

**NEWSLETTER**

Vol. 5 No.2, June 1987

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Articles of a technical nature, as well as reports of interesting events, reviews and other topical items are welcome. Contributions must be short. 1,200 words is regarded as the normal acceptable length, 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 all be 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 of the paper only with a 2.5 cm 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 and lettering suitable for reduction. A metric scale should be included, and north point (or where relevant, coordinates of latitude and longitude) on all maps.

**References:** The author is responsible for ensuring that the references are correct and that Journal titles are given in full.

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*transfers*  
18.11.1987

## Editorial comments

Since its inception in 1983, Mr Edmund P.Y. Chau has performed a valued service in producing the Society Newsletter. At the election of the present Committee, Mr Chau handed over the editor's task, although happily, he remains on the editorial sub-committee. I should like to thank Mr Chau on behalf of the members for all his past hard work which has proved to be a great benefit to the Society.

## Editorial policy

### Articles and discussion

The aim of this Newsletter is to disseminate significant findings in geological and related disciplines as quickly as possible. Discussion of contributions will be carried in the issue following receipt.

### Field excursion descriptions and Field Guides

Hong Kong has many good exposures of important scientific and educational value. This Society has visited many of these sites in the past, but the field trip descriptions have previously often carried insufficient information to be used for subsequent independent visits.

Given the range of sites available, from temporary excavations to long walks across remote parts of the Territory, a standardised format may be too constricting, however, for general use a field excursion description should include the following:

Access - including public transport,

Site location(s) - including Grid reference and map if possible,

Description of features or exposures, including a scaled photograph.

There are two options for the use of these descriptions; if they can be submitted sufficiently in advance of the excursion, they can be carried in the Newsletter to allow participants (and others) to consider the implications. Potential excursion leaders may find this approach particularly useful where the excursion is planned several months in advance. Descriptions of field excursions may always be carried after the event, and may then include significant on-site discussion.

The aim of these descriptions should always be to allow readers to use the text as a Field Guide. If enough of these guides can be collected, the Society will produce a printed guidebook.

## In this issue

### Monzonite or Syenite?

Mr Paul Strange of the Hong Kong Geological Survey, describes the petrology of the quartz syenites, noting that most of the areas mapped as quartz monzonite by Allen & Stephens should be renamed quartz syenite. The distinction seems academic, but in practice may prove useful, as both are low-quartz rocks. In syenites, the feldspars are dominated by alkali varieties, whereas in monzonites alkali feldspar and calcic plagioclase are present in roughly equal amounts. Engineers should note this as the reclassification will not greatly affect the engineering properties and behaviour of both the fresh and decomposed materials - the sense of relief noted by at least one engineer, on discovering that a site was underlain by syenite rather than monzonite, is not necessarily warranted! Both these materials should be treated with caution. If readers have further information about the properties of fresh and decomposed monzonite or syenite, please send in the information.

## Petrographical descriptions of the San Tin Group

As the Hong Kong Geological Survey continues its mapping work, the Stratigraphical column is being extended. The second paper in this issue gives a petrographical description of the San Tin Group, which includes the marble of the Yuen Long Formation which has been so newsworthy recently. It is hoped that the Geological Survey will continue to keep the geological fraternity informed of advances in the field through this Newsletter.

### Newsletter format

The discerning reader may notice slight changes to the format of the Newsletter! The modifications have been introduced to match that of the Bulletin. The editorial committee welcomes suggestions regarding format or topics for inclusion in the Newsletter, and looks forward to a healthy dialogue between the membership.

Andy Hansen  
Editor

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Telephone: 3-7213719

### Dates for your diary

- |                           |   |
|---------------------------|---|
| 4th December 1987         | Marine Studies Group Seminar: Marine sources of sand. (Contact Mr Peter Whiteside on 3-7213684)   |
| 12th December 1987        | Field excursion to the Clear Water Bay Peninsula (date is confirmed. Contact Mr P.S. Nau at the Department of Geography, University of Hong Kong, on 5-8592825)   |
| 24th - 31st December 1987 | Geological trip to the western part of Guangdong Province. (Contact Mr C.M. Lee at the Department of Civil and Structural Engineering, Hong Kong Polytechnic, on 3-638344, ext 591- Note that bookings close 7th November 1987) |

## Petrological aspects of the Hong Kong quartz syenites

P.J. Strange

*Geotechnical Control Office, Hong Kong*

### Introduction

The syenites are a group of plutonic igneous rocks containing essentially alkali feldspar, with smaller amounts of plagioclase, mafic minerals and less than 5% quartz. Quartz syenites contain between 5 and 20% quartz (Middlemost, 1985). They are considered to be the intrusive equivalents of trachyte and quartz trachyte. In monzonites and quartz monzonites, the alkali feldspar and calcic plagioclase are present in roughly equal amounts.

The present geological survey of Hong Kong Island by the Geotechnical Control Office (Strange & Shaw, 1986), has examined in detail the areas mapped as quartz monzonite by Allen & Stephens (1971) and has concluded, from thin section modal analyses and geochemical analyses, that most of the analyses plot within the field of quartz syenites.

### Previous work

The largest syenite body on Hong Kong Island, on the D'Aguilar Peninsula, was first delineated on the 1936 geological map of the Territory. Williams *et al* (1945) defined the D'Aguilar Syenite rock unit and provided a norm calculated from geochemical analysis of a rock sample from Cape D'Aguilar. Schofield and Phemister (in Williams *et al*, 1945) described the occurrences of the D'Aguilar Syenite on Hong Kong Island and gave a detailed petrological description of the rock. Davis (1952) and Ruxton (1960) retained the term, but the latter considered a porphyritic syenite dyke near Aberdeen graded to Monzonite on its northern margin.

Allen & Stephens (1971) grouped all rocks previously mapped as syenite into their quartz monzonite category. The term quartz monzonite is thus widely used in the geological and geotechnical fields in Hong Kong. The current detailed geological remapping of the Territory recognizes quartz monzonite in the Sha Tin district, but on Lamma and Hong Kong Islands and the Clear Water Bay Peninsula all the previously mapped quartz monzonite is now classed as quartz syenite.

### Classification of syenites

There are a number of systems of igneous rock classification, some based on chemical composition and others that use the actual mineral composition or modes.

#### Modal classification

The modes are most useful in providing a rapid classification by examination of the rock in thin section, especially if the rock has a crystalline groundmass. However, modal analysis of a coarse-grained rock is ideally done on a rock slab in order to eliminate sample bias inherent in the sample size of a thin section. The very fine-grained rocks with aphanitic groundmass are unsuitable for modal analysis except for providing an indication of the phenocryst mineral assemblage. In 1973, the International Union of Geological Sciences Subcommission on the Systematics of Igneous Rocks (Streckeisen, 1974) introduced a new modal classification of the plutonic rocks (Figure 1). The relative percentages of quartz, alkali feldspar and

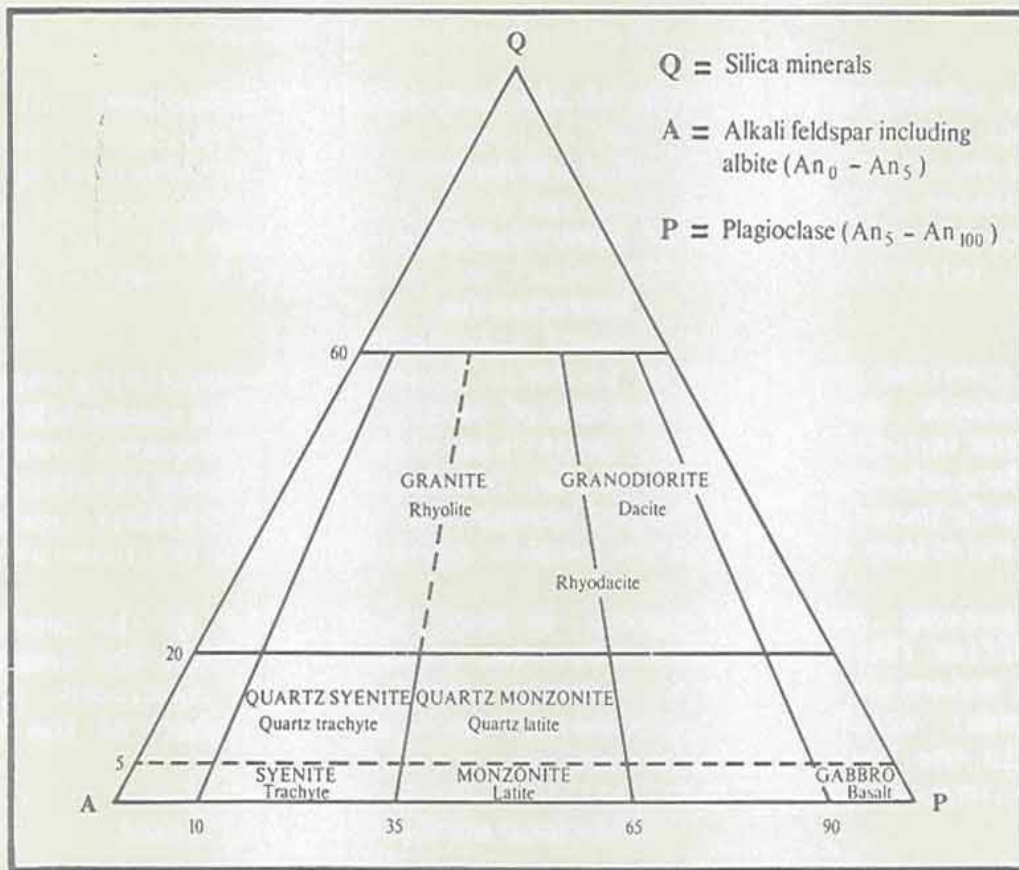


Figure 1 General classification and nomenclature of major and minor intrusive rocks (after Streckeisen, 1974)

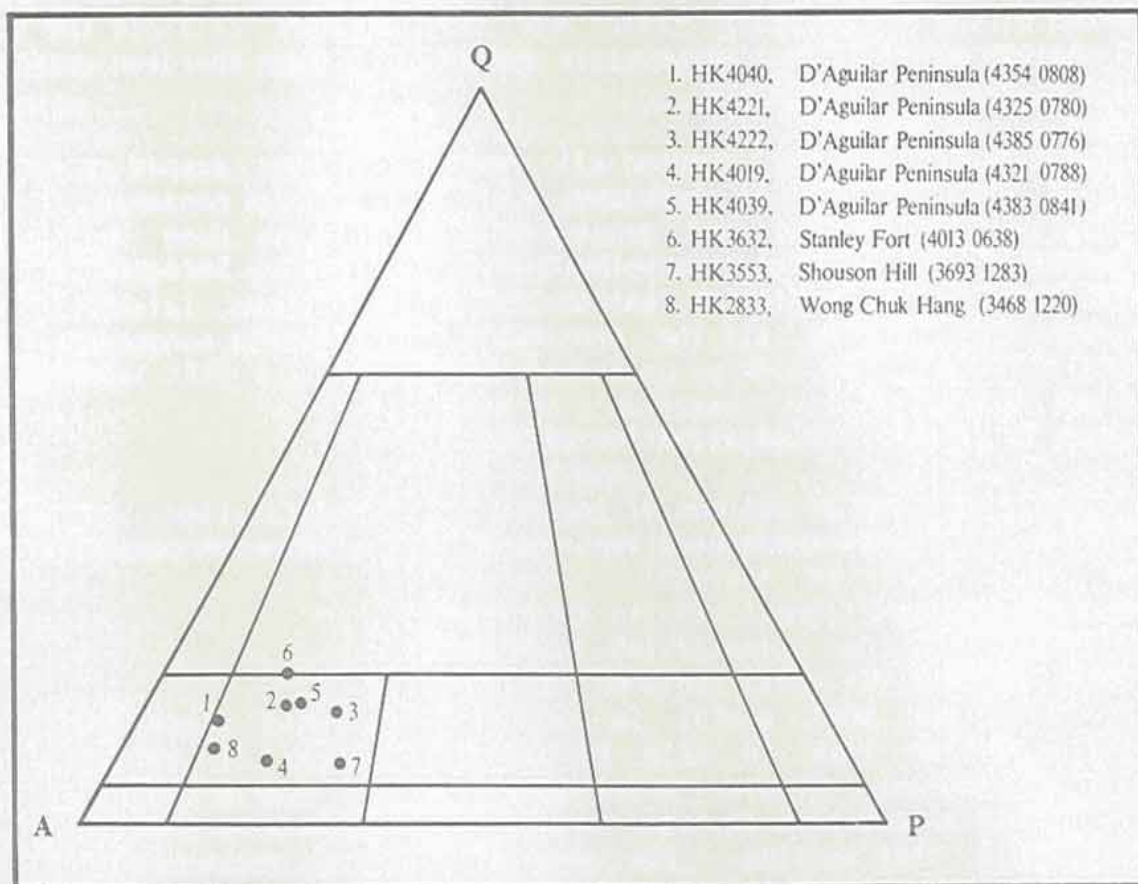


Figure 2 QAP diagram (after Streckeisen, 1974), showing plots of quartz syenite samples from Hong Kong Island

plagioclase feldspar are determined from point counting of the rock thin section or polished rock slab, and these are plotted on the triangular diagram. Streckeisen's classification has been adopted here, and the modal plots of 8 thin sections of Hong Kong Island syenites are shown in Figure 2.

### Chemical classification

The common igneous rocks can be classified based on their silica and alkali contents (Figure 3). Chemical analysis is undertaken and from the results, the weight percentage of combined sodium and potassium oxides is plotted against the weight percentage of silica. Three samples of quartz syenite from Hong Kong Island, and one sample from Pyramid Hill were analysed by the Analytical Chemistry Research Group of the British Geological Survey for geochemical analysis of major and trace elements. The results are shown in Table 1, which also includes the mean chemical composition of syenites (after Le Maitre, 1976).

The four samples have been plotted on Figure 3, and fall within the syenite field. However, they can be divided into two groups, based not only on their silica percentages but also on variations in their trace element geochemistry (Table 2). The rocks of Shouson Hill (HK3553) and Wong Chuk Hang (HK3552) form one group and those from Ap Lei Chau (HK3636) and Pyramid Hill (HK200) form the other. Examination of the trace element results shows considerable variation between the syenites, for example samples HK3636 and HK200 are low in strontium and barium, whilst HK3552 and HK3553 are low in lanthanum and cerium. These trace elements are quite anomalous when also compared with the majority of granitoid rocks in Hong Kong.

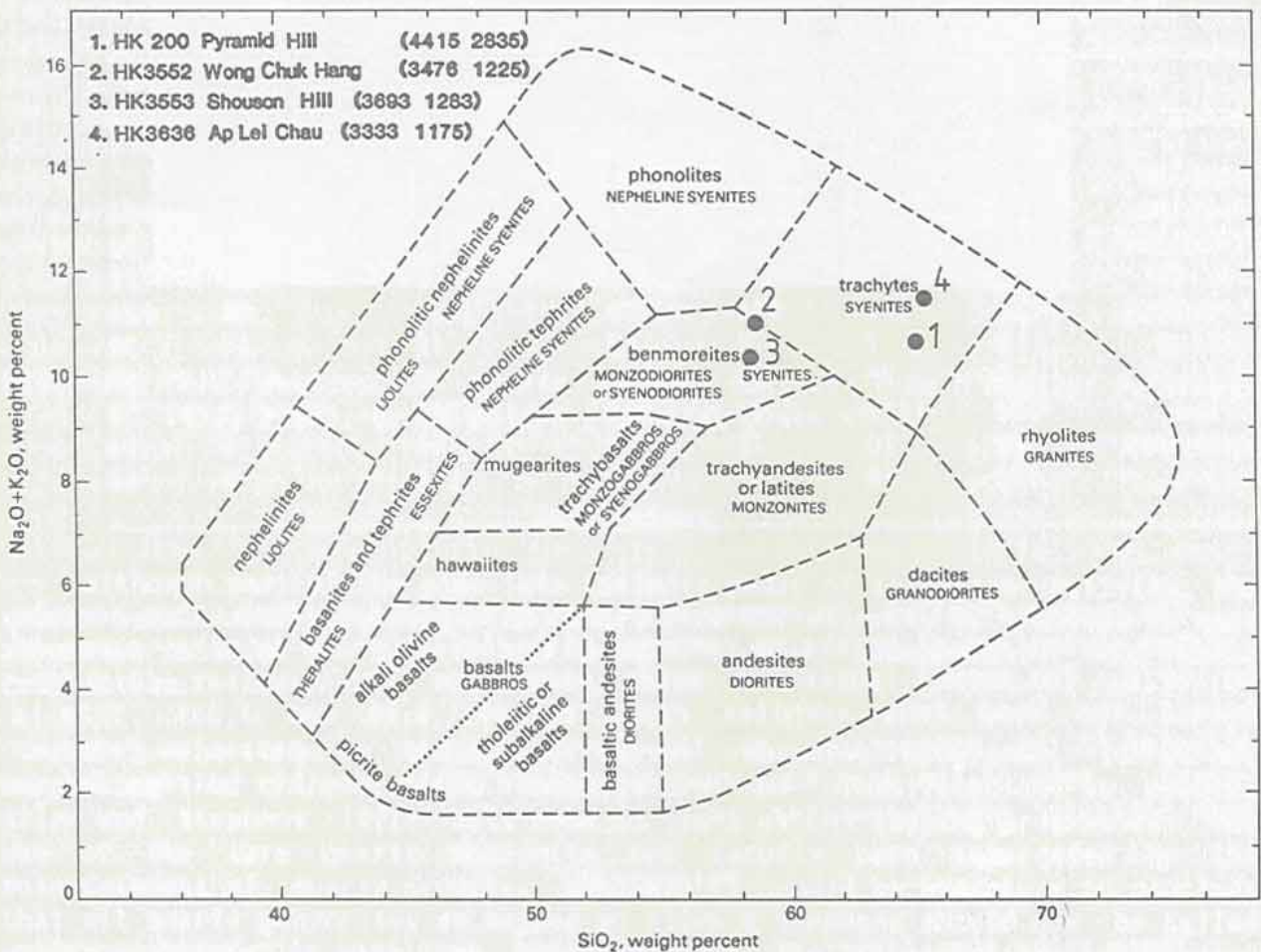


Figure 3 Chemical classification of igneous rocks (after Cox, Bell & Pankhurst, 1979), showing the plots of four Hong Kong quartz syenites

Table 1 Major element analysis of syenites from Hong Kong, and mean chemical analysis of syenite (after Le Maitre, 1976)

Element	Sample Number				Syenites (mean) <sup>1</sup>
	HK200	HK3552	HK3553	HK3636	
SiO <sub>2</sub>	65.64	59.06	58.74	65.74	58.58
TiO <sub>2</sub>	0.33	0.46	0.60	0.33	0.84
Al <sub>2</sub> O <sub>3</sub>	16.42	19.17	18.67	16.74	16.64
Fe <sub>2</sub> O <sub>3</sub>	1.57	1.32	1.77	0.73	3.04
FeO	1.50	2.36	2.91	2.02	3.13
MnO	0.13	0.10	0.14	0.12	0.13
MgO	0.60	1.02	1.40	0.33	1.87
CaO	1.38	3.97	4.36	1.40	3.53
Na <sub>2</sub> O	3.66	3.25	3.27	3.98	5.24
K <sub>2</sub> O	7.23	7.55	6.80	7.55	4.95
H <sub>2</sub> O <sup>+</sup>	1.03	1.02	1.12	0.96	0.99
H <sub>2</sub> O <sup>-</sup>	0.42	0.00	0.04	0.20	0.23
P <sub>2</sub> O <sub>5</sub>	0.11	0.25	0.31	0.07	0.00
Total	100.02	99.53	100.13	100.17	99.17

<sup>1</sup> after Le Maitre (1976)

Table 2 Trace element analysis of Hong Kong syenites, together with typical values for Hong Kong granodiorites and granites (in parts per million)

	Sample Number				Granodiorites	Granites	
	HK200	HK3552	HK3553	HK3636		low	high
Vanadium	20	26	41	3	70		
Rubidium	153	128	123	207	216	372	643
Strontium	345	1710	1190	225	236	4	52
Yttrium	32	18	22	29	33	31	179
Zirconium	441	620	684	704	230	88	124
Niobium	8	7	9	12	12	14	55
Uranium	2	26	4	1	6	13	28
Barium	860	4236	2395	366	700	0	70
Lanthanum	80	16	21	79	40	0	10
Cerium	170	40	52	146	110	0	60

The quartz syenites, in common with many granites from Hong Kong contain a higher percentage of potassium compared with similar rocks in other parts of the world. The normal potassium oxide percentage for syenites is 4.95%, whereas the Hong Kong syenites range between 6.48 and 7.23%. This is reflected in the petrography by the large amounts of potassium feldspar present. Some of the Hong Kong quartz syenites could possibly be regarded as 'high potassic' quartz syenites.

#### Petrography

These rocks are fine- or medium-grained syenites with hypidiomorphic granular or porphyritic textures (Plate 1). The alkali feldspars are usually microperthite and microcline and occur as euhedral, tabular crystals which are often aligned. This parallel disposition is described as a trachytoid texture, and is particularly well seen on weathered rock surfaces. In the



larger intrusions, the groundmass is roughly equigranular, for example at Cape D'Aguilar and Stanley, but in the smaller dyke-like bodies, notably at Wong Chuk Hang and Mount Butler, the groundmass is inequigranular. Megacrysts of alkali feldspar average 6 to 9mm in length; no quartz megacrysts have been noted. Quartz usually makes up less than 15% of the total rock and biotite constitutes 5-6%. Other accessory minerals include chlorite, amphibole, orthite and apatite.

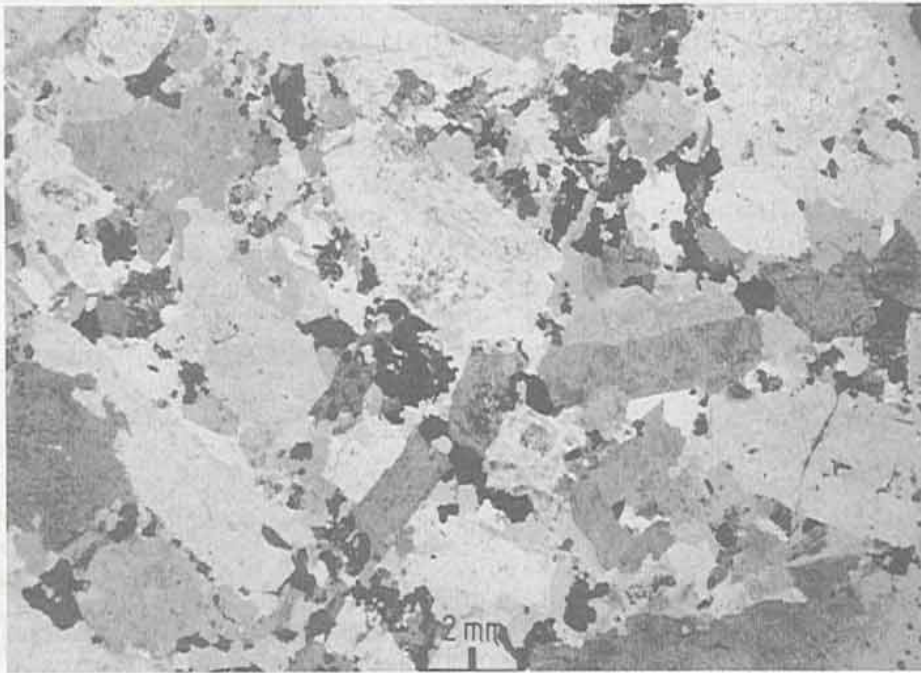


Plate 1 Thin section of quartz syenite (HK4019) from D'Aguilar Peninsula (4321 0788), cross polars plus  $1/4\lambda$  plate x7.

### Conclusions

Although part of the same late tectonic phase of intrusive activity, the quartz syenites of Hong Kong stand apart from the majority of granites in many aspects, notably in major and minor element geochemistry and modal composition.

With the ongoing geological survey remapping programme, it is not surprising that changes to the nomenclature and classification as used by Allen and Stephens (1971) will come to light as the mapping progresses. The use of the term quartz monzonite has largely been superceded by the reinstatement of quartz syenite, although it would be premature to conclude that all quartz monzonites as mapped by Allen & Stephens should now be called quartz syenites. With the recognition of infiltration and modification processes within some of the Hong Kong granites (Strange, 1985), it is probable such variations in the syenite bodies will be found. Only detailed petrographic examinations and geochemical analyses will confirm the appropriate rock name to be used.

## Acknowledgements

The author is grateful to Mr A. So for his assistance in plotting the geochemical data, and to Miss Alice Lai for modal analyses of the thin sections. Acknowledgement is made to the Director of Civil Engineering Services, Hong Kong Government, for permission to publish this paper.

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## Petrography of the Lower Carboniferous San Tin Group, Hong Kong

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### Introduction

This paper describes certain petrographic features of the metamorphosed sedimentary rocks of the San Tin Group in Hong Kong, with special emphasis on the Lok Ma Chau Formation. A total of 32 thin sections from the Hong Kong rock collection of the Geological Survey Section, Geotechnical Control Office were selected and examined. The samples included representative rock cores of the Yuen Long Formation, which is entirely covered by superficial deposits. The rocks of the Group have undergone low-grade greenschist facies metamorphism. There is also evidence of localized retrograde metamorphism in marble of the Yuen Long Formation. This metamorphism is associated with deformation in a broad belt of Lower Carboniferous strata thrust over the Jurassic volcanic sequence.

### General geology of the San Tin Group

The outcrops of the San Tin Group occur as a northnortheast-trending linear belt in the northwestern part of the New Territories, Hong Kong, where they are covered by extensive superficial deposits. The exposed rocks were mapped by Allen and Stephens (1971) as the Lok Ma Chau Formation. The San Tin Group consists of three formations, namely the Lok Ma Chau Formation, the underlying Yuen Long Formation and the Tai Kei Leng Formation. The general stratigraphic column is based on that of Lai & Mui (1984) and Langford *et al* (in preparation), and is shown in Figure 1. The Lok Ma Chau Formation can be subdivided further into the Tai Shek Mo Member and the underlying Mai Po Member. The Tai Shek Mo Member consists of schistose metaconglomerate, metasandstone and some phyllite. The Mai Po Member is composed of dark grey phyllite, mica schist, metasandstone and impersistent beds of graphite schist. The lithologically distinctive Yuen Long Formation consists of marble, with some dolomite and thin layers of phyllite. The Tai Kei Leng Formation is composed of fine- to medium-grained metasandstone, but very little information is available on this formation.

The San Tin Group has been subjected to low-grade, greenschist facies regional metamorphism prior to the emplacement of granitoid bodies. Allen and Stephens (1971) suggested a greenschist facies mineral assemblage of sericite-chlorite-biotite-quartz-(albite) for the Jurassic sequence in Tuen Mun, which has been involved in the same metamorphic episode, at least in part. This low temperature prograde metamorphic belt is thought to be continuous with the Shenzhen schist belt of Guangdong Province. The Shenzhen metamorphic schist is Lower Carboniferous in age and is overlain by unmetamorphosed fusulinid-bearing limestone of late Carboniferous age. The Lower Carboniferous rocks in Hong Kong have been correlated with the Lower Carboniferous strata in Guangdong Province (Bennett, 1984). Garnet- and staurolite-bearing pelite, and tremolite-actinolite limestone form part of the Devonian succession (about 15 km north of Shenzhen), suggesting that there might be a prograding of metamorphism to garnet-amphibolite facies to the north (Bennett, 1984).

The contact between the Lower Carboniferous strata and the younger but underlying Repulse Bay Volcanic Group is a reverse or thrust fault (K. W. Lai, 1976 & 1977). Bennett (1984) reported in his review that the deformation and metamorphism in South Guangdong Province is related to the Mesozoic Yenshanian tectonism, and that the metamorphism and deformation is very localized and

			LITHOLOGY	THICK- NESS, m
SAN TIN GROUP	LOK MA	TAI SHEK MO MEMBER	White to yellowish-grey, metamorphosed fine- to medium-grained sandstone and quartzite, with some phyllite and meta-conglomerate	>300
	CHAU FORMATION	MAI PO MEMBER	Pale- to dark-grey, phyllite and mica schist, with thin layers of graphite schist and metamorphosed fine-grained sandstone	>500
			Calcareous siltstone	1-15
	YUEN LONG FORMATION		White to dark grey, fine- to coarse-grained marble, partly dolomitic, with thin layers of phyllite	>300
	TAI KEI LENG FORMATION		White to grey, metamorphosed fine- to coarse-grained sandstone and quartzite, with some siltstone	>10

Figure 1 Lithostratigraphy of the Lower Carboniferous San Tin Group. After Lai & Mui (1984) and Langford *et al* (1988)

related to conditions of high stress and moderate temperature along major fault zones. This could explain the close juxtaposition of unmetamorphosed and strongly metamorphosed Paleozoic sequences. However, the belt of metamorphism associated with this tectonism is very wide, covering the whole outcrop of the Lower Carboniferous sedimentary strata and extending at least 6km into the Jurassic volcanics.

#### Petrography

Thirty-two thin sections of the San Tin Group were studied and divided into eight main groups:

- a) Metasiltstone
- b) Metasandstone
- c) Conglomeratic metasandstone
- d) Schistose metaconglomerate
- d) Phyllite
- e) Mica schist
- f) Graphite schist
- g) Marble

#### Metasiltstone

Metasiltstone mainly occurs as thinly-bedded units within the Tai Shek Mo Member. The rock is very fine-grained, with a grain size in the silt size range. In fresh specimens the rock is dark grey, and it is schistose. In thin section, the rock consists of small equant quartz grains about 0.025 mm across in a matrix of sericite, quartz and opaque minerals. The relict quartz grains are often strained and flattened, and may be partially recrystallized. Preferred orientation of the sericite defines the schistosity. The appearance of small biotite crystals associated with small calcite veins suggests metasomatism.

## Metasandstone

Metamorphosed fine- to medium-grained sandstone occurs mainly in the Tai Shek Mo Member. The sandstone is a massive crystalline rock which weathers to a beige-white colour. The petrography of the metasandstone is dominated by recrystallized, microcrystalline quartz grains about 0.3 mm in size with interstitial sericite, minor biotite and opaque minerals. The microcrystalline quartz gives a mosaic texture, with characteristic triple point grain boundaries, and the foliation is largely defined by the preferred orientation of sericite. In some samples the development of sericite is so extensive that the quartz grains are matrix supported, and the rock is textually similar to the sericite-rich mica schist. The microcrystalline quartz also displays preferred orientation, with the c-axes parallel to the foliation. The large quartz grains commonly have undulatory extinction characteristic of strained crystals.

Opaque minerals such as haematite, pyrite and magnetite are always present, amounting to 15% of the rock in modal content. The occurrences of accessory minerals vary from sample to sample, but include as calcite, muscovite, biotite, epidote and tremolite. Some recrystallized quartz crystals have rutile and fluid inclusions of one homogeneous phase, reflecting a volatile- or water-rich crystallization environment. From the occurrence of calcite, opaque minerals, white mica and quartz overgrowths, it is believed that the metasandstone has undergone low temperature metasomatic alteration and recrystallization.

## Conglomeratic metasandstone

Conglomeratic metasandstone forms only a minor part of the Tai Shek Mo Member. It occurs at the transition from metasandstone to metaconglomerate, and is characterized by the presence of coarse quartz granules from 0.25 up to 3.5 mm in a fine matrix. The sub-rounded and flattened quartz clasts commonly have undulatory extinction. There are dark laminae of biotite and opaque minerals separating the individual quartz grains. Needles of sericite occur as interstitial material and also define a weak foliation. Very few opaque or accessory minerals occur in the matrix, and this reflects either relatively insignificant metasomatism or a very pure original lithology. In part the quartz grains are completely recrystallized to a mosaic texture within the matrix. Under plane polarized light the quartz grains have fused boundaries with neighbouring grains. No preferred orientation or alignment of the quartz grains was noted.

## Metaconglomerate

Bimodal distribution of grain sizes is the characteristic of the metaconglomerate (Plate 1). Rounded relict grain shapes can be easily seen in thin section. The quartz grains, ranging in size from 5 to 15 mm, show undulatory extinction or microcrystalline texture. The pebble-size and granule-size quartz grains commonly show elongation and flattening due to tectonic deformation. Interstitial flakes of sericite occur between the quartz grains. The occurrence of brownish white mica (strained sericite) often defines the boudin shape of the quartz pebbles. Quartz pebbles and granules can have either sutured or straight grain boundaries, with the flattening direction paralleling the foliation. The metaconglomerate has undergone very low-grade metamorphism in which pressure is the dominant factor, resulting in flattening of the pebbles. Epidote is quite common in the metaconglomerate, and in one thin section partially sericitized plagioclase feldspar (oligoclase) clasts are also found.

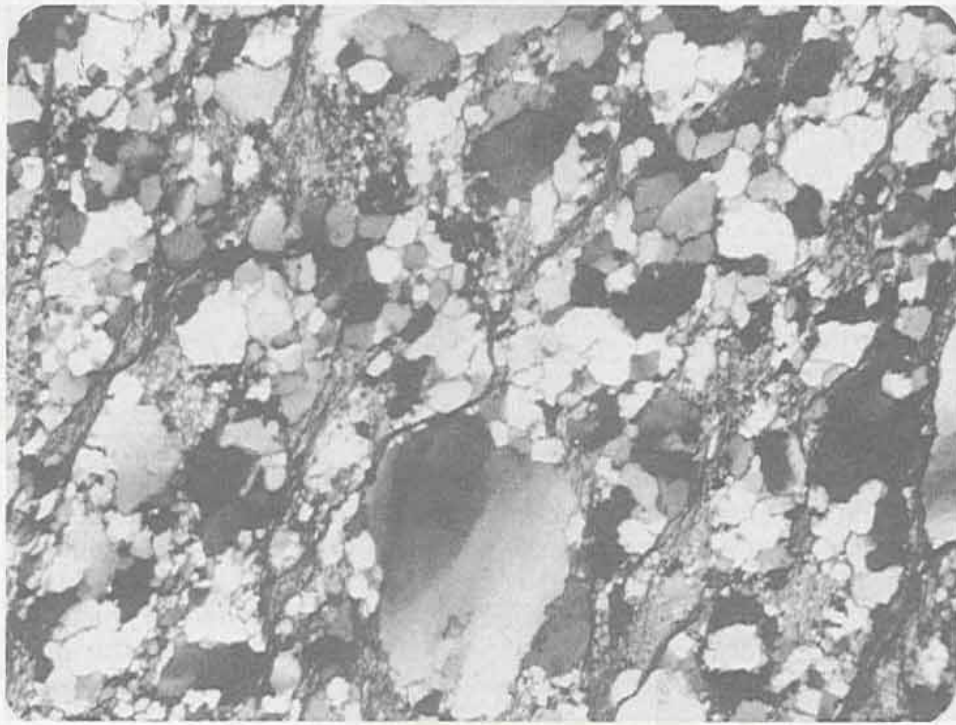


Plate 1 Bimodal distribution of quartz grains in foliated metaconglomerate, cross polars, x40

### Phyllite

The petrographic characteristic of the phyllite is the extensive crystallization of minute, wavy crystals of sericite surrounding microcrystalline quartz porphyroblasts or augen. Commonly the quartz porphyroblasts are stretched and flattened. Schistosity is well accentuated, with the occurrence of an S-penetrative schistosity normal to the direction of applied stress. A second schistosity,  $S_2$ , is defined by a non-penetrative crenulation cleavage surface. This cleavage results in the realignment of the mica along the cleavage plane. The average quartz grain size in the microcrystalline matrix is about 0.04 mm. The augen of quartz are generally sub-rounded to rounded, with an average size of about 0.3 to 0.4 mm. This phyllite is the characteristic product of low-grade dynamic metamorphism of siltstone, and there is no evidence of any retrograde metamorphism.

### Mica schist

The occurrences of mica schist are mainly confined to the Mai Po Member of the Lok Ma Chau Formation. The mica schist is highly schistose and micaceous, and occurs as thin layers intercalated with phyllite and metasandstone. In hand specimen the schist has a coarser texture than the phyllite, but in thin section the rocks are very similar in appearance. However, the phyllite usually has a very well defined crenulation cleavage, which is not common in the mica schist. In addition, the mica in this schist is much finer grained than in the phyllite, with larger but more intensively flattened quartz grains commonly occurring as augen. Flattened pebbles and granules of microcrystalline quartz are very common, giving the rock its characteristic schistose appearance. Incipient growth of sericite, biotite and muscovite is interstitial to the quartz grains. Occasionally, the crystallization of sericite is so extensive that it may obscure the relict mineralogy.

## Graphite schist

Graphite schist occurs in only a few localities in the study area. In fresh rock, the graphite schist is dark grey, strongly schistose and very fine-grained. Under the microscope, the schist is composed of microcrystalline quartz grains in a very fine-grained matrix of sericite and graphite. The graphite and sericite occur as tiny needles and platy aggregates within the matrix, with graphite making up 10 to 25% of the rock. Preferred orientation of crystals of quartz and sericite is well defined. The microcrystalline quartz crystals range in size from 0.02 to 0.005 mm. There are dark laminae of opaque minerals parallel to the foliation.

## Marble

Crystalline marble of the Yuen Long Formation is concealed under a thick superficial cover around the Yuen Long area. In fresh rock core specimens, the marble is massive and crystalline with a greyish-white or white colour. The marble generally consists of highly crystalline calcite crystals with triple point crystal junctions and glide twins, with crystal sizes from 0.125 to 0.30 mm. Small calcite veins are quite common and represent a secondary crystallization. In some thin sections, trace amounts of either partially resorbed or primary poikiloblastic (sieve-like texture) crystals of tremolite, epidote-zoisite, wollastonite (Plate 2), quartz and opaques are found. The occurrence of these accessory minerals varies from sample to sample, but tremolite, epidote and opaques occur quite consistently in amounts of 3 to 5%. The cubic crystal habit of the opaques suggest the mineral is pyrite, along with a small amount of reddish-brown haematite.

## Discussion

A reduction of quartz grain size in the metasandstone and mica schist was noted. As the large quartz grains are strained (undulatory extinction) continuous deformation begins to create a microcrystalline texture and results

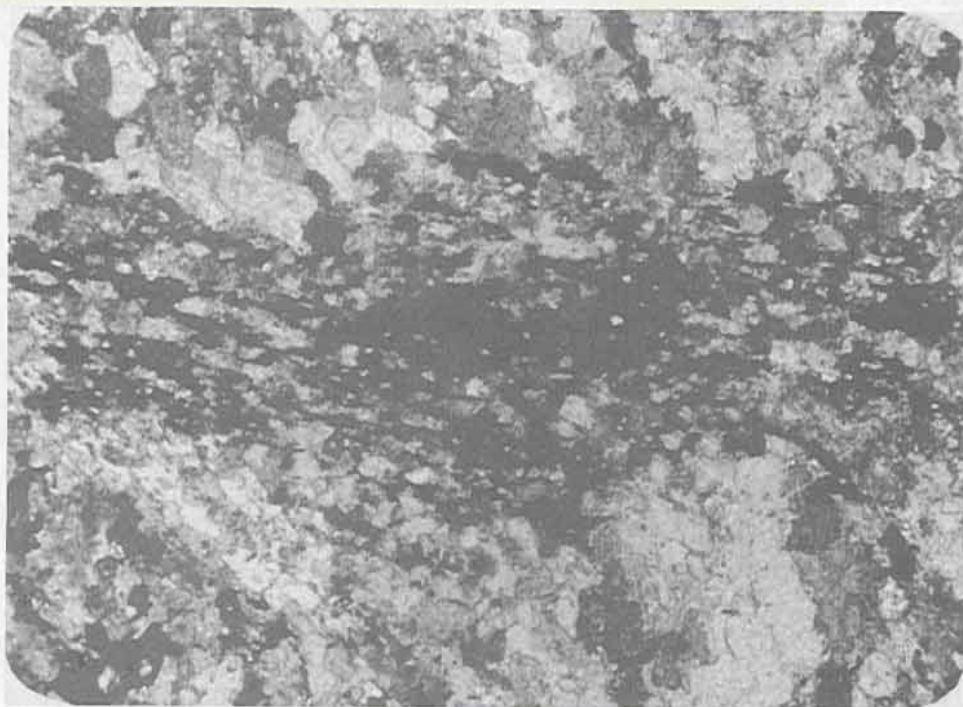


Plate 2 Partially resorbed or poikiloblastic (sieve-like) wollastonite in marble from the Yuen Long Formation, cross polars, x100

in strain release. Subsequent cracking of the microcrystalline grain boundaries during continued deformation opens up void spaces. Mineralization by hydrous minerals in the interstitial voids then takes place and results in a finer grained rock. The grain fining is characteristic of low-grade metamorphism as higher metamorphic grades are generally accompanied by an increase in crystal size.

The occurrence of epidote, tremolite, wollastonite and quartz in the marble might suggest the possibility of retrograde metamorphism, as this epidote-tremolite-wollastonite assemblage defines a low- to medium-grade transition isograd from greenschist to amphibolite facies. It is also possible that this higher metamorphic grade may have been preserved because of the more sensitive nature of the calcite due to the localized effect of small intrusions, or a longer period of temperature-pressure induration conditions associated with major fault zones. The author has found that epidote commonly has fluid inclusions within the crystals, and it is suggested that the epidote probably crystallized in a volatile or water-rich environment. The development of opaque minerals (haematite and pyrite) is very extensive and consistent, and it is suggested that a regional metasomatism by a ferromagnesian-rich fluid took place during the metamorphism. Therefore, it is proposed that the alterations in the mineralogy and chemistry of the marble result from metasomatism and thermal metamorphism associated with major structural features.

### Conclusion

The San Tin Group seems to have experienced low-grade regional metamorphism of greenschist facies, with a mineral assemblage of quartz-sericite - calcite - haematite - epidote - biotite - chlorite +/- (tremolite and wollastonite). Evidence of retrograde metamorphism from the epidote-amphibolite facies in the marble of the Yuen Long Formation is also suggested. The occurrence of resorbed epidote, tremolite, quartz and wollastonite might indicate that a certain area of the outcrop has experienced a higher metamorphic grade, with a transition from greenschist to amphibolite facies. In addition to the metamorphism, the Lower Carboniferous rocks were subjected to metasomatism with haematite and pyrite as common opaque minerals. The occurrence of fluid inclusions within some of the recrystallized minerals also supports this view.

### Acknowledgments

The author would like to thank Dr R Addison, Mr K W Lai and Dr R L Langford for their helpful comments on this paper. Special thanks are due to Dr R L Langford for his kind assistance in editing the manuscript.

The author is employed by the Geotechnical Control Office under the Engineering Geology Graduate training scheme. The paper describes the findings of work carried out as part of a project completed by the author under the direction of staff of the Geological Survey Section, Planning Division, Geotechnical Control Office. Acknowledgment is made to the Director of Civil Engineering Services, Hong Kong Government, for permission to publish this paper.

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### Dredging of marine sand

Report of the Marine Studies Group Meeting: 3rd August 1987

addressed by Mr N. Wragge-Morley

Mr Wragge-Morley began his talk with a brief resume of the various major marine dredging operations in which he had been involved before coming to Hong Kong to supervise the Container Terminal 6 dredging work. This resume centred mainly on work in the Middle East and China, and included experience in design and supervision of a wide variety of projects.

The main part of Mr Wragge-Morley's talk concerned the dredging techniques and reclamation procedures that are being used at the Kwai Chung Container Terminal 6, which is currently under construction. He described in some detail the workings of the large trailing hopper suction dredgers which the Dutch company HAM are employing to extract sand from the seabed between Tsing Yi and Ma Wan. These dredgers, which are in fact ocean-going ships, trail large diameter suction pipes down to the seabed. They dredge while moving at 2 to 3 knots in an operation that is very similar to the use of a domestic vacuum cleaner. Most of the operations within the ship are highly automated with positioning, dredging and so on being controlled and recorded by several on-board computers. A particular feature of these ships is their ability to wash out the fine material and so to concentrate the sand, which is then stored in the 8000 m<sup>3</sup> hopper in the middle of the ship for transport. *In situ*, the material could have in excess of 40% fines, but when finally pumped out of the hopper into the reclamation area at Kwai Chung it commonly only includes only 2% fines. This, and the fast rate of dredging (1 million m<sup>3</sup> per week has been possible) has enabled the project to go ahead of schedule.

Mr Wragge-Morley also described in some detail how sampling of the *in situ* and reclamation material has been carried out using a vibrocoreing technique. This method of obtaining a long sample of sediment by vibrating a metal tube into the seabed had, he said, proved very effective being both quick and relatively inexpensive. It was clearly a technique with great potential as an alternative method of marine site investigation in Hong Kong.

At the end of his talk, Mr Wragge-Morley showed a series of excellent slides illustrating the various parts of the dredging ship.

Peter Whiteside  
Secretary, Marine Studies Group

# Report of a field trip to the northwestern New Territories

17th May 1987

K.W. Lai & A. Hansen

A field trip to the northwestern New Territories was organised by Mr K. W. Lai for the 17th May 1987 to see the metamorphic rocks of the San Tin Group. This Group is composed of metasandstone and quartzite of the Tai Keng Leng Formation (the lowest member), marble of the Yuen Long Formation, metasilstone (phyllite) with graphite schist and sandstone of the Mai po Member and metasandstone with metaconglomerate of the Tai Shek Mo Member.

The weather was poor in the morning, but this did not prevent enthusiastic members from conducting a thorough inspection of the localities visited; their persistence was rewarded by improved weather later in the day.

The first stop was at Shui Ngan Leng, southwest of Yuen Long, where the existence of marble in boreholes had been confirmed by the revised geological remapping programme. In a nearby construction site, marble was also found in material excavated from caissons. Although not able to see the marble in situ, members were able to search for interesting samples amongst the excavated material. The marble excavated from the caissons near Yuen Long could be seen to be composed of recrystallised calcite, forming a granular texture, with significant amounts of tremolite [see the petrographical descriptions of the rocks of this Group, contained in Chan, 1987, in this Newsletter - Ed.]. Amongst the larger blocks of material excavated, several contained surfaces that had evidently once been the edges of cavities within the marble. These surfaces could be seen to be crenulated and smoothed by solution from moving water, and were all covered to thicknesses of between 2 and 8 mm by layers of a brown, silty clay deposit (Plates 1 to 4).

The second stop was at Mai Po, where the metasilstone (phyllite) with graphite schist of the Mai Po Member unconformably overlying phyllitic volcanic tuff were exposed in one of the cut slopes for the New Territories Circular Trunk Route. This indicated that the Mai Po Member, which is of early Carboniferous age, was thrust over the Jurassic volcanics. The thrust dips to the northwest at approximately 40 degrees.

In the early 1970's, a graphite mining company operated at Tam Kon Chau, to the west of Mai Po. A 220 m deep borehole and an inclined adit were driven in this area. Members were able to collect graphite samples from the mine-waste dump adjacent to the now-flooded adit (Plate 5).

The third part of the excursion was to the summit of Tai Shek Mo, which is the highest hill in the Lo Wu area, inspecting the metasandstone and metaconglomerate of the Tai Shek Mo Member on the way (Plate 6).

The thrust fault at Ho Sheung Heung was also visited. This is similar to the thrust fault at Mai Po, as mentioned above. Dynamic metamorphism is evident on either side of the fault.

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Plate 3 (Opposite) Large marble block showing a weathered surface. Small sub-parallel and irregular ridges on the weathered surface possibly indicate veining within the marble that is slightly more resistant to weathering

Plate 4 (Opposite) Excavated marble block with approximately 8 mm layer of slightly clayey silt at the edge of a cavity. The deposit is flaking off in layers and covers an irregularly curved solution surface



Plate 1 Marble block shows curved surface due to solution, with thin (<2mm) covering of silty soil

Plate 2 Small marble block showing curved solution surface. The 4 mm thick layer of fine sandy silt that was deposited at the edge of the cavity is cracking off. The marble under the surface deposit has a fine granular texture due to partial solution along grain boundaries



Plate 3



Plate 4

Plate 5 Members collecting samples of graphite schist from the spoil dump at the Tam Kon Chau Graphite Mine



Plate 6 The outcrop of metaconglomerate at the summit of Tai Shek Mo

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## Land resources of the Territory - Geotechnical Area Studies Programme

### GASP Report No. 1 - Hong Kong & Kowloon

The first of the Geotechnical Area Studies Programme Reports is now available to the public through the Government Publications outlets and selected bookshops. The Report, printed in May 1987, covers Hong Kong Island and Kowloon, and contains information which will be of special interest to those involved in planning and land development. A total of twelve GASP Reports will be published in this series, to give coverage of the whole Territory.

The series is produced by the Geotechnical Control Office and provides general geotechnical information on slope gradient, terrain, geology, geomorphology, vegetation, land use, rainfall, erosion and slope instability. The series is designed specifically for town planners, estate surveyors, landscape architects, civil and geotechnical engineers, engineering geologists and other involved in the application of geological and terrain-related information for planning, land development and engineering feasibility. Teachers and academics involved in secondary and tertiary education will also be interested in the document because it provides a comprehensive inventory of the natural land resources of the Territory.

## Details of GASP Report No. I - Hong Kong & Kowloon

This 170 page Report is based on a Terrain Evaluation system designed especially for Hong Kong. It contains 20 black and white plates, more than 30 figures (including computer-generated maps), 7 clear-film overlays, and several fold-out maps and legends.

Accompanying the Report is a Map Folder which contains four 1:20 000 scale maps, printed in two colours for clarity:

- |   |   |
|---|---|
| * Geotechnical Land Use Map (GLUM)                              | designed for non-technical users, to depict the general level of geotechnical limitations   |
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| * Generalised Limitations and Engineering Appraisal Map (GLEAM) | designed for both technical and non-technical users, to highlight areas of potential for development from a geotechnical point of view              |

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ISBN 962-02-0005-5

For further information on either the Geotechnical Area Studies or the Geological Remapping Programmes that are currently under way in the Geotechnical Control Office, please contact:

Principal Government Geotechnical Engineer  
Geotechnical Control Office  
6th Floor, Empire Centre  
68 Mody Road  
Tsim Sha Tsui East  
Hong Kong

## Representation of geological interests

### on the Antiquities Advisory Board

Earlier this year the Society, together with the Hong Kong Archaeological and Anthropological Societies, and the Royal Asiatic Society, was invited to nominate a person to serve, in an individual capacity, on the Antiquities Advisory Board of the Hong Kong Government. This was part of a re-structuring of the Board to reduce its civil service composition and increase the representation of interested members of the public. The person nominated by the Society (for an initial 2-year period) was **David Workman**, the present Chairman.

The Society's interest in matters which come under the Board's scrutiny is direct, in the field of palaeontology. Under the Laws of Hong Kong (Antiquities and Monuments Ordinance) the word 'antiquity' covers all 'relics', and 'relic' includes 'fossil remains and impressions'. As all field workers should know, all relics found in Hong Kong since 1976 are deemed to belong to the Government.

Many of our members will know the contents of the Antiquities and Monuments Ordinance, which, because of the definitions given above, covers all forms of palaeontological field work. There is a view that the provisions of the Ordinance in respect of geological, as distinct from archaeological and historical, antiquities are unduly restrictive. At the same time, there is clearly a need to ensure that field work is done in a scientifically and socially responsible way, that significant finds are duly reported to the proper authorities, that such finds are made available for study by experts and that important results are published. Practical methods of protecting and conserving vulnerable palaeontological sites need to be given due consideration.

Members may like to make their own views known on this subject. If enough are interested, we will organise a discussion session. All members who have anything they wish to say or who would like to be informed of any such meeting are invited to write to the Society, or personally to the Chairman or give him a call. Any action that may be taken in the future will be after due consultation with those known to be interested. If the Society itself is involved in any such action, then members will be given due notice of the action proposed. However, it is emphasized that the invitation to the Society to nominate someone to serve on the Board does not in itself involve the Society in any way with the activities or decisions of the Board. The persons so nominated by the four Societies are not representatives of the Societies but serve in a purely personal capacity.

### Forthcoming conferences

#### Second International Conference on Geomechanics in Tropical Soils

12th - 14th December 1988, Singapore, organised by the International Society for Soil Mechanics and Foundation Engineering.

Address: 21COTS, 150 Orchard Road #07-14, Orchard Plaza, Singapore 0923

#### INTERPRAEVENT

3rd - 8th July 1988, Lausanne, Switzerland. Themes are effects and management of floods and avalanches.

Address: INTERPRAEVENT, Postfach 43, A 8010 Graz, Austria

#### International Symposium on Landslides

10th - 15th July 1988.

Address: Secretariat, International Symposium on Landslides, Case Postal 83, CH 1015, Lausanne 15, Switzerland

#### International Conference and Exhibition on the Application of Geology in the Developing Countries

26th - 29th September 1988, University of Nottingham, England, organised by Association of Geoscientists for International Development (AGID), Geological Society, Institution of Geologists, and the Institution of Mining and Metallurgy.

Address: Conference Secretariat, Geosciences in Development Conference, Department of Geology, University of Nottingham, University Park, Nottingham NG7 2RD, England

### Recent library acquisitions

Research reports donated by K.S. Li (Member) and W. White:

University College  
Australian Defence Force Academy  
University of New South Wales  
Canberra ACT  
Australia

- No. 9: Rapid evaluation of the critical slip surface in slope stability problems, 28p. plus tables and figures, ISBN 0 908254 82 2, November 1986.
- No. 19: Probabilistic characterization of soil profiles, 30p. plus tables and figures, ISBN 0 7317 0001 5, March 1987.
- No. 20: Probabilistic approach to slope design, 32p. plus tables and figures, ISBN 0 7317 0002 3, March 1987.
- No. 21: A unified solution scheme for the generalised procedure of slices in slope stability problems, 20p. plus tables and figures, ISBN 0 7317 0003 1, March 1987.

Symposium proceedings donated by Professor Liu Zhaoshu, Hon. Member:

Proceedings of the International Symposium on Oil Development Environment of South China Sea (in English and Chinese). 4-7 December 1985, Guangzhou, Guangdong Society of Oceanology, Society of the South China Sea Environment of Petroleum Development, 299 p.

## MARINE STUDIES GROUP

One-day Seminar: Friday, 4th December 1987

### 'MARINE SOURCES OF SAND'

As previously announced, the Marine Studies Group of this Society is holding a one-day Seminar on the subject of marine sources of sand for reclamations and use as fine aggregate. The Seminar will cover the locating, testing, extraction and utilisation of sub-sea sand.

The Seminar will be open to Geological Society members and non-members. There will be thirteen presentations with periods for discussion. The proceedings of the Seminar will be published by the Society and preprints in the form of extended abstracts will be available to the Seminar attenders.

The programme of main speakers has now been finalised as shown below. However, any of those attending will be able to make short contributions during the various discussion periods. Anyone who knows in advance that they will be wishing to make a short contribution should inform the Secretary of the Marine Studies Group as soon as possible.

The main speakers and the preliminary titles of their papers are:

- Guilford, C.M. (Scott Wilson Kirkpatrick & P<sup>o</sup>trs): Marine fill in Hong Kong - a 35 year resume.
- Earle, Q.G. & Evans, A.G.S. (Quarries Section, Geotechnical Control Office): Review of aggregate supply in Hong Kong.
- Shaw, R. (Geological Survey, G.C.O.): Synopsis of the offshore geology of Hong Kong.
- Millar, M. (Maunsell Consultants): Specifications for reclamation fill.
- Carbray, T. (Materials Division, G.C.O.): Marine dredged sand for aggregate.
- Nieuwenhuijs, G.K. (Electronic and Geophysical Services Ltd.): Marine geophysical methods.
- Evans, C.D.R. (British Geological Survey): Seismostratigraphy of the early Holocene sandbanks.
- Blacker, P. (Fugro (Hong Kong) Ltd.): Marine investigations for sand.
- Groothuizen, B. (Van Ord): Dredging methods and materials for reclamations.
- Wragge-Morley, N. (Maunsell Consultants): Dredging for Container Terminal 6 - a case history.
- McMillan, M. (Binnie & P<sup>o</sup>trs): Dredging for Tin Shui Wai - detailed design considerations.
- Holmes, P. (Environmental Protection Department): Environmental aspects of dredging.
- Whiteside, P.G.D. (G.C.O.): Preliminary indications from the G.C.O. sand search.

The cost of the Seminar will be HK\$100 (HK\$60 for Society Members). This includes a set of Preprints, a copy of the bound Proceedings and tea and coffee. Lunch arrangements will be left to individuals. The Seminar will be held at Hong Kong University, Room LG 01, Hui Oi Chow Science Building, starting at 9.00 a.m.

Those who wish to attend should fill in the enclosed reply slip and return it, together with a cheque made payable to the GEOLOGICAL SOCIETY OF HONG KONG, to the Secretary of the Marine Studies Group, Mr Peter Whiteside, c/o Geotechnical Control Office, 6/F Empire Centre, 68 Mody Road, Tsim Sha Tsui East, Kowloon. Peter can be contacted on 3-7213684.

A full timetable for the day will be sent to those who send in payment to attend.



# 新界西北區的地質旅行

黎權偉

五月十七日，由香港地質學會組織了一次到新界西北區的地質旅行。主要參觀了早石炭紀的地層，包括元朗組的大理岩，落馬洲組米埔段的含石墨片岩，大石磨段的變質砂岩和礫岩。

出發前夕滂沱大雨，當天早上仍然烏雲密布，但對地質有濃厚興趣的會員堅持出發。最幸運是出發後，天氣漸轉晴朗，整個旅程均沒下雨。

首先到達元朗水牛嶺西邊的山下路，路旁剛完成鑽探，在幾個鑽孔中均發現有大理岩。附近進行沉箱地基的工地開掘出來的大理岩石塊也堆積在附近。會員們鑽到廢石堆中找尋各種感興趣的岩石和礦物。近年來未經地質調查證實，元朗的東南部在沖積層下普遍存在大理岩。

最有趣是姜漢銘先生首先發現有漂亮的直角石化石，大家也跟隨找尋，不少人都搜集到直角石化石，有些化石還經過打磨，十分清楚。這些化石均保留在石灰岩中，是從外地進口的建築石料用剩的廢料，所以也棄置在廢堆中。

接着到達米埔，這裏正進行新界迴環公路工程，在一個正在開挖的公路斜坡上，可以清楚看到米埔段的地層，以變質的粉砂岩夾石墨為主，在斜坡腳下出現片岩化的凝灰岩，說明早石炭世的米埔段地層直接逆掩於侏羅紀的淺水灣群火山岩上。斷層面傾向北西，傾角40°。

米埔保護區內有一個地方叫擔捍洲，以前有一個石墨礦公司在這裏開採過石墨礦，在七十年代初期曾在這裏打過一個深達二百廿米的鑽孔。現在附近還有一個廢棄了的開採石墨礦的平峒。會員們在石墨礦的礦石堆中也搜集了各種石墨標本。

下午到達上水的河上鄉，大家攀登上 185 米高的大石磨主峯。沿途參觀了落馬洲組大石磨段的地層。主要為變質的砂岩和礫岩。就在羅湖區最高的山峰上，會員們愉快地邊進午餐，邊欣賞深圳河沿岸的風光。從這裏可以遠眺深圳水庫。

下山途中會員們繼續考察和搜集岩石標本，還觀察了河上鄉附近的逆斷層，這裏的斷層與米埔山的相似，亦為石炭紀地層推覆在侏羅紀的火山岩上。兩側地層均發生強烈動力變質現象。

下午四時許，順利完成整個旅程，回到了尖沙咀。

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## Marine Studies Group Seminar, Reply slip: MARINE SOURCES OF SAND

I expect to attend the Seminar on Friday 4th December 1987.

NAME : .....

ADDRESS: .....

TELEPHONE : (Home) ..... / (Office).....

I wish to contribute a discussion item on the subject of:

.....  
Please send this reply slip, together with a cheque for \$60 (members) or \$100 (non-members), made payable to the GEOLOGICAL SOCIETY OF HONG KONG to:

Mr P Whiteside, c/o GCO, 6/F Empire Centre, 68 Mody Road,  
Tsim Sha Tsui East, Kowloon.

# 香港之土地資源地區岩石土力研究計劃

## 第一份報告——香港及九龍

有關全港地區岩石土力研究計劃的一系列報告(合共十二份)，其中的首份報告已經於五月出版，並可以在各政府刊物銷售處和特定商號購買。此首份報告範圍包括香港及九龍地區，內容應適合給對城市設計及土地發展有興趣的人。

這項岩石土力研究計劃是由土力工程處策劃，主要提供一些土力資料如山坡斜度、地形、地質、植物、土地用途、雨量、侵蝕和山坡穩定情況。這些新編訂的地區岩石土力研究計劃報告，對城市設計、土地發展及工程可行性研究工作都很有用處，因此特別適合城市設計師，房地測量師，園林建築師、土木工程師、土力工程師和工程地質師等。教師和學者對這些報告也會感到興趣，因為他們詳盡地提供了有關全港土地資源的調查結果。

這本厚達一百七十頁的報告是根據一個獨特方法來評估某地區在土力方面的限制。此報告有黑白相片二十張，圖表30張及附有有關地圖。

報告附有四張1比2萬比例的地圖：

1. 土力土地用途圖(GLUM) — 根據經評估的土力困難而將所有土地分為四類。適合一般非技術性人士使用。
2. 自然限制圖(PCM) — 顯示對土地發展可能有所影響的各種主要自然限制，適合任何人士使用。
3. 工程地質圖(EGM) — 則提供基本的地質及土力工程資料，對工程可行性的研究工作應有所幫助。適合專業人士使用。
4. 一般規限及工程評估圖(GLEAM)則從土力工程的角度，將具有優良發展的地區加以劃分。適合任何人士使用。

## 古物古蹟諮詢委員會下之地質權益

年初，香港政府古物古蹟諮詢委員會為增加其代表性而改組，並邀請香港地質學會、考古學會、人類學會，及皇家亞洲人類學會等，四會各派一員以個人名義參加。因此本會推舉會長Dr. David Workman參加(任期兩年)。

依委員會的指示，本會的權益為古生物方面。根據香港古物及遺蹟條例：「“古物”是指所有的遺蹟，而遺蹟是指化石殘留物或痕蹟」。因此野外工作者應明白自1976年起所有遺蹟都是屬香港政府的。

部份本會會員認為上述之古物及遺蹟條例是包括各種化石標本的野外採集。但有人認為此條例不應包括地質方面的。有一點要確保的是，任何野外標本採集的工作都是為了科學上和社會上的需要。一旦有重要發現，應通知有關當局，並讓專家等研究及將研究結果發表。同時，應設法保護及保存那些容易損壞的古生物地點。

會員如對這方面有意見，請寫信或直接與本會主席聯絡。若人數較多，本會則會安排一次討論會，將來在決定進行任何事情前都會與有意見的會員相討。若事件是與本會有關，則會諮詢各會員。在此強調一點，任何人被推薦參與委員會的會員，純屬以個人名義，並不代表本會立場。

# 香港地質學會

1987—88年度常務委員會

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我們歡迎一些專門性的稿件，有趣事項的報導，書評或專題討論等。來稿以簡為主。雖然有些時候本會可作出例外，但普通稿件請以一千二百字為限。請盡量減少插圖及附表等，而所有圖表請另外分頁。

所有來稿必須清晰——英文稿用打字機打出，中文則以正楷謄寫。來稿需寄兩份。英文稿（包括援引）必須隔行，不可一紙兩面用；請用A4號紙張。中文稿則請用原稿紙。中英文稿每頁均必須有頁編號及作者姓名。

所有插圖請只寄影印本，待本會通知時始可將原版寄來，而必須註有來稿者姓名。圖表必須用黑色繪在描圖紙或滑面白紙或紙板上；所有綫條或字體之粗幼必須能縮影後仍可保持清晰，所有地圖必須附有公制比例，正北指向及如適用的話附有經緯綫座標。

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李作明



八七年十一月十九日

# 香港地質學會

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