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GEOLOGICAL SOCIETY OF HONG KONG
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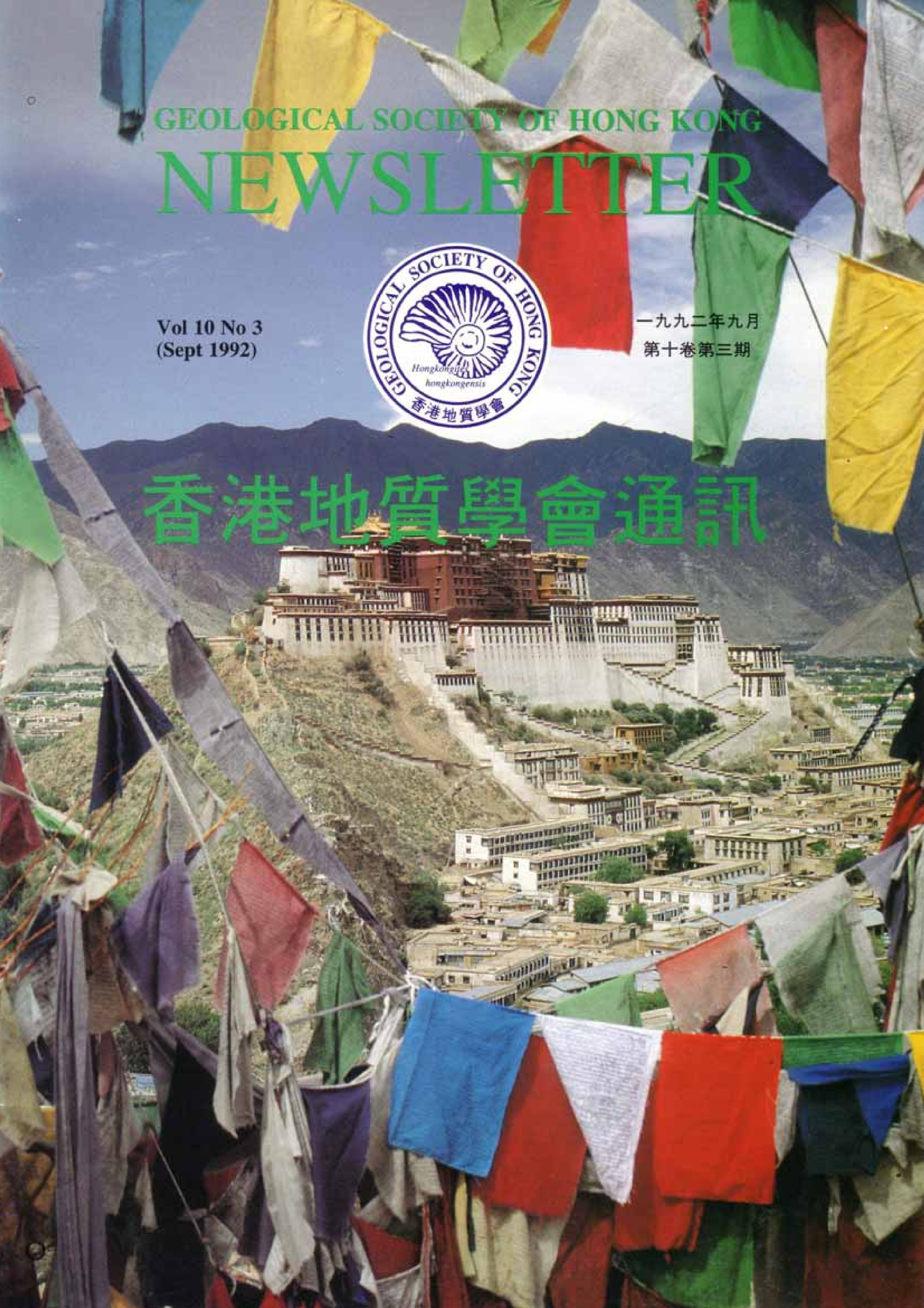
香港地質學會

香港地質學會通訊



Geological Society of Hong Kong

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Articles of a technical nature, as well as reports of interesting events, reviews and other topical items are welcome. Typescripts, enquiries and all correspondence pertaining to the Newsletter should be addressed to the Editor, Geological Society of Hong Kong, c/o Department of Geography and Geology, University of Hong Kong, Pokfulam Road, Hong Kong. The Society does not assume copyright of material published in the Newsletter. Any other previous, current or expected future use of such material by the author must be stated at the time of submission.

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Typescripts must be accurate, legible and in their final form; two complete copies should normally be sent to the Editor. Typescripts should be double-spaced, including references, on one side only of A4 paper, with 25 mm margins on all sides. All pages should bear the authors name and be numbered serially. Text supplied on diskette using any conventional DOS word processing package (Wordperfect, Wordstar, Multimate, etc) or ASCII text is preferred to hard copy.

Illustrations

Send the originals of all illustra-tions, each marked with the author's name, figure number and caption. Illustrations can be in black on tracing material or smooth white paper or board, but clear film positives to final size are preferred, with a line weight suitable for reproduction. A metric scale should be included, and North Point (or where relevant, coordinates of latitude and longitude) on all maps. Plates should normally be provided as negatives plus prints, or as transparencies. However, half-tone plates to final publication size should be supplied if possible. Refer to a recent issue of the Newsletter for size and style of tables, figures and plates, although generally they should be exactly 16 cm wide by no more than 23 cm high.

References

The author is responsible for ensuring that all references are correct. The list of references should be given in full, including volume, part and page numbers, with no abbreviations in the title of the paper or journal.

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Offprints

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EDITORIAL

This copy of the Newsletter is arriving late again, but we hope you find it was worth the wait. As we are paying for full colour on the front cover, it seemed reasonable to fill the cover as much as possible. If we continue to get articles from members of this quality, then the Newsletter will go from strength to strength.

Unfortunately, a lack of articles, photographs, news and reviews is the sole reason for the slow production rate of the Newsletter. If the Editor does not receive more contributions within the next six months, we are in serious risk of having no Newlstter at all.

The knock-on effect of this lack of material is a steadily dwindling membership. It will soon be too costly and time consuming to produce the Newsletter, or any other Geological Society publications, sending the Society into a downhill spiral from which it can not recover.

Of course, this perspective is with my Editor's hat on. When I look at the successes of the Society in organizing field visits, such as the Tibet trip, and the regular series of lectures, it is clear that after ten years there is still a great deal of interest in geology and our environment.

This Newsletter contains some very interesting scientific discussion, with Rod Sewell giving us an insight into the complexities of granite and dyke emplacement. This contrasts with the remarkable discovery, by Kevin Styles of GEO, of a hitherto unknown account of the geology of Hong Kong.

On a sad note we mark the untimely death of Arthur Stephens, who was known to me personally, but who to most will be known as the joint author of "Allen & Stephens". It is a tribute to his work in the colony that the report is still used by geologists and engineers.

Geological Society of Hong Kong Newsletter Vol 10 No 3 p 2-7 (1992)

ACROSS THE TIBETAN PLATEAU

GEOLOGICAL SOCIETY OF HONG KONG
FIELD TRIP TO TIBET AND NEPAL,
25 JULY-9 AUGUST 1992

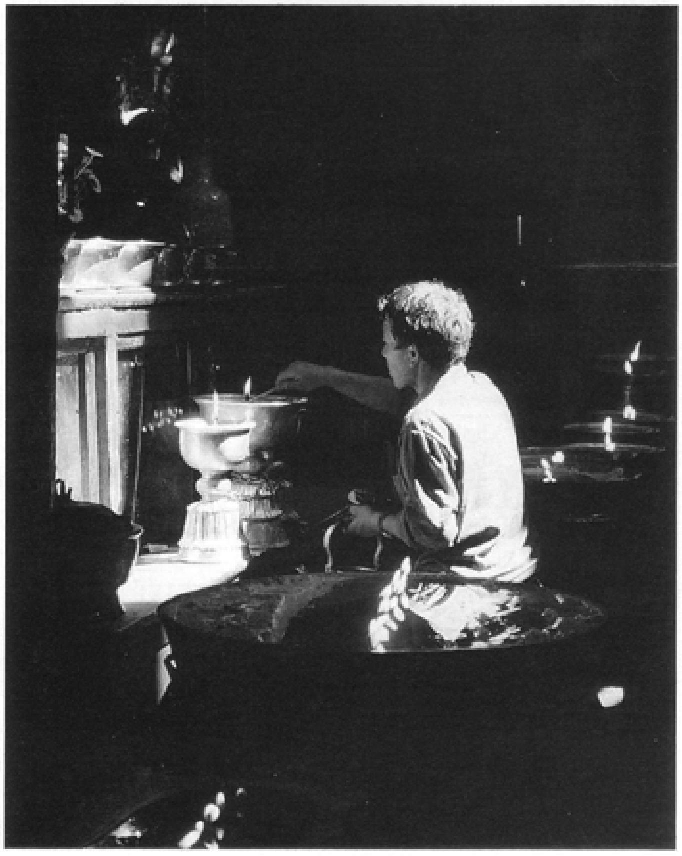
Philip Kirk

Hong Kong Geological Survey, 11/F Civil Engineering Building, 101 Princess Margaret Road, KOWLOON

The Society has made several "international" field trips over its 10 year existence: to Hainan Island (1985), to Taiwan and Guilin (1986), and a number of extensive trips through Guangzhou Province, as well as several day trips into Shenzen. However, the Tibet trip has been the most ambitious to date, partly due to its remoteness and altitude, but mainly because China is so sensitive about tourist access to this autonomous region.

Early plans for the trip were laid more than five years ago, after a period in the mid-80s when foreigners were, for the first time in decades, allowed to travel to Tibet. Further unrest in the late-80s meant that these plans had to be put on hold. When travel into Tibet recently became easier, the Society got back in touch with the Tibetan Geological Bureau and started planning again.

There was no shortage of interest from our members, with the varied attractions of mountains, culture, a unique geology and the fact that few people have ever been to Tibet. In the end though, a party of 13 made the trip. Several others were keen to go but were unable to due to work commitments - this latter group unfortunately including Mr C M Lee, who had been the main organizer from the start!



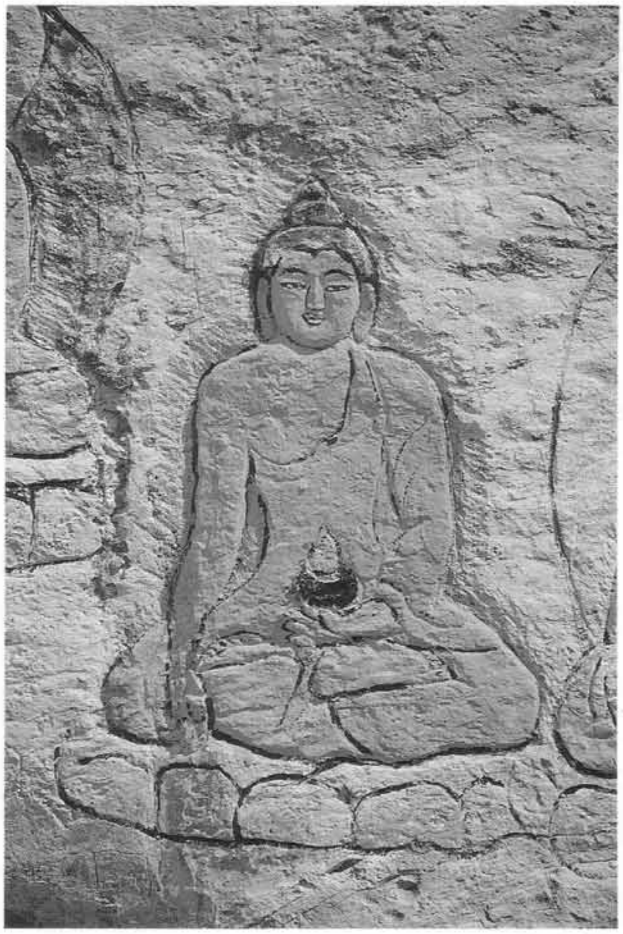
Attendant trimming the yak-butter candles in the Jokhang Temple.

Mr Lee's absence also left a vacancy as leader, filled by Michael Chan, who did a much appreciated job solving innumerable logistical problems along the way. These started early! Even getting onto the plane from Chengdu to Lhasa proved to be difficult.

After a flight through cloud-shrouded mountains, we made a spectacular descent into Gonggar airport, situated in a steep- sided valley. After Hong Kong's hot humid weather and muggy polluted atmosphere, Tibet's cooler climate, fresh air and blue skies were pleasant. The lack of oxygen (Gonggar is at 3900 m) probably contributed to the euphoric mood. We were met by Mr Tsi, a geophysicist from the Tibetan Geological Bureau.

The trip to Lhasa was a mini-tour in itself, and a taste of sights to come. It is a spectacular route through glacier-cut valleys, with sand dunes, alluvial fans, braided rivers, and a remarkably varied geology: turbidites, granite, migmatite and some wonderful folding and faulting. We passed many villages - clusters of houses with thick mud-brick walls and small windows (if any at all), all with colourful prayer-flags on poles. The harvest had begun, and many villagers were in the barley fields. In places, sheaves of barley were laid on the road for "auto- threshing".

In a broader part of the valley is the city of Lhasa. A couple of limestone hills poke out of the alluvial plain, and on the larger, looking as though it has been there forever, sits the Potala Palace, massive and dominating. The older, Tibetan, part of town is centred on the base of the hill, though the town has spread over recent years with much new building in the typical



Rock carving in silty limestone near the Potala.

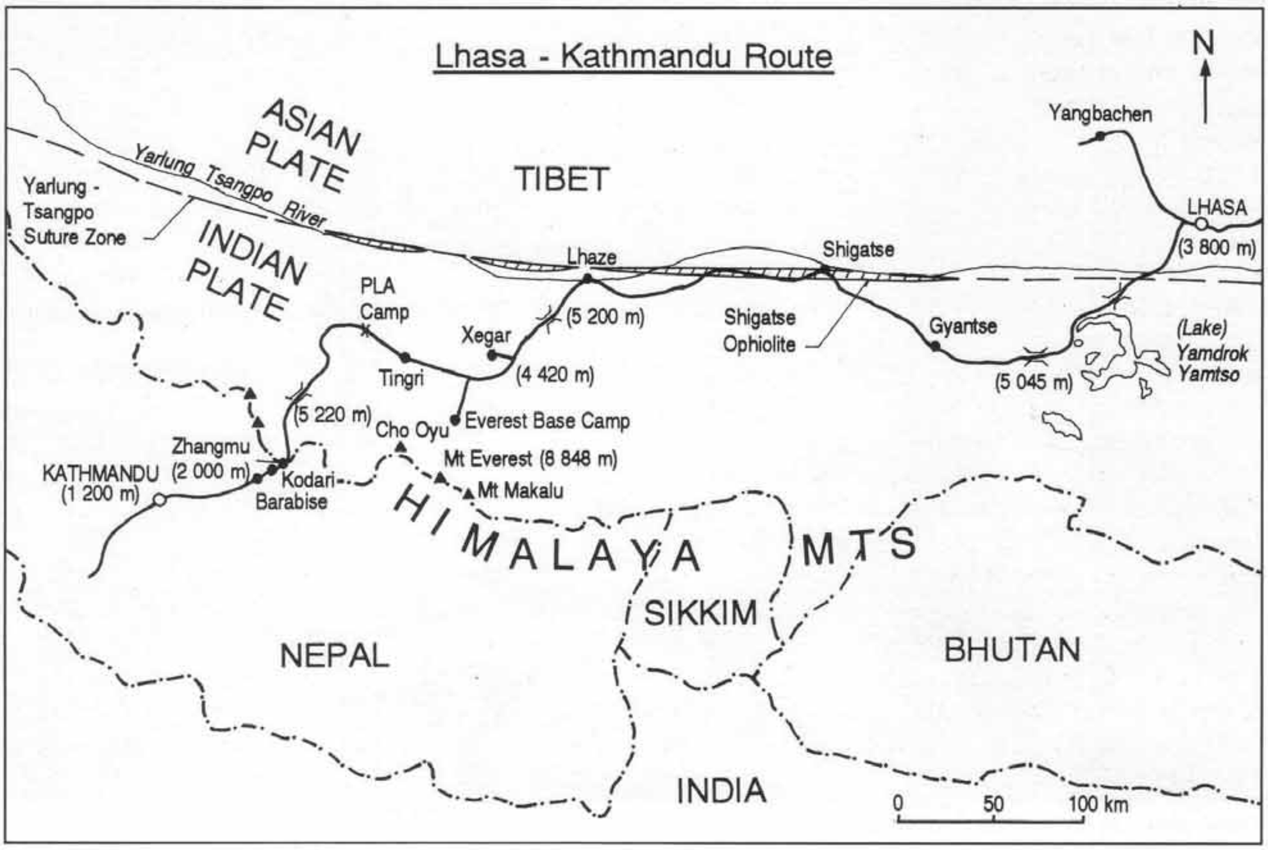
Chinese modern style of squarish concrete low-rise buildings.

Our hosts advised us to take it easy for the first few days. Apparently the Tibetan Geological Bureau have seen a number of over-enthusiastic visitors succumb to the altitude because they did not give themselves time to acclimatise! Our plan, therefore, was to spend a quiet five days in Lhasa, seeing some of the famous sights, and then the next eight days travelling by bus to Kathmandu.

Old Lhasa is beautiful (cover photograph). It is a great privilege to be able to visit the Potala and Drepung Monastery, homes of the Dalai Lama (currently exiled) and the Panchen Lama (currently between incarnations). The golden-roofed Jokhang Temple, object of innumerable pilgrimages that have worn the Barkhor Circuit's flagstones smooth with clockwise circambulations, is equally impressive.

Though these buildings have all suffered depredations due to time, the Cultural Revolution and other civil strife, they are now all being restored. Nor is the restoration merely for tourists. While we were there these were active places of worship, with monks young and old attending the shrines, chanting, playing drums, burning herbs, trimming the ubiquitous (and pungent) yak-butter candles. The visitors too, were mainly Tibetan people, praying, making offerings and spinning the prayer-wheels.

Our programme in Lhasa included a day at the Geological Bureau, where Mr Cao, the Chief Geologist, gave a fascinating marathon lecture on the geology of Tibet. It lasted most of a day, but we were comfortably ensconced in armchairs and sofas, and generously supplied with tea, sweets and fruit.



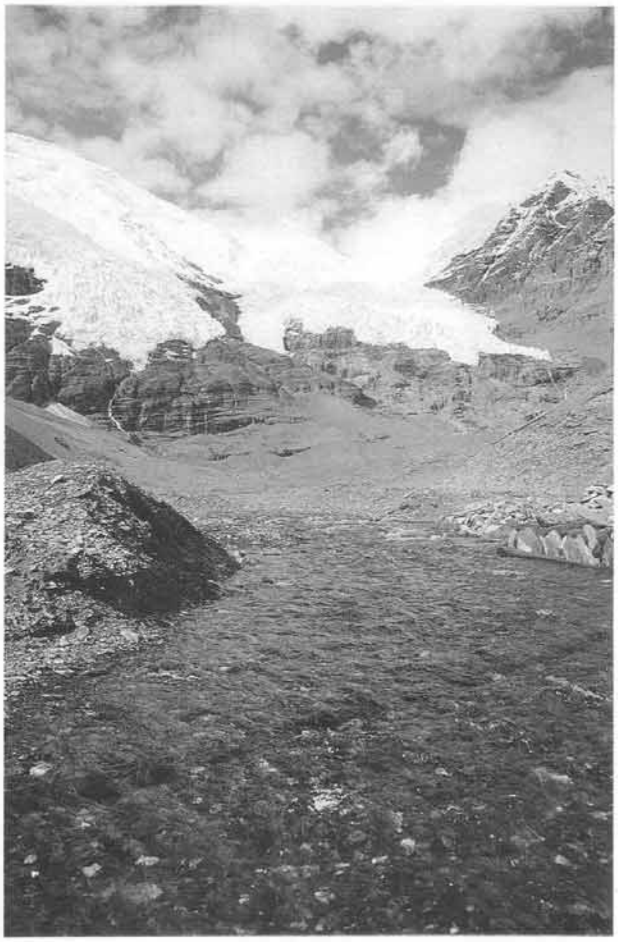
There were tantalising slides of stops along the route, though unfortunately all too many were "an hour's walk from the road". Frustratingly, even though we had come all the way from Hong Kong to see this geology, our schedule did not permit us to make so many stops.

The Bureau was very generous with gifts of maps, reports and even books. These included a donation of a full set to the Society library.

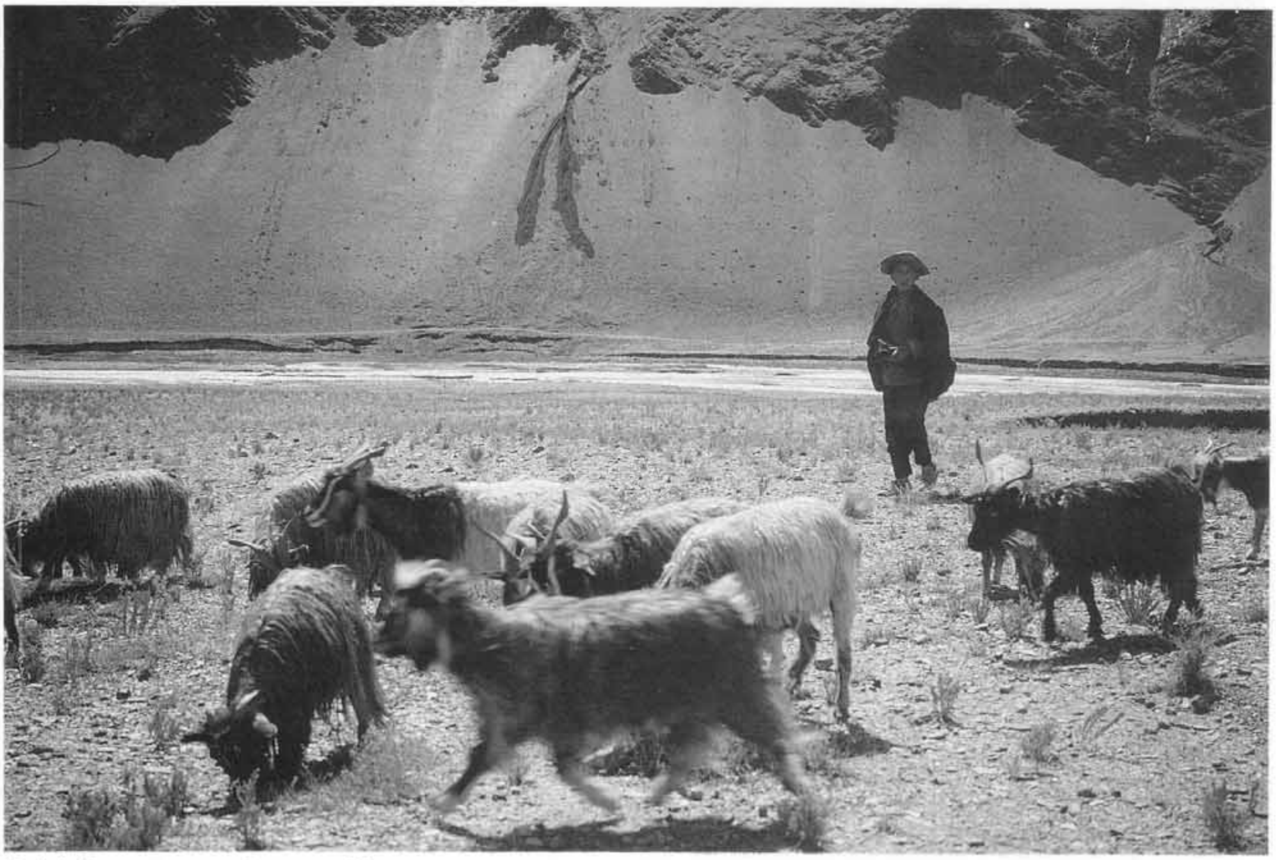
While based in Lhasa, we made a day trip to the Yangbachen geothermal area. The surface manifestations of geothermal activity are slight, but we had a look at a couple of small power stations and some geothermally heated greenhouses. Bernie Owen and K W Lai also took the opportunity to have the highest swim of their lives (4400 m) by taking a dip in the Olympic size pool. At one point, Bernie struck out strongly for the far end only to stop halfway due to lack of oxygen!

The effects of altitude are not to be underestimated. Lhasa is at 3800 m, and everybody in the party suffered to some extent. A common symptom was waking up with a headache, though that would usually disappear once you got going in the morning. Other problems were insomnia, nausea and worse. An indication of the extent of discomfort was that on the eve of our departure fully two-thirds of our group took an opportunity to visit the Geological Bureau's doctor!

Though travelling by such a prosaic conveyance as a bus there was a great deal of excitement about the second part of our trip - to cross the Tibetan Plateau, the Great Himalayan



Glacier near Gyantse.



Debris flows on scree slope near Xegar.

Range and then descend into Nepal.

It seemed an unlikely route, and even more unlikely that we would make it through on schedule. Even though roads washed out behind us, and there were tales of blocked roads ahead of us (and people who had been turned back to tell the tale), get through we did - on schedule. Even more amazingly, we enjoyed reasonable weather, though it rained at night and we sometimes saw fierce thunderstorms on the horizon.

This vast massif was thrust upward as the Indian Plate collided into the Eurasian Plate, and we had come to see the evidence of this collision in the rocks, and to look at the processes that have shaped, and continue to act on, the landscape.

The main plate boundary, the Yarlung-Tsangpo Suture Zone, trends east-west, following a major river of the same name (the Yarlung Tsangpo River cuts through the Himalaya far to the east, and is better known by its Indian name of Brahmaputra). As we headed generally west from Lhasa, our route crossed the suture zone several times. Then, from Lhaze we turned southwest, coming within 70 km of Mt Everest, before winding up toward a pass through the Himalaya further west.

We were overwhelmed by the geology, glacial and alpine geomorphology, and the most extraordinary collection of natural and man-induced slope failures.

On the northern side of the suture, the geology is dominated by Gangdise granitoids, which represent the root of a Jurassic-Cretaceous (ie, pre-collision) volcanic arc, with small inter-arc basin deposits (such as the shaly limestone knobs on which the Potala sits) and extensive volcaniclastic forearc basin rocks. This sequence was much deformed as India began to underplate Eurasia in the early Tertiary.

At the suture itself, an ophiolite complex is preserved. It is formed from fragments of the ancient sea-floor and oceanic crust of the sea (Tethys) that once separated Asia and India. Though now much cut by faults, it is possible to see all the elements that characterise ophiolite complexes: ultramafics, massive and layered gabbroic rocks, sheeted sills, pillow basalt and the overlying ocean floor sediments (chert in the case of the Shigatse Ophiolite).

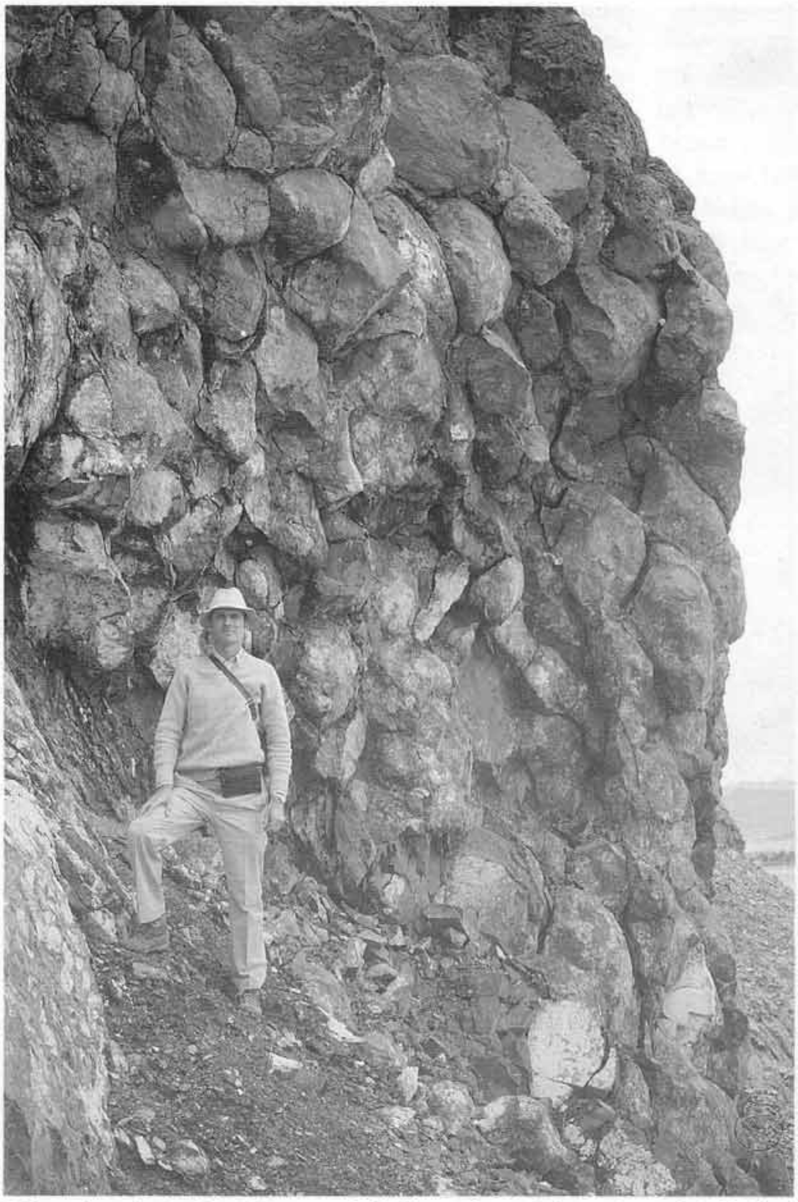
South of the suture (Indian Plate) there is again a complex sequence of rocks. Now built into a thick wedge of thrust slices (an accretionary prism) that underlies the Himalayan massif, they are derived from the rocks that once formed part of Gondwana, and the passive margin sedimentary rocks associated with this continent.

The average elevation of the Tibetan Plateau is over 4000 m, and we crossed four passes over 5000 m high, each marked by colourful arrays of prayer-flags and cairns (built to bring good luck during the journey). Though the ranges separating the main valleys are over 6000 m, the scenery does not become truly "alpine" until you reach the Himalayan Mountains.

Where plates collide. The Yarlung-Tsangpo Suture runs through the background col. The Indian Plate to the south (right) is represented by Mike Nash, the Eurasian Plate by Charles Chow.

There are numerous villages in the valleys, and we saw a number of nomad encampments. Since it was summer, the goat herds were in the hills. It seemed that wherever we stopped, no matter how remote, we would see a few people. If we stopped in a village all the locals would soon be crowding around our bus - not selling or begging, but as curious about us as we were about them.

In the towns it was somewhat different, with the locals well used to tourists. Most of the towns have built up adjacent to ancient temples or monasteries, and are now complete with Chinese-style tourist hotels, all concrete and marble. They had Star TV and people were watching the Olympics - even Madonna! The



Pillow basalt in the Shigatse Ophiolite. Flow deformation of individual pillows indicate that the deposit is vertically bedded and youngs to the right.

Gyantse, Shigatse and Xegar hotels were so similar to each other that they have merged in my memory. They even had the same set menus and bizarrely dysfunctional plumbing.

I think our best night's accommodation was at a small PLA camp near Tingri, at about 4500 m. Somewhat run down, it is in a beautiful valley, and the wild flowers were in full bloom. Obviously, this is a strategic site, as we saw several ruins of much older fortifications nearby.

The soldiers were friendly. They treated us to a huge bowl of new potatoes, much to the delight of those in our party who had got a little bored with the exclusively Chinese fare. Our stay at the camp was capped by a clear dawn with Everest splendid at the head of the valley.

The last segment of our journey in Tibet, from the army camp to Zhangmu, is a stratigraphic phenomenon. According to Mr Cao, every era from Cretaceous back to the Pre-Cambrian is represented in a sequence of imbricate thrust slices. Unfortunately, time and terrain were against us, so we had to content ourselves with the knowledge that as we plunged off the edge of the Plateau our dizzying descent vertically was being paralleled by a trip back through time . . .

From the Himalayan pass, we dropped more than 3 km vertically to the border town of Zhangmu. The atmosphere gradually became more humid, and we were soon in cloud and then rain. The vegetation became more and more lush, the steep valley sides becoming well-forested at these lower altitudes.

Zhangmu clings to the hillside. It is a one-street town, but the street has seven hairpin bends. Having made it all the way from Lhasa without a delay, we found our path blocked by a bus that had got stuck trying to cross a makeshift road repair - but we were only about 20 minutes walk from the hotel.

Hotel Zhangmu is one of the few hotels that could honestly boast a remarkable view from every room. When the mists cleared we looked out over the rain-swollen river in the gorge far below to the far side of the valley. Some of us celebrated our return to comfortably oxygenated levels in the bar.

Chinese immigration procedures completed, we only had to suffer the casual extortion from our "porters" for the short trip down to the Nepalese border post at Kodari. Another brief flurry of forms and we were in Nepal.

The first part of the road down to Kathmandu is through very difficult terrain, with roads optimistically cut along gorges and down steep valley sides. As on the Tibetan side, it is a matter of more or less constant repairs to keep the road open.

Towards the end of the day we reached a viewpoint which looked out over the Kathmandu Valley, vivid green in the late afternoon sunshine. The last stop of the trip.

Our time in Nepal was all too short, as most of us returned to Hong Kong late the next day. Some stayed on longer and were able to further explore the Kathmandu Valley and beyond. Raynor Shaw visited the Geological Survey of Nepal, and met some members of the Nepalese Geological Society.

They were interested in our trip through

Team photo at the PLA Camp: Bernie Owen, Petra Bach, Miss Li, Miss So, H M Tsui, Michael Chan, K W Lai, Sarah Li, Charles L W Chow, Mike Nash, Henry Steele.

Ruins of old fortifications near the PLA Camp.

Tibet, and keen for us to organise a similar trip to Nepal! Our next international trip perhaps? Raynor has subsequently written back to Nepal and is awaiting a response. He will let members know as soon as there is any news.

Geological Society of Hong Kong Newsletter Vol 10 No 3 p 8-14 (1992)

MESOZOIC GRANITES OF HONG KONG: TECTONIC IMPLICATIONS

EXTENDED ABSTRACT OF PAPER PRESENTED AT THE WESTERN PACIFIC GEOPHYSICS MEETING, AMERICAN GEOPHYSICAL UNION, HONG KONG, 17-21 AUGUST 1992

R J Sewell

Hong Kong Geological Survey, 11/F Civil Engineering Building, 101 Princess Margaret Road, KOWLOON

On the basis of whole rock geochemistry, Rb-Sr geochronology, and field characteristics, granites of Lion Rock Suite of Hong Kong (Sewell & Langford 1991, Sewell et al 1992) have been classified into three main types: I-type granites, A-type granites and contaminated I-type granites which have mixed A- and I-type characteristics.

Deformed I-type and A-type granites are found mostly in northwestern parts of the Territory, whereas younger, undeformed I-type granites predominate in the southeast (Figure 1).

Contaminated I-type granites are confined to a northeast-trending central zone between these two areas.

Linear dyke swarms of both I- and A-type granitic composition, together with subordinate mafic dykes, are a common feature of the central zone.

In terms of the published nomenclature for the Lion Rock Suite (Sewell et al 1992), deformed I-type and A-type granites belong to subgroup I, contaminated I-type granites belong to subgroup II, and undeformed I-type granites belong to subgroup III.

In northwestern New Territories, fractionated and deformed I-type granites are intruded by undeformed A-type granite which has yielded an age of 155±6 Ma (Tai Lam Pluton, Sewell et al 1992). This A-type granite clearly post-dates the compressional deformation which led to thrusting of Carboniferous strata over Mesozoic volcanics along the Tuen Mun-Lo Wu Fault Zone.

Contaminated I-type plutons in the central zone have not yet been radiometrically dated, but are intruded by I-type porphyritic dykes which have yielded an age of 154±6 Ma (Darbyshire 1990)(Figure 2). These dykes are similar in age to stocks of quartz syenite forming a partial ring complex around the collapsed Lantau Caldera in central Lantau Island. I-type dykes in the central zone have subsequently been intruded by A-type granites, and later by a linear swarm of A-type granite dykes.

Although undated, the A-type plutons in the central zone are probably of similar age to

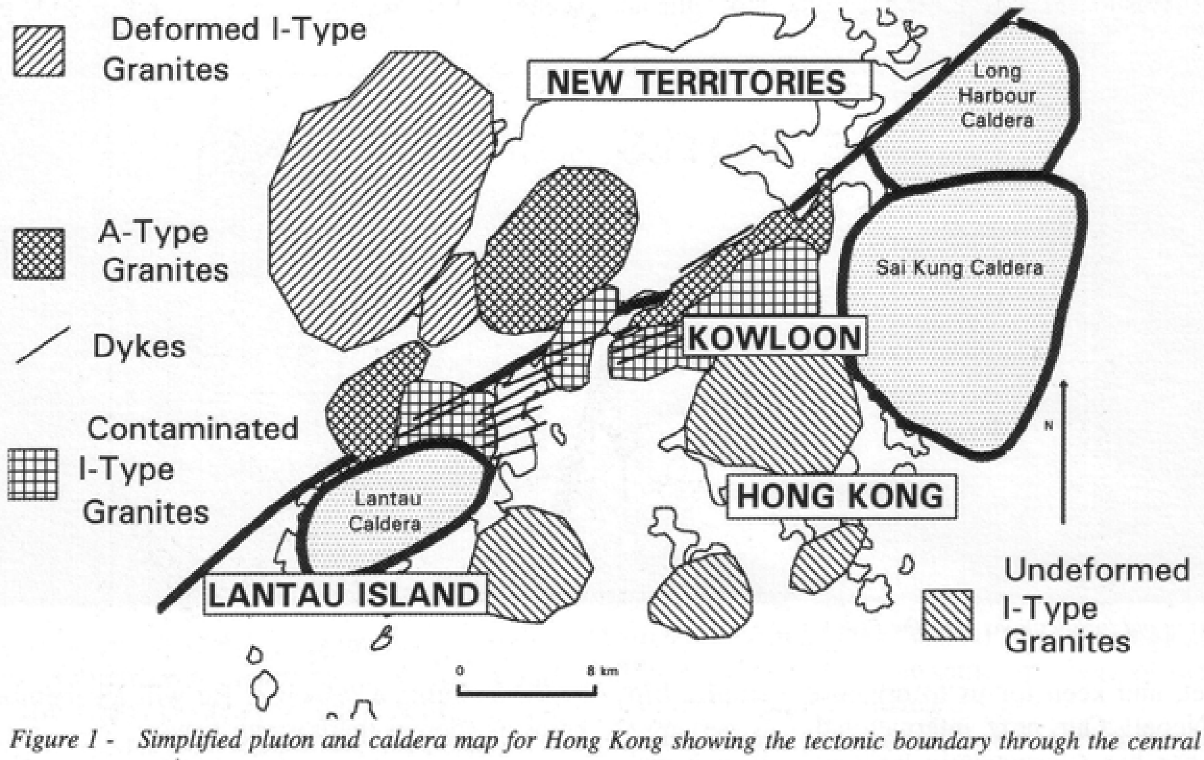


Figure 1 - Simplified pluton and caldera map for Hong Kong showing the tectonic boundary through the central region

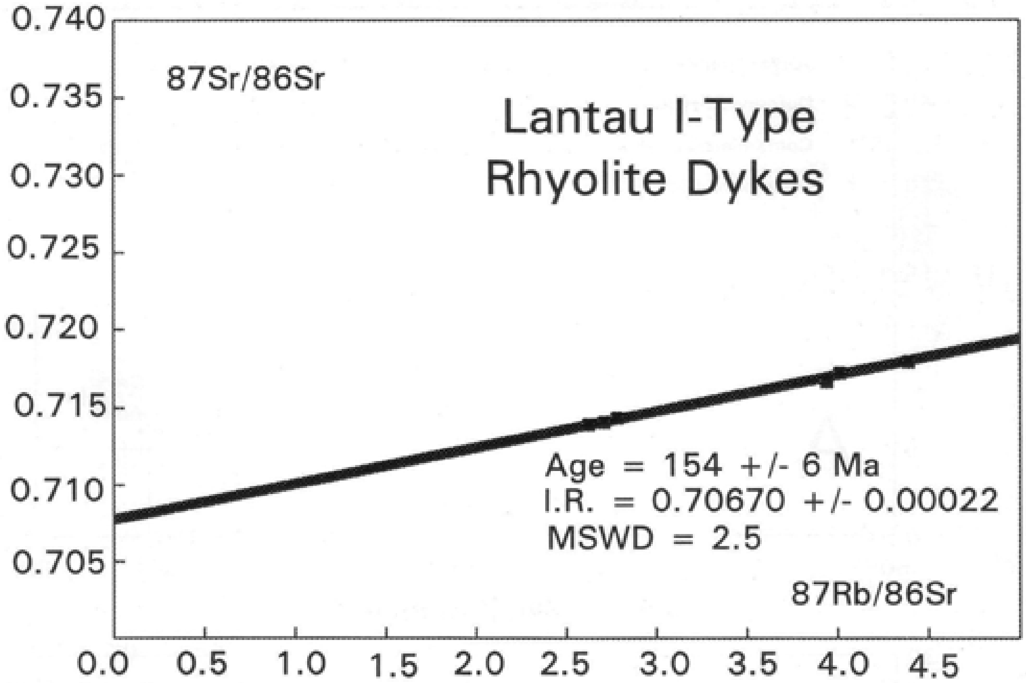


Figure 2 - Rb-Sr isochron for Lantau I-type rhyolite dykes. Data from Darbyshire (1990)

the Tai Lam Pluton of northwestern New Territories. A-type dykes commonly form composite intrusions featuring porphyritic microgranite injected into shoshonitic basalt and are associated with scarce lamprophyres.

Geochemical studies indicate that the quartz syenites are genetically related to the I-type dykes. They have similar chondrite-normalized trace element patterns (Figure 3), and lie on similar fractionation trends on selected Harker variation diagrams (Figures 4-6).

These diagrams also suggest that the A-type dykes may be genetically related to their host shoshonitic basalt. The basalts show linear fractionation trends with increasing SiO_2, but are separated from their A-type counterparts by a compositional gap between 68 and 74 wt% (Figures 4b, 5b & 6b). These characteristics suggest that the A-type dykes may represent the products of extreme crystal fractionation from a mantle-derived K-rich magma.

A-type dykes and granite plutons have particularly high abundances of U, Th and Y, as do the fractionated I-type granites. Deformed I-type and A-type plutons have the highest concentrations of these elements, whereas contaminated I-type granites show the greatest scatter in all diagrams. On a U versus SiO_2 plot

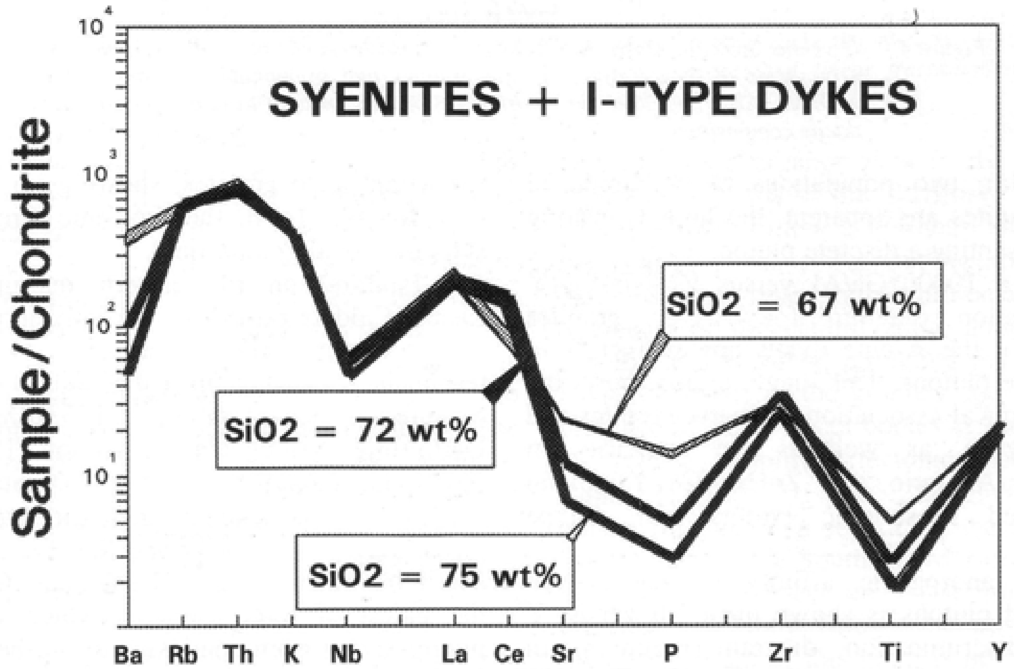


Figure 3 - Spiderdiagram for Lantau Syenite (SiO2 = 67 wt%) and two I-type rhyolite dykes showing the similarity in abundances of trace elements

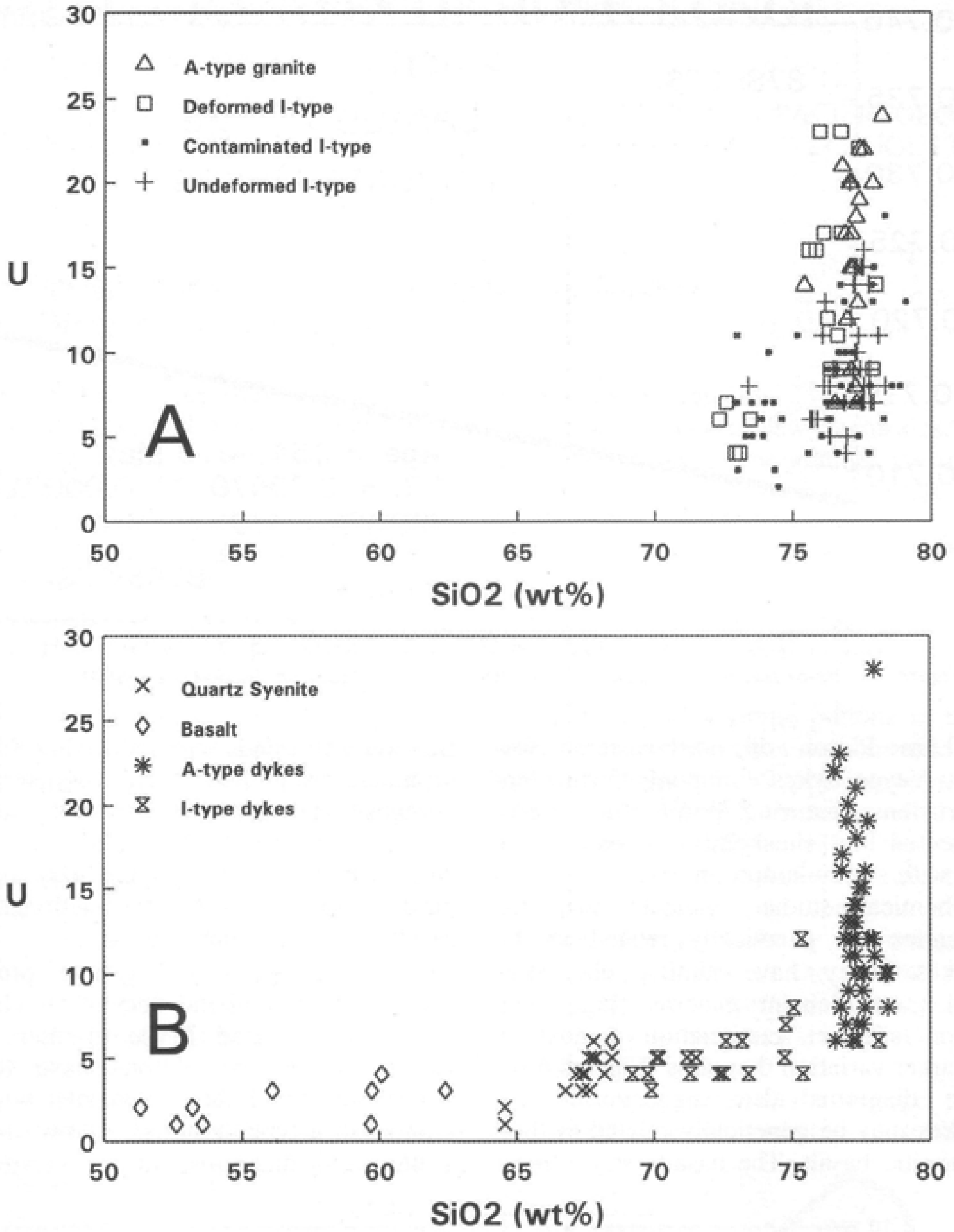


Figure 4 - U versus SiO2 for Hong Kong granites (A) and related rocks (B). Note the high U contents of A-type dykes, A-type granites and fractionated deformed I-type granites. Also note that the shoshonitic basalts include basaltic andesite and dacite compositions

(Figure 4a), two populations of contaminated I-type granites are apparent, the high U-bearing one representing a discrete pluton.

On a 10000*Ga/Al versus Zr+Nb+Ce+Y discrimination diagram for A-type granites (Figure 7), the A-type dykes are distinct from the A-type plutons. This diagram also shows the close chemical association of quartz syenites and I-type dykes, as well as the similarity in 10000*Ga/Al ratio and Zr+Nb+Ce+Y among fractionated shoshonitic basalts and A-type dykes.

The anorogenic affinity of the A-type dykes and plutons is shown on a Nb versus Y tectonic discrimination diagram (Figure 8). In contrast to the fractionated I-type granites, the A-type compositions plot distinctly in the field for within-plate granites, showing no fractionation lineage from the volcanic arc granite/ syn-collisional granite field.

Faulting on the eastern margin of the Lantau Caldera post-dates the intrusion of linear dyke swarms in the central zone, as all dykes terminate abruptly against the fault. The Lantau Syenite has yielded an age of 155±8 Ma (D P F Darbyshire, written communication, 1992), and field evidence indicates that it post-dates caldera collapse and is younger than the Lantau porphyritic dykes (P A Kirk and R L Langford, oral communication, 1992). The Lantau Caldera is the oldest of three calderas which developed progressively from southwest to northeast in the southern and eastern parts of the Territory during the Late Jurassic and Early Cretaceous.

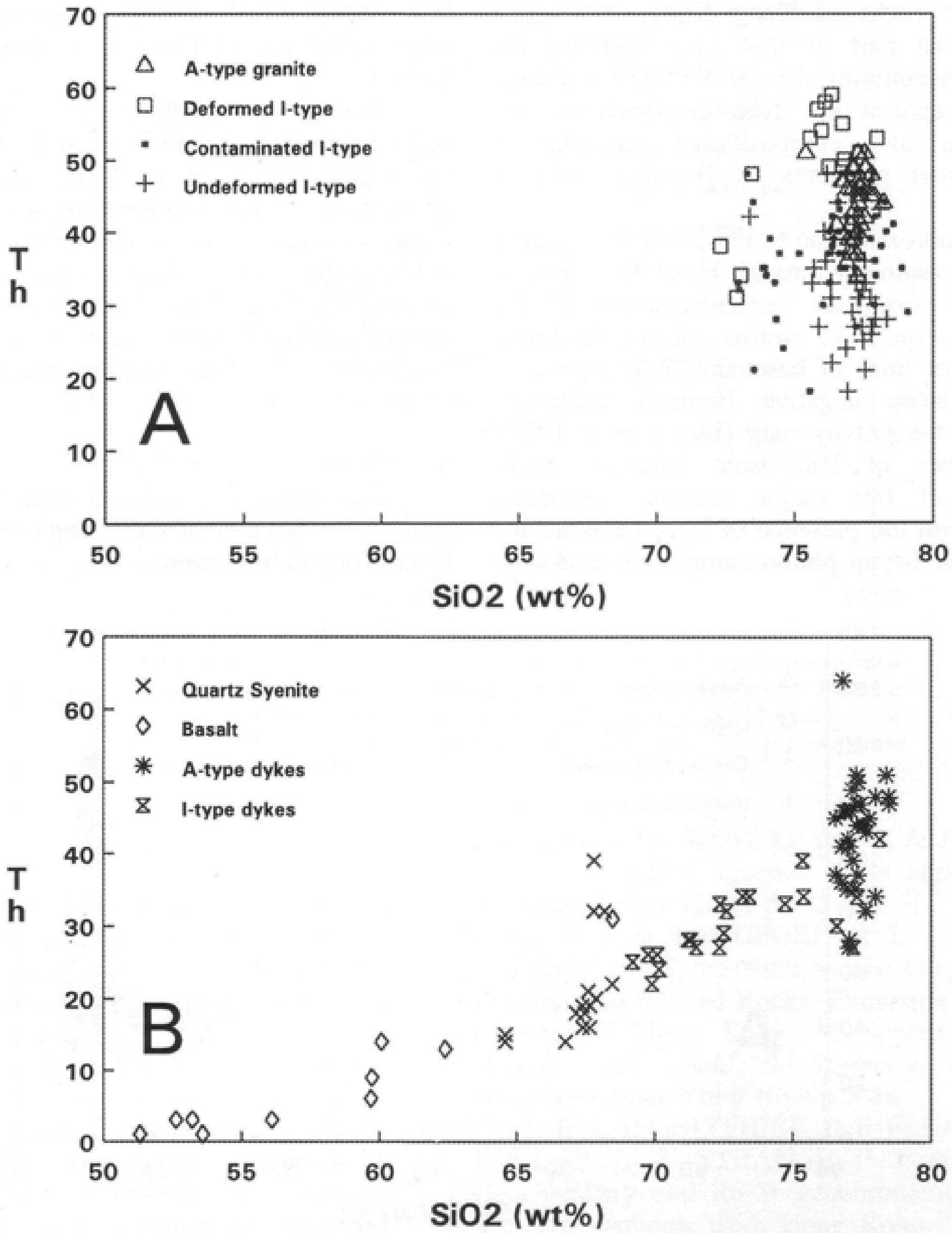


Figure 5 - Th versus SiO2 for Hong Kong granites (A) and related rocks (B). Note the high Th content of fractionated deformed I-type granites, and linear fractionation trends shown by quartz syenites and I-type dykes, and shoshonitic basalts

Caldera development was probably coeval with emplacement of fractionated I-type granites in the southeastern parts of the Territory (Sewell et al 1992).

Structural, compositional and age variations among the granitic rocks of Hong Kong suggest a Late Jurassic to Early Cretaceous southeastward transition from compressional to extensional tectonics across the Territory. The presence of contaminated I-type granites, together with well-developed linear dykes swarms, quartz syenites and bimodal A-type granites in the central zone, suggests that plutonism was influenced by a northeast-trending deep crustal discontinuity.

A recently published gravity map of the Hong Kong (Busby et al 1992) reveals strong negative Bouguer anomalies in the central and northwestern parts of the Territory. These negative anomalies follow a northeast trend through the central zone, corresponding to the major outcrops of A-type granite plutons and dykes. Southeast of the central zone, anomaly values become less negative, reflecting the pronounced I-type character of the granites and the possible presence of mafic basalt bodies at shallow depth.

On a simplified tectonic map of South China (Figure 9), the Zhenghe-Dabu deep crustal fracture zone separating the South China Fold Belt from the Southeast Maritime Fold Belt is shown to intersect the coast immediately to the north of Hong Kong. The position of the fault zone south of this point is not well known. From studies of the structure and geochemistry of granitic rocks in Hong Kong, it is quite possible that part of this zone transects the Territory, accounting for the dominant northeast structural control on dyke emplacement, the distribution and compositional variation in granites, and gradients in Bouguer anomaly values.

An approximation to the position of a deep crustal discontinuity through Hong Kong can be determined from the outcrop pattern of the bimodal A-type dyke swarm and syenite dykes, the southern limit of basement rock exposures, and the steep negative Bouguer anomalies shown on the gravity map (Busby et al 1992). The absence of Palaeozoic basement rocks southeast of this major tectonic lineament, together with the presence of large calderas and undeformed I-type plutons emplaced at a shallow crustal level, further suggests that the southeastern part of Hong Kong may be down-faulted.

The strong possibility of mantle-derived mafic magmas at a shallow crustal level beneath this region (Busby et al 1992) implies crustal attenuation. If the southeastern part of Hong Kong is viewed as a half-graben, then its development may reflect either intermittent extension during Late Mesozoic subduction-related tectonics, or the inception of widespread late Yenshanian block faulting along the South China continental margin.

ACKNOWLEDGEMENTS

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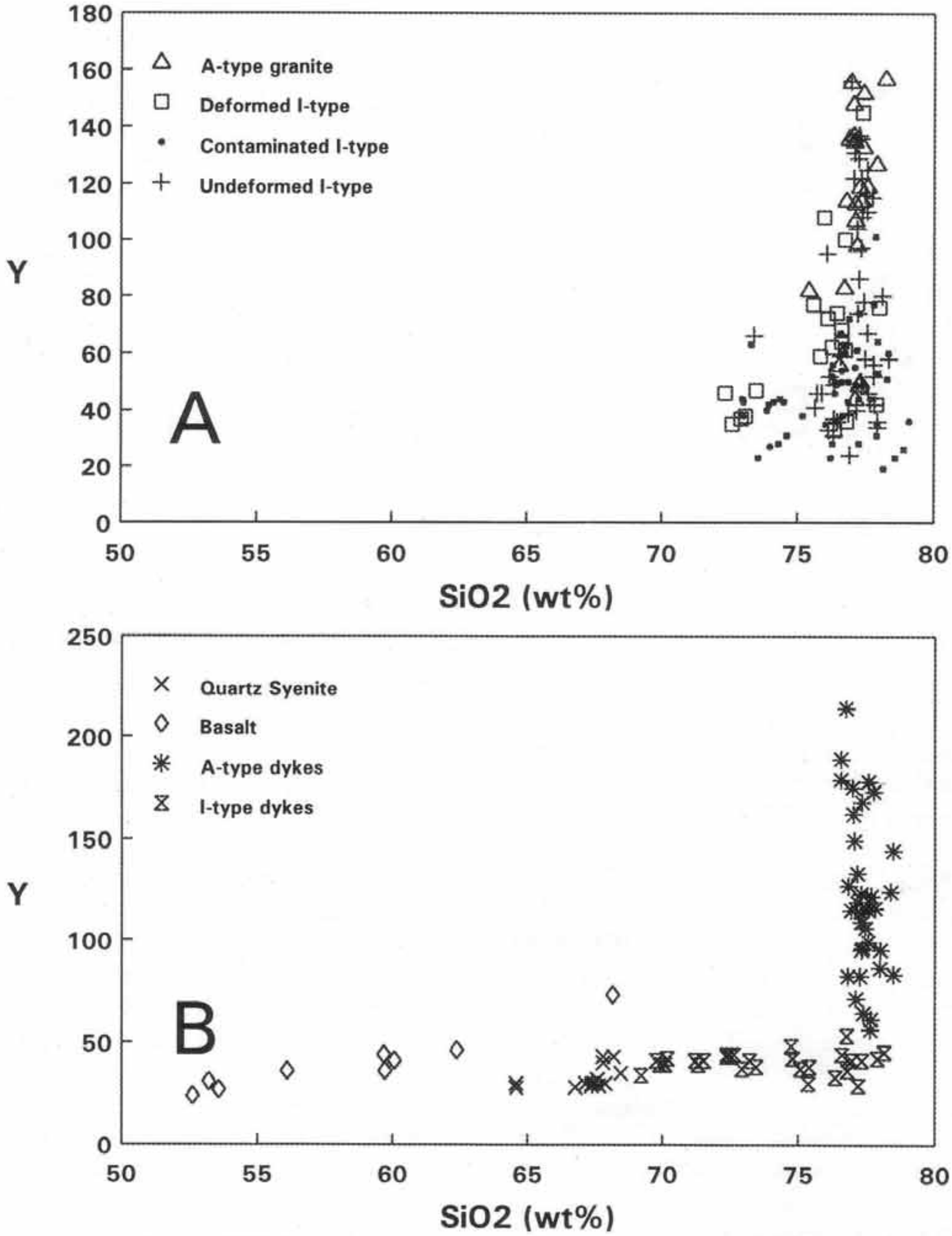

Figure 6 - Y versus SiO2 for Hong Kong granites (A) and related rocks (B). Note the linear fractionation trends of quartz syenites and I-type dykes, and shoshonitic basalts

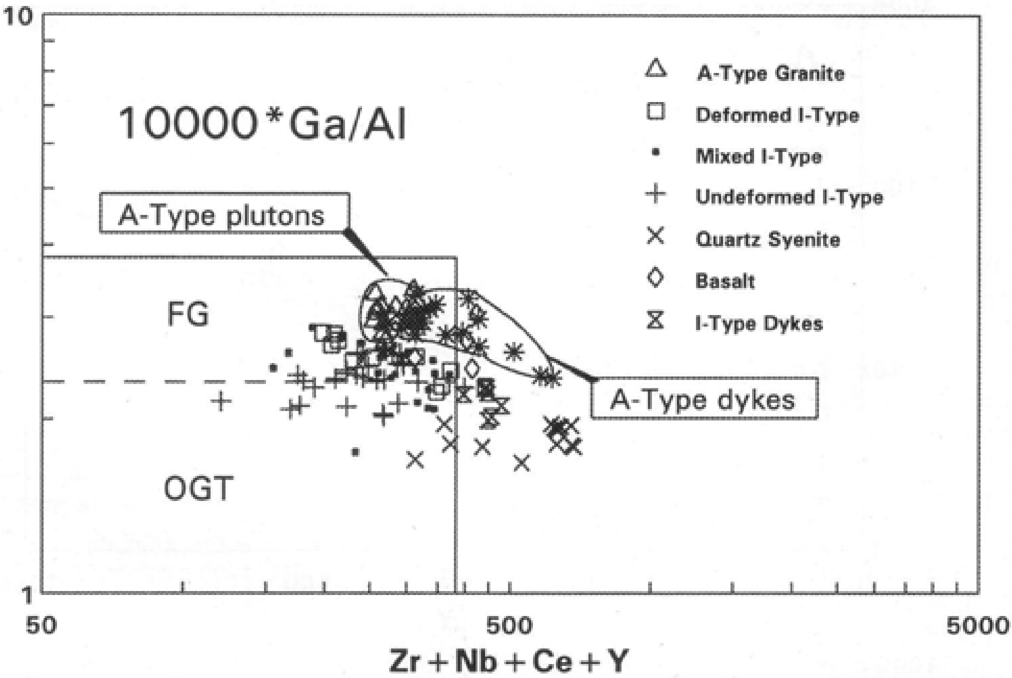

*Figure 7 - 10000*Ga/Al versus Zr+Nb+Ce+Y discrimination diagram for A-type granites (after Eby 1990) showing the plots of Hong Kong granites and related rocks. Note the distinction between A-type dykes and plutons, and the lower Ga/Al ratios of the fractionated I-type granites (both deformed and undeformed). FG = fractionated granites; OGT = I-, S-, and M-type granites*

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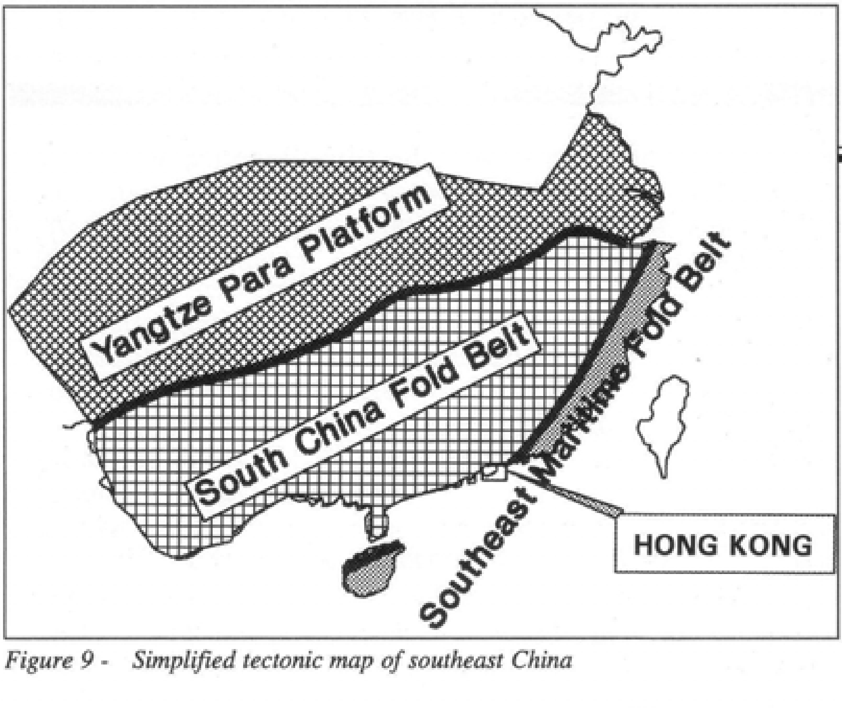

Figure 9 - Simplified tectonic map of southeast China

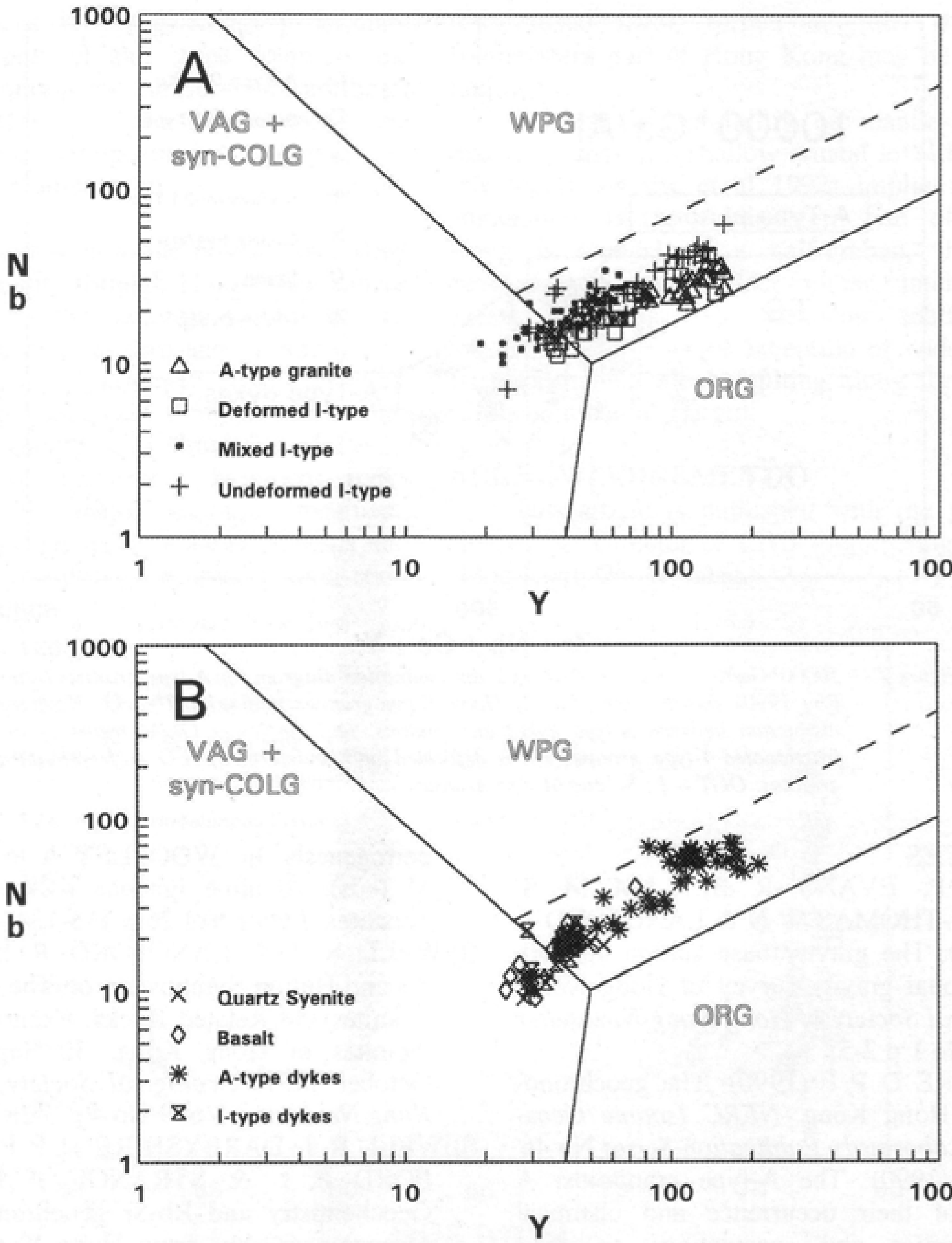

Figure 8 - Y versus Nb tectonic discrimination diagram for Hong Kong granites and related rocks. WPG=within-plate basalt; ORG=ocean ridge granite: VAG+synCOLG=volcanic arc and syn-collisional granite

Geological Society of Hong Kong Newsletter Vol 10 No 3 p 15-16 (1992)

REPORT ON THE GEOLOGY OF THE NEW TERRITORY, 8 OCTOBER 1898

Robert Daly Ormsby

Director of Public Works, Hong Kong Government, 1897-1901

The geological formation of this territory is simple, granitic, trappean, and metamorphic rocks largely predominating, the only stratified rocks which are found belonging to the hypozoic period. There are in places evidences of volcanic action, but of a very remote period, while the granitic and trappean rocks are very prominent everywhere. The hills facing Hong Kong are chiefly of granite, of which many varieties occur, from a fine close-grained felspathic white rock and a pink coloured granite like that of Aberdeen, to a very coarse porphyritic granite. Kaolin probably exists, but I did not come on any defined beds of it, though told that it was to be found near the west point of Castle Peak Bay. Syenite is common and of very good quality, a dark, highly crystalline variety, in many cases the large distinct crystals of hornblende being well shown.

The bold and rocky east coast shows some very characteristic cliffs of columnar basalt, and blocks of this, an almost black and highly crystalline rock, are largely used for bridging streams inland.

Further inland other trap rocks appear, while some of the islands in Mirs Bay show very distinctly the terraced and step-like appearance of these formations. The more compact and crystalline varieties seem to predominate, though trap tuffs and claystone porphyries are not absent. Specimens of basalts, greenstones, and felspar porphyries were numerous.

It is extremely difficult in such a country as I have described, where the varieties of trap rocks are so numerous and so mixed up with rocks of the granitic system, to say what other rocks may not exist. One thing is certain, there is everywhere an abundance of the best building material, and for road macadamizing nothing could surpass the hard basalts.

In one or two places I came on distinctly stratified rocks, of a hard, crystalline, close-grained variety, dark grey or bluish grey in colour, which I would call syenitic gneiss.

Pure quartz rock is uncommon, though in places distinct out-crops of quartzite were to be seen. I saw no mica schists, and except in the pure granites mica is not to be seen. Talc also is absent, but hornblende appears everywhere, and I should say chlorite schists, hornblende schists, and actynolite schists are fairly common.

I saw no limestone, all lime used in buildings being obtained from the burning of coral or oyster shells.

The lower hills between the mountain ranges are of laterite, rounded or conical in shape, and well covered with vegetation, combining to form the extremely picturesque scenery usually associated with such formations. The richly cultivated valleys lying between, formed by the denudation of the surrounding mountains, seem in most cases to have a few feet of good soil overlying laterite; some excavations, as in wells, showed this very distinctly. The laterite is what would be called a coarse cabook in Ceylon, fit for cutting out in blocks for building purposes. This is extremely like the disintegrated granite of Hong Kong, but contains more silicate of alumina and oxide of iron, the latter showing in large nodules.

Some excellent pottery clay exists on the slopes of Taimo Shan, of which we saw specimens in the village of Un-iu, of a light brown colour and extremely fine texture brick clay is found in all the valleys and is used in the form of large sun-dried bricks in many of the village houses and walls.

Possibly beds of primary limestone will be found, but the lime obtained by the burning of coral or shells is as a rule better for building purposes, so the absence of rock limestone, if such turns out to be the case, does not matter. A lead mine was worked for some years on the side of Taimo Shan, but the working discontinued for some reason about 6 years ago. Galena was also found near Kowloon, and on the north side of Lantao, and elsewhere. These workings should be examined by a mining expert, and the richness of the ore ascertained. The natives also speak of alluvial tin being found. Silver and lead were worked on the south of the island of Lantao within recent years, but without success financially, possibly due rather to Chinese official interference and bad management than to the absence of a paying richness in the ore. Expensive buildings were erected on the sea-shore, and machinery said to have cost

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OBITUARY - E A STEPHENS

Edward Arthur Stephens - Steve to his friends and colleagues - died at the age of 68 on 10 June 1992, after a valiant fight against cancer.

Following four years' war service in the Royal Air Force as a flying officer, aircrew, Steve graduated with an honours degree in geology from the University of Sheffield in 1950. His initial interests lay in the academic field, and he served as an assistant lecturer at Queen Mary College, University of London, from 1950 to 1951. He then made his first excursion to the Territory as lecturer at the University of Hong Kong from 1951 to 1953. During his spell in Hong Kong he undertook research in the then British Colony of North Borneo. This work later led to the award of the degree of MSc by his alma mater and also to a liking for fieldwork, which resulted in his appointment in November 1953 to the Colonial Service as geologist in the Geological Survey of North Borneo.

Aerial photographs played an important role in geological reconnaissance work in largely uncharted territories, such as North Borneo, and he soon developed a considerable expertise in their interpretation and application. It came as no surprise, therefore, that in 1957 he joined the burgeoning Photogeology Unit of the parent Colonial (later Overseas) Geological Survey Service, the unit then being based at Tolworth, Surrey. From then his career was devoted to the application of photogeological methods in UK-funded technical cooperation programmes in the developing nations, from 1968 as head of the unit.

This career in photogeology was only punctuated by a break of two years when he was seconded, along with Peter Allen, back to Hong Kong to carry out a geological survey of the Territory. By that time the OGS had been amalgamated with the Geological Survey of Great Britain and had become the Overseas Division of the Institute of Geological Sciences, NERC. The result of their work was the well known 1:50,000 geological map of Hong Kong and accompanying report on the geology. These published works are still held in high regard in the geological community in Hong Kong, and are a cornerstone in the Hong Kong Geological Survey's remapping programme. Steve had also by then somehow managed to complete a dissertation on the application of photogeological methods that led to the award of the degree of DSc by the University of Bloemfontein.

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100,000 dollars imported and erected. Even when the speculation collapsed, the plant was valued at $30,000, all of which is said to have been abandoned. Only the foundations and cement floors of some of the buildings remain, and the brick chimney shaft of the smelting works.

I should say that on the Taimo Shan range gneiss syenite and trap rocks predominate. Massive boulders of gneiss of a bluish grey or greenish colour are scattered over the mountain side and in the ravines. On the slopes in which the best pasturage is found there is a stiff yellow clay, with veins of quartz gravel.

Lantao Island is chiefly granite on the south face and trap rocks on the north, the latter being consequently much better covered with vegetation and trees. The smaller islands, such as Ch'eung-chau, P'ing-chau, and Lamma seem to be almost entirely granite.

It will be understood that as only 12 days in all were spent in the exploration of the mainland and islands, no accurate or close geological survey was possible, the predominating rocks were judged as much from the stone used in the paved footpaths, stream crossings, sea walls, and houses, as from the bed rocks on the hill sides, usually difficult of access. This geological description of the country is therefore of a very sketchy and imperfect character, and a closer and more careful examination by a professional geologist, or an expert in mineralogy, will doubtless bring to light much that has escaped my observation.

Editor's note

This account of the geology of the newly acquired territories (Lantau and the New Territories) was included as p66-68 in "Correspondence (June 20,1898, to August 20, 1900) respecting the extension of the boundaries of the Colony. Colonial Office, November, 1900." This 466 page document, held both in the Public Record Office, London, and in the PEL and Works (formerly PWD) Library, Hong Kong Government, includes one of few early observations on geology in Hong Kong.

Acknowledgments

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Edward Arthur STEPHENS, 1923-1992

Continued

During his tenure as Chief Photogeologist the Unit was considerably expanded and, in particular, its teaching role assumed increasing significance. Formal instructional courses were established for earth scientists and engineers from developing countries, and such was the demand that many were held in the developing countries themselves.

The increasing availability of high-quality remote sensing images provided by earth satellites in the late 1960s and the 1970s demanded a fresh approach from that applied to the interpretation of aerial photographs. Under his guidance the change was successfully achieved, and he also played an important role as a United Kingdom representative in the negotiations concerning the ERTS programme and its development.

Over the years Steve lost none of his flair as a communicator, and he proved himself an excellent instructor in photogeology and remote sensing methods. Widely read and possessed of a well-rounded turn of phrase coupled with a ready wit and a wide repertoire of stories from around the world, he achieved further acclaim as the editor of a quarterly newsletter circulated to the many IGS Overseas Division officers working abroad. Although entitled 'Confidential to members of the Overseas Division, more or less', there is no denying that it was read and enjoyed by a far wider circle than the Overseas Division itself!

Following his retirement from Keyworth in 1983, he and his wife Sheila moved to Goudhurst in Kent where they were able to employ to the full their very considerable gardening abilities. He also undertook advisory work for the Government of Saudi Arabia, and as well as everything else, entered wholeheartedly into village affairs, for several years serving as the Parish Church Treasurer; the large congregation at his funeral service bore ample testimony to the high regard in which he was held in the community.

***I G Hughes** (Formerly Head of Overseas Division, British Geological Survey) (Edited by R L Langford from an original published by the IMM)*

Geological Society of Hong Kong Newsletter Vol 10 No 3 p 18-19 (1992)

A NEW CONCEPT PROPOSED BY WOOD & MALLARD (1992) TO IDENTIFY ACTIVE FAULTS

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INTRODUCTION

The definition of active fault has long been a controversial issue. In the State of California, an "active" fault is one that has moved in the past 10,000 years, ie, the Holocene, but some geologists believe that almost certainly there are active Californian faults that have not moved in the past 10,000 years. In China, geologists often adopt a different definition for "active" fault, and they refer to those faults which are "really active" as "capable" faults.

In a recent paper, Wood & Mallard (1992) approached the problem in a different way. Instead of trying to define an active fault, the authors inverted the problem and tried to identify when a fault is "not active". The concept proposed by Wood & Mallard is very interesting and is summarised herein.

THE NEW CONCEPT

Wood & Mallard (1992) proposed the following two possible approaches to demonstrate that a fault is "not active":

a Phenomenological approach, by which it must be established that there has been no activity for a time period considerably in excess of the extreme recurrence interval of that phenomenon.

b Mechanistic approach, by which it must be proved that the external motivation for the occurrence of that phenomenon has changed.

As an example, an electronic watch may be considered to have "stopped" either : (a) if it is observed that the second hand does not move for a period considerably in excess of one second, or (b) if it is known that the battery has been removed.

Another example of the application of the above principles can be found in volcanic activity. A volcano could reasonably be classified as "extinct" where the time elapsed since the last eruption is considerably greater (perhaps by an order of magnitude) than the longest recurrence interval in the volcano's history. Alternatively, a volcano becomes extinct when the magma supply dwindles or when it is permanently blocked.

In the case of faults, a fault may be termed "extinct" if it has not moved for a time period considerably greater than the longest recurrence interval of significant displacement events in the region. Such recurrence interval is not unique and it varies from region to region. Wood & Mallard (1992) quoted a number of examples on the durations of recurrence intervals, some of which were:

a For the San Andreas Fault, at Pallet Creek, Sieh (1984) found that recurrence intervals varied between 50 and 250 years.

b Around the Mediterranean, historical seismicity suggests recurrence intervals in the range of 100 to 300 years along the North Anatolian fault in Turkey (Ambraseys, 1970).

c In Europe, to the north of the Alps, Quaternary displacement in the 30 km Erft Sprung system to the west of Cologne suggests an average recurrence interval of about 40,000 years. Other NW European active faults are likely to have recurrence intervals in excess of 100,000 years.

Fault movement recurrence intervals can be properly assessed only where the movement history of a large population of faults is available for study, as can be observed in offshore seismic reflection profiles. In continental intraplate regions, such an assessment is often difficult because of the lack of adequate data. In such a situation, the mechanistic approach may be pursued.

Fault movements are initiated by tectonic stresses. Wood & Mallard (1992) suggested that, if a fault can be demonstrated not to have moved within the duration of the current tectonic regime, it can be termed "extinct". The current tectonic regime can be described from observations of the stresses and strains occurring within the crust.

There is no unique value for the duration of current tectonic regime, and this must be estimated from careful reconstruction of geological and tectonic evidence in a region. For intraplate western Europe, Wood & Mallard (1992) quoted that the current tectonic regime is no older than 8 Ma and is probably younger than 4 Ma.

Wood & Mallard (1992) concluded that,

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Geological Society of Hong Kong Newsletter Vol 10 No 3 p 19-23 (1992)

DISCUSSION ON TOWARDS A QUATERNARY STRATIGRAPHY FOR HONG KONG

Newsletter Vol 10 No 2 p 5-10, 1992

W W S Yim writes: An attempt to review the current knowledge on the offshore Quaternary stratigraphy of Hong Kong has been given by Fyfe (1992). Although I welcome this account in general, I feel that I must write in to correct some inaccuracies in the account as well as contributing to the discussion on the topic. I will deal first with the inaccuracies before contributing to the discussion.

INITIAL WORK

The earliest borehole descriptions in Hong Kong date back at least to the 1950s when Kai Tak Airport, including a large section of the present day runway, was built (Grace & Henry 1957). Borehole sequences in Hong Kong down to a depth of almost 200 feet (c 65 m) were referred to in Berry (1959), while information obtained from the site investigations of Hong Kong's coastal waters, which were presumably based on offshore boreholes, was given by Holt (1962).

The credit for the first detailed stratigraphic division of offshore deposits should really go to three University of Hong Kong undergraduates. They were undertaking their Bachelor of Arts dissertation studies on the dam site excavations of sea- floor sediments during the construction of the High Island Water Scheme (Ma 1974, Tang 1974 and Yeung 1976). Ma (1974) and Tang (1974), who carried out studies on the excavation at the West Dam site, were under the supervision of the late Dr C J Peng, while Yeung (1976), who carried out a study on the excavation of the East Dam site, was under the supervision of myself. It was based on these studies, particularly that of Yeung (1976), that RMP Encon Ltd (1982) derived the names for the four depositional stages. These are referred to as the Upper Marine, Upper Alluvial, Lower Marine and Lower Alluvial in Table 2 of Fyfe (1992).

The statement made in Fyfe (1992) that Yim (1984) further divided the Upper Marine into the Lower and Upper units and included a radiocarbon date originally published by Kendall (1975) is incorrect. The study of Kendall (1975) was restricted to the West Dam site. In Yim (1984), the radiocarbon date of 5,980±180 years BP (Laboratory number KWG-286) was for a driftwood sample collected from the East Dam site by myself.

FORMAL STRATIGRAPHY

Table 1 in Yim (1992a) gives a classification of offshore transported soils in Hong Kong, including their estimated ages. The ages of the Middle Terrestrial and Lower Terrestrial are Second last glacial and pre-Second last glacial respectively. In Fyfe (1992), they were incorrectly shown as Last interglacial and Second last glacial respectively.

The description of sediments shown in Table 8 of Fyfe (1992) is misleading. A range of selected palaeontological, sedimentological, mineralogical, chemical and engineering features (Yim 1992) was used to distinguish between marine and terrestrial deposits.

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Continued

provided movement recurrence intervals for regional faults are shorter than the duration of the current tectonic regime and there is no evidence that the configuration of active faulting is changing, "extinct" faults can be considered to have negligible potential for surface displacement in the near future.

The above concept looks useful and is to be preferred to criteria based simply upon some "arbitrarily-decided", extrinsic time period.

ACKNOWLEDGEMENT

This note is published with the permission of the Director of Civil Engineering, Hong Kong Government.

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WOOD R M & MALLARD D J (1992). When is a fault "extinct"?. Journal of the Geological Society Vol 149 p 251-255

The differences between the pre-Holocene marine and Holocene marine (Upper Marine) are presented in Yim (1992) and Yim & Yu (in press).

The age of the Middle Marine was examined by Yim *et al* (1990) and Yim (1991). It is a gross oversimplification to say that the age of the unit is based on the age of an oyster shell retrieved from Sheung Wan. The following is a list of some of the evidence which is considered to be important:

1 - Numerous finite and infinite radiocarbon dates which are pre-Holocene have been obtained for the unit. Such dates are particularly prone to error (eg, Thom 1973) and are likely to be minimum ages.

2 - Two uranium-series dates of 130,500 ±5,300 years BP and 142,000±20,000 years BP for *Crassostrea gigas* and *Anadara* sp respectively were obtained by Yim *et al* (1990). For the *Crassostrea gigas* sample, two radiocarbon dates by separate laboratories have been obtained using the same specimen. The finite ages of 36,230±680 years BP and 45,700±2,000 years BP obtained were considered to be underestimates of the true age.

3 - Palaeotemperature information indicated by the palynological assemblage is supportive of a Last interglacial age. For example, the presence of *Sonneratia caseolaris*, which in the present day is not found north of the Hainan Island (Muller 1969).

4 - Soil microfabric and porewater chemistry information obtained from marine deposits (Tovey 1986, 1990 & 1992). For example, the Upper Marine may show a honeycomb fabric, while pre-Holocene marine deposits show a distinctive porewater chemistry with enrichment in iron and manganese ions and depletion in sodium, magnesium, chloride and sulphate ions.

5 - There is no evidence to support the high rate of local uplift needed if the finite radiocarbon dates ranging from 21,580±1,210 to 45,700±2,000 years BP are accepted for the Middle Marine. On the other hand, if the Middle Marine is Last interglacial in age, no uplift is needed.

6 - The fit of correlation shown by the stratigraphic sequence of boreholes within Hong Kong. Although some of the units may be missing, this is explained by their non-deposition or erosion.

7 - The greater soil strength of the Middle Marine and Lower Marine in comparison to the Upper Marine. Laboratory tests on borehole samples and in situ cone penetration tests are in support of this.

8 - The fit of the Hong Kong sequence with oxygen-isotope stratigraphy, including a deep-sea core in the South China Sea studied by Wang & Chen (1990).

QUATERNARY STRATIGRAPHY IN CHINA

In China, there is a tendency to overemphasize the validity of finite pre-Holocene radiocarbon dates without the examination of other supporting information. The use of palaeomagnetic excursions, including the Gothenburg (12,350 to 13,750 years BP) and Mungo (35,000 to 40,000 years BP), in verifying the age of borehole sequences by Zhao & Qin (1986) is also not supported by the recognition of these excursions outside China. Therefore, a major dilemma exists as to whether the age of the Middle Marine is Last interstadial (Yim 1988) or Last interglacial.

QUALITY OF BOREHOLE LOGGING

One important point highlighted by Yim (1992a) is the urgent need to improve the quality of borehole logging. It is in this area that Quaternary geologists involved in site investigation have a major role to play. Both seismic and cone penetration test records are complementary to borehole logging and laboratory testing of borehole samples to provide stratigraphic information.

All four are at least equally important for elucidating stratigraphic relationships, and it is often because of the agreement shown by the results of each that the conclusions drawn on the stratigraphic sequence is judged to be valid. However, borehole logging is often of poor quality, due mainly to the widespread practice of using widely spaced disturbed jar samples, usually at one metre intervals.

A good remedial measure is the use of continuous vibrocores (Smyth *et al* 1992), which is low in cost and fast relative to the traditional rotary boring method as a means of obtaining stratigraphic information.

There is a general misconception by civil and geotechnical engineers in the light of the difficulty in obtaining a consensus on the Quaternary stratigraphy of Hong Kong that palaeoenvironmental changes are not helpful in accounting for the engineering properties of offshore soils. It is in this area that Quaternary geologists involved in offshore site investigation should contribute to changing this attitude.

After all, if palaeoenvironmental change does not help to explain seismic and cone penetration test records, borehole logs and laboratory results on engineering properties of soils, there must be something fundamentally wrong with the discipline of Quaternary geology.

FUTURE WORK

The advancement of Quaternary stratigraphy clearly requires better dating control. Dating is essential to test the validity of the stratigraphic sequence established, which may in turn be further tested by correlation with sequences outside Hong Kong. As the Hong Kong representative of the International Geological Correlation Programme Project No 274 'Coastal evolution in the Quaternary', as well as the official member of the West Pacific Subcommission, Commission on Quaternary Shorelines, International Union for Quaternary Research, I am in communication with an international network of researchers who can provide advice.

W W S Yim, Department of Geography & Geology, The University of Hong Kong, Pokfulam Road, HONG KONG

J A Fyfe replies: I welcome the comments made by Yim. These have indeed helped to fulfil my aim of opening up the discussion on the offshore Quaternary stratigraphy of Hong Kong, and I hope that other workers may also wish to contribute to the debate.

INITIAL WORK

Yim's mention of earlier publications (Grace & Henry 1957, Berry 1959, Holt 1962) is certainly of historical interest, as these appear to be the first references to the offshore marine deposits of Hong Kong. I am not aware of the availability of the original borehole records, however, and I believe that the reports mentioned in my paper (Binnie & Partners 1974, Hong Kong Malayan Drillers & Engineers 1974) are probably the earliest offshore borehole records in the public domain. The Geotechnical Engineering Office is currently implementing a comprehensive borehole database for Hong Kong, and if earlier records are available in the private sector, we should certainly be interested to know of their existence.

The work by Ma (1974), Tang (1974) and Yeung (1976) is of particular interest. There is clearly a wealth of geological information contained in undergraduate dissertations held by Hong Kong University and, presumably, by other tertiary education centres. I have had the benefit of using some of these in previous work (Fyfe 1991), and can attest to the high standard of those which I saw. It would be of great benefit to the scientific community in Hong Kong if references to such dissertations could be catalogued in a similar way to those of Geological Society publications, compiled by Langford (1991, 1992).

I apologise for the inaccuracy in suggesting that Yim (1984) had included a date originally published by Kendall (1975). In his paper, he refers to Kendall's (1975) East Dam site age determinations of between 7,920±110 and 6,640±100 years BP, and compares these with his own younger date of 5,980±180 years BP from the West Dam site, which is at a higher elevation.

FORMAL STRATIGRAPHY

I thank Yim for pointing out the error in the text referring to Table 8. Clearly, low-stand terrestrial deposits must be related to glacial rather than interglacial periods. The sentence should have read "..... pushing the Middle Marine back to the last interglacial and the Lower Marine back to the second- last interglacial" (see Erratum in this issue).

If he feels that my description of sediments in Table 8 is inadequate, this criticism should be levelled at many of the other tables too. In an attempt to provide some uniformity in these summaries, I had to leave out information from all workers and, as in this case, to produce descriptions where they were missing. In no way do I fail to recognize the work which goes into such research.

Again, the "gross oversimplification" of the dating of the Middle Marine on the basis of one oyster shell is a facet of attempting to summarize twenty years of work by several researchers in a brief review. However, much of the evidence outlined by Yim in his discussion must be considered as circumstantial; while the overall balance of evidence may suggest a last interglacial age for the Middle Marine, the factual evidence is limited.

Whilst agreeing that radiocarbon finite ages of around 40,000 years are likely to be underestimates of their true ages, I feel that there is some doubt on the uranium series date of *Anadara* sp of 142,000±20,000 years. Even Yim *et al* (1990) state that the inferred age should be viewed with caution because of the small sample weight, the low uranium content and the high value of the $^{234}U/^{238}U$ activity ratio. There is no statistical validity in accepting the age of a suspect sample merely because a specimen whose determination can be trusted lies within one (very broad) standard deviation. For this reason, therefore, I still maintain that the only direct evidence for the age of the Middle Marine is from the *Crassostrea gigas* age determination. It should be noted, however, that even this single determination is very important in that it certainly demonstrates the presence of marine sediments deposited during the last interglacial.

CURRENT AND FUTURE WORK

I would agree that the advancement of Quaternary stratigraphy requires better dating control, but it should be noted that the difficulties in dating Quaternary sequences beyond oxygen isotope level 3 are not confined to Hong Kong. Similar problems arise with seismic stratigraphic mapping (Evans *et al* 1992, Toscano & York 1992), where reflectors identified as low-stand or transgressive horizons may be resolved relatively but allow no means of absolute dating. This dilemma is also found in Hong Kong in resolving the age of the Sham Wat Formation basal unconformity, which represents a low-stand erosion surface.

What is required is a multi-disciplinary approach, and I would reiterate my plea for workers to share their ideas. It is only by pooling thoughts and discussing views that our knowledge of Hong Kong Quaternary stratigraphy will progress. The Newsletter is an ideal vehicle for workers to outline research currently in progress.

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If you have any queries, or would like a membership form for a new member, please write to the Society or phone the Committee.

ANNUAL GENERAL MEETING

The AGM will be held at the beginning of May. A notice will be issued to inform all members of the exact date of the meeting and to ask for committee nominations.

The Society survives because of the efforts of a handful of volunteers. From year to year many of the same faces can be seen on the committee. While continuity is a good thing, it is also a good idea both to spread the load and get in new blood.

Between now and the AGM please decide whether you have the time and energy to help the Society.

BOOK REVIEW

Geology of Yuen Long by **D V Frost**
Hong Kong Geological Survey Sheet Report No.1
Geotechnical Engineering Office, Hong Kong, 1992, 69pp

Oblique aerial view of Yuen Long and Tin Shui Wai in 1987

The Hong Kong Geological Survey recently published the results of studies on the buried marble in the Yuen Long area, Northwest New Territories. The report is the first in a series which will cover important development areas such as Chek Lap Kok (No.2), North Lantau, Tsing Yi, West Lantau, Tolo Harbour and East Kowloon. Copies of the report and maps can be obtained from:

Hong Kong Geological Survey
Geotechnical Engineering Office
11/F Civil Engineering Building
101 Princess Margaret Road
Homantin, Kowloon
HONG KONG

This report specifically relates to the Designated Area, which is the part of the northwest New Territories defined by the Hong Kong Geological Survey in 1987 as possibly underlain by marble.

The geology of the area is depicted on thirteen sheets of the 1:5 000 Geological Map Series HGP5A and HGP5B. This work has greatly enhanced our understanding of Hong Kong's stratigraphy and structure, and is establishing the geological database necessary for the continuing economic development of the Territory. The mapping programme is being undertaken by the Hong Kong Geological Survey, which is a section of the Planning Division of the GEO.

The 1:5 000 scale geological survey of the Designated Area was conducted by Dr D. V. Frost of the British Geological Survey under a consultancy agreement between Hong Kong Government and the Natural Environment Research Council, United Kingdom.

GEOLOGICAL SOCIETY OF HONG KONG PUBLICATIONS

Bulletin No 1 (1984). Geology of surficial deposits in Hong Kong, 177 p.
YIM W W S (Editor)

Bulletin No 2 (1985). Geological aspects of site investigation, 236 p.
McFEAT-SMITH I (Editor)

Bulletin No 3 (1987). The role of geology in urban planning, 601 p.
WHITESIDE P G D (Editor)

Bulletin No 4 (1990). Karst geology in Hong Kong, 239 p.
LANGFORD R L, HANSEN A & SHAW R (Editors)

Marine geology of Hong Kong and the Pearl River mouth (1985), 96 p.
WHITESIDE P G D & ARTHURTON R S (Editors)

Marine sand and gravel resources of Hong Kong (1988), 221 p.
WHITESIDE P G D & WRAGGE-MORLEY N (Editors)

Abstracts No 1 (1983). Abstracts of papers presented at the meeting on ''Geology of surficial deposits'', September 1983, 79 p

Abstracts No 2 (1984). Abstracts of papers presented at the conference on ''Geological aspects of site investigation'', December 1984, 50 p

Abstracts No 3 (1986). Abstracts of papers presented a meeting on ''Sea-level changes in Hong Kong during the last 40 000 years'', May 1986, 51 p

Abstracts No 4 (1986). Abstracts of papers presented at the conference on ''The role of geology in urban development'', December 1986, 65 p

Abstracts No 5 (1988). Abstracts/Extended Abstracts of six papers presented at a meeting on ''Future sea-level rise and coastal development'', April 1988, 79 p

Abstracts No 6 (1990). Abstracts of papers presented at the conference on ''Karst geology in Hong Kong'', January 1990, 58 p

Abstracts No 7 (1991). Abstracts of papers presented at the international conference on ''Seismicity in Eastern Asia'', October 1991, 63 p

Abstracts No 8 (1992). The logging and interpretation of transported soils in offshore boreholes. Proceedings of a workshop organized by the Geological Society of Hong Kong and the University of Hong Kong, June 1992, 78 p

Newsletter

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Cover photograph: Potala Palace behind prayer flags. The Palace is built on a silty limestone inter-arc deposit. The hills beyond are formed of Gangdise granitoid from the root of the volcanic arc.

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