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ERRATUM

In the Geological Society of Hong Kong Newsletter Vol. 11, No. 1-2 (1993), the report on the Heng Gang field trip on page 16 was incorrectly attributed to M. Atherton. The author was K. Nicholls.

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EDITORIAL

In this issue is a rather interesting debate on C L Chan's hypothesis that Victoria Harbour is an impact crater. With C L Chan's permission we have reprinted his 1993 paper and invited two response papers, one from the Geological Survey and another from Hong Kong University. The Editor would like to thank C L Chan for his cooperation, both in permitting this debate and in providing the original materials.

Not quite so controversial, but nevertheless of interest, is an article submitted by I Chan on the engineering geology of Ap Lei Chau. In this issue R Shaw also reminds us that the Society actually has a library(!) which has now been integrated into the Civil Engineering Library of the Civil Engineering Department. These holdings, as indeed the broader collection of the CEL are available for perusal to members of the Society.

HONG KONG IS AN IMPACT CRATER: GEOMORPHOLOGICAL AND GEOLOGICAL EVIDENCE

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Reprinted, with minor modifications, from 20th Anniversary Special Issue of the Hong Kong Laboratory Technicians' Association (1993)

ABSTRACT

Hong Kong is a famous city in southern China, 22°19'N, 114°10'E, within which the urban districts of Hong Kong, Kowloon and Victoria Harbour are situated. Hong Kong is surrounded by mountains with a diameter of 11 km. Three million people live inside this basin (Figure 1).

The round structure of the mountains in Hong Kong has been described as a granite dome that is deeply eroded (batholith). In this paper, the circularity of the

mountains, the existence of a central hill, the inner slope of the mountains being greater than the outer slope and depth-to-diameter ratio have been studied. All this evidence shows that the Hong Kong structure satisfies the geomorphological requirement of an impact crater.

Some shock-metamorphic phenomena of rocks in Hong Kong such as planar features, micro-spherulitic silica glass (lechatelierite), fused margins of rock fragments, concussion fractures, impact glass in which some schlierens are consistent with pyroxene spiculites, and

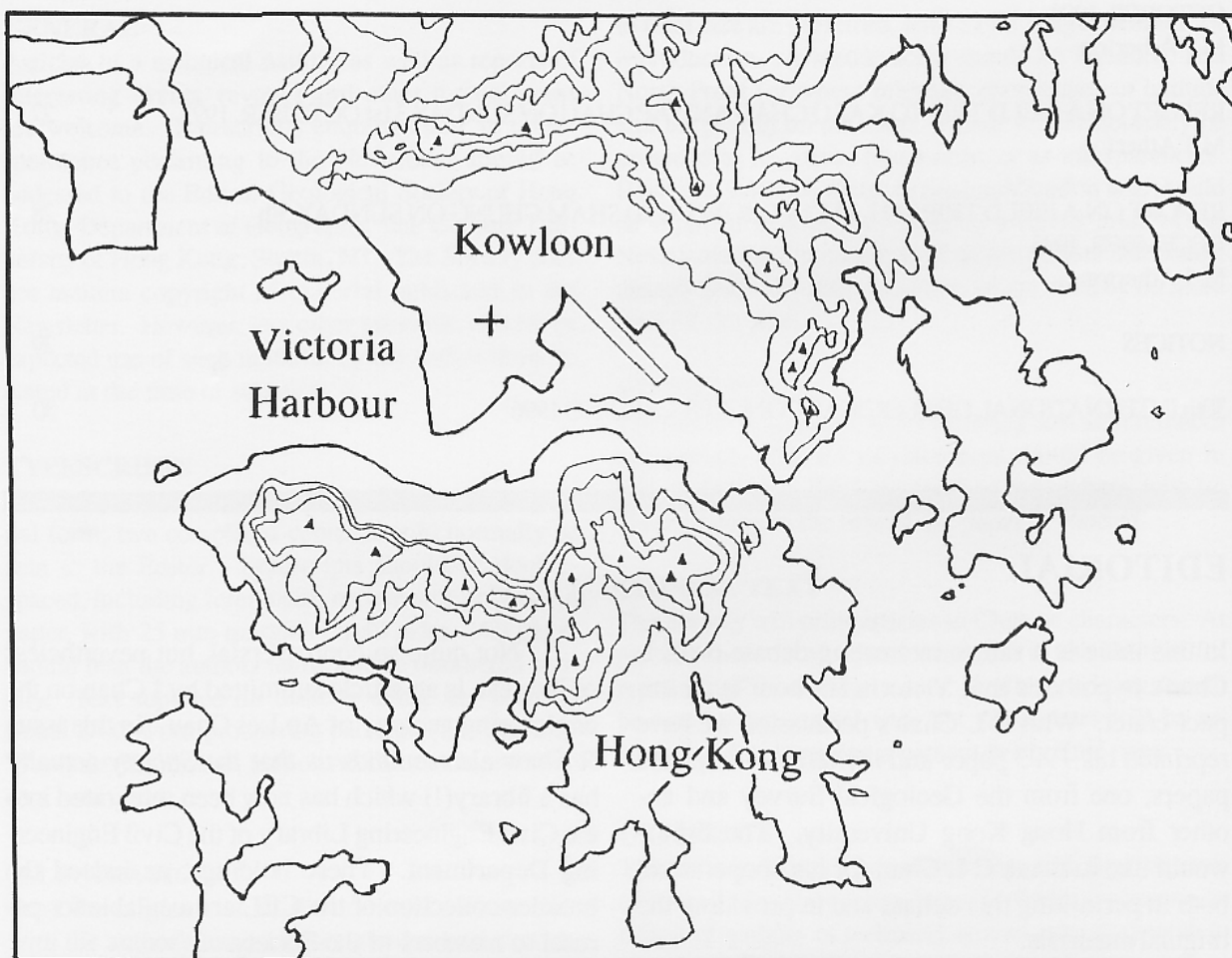


Figure 1 - Circular mountains in Hong Kong. The central hill is denoted with a + mark. The mountains in the northern rim are granites which are 4 km to the central hill. The mountains in the eastern and southern rims are tuff which are 6 km to the central hill.

so on, were first discovered in October 1990. On Hong Kong Island, an impact melt sheet has been observed from the Victoria Peak to the southern shore. Quenching fractures of quartz in Kowloon fine-grained granite have also been discovered.

GEOMORPHOLOGICAL EVIDENCE

Circularity of the mountains

Hong Kong is surrounded by mountains with heights from 200 to 600 m to the north, east and south. In the north, mountains are granite, and are at a distance of 4 km from the central hill. To the east and south, mountains are tuff with a distance of 6 km to the central hill. So, if this circular structure was produced by a meteorite impact, it seems that the same explosion only produced a smaller crater in the granite but a larger crater in the tuff.

In 1970, Murray and Guest investigated a method of calculating the five circularities of impact craters. In 1990 we studied the circularities of mountains in Hong Kong based on the method of Murray and Guest.

We found that the values of four circularities C1, C2, C3, and of the Hong Kong crater are within one standard derivation of the statistical curve of 19 terrestrial craters ($P < 1$). Only C4 is out of the range ($P > 1$), probably because Hong Kong mountains are made of granite or tuff and have two different radii to the central hill. (Table 1). σ is the standard derivation of the statistical curve: $P = -X / \sigma$. If $P < 1$, it means X is within one standard derivation, otherwise it is outside of one standard derivation.

Existence of a central hill

Terrestrial craters greater than 3 km always have a central hill. The Hong Kong crater also has some kind of central hill. In Kowloon, there is an ear-ring like granite hill which is about 1 km in diameter, and 100 m in height (Figure 2).

Inner slope is deeper

Hong Kong mountains also have the property that the inner slope is greater than the outer slope. The geology book in Hong Kong says that: the deeper southern slope of mountains in Kowloon (northern rim) were caused by the erosion of typhoon and monsoon rains from the south. But we found that this hypothesis cannot apply to the mountains in Hong Kong (southern rim), because they have a deeper slope facing the north (see Figure 1).

Depth-to-diameter ratio

The depth-to-diameter relation of other terrestrial craters (McCall, 1977) and the Hong Kong crater were

Table 1 - Circularities of Hong Kong crater compared with 19 terrestrial craters. C1 to C4 are four different circularities. $\bar{C}$ is the average of C1 to C4.

Type of Crater	Circularities				
	C1	C2	C3	C4	$\bar{C}$
Hong Kong Crater X	1.73	1.15	1.06	1.19	1.28
19 Terrestrial Craters (Mean)	1.56	1.12	1.05	1.10	1.20

plotted on a graph. The Hong Kong crater is lined up with six larger and deeper terrestrial craters (Figure 3).

GEOLOGICAL EVIDENCE

Rocks collected from the central hill, eastern rim and southern rim were sectioned and inspected.

Shock-metamorphis phenomena.

Photomicrographs are shown as Plates 1 to 6. In Hong Kong and Kowloon, we have found an unusual type of rock that is regarded as an impact melt. The characteristics of the impact melt show:

1. The mineralogical composition of pseudophenocryst consists of refractory minerals (quartz and feldspars) and is lacking mafic mineral phenocrysts (biotite, hornblende). By this property the kind of impact melt can be easily distinguished from lava.
2. In the impact melt, some rock fragments have fused margins (crystallization front) whose forming temperature is more than 1400°C.
3. In the rock, there are microspherulitic silica glasses (lechatelierite) whose forming temperature is more than 1740°C.

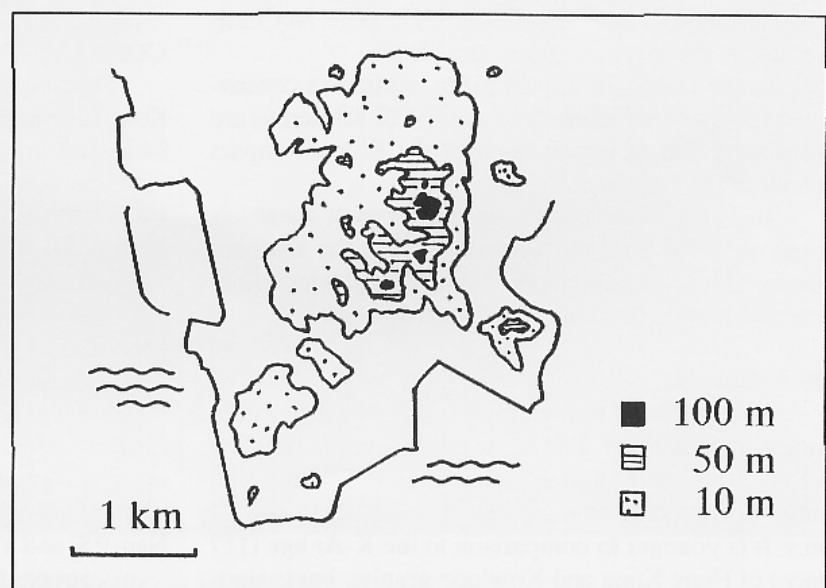


Figure 2 - Central hill at Kowloon

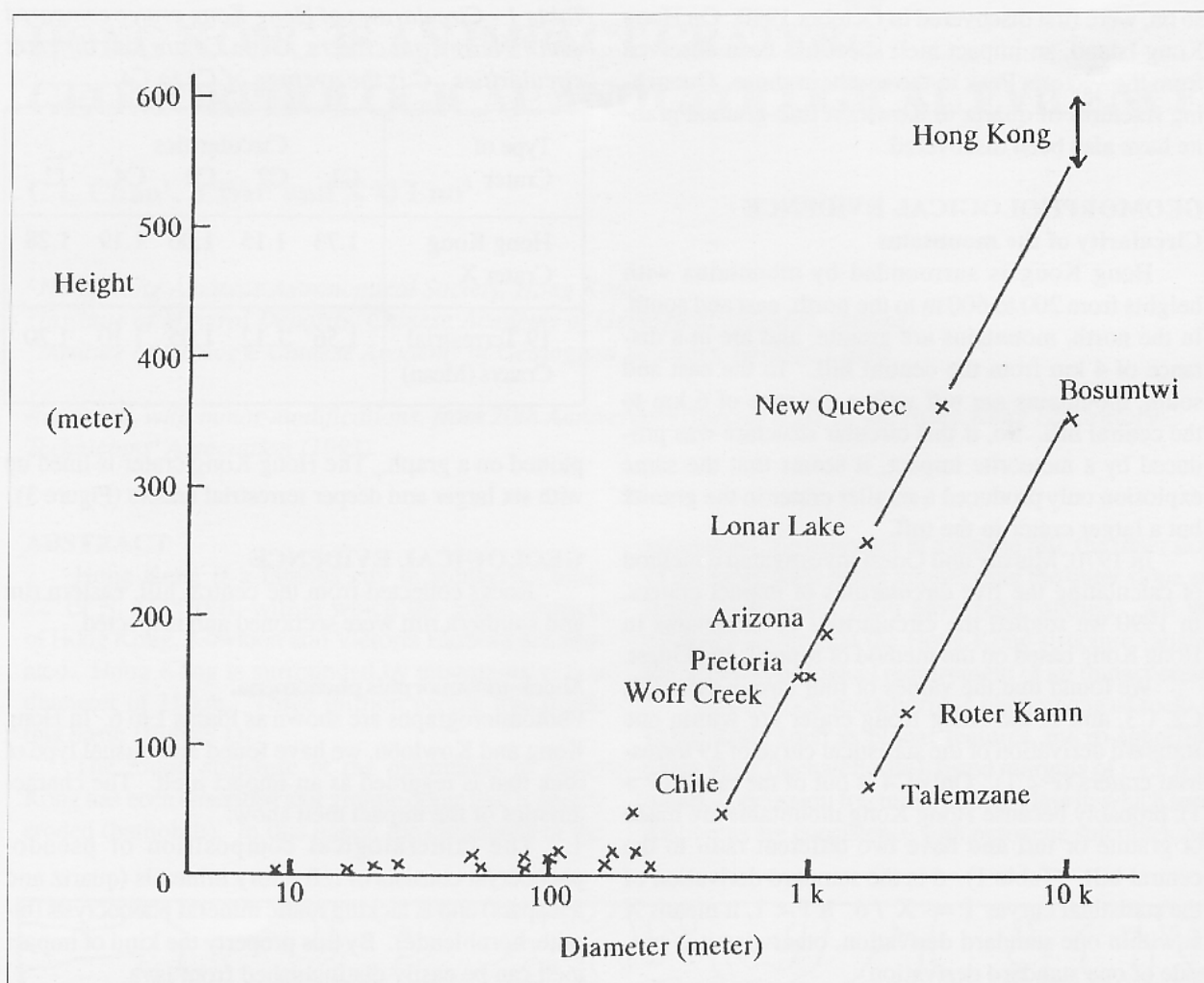


Figure 3 - Depth-to-diameter relation of terrestrial craters. The height of the highest mountain in Hong Kong is 603 m, and the second one is 554 m.

4. Planar features and concussion fracture of quartz have been observed in the rock. The concussion fracture between two quartz grains is similar to that of a meteor impact crater (Kieffer, 1971). The fact indicates that those quartz grains are clasts.

5. In the matrix of impact glass, schlierens consisting of pyroxen spiculites are found. The schlierens are similar to that of impact melt of the Boltysh impact crater in the Ukraine.

In Hong Kong Island, an impact melt sheet has been observed from the Victoria Peak to the southern shore. Quenching fractures of quartz in Kowloon fine-grained granite have been discovered.

K-Ar dating

Two pieces of impact melt rock from the eastern rim were examined. The K-Ar age of sample HK42 is 91.06 ± 1.32 m.y., and sample HK45 is 84.34 ± 1.26 m.y. The average of K-Ar age of impact melt is 87.7 m.y. It is younger in comparison to the K-Ar age (117 m.y.) of Hong Kong and Kowloon granite, but is similar to fission track age (88.6 m.y.) of Zircons in granite of the northern rim (Nau and Yim, 1988). This phe-

nomenon indicates that after the granite body formed, there was another geologic event. Maybe this was the Hong Kong impact cratering event.

CONCLUSION

From our preliminary work, we conclude that Hong Kong is an impact crater. The event happened between 84 and 91 m.y. ago.

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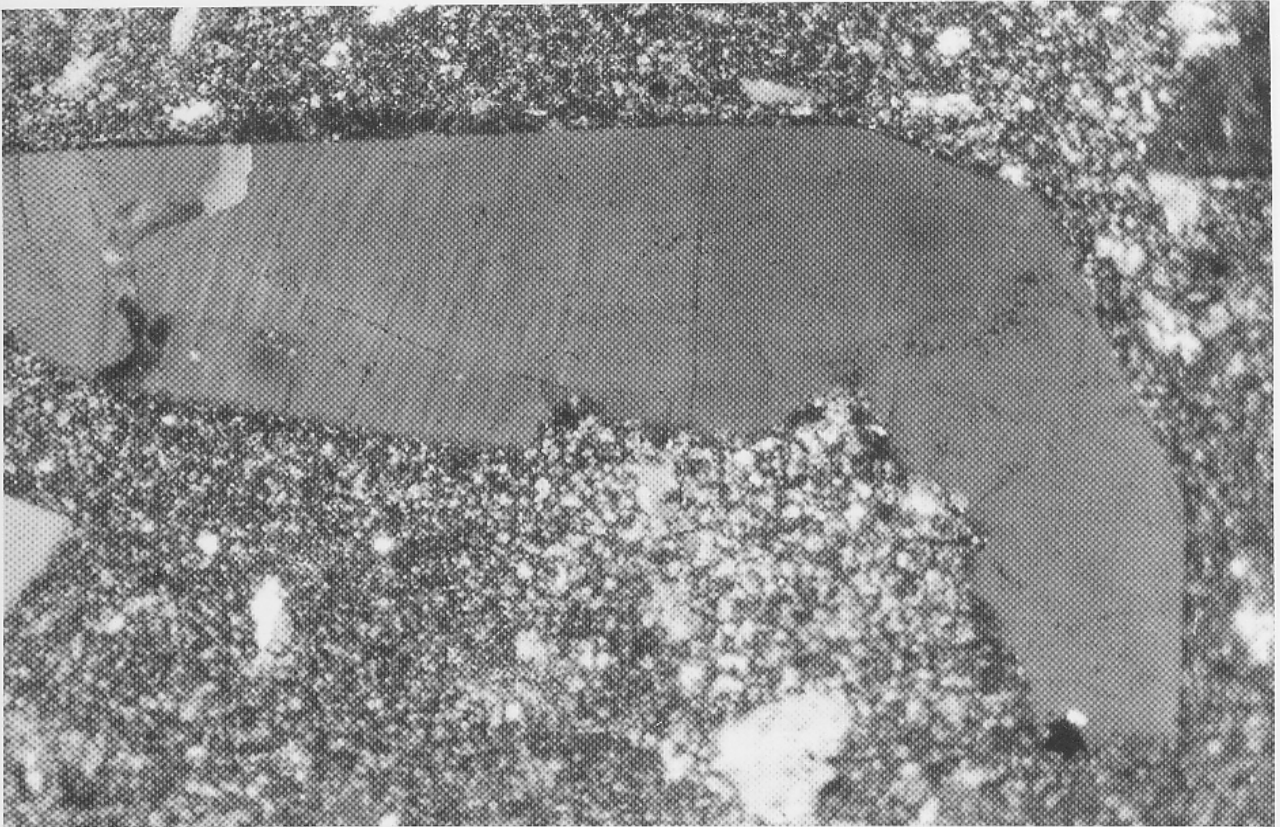


Plate 1 - Planar feature in quartz from impact melt.

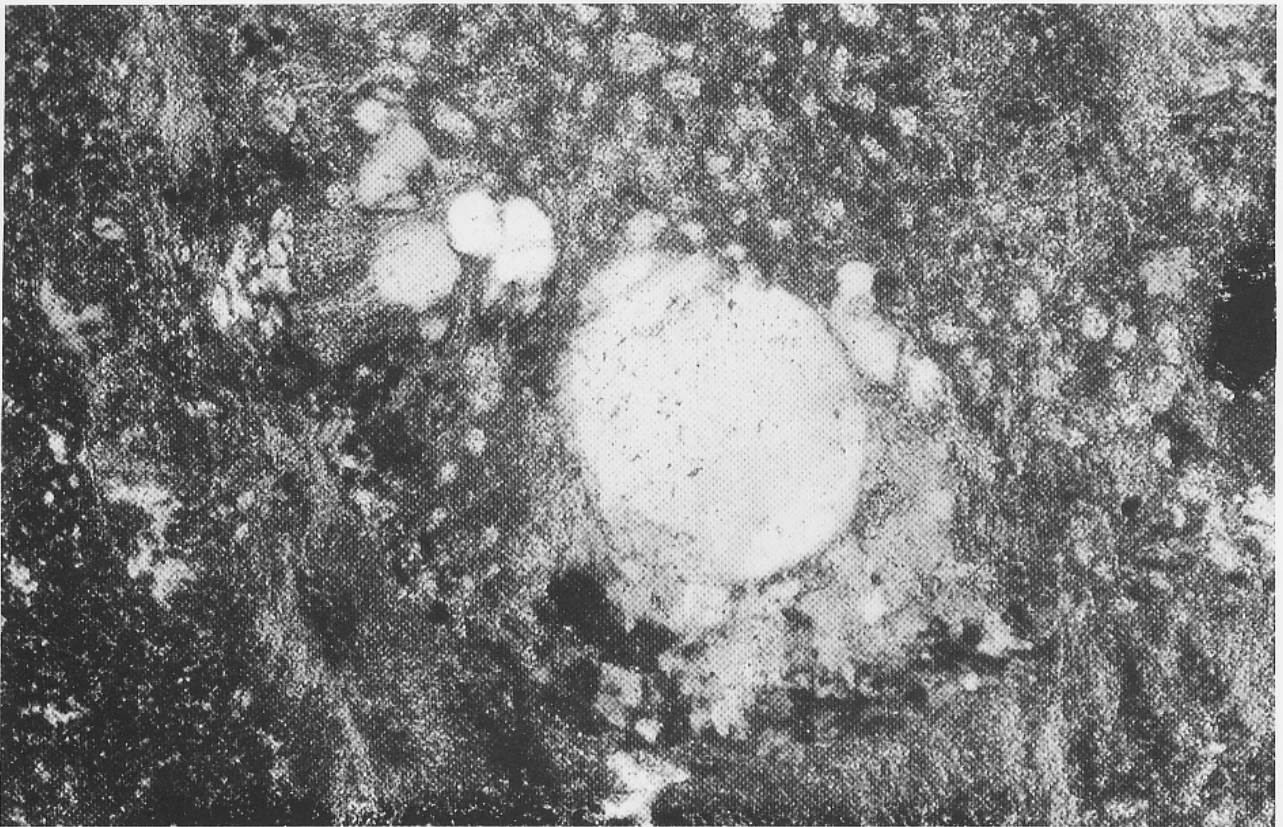


Plate 2 - Microspherulitic silica glass (lechatelierite) in impact melt.

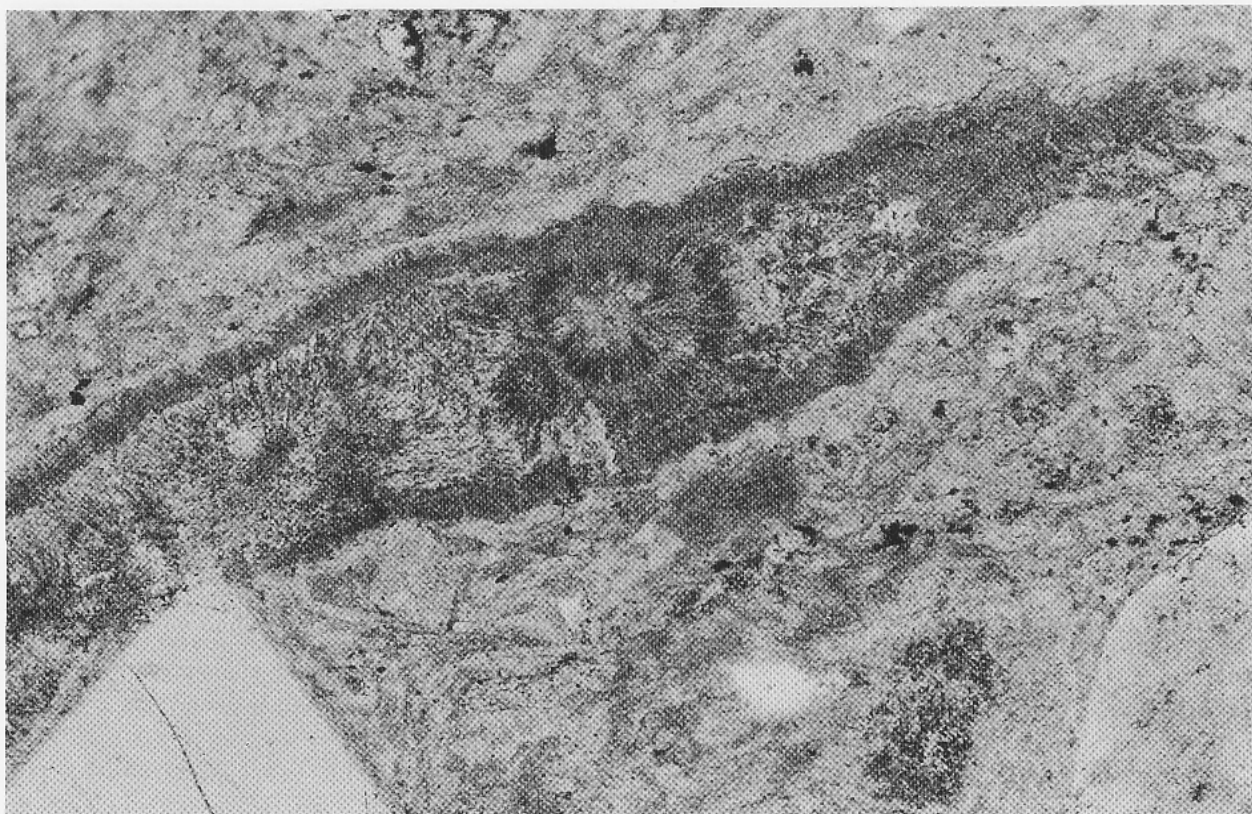


Plate 3 - Fused margin of rock fragment in impact melt.

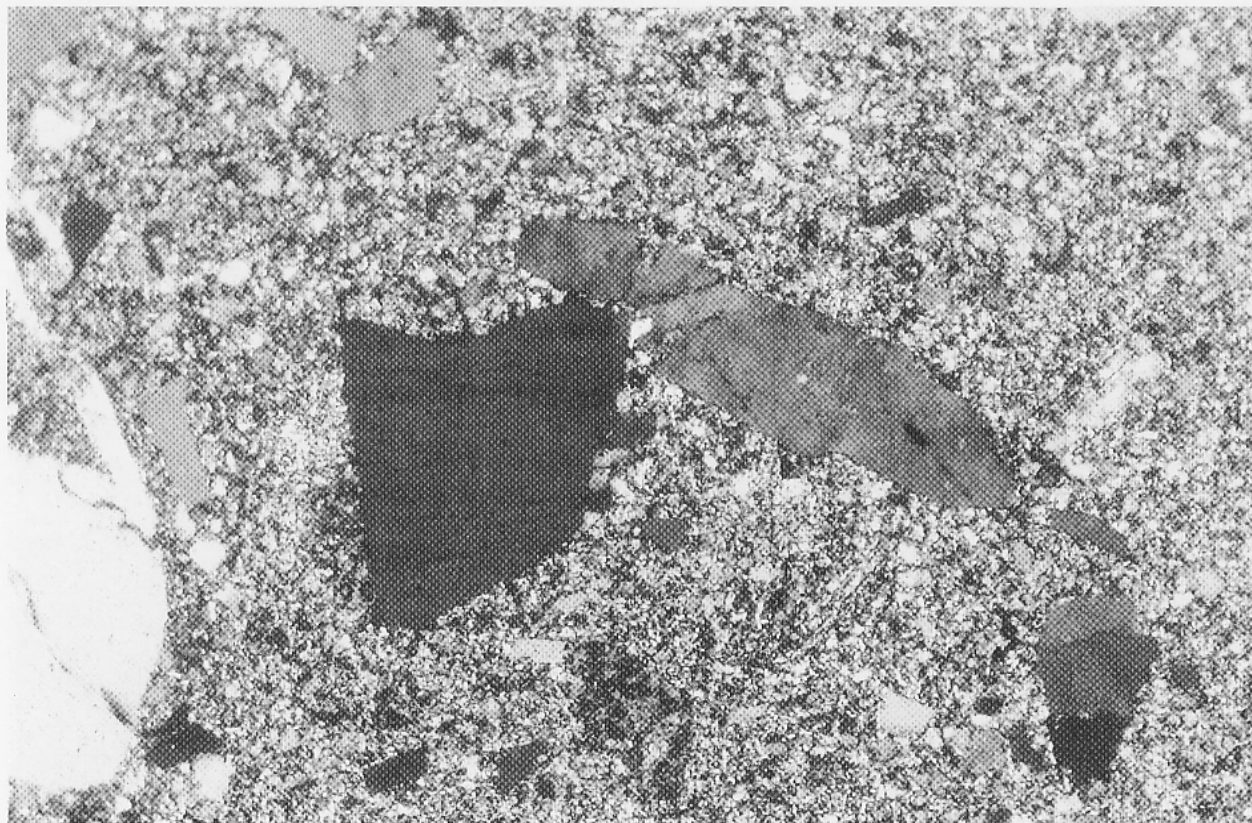


Plate 4 - Concussion fracture between two quartz grains in impact melt.

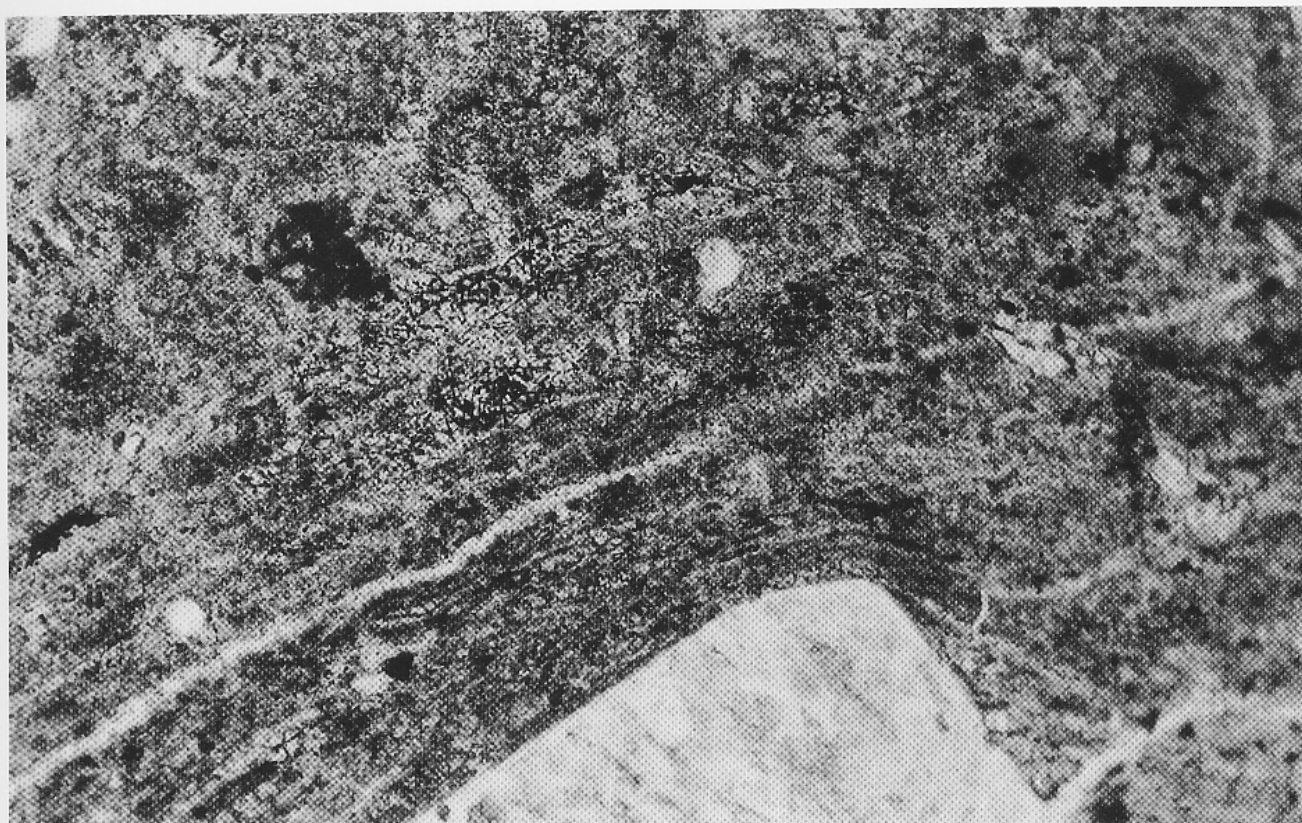


Plate 5 - Schlierens consisting of pyroxene spiculites in impact glass.

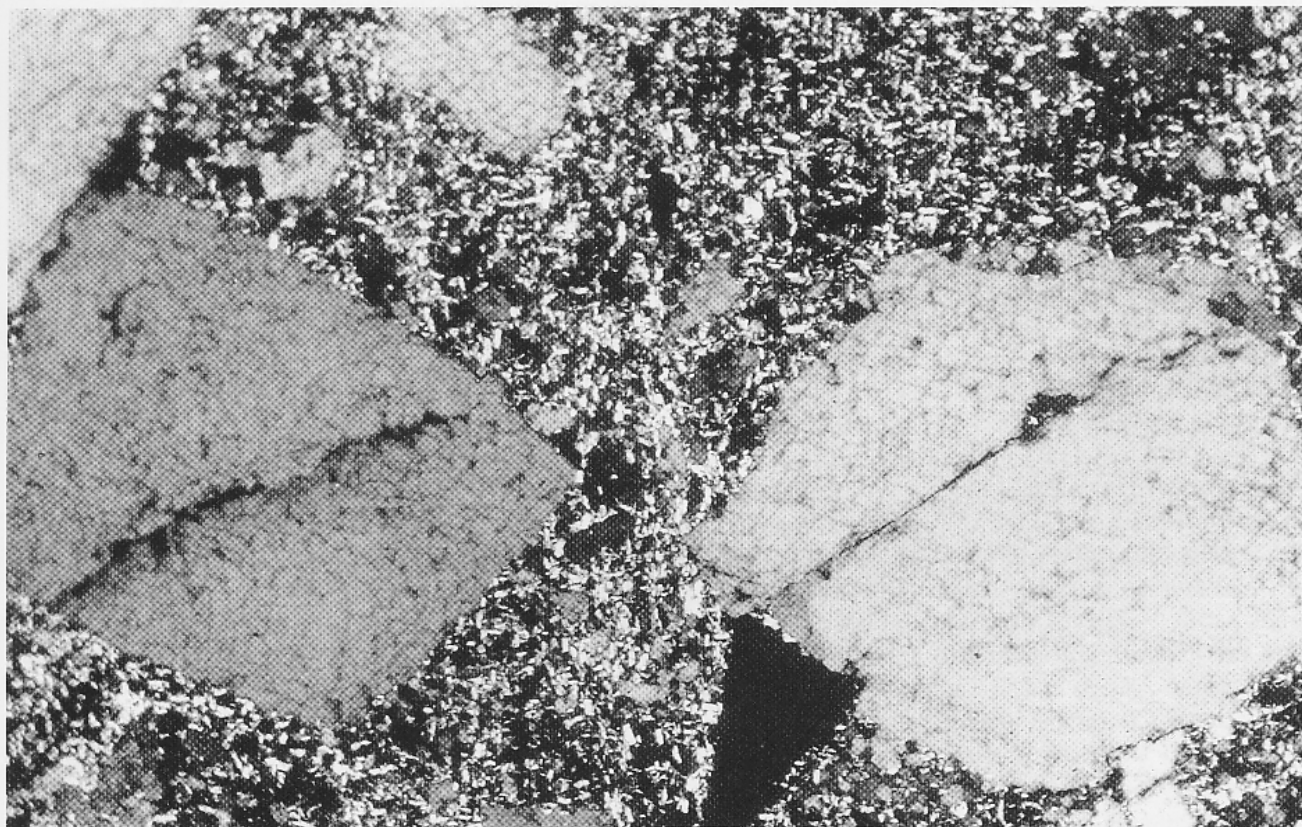


Plate 6 - Quenching fracture of quartz in Kowloon fine-grained granite.

IS VICTORIA HARBOUR IN HONG KONG AN IMPACT CRATER?

W W-S YIM

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ABSTRACT

Some of the positive and negative evidence for an impact crater origin for the Victoria Harbour basin is examined briefly. Amongst the strongest positive evidence not previously pointed out is the fact that the younger granitoid rocks intruded into the older volcanics was eroded to a depth of over 40 metres below the sea level within the harbour. Since the highest topographic features in the present day are in the older volcanics, erosion rates are thought to be slow and an impact crater origin may be helpful to account for the present morphology of the Victoria Harbour basin.

INTRODUCTION

The area surrounding Victoria Harbour was first referred to as the Hong Kong Harbour basin in a paper by Berry and Ruxton (1960). In the present paper, Victoria Harbour basin is adopted because it is better accepted.

In January 1990, Mr. Chan Chu-lok of the Hong Kong Astronomical Society first put forward his suggestion to the Hong Kong news media that the Victoria Harbour basin has an impact crater origin. Although Mr. Chan has no previous training in geology, his interest in extra-terrestrial impact craters as an amateur astronomer led him to pursue a joint investigation with Professor Wu Sibei, an igneous petrologist at the Chinese Academy of Geological Sciences who has worked on the Duolun, Longboushe and Shanghewan impact craters in China. In 1991, Professor Wu was invited to visit Hong Kong where he made a joint presentation with Mr. Chan entitled 'Evidence for an impact crater origin of the Victoria Harbour basin' to the Geological Society of Hong Kong at the University of Hong Kong. This was the first opportunity for Professor Wu to carry out field studies in Hong Kong. In August 1992, a paper entitled 'Hong Kong is an impact crater: proof from the geomorphological and geological evidence' by C L Chan, S Wu and X Luo was presented at the International Conference on Large Meteorite Impacts and Planetary Evolution in Sudbury, Canada (Chan et al. 1992).

Because of my interest in landscape evolution in Hong Kong, I have kept in touch with Mr. Chan on the development of the hypothesis. This paper is a short account of my personal views focusing mainly on whether the hypothesis provides a satisfactory explanation for the present day morphological features of

the Victoria Harbour basin.

POSITIVE EVIDENCE

The Victoria Harbour basin was described by Berry and Ruxton (1960) as being formed from the drowned denuded centre of a granite cupola. These authors recognised that the surrounding hills on the mainland and on Hong Kong Island are partly capped by more resistant volcanic rocks and steep scarp-like concave slopes lead to the inner harbour. However, based on these observations, there is a relief inversion problem. Why is the less resistant granitoid rocks eroded to a depth of over 40 metres below the sea level in Victoria Harbour (Hong Kong Geological Survey, 1986). The granitoid rocks must have been concealed by more resistant volcanic rocks during some stages in the past. So, why were the volcanic rocks eroded away in Victoria Harbour to expose the granitoid rocks at such a deep level?

At the present day, both the highest topographic features on the mainland and on Hong Kong island, Tai Mo Shan and Victoria Peak respectively, are in older volcanics. Tai Mo Shan shows a radial drainage pattern which may have been inherited from an old volcanic centre. Based on the dominance of high ground formed by the older volcanics and the preservation of the radial drainage pattern, erosion rates are thought to be slow with the major topographic features traceable to a Mesozoic origin. The present day south facing slope of Lion Rock and the north facing slope of Victoria Peak both have a rock face and a debris slope. Little significant slope processes can be seen to operate in the present day except when the slopes were interfered with by man such as through the removal of natural vegetation and/or cutting of the hillslopes for construction. Because of the steep gradient of the slopes and the absence of active processes, the scarp face must be a relic feature. The slopes are effectively escarpments formed by a mechanism of parallel retreat (Ollier, 1991). However, with an impact crater origin it may be easier to account for the escarpments on both sides of the Victoria Harbour basin.

The existence of a central hill is often used as evidence for an impact crater origin. Chan et al. (1992) identified the central hill to be located at Homantin Hill. However, because the present hill has been severely altered by man through the cutting and removal

of soil for construction, it is difficult to determine the original morphology of the hill. Since the word 'Kowloon' refers to the existence of nine hills, it may be important to determine the original pattern of hills in the vicinity. How far they represent the form of a central hill is impossible to ascertain now because of the extensive interference by man. It is nevertheless possible that a central hill covered a larger area than what is suggested by the present Homantin Hill.

Glass was discovered at a depth of 12.1 to 12.3 metres below ground level in a borehole at site 11 of the Mid-levels study (Ruxton, 1987). The existence of glass may be linked to the impact event (B P Ruxton, personal communication).

The circularity of the hills around the Victoria Harbour basin has been used by Chan et al (1992) to support the impact crater hypothesis. An important observation to add is that the Lion Rock hills like Victoria Harbour are also composed of granitoid rocks. Therefore the granitoid rocks form a part of the northern crater rim. Because of this, the impact crater event should postdate the age of the granitoid rocks on Lion Rock. It is possible that the fine-grained granite in the Homantin Hill and King's Park area (see Hong Kong Geological Survey, 1986) are younger and represented the centre of the impact.

NEGATIVE EVIDENCE

The most important negative evidence stems from the fact that virtually all of the petrographical evidence found to date may be accounted for both by a volcanic origin and by an impact crater origin. Unless the evidence can be resolved and shown without doubt to be related to the impact event only, it will give rise to uncertainty and controversy.

CONCLUSIONS AND FUTURE INVESTIGATIONS

In this short account, I have attempted to present some of the positive and negative evidence for an impact crater origin of the Victoria Harbour basin in order to encourage discussion. The morphological evidence which may be used to support an impact origin includes relief inversion, the existence of a central hill and circularity. Future investigation should provide more convincing evidence including the presence of

coesite, stishovite, lamellar quartz and breccia, in addition to age. In closing it is worth pointing out that without controversy geology is boring. Until somebody comes up with a convincing alternative explanation for the present day morphological features shown by the Victoria Harbour basin, I believe an impact crater origin would help. Further research work on the origin of the Victoria Harbour basin should be encouraged rather than discouraged.

ACKNOWLEDGEMENTS

I am grateful to Bryan Ruxton for discussion on the subject and to David Workman for his comments on an early draft of this paper.

FOOTNOTE

Another possible impact crater indicated by the presence of breccia beds devoid of matrix may exist north of Crooked Harbour in Mirs Bay. This is an alternative explanation to the drowned volcanic crater origin reported in Heim (1929).

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SEISMICITY IN EASTERN ASIA, Geological Society of Hong Kong Bulletin No.5

The proceedings of the International Conference on Seismicity in Eastern Asia, held at the Hong Kong Polytechnic 23-26 October, 1991, will shortly be available. To assist us in determining the size of the print run, we would appreciate orders for the Bulletin being sent to:

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VICTORIA HARBOUR AND THE SURROUNDING AREA OF HONG KONG: A GRANITE BATHOLITH, NOT AN IMPACT CRATER

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INTRODUCTION

A paper presented at an International Conference on Large Meteorite Impacts and Planetary Evolution in 1992 by Chan, Wu and Luo (1992) proposed that the geomorphological features of the urban districts of Hong Kong and Kowloon, bordering Victoria Harbour, are consistent with features of a meteorite impact crater. The authors also gave other geological and petrological evidence in support of this model. Since publication of the account, the Hong Kong Geological Survey of the Hong Kong Government's Geotechnical Engineering Office has received and responded to a number of related enquiries, from both within Hong Kong and overseas. We are also aware that the theory has been quoted as a proven model at formal scientific gatherings, including at least one international conference. The Hong Kong Geological Survey has conducted a programme of detailed mapping and interpretation of the geology of the territory over the last twelve years, has collected and examined over 11,500 rock specimens, studied more than 6000 of these petrographically in thin sections and obtained a large amount of supporting geochemical and geochronological data. At no time has any evidence been found to suggest meteorite impact in Hong Kong, and we feel that it is appropriate to take this opportunity to comment on the model proposed by Chan et al (1992), which is reproduced in this issue.

GEOMORPHOLOGICAL EVIDENCE

The geomorphology of the present day Victoria Harbour area and the surrounding hills of Kowloon and Hong Kong can be explained quite satisfactorily on the basis of the distribution of the volcanic and granitic rocks, their susceptibility to weathering and the subsequent effect of differential erosion. Figures 1 and 2 illustrate the similarity in landform, cited by Chan et al (1992), between a typical impact crater and the local Hong Kong setting. They also illustrate in section the contrast between the underlying geology. Deep weathering is widespread and well-known in Hong Kong, with the granites being more strongly affected than volcanic rocks. The process is thought to have been most active during the Tertiary period but continues to the present day. Differential weathering has led to differential erosion, giving rise to the distinction in the topographical expression between the granites and volcanics.

Chan et al (1992) place some emphasis on the circularity of the hills of Hong Kong and Kowloon, employing the methods of Murray and Guest (1970) to calculate five indexes of circularity, C1, C2, C3, C4 and C, based on measurements of radii or axes. They suggest a high correlation between indexes for Hong Kong with the averages for nineteen terrestrial craters analysed by Murray and Guest (1970). However, in their Table 1, the value of 1.04 given as the average for C1 from Murray and Guest's data, is in error and should be 1.56. This corrected figure is significantly different from Chan et al's C1 for Hong Kong, 1.00. There is also a consequent difference between the corrected C of 1.21 from the Murray and Guest data and Chan et al's 1.10 for Hong Kong. As Murray and Guest (1970) consider C1 to be the most sensitive of the methods used, it seems that there is little basis for citing circularity of the hills of Hong Kong as evidence of meteorite impact.

Other aspects of landform considered by Chan et al (1992) as indicative of an impact crater relate to the existence of a "central" hill, different degrees of slope, and depth to diameter ratios. In making these comparisons, the authors have considered only present-day onshore topography and have ignored the progressive modifications evolved during the Tertiary and Quaternary periods by weathering and extensive removal of weathered rock by erosion, transport and deposition. If, as is suggested, an impact were to have occurred around 88 Ma, any geomorphological analysis should be based on reconstruction of the obviously very different pre-Tertiary landform.

PETROLOGICAL EVIDENCE

Chan et al (1992) describe several rock samples containing crystal or textural features which they suggest to be usual features associated with impact phenomena. We have examined all six plates in the paper and compared them with specimens and thin sections from the same locations held in the Hong Kong Geological Survey Rock Collection. We conclude that all of the phenomena illustrated by Chan et al are features typical of normal igneous rocks and can be found in many specimens from Hong Kong. With reference to Plates 1 to 6 in Chan et al's paper, we give the following explanations:

Plate 1 - A quartz porphyroclast with embayed margin

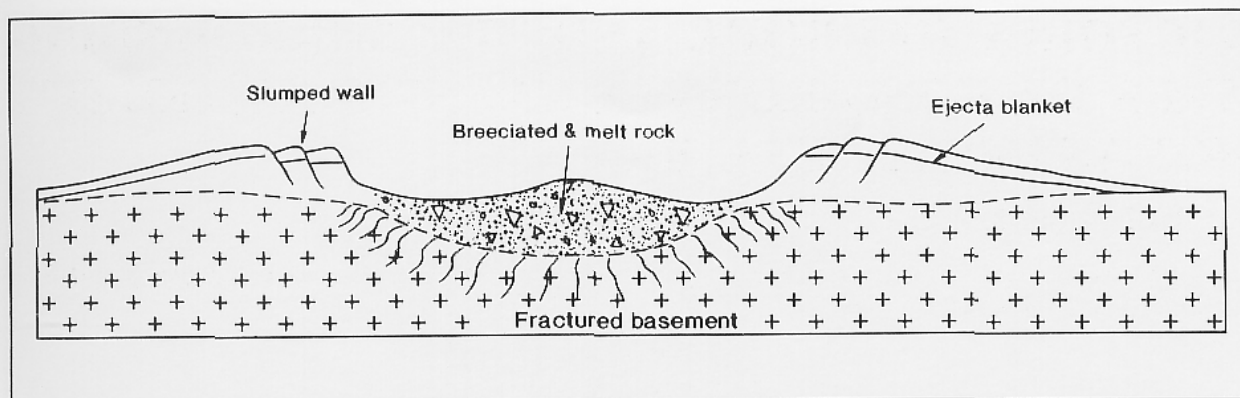


Figure 1 - Sketch section showing the structure of an impact crater

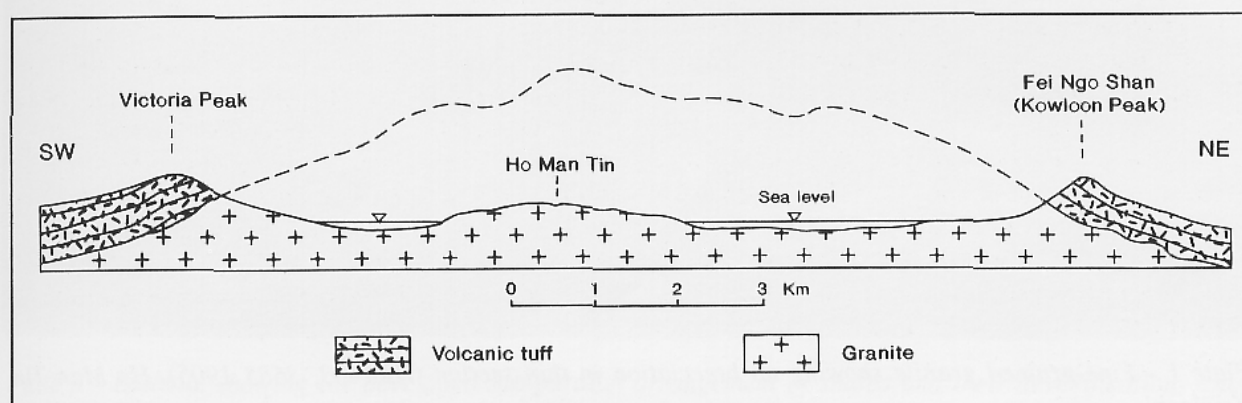


Figure 2 - Sketch section showing the Hong Kong granite batholith

in the fine ash tuff. Mau Wu Tsai, Cheung Kwan O (Junk Bay).

Plate 2 - An amygdaloidal structure in a probable rhyolite lava. Mau Wu Tsai, Cheung Kwan O.

Plate 3 - Typical eutaxite of Ap Lei Chau Formation with devitrified spherulite texture, not a fused margin of the impact melt. Mau Wu Tsai, Cheung Kwan O.

Plate 4 - Quartz mortars in the fine ash tuff. Ap Lei Chau, Hong Kong.

Plate 5 - Typical eutaxite with devitrified texture, not schlierens and no pyroxene. Mau Wu Tsai, Cheung Kwan O.

Plate 6 - Quartz mortars in the groundmass with pilotaxitic texture. The rock is probably welded vitric tuff. Lugard Road of Victoria Peak, Hong Kong.

We have also examined rock samples and thin sections, from a traverse from Fei Ngo Shan (Kowloon Peak), through Kowloon to Victoria Peak and illustrate representative rock types in Plates 1-4. In the centre (Chan et al's "central hill"), the rocks of Ho Man Tin and Kowloon are normal granite (Plates 1 and 2). On either side of the eroded pluton, the overlying rocks are eutaxite and fine ash tuff (Plates 3 and 4).

No brecciated or impact melt fragments or associated phenomena can be found in any of these rock types.

ISOTOPE DATING

Chan et al (1992) cite K-Ar age determinations as evidence of an impact around 88 Ma. Although the K-Ar method can give an indication of age resetting, due to Ar loss, interpretations are often ambiguous due to the susceptibility to modification by even low-temperature processes. The K-Ar age of 117 Ma quoted by Chan et al for supposedly normal Kowloon granite typifies this uncertainty, as the accepted age, established by the Rb-Sr isochron method, is 138 Ma (Sewell et al, 1992).

METAMORPHISM AND MELT PHENOMENA

Meteorite impact events are typically associated with high-strain, shock metamorphism, forming impact melts. Recognition of these melts is typically related to the occurrence of glass included in mixed breccias, which are distinguished from normal volcanic rocks by their heterogeneity, abundant inclusions of shocked country rocks and lack of phenocrysts (Dence, 1971). No evidence of these phenomena has been found in Hong Kong and the volcanic rocks overlying both sides of the granite batholith are normal crystal or vitric tuffs, in which no ejective fragments of granite or any dynamic metamorphic texture can be found. Likewise,

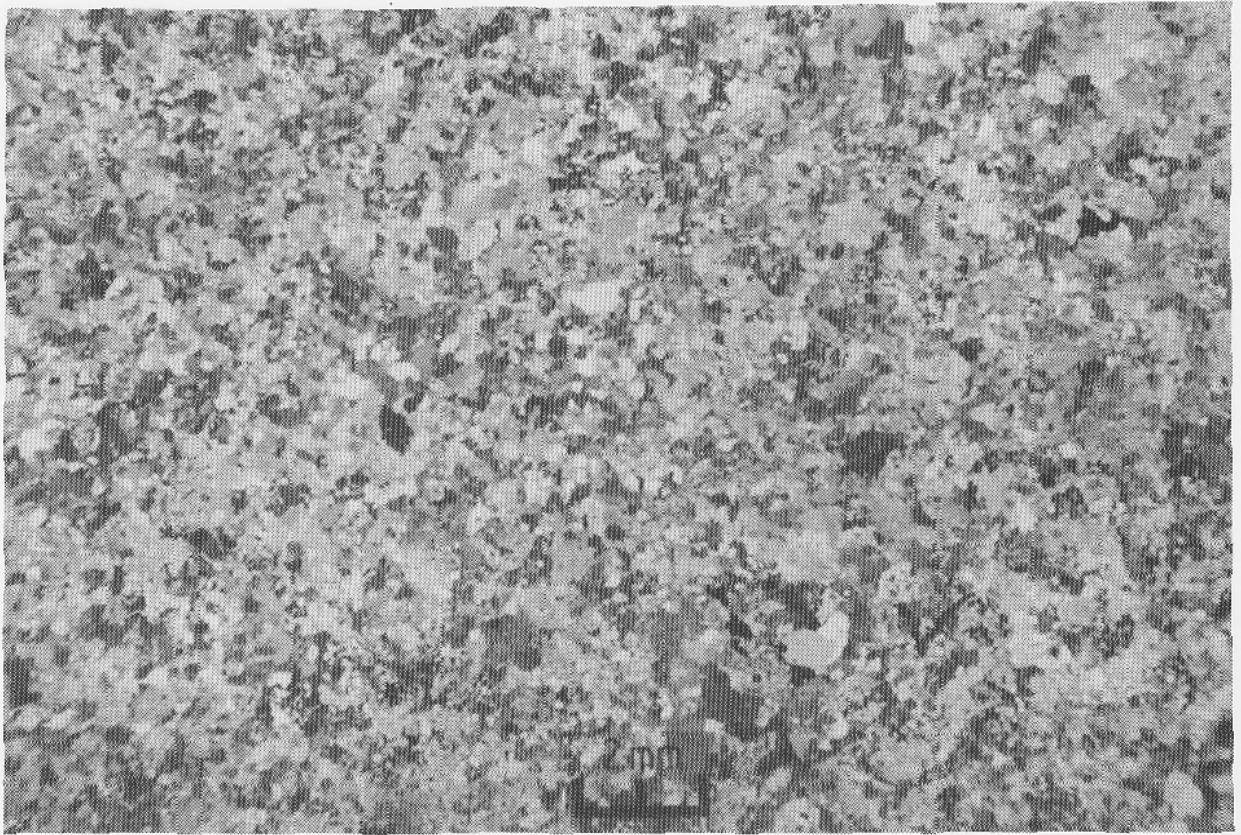


Plate 1 - Fine-grained granite showing no brecciation in thin section (HK1483, 3683 1905), Ho Man Tin, Kowloon

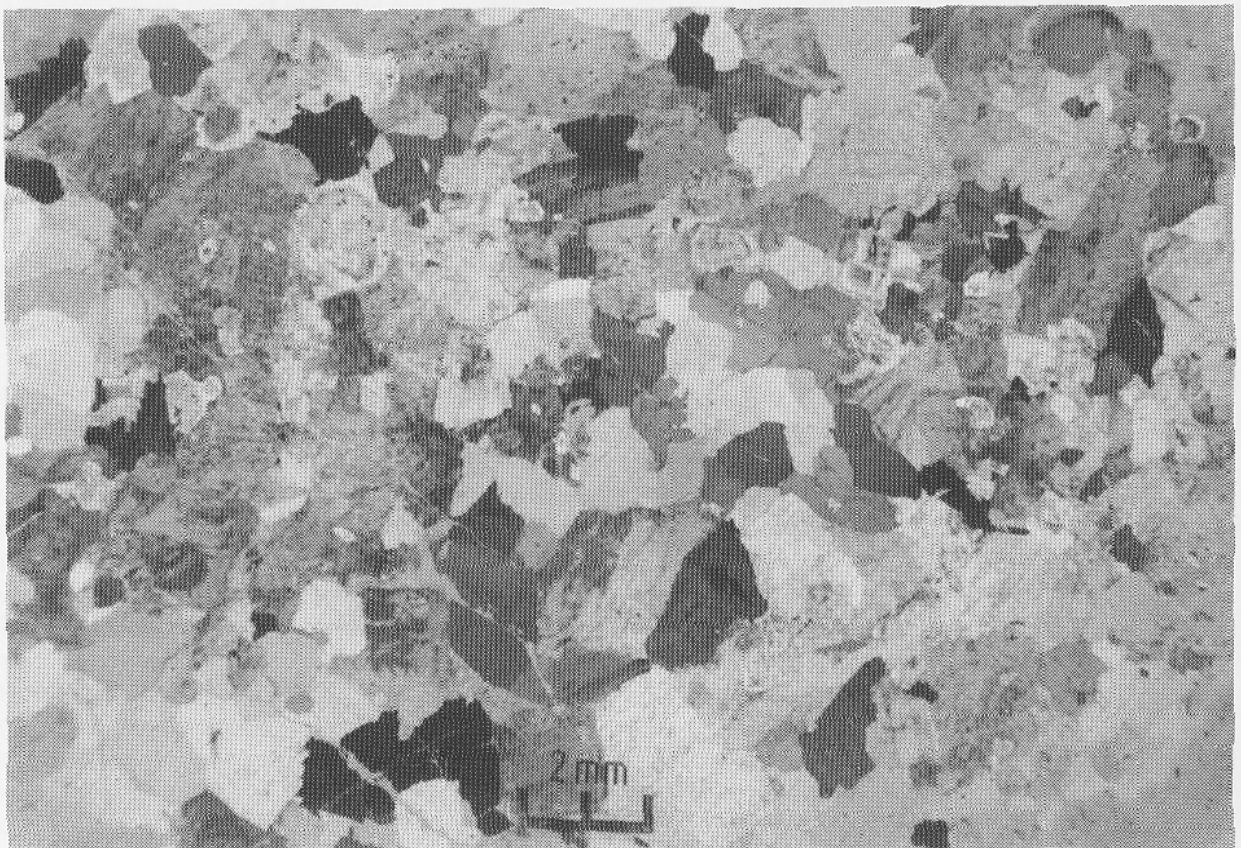


Plate 2 - Medium-grained granite showing no impact melt in thin section (HK 1608, 3760 1882), Hung Hom Estate, Kowloon

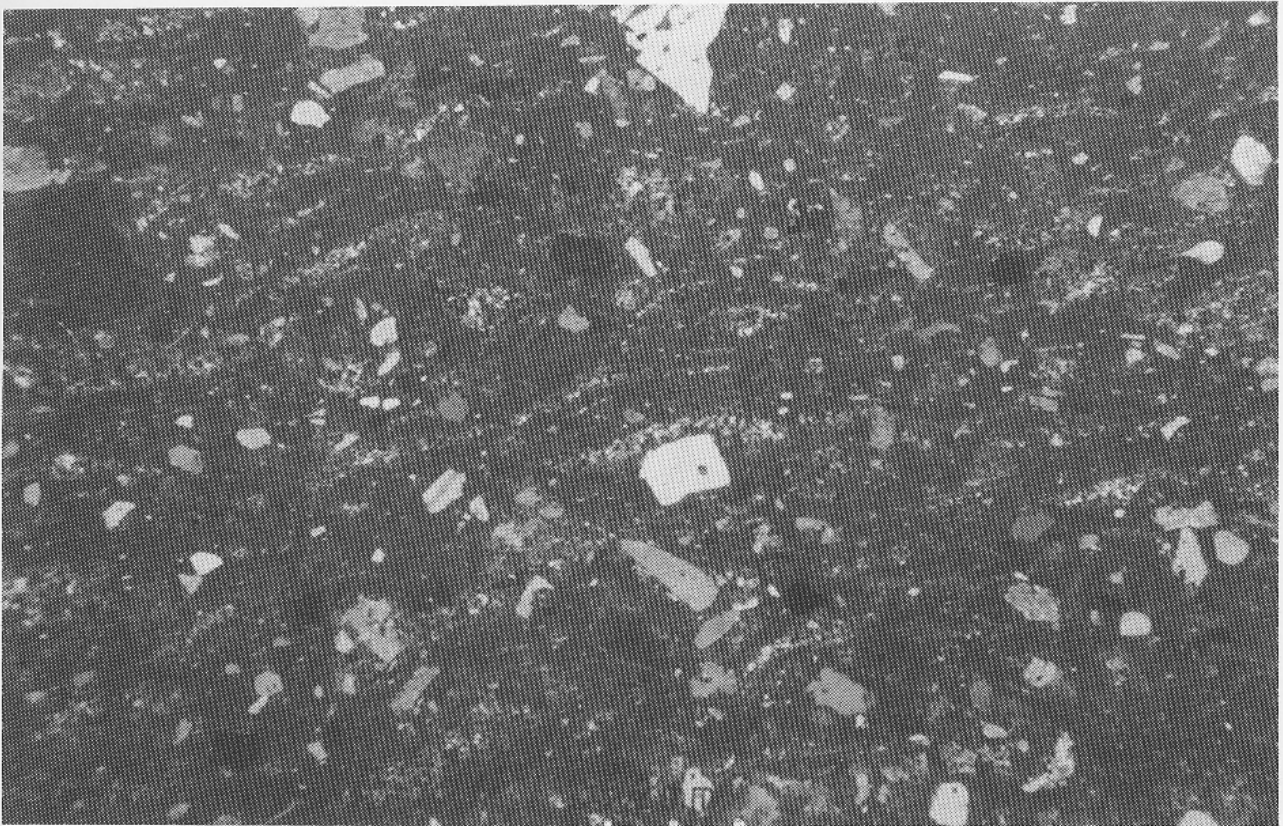


Plate 3 - Eutaxite showing the developed sub-parallel arrangement of shards and their devitrification, not impact melting (HK 1215, 4268 2239). Kwai Au Shan, 1.7 km north of Fei Ngo Shan, Kowloon

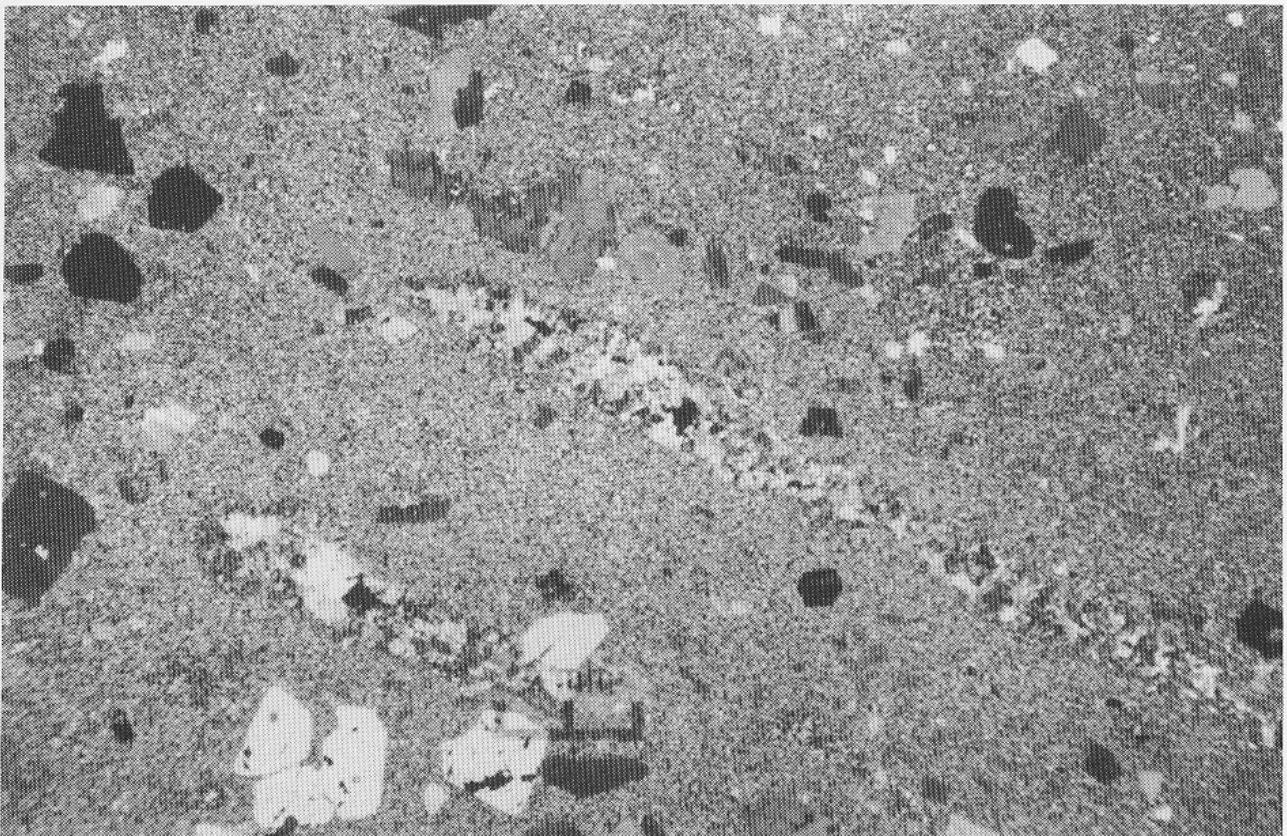


Plate 4 - Fine ash vitric tuff showing the devitrification of two elongated lens, not the fused margin of an impact melt (HK 2230, 3321 1520), Victoria Peak, Hong Kong Island

in the granites the textures are typically holocrystalline and totally lacking in glasses or breccias of different composition, as would be expected in impact melt rocks.

GEOLOGICAL STRUCTURE

Structurally, a large impact crater of 11 km diameter normally has a central hill composed of brecciated and melt rocks overlying fractured basement. On the outer sides of the crater there are ejecta blankets and slumped walls (Figure 1). The ejecta blankets contain melt clasts and inclusions of basement rock. In fact, none of these structural features can be found in Hong Kong. In contrast, as noted earlier the evidence is that a granite batholith occupies the area (Figure 2). The rock is massive and sound in the central Ho Man Tin area and on both sides of the granite pluton, Plates 5 & 6 show granite with widely-spaced joints occurring on the hillslopes of Fei Ngo Shan in Kowloon and Victoria Peak in Hong Kong. The contact between the volcanic tuff and the granite on both sides of the batholith is a normal intrusive contact. No ejecta blankets and slumped walls can be found.

CONCLUSION

On the basis of geomorphology, geological structure, petrology and all related criteria, there is no known evidence to support the theory that a meteorite impact crater exists in the Victoria Harbour, Kowloon and Hong

Kong area.

ACKNOWLEDGEMENT

The authors wish to express their appreciation to Mr. C L Chan for the provision of his photographs and rock sample locations. They also compliment Mr. Chan for the enthusiasm with which he, as an amateur astronomer, has proposed his meteorite impact theory and stimulated much interest and discussion in the geological community. This paper is published with the permission of the Director of Civil Engineering of the Hong Kong Government.

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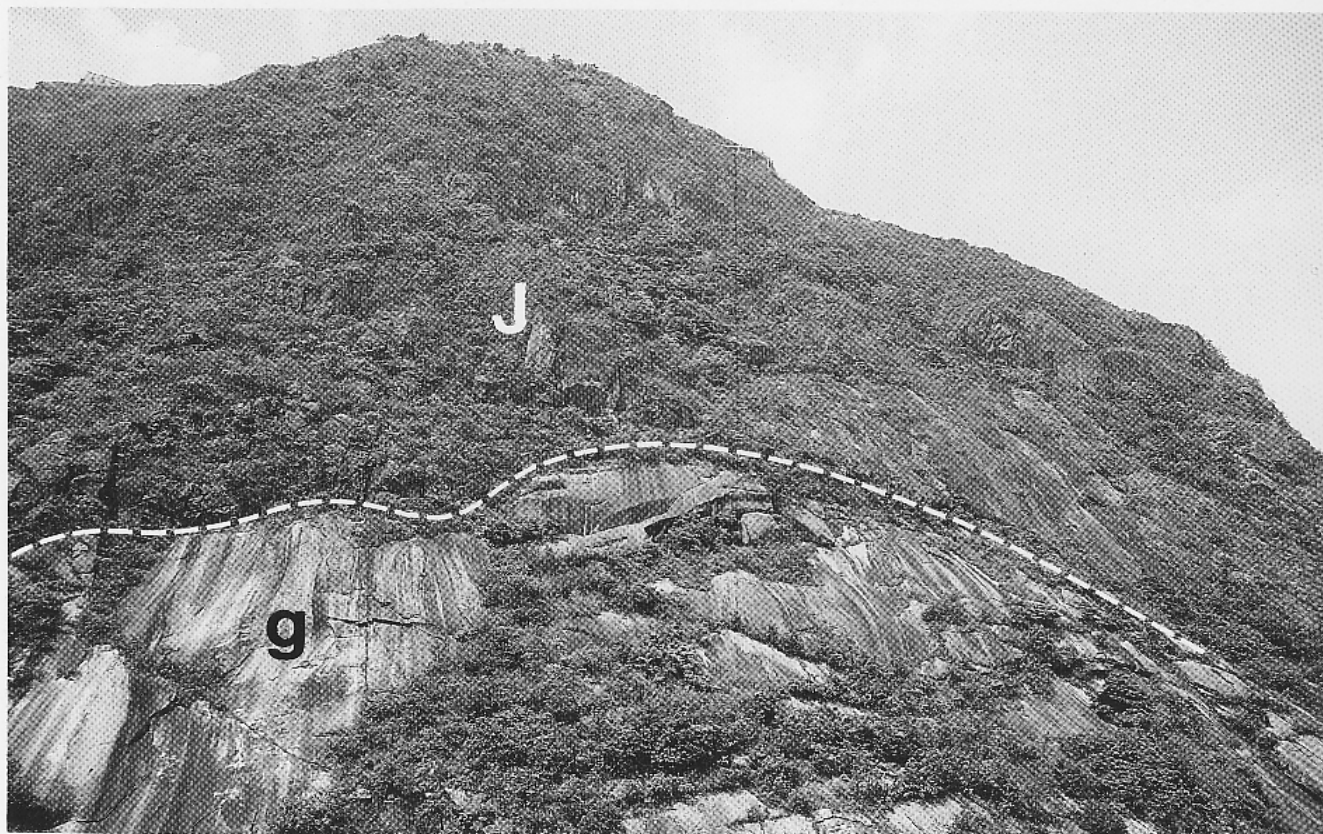


Plate 5 - The contact zone of volcanic tuff (J) and granite (g) on the south side of the granite batholith, the granite showing very widely-spaced joints and no brecciation. Victoria Peak, Hong Kong

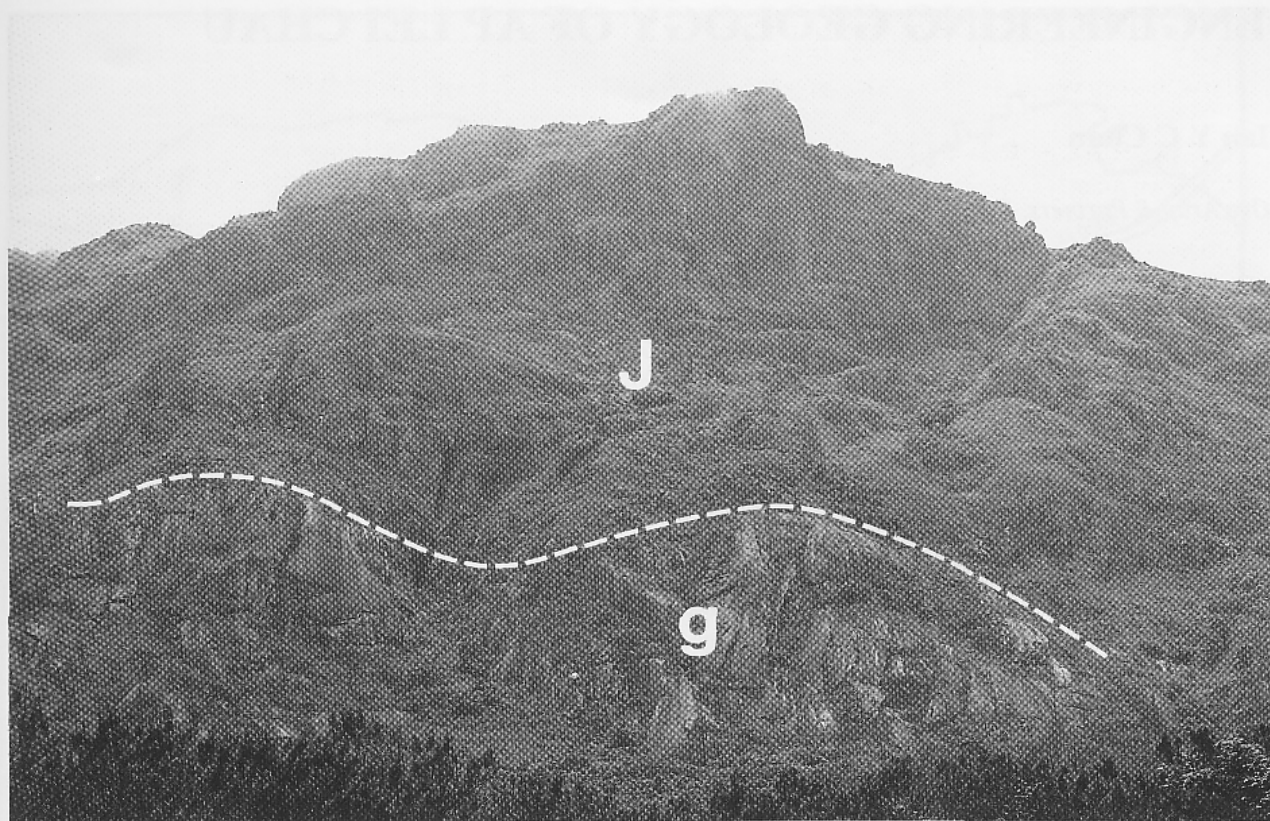


Plate 6 - The contact zone of volcanic tuff (J) and granite (g) on the north side of the granite batholith, the granite showing very widely-spaced joints and no brecciation. Fei Ngo Shan (Kowloon Peak)

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Gas in Marine Sediments (Third International Conference). September 1994. Contact the Secretariat, P.O. Box 59, 1790 AB Den Burg - Texel, The Netherlands.

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ENGINEERING GEOLOGY OF AP LEI CHAU

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ABSTRACT

A study of engineering geology was carried out in a confined area of north west Ap Lei Chau (Figure 1). An engineering geological map together with corresponding sections was produced to present not only the solid geology but also the structural geological aspects and to pinpoint the potential hazards of the area.

The majority of the area was covered by medium to fine grained pyroclastic tuff which was formed during the Upper Jurassic, about 150 million ago. A small area of very fine grained to glassy water laid tuffite exposure was found at the south eastern part of the area.

With reference to recent site investigation logs, the eastern built up area is overlain by fill material of one to two metres thick. Under this are in situ rocks of different degrees of weathering. The western part of the area is covered by a layer of colluvial superficial deposits.

In accordance with the geological maps available from the Geotechnical Engineering Office (G.E.O.), the southern part of Hong Kong Island underwent substantial fault action. However, according to these reports, faults are located outside the survey area and no signs of fault and fold were surveyed. However, a rogue joint found during the survey disclosed that the area has previously been subject to considerable movement and stress.

In situ rocks were exposed by excavation activities. The different degrees of weathering of rock outcrops were categorized as shown in Figure 2. The rock outcrops showed the rocks within the area are highly fractured. Contourplots of rock joint orientations were also prepared.

Some of the rock slopes, especially those located at the southern part of the area, seemed to have potential for toppling and plane failure when referred to the slopes orientation and the contourplots. Slumping scars were also identified during the field work which showed the possibility of failure of slopes. A detailed analysis of slope stability, however, is outside the scope of this work.

The details of these findings are discussed in the following sections.

DETAILS OF THE INVESTIGATION

a. Solid Geology

Apart from a minor outcrop, the only type of rock found on the survey area was medium to fine grained pyroclastic tuff, which was believed to have formed during the Upper Jurassic (150 million years ago). With

reference to the 1:20,000 geological map published by the Geological Engineering Office, a narrow area of sandstone is present at the eastern part of the survey area. However, during the field work no trace of sandstone could be found. The dominant rock type that was recognized is fine to medium grain welded tuff which agrees with the description on the published geological map and reports by both G.E.O. and Atherton and Burnett (1986).

A minor outcrop, about 6m x 10m in area, of very fine grained, almost glassy, water laid tuffite was found on the southern slope opposite to Tung Hing House.

The rock outcrops were found to have different degrees of weathering. The slightly weathered rock outcrops were exposed by excavation mainly during development activities. Grade V rock slopes can be found abutting the multi-storey car park of Yue On Court, the junction of Ap Lei Chau bridge Road and Lee Chi Road, the southern part of Nam Road and around the recreation area adjacent to Tung Cheong House and Tung Yip House of Lei Tung Estate. The only outcrop of water laid tuffite is slightly to moderately weathered.

The outcrops of Grade III rocks lie mainly in the western part of the survey area. These outcrops have also been exposed by excavation. Scattered patches of Grade III rock can be found along the southern service road, the slope opposite to the bus terminal of Lei Tung Estate and the western down hill slope of Yue On Court.

Grade IV outcrops are more difficult to recognize because most of the outcrops have been covered by shotcrete. Some of these were hydroseeded and planted with vegetation. Grade IV outcrops can be found overlaying grade II and grade III outcrops at the southern service road. A large area of Grade IV outcrop was found near the junction of Ap Lei Chau Bridge Road and Lee Nam Road. At Yue On Court area, excavation showed the existence of a Grade V rock slope. The western part of the survey area is covered by a layer of Grade IV to Grade V decomposed materials.

These weathered materials have been eroded and, as a consequence, the area has been lowered. The weathered profile is, typically, a thin layer of completely weathered material overlaying a moderately to highly weathered strata.

By interpretation from sections and verification on site, a layer of completely weathered volcanic covers the northeastern corner of the surveyed area. Also, in the western part, underneath the colluvial deposits, a layer of completely weathered volcanic extends in an uphill direction.

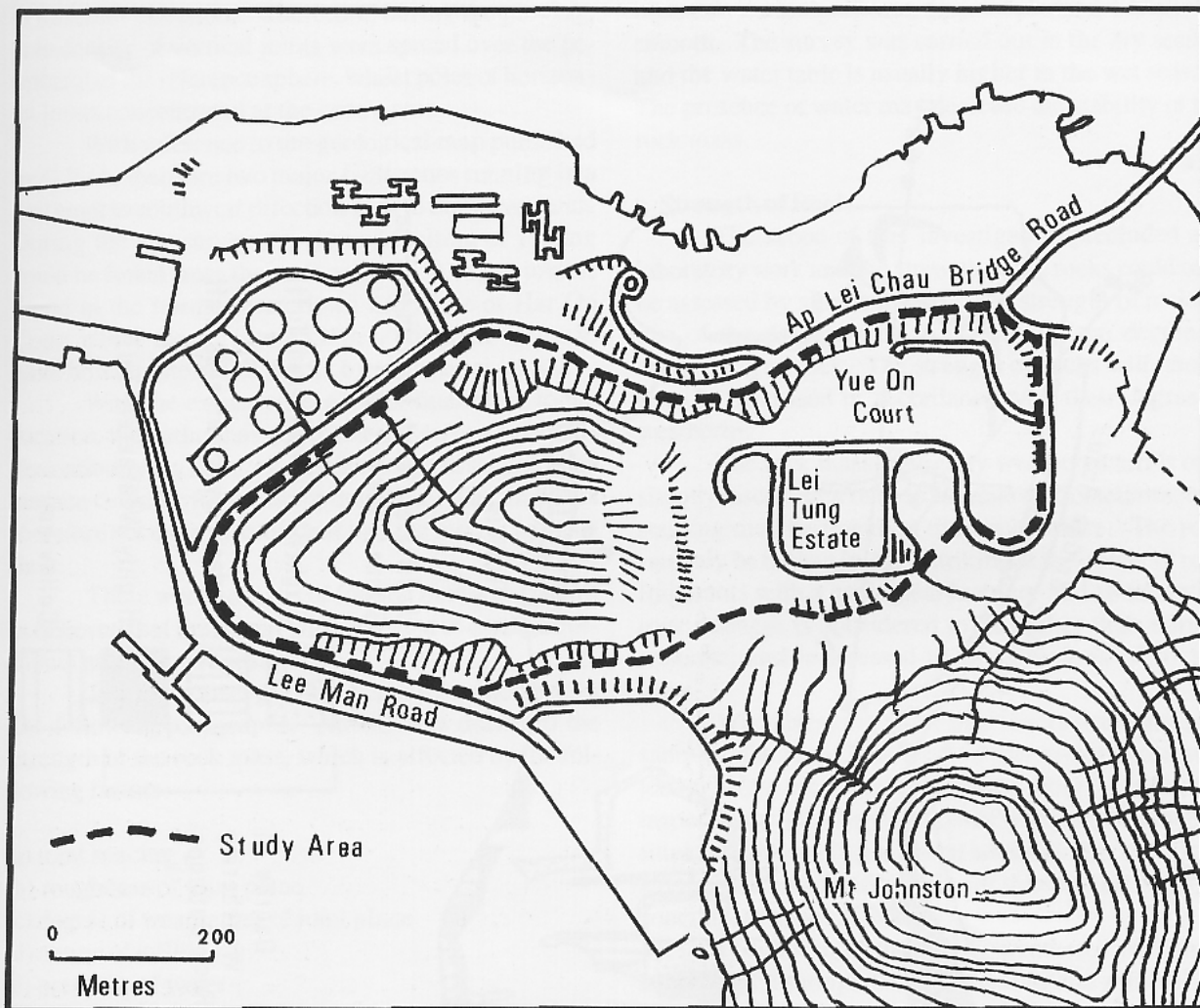


Figure 1 - Location of Study Area, NE Ap Lei Chau

Weathered materials at the top of hills have been transported downslope by denudation process and deposited on the downhill slope, forming a colluvial superficial layer. Indeed the aerial photographs alerted the author to the notion that colluvial deposits covered much of the western part of the survey area. The trial pit records had not disclosed the existence of colluvium. The top soil layer as stated in the trial pit records was reclassified as colluvium by the author after verifying the logging on site.

Colluvial material is found at the western downhill slope of the area. The thickness of colluvium is relatively small and is shallower uphill. Scattered patches of colluvium can also be found along some stream courses.

The author suspects that more superficial colluvial deposit could be found near the coastal region. Only a small area of colluvium was found during the survey because the surveyed area lies within the upper levels of the island.

Most of the rock outcrops were exposed by excavation since substantial development was taking place. Extensive formation works have been carried out in the eastern part of the survey area and the highly weathered materials have been removed to form flat land

for buildings and access roads and were covered by a thin layer of fill material.

With reference to the site investigation report obtained from the government library, the eastern built-up area is covered by a layer of fill material not exceeding 1.5m thick. The fill material was verified on site by inspecting excavated materials.

b. Structural Geology

Contour plots prepared for individual slopes show that horizontal and vertical sets of joints are co-dominant. Most of the rock slopes have three sets of joints, one horizontal joint set together with two vertical joint sets. The three sets of joints are in orthogonal orientation. This phenomenon can be explained by the fact that the rock mass was subjected to isotropic tensile stress during the cooling process of formation.

All the joint orientations have been combined into one contour plot (Figure 3) which reveals that horizontal joints produced a density of over 9%. The two vertical joint sets had dip directions of 060° and 145°.

It was noted that the horizontal joint concentration is large. Contour plots are a kind of statistic analysis. With reference to the individual stereoplots (available on request to the author), vertical joints are dipping

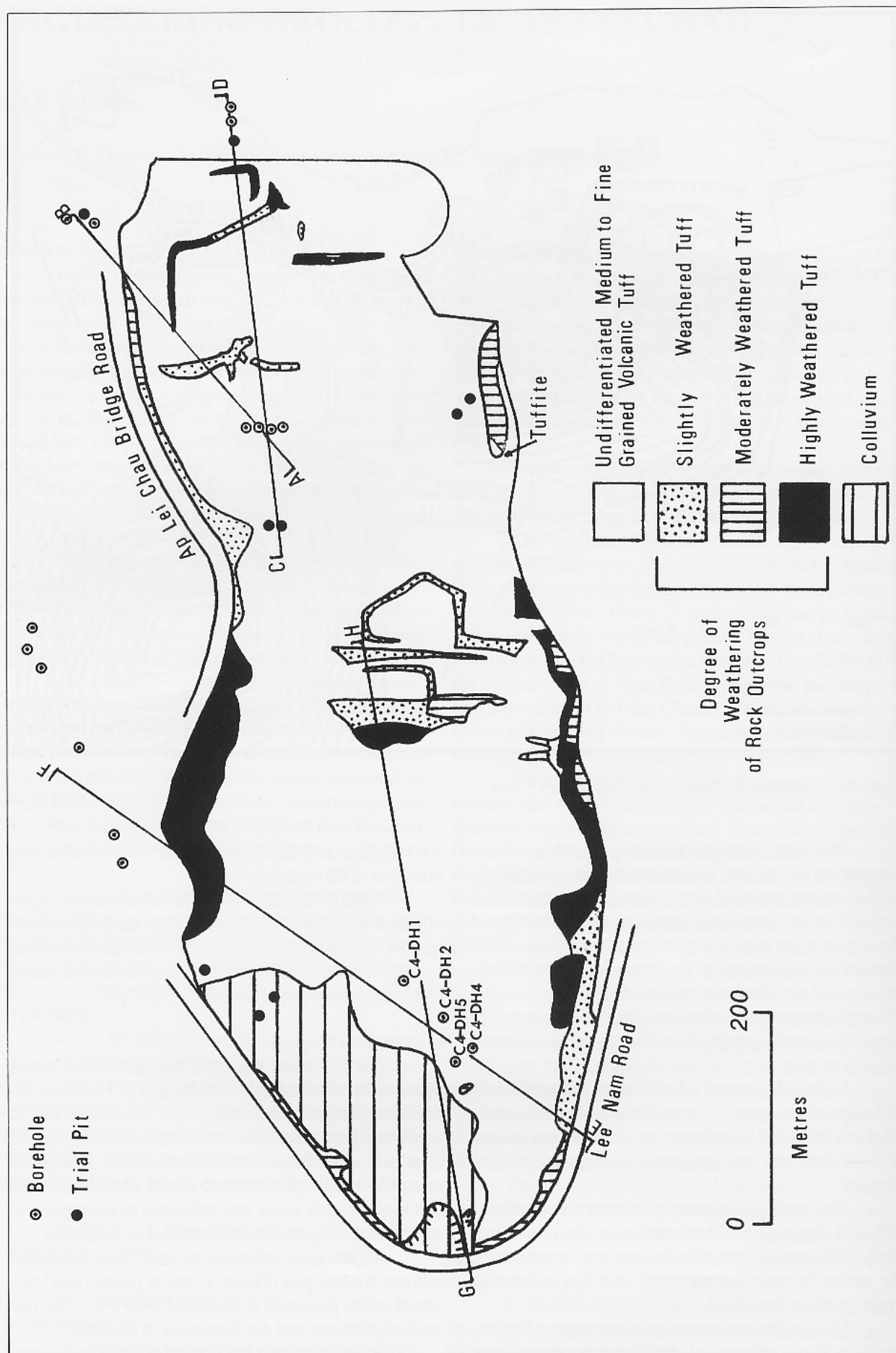


Figure 2 - Geology of NE Ap Lei Chau

in different directions. Therefore, during the plotting, pole density of vertical joints were spread over the peripheral of the reference sphere, whilst poles of horizontal joints concentrated at the centre area.

With reference to the geological map published by G.E.O., there are two major fault zones running in a northeast to southwest direction near to the survey area. During the site survey, no sign of faulting or folding could be found from the rock outcrop. A rogue joint is found at the northeastern down hill slope of Har On Court where the surface rock near the joint seems to have broken into small pieces by substantial stress.

With the existence of a major fault close to the location, the author has sufficient reason to suspect the discontinuity is a fault. However, no sign of slickensided surface could be found along the plane. The author is therefore not entirely confident that the joint is in fact a fault.

There were no signs of folding in this area but it is believed that the island was subjected to earth movements in previous ages.

The intact strength of rocks will be discussed in the following paragraphs. Attention is drawn to the strength of the rock mass, which is affected by the following factors.

- a) joint spacing
- b) roughness of joint plane
- c) degree of weathering of joint plane
- d) nature of infilling
- e) presence of water

Rocks in the area have closely spaced joints, thus reducing the strength of the rock mass. Although most of the joints are narrow and the presence of infill

materials is not significant, the joint planes are relatively smooth. The survey was carried out in the dry season and the water table is usually higher in the wet season. The presence of water may decrease the stability of the rock mass.

c. Strength of Rock

The scope of this investigation precluded any laboratory work and the strength of the rocks could only be assessed by simple means. The strength of rocks is one of the designations in classifying the degree of weathering of rock. The strength of rocks will, therefore, be discussed in accordance with their degree of weathering.

The rock mass of slightly weathered tuff is only slightly discoloured in the joint region. Sometimes, iron staining may be found on the joint surface. The rock can only be broken by hard striking at the corner of rock fragments with a geological hammer and so the intact rock strength is considered to be higher than normal concrete, and is assessed to be as high as 50 to 100 MPa.

When breaking up the moderately weathered rock samples, the core of the sample has usually been subject to slight weathering processes only. During the inspection of the sample, it could be easily broken by a single firm blow of a geological hammer. The intact rock strength is considered to be lower than normal strength concrete, at about 20 MPa.

The colour of the highly weathered rock mass had changed though the rock texture and mineral arrangement still remained. The weathering for some of the minerals remained incomplete. The rock could be broken by hand with effort. If a geological hammer was used to strike the sample, the sample broke into small

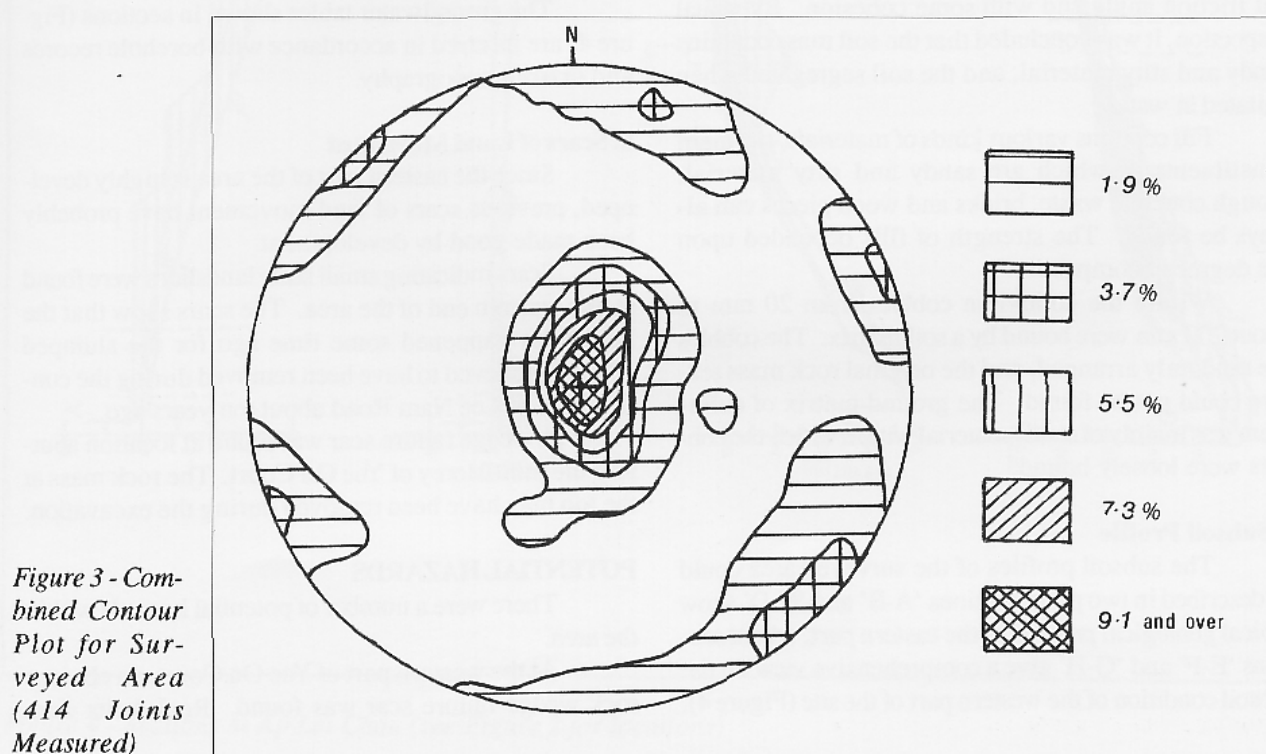


Figure 3 - Combined Contour Plot for Surveyed Area (414 Joints Measured)

pieces. The strength is assessed to be around 10 MPa for these grade IV rocks.

d. Discontinuities

The survey of discontinuities comprised orientation measurement, persistence, description of infilling, aperture, spacing and degree of weathering. Most of the rock masses had three dominant sets of joints. Horizontal or nearly horizontal joints are one of the major sets. The other two sets are vertical joints. The dip direction of vertical joints varied from different rock outcrops. A combined stereonet was made to incorporate all the survey data (Figure 3).

It is the characteristic of volcanic rock to have very closely spaced joints. Two slopes were found to have polyhedral blocks. Most of the other slopes were orthogonal blocked. The block size is very small with joint spacings as close as 100 mm to just below 1m.

The degree of weathering of joints correspond to that of the rock mass. It is a fact that the weathering process starts from the joint surface. It was found that most of the rock joints were only surface stained since the aperture of rock joints were either narrow or tight.

e. Soil Properties

There are only three types of soil found in the survey area, namely in situ completely weathered tuff, fill and colluvium.

Completely weathered tuff retained the texture of the parent rock. Unlike completely decomposed granite, the most common type of in situ soil that can be found in Hong Kong, this soil is of homogenous texture and corestones do not exist. At an excavation site along Ap Lei Chau Bridge Road a temporary cut slope of about 45 degrees was found. The cut slope showed no unstable phenomena, evidence that the soil had a high internal friction angle and with some cohesion. By visual inspection, it was concluded that the soil mass contains sandy and silty material, and the soil segregated when agitated in water.

Fill contains various kinds of materials, the main constituents of which are sandy and silty material, though concrete waste, bricks and wood pieces can always be found. The strength of fills depended upon the degree of compaction.

Within the colluvium cobbles from 20 mm to about 200 mm were bound by a soil matrix. The cobbles are randomly arranged, and the original rock mass texture could not be found. The ground matrix of colluvium was mainly of sandy material within which the cobbles were loosely bound.

f. Subsoil Profile

The subsoil profiles of the surveyed area could be described in two parts: sections 'A-B' and 'C-D' show typical geological profiles of the eastern part, whilst sections 'E-F' and 'G-H' give a comprehensive view on the subsoil condition of the western part of the site (Figure 4).

Section 'A-B' and 'C-D' show the typical sub-soil profile of the eastern part of the Island. A 15m thick layer of completely weathered tuff lies along Ap Lei Chau Bridge Road. Uphill from this, the layer was removed by excavation and the layer of moderately weathered tuff was exposed. Further uphill, slightly weathered tuff bedrock was exposed.

With reference to section 'C-D', slightly weathered rock is overlaid by a layer of highly decomposed materials. The major part of the highly decomposed layer was removed by excavation.

The geological profile was not greatly disturbed by human activities in the western area and a very typical weathering profile could be found. A layer of 8m (maximum) thick completely weathered material overlays highly weathered rock. Bedrock of slightly weathered tuff lay at an average depth of about 10 - 15m below existing ground. In some portions, a layer of moderately decomposed rock could be found above the slightly weathered tuff. At the top of the hill, highly weathered materials have been washed away by erosion. The materials were deposited in the downhill area and formed a thin layer of colluvium.

g. Hydrology

The seepage of water from rock joints along the uphill slope of Ap Lei Chau Bridge Road opposite to Ap Lei Chau Centre, denoted that the water table lies above the road level at that location. On the other hand, seepage of ground water could not be found during measurement of discontinuities other than at this location. Furthermore, with reference to the borehole records, water levels downslope were about 1 to 2m below ground. Boreholes located at mid-levels (C4-DH1, DH2, DH4 and DH5) showed that the watertable lay at a greater depth of about 10 - 15m.

The groundwater tables shown in sections (Figure 4) are inferred in accordance with borehole records and existing topography.

h. Scars of Land Movement

Since the eastern part of the area is highly developed, previous scars of land movement have probably been made good by development.

Scars indicating small scale landslides were found at the western end of the area. The scars show that the landslides happened some time ago for the slumped debris is believed to have been removed during the construction of Lee Nam Road about ten years ago.

A wedge failure scar was found at location abutting the multistorey of Yue On Court. The rock mass at the top may have been removed during the excavation.

POTENTIAL HAZARDS

There were a number of potential hazards within the area.

At the western part of Yue On Court, an obvious rock wedge failure scar was found. Rock bolts were

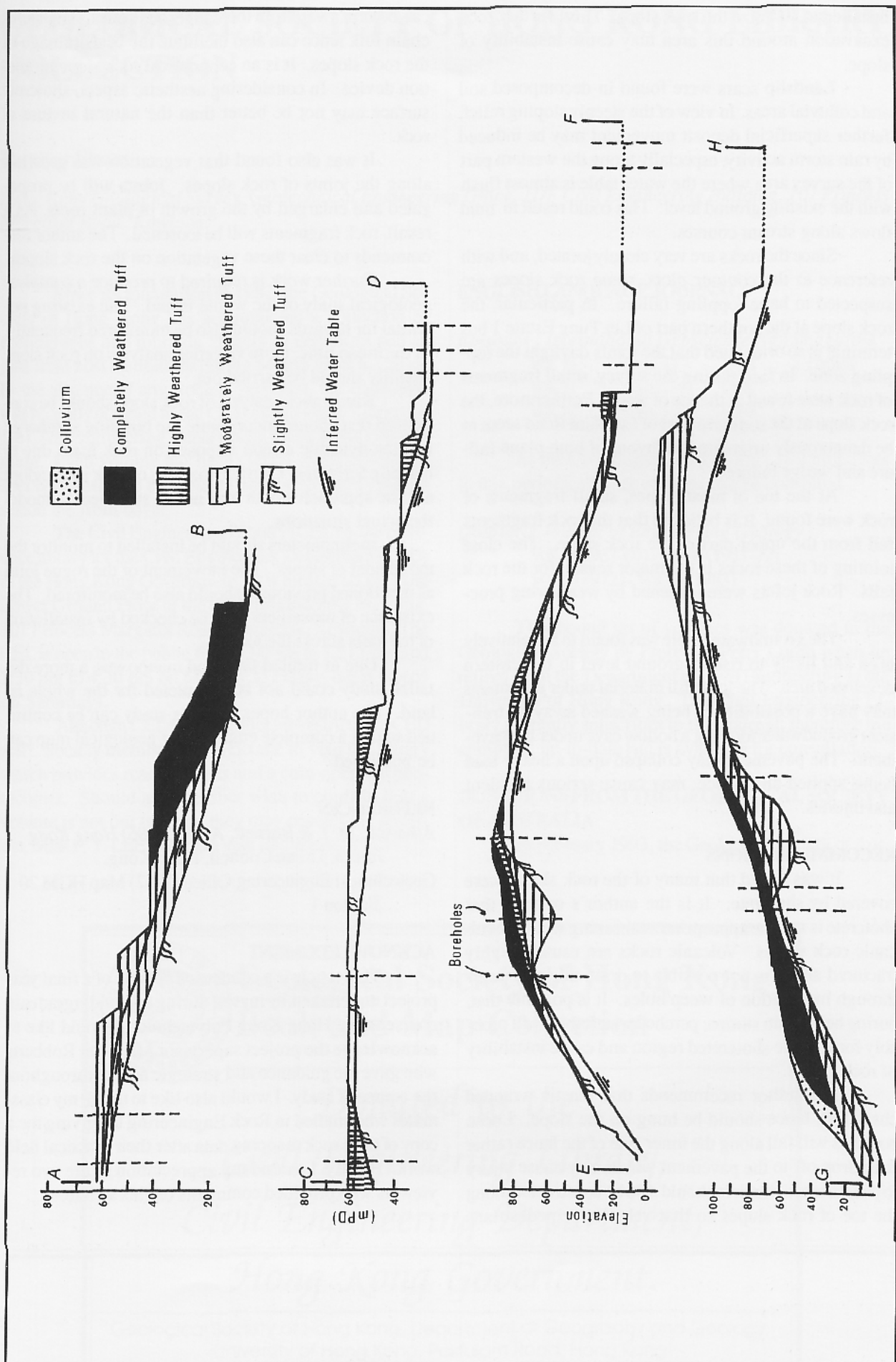


Figure 4 - Sections at Ap Lei Chau (see Figure 2 for locations)

installed to stabilize the rock slope. Thus, further rock excavation around this area may cause instability of slope.

Landslip scars were found in decomposed soil and colluvial areas. In view of the steeply sloping relief, further superficial deposit movement may be induced by rain storm activity, especially along the western part of the survey area where the water table is almost flush with the existing ground level. This could result in mud flows along stream courses.

Since the rocks are very closely jointed, and with reference to the contour plots, some rock slopes are suspected to have toppling failure. In particular, the rock slope at the southern part of Lei Tung Estate 1 bus terminal is so orientated that the joints daylight the toppling zone. In fact, during the survey, small fragments of rock were found at the toe of slope. Furthermore, the rock slope at the southern part of Lei Nam Road seem to be dangerously orientated in favour of both plane failure and wedge failure.

At the toe of most slopes, small fragments of rock were found. It is believed that the rock fragments fell from the upper part of the rock slope. The close jointing of these rocks is the major reason for the rock falls. Rock joints were loosened by weathering processes.

The groundwater table was found to be relatively high and likely to rise to ground level in the eastern developed area. The loose fill material under pavements may have a possibility of being washed away by transient groundwater forming a hollow cave under the pavement. The pavement may collapse upon a heavy load being applied and hence, may cause serious accident and injuries.

RECOMMENDATIONS

It was found that many of the rock slopes were covered by shotcrete. It is the author's opinion that shotcrete is not the appropriate stabilizing work for volcanic rock slopes. Volcanic rocks are usually highly fractured and it is not possible to drain all joint water through installation of weep holes. It is possible that, during heavy rain storms, perched watertables will probably form in the shotcreted region and cause instability of rock slopes.

The author recommends that plastic wrapped chain link fence should be hung on the slope. Loose boulders will fall along the inner side of the fence rather than drop off to the pavement which may cause injury to pedestrians. Barriers should also be constructed along the toe of rock slopes so that vehicles or pedestrians

can be kept away from the dangerous zones. The use of chain link fence can also facilitate the best drainage of the rock slopes. It is an economical rock slope protection device. In considering aesthetic aspect, shotcrete surface may not be better than the natural texture of rock.

It was also found that vegetation was growing along the joints of rock slopes. Joints will be propagated and enlarged by the growth of plant roots. As a result, rock fragments will be loosened. The author recommends to clear these vegetation on the rock slopes.

Further work is required to produce a complete geological study of the whole island. The existing potential for hazards should also be monitored frequently. In the mean time, more vigorous analysis on rock slope stability should be carried out.

Kinematics analysis of rock slope should be considered that should incorporate the building surcharge and the dynamic effects imposed on rock mass due to blasting activities. Current analyses of rock mass adopt a static approach which may not be sufficient to model the actual situations.

Inclinometers should be installed to monitor the movement of slopes. The movement of the rogue joint as mentioned previously should also be monitored. The existence of movement may be checked by installation of tell-tails across the joint.

Due to limited time and manpower, a more detailed study could not be completed for the whole island. The author hopes that this study can be continued so that a complete engineering geological map can be published.

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GEOLOGICAL SOCIETY OF HONG KONG LIBRARY COLLECTION

Raynor Shaw

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

Since its foundation in 1982, the Geological Society of Hong Kong has accumulated a collection of monographs and journals, largely as donations and as gifts from host institutions during Society visits to China. In the absence of any Society premises, the collection was recently donated to the Civil Engineering Library of the Civil Engineering Department, Hong Kong Government. Each volume has been clearly identified with a specially designed bookplate (illustrated below) placed inside the front cover.

The Civil Engineering Library (CEL) is the reference library for the Civil Engineering Department (CED) of the Hong Kong Government. It is located on the First Lower Ground Floor of the Civil Engineering Building, 101 Princess Margaret Road, Homantin, Kowloon. The CEL is open to the public from 9:00 am to 12:15 pm and 1:30 pm to 4:30 pm on Monday to Friday, but is closed on Saturdays.

Although CEL loan facilities are restricted to CED staff, Society members are welcome to visit the library which provides reading areas and a coin-operated photocopier. Should any member wish to confirm that a volume is not out on loan, they may contact the librarian, Miss F. Y. LEE prior to a visit (telephone 762-5147).

ENGLISH LANGUAGE JOURNALS

Episodes : International Geoscience Newsmagazine

Vol. 11	(No. 1)	1988	2 copies
Vol. 11	(No. 2-4)	1988	
Vol. 12	(No. 1-2)	1989	

As the Civil Engineering Library also subscribes to this periodical, later editions can be consulted.

Quarterly Journal of Engineering Geology

Vol. 1 (1967-69) - Vol. 4 (1971-72)
Vol. 5 (1972) - Vol 16 (1983)

This bound set of volumes was donated to the Geological Society by Professor Peter Lumb when he retired from the Department of Civil Engineering at the University of Hong Kong. The Civil Engineering Library currently subscribes to this journal; therefore the complete, up-to-date run is available for consultation.

DONATIONS FROM THE GEOLOGICAL SOCIETY OF AUSTRALIA

In February 1993, the Geological Society of Aus-

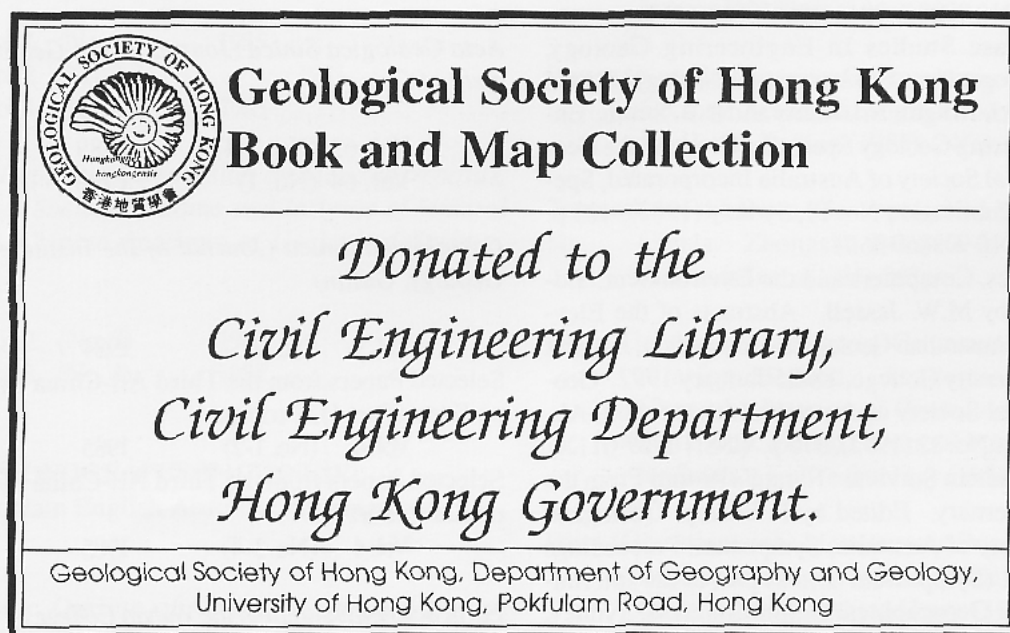


Figure 1 - Acknowledgement Identifying Society Acquisitions Within the Civil Engineering Library

tralia donated the items listed below as a goodwill gesture. These are now registered as part of the Geological Society of Hong Kong Collection.

The Australian Lithosphere. Edited by B. Drummond. Geological Society of Australia Incorporated, Special Publication No. 17, Brisbane (1991), 208 p. (ISBN 0 909869 78 2) (ISSN 0072-1085)

Geology of Victoria. Edited by J.G. Douglas and J.A. Ferguson. Victorian Division, Geological Society of Australia Incorporated (Supported by the Geological Survey of Victoria, Department of Industry, Technology and Resources, Government of Victoria), Melbourne (1988), 663 p. (ISBN 0909869 677)

Contributions to the Geology and Hydrocarbon Potential of the Eromanga Basin. Edited by D.I. Gravestock, P.S. Moore & G.M. Pitt. Geological Society of Australia Incorporated, Special Publication No. 12, Sydney (1986), 384 p. (ISBN 0 909869 39 1) (ISSN 0072 1085)

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Mafic-Ultramafic Complexes of Western Australia. Guidebook for the Post-Symposium Field Excursion of the Sixth International Platinum Symposium, Perth. Edited by S.J. Barres & R.E.T. Hill Geological Society of Australia (W.A. Division), Excursion Guidebook No. 3. (1991) 111 p. (ISBN 0 909869 79 0) (ISSN 0819-6613)

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DONATIONS FROM THE NEPAL GEOLOGICAL SOCIETY

Journal of the Nepal Geological Society

Vol. 7	February	1991
(Special Issue : Proceedings of the Seminar on the Geology of the Nepal Himalayas)		
Vol. 7	June	1991

Nepal Geological Society News Bulletin

Vol. 8	February	1991
Vol. 9	February	1992

CHINESE LANGUAGE JOURNALS

(Many contain English abstracts and/or lists of contents)

Acta Geologica Sinica (Journal of the Geological Society of China)

Vol. 63 (No. 1-4)	1989
Vol. 64 (No. 1)	1990

Carsologica Sinica (Journal of the Institute of Karst Geology, Guilin)

Vol. 3 (No. 2)	1984
Selected Papers from the Third All-China Symposium on Karst (Part 1), 2 copies	
Vol. 4 (No. 1-2)	1985
Selected Papers from the Third All-China Symposium on Karst (Part 2)	
Vol. 4 (No. 3-4)	1985

Earth Science (Journal of the Wuhan College of Geology)

Vol. 11 (No. 4)	1986
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Geology of Fujian (Bureau of Geology and Mineral Resources of Fujian Province)

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Vol. 8	(No. 1-4)	1989
Vol. 9	(No. 1)	1990
Vol. 9	(No. 3-4)	1990

Geology of Zhejiang (Bureau of Geology and Mineral Resources of Zhejiang Province and the Geological Society of Zhejiang Province)

Vol. 4	(No. 2)	1988
Vol. 5	(No. 1)	1989
Vol. 5	(No. 2)	1989

Geotectonica et Metallogenica (Journal of the Changsha Institute of Geotectonics, Academia Sinica, Hunan)

Vol. 5	(No. 1-2)	1981
Vol. 6	(No. 1-2)	1982
Vol. 7	(No. 1-2)	1983
Vol. 8	(No. 1-4)	1984
Vol. 9	(No. 1-4)	1985

Guangdong Geology (Bureau of Geology and Mineral Resources of Guangdong Province)

Vol. 5	(No. 1-4)	1990
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Journal of the Chengdu College of Geology

Unknown Vol. (No. 1) 1984

Journal of the Hunan Science and Technology University

Vol. 1	(No. 1)	1985
Vol. 1	(No. 2-3)	1985
Vol. 1	(No. 4)	1985

Mineral Deposits (Commission on Mineral Deposits, Geological Society of China and Institute of Mineral Deposits, Chinese Academy of Geological Science, Beijing)

Vol. 2	(No. 3)	1983
Vol. 3	(No. 4)	1984

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(Many Contain English Abstracts, Summaries or Sections)

Geotectonic Outline of China. Compiled by the Guangzhou Seismological Division of the Seismological Bureau of China. Seismological Publishing House (1977), 121 p.

Research on Geology Volume (1). Institute of Geology, Academia Sinica. Cultural Relics Publishing House (1982), 376 p. and 16 Plates.

Contributions from the Various Organisations of the Ministry of Geology and Mineral Resources. Ministry of Geology and Mineral Resources, People's Republic of China.

1953 - 1982 116 p. (English) and 71 p. (Chinese)
1983 133 p. (English) and 79 p. (Chinese)
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Precambrian Sedimentary Rocks in the Ming Tombs District, Beijing. Song Tianrui and Gao Jian. Geological Memoirs, Series 3, Number 3, Ministry of Geology and Mineral Resources. Geological Publishing House, Beijing (1987), 193 p.

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Problems of Geomechanics for Rock Engineering. Institute of Geology, Academia Sinica (1980). Volume III 253 p. Volume IV 152 p.

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Transcript of the Diwa (Geodepression) Theory. Chen Gouda. Zhongsha Institute of Geotectonics, Academia Sinica (1985), 368 p.

Diwa (Geodepression) Theory Geotectonic Map Compilation Method. Academia Sinica and Changsha Institute of Geotectonics Compilation Group. Hunan Provincial Publishing House for Science and Technology (1980), 201 p.

Diwa (Geodepression) Metallogenic Province. Translated from Russian by Zhou Yufan. Metallurgical Industry Publishing House (1980), 200 p.

Continued p29

REPORT ON A FIELD TRIP TO AP CHAU AND LEDGE POINT ON SATURDAY 23rd OCTOBER 1993

M J ATHERTON

Some thirty five members and friends set off from the Chinese University on a lovely sunny day for Mirs Bay and the northeastern islands of Hong Kong. Members were led by K W Lai to view the Kat O Formation which outcrops on three islands and on the mainland. The Formation consists of a crudely bedded calcite-bearing breccia of mainly angular weathered volcanic rocks and is of uncertain age and may be a fanglomerate deposited against a fault line escarpment.

On Ap Chau the party walked along a river or wave cut Pleistocene platform to see the Natural Arch

cut right through the island before transferring to Ledge Point by sampan.

At Ledge Point the Kat O Formation is separated from the mainland volcanics by a fault. The fault breccia contains blocks of pink, white and black limestone which was formerly quarried by a Kowloon Cement works in the 1880's leaving a large water filled pit. The limestone is thought to be of Permian or Carboniferous age.

The party returned via Governor's Beach where an enjoyable swim was had by all on this delightful beach on Double Island.

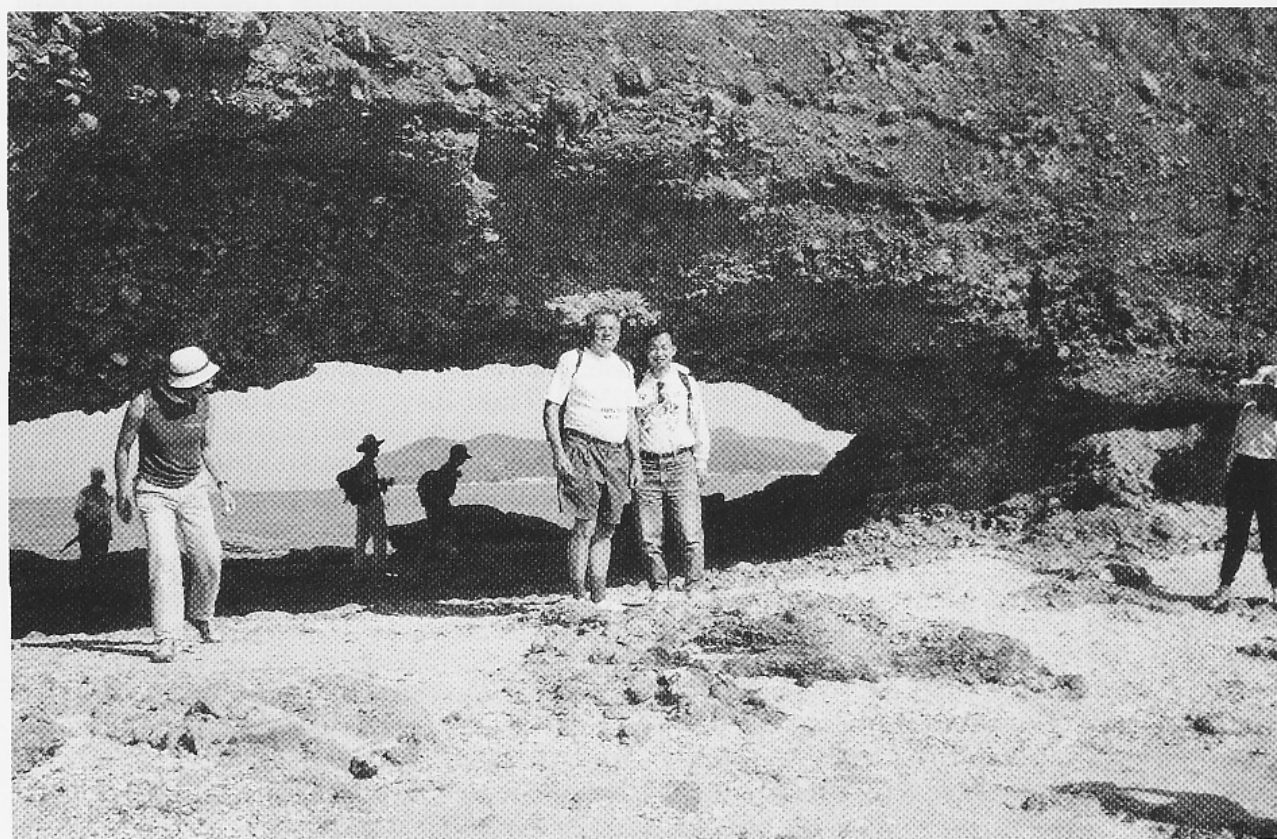


Figure 1 - Natural Arch in sandstone and breccia of the Kat O Formation on Ap Chau.

REPORT ON A FIELD TRIP TO KAT O CHAU AND AP CHAU ON SUNDAY 31st OCTOBER 1993

M J ATHERTON

Some thirty five members and friends set off by junk from the Chinese University on a crystal clear day into the teeth of the winter monsoon. It had been intended to visit Ping Chau but rough conditions in Mirs Bay caused the diversion to the sheltered water of Double Haven and Kat O Chau Pier.

Approximately thirty members were then led by M.J. Atherton to view the Kat O Formation which outcrops at the extreme north of the island against a fault plane. The Formation comprises a crudely bedded calcite bearing breccia of angular weathered volcanic rocks and is of uncertain age. To the east of the exposure is a fault breccia followed by vertically dipping contorted black shales containing slivers of limestone, and further east tuff containing large blocks of purple shale similar

in appearance to the Port Island Formation. If it really is the Port Island Formation, then we need a completely new stratigraphy for Hong Kong!

After a visit to the temple of Tin Hau some 20 members embarked for a trip to Ap Chau, previously visited by the Society only 8 days before. With more time available a complete circuit of the island was possible on the wave cut terrace. A visit was made to a smugglers cave on the south coast formed by marine erosion along a major joint.

The boat returned to Kat O Chau to pick up the remaining members before sailing around Kat O Chau to see some sea caves in the north of the island and then back to the Chinese University.



Figure 1 - Large boulders of Kat O Formation at base of cliffs

REPORT ON A FIELD TRIP TO LAI CHI CHONG AND SHAM CHUNG ON SUNDAY 5th DECEMBER 1993

M J ATHERTON

Eighteen members and friends set off for another attempt to reach Ping Chau from the Chinese University on a sunny but windy day. Once again the winter north-east monsoon defeated us (see page 27) and we put into Lai Chi Chong for a walk along the beach and an over-land hike to Sham Chung. It was the first time that many of the party had seen the magnificent succession of cherts at Lai Chi Chong (Figure 1) and the day proved to be a very pleasant one even though the high tide of 1.6 metres at 1.00 pm led to some difficulty scrambling over boulder runs from past landslides.

The succession at the eastern end of the walk comprises thin bedded mudstones and shales with inter-bedded sandstones and tuffs. Laminated tuffaceous sandstones with graded and current bedding are dominant. Near the ferry pier a fossil tree and other plant remains have been found. Larger rock fragments are thought to be volcanic missiles landing in sediment as load and flame structures are evident.

Convolute laminations caused by deformation during sediment deposition are common as are slump

breccias. These are many beds of black chert which have been interpreted as the result of deposition in water of a fine siliceous volcanic ash. The structure is of a series of beds with a strong dip to the southeast. In several places anticlines and synclines plunge to the northeast and are inclined to the southeast with steep or overturned northwest limbs. There are numerous small faults trending to the north.

The succession at the centre of the walk is largely tuff and towards the western section of the walk beneath the tuff appear outcrops of pink siltstone and sandstone similar in appearance to the siltstones and sandstones of Sam Pui Chau and Ma Shi Chau followed by the black fossiliferous shales of the Lower Jurassic (Sinemurian), an account of which appears in our Newsletter (Vol 2, No 6, November 1984).

After examining the conglomerate bed of white quartzite pebbles on the headland of Sham Chung Wan, the party embarked at Sham Chung Pier for the trip back to the Chinese University.



Figure 1 - Chert Bedding at Lai Chi Chong

Methods of Metallogenic Researches. Chen Guoda. Geological Publishing House, Beijing (1978), 413 p.

The Application of the Stable Isotope to Geology: The Hydrothermal Mineralisation of Metal Activation and its Prospecting. Zhang Ligang, Yichang Institute of Geology and Mineral Resources, Yichang, Hubei. Shaanxi Science and Technology Publishing House (1985), 267 p.

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International Symposium on Metallogeny of the Early Precambrian: Selection of Abstracts. Changchun College of Geology, Jilin, China (1985), 85 p. (English) and 64 p. (Chinese).

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GAS IN MARINE SEDIMENTS (THIRD INTERNATIONAL CONFERENCE) GEOLOGY - CHEMISTRY - MICROBIOLOGY

Methane from biodegradation of organic matter in near surface sediments, or emitted by and migrated from deeper sources, influences the seismic and acoustic characteristics and may affect the morphology of the seabed and the subsurface layers. It is the purpose of this conference, an initiative of the shallow gas group, to critically examine the related processes, pathways and products, and to study global change and climatic impacts.

Topics include cold seeps and gasvents, migration and fluxes, mud-diapers and mudvolcanoes, seis-

mic and acoustic characteristics, hydration formation, (bio)cycling of methane, (bio)cycling of sulphur, microbial communities, chemosynthesis, oxic-anoxic boundaries, carbon, oxygen and sulphur fluxes.

To be held in September, 1994. Abstracts should be submitted by 30 June 1994. In addition to a proceedings the more significant papers will be published in a selected volume of a scientific journal. For further details contact the Secretariat, P.O. Box 59, 1790 AB Den Burg - Texel, The Netherlands.

FOURTH INTERNATIONAL CONFERENCE ON THE EVOLUTION OF THE EAST ASIAN ENVIRONMENT

Papers on all aspects of the Cainozoic environment of east Asia are invited but contributions dealing with the following topics are particularly welcomed:

- recent advances in chronology
- marine/terrestrial correlation
- correlation between east Asia and elsewhere
- biogeography and environmental change
- new discoveries pertaining to the origin and movements of early humans
- palaeoceanography and global change
- palaeomonsoon

- palaeosols and landscape evolution
- loess stratigraphy
- humans and environmental change in the Quaternary
- Quaternary coastal evolution
- historical floods and droughts
- glaciers and glaciations

East Asia is defined as the area within latitude 0 and 50 degrees North and longitude 75 and 150 degrees East. To be held in January 1995. Contact the Secretariat, Centre of Asian Studies, The University of Hong Kong, Pokfulam Road, Hong Kong.

30TH INTERNATIONAL GEOLOGICAL CONGRESS

Beijing China 4-14 August 1996

The Organizing Committee of the 30th International Geological Congress (IGC), representing the Geological Society of China, the Ministry of Geology and Mineral Resources of China, and the relevant Chinese governmental agencies, scientific institutions and industrial organizations, in collaboration with and under the sponsorship of the International Union of Geological Sciences (IUGS), has the honour of inviting you to participate in the

30th Session of the International Geological Congress in the Great Hall of the People, Beijing From 4 to 14 August 1996

Colloquia (Congress-wide)

Colloquia will focus on new advances in continental geology, changes and protection of global environment, energy and mineral resources for the 21st century, and the interrelationship between geological sciences and human survival and sustainable development.

Special Symposia

- A. Origin and History of the Earth
- B. Geosciences and Human Survival, Environment and Natural Hazards
- C. Global Changes and Future Environment
- D. Structure of the Lithosphere and Deep Processes
- E. Contemporary Lithospheric Motion
- F. Global tectonic Zones
- G. Orogenic Belts
- H. Basin Analysis
- I. Energy and Mineral Resources for the 21st Century
- J. New Technology for Geosciences
- K. Progress of International Geoscience Projects

Symposia

- 1. Stratigraphy
- 2. Palaeontology and Historical Geology
- 3. Sedimentology
- 4. Marine Geology and Palaeoceanography
- 5. Structural Geology and Geomechanics
- 6. Igneous Petrology
- 7. Mineralogy
- 8. Precambrian Geology and Metamorphic Petrology

rology

- 9. Geology of Mineral deposits
- 10. Geology of Fossil Fuels
- 11. Mineral Economics
- 12. Geochemistry
- 13. Geophysics
- 14. Seismogeology
- 15. Quaternary Geology
- 16. Hydrogeology
- 17. Engineering Geology
- 18. Environmental Geology
- 19. Mathematical Geology and Geoinformatics
- 20. Comparative Planetology
- 21. Geological Education
- 22. History of Geosciences

Poster Sessions

A part of the Congress papers and maps will be presented in Poster sessions. Detailed information will be announced in the Second Circular.

Field Trips

There are 24 Pre-Congress field trips, 23 During-Congress trips and 95 Post-Congress Trips.

Registration Fees

	<u>Pre-Registration</u>	<u>On-site Registration</u>
Participating Members	US\$ 300	US\$ 350
Accompanying Members	150	175
Students in 1996	100	120
Non-attending Members	175	-

PRELIMINARY QUESTIONNAIRE

30th International Geological Congress

Beijing, China

4-14 August 1996

TO BE RETURNED IN THE ENCLOSED ENVELOPE TO:

30th International Geological Congress

P.O. Box 823

Beijing 100037

P.R. China

BEFORE 31 OCTOBER 1994

Please complete this Questionnaire in capital letters and check the boxes.

NAME: Ms Mr _____
☐ ☐ (Family Name) (Given Name)

TITLE: _____

ORGANIZATION: _____

DETAILED ADDRESS
FOR CORRESPONDENCE: _____

(City)

(Postal Code)

(Country)

TELEPHONE: _____ FAX: _____

Primary field of geological interest: _____

In 1996 I plan to register as: ☐ Participating member ☐ Student in 1996
☐ Accompanying member ☐ Non-attending member

My attendance at the Congress is:

☐ Very probable ☐ Probable ☐ Unlikely

Probable number of accompanying persons:

Adults _____ Children _____

Class of hotel desired:
(per day in US\$)

A
(\$180—\$150)

B
(\$140—\$100)

C
(\$90—\$60)

D
(\$50—\$40)

Number of single rooms: _____

Number of double rooms: _____

Scientific Programme

Symposia and Sessions: Please list symposium and/or session numbers for which you might submit abstracts. Use numbers in the First Circular.

Oral Presentations:

1st

2nd

3rd

Poster Sessions:

1st

2nd

3rd

If you might present papers not covered in the symposia or sessions listed in the First Circular, please write the titles and/or fields:

Short Courses and Workshops: Which topics and subjects are you interested in? Convenors wishing to hold short course(s) and/or workshop(s) please write your proposals.

Convenor(s): _____

Theme: _____

Contents: _____

Duration: _____ Fee per person: _____

Field Trips: Please list the numbers of field trips which you might attend. Use numbers in the First Circular.

Pre-Congress Trips (T101-T124):

1st

2nd

3rd

During-Congress Trips (T201-T223):

1st

2nd

3rd

Post-Congress Trips (T301-T395):

1st

2nd

3rd

Are there any areas not covered in the First Circular that are of special interest to you?

Signature

Date

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 and Shaw R (Editors)
- Bulletin* No 5 (1994) Seismicity in Eastern Asia
Lai K W and Owen R B (Editors)
- Marine Geology of Hong Kong and the Pearl River Mouth* (1985), 96 p.
Whiteside P G D and Arthurton R S (Editors)
- Marine Sand and Gravel Resources of Hong Kong* (1988), 221 p.
Whiteside P G D and 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 at 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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Vol 10 (4 issues) 1992	Vol 11 (2 issues) 1993	

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