern parts of Guangdong. Except for one rock body which is granitic, all the others are composed of granodiorite which may grade locally into quartz diorite or quartz monzonite.

Indosinian Intrusive Rocks

Plutonic activity was rather intense in the Indosinian period, resulting in the formation of more than 10 batholiths or stock-like intrusions with a total exposed area of more than 9,000 km² which amounts to 11.2 per cent of that of all the intrusive rocks in this province. These rocks are largely distributed in Hainan, and then in West and North Guangdong. The youngest strata intruded by Indosinian intrusive rocks is the Lower Permian Series. The isotopic age range is 208-257 Ma. Indosinian intrusive rocks are dominated by granite with subordinate monzonitic granodiorite and minor monzonite.

Early Yanshanian Intrusive Rocks of Phase I

These rocks were formed in the Early Jurassic which was a time of intense plutonic activity. More than 10 intrusions have been recorded with a total exposed area of about 11,200 km², amounting to 14 per cent of that of plutonic rocks in the province. They are distributed largely in North Guangdong and secondarily in West Guangdong. The youngest strata intruded by these rocks are Lower Jurassic, while these rocks themselves are covered by the Middle Jurassic strata. Isotopic dating on these rocks yields ages of 172 - 195 Ma. Intrusive rocks of this phase are demoninated by monzonitic granite.

Early Yanshanian Intrusive Rocks of Phase II

More than 20 intrusions of this phase were formed in Middle Jurassic times, with a total exposed area of about 3,000 km², covering 3.5 per cent of the exposed area of intrusive rocks in the province. They are distributed sporadically over the province. Isotopic dating gives ages between 155 and 175 Ma. Intrusive rocks of this phase consist largely of granodiorite with rare monzonitic granite and quartz diorite. Enclaves of quartz diorite are common.

Early Yanshanian Intrusive Rocks of Phase III (Late Jurassic)

The Late Jurasic is a time of most intense plutonism in Guangdong. More than 320 intrusions occur throughout the province with a total outcropping area of 19,000 km², which is equal to 24 per cent of the exposed area of intrusive rocks in this province. They are distributed largely in Central and East Guangdong, commonly as voluminous batholiths. Whole rock Rb-Sr isochron ages for these plutons are consistent with U-Pb dating on zircon, being 140 - 156 Ma, whereas K-Ar dating on biotites yields ages between 130 - 153 Ma. Rock types are dominated by monzonitic granite. Intrusive rocks of this phase were derived from the upper crust, and part of them may be the transformation product of older granites.

Late Yanshanian Intrusive Rocks of Phase I (Early Cretaceous)

Plutonic activity became rather weak in Early Cretaceous times, during which only a little more than 20 plutons were formed with a total exposed area of about 2,600 km² which amounts to 3.2 per cent of that of intrusive rocks in this province. They appear as stocks chiefly in Central and East Guangdong, but some are also exposed in, or concealed under North and West Guangdong and Hainan. Whole rock Rb-Sr isochron ages for these plutons fall within the range of 101 - 136 Ma, whereas zircons from the same plutons were dated by U-Pb method at 111 - 131 Ma, while biotites by K-Ar method give 97 - 136 Ma. Fundamentally two rock types can be distinguished: dominant biotite granite and monzonitic granite.

Late Yanshanian Intrusive Rocks of Phase II (Late Cretaceous)

Only about 10 stock-like intrusions are exposed with a total area of about 500 km², occuping merely 0.6 per cent of the area of intrusive rocks of this province. They are exposed in East and Central Guangdong, while in West and North Guangdong they occur only as concealed stocks. Whole rock Rb-Sr isochron age of these plutons is 88 Ma, U-Pb dating on zircon gives 89-97 Ma while K-Ar dating on biotite yields 76 - 95 Ma.

Himalayan Intrusive Rocks

Plutonic activity in Himalayan stage appear to have been relatively insignificant. Only a few acid porphyry and basic dykes and veins have been reported.

Intrusive Rocks of Undetermined Age

This category includes ultra-basic, basic, intermediate and alkali rocks.

1. Ultra-basic rocks

Ultra-basic rocks are distributed sporadically over the province in the form of dykes and stocks. Typical examples are of augite peridotite, pyroxenite and hornblendite compositions. Their ages may be assigned partly to Sinian and partly to Yanshanian.

2. Basic rocks

Basic rocks occur as dykes and stocks largely in northeastern and eastern Guangdong as well as in Hainan, but rarely elsewhere. They may have been formed in Indosinian and Yanshanian stages.

3. Intermediate rocks

Intermediate rocks are distributed sporadically over the province but largely in Hainan and East Guangdong. The age of formation may be assigned to Indosinian and Yanshanian stages.

4. Alkali rocks

There is only one known occurrence - in the north of Conghua County: a sodalite hastingsite syenite stock. The age may be assigned to Late Yanshanian stage.

MESOZOIC VOLCANIC ROCKS IN EAST GUANGDONG

Wang Wen-xiao

Volcanic rocks are found in Guangdong in every geological era from Proterozoic through Cenozoic. They can be grouped into four suites: i) Proterozoic alkali basalt - spilite-keratophyre suite; ii) Palaeozoic tholeiitic basalt-andesite-rhyolite suite; iii) Mesozoic high-alumina basalt-andesite-dacite-rhyolite suite; and iv) Cenozoic alkali basalt-olivine basalt-dacite-trachyte suite. These suites represent respectively volcanic activity in i) the early development stage of Caledonian eugeosyncline; ii) the Hercynian paraplatform stage; iii) the Yanshanian southeast mobile continental margin tectonic belt; and iv) the Himalayan continental margin rift depression belt.

Covering a total area of approximately 14000 km², volcanic rocks occupy nearly 7% of the land area of Guangdong. In these volcanic rocks, those of a Mesozoic age have a proportion as high as 46% which amounts to 6500 km² in area. The Mesozoic volcanic rocks can be divided into two belts, the East Guangdong coastal (or continental margin) belt and the Central Guangdong fault-basin belt.

Mesozoic (or Yanshanian) volcanic activity started in the Late Triassic with rhyolitic tuff and volcanogenic sedimentary rocks intercalated with marine sandstones and shales. In different area, basalt and andesitic tuff are intercalated with Early Jurassic marine sandstones and shales. Mid-Jurassic volcanic rocks are dominated by a volcanic-sedimentary formation with a thickness of more than 5000 m in continental intermontane basins.

The Mesozoic volcanism culminated in Late Jurassic times during which the voluminous and widespread Gaojiping Group was formed and three cycles can be differentiated.

Cycle I : This cycle is dominated by andesitic-basaltic rocks which appear largely in the Central Guangdong volcanic belt.

Cycle II : This cycle is made up predominantly of rhyolitic rocks flanking the Lianhuashan mountain range on both sides with considerable ignimbrite and occasionally sedimentary intercalations.

Cycle III : Predominantly dacitic rocks were formed in this cycle. They are distributed to the east of the Lianhuashan fracture zone.

The isotopic ages of the Late Jurassic volcanic rocks fall within the range of 145 - 169 Ma.

Volcanic activity in Cretaceous times is controlled by fault basins. Volcanic rocks of this period are restricted to no less than 20 basins in Central and East Guangdong regions. The lower part of this rock suite is made up of basaltic andesites while the upper part, of rhyolites.

Three facies and 5 sub-facies of volcanic rocks are differentiated on the basis of mode of occurrence, rock assemblage and environment of formation of the volcanic rocks.

(1) Intrusive facies

Volcanic vent (neck) and subvolcanic subfacies. The subvolcanic subfacies is often associated with mineral deposits.

(2) Extrusive facies

Explosive subfacies (pyroclastics) and effusive subfacies (lavas)

(3) Volcanic-sedimentary facies

Geochemical and petrologic studies show that the Mesozoic intermediate-acid volcanic rocks and a considerable amount of the intrusive rocks of the same composition in the coastal area are comagmatic. The activity of both the intermediate-acid volcanic rocks and the intrusive rocks started at Late Triassic, culminated in the Late Jurassic and ended in Late Cretaceous times. In spatial-temporal distribution, they have a general younging direction towards the sea, with the volcanic rocks and intrusive rocks being roughly equivalent in chemistry. The volcanic suite and the intrusive rock suite belong to the same tectonogenetic region (which represents a tectonic setting corresponding to that of the inner side of the Japan Island Arc).

The East Guangdong Mesozoic intermediate-acid volcanic-intrusive rock suite extends northeastward into Fujian, Jiangxi and Zhejiang provinces, and farther on into South Korea, Southwest Japan and beyond. Petrochemically, it belongs to the calc-alkaline series. It is rich in elements characteristic of the continental crust but poor in those characteristic of the oceanic crust (mantle source).

The author believes that this rock suite is a product of gentle subduction of the Kula Plate-Pacific Plate against the Eurasian Plate. The Kula Plate subducted westward until 135 Ma BP when the subduction accelerated and turned in a northward direction, which is consistent with the culminating period of magmatic activity in this area. Finally, at 100 Ma BP, this area was influenced only by the action of the E-W spreading ridges of the Pacific Plate, and this is in conformity with the waning stage of magmatic activity.

INTRODUCTION TO REGIONAL METALLOGENY OF SOLID MINERAL RESOURCES IN GUANGDONG PROVINCE

Pang Cun-rui

As many as 116 kinds of mineral resources have been discovered in Guangdong up to 1985. Eighty-eight have identified reserves and 38 of these are important in terms of contribution to the national production. Several tens of large-and medium-scale mines have been established. Mineral resources include those of non-ferrous heavy metals (e.g. Pb, Zn, Cu, W, Sn, Bi and Mo), rare metals and rare earth metals (e.g. Nb, Ta, Be, Zr, Y and Ce), precious metals (e.g. Au and Ag), dispersed elements (e.g. To, Ge, Ga, In, Tl, Gd and Se), radioactive elements (e.g. U), and nonmetalliferous resources such as sulphur, arsenic, limestone, fluorite, kaolin, quartz sand, marble, oil shale and gem stones.

Stratigraphic controls Quite a few mineral deposits occur in stratigraphic units and are restricted to certain 'ore-bearing beds' or 'source beds' of specific lithofacies and lithology in a definite stratigraphic position. Such strata carrying relatively abundant ores are largely of four suites, namely the Sinian-Cambrian, the Devonian-Carboniferous, the Upper Triassic-Lower Jurassic and the Tertiary-Quaternary. These can be further divided into several second-order ore-bearing horizons in certain tectonic units (regions).

The Sinian-Cambrian suite is primarily metamorphosed shallow sea flyschoid clastics. Ore-bearing beds or source beds found in this suite are mainly linked to deposits of Fe, Sn or W-Sn, Au, S and U. The formation and distribution of all the ore-bearing beds in the Sinian-Cambrian are restricted to depression regions.

The Devonian-Carboniferous suite comprises platform-type clastics: carbonates and coal-bearing formations. A wide variety of metalliferous deposits has been found in the carbonate rocks or where they grade into clastic rocks. The major mineral resources are: S, Pb-Sn-Cu-S, Fe, W or W-Sn and Sb-Hg-As. Ore-bearing beds are restricted to the margins of depressions and are closely linked to transgressive sequences and carbonate sedimentary facies.

The Upper Triassic-Lower Jurassic suite is composed largely of clastics intercalated with volcanic-pyroclastic rocks and occurs mainly in East Guangdong. The major mineral resources carried in this formation are: Sn or Sn-Sulphides and Fe. The Upper Triassic-Lower Jurassic ore-bearing beds bear intimate relationships with fracture tectonism and magmatism.

The Tertiary-Quaternary suite consists mainly of (Tertiary) clastic carrying coal, oil shale, gypsum and U and (Quaternary) loose accumulative layers carrying gem stones, rare earth deposits, bauxite, kaolin, various placers and building materials.

Magmatic conditions In the Yanshanian (Mesozoic) stage which is the major metallogenetic epoch in Guangdong, basic rocks were the mother rocks of vanado-and titano-magnetite deposits; granitoids were those of the deposits of non-ferrous heavy metals, rare metals, rare earth metals, U, Au, Ag, pyrite and rock crystal; while alkaline rocks were the mother rocks of rare earth mineralization.

Volcanic rocks are largely of the intermediate-acid composition and their ore-bearing potential resembles that of the Yanshanian granitoids. Porphyry tin, porphyry tungsten and porphyry molybdenum deposits probably connected to volcanic activity are generally distributed close to large deep fractures and may be the final products of the Yanshanian granitic magmatism.

The following five major regional metallogenetic areas and metallogenetic belts can be delineated on the basis of the regional metallogenetic features and the distribution of known ore deposits and occurrences.

(1) North Guangdong poly-metal and sulphur metallogenetic area. This area lies in a Late Palaeozoic depression region in the northern part of Guangdong. Ore-bearing strata are of Devonian-Carboniferous age. The country rocks are dominated by carbonates. Ore deposits including those of Pb, Zn, Cu and pyrite are markedly controlled by strata and lithology.

(2) Eastern North Guangdong tungsten-tin metallogenetic area. Ore deposits are mostly of a quartz vein-type producing mainly W-Sn, Sn-Cu-Pb-Zn, and W-Sn-Bi-Mo. The ore-bearing strata are Sinian-Cambrian and the country rocks are metamorphosed sandstones and shales.

(3) West Guangdong Au, Sn, S, poly-metal metallogenetic belt. The ore-bearing strata are Sinian-Cambrian and the country rocks are composed of argillo-arenaceous metamorphic rocks with or without carbonate rock and pyroclastic rock intercalations. Ores also occur in migmatites and igneous rocks.

(4) East Guangdong coastal tungsten and tin metallogenetic belt. Mineralization is closely associated with igneous activity of the Yanshanian age. Part of the ores are hosted in granite. The major ore-bearing strata there are Upper Triassic-Lower Jurassic and the country rocks are comprised mainly of clastic rocks and pyroclastic rocks.

(5) Coastal littoral placer metallogenetic belt. Littoral placers are widespread forming a series of large-or medium-sized deposits producing zircon, placer titanium, monazite and quartz sand.

FUNDAMENTAL FEATURES OF THE GEOLOGICAL STRUCTURE OF GUANGDONG PROVINCE

Chen Ting-guang

Beginning from Palaeozoic times, the Caledonian, the Indosinian, the Yanshanian and the Himalayan movements all have strong manifestations in Guangdong.

The Caledonian structural layer (Lower Palaeozoic) is distributed over western and northern Guangdong, and is composed of clastic sediments of shallow marine facies with a total thickness of around 7000 to 10000 metres. This structural layer corresponds to a sedimentary formation of geosynclinal type. Intense Caledonian movements took place at the end of Silurian period. The strata have been extensively subjected to low-grade regional metamorphism. The lower and middle Devonian series universally rest unconformably on lower Palaeozoic strata. The Indosinian structural layer consists of the Devonian, the Carboniferous, the Permian, and the lower and middle Triassic which are distributed over northern and northeastern Guangdong. It is composed of shallow sea limestones and coal-bearing clastic sediments with a total thickness of 5000-6000 metres.

After the Caledonian movements, there was erosion and subsequently subsidence giving rise to many depressions following the earlier structural line and serving as the basement for sedimentation. The land was low in the west and high in the east. The direction of marine invasion was from west to east.

From middle to late Triassic, Indosinian movements prevailed throughout Guangdong province. A series of fractures was formed, along which regional dynamic metamorphism took place. The Upper Triassic everywhere in Guangdong rests upon the underlying strata with angular unconformity.

The Yanshanian structural layer is composed of the Upper Triassic, Jurassic and Cretaceous series. Except for East Guangdong where paralic sediments of upper Triassic to lower Jurassic age are found, Jurassic and Cretaceous strata in Guangdong are universally composed of continental clastic sediments which are restricted to intermontane basins and fault basins.

Fracture structures striking mainly NE and resulting from Yanshanian movement are very well developed. They control the distribution of the continental depositional basins.

These basins, more than 100 in number, are often cut by younger fractures, therefore most of them are hemi-basins or graben-like basins.

The Yanshanian tectonic stage witnessed a very complex tectonic movement characterized by faulting, folding, magmatism, metamorphism and metallization. At the beginning of this stage, orogenic folding took place. This gradually weakened, while faulting occurred on a larger and larger scale and cut deeper and deeper into the crust. Igneous activity was intense at the middle phase but weak in the earlier and later phases. Intensity of tectonic deformation and magmatism migrated from northwest to southeast through the Yanshanian stage.

The Himalayan structural layer consists of the Tertiary and the Quaternary systems. Sedimentation at this stage was largely restricted to isolated fault basins where red polymict and molasse-like sediments were deposited. Lacustrine gypsum-bearing saline deposits and littoral paludal sequences with coal and oil shale also occur in certain areas. In Leiqiong region, Late Tertiary-Quaternary basalt formation and unconsolidated paralic clastic sediments are also identified.

The highly variable lithology and thickness of the strata and unconformities existing between different rock systems indicate that tectonic movement was still very active during the Himalayan stage. Faulting still occurred constantly. Many neogenic fractures were formed and some old fractures were revived. More than 200 hot springs in Guangdong are closely related to faulting.

<u>Migration of the centre of tectonic activity</u>

The centre of tectonic activity migrated gradually in the course of time from northwestern Guangdong towards the coastal area. For instance, the geology in western Guangdong is dominated by Caledonian folding, in central Guangdong it changes into an Indosinian zone, in eastern Guangdong it gives place to the Yanshanian fault-folding zone while finally along the southeastern coast it turns into a Himalayan fold belt. From west to east, the strata are getting younger and younger, the tectonism is progressively stronger, while fractures are becoming more developed and igneous activity more intense and more frequent.

<u>Faults associated with Yanshanian Movements</u>

In the coastal area between Zhanjiang and Shantou, there are numerous large-scale compresso-shear fracture zones trending NE40° - 60° accompanied by tenso-shear fractures trending NW. All these are products of the Yanshanian movement. Five major fracture zones are distributed at equal intervals of about 70 km. They are aligned roughly parallel to the shoreline and are hence convex slightly towards the southeast. The faults have an anti-clockwise shearing nature and are aligned in a left-lateral en echelon pattern.

The major fracture zones dip mainly to the southeast but locally to the northwest. Dynamo-metamorphic zones several to more than 10 km in breadth are developed along some of the fracture zones.

Large-scale faulting is one of the fundamental features characterizing the Mesozoic geological structure of Guangdong. The fracture zones have strictly controlled the more than 100 Cretaceous-Tertiary basins widespread in the whole province. These basins are largely fault basins and single-fault basins in particular, which are controlled by a single fracture, while others are graben-basins controlled by fractures at both sides. The floor of the basin always inclines towards one side, displaying distinct asymmetric nature. The lower strata at one side of the basin always lie unconformably on older ones, while the upper strata overlap progressively towards the other side of the basin. The cause of this phenomenon is that the basement fracture has been all along in a constantly active stage, and that because of the differentiated movement of the two walls of the fracture which has often been active only at one side, causing a constant migration of the sedimentary centre towards one side. This migration is mainly towards northwest, but when related to the associated NW-trending fracture, it is towards southwest.

These fracture zones were formed largely in Jurassic times. Even in recent times they are still active as indicated by the occurrence of earthquakes and hot springs, and also by geomorphological contrast. Generally speaking, these fractures belong to a complex fracture zone which has been repeatedly active over a long period of time.

The Leiqiong Region is a coastal area where neotectonic movement is most active. The NW-trending fractures are the main effusion channelway for Quaternary volcanoes. The alignment of epicentres recorded in history is related also to NW-trending fractures. The Zhujiang delta and Hanjiang delta are actually Quaternary sedimentary basins bounded by two or more than NW-trending fractures.

EVALUATION OF THE CRUST STABILITY IN THE SITE AREA OF DAYA BAY NUCLEAR POWER STATION

Chen Ting-guang

The Daya Bay Nuclear Power Station is the first large scale nuclear power station planned in China. Installed capacity of the reactors will be 1,800 MW. The site of the station is in Dakeng district on the eastern flank of the Dapeng Peninsula, about 40 km east of Shenzhen.

Stringent regulations concerning the siting of a nuclear power plant have long been in force. Various factors must be taken into consideration including geological structure, seismology, regional physical processes, underlying tectonic background, hydrothermal activity, human activities such as civil engineering works, environmental protection, water supply, communications, power supply system and the load centre, of which geological structure and seismology are of most vital importance. In other words, the stability of the site of the nuclear power plant and of the regional crust underlying and around it must be evaluated accurately, in order to choose a relatively stable mass (the so-called 'safety island') for the siting. According to the experiences obtained from the 360 nuclear power plants already set up in the world, the general requirements are as cited below :

1. <u>The potential activity of regional structure</u>: The site of the plant must be 20 km away from any deep large fault zone or from currently active or capable faults. Siting is absolutely prohibited within 8 km from such faults. Moreover, siting must be well away from active regions of neotectonic movements and areas of current high tectonic stresses.

2. <u>Seismic activity</u>: Siting must be more than 320 km from historical epicentres with $M \geqslant 8$, more than 250 km from those with $M \geqslant 7$, or more than 150 km from those with $M \geqslant 6$. A sufficient attenuation distance must be maintained in order that high intensity earthquake is not likely to happen. The basic intensity of earthquake must be lower than VII, and any site where an earthquake of an intensity higher than VIII has been recorded in past history must be abandoned. The Daya Bay district is currently an area of low intensity of earthquake, with very infrequent microseismic activities and insignificant seismic effects.

3. <u>Local geological processes</u>: No recent igneous, volcanic or hydrothermal events, nor any recent landslides, collapses or mud-rock flows.

4. <u>Other conditions</u>: No damaging engineering geological events caused by human activity, such as land subsidence or collapse due to removal of water and gas from the ground, and earthquake induced by injection of water into strata at depth and by impoundment of water reservoir. Areas below plain or storm tidal level, town and densely populated area, district of important factories and mines, area of inconvenient communication and transportation, and regions of unfavourable climatic conditions are not suitable for the erection of a nuclear power plant.

According to the above requirements, several dozens of localities within this province have been chosen and delineated since 1978 for a final selection. Dapeng Peninsula was determined to be the key district for detailed site studies. Interpretation of satellite imagery, microseismic observation, measurement of ground-stress and regional geological survey on the scales of 1:200,000 and 1:50,000 were carried out in this peninsula in 1979. Through the efforts of the last few years, Dakeng district on the eastern flank of Dapeng Peninsula has been chosen as the site of the plant. In order to study the engineering geological conditions and the construction conditions of the site and to obtain necessary data for the design, survey and test work are proceeding.

With a view to finding a relatively stable landmass for the siting of the nuclear power station in Dapeng Peninsula, large scale detailed investigations have been carried out by many departments in the last few years, in some of which the author has taken part.

<u>Study on the Tectonic Stability of the Daya Bay District</u>

I. <u>Study on the regional NE-striking capable faults</u> : The NE-striking Lianhuashan fracture zone bounding the Daya Bay district on the north consists of strong fracture bundles and dynamometamorphic zones. It displays a compresso-shear property and branches off into two sub-zones, one running along the northwestern and another along the southeastern side of the Lianhuashan mountain range. The former is known as the Shenzhen-Wuhua fracture sub-zone while the latter is the Haifeng-Dapu fracture sub-zone. They join again at Danshui, and thence extend farther southwestward to Shenzhen and to Yuen Long and Tuen Mun in Hong Kong. Aeromagnetic data have shown that the fracture zone extends to depths of more than 20 km. This fracture zone is still active and releases energy in a form of creep deformation. Another relatively large bundle of fractures is recognized southeast of the Lianhuashan fracture zone. This is known as the Meilong-Pinghai fracture zone. Faults in this zone extend up to about 10 km depth according to aeromagnetic data. A moving rate of 0.7 mm/y has been recorded.

Tectonic activity, seismic activity and dynamometamorphism are more intense in the northeast and tend to be weaker in the southwest sectors of the fracture zones mentioned above. In the N-S direction, the northern side of the fracture zone is occupied by some Cenozoic continental basins, the southern side borders the offshore area of relatively strong activity, whereas the middle part is an uplifted area and therefore less mobile.

The site of the Daya Bay nuclear power station is chosen at a comparatively stable landmass about 20 km from the fore-mentioned fractures. This landmass is amenable for siting of a nuclear power plant as no NE-striking currently active or capable fractures have been recognized in it.

II. <u>Study on the NW-striking active fractures</u> : Along the coast zone of Guangdong are developed a series of faults with their long axes trending north-northwesterly and nearly perpendicular to the coast. A set of fractures with strike 330 - 340° are developed in Pinghai Peninsula and Dapeng Peninsula flanking Daya Bay on both sides, and in Zhongyang Islands within Daya Bay. These fractures are generally about ten to several tens of kilometres in length, with their fracture planes dipping rather steeply. Investigation reveals that they are commonly not very deep, and become progressively shallower from the coast towards the interior. They must be relatively young in age, since they always cut structures with other trends and they are rarely deformed by other fractures. No fractures of this set have been recognized in the vicinity of the site proposed for the nuclear power station, therefore they have not essentially any effects on the site.

III. <u>Study on seismic activity</u> : Historical seismological data show that earthquakes in this area have occurred only along fracture zones, and the intensity is different from section to section.

Earthquake have occurred only along fracture zones and rarely in places without significant fractures, for example :-

The southwestern section of the Shenzhen-Wuhua fracture zone: Earthquake with a magnitude of 4 and 3/4 occurred near Macao on 11, August 1905. Something like 150 earthquakes have occurred since 1970 with a maximum magnitude of 3.1. Between 25 May and 3 June 1981, three micro-seismic shocks were recorded in the Huidong-Danshui area.

The Meilong-Pinghai fracture zone : Earthquake has taken place frequently along this fracture zone. More than 10 earthquakes with magnitudes not exceeding 5 have occurred in past history. Of these, three earthquakes with a magnitude of 5 took place near Haifeng in 1874 and 1911. From 1970 to 1979, the Meilong Seismological Observatory recorded 800 small seisms, and 460 weak ones, of which 10 are of a magnitude of 3-3.9. On 4 February, 1981, a swarm of small seisms occurred near Meilong. More than 1500 small seisms were recorded of which 16 are of a magnitude of 1.7-2.7 with the strongest reaching 3.9.

The Daya Bay fracture : Much small seismic activity has happened frequently near this fractures, along which the epicentre seems to have moved to and fro in a NNW-SSE direction. In 1982, a swarm of micro shocks took place at the northern end of the fracture at Xiayong. Seismic activity is significantly concentrated in certain segments, and the intensity is different from place to place.

With a dividing line running N-S through Jiantoukeng on the eastern margin of Daya Bay, the intensity and frequency of earthquake appear to be higher on the eastern and lower on the western side. The Meilong-Pinghai fracture on the eastern side appears to be the source of earthquake shocks characterized by high intensity and frequency. On the contrary, in Dapeng Peninsula on the western side, no damaging earthquakes have ever occurred and small shocks have very seldomly occurred, if ever. For instance, only 6 sensible shocks have been recorded in Baoan County for the last more than 400 years, since the sensible earthquake of December 12, 1567 occurred at Nantou of Baoan County about 100 km from Dapeng. Therefore, seismic activity has not only been very weak but also very rare in this district.

The site of the nuclear power plant is 280-300 km to the west of Nanao, a region of seismicity of the magnitude of 7, and to the east of Yangjiang, a region of seismicity of the magnitude of 6.4. It is about 125 km to the south of Heyuan which is a region of high seismicity of the magnitude of 6.1, and more than 100 km to the north of the offshore deep and large fracture. In short, the site is located well outside the area of seismic risk. The deep-seated tectonic background is simple, deep fractures are not developed, and seismic activity is weak.

IV. Study on Present Tectonic Stress Field: According to the ground stress measurements conducted by the 562 Geomechanical Research Party of the Ministry of Geology and Mineral Resources, the present maximum principal compressive stress is oriented in a SE130° - 150° direction in this district, and the stress is acting mainly horizontally.

As regards the Dakeng area, the shear stress measured there is much lower than in other areas (Chaoshan, 103 - 106; Heyuan, 96 - 94; Yangjiang, 75 - 77; Guangzhou, 68 - 70; Haifeng, 66 -65;

Dakeng, 51 - 53. Unit: bar). The Dakeng area is dominated by Yanshanian granitic masses in which no large fractures are recognizable, and which join into a complete whole of large dimension at depth. So, this area is not a seismic area where medium and strong earthqukake is likely to happen as far as its crustal structure is concerned, and it is really a good 'safety island'.

The results of the above-mentioned studies all prove that Dakeng area in Daya Bay is suitable for siting of a nuclear power station.

Footnote

Seven references supplied.

DOLOMITIC LIMESTONE IN TOLO HARBOUR

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During offshore drilling forming part of site investigation works carried out by Energy Consultants Asia on behalf of the Hong Kong & China Gas Co., dolomitic limestone was found underlying the seabed of Tolo Harbour in two boreholes some 500 m from the southern tip of Harbour Island (Fig. 1). The dolomitic limestone was determined based on the thin sections of the rock and acid reaction. The chemical compositon of CaO and MgO of the rock has not yet been supplied. Granodiorite and fine grained granite were found in boreholes at adjacent locations.

A total of twelve boreholes have been drilled in the proposed foundation for a fixed dolphin terminal at the site (Fig. 1). Each borehole was carried at least 5 m into fresh to slightly decomposed bedrock. The results gave a general submarine profile of the site, consisting from top to bottom of marine deposits, alluvium with probably estuarine deposits, decomposed bedrock and bedrock (dolomitic limestone, granodiorite or fine grained granite). A composite borehole section of the site is shown in the table 1.

Discussion :

1. The site is situated 500 m southwest of Harbour Island, which is made up mainly of quartz-rich sedimentary rocks of Devonian age (Lee, 1982). Further west on Ma Shi Chau, along the southeastern coast of the island, is the Tolo Harbour Formation of Permian age (Allen and Stephens 1971). The dolomitic limestone is considered to be of Carboniferous age by comparison with the Northwest New Territories (Siu and wong, 1984) and the area around Shenzhen (Lai and Mui, 1985).

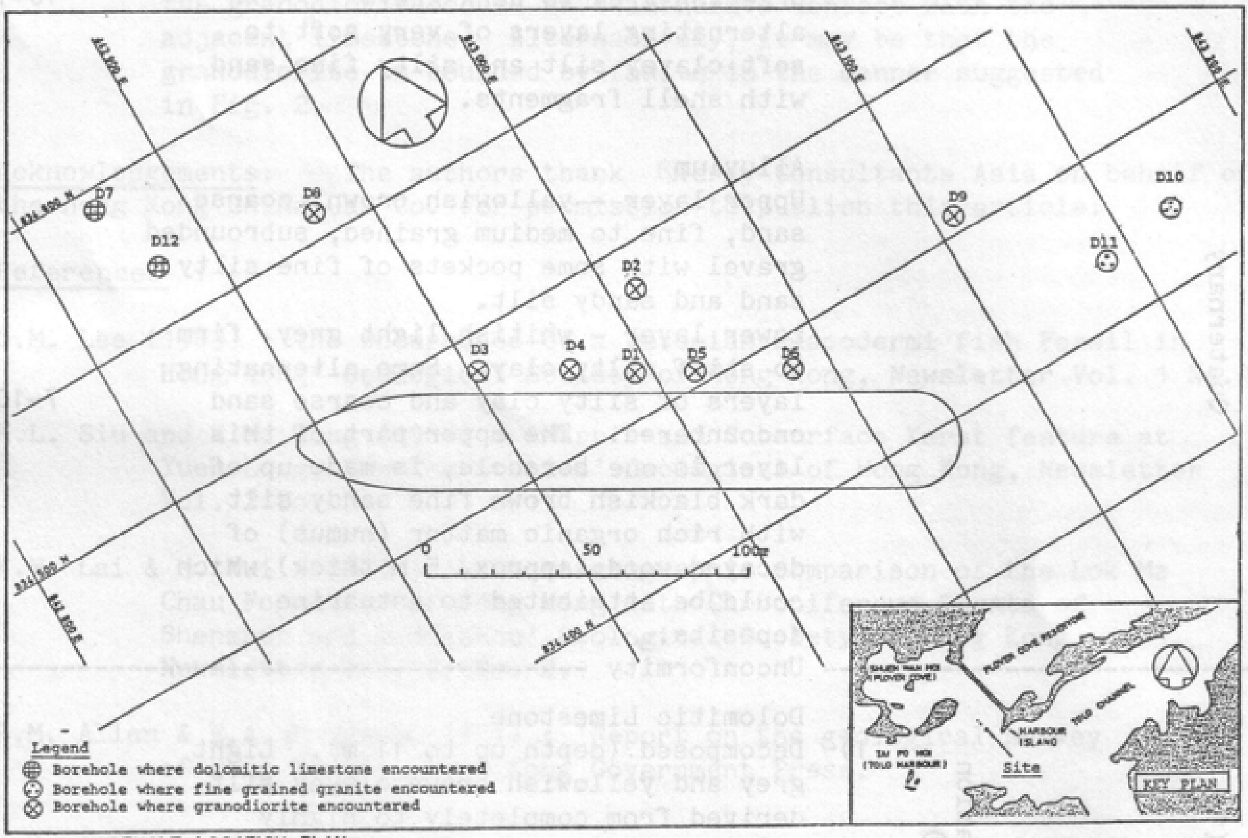

FIG.1 BOREHOLE LOCATION PLAN

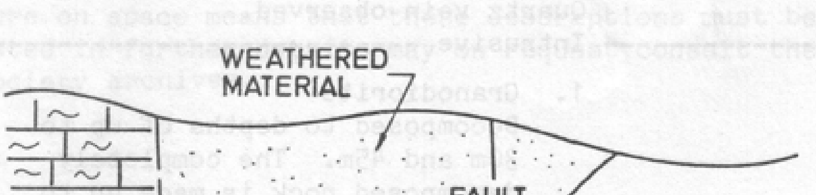

FIG. 2 THE POSSIBLE RELATIONSHIP OF GEOLOGICAL STRUCTURE OF SITE

TABLE 1 : A COMPOSITE BOREHOLE SECTION OF THE SITE

Geological Age	Formation	Stratum Description	Thickness
Quaternary		Marine Deposits Greenish grey to dark grey alternating layers of very soft to soft clayey silt and silty fine sand with shell fragments.	10-15m
		Alluvium Upper layer - yellowish brown, coarse sand, fine to medium grained, subrounded gravel with some pockets of fine silty sand and sandy silt. Lower layer - whitish light grey, firm to stiff silty clay. Some alternating layers of silty clay and coarse sand encountered. The upper part of this layer in one borehole, is made up of dark blackish brown fine sandy silt with rich organic matter (humus) of decayed wood (approx. 5 m thick) which could be attributed to estuarine deposits.	7-10m
		Unconformity	
Carboniferous (?)	Yuen Long Formation (Lee, 1982)	Dolomitic Limestone 1) Decomposed (depth up to 11 m). Light grey and yellowish brown clayey silt derived from completely to highly decomposed material and immediately overlying the bedrock. 2) Fresh dolomitic limestone, whitish grey and white, very fine grained, hard, silicified, massive with moderately spaced joints and some corroded voids infilled with gravel and subrounded sandy material. Quartz vein observed.	>5m
		Intrusive	
Jurassic		1. Granodiorite Decomposed to depths of up to 30m and 45m. The completely decomposed rock is made up to yellowish brown, mottled white clayey silt. The intact rock is dark grey with white spots, coarse grained, massive, veined with quartz and calcite.	>5m
		2. Fine Grained Granite Decomposed to depths of up to 6m. The completely and highly decomposed rock is usually pinkish light brown silty fine sand with rock fragments. The intact rock is pale pink, strong with closely spaced joints coated with calcite and kaolinite. Locally sheared with clearly defined fault zones.	>5m

2. A steep fault was observed in the granodiorite and fine grained granite found in boreholes D8, D10 and D11 (Fig. 1). The boreholes revealed that the bedrock level of both dolomitic limestone and fine grained granite are 25 m higher than the intervening bedrock of granodiorite. The evidence of quartz veins in the dolomitic limestone may suggest that the granodiorite could have intrusive contact with the adjacent limestone. Alternatively, it may be that the granodiorite is bounded by faults in the manner suggested in Fig. 2.

Acknowledgements. The authors thank Energy Consultants Asia on behalf of the Hong Kong China Gas Co. for permission to publish this article.

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REPORT OF FIELD TRIP TO TAIWAN, JUNE 1986 (CONTINUED)
THE FETSUI AND MINGHU PROJECTS

In the description of the Taiwan field trip in the previous issue of the Newsletter, it was stated that a description of two new hydro-projects visited, Fetsui and Minghu (Mingtan), would follow in the next issue. Pressure on space means that these descriptions must be very brief. Anyone interested in further details may on request consult the references held in the society archives..

Fetsui Project

The Fetsui Reservoir Project is aimed at providing the Taipei water supply region with a dependable source of water for domestic and industrial use. It is located about 30 km south of Taipei City.

The Fetsui Dam is a 122.5 m high double-curvature concrete thin arch dam with a crest length of 510 m. It has a width of 25 m at the base and 7 m at the crest. It impounds a reservoir of 406,000,000 cu m capacity with a surface area of 10.2 sq.km. This will ensure a yield sufficient to satisfy the demands up to the target year of 2030. The prime purpose of the project is water supply, but for full utilization of the available water resources a 70 MW power plant will be installed. The project was completed in 1986.

Details of the reservoir and damsite geology, stress analysis of the dam and choice of dam type, and foundation treatment are given in Reference 1.

Minghu Pumped Storage Project

The Minghu pumped storage project is conceived to develop an average gross head of 390 m between the upper reservoir, Sun-Moon Lake, in the western foothills of central Taiwan, and a lower reservoir some 3 km away to the west, formed by building a concrete gravity dam with a height of 57.5 m on the Shuili river. The large storage capacity of Sun-Moon Lake provides the proposed pumped-storage powerplant with the operational flexibility and capability required for continuous power generation. The total installed generating capacity will be 1,000 MW. The project comprises an upper reservoir, an intake structure, two headrace tunnels, two surge tanks, two penstocks, an underground pump-house cavern equipped with six 267 MW Francis reversible pump-turbines, six tailrace tunnels, the lower reservoir dam and a switchyard. The powerhouse cavern has dimensions of 21 x 127 x (height) 40 m, and the transformer cavern 13 x 104 x (height) 14 m.

Generally speaking, the rock strata of the project area (slightly metamorphosed sandstones, siltstones and shales) are substantially weathered and weak, and the geological structure is fairly complicated. These conditions have given rise to difficulties in the construction of the pressure tunnels, surge tanks, penstocks and underground caverns. For the engineering geology of the project, see References 2 and 3.

Acknowledgements

The Society is indebted to the Taiwan Power Co. for providing extensive tours and detailed briefings of both projects during its visit to Taiwan in June. We thank especially Mr. H.H. Sung, Project Director at Fetsui and Mr. F.L. Lin, Deputy Project Director at Minghu, for arranging the programme of the visits and receiving and accompanying us.

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LANDPLAN III - A SOUTHEAST ASIAN SYMPOSIUM: THE ROLE OF GEOLOGY IN URBAN DEVELOPMENT

The Landplan III Symposium was held 15-20 December 1986 at the University of Hong Kong, with several seminars at the Geotechnical Control Office (GCO), Hong Kong Government. One hundred and twelve persons attended, about 65 from Hong Kong, 18 from the People's Republic of China and the remainder from 11 other countries. The symposium was organized by the Geological Society of Hong Kong, with the support and cooperation of the International Union of Geological Sciences (IUGS), the Association of Geoscientists for International Development (AGID) and Unesco. Representatives of each of these organizations as well as the International Association of Engineering Geologists, spoke at the opening session, at which the Vice-Chancellor of the University of Hong Kong, Dr. Wang Gungwu, gave a welcoming address and the head of the GCO, Dr. E.W. Brand, spoke on geology and engineering development in Hong Kong with special reference to the role of the GCO and the geological work which it undertakes.

The LANDPLAN series of meetings began with an international conference - LANDPLAN I - held in Bangkok in 1982, on the impact of soil, geology and landforms on land use planning in developing countries. In the aftermath of this meeting, a proposal was formulated by AGID for a 5-year programme of activities focussing attention on the role of geology in urban development in Southeast Asia and the environmental problems which are commonly encountered. The aims were to promote awareness of the role of geoscience in urban land use planning, increase its effective application to urban problems, and initiate inter-disciplinary research applied to problems common to many cities. It was hoped that this would provide a stimulus towards the strengthening of local and regional groups, including government departments, research institutions and professional societies.

LANDPLAN II, held in Kuala Lumpur in April 1984, was a workshop on the role of geology in planning and development of urban centres in Southeast Asia. LANDPLAN III was designed to continue and develop this theme, using as its setting a city where the influence of topography, climate and geology on many aspects of urban development is seen at its most striking, as well as providing an opportunity for participants from neighbouring countries to see at first hand the geological work of the GCO.

Of particular interest to many of the participants were the first two map sheets and first area memoir of the new 1:20 000 Geological Survey of Hong Kong, on public display for the first time at Landplan III. There were also poster displays and office and laboratory visits to show the work of the GCO and that of a number of private consultants and contractors in land use evaluation, slope monitoring, rock and soil testing and the like.

Landplan III was undoubtedly a success, measured by the quality and the coverage, both technical and geographic, of the papers presented. A total of 58 papers were given over 3 days, the various technical sessions covering, principally, Geological mapping in the urban environment, Geological aspects of urban planning, Engineering geological considerations in urban development, Ground instability, Hydrogeology and groundwater resources, Geological aspects of environmental management and Seismicity and seismic risk.

LANDPLAN III

Above L: D.B. KRINSLEY (IUGS) and R: S.J. WANG (Asia Vice-President, IAEG), A.D. BURNETT (Chairman, GSHK), E.W. BRAND (Geotechnical Control Office, H.K. Government) and S.T. MALLING (Unesco) were among the speakers at the opening ceremony.

Opposite L to R, top to bottom: 1. J.L. NEILSON, Dept. of Industry, Technology and Resources, Australia; 2. Prof. YUDHBIR, Indian Institute of Technology and S.H. ISRAILI, Aligarh Muslim U., India; 3. H.L. ZHANG, State Seismological Bureau, China; 4. C. ANANTASECH, Chiang Mai U., Thailand; 5. D.T. BERGADO, Asian Institute of Technology, Bangkok, K.K. CHEANG, Science U. of Malaysia, I. KOMOO, National U. of Malaysia and R.M. LUIS, Bureau of Mines and Geological Sciences, Philippines; 6. D.H. BELL, U. of Canterbury, New Zealand; 7. A.A. FINLAYSON, Terrain Consultants, Australia and E.J.A. LOHMAN, Infraplan, The Netherlands; 8. Dr and Mrs SAMPURNO, Bandung Institute of Technology, Indonesia; 9. S.Y. LIN, Guangdong Institute of Geology, China; 10. R. GHOSH, Indian School of Mines and M.K. ZAMBRE, D.F.B. Dayanand College of Arts & Sciences, India; 11. W.R. DEARMAN, U. of Newcastle upon Tyne, U.K.; 12. C. CHAUBY, Bureau de Recherches Geologiques et Minieres, France and I. MCFEAT-SMITH, Charles Haswell & Partners, Hong Kong; 13. Y.Z. DING, Guangdong Seismological Bureau and S.J. WANG, Academia Sinica, China; 14. M. KHAWLIE, American U. of Beirut, Lebanon; 15. S.T. MALLING, Unesco, G. TAYLOR, Canberra College of Advanced Education, E.B. YEAP, U. of Malaya, W.W.S. YIM, U. of Hong Kong and S.L. LI, Nanjing U., China.















There were three guest speakers at the symposium, sponsored by IUGS: J.L. Neilson, Department of Industry, Technology and Resources, Australia, Dr. M.J. Knight, University of New South Wales, Australia, and Professor W.R. Dearman, University of Newcastle upon Tyne, U.K. They gave keynote lectures on, respectively, 'Geological Mapping in the Urban Environment', 'Applications of Geology in Environmental Protection' and 'Weathering Profiles and Subsurface Excavations in Tropical Areas'.

A feature of the symposium was the holding of eight well-attended half-day seminars over a two day period at the start of the symposium:

- Geological mapping in the urban environment.
- Applications of geology in environmental protection.
- Weathering profiles and subsurface excavations in tropical areas.
- Geotechnical area studies and terrain evaluation for urban development.
- Geological aspects of slope stability.
- Site investigation and laboratory testing.
- Marine studies for harbours, reclamations and foundations.
- Education of geologists for employment in civil engineering.

These (apart from the last) highlighted the work now being done in Hong Kong. They were organized and run by Hong Kong geologists and engineers, with the assistance of the IUGS guest speakers in the case of the first three. There will be a brief report on some of the seminars in the next issue of the Newsletter.

Concerning the LANDPLAN concept, some reservations were expressed about the way it had evolved from its 1982 beginnings (this evolution being largely determined by the type of interest which had been shown, as gauged by attendance and offers of contributions). Were the original LANDPLAN objectives being met, or were they likely to be met by further similar activities in the short term ? The hoped-for emphasis on training of young geoscientists and interchange between geoscientists and planners did not materialize for Landplan III. In the first place, those able to attend were all established in middle to senior professional positions, except for some young local Hong Kong participants. Secondly, the interest shown in LANDPLAN III by government agencies in the region could only be described as minimal. Nearly all the participants from outside Hong Kong were academics. Among the participants from Southeast Asian countries, there was only one government scientist. Thirdly, no planners or representatives of planning agencies from Southeast Asia attended.

It does look very much as though in most countries in the region engineering geology in all its various aspects is still restricted to a handful of specialists. It is probably true, and perhaps an understatement, to say that this small but dedicated band is having some difficulty in persuading planners and engineers, and possibly even in some cases other, more senior, geologists, that geology has an important role to play in urban development. This may seem remarkable. It is in any case no more than a generalization which certainly does not apply equally to all countries. But the fact remains that only a few Southeast Asian engineering geologists are regionally or internationally well known through their published work, and it was almost entirely these established figures who were responsible for the Southeast Asian input for Landplan III. Some authors of interesting papers failed to make it to Hong Kong while other promising contributions were nipped in the bud, the reason being in every case lack of funds to attend.

This is of course true of all conferences everywhere, but it is none the less a serious problem. It meant that Bangladesh, Sri Lanka and Pakistan were unrepresented at Landplan III even though some very worthwhile contributions were initially offered. Things can improve, but it is difficult to see at present how quickly significant improvements can be made.

There are, however, some hopeful portents for better regional interchange and cooperation. There are several relevant IGCP projects active in the region, especially those dealing with Quaternary geology and aspects of natural hazards. The United Nations has the potential, if resources are available, to expand greatly its programmes in this area. A significant recent event was a seminar on Geological Mapping in the Urban Environment held at the United Nations Economic and Social Commission for Asia and the Pacific in Bangkok in October 1986. This will, it may be hoped, lead to increased governmental activity in the engineering geology field. At the same time, an effort should be made to ensure that international meetings bring together those working in government, industry and academic research more effectively than at present.

So where next for LANDPLAN ? The need for more use of geology and geologists in urban development in Southeast Asia is hardly disputable. The range of geological problems, many severe and even critical, is there for all to see. But there definitely needs to be better, more effective communication and interaction between geoscientists, engineers, environmentalists and physical planners.

At its final session, Landplan III considered some recommendations drawn up by an ad hoc working group aimed at improving such communication and interaction. Those present endorsed a proposal to set up a 3-member working group consisting of a geoscientists, an engineer and a physical planner to work out the details of proposals for further initiatives, including the scope and objectives of "Landplan IV" or whatever other follow up action is decided upon, and to initiate national contacts at various levels. This group, consisting of AGID members Yudhbir (India), Sampurno (Indonesia) and E.J.A. Lohman (The Netherlands),will work under the aegis of AGID and will report to the AGID Council.

The Proceedings of LANDPLAN III promises to be a useful reference document and will be published by the Geological Society of Hong Kong in August 1987. Enquiries should be addressed to the Society, c/o Department of Geography and Geology, University of Hong Kong.

Acknowledgements

On behalf of the Organizing Committee, I should like to thank all the many members of the society whose collective and individual efforts ensured the success and smooth running of Landplan III. Much work was done before and during the symposium by Liza Nam Ho Fung Mee, C.M. Lee, P.S. Nau, P.L. Tang and Andy Tse Kok Cheong. I apologize to anyone I have inadvertently overlooked.

D.R. Workman

REPORT ON THE INTERNATIONAL SYMPOSIUM ON SEA-LEVEL CHANGES AND APPLICATIONS, 7-14 OCTOBER 1986, QINGDAO

W.W.-S. Yim

Over 100 participants from seventeen countries gathered in Qingdao in October for the first International Symposium ever to be held there. The China Working Group for the International Geological Correlation Programme Project Number 200 and the Institute of Oceanology, Academia Sinica, the organisers and hosts, made painstaking efforts to ensure that the event was a success.

More than 30 papers were presented at the symposium including nine papers by participants from China. Topics covered included Pleistocene to present day sea-level changes, neotectonics and geoidal changes as well as the applications of knowledge of sea-level changes in densely populated coastal areas. Although only a small number of papers were presented by Chinese participants, a volume of papers in Chinese with English abstracts prepared by the China Working Group for IGCP Project Number 200 and entitled 'China Sea Level Changes', was presented to all participants. The publication of the proceedings of the symposium in English next year will be an important step in making the results of research in China known internationally.

The symposium also included a 4-day field excursion along the coast of the Shandong Peninsula. An excellent introduction to controversial features thought by previous workers to represent remnants of former higher sea levels was given to participants.

The Chinese delegates included Professor David Lin (Foochow Normal University), Professor Liu Tungsheng (Institute of Geology, Hon. Member of GSHK), Professor Yang Huaijin (Nanjing University), Professor Shi Yafeng (Section of Earth Science, Academia Sinica), and Professor Yeh Lientsun (Division of Earth Science, Academia Sinica).

1986 IN RETROSPECT

The major event of 1986 was the Society's first international symposium, on the role of geology in urban development, held in December (see elsewhere in this issue). Another important meeting was the half-day conference on recent sea-level changes in Hong Kong, held in May. A particular landmark in the developing relations with geologists in Guangdong was the visit by a group of six geoscientists from the Guangdong Bureau of Geology and Mineral Resources in October (also reported elsewhere in this issue). Honorary Member Professor Chen Guoda of the Changsha Institute of Geotectonics gave a lecture in May. Altogether, two conferences and 5 lecture/seminar meetings were held in 1986. In addition, 9 field meetings were held, including trips to Taiwan (10 days) and Shenzhen (2 days). Several of these were affected, to various degrees, by poor weather, and one trip was rained off entirely. We hope for better luck in 1987. The

Marine Studies Group and Teachers Group held regular meetings through the year. The latter group achieved a notable success with its first field trip outside Hong Kong: a 12-day excursion to the Yangzi Gorges and Hunan Province.

SUMMARY OF PROGRAMME

SYMPOSIUM	The Role of Geology in Urban Development (Landplan III), in cooperation with IUGS, AGID and Unesco (December, 6 days).
SPECIAL MEETINGS	Sea Level Changes in Hong Kong during the last 40,000 years (May, $\frac{1}{2}$-day) Speakers: A.J. Brimicombe, T.S. Cheng, R.S. Arthurton (reading a paper by C.D.R. Evans), M.D. Howat, W. Meacham, D.R. Workman (Introduction) and W.W.S. Yim.
	Geology and Geological Investigations in Guangdong Province (October) Speakers: Members of staff of the Guangdong Bureau of Geology and Mineral Resources.
JOINT MEETING WITH HKIE GEOTECHNICAL GROUP (3rd Annual Meeting)	Sources of fill from offshore Quaternary sands around Hong Kong (April). Speakers: R. Arthurton and C. Dutton.
LECTURES	The new classification of the Repulse Bay volcanic group (May). Speaker: R.L. Langford
	The "Diwa" or Geodepression Theory (May) Speaker: Chen Guoda
SEMINAR	Karst (January). Speakers: Members who went on the Guilin excursion in October 1985.
FIELD MEETING AND EXCURSIONS	High Island (January) Ma On Shan (February) Plover Cove Dam (March) Shenzhen and Daya Bay (March, 2 days) Tai O (May, abandoned because of rain) Taiwan (June, 10 days) Chek Chau (Port Island) (June) Sha Chau (August) Sham Chung/Lai Chi Chong (October) Lin Fa Shan (December)
ANNUAL GENERAL MEETING	(May)

THE MARINE STUDIES GROUP IN 1986 AND PLANS FOR 1987

During the last year the Marine Studies Group of the society has held seven technical meetings on a wide range of subjects. In addition two members of the group addressed the annual joint meeting of the Hong Kong Institution of Engineers and the Society. Of the seven MSG meetings, three were addressed by visiting geologists and engineers. A summary of meetings is as follows:

Mr. N. Ridley Thomas of EGS Ltd. Hong Kong, on marine geophysics and oceanographic studies.

Dr. Yvonne Barton of BP Civil Offshore Division, U.K., on offshore site investigation west of Hainan.

Dr. Evans of the British Geological Survey on the geological interpretation of geophysical data from Hong Kong waters.

Mr. R. Arthurton and Mr. C. Dutton of, respectively, GCO and Binnie & Partners on Quaternary sands as sources of marine fill. (Joint meeting of GSHK and HKIE).

Professor A.J. Silva of the University of Rhode Island on the disposal of radioactive waste in seafloor sediments.

Dr. Pryor, Project Manager for Tsuen Wan New Town on strategic development opportunities in Hong Kong.

Dr. G. Taylor of Canberra College of Advanced Education on Sedimentation in Jervis Bay, Australia.

Dr. R. Shaw and Mr. R. Arthurton of the GCO on the recent progress of the Hong Kong Geological Survey work offshore.

The Marine Studies Group organised a workshop on Marine Geology as part of the Landplan III Symposium. Three members of MSG, M. Chalmers of Scott Wilson Kirkpatrick & Partners, R. Shaw and R. Arthurton of the GCO made individual presentations and led the ensuing discussion. Dr. R. Shaw (GCO) recently presented papers at the Quaternary Geology Research Symposium in Bangkok organised jointly by CCOP/IGCP/UNDP-ESCAP, and at the Second Palaeoenvironment Conference in Hong Kong organised by HKU. Mr. W. Yim presented papers at the sea level symposium at Qingdao, at Landplan III, at the HKU sea level meeting, at the Second Palaeoenvironment Conference in Hong Kong and at the National Sedimentological Congress in Canberra, Australia. Mr. W. Meacham and Mr. M. Howat also presented papers at the HKU sea level meeting.

The membership of the MSG has remained at about twenty five with new arrivals more or less balancing departures. However, in December Russell Arthurton returned to the British Geological Survey in England. His departure is a great loss to the MSG. He contributed greatly to the work of the Group and did much to engender interest in offshore geology in Hong Kong.

It is now one year since the MSG's first publication the "Marine Geology of Hong Kong and the Pearl River Mouth" appeared. All one hundred copies were sold after about six months. It provided a record of the papers presented at the Seminar which was held in late 1985 and it is the Group's intention to hold another such seminar, with published proceedings, in late 1987. The theme for the 1987 Seminar, and indeed for 1987's meetings, is to be sub-sea deposits as sources of fill material and fine aggregate. Any member of the Society who is interested in joining the MSG should write to the Secretary.

Peter Whiteside,
Secretary, Marine Studies Group, GSHK,
c/o Geotechnical Control Office,
6/F, Empire Centre,
68 Mody Road,
Tsimshatsui East.
Kowloon.

Tel. 3-7213684

THE TEACHER'S GROUP IN 1986 AND PLANS FOR 1987

The Teacher's Group mailing list at the end of 1986 totalled 83. All our field trips continued to be well attended. The highlight of the year was the Group's first excursion to China, in July, reported in the September issue of the Newsletter. In addition, there were local field trips to Devil's Peak, Deep Bay, the Ninepin Islands and the Lowu - Man Uk Pin - Sha Tau Kok sector of the closed border zone. In November, the group visited the Geotechnical Control Office for a tour of the facilities and briefings by staff members.

A regular programme of field meetings is in hand for 1987, starting with trips to Cheung Sheung in Sai Kung (February), Crescent and Double Islands in Mirs Bay (March) and Castle Peak (April).

MEMBERSHIP NEWS

On 31st December 1986, membership stood at 312, one more than on 31st December 1985. There was a net increase of 7 in the Resident membership, to 275 and of 6 in Non-resident membership, to 21. Student membership fell from 19 to 7.

The number of Honorary members remained 9.

* * * * *

The Society offers its congratulations and best wishes to KEUNG Hon-ming, Secretary of the Teacher's Group, and Miss POON Yuen-han, Member, on the occasion of their marriage, December 20, 1986.

* * * * *

We record with regret the departure of Russell Arthurton, who is returning to the British Geological Survey in December after his period of secondment to the Hong Kong Government, latterly as head of the Geological Survey Section of the Geotechnical Control Office. The Secretary has benefitted greatly from Russell's active participation in many of its activities, and we wish him every success in the future.

INDEX OF TECHNICAL ARTICLES IN VOL.4 OF THE BULLETIN

1. Technical Articles on Geology of Hong Kong

2. Articles on Geology of the Region

ANON	Outline of the Geology of Taiwan (No. 3, pp. 17-21).
CHAN L.S.	Paleomagnetic Research in Hong Kong (No. 2, pp. 17-22).
CHEN T.G.	Fundamental features of the Geological Structure of Guangdong Province (this issue).
CHEN T.G.	Evaluation of the Crust Stability in the Site Area of Daya Bay Nuclear Power Station (this issue).
LIU G.M.	Intrusive Rocks in Guangdong (this issue).
NAN Y.	A Brief Introduction to the Stratigraphy of Guangdong Province (this issue).
PANG C.R.	Introduction to Regional Metallogeny of Solid Mineral Resources in Guangdong Province (this issue).
SHU C.M.	General Situation of Geological Work in Guangdong Province (this issue).
WANG W.X.	Mesozoic Volcanic Rocks in East Guangdong (this issue).
ZHOU S.Q.	A Brief Historical Review of Regional Geological Research in Guangdong Province (this issue).

3. Field trip reports

Guilin, October 1985 (D.R. Workman, R. Shaw and A.D. Burnett) (with geological map) - No.1, pp. 19-22.

Shenzhen & Daya Bay, March 1986 (A. Hansen) - No.1, pp. 23-27

Taiwan, June 1986 (Anon.) - No.3, pp. 13-17 (also this issue) (with geological map)

Yangzi Gorges and Hunan, July 1986 (Anon). - No. 3, pp. 8-12 (with geological map)

FUTURE INTERNATIONAL MEETINGS

(see also Newsletter vol. 4 no. 1, March 1986) for period to August 1987.

19-22 May 1987

GEOLOGIC HAZARDS
Anchorage. (Alaska Geological Society,
Box 101288, Anchorage, 99510, Alaska, U.S.A.)

25-27 May 1987

COASTAL LOWLANDS: GEOLOGY & GEOTECHNOLOGY
Royal Geological & Mining Society of the Netherlands,
Congresgebouw, The Hague, the Netherlands, (H.J.W.C. Schalke,
Box 85947, 2508 CP The Hague, Netherlands)

14-18 June 1987

RAPID EXCAVATION & TUNNELLING
New Orleans, American Institute of Mining, Metallurgical Petroleum
Engineers and the American Society of Civil Engineers. (D.D. Daley,
Society of Mining Engineers of A.I.M.E., Caller D. Littleton, Colo.,
80127, U.S.A.

29 June - 1 July 1987

ROCK MECHANICS
Tucson, Ariz. (Special Professional Education, Box 9, Harvill Building,
University of Arizona, Tucson, 85721, U.S.A.)

6-12 July, 1987
GEOLOGY, MINERAL AND HYDROCARBON RESOURCES OF SOUTHEAST ASIA
(GEOSEA VI Regional Congress), Jakarta, Indonesia.
(Rudy Phoa, Trend Energy, P.O. Box 209, Jakarta, Indonesia)

13-15 August 1987

HAZARDOUS-WASTE MANAGEMENT
Denver(D. McCaffrey, HAZTECH Intl, Suite 100, 6143 S Willow Drive,
Englewood, Colo., 80111, U.S.A.

8-14September 1987

INTERNATIONAL SYMPOSIUM ON THE TERMINAL PRECAMBRIAN AND CAMBRIAN GEOLOGY
Yichang, China (Dr. Wang Xiao-feng, Secretariat of International
Symposium on the Terminal Precambrian and Cambrian Geology
c/o Yichang Institute of Geology and Mineral Resources,
P.O. Box 502, Yichang City, Hubei Province, People's Republic of China.)

13-17 September 1987

ENGINEERING GEOLOGY OF UNDERGROUND MOVEMENTS
23rd Annual Conference of the Engineering Geology Group of the
Geological Society of London, University of Nottingham.
(Dr. M. Lovell, Department of Geology, University of Nottingham,
Nottingham NG7 2RD, England).

7-10 December 1987

INTERNATIONAL SYMPOSIUM ON PETROGENESIS AND MINERALIZATION OF GRANITOIDS, Gunagzhou.
(International Symposium on Petrogenesis and Mineralization c/o Institute of Geochemistry, Academia Sinica, Guiyang, Guizhou Province, P.R.C.).

7-11 December 1987

NINTH SOUTHEAST ASIAN GEOTECHNICAL CONFERENCE: GEOTECHNICAL ENGINEERING IN SOUTHEAST ASIA, Asian Institute of Technology, Bangkok. (The Hon. Secretary, 9th SEAGC, c/o Division of Geotechnical & Transportation Engineering, Asian Institute of Technology, P.O. Box 2754, Bangkok 10501, Thailand).

21 January 1988
7TH OFFSHORE S.E. ASIA CONFERENCE AND EXHIBITION, Singapore. First call for papers (abstracts by 1.5.87). (D.H. Morgan, SEAPEX Program Committee, Southeast Asia Petroleum Exploration Society, P.O. Box 423, Tanglin P.O., SINGAPORE 9124.

8-11 March 1988

ASIAN MINING 88, Kuala Lumpur, Malaysia. The Conference Office, The Institution of Mining and Metallurgy, 44 Portland Place, London WIN 4BR, England.

11-15 April 1988

6th INTERNATIONAL CONFERENCE ON NUMERICAL METHODS IN GEOMECHANICS, Innsbruck, Austria. from the call for papers" .... Above all, an attempt will be made to introduce new numerical models for describing geological materials, particularly discontinuum models". (Kongresshaus Innsbruck, ICOMING 88, Rennweg 3, A-6020 Innsbruck, Austria. Scientific enquires should be addressed to the Conference Chairman: Prof. Dr. G.A. Swoboda, University of Innsbruck, Technikerstr. 13, A-6020 Innsbruck, Austria).

NEW FROM THE URBAN COUNCIL

HONG KONG ROCKS
(ENGLISH EDITION, 1986)

M.J. Atherton
Dept. of Civil and Structural Engineering,
Hong Kong Polytechnic

A.D. Burnett
Geotechnical Control Office

145 PAGES, plus GEOLOGICAL AND LOCATION MAPS

Contents

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Classification of the Sedimentary Rocks
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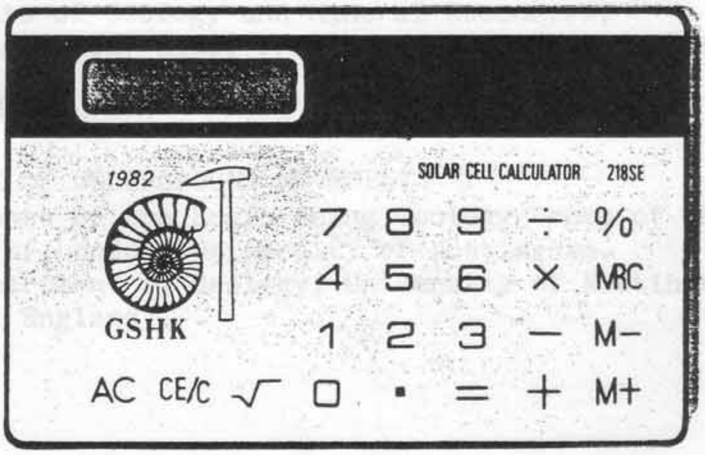

廣東省地質科學研究所總工程師周樹強高級工程師作了廣東區域地質研究簡要的回顧，對近百年來廣東地質工作進行了客觀評價，進一步指出今後研究的方向。最後，他代表全體成員對我會的盛情邀請及學術交流表示感謝和滿意，展望今後粵港兩地同行加強合作和交流。

上述八個報告概括了廣東省地質研究現今程度，特別是大亞灣核電站地殼穩定性評價受到大家的注視並深受與會者的歡迎，次日各報均有客觀正確的報導。所以學術報告會是成功的。

會後，在尖沙咀酒樓設宴款待了客人們，並爲他們洗塵，我會十多位會員熱情參加。

第二日及第三日前往吐露港及新界北部作現場地質考察。星期二由大埔經粉嶺到沙頭角觀察了火山岩，新娘潭赤洲組受變質礫岩及紫紅色板岩。而後乘船觀察了吐露港兩岸地質及構造和斷裂，參觀了白沙頭洲泥盆系及魚化石產地岩性、鳳凰笏香港菊石及附近泥盆系地質。第三日參觀了大帽山火山岩，而後前往河上村至羅湖附近，沿坡觀察落馬洲受變質砂岩及千枚岩，現場對比深圳河兩岸變質岩地質。下午折向尖鼻咀及流浮山觀察了深圳大斷裂地區延伸特點。而後順路參觀屯門斷裂及市鎮發展。

星期四，客人們拜會了我會榮譽會員，著名實業家、礦冶專家和慈善家許士芬博士。許博士熱情接待並設宴款待了客人們。會後還觀看了地質學及礦冶開發的電影。該晚，去歲曾赴穗訪問的十多位會員又宴請了他們。

星期五，代表團應香港預壘(遠東)打樁工程公司邀請，訪問了該公司並參觀了銅鑼灣工地，該公司余成堃先生熱情介紹現場無噪音螺旋掘進打樁工程，並設午宴。

星期六，他們登上香港島太平山頂觀察了火山岩系，鳥瞰維多里亞港及其兩岸的香港島和九龍半島地貌及其風光。然後參觀了淺水灣原火山岩命名地及亞洲著名的海洋公園，欣賞了鯨魚、海豚等表演及水族館。

經過六日緊張而又緊密安排的活動，客人們終于星期日結束訪問，在十二日下午離開紅磡車站回穗。

我們收到蘇成曼副局長的來信，向潘納德會長，沃克曼秘書長及許士芬博士表示感謝，並認爲是次訪問雖然時間短、安排緊、活動多，但都完成了訪問計劃，訪問是成功的，期望今後加強聯系和進一步開展交流。

最後，應指出土力工程處，香港大學，香港理工學院和預壘(遠東)有限公司熱情幫我會安排廣東客人在香港參觀訪問，許士芬博士抽空專門殷切接待並宴請了他們，我們表示感謝。

廣東省地質局代表團訪問香港紀實

李作明

應我會邀請，由副局長蘇成曼先生率領的廣東省地質局七人代表團於十月六日抵達香港進行了爲時一周的友好回訪和學術交流活動，深受歡迎。訪問及交流非常成功。

十月六日淸晨，客人們由大角咀碼頭踏上香港，到酒店安頓行李之後便立即展開活動，首先訪問參觀了香港大學地質地理系，該系主任克蘭博士會見了他們。而沃克曼博士及鈕栢燊先生則介紹並帶他們參觀了地質陳列館及實驗室。

十一時應邀訪問了政府的土力工程處，受到潘納德博士等熱烈歡迎和殷切接待。他向客人們介紹了香港政府機關體制和土力工程處職能，接着引他們參觀了製圖室、船照分析室、台風土力警報中心及地質測量組，地質人員介紹了當前正在進行的一比兩萬比例尺分幅地質測量工作方法及成果。

下午四時許訪問了香港理工學院土木與結構工程學系，該系主任黃啓傑博士會見了他們。

下午五時半，我會假香港理工學院科學講演堂舉辦了粵港兩地同行的會見並邀請廣東客人作廣東省地質的學術報告。我會約有六、七十位會員參加，香港十多家主要報館均派記者參加，聽取他們的報告並索取資料。廣東客人有備而來，均準備了中、英文專題報告文稿，深受與會者歡迎。

會議由潘納德會長主持，致歡迎詞並逐一介紹我們的客人，隨即進行學術報告。

首先由廣東省地質局副局長、廣東省地質學會副會長、高級工程師蘇成曼先生作關于〈廣東省地質工作概況〉的報告，介紹廣東省地質工作發展情況、地質工作區域地質調查與基礎地質、礦產普查勘探與礦床地質研究、水文地質與工程地質及物化探與其它新技術、新方法等各專業的現狀及主要成果。

接着廣東省地質科學研究所高級工程師、廣東省地質局地層古生物委員會主任南頤先生從地層劃分及分區兩個方面介紹了廣東省地層概況，廣東省地層發育較齊全和較複雜，自元古界至第四系均發育，研究程度已漸細緻，並可劃分包括粵北、粵東北、粵中、粵東及海南島等分區。

廣東省地質科學研究所所長，高級工程師劉公民先生接着作〈粵東省侵入岩概況〉的報告，他認爲廣東省境內的岩漿侵入活動強烈、頻繁，形成了五百多個各類侵入體，面積達全省三分之一強，侵入活動自加里東期以來，海西、印支、燕山乃至喜山期均有活動，燕山期侵入活動達到高峯，且以酸性花崗岩的侵入爲主。

接下來，廣東省地質科學研究所副所長、高級工程師王文校先生介紹了廣東中生代火山岩。他指出廣東省自元古代至新生代均具火山活動，其岩性複雜，具四個岩石系列或岩套，元古界碱性玄武岩系列，古生界拉斑玄武岩系列，中生界高鋁玄武岩系列，新生界碱性玄武岩系列。其中中生代中酸性火山岩最發育且集中於粵東地區。

廣東省地質科學研究所高級工程師、廣東省地質學會構造委員會主任委員陳挺光先生作關于〈廣東省地質構造基本特徵及大亞灣核電站地殼穩定性評價〉的報告。在叙述複雜的廣東地質構造層及構造運動和構造體系基礎上，論述了大亞灣核電站地質特點，根據陳本人參與研究基礎上認爲，大亞灣地區區域北東向及北西向現今活動斷裂規模不大，切割不深，遠離五華——深圳大斷裂，地震活動具明顯分段且微弱，未見強震發震的構造背景，地殼和上地幔構造穩定，廠址附近設有現代岩漿活動及非構造活動的物理地質現象，廠址地基花崗岩岩基穩定，大亞灣核電站的地殼穩定性良好，選址是適宜的。

廣東省地質局地礦處處長、高級工程師彭存銳先生淺析廣東省固體礦產區域成礦特徵，成礦地質條件良好，礦產資源豐富，已知礦產地千餘處，礦種有 116 種，已探明儲量有88種，在全國佔重要地位，並劃分出粵北多金屬、硫成礦區，粵北東部鎢錫成礦區、粵西金、錫、硫多金屬成礦帶、粵東沿海鎢錫成礦帶及沿海高嶺土及濱海砂礦成礦帶。

香港地質學會

1986－87年度常務委員會

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封面圖片：赤門海峽荔枝庄淺水灣組中具交錯層理的凝灰質沙岩和燧石狀細火山灰凝灰岩中的斷裂序列。

香港地質學會

通　訊

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