UPDATING OF HONG KONG GEOLOGICAL SURVEY 1:20,000-SCALE MAPS

MAJOR FINDINGS AND REVISIONS MAP SHEET 7 - SHA TIN

GEO REPORT No. 179
(Second Edition)

R.J. Sewell, J.C.F. Wong & R. Shaw

GEOTECHNICAL ENGINEERING OFFICE
CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT
THE GOVERNMENT OF THE HONG KONG
SPECIAL ADMINISTRATIVE REGION

UPDATING OF HONG KONG GEOLOGICAL SURVEY 1:20,000-SCALE MAPS

MAJOR FINDINGS AND REVISIONS MAP SHEET 7 - SHA TIN

GEO REPORT No. 179
(Second Edition)

R.J. Sewell, J.C.F. Wong & R. Shaw

This report includes material in the reports originally produced in July 2005 and November 2008 as GEO Geological Report No. GR 3/2005 and GR 1/2008 respectively

Table of Contents
Table of Contents
Table of Contents
Table of Contents

First published, February 2006
Second Edition, April 2010

Prepared by:

Geotechnical Engineering Office,
Civil Engineering and Development Department,
Civil Engineering and Development Building,
101 Princess Margaret Road,
Homantin, Kowloon,
Hong Kong.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

PREFACE

In keeping with our policy of releasing information which may be of general interest to the geotechnical profession and the public, we make available selected internal reports in a series of publications termed the GEO Report series. The GEO Reports can be downloaded from the website of the Civil Engineering and Development Department (http://www.cedd.gov.hk) on the Internet. Printed copies are also available for some GEO Reports. For printed copies, a charge is made to cover the cost of printing.

The Geotechnical Engineering Office also produces documents specifically for publication. These include guidance documents and results of comprehensive reviews. These publications and the printed GEO Reports may be obtained from the Government's Information Services Department. Information on how to purchase these documents is given on the second last page of this report.

R.K.S. Chan
Head, Geotechnical Engineering Office
April 2010

Table of Contents
Table of Contents
Table of Contents
Table of Contents

FOREWORD

This report describes further revisions to Hong Kong Geological Survey 1:20,000-scale Geological Map Sheet 7 – Sha Tin. The work was carried out by the Hong Kong Geological Survey Section of Planning Division between 2004 and 2007 as part of a programme to continually improve the reliability of the Hong Kong Geological Survey maps. The updating exercise has taken into account the vast amount of new information, and advances in geological knowledge gained since the previously published maps were first surveyed. Updating of Sheet 7 has been implemented on a GIS platform using a standard GIS template, and the map is available for promulgation in ArcReader format.

Dr R.J. Sewell, the senior author of the report, managed the updating of Map Sheet 7, supported by Mr J.C.F. Wong and Dr R. Shaw. Other colleagues in GEO contributed to the study, including Ms D.L.K. Tang, and Mr W.W.L. Shum. Dr S.D.G Campbell (formerly of GEO) provided an overall review during the initial stages of the map updating and the first edition of this report. Technical support was provided by cartographical and Geological Survey staff.

K.C. Ng
Ag. Chief Geotechnical Engineering/Planning

Table of Contents
Table of Contents
Table of Contents
Table of Contents

ABSTRACT

There have been many changes in Hong Kong since the first edition of 1:20,000-scale geological maps were surveyed and published by the Hong Kong Geological Survey of the Geotechnical Engineering Office. Consequently, the Hong Kong Geological Survey Section of the Planning Division has embarked on a programme to update the 1:20,000-scale maps and to release them in both printed and digital form. This will make these geological maps more easily accessible to the public, and more useful to engineers and planners.

The map updating work is being digitised on a GIS platform using a standard GIS template, and the maps are being published and disseminated in ArcReader format.

Geological Map Sheet 7 - Sha Tin, surveyed between 1983 and 1984, and published in 1986, is the first of fifteen 1:20,000-scale geological maps to be updated. The ten-year programme of updating gives priority to urban areas. Reliability of the geological maps has been improved after incorporation of the vast amount of new information that has accumulated over the past twenty years, and advances in the understanding Hong Kong's geology since the published maps were first surveyed.

The key findings on, and revisions to, Map Sheet 7 are described in this report. They include: a revision of the stratigraphic nomenclature, a reinterpretation of the onshore and offshore superficial deposits, a revision of the intertidal units and beach deposits, an updated history of reclamation, an improved understanding of magmatic and volcanic events, a revised stratigraphy of the volcanic and sedimentary rocks, and the more accurate location of the concealed major faults and rock type boundaries. A further major improvement is the addition of a solid-only GIS layer, which includes the first interpretation of the offshore solid geology based on geophysical and borehole data, and a large number of additional GIS layers containing geological and related information.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

CONTENTS

Page No.

1. INTRODUCTION

1.1 Background

The Geotechnical Engineering Office (then Geotechnical Control Office) commenced a geological survey of Hong Kong in 1982, and a series of fifteen 1:20,000 scale, HGM 20 Series, geological maps with six geological memoirs was published between 1986 and 1996 (Figure 1). The first edition of Hong Kong Geological Survey Map Sheet 7 (hereafter, Sheet 7) - Sha Tin, updated by this report, was published in 1986 (GCO, 1986a) based on field surveys carried out in 1985 and 1986. From 1989 to 1997, thirty-four geological maps of 1:5,000 scale covering selected, mainly onshore development areas, were also produced. In 2000, a series of ten 1:100,000 scale solid and superficial geology and thematic maps, and accompanying memoirs on the pre-Quaternary and Quaternary geology of Hong Kong, synthesizing all of the available geological data at that time, were published (Sewell et al., 2000; Fyfe et al., 2000).

In the succeeding years since publication of the 1:20,000 scale maps, new geological information has become available and advances in knowledge and map publishing techniques have occurred. Hence, a geological map updating programme was initiated to improve the reliability of the geological maps. In addition, the updated maps will be available in printed and Geographic Information System (GIS) versions.

1.2 Description of the Project

The map updating project is scheduled to be conducted on a map-by-map basis (Table 1). The geology of the approximately 10 km^2 of offshore areas not previously surveyed (including part of Deep Bay, and areas northwest, west and southwest of Lantau Island), which have been included within the HKSAR since July 1997, will be incorporated within the update. Priority will also be given to establishing the locations of faults concealed by superficial deposits in both onshore and offshore areas, and to revising areas of complex geology, such as Yuen Long and Ma On Shan. Several inconsistencies between individual map sheets, which resulted from developments in terminology and interpretation that occurred during the preparation of the 1:20,000 scale maps between 1986 and 1996, will also be resolved.

1.3 Scope and Objectives

The scope of the map updating project is comprehensive. Nevertheless, it is not a resurvey and relies heavily on desk studies of available information with only limited field confirmation. The desk studies involve integration of new data from ground investigations (both onshore and offshore and including results from recent geophysical surveys), site formation data together with a re-evaluation of the data collected during the original field survey (e.g. original field records, sketches, field photographs, sample descriptions, etc). Other published maps and related publications will also be updated where necessary, including the 1:100,000 scale maps covering the whole of the HKSAR. The objective is to produce up-to-date, on-demand geological reports, including geological maps, cross-sections, legends, and 3D models, for specified areas.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

2. METHODOLOGY

Except for the most recent 1:5,000 scale and 1:100,000 scale geological maps, the original 1:20,000 scale geological maps relied heavily on conventional cartographical methods for publication, and paper maps were printed for distribution. The maps have been available for purchase through Government outlets, and reprinting has been carried out on an as-need basis. No modifications of the published maps have been released except for two provisional 1:5,000 scale maps covering Chek Lap Kok and Tung Chung (GEO, 2002a & 2002b).

In line with modern trends in map production, the updated 1:20,000 scale geological maps are being implemented on a GIS platform using a standard GIS template. The primary software is ARC/INFO®. Multiple layers of geological information (Table 2) are being developed within a Geodatabase that will form the basis of the data storage and retrieval system. Interrogation of geological data within the Geodatabase will be possible using the latest GIS tools and Digital Elevation Models (DEM). The digital geological maps will be published and disseminated as GIS publications in ArcReader (or equivalent) format making them accessible to the public, useful to engineers and town planners. Hard copies of the combined solid and superficial map will be printed and available for purchase.

Geological datasets that have been used for the updating of Sheet 7 are available on request from the Chief Geotechnical Engineer/Planning, Geotechnical Engineering Office, Civil Engineering and Development Department. These datasets represent geological information available up to early 2005. The Geodatabase will be updated regularly, and new editions of the digital geological maps will be released from time to time along with revised datasets.

The procedures and specifications for the Hong Kong Geological Survey (HKGS) GIS Maps, Data Model and Geodatabase Schema Diagram will be contained in a separate report.

3. DATA SOURCES

The primary data sources for the geological map Sheet 7 update are the records of field notes, sketches, rock samples, mapping traverses, structural measurements, photographs, and analyses compiled during the original field survey and contained in the HKGS archive. These records are accessible within the Geodatabase. In addition, GIU borehole records, whole-rock geochemical analyses (Sewell & Campbell, 2001), stream sediment geochemical analyses (Sewell, 1999; 2007), landslide data (King, 1999), seismic lines and selected scanned traces (Cheung & Shaw, 1993, HKGS archive), and reclamation histories, have also been added to the Geodatabase. Gravity and magnetic data used in the map update have principally come from onshore and offshore surveys conducted by Electronic & Geophysical Services Ltd. (EGS, 1991, 1993, 1999), and the summary in Sewell et al. (2000). Tunnel data have been derived from various sources.

4. MAJOR FINDINGS AND REVISIONS TO MAP SHEET 7 - SHA TIN

Based on a desk study review of all available geological information for the area

Table of Contents
Table of Contents
Table of Contents
Table of Contents

covered by Map Sheet 7, including a review of approximately 18,000 borehole records and limited field checking, the following key revisions have been made.

4.1 Rock Nomenclature

The first editions of the HKGS 1:20,000-scale geological maps (GCO, 1986a, b; GCO, 1987; GCO, 1988a, b; GCO, 1989a, b, c & d; GCO, 1991; GEO, 1991; GEO, 1992, GEO, 1994; GEO, 1995; GEO, 1996b) assigned the volcanic, sedimentary and metamorphic rocks to lithostratigraphic formations, whereas the intrusive, granitic rocks were classified primarily on the basis of grain size. Subsequent detailed petrological, geochemical and geochronological analyses of the mapped units, enabled a volcanic formation and pluton-based nomenclature to be adopted for the major extrusive and intrusive units depicted on the 1:100,000-scale geological map (Sewell et al., 2000). Similarly, formation or pluton names and rock type descriptors have been assigned to all the geological units depicted on the updated maps. Thus, on the new map, rock type descriptors indicate the dominant lithology of the geological units, so it is possible to depict lithologies alone, or to depict the formation and pluton nomenclature. As a result, several inconsistencies between the original 1:20,000-scale maps have now been rectified, and the nomenclature has been brought into line with the 1:100,000-scale geological map.

4.2 Superficial Geology

4.2.1 Quaternary Stratigraphy

In common with the onshore pre-Quaternary stratigraphy, understanding of the Quaternary stratigraphy of Hong Kong steadily evolved over the original ten-year mapping period (1983 to 1993). As the mapping progressed, differences emerged in the nomenclature adopted, and the classifications employed, for the superficial deposits (Tables 3 & 4). Consequently, the terminology has been re-examined and rationalised as part of the map-updating programme. For example, various terms for “raised beaches” have recently been addressed by Wong and Shaw (2007). Important advances have been made in the offshore area, particularly as a result of the SEAMAT Study (Cheung & Shaw, 1993), a Territory-wide offshore reconnaissance seismic and borehole survey that ran concurrently with the original geological mapping programme. Following finalisation of the 1:20,000 scale maps and memoirs, a comprehensive Quaternary onshore and offshore lithostratigraphy was compiled and presented by Fyfe et al. (2000).

There were no seismic records available for the offshore area when the first edition of Sheet 7 (GCO, 1986a) was compiled, and very few offshore boreholes. In the absence of any precedents for classifying the superficial deposits, and with only limited information, a genetic classification was adopted for the fluvial and mass movement deposits, and a lithological classification for the offshore and intertidal deposits (Tables 3 and 4). Interestingly, beaches were not distinguished. Fill and offshore units were grouped as Quaternary/Holocene deposits, whereas the onshore superficial deposits were grouped as Quaternary/Pleistocene and Holocene deposits on the map legend. The offshore Pleistocene alluvium, subsequently assigned to the Chek Lap Kok Formation, was not distinguished as a discrete unit but mapped as Qa (Quaternary alluvium), of Pleistocene and Holocene ages.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

On the updated map, both the onshore and offshore superficial deposits have, wherever possible, been assigned to the formations defined in Fyfe et al. (2000). Onshore, the superficial deposits have been reassessed on the basis of detailed aerial photograph interpretation (API) and/or borehole interpretation, supplemented by existing data on absolute ages (Sewell et al., 2000, and references therein). However, it has not been possible to reclassify all the onshore superficial deposits, and there remain large areas of undifferentiated mass movement deposits that are grouped as "Pleistocene and Holocene" without a unit designation. Offshore, the superficial deposits have now been assigned to their respective formations.

4.2.2 Lam Tsuen Valley

The boundaries and classification of the superficial deposits that form the extensive river terraces in the Lam Tsuen Valley have been revised (Figure 2). This revision largely comprised refinement of geological boundaries by detailed API, recent borehole information, subdivision of the deposits into Pleistocene and Holocene units based on new age data obtained from sites immediately to the north (on Map Sheet 3), and other absolute age data (Figure 3, Sewell et al., 2000, and references therein).

4.2.3 Intertidal Units and Beaches

The stratigraphy and boundaries of the intertidal units and beaches, which had not previously been separately distinguished, but were combined as Qams (Quaternary estuarine (alluvial) mud and sand) and Qms (Quaternary marine sand)(Table 4), have now been substantially revised. This was accomplished by detailed API, and by the incorporation of recent borehole information, particularly boreholes associated with recent reclamations (Figure 4). Intertidal deposits have now been identified by the symbol Qhi, and beach deposits by Qhb.

4.2.4 Reclamation History

In the first edition of Map Sheet 7 (GCO, 1986a), the development history of the reclamations was not shown. This is inconsistent with some of the later 1:20,000-scale geological maps that broadly portray the advance of coastal reclamations in the major urban areas. In addition to the older reclamations in the Sha Tin, Tai Po and Kwai Chung districts, there are substantial, more recent reclamations at Ma On Shan, Ma Liu Shui, and east Tai Po. The updated map portrays the reclamation history for each of these areas, based on detailed interpretation of selected aerial photographs from 1964 onwards, supplemented by information from available topographic maps.

4.2.5 Ma On Shan Reclamation

Considerable thicknesses of superficial deposits, extending to depths greater than -100 mPD, have been identified in boreholes located along the marble/granite contact zone beneath the Ma On Shan reclamation. These deposits, which occur below marine mud and

Table of Contents
Table of Contents
Table of Contents
Table of Contents

alluvium assigned to the Hang Hau and Chek Lap Kok formations, were previously described as debris flow deposits (Sewell, 1996). The mixed character of the deposits, which may contain blocks of granite and marble, are similar to those described from Tung Chung as "diamict" (Fletcher et al., 2000), a classification adopted in later Hong Kong Geological Survey publications (Sewell & Kirk, 2002). Therefore, the deposits have been provisionally reclassified as "diamict", a term that implies a mechanism of progressive collapse similar to that indicated at Tung Chung, may have occurred along the marble/granite contact zone at Ma On Shan.

4.3 Solid Geology

4.3.1 Marble Subcrop

In 1986, dolomitic limestone was discovered at a depth of 25 m below the seabed in two boreholes east of Ma Shi Chau in Tolo Harbour (Wong & Ho, 1986). Subsequently, marble containing cavities was discovered in boreholes beneath the Ma On Shan reclamation (Frost, 1991). Geophysical surveys carried out by EGS (1991) also suggested that slivers of marble underlay portions of eastern Tolo Harbour. Based on the geophysical and borehole evidence, Frost (1991) interpreted the marble beneath the Ma On Shan reclamation, and dolomitic limestone beneath Tolo Harbour, as belonging to a discontinuous NNE-trending fault-bounded marble subcrop extending from Sha Tin Hoi in the south offshore Harbour Island in the north. Revision of the borehole and geophysical data has led to a refinement of the offshore extension of marble subcrop (see Section 4.3.11(a)).

In a detailed petrographic study of the Ma On Shan and Yuen Long formations, Field & Smale (1991) concluded that there were no discernible differences between the two marbles. Thus, the Ma On Shan Formation was assigned a Carboniferous age (Sewell, 1996), and the type section was designated as Borehole WKS23 from the Ma On Shan reclamation (Sewell et al., 2000).

4.3.2 Monzonite Subcrop

A large, previously unmapped, quartz monzonite subcrop has been identified in the Sha Tin district in the vicinity of Siu Lek Yuen (8399 8269) valley. The quartz monzonite appears to form a sill-like body protruding from a swarm of quartz monzonite dykes that characterise a deep crustal discontinuity extending in a NE-SW direction across the southern part of the map sheet. This subcrop most probably determines the location of the Shek Mun valley area, because quartz monzonite is more susceptible to weathering and erosion than the adjacent granite outcrops. In a regional context, the large volume of quartz monzonite suggests that it may form the subvolcanic root to the Kau Sai Chau Volcanic Group, which is known to originate partly from rhyolite feeder dykes belonging to the Clear Water Bay Formation in the Ma On Shan - Pyramid Hill area (Campbell & Sewell, 1997; Sewell et al. 2000). Previously, these rhyolite feeders (classified as "feldsparphyric rhyolite" on the first edition of Map Sheet 7, GCO, 1986a) were unassigned (Addison, 1986). However, a reassessment of their position with respect to the tripartite granite-rhyolite dyke-volcanic association observed on Lantau Island (Campbell & Sewell, 1997; Sewell et al., 2000) suggests that these rhyolite dykes may serve as the main feeders from the parental monzonite stock. It is noteworthy that the monzonite body does not extend much farther southeastward

Table of Contents
Table of Contents
Table of Contents
Table of Contents

from Shek Mun, but reduces to a series of narrow monzonite dykes.

4.3.3 Minor Intrusions

In the first edition of Map Sheet 7 (GCO, 1986a), numerous minor intrusions of feldsparphyric rhyolite and quartzphyric rhyolite were mapped over a broad area. However, because of the uncertain ages of the various intrusive units, no attempt was made to relate these minor intrusions to individual plutons, or to elucidate their mode of origin.

On the basis of U-Pb age data obtained more recently, Sewell et al. (1998) have proposed a new unit, the Chek Mun Rhyolite, for a swarm of quartzphyric rhyolite dykes that intrude volcanic rocks of the Tseun Wan Volcanic Group, the Tai Po Granodiorite, and pre-volcanic sedimentary rocks in the New Territories. These dykes have now been formally distinguished on the updated Map Sheet 7. Another swarm of quartzphyric rhyolite dykes, associated mainly with the Sha Tin Granite pluton, have been assigned to the East Lantau Rhyolite of the Lantau Dyke Swarm.

Feldsparphyric rhyolite was mapped on Sheet 7 occurring in a diverse range of geological settings. These include margins to quartz monzonite (see above), quartz latite, granite and granodiorite intrusions, and well as within granite intrusions. Large stocks of feldsparphyric rhyolite have also been mapped in the Shek Nga Shan and Pyramid Hill areas. Following a comprehensive review of these settings in light of new absolute age data (Sewell et al., 2000), the feldsparphyric rhyolites have now been assigned to various volcanic and plutonic units. For example, feldsparphyric rhyolite, marginal to granodiorite intrusions, is likely to be a chilled marginal facies. Isolated outcrops of feldsparphyric rhyolite within the Tseun Wan Volcanic Group are probably sills or dykes of chilled Tai Po Granodiorite.

4.3.4 Granite Intrusions Southeast of the Sha Tin Valley

Strange et al. (1990) considered that the Sha Tin Granite pluton exhibited a series of broadly concentric textural zones centred on the Sha Tin Valley, comprising a coarse-grained granite core, surrounded by medium- to fine-grained lithologies. Sewell et al. (1992) attempted to date the Sha Tin granite by Rb-Sr isotope methods using seven samples of coarse-grained granite. Four samples showing similar textural modification were used to define a four point isochron with an age of 148 ± 9 Ma. These samples came from the southeast side of the Sha Tin Valley. The remaining samples from northwest and southeast sides of the Sha Tin valley did not lie on a linear array. A medium-grained textural variant of the Sha Tin Granite was identified on Tsing Yi (Tsing Yi Granite of Sewell & Fyfe, 1995). Sewell & Campbell (1997) assigned much of the fine-grained granite on the northwest side of the Sha Tin Valley to the Needle Hill Granite of the Kwai Chung Suite. The remaining coarse- and medium-grained granite lithologies in the vicinity of the Sha Tin Valley were designated as the Sha Tin Granite of the Kwai Chung Suite.

Based on a single U-Pb zircon age (144.0 ± 0.3, GEO unpublished data) and geochemical data, Sewell et al. (2000) distinguished a new pluton, called the Shui Chuen O Granite, from much of the medium-grained Sha Tin Granite on the southeast side of the Sha

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Tin Valley. The Shui Chuen O Granite was assigned to the Cheung Chau Suite. On the 1:100,000-scale geological map that accompanied the Pre-Quaternary Geology memoir (Sewell et al., 2000), coarse-, medium, and fine-grained granite lithologies on the southeast side of the Sha Tin Valley were shown as the Sha Tin Granite, Shui Chuen O Granite, and Needle Hill Granite, respectively.

On the first edition of Geological Map Sheet 7 (GCO, 1986a), coarse-grained granite in the vicinity of Heather Pass on the southeast side of the Sha Tin Valley, was shown intruding the Shing Mun (JSM) and Ap Lei Chau (JAC) formations. Based on geochemistry and age relationships, Campbell & Sewell (1998) reclassified the JSM in this area, assigning it to the Early Cretaceous Mount Davis Formation of the Repulse Bay Volcanic Group, while the JAC was assigned to the Early Cretaceous Chek Kwu Shan Formation of the Repulse Bay Volcanic Group. Therefore, on geochronological grounds, the fine- and coarse-grained granite at Heather Pass cannot belong to the Needle Hill Granite or Sha Tin Granite and must be reassigned.

Further assessment of the available whole-rock geochemistry has revealed that coarse-grained granite on the southeast side of the Sha Tin Valley, and fine-grained granite immediately west of Ma On Shan (excluding intrusions associated with quartz monzonite stocks and feldsparphyric rhyolite dykes), most probably belong to the Shui Chuen O Granite of the Cheung Chau Suite. For example, on a TiO_2 versus Zr plot, the coarse-grained granite and fine-grained granite samples have slightly higher TiO_2/Zr ratios than samples of Sha Tin Granite from the northwest side of the Sha Tin Valley, and generally plot with Shui Chuen O granite samples in the same array as the Chueng Chau Suite (Figure 5).

Contrasting histories of the minor intrusions further supports the existence of distinct plutons on opposite sides of the Sha Tin Valley. For example, except for minor intrusions associated with quartz monzonite stocks, feldsparphyric and quartzphyric rhyolite dykes are generally absent from major granite bodies southeast of the Sha Tin Valley. This is in marked contrast to the geology northwest of the Sha Tin Valley, where feldsparphyric and quartzphyric dykes intruding granite are relatively common. Similarly, the presence of quartz monzonite stocks on the southeast side of the Sha Tin Valley in contrast to their absence on the northwest side suggests a major difference in intrusive history across the valley.

Although notable differences in the geology on opposite sides of the Sha Tin Valley could be partly explained by displacement along the Tolo Channel Fault, the intrusive history, geochemistry, and age-dating suggests that there are important underlying differences in tectonomagmatic structure. Thus, on the updated Geological Map Sheet 7, all coarse- and fine-grained major granite intrusions south of the Tolo Channel Fault are grouped within the Shui Chuen O Granite of the Cheung Chau Suite.

4.3.5 Hydrothermally Altered Intrusive Rhyolitic Hyaloclastite

Kwan Yam Shan, a prominent landmark in Kadoorie Farm, was previously mapped as granodiorite. However, it is now considered to be formed of altered intrusive rhyolitic hyaloclastite belonging to the Shing Mun Formation. The rhyolitic breccia varies from massive to strongly foliated, and has been pervasively altered by siliceous fluids that replaced

Table of Contents
Table of Contents
Table of Contents
Table of Contents

rhyolite clasts, and infilled voids with clusters of quartz crystals (Plate 1). It is possible that this feature marks the site of a vent feeder within the Shing Mun Formation.

4.3.6 Volcanic Stratigraphy of Ngau Ngak Shan and Ma On Shan

On the first edition of Geological Map Sheet 7 (GCO, 1986a), the tuffaceous rocks underlying Ngau Ngak Shan and Ma On Shan in the eastern part of the district were assigned to the Ap Lei Chau Formation. However, on the basis of their stratigraphy and lithology, Sewell (1996) tentatively correlated these rocks with tuffaceous rocks exposed on the east side of Three Fathoms Cove (previously assigned to the Lai Chi Chong Formation). U-Pb zircon dating (Campbell et al. 2007) subsequently revealed that the tuffaceous rocks on the east side of Three Fathoms Cove were the same age as the Tsuen Wan Volcanic Group. Although stratigraphic correlation on the basis of geochemistry between the tuffaceous rocks at Ma On Shan and Three Fathoms Cove has not been possible due to the altered nature of the rocks, both sequences contain intrusive rhyolite sills that have similar Zr vs. TiO_2 ratios to the rhyolite dykes and granites of the Kwai Chung Suite (Campbell et al. 2007). One sample of intrusive rhyolite from Sham Chung on the east side of Three Fathoms Cove yielded a U-Pb zircon age of 146.6 ± 0.2 Ma (Campbell et al. 2007). Therefore, on the basis of lithological studies by Sewell (1996), and dating and geochemical studies by Campbell et al. (2007), the tuffaceous rocks beneath Ma On Shan and Ngau Ngak Shan have now been assigned to the Shing Mun Formation of the Tsuen Wan Volcanic Group, whereas the intrusive rhyolite has been assigned to the Sham Chung Rhyolite of the Kwai Chung Suite. Sedimentary breccia at the base of the volcaniclastic sequence at Ngau Ngak Shan, and exposed on the summit of a small hill immediately west of Nai Chung, has been correlated with sedimentary breccia of the Yim Tin Tsai Formation exposed on Ma Shi Chau. At both locations, the sedimentary breccia conformably overlies Early to Middle Jurassic sedimentary rocks (see Section 4.3.8(a)(v)).

4.3.7 Refined Location of Major Faults

Detailed interpretation of borehole data in the Sha Tin valley has permitted identification of the Tolo Channel Fault beneath the reclamation fill. The fault has also been shown to coincide with the northern boundary of the Shui Chuen O Granite. In the northeastern part of the Sha Tin valley, the Tolo Channel Fault marks the boundary between the Sha Tin and Shui Chuen O granite plutons. Borehole records have allowed the extension of other faults beneath superficial deposits in the Sha Tin Valley, particularly in areas where especially deep weathering has been detected. For example, in the vicinity of the Sha Tin Water Treatment Works (8352 8243), unusually deep rockhead, locally in excess of -60 mPD, occurs at the intersection of a prominent NW-trending fault and a NE-trending fault beneath a cover of superficial deposits. In the offshore area, the locations of major faults have been inferred from gravity and magnetic data (EGS, 1993).

4.3.8 Locations of Concealed Solid Geological Boundaries

The locations of concealed solid geological boundaries occurring below reclamation, and also offshore, have been constrained by borehole and geophysical data. The offshore

Table of Contents
Table of Contents
Table of Contents
Table of Contents

extension of the marble subcrop, in particular, has been inferred from gravity and magnetic data (EGS, 1993), suggesting the potential for defining a Tolo Harbour Designated Area (see below).

4.3.9 Revised Stratigraphy in Tolo Harbour

Based on stratigraphical assessments, lithological correlations, and heavy mineral analyses, it is now considered that the sedimentary rocks cropping out at the Chinese University, Sham Chung, and Three Fathoms Cove do not belong to the Permian Tolo Harbour Formation as previously reported by Addison (1986) and by Strange et al. (1990). These rocks are now more appropriately assigned to the Middle Jurassic Tai O Formation for the following reasons.

(a) Key Observations

(i) No diagnostic Permian fossils have been found in the sedimentary rocks exposed at Chinese University, Sham Chung, or Three Fathoms Cove (Lee et al., 1997; 1998).

(ii) The sedimentary rocks exposed at the Chinese University are bioturbated (Addison, 1986). They share many structural and lithological characteristics with the sedimentary rocks exposed at Sham Chung, Three Fathoms Cove (Strange et al., 1990) and Tai O, which are also bioturbated (Jones, 1996).

(iii) The deformation history of known Permian rocks exposed on Ma Shi Chau and Centre Island is generally distinct from that of sedimentary rocks exposed at the Chinese University, Sham Chung, and Three Fathoms Cove.

(iv) The heavy mineral assemblages of sedimentary rocks exposed at the Chinese University, Sham Chung and Tai O (Figure 6) are characterised by a high proportion of rounded and subhedral purple zircon, a moderate proportion of subhedral to colourless zircon, a low tourmaline and low rutile content (Table 5, Morton, 1988a, 1988b, 1988c). By contrast, the one sample taken from known Permian rocks on Centre Island, proved by the presence of Permian fossils (Lee et al., 1997), is characterised by a high proportion of rounded purple zircon, a moderate proportion of rounded colourless zircon, and a high rutile content (Table 5, Morton, 1988b).

(v) The sedimentary rocks exposed at Yim Tin Tsai/Ma Shi Chau, the Chinese University, Ma On Shan, Nai Chung

Table of Contents
Table of Contents
Table of Contents
Table of Contents

and Sham Chung, Sham Wat Wan, and Tai O are all conformably overlain by basal units (tuffite and sedimentary breccia) (Allen & Stephens, 1971) of the Tsuen Wan Volcanic Group (Sewell et al., 2000). Field notes by P.M. Allen also report interbedded tuff, sandstone and siltstone at To Tung Wo Liu on the west side of Three Fathoms Cove.

(vi) An outcrop of fine-grained sandstone containing a single Jurassic ammonite has been described from near Yuen Long (Yuen, 1989). One sample taken from this outcrop has yielded a heavy mineral assemblage with a low tourmaline content similar to that from the Chinese University, Sham Chung and Tai O outcrops (Table 5, Morton, 1988a, 1988b, 1988c, Morton & Nancarrow, 1990).

(b) Discussion

(i) The apparent absence of fossils in the sedimentary outcrops at the Chinese University, Three Fathoms Cove and Sham Chung compared to the fossiliferous Permian rocks exposed on Ma Shi Chau and Centre Island was explained by Jones (1996) who suggested that the sedimentary rocks in the two groups of localities belong to different facies, namely: a shore-plain to shoreside tidal flat facies at Ma Shi Chau and Centre Island, and a fluvial-plain facies for the Chinese University, Three Fathoms Cove and Centre Island rocks. However, the two facies have never been seen in stratigraphic contact. Addison (1986) divided the Permian rocks on Ma Shi Chau into a lower marine and an upper non-marine succession, whereas Ruxton (1960) and Allen & Stephens (1971) considered the upper succession to belong to the Devonian Bluff Head Formation. The two successions are in fault contact (Lai et al., 1986). The upper succession is now reassigned to the Devonian Bluff Head Formation based on lithology, and on the earlier interpretations. Given the relatively close proximity of the marine rocks to the non-marine rocks, the most likely explanation is that the sedimentary rocks exposed at the Chinese University, Three Fathoms Cove and Sham Chung belong to a separate formation and are possibly of different age.

(ii) The sedimentary rocks at Tai O and Chinese University are dominantly reddish grey sandstones and siltstones. In addition to worm burrows, ripple marks and cross-bedding are also preserved in some exposures.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

The available lithological descriptions of these rocks and detailed facies interpretations suggest that they belong to the same formation and that the sediments were laid down on an alluvial plain.

(iii) The Permian rocks on Ma Shi Chau and Centre Island are tightly folded and faulted (Addison, 1986). Kink bands developed in tightly folded sandstone on Ma Shi Chau suggest at least two phases of folding. In general, the non-marine rocks exposed at Chinese University, Sham Chung, Three Fathoms Cove and Tai O are only gently folded or tilted, and show only one phase of folding. The apparent difference in deformation history has been explained by suggesting that the tightly contorted nature of the rocks exposed on Ma Shi Chau is due to mainly soft-sediment slumping. However, it is unlikely that such slumping would have occurred in a tidal-flat depositional setting which has been proposed for the Permian succession.

(iv) The similarity in the heavy mineral contents of six of the nine samples collected from sedimentary rocks exposed at the Chinese University, Sham Chung, and Tai O (Morton, 1988a, 1988b, 1988c) is compelling evidence of a stratigraphic relationship. This evidence alone is stronger than that of the one sample analysed from known Permian sedimentary rocks that appear to have a distinct heavy mineral assemblage (Morton, 1988a, 1988b, 1988c). Therefore, the available heavy mineral data indicate that the sedimentary outcrops at the Chinese University, Sham Chung, and Tai O can be assigned to the same formation.

(v) The basal volcanic units of the Tseun Wan Volcanic Group have not been observed in contact with sedimentary rocks containing Permian fossils. The pre-volcanic sedimentary rocks containing Middle Jurassic fossils at Tai O in the southwest of Hong Kong are dominantly reddish grey sandstones and siltstones, conformably overlain by coarse ash crystal tuff (Sewell et al., 2000). Similarly, the pre-volcanic sedimentary rocks containing marine Jurassic fossils at Yim Tin Tsai/Ma Shi Chau and Sham Chung in Tolo Harbour are dominantly black siltstones and mudstones, which are also conformably overlain by tuffite and sedimentary breccia. Although the sedimentary rocks exposed at the Chinese University have not yielded fossils, they are also conformably overlain by tuffite and sedimentary breccia. The basal tuffite (Jty_tt) also has a very similar heavy mineral assemblage to the underlying sandstones (Table 5). The repeated occurrence of basal volcanic units conformably overlying sedimentary rocks in the vicinity of Tolo Harbour, and at Tai O, is strong evidence that the underlying sedimentary rocks, even those that have not yielded fossils, probably belong to the same formation. The reported occurrence of tuff interbedded with sedimentary rocks at Tai Tung Wo Liu also supports a Jurassic age for the sedimentary rocks exposed on the west side of Three Fathoms Cove.

(vi) Although relatively little is known about the Jurassic sedimentary sequence exposed at Yuen Long, the heavy mineral assemblage is generally similar to that of the sedimentary rocks exposed at Chinese University, Sham Chung, and Tai O (Table 5). This provides further evidence that these sedimentary rocks are probably of Jurassic age.

4.3.10 Devonian and Permian Rocks on Ma Shi Chau

The Devonian and Permian rocks on Ma Shi Chau have also been reinterpreted, based largely on the previous work of Allen & Stephens (1971) and more recent work by Lai et al. (1986) and Lee et al. (1997). The sedimentary rocks cropping out on the northern part of the island are now considered to belong to the Devonian Bluff Head Formation (see Section 4.3.8(b)(i)). These rocks are in fault contact with strongly folded Permian rocks in the southern part of the island.

4.3.11 Solid Only Geological Map

Combining the available gravity, magnetic and borehole data for offshore areas, with borehole data for onshore areas, a solid only geological interpretation has been produced. This is the first time such an interpretation has been undertaken for Map Sheet 7, and it now forms a separate GIS layer.

(a) Proposed Offshore Extension of Marble Subcrop

The distribution of other intrusive units, and the inferred location of offshore faults and intrusive boundaries in the Tolo Harbour area, are largely based on lineaments interpreted from the magnetic anomaly map (Figure 7), as well as the extension of known fault trends from beneath the Ma On Shan reclamation (Frost, 1991; Sewell, 1996). Key interpretations of the magnetic lineaments are as follows:

(i) Subcrop of marble south of Harbour Island. The

Table of Contents
Table of Contents
Table of Contents
Table of Contents

presence of marble is known from boreholes immediately south of Harbour Island (Wong & Ho, 1986). Two boreholes drilled for a fixed offshore gas terminal intercepted marble, whereas adjacent boreholes to the east encountered granodiorite and fine-grained granite. The magnetic anomaly map shows a strong negative anomaly in the vicinity of the boreholes that encountered marble (Figure 7). Although there is no additional borehole evidence, the magnetic anomaly is elongated southwestward suggesting that this subcrop is probably an extension, or outlier, of the marble unit (the Ma On Shan Formation) identified beneath the Ma On Shan reclamation (Frost, 1991). Intrusive contacts with the adjacent igneous rocks are postulated.

(ii) NW-trending fault extending offshore from Nai Chung. Fault material and quartz veins encountered in three of the boreholes to the east of the marble subcrop south of Harbour Island suggest the existence of a major fault offshore. Contours on the anomaly map to the northeast of the marble subcrop, and to the northeast of Ma Shi Chau, reveal abrupt changes in magnetic intensity that coincide with marked changes in the onshore geology. The most likely explanation is the offshore continuation of a NW-trending fault at Nai Chung, which is responsible for terminating the Bluff Head Formation southwest of Harbour Island, and the Ma Shi Chau Formation northeast of Ma Shi Chau.

(iii) NW-trending fault extending offshore from Wu Kai Sha. A slight offset in the magnetic anomaly ridge extending northeastward from the Ma On Shan reclamation is interpreted to indicate displacement on a NW-trending fault that extends offshore from Wu Kai Sha and coincides with a known fault at the southeast end of Ma Shi Chau. The presence of this fault is also revealed by Euler gravity anomalies for Tolo Harbour (Fletcher et al. 1997).

(iv) Granodiorite outcrop. The proven existence of granodiorite in boreholes south of Harbour Island (see 4.11(a)(i) above), together with exposures on Centre Island, suggest that the offshore areas surrounding Centre Island, and to the south of Ma Shi Chau, are largely underlain by granodiorite. This is also reflected by the broad positive magnetic anomaly underlying the region (Figure 7).

(v) Western limit of marble subcrop adjacent to Ma On

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Shan. The western limit of marble subcrop adjacent to the Ma On Shan reclamation is relatively poorly constrained due to the absence of borehole data. However, lineations in the magnetic data (EGS, 1993), coupled with the decrease in magnetic intensity toward the Ma On Shan reclamation, is interpreted to mark a possible faulted western boundary against intrusive rocks. A faulted boundary, rather than a purely intrusive boundary, is considered more likely due to the northeast-oriented lineations in the magnetic data. However, a combined intrusive/faulted marble subcrop boundary, as proven beneath the Ma On Shan reclamation, cannot be entirely discounted.

(vi) NW-oriented faults displacing the marble subcrop adjacent to Ma On Shan reclamation. Boreholes on the Ma On Shan reclamation have revealed the existence of several small offsets in the boundary between marble and granite, which are interpreted to represent northwest-trending faults. These are likely to extend offshore, but except for slight perturbations in the magnetic anomaly contours (Figure 7), their precise location is uncertain. Additionally, the southern boundary of the marble subcrop is thought to be constrained by a northwest to northeast-trending fault that is a possible offshore extension of a displaced fault forming a major northwest-oriented valley adjacent to Tai Shui Hang. This also coincides with an abrupt termination of the magnetic anomaly low immediately to the southwest of the Ma On Shan reclamation (Figure 7).

(b) Centre Island

South and west of Ma Shi Chau, the magnetic data suggests that Centre Island is probably a roof pendant of Permian rocks on top of the Tai Po Granodiorite. The small intrusion of granodiorite exposed on Centre Island corroborates this interpretation.

4.4 Structural Geology

A systematic review of the trends of offshore faults, and their relative displacements onshore, suggests that the last major phase of movement occurred predominantly on N- and/or NW-trending faults. In particular, the NE-trending Tolo Channel Fault, which is now considered to pass immediately south of the Ma On Shan reclamation, appears to be systematically offset by sinistral movement along NW-trending faults. The most recent fault movement, which is suggested by a fault trace that apparently displaces superficial deposits at

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Ho Lek Pui, also occurs on a NW-trending fault.

Significantly more structural data than were published previously have been gleaned from the original field survey notebooks and added to the Geodatabase. These structural data principally include joint data and bedding data. This has permitted all the available structural data to be made readily available.

In the first edition of Map Sheet 7 (GCO, 1986a), thermally altered tuff associated with fault zones was mapped as a separate lithological unit. This practice is inconsistent with that adopted for later maps and has been discontinued on the updated map. However, in order to preserve the importance of the original field observations, the thermally altered tuff has been indicated by an overprint screen.

5. FURTHER STUDIES

5.1 Ma On Shan Designated Area

A review of boreholes for the Ma On Shan reclamation indicates that the current Scheduled Area No. 4 has adequately covered the onshore marble subcrop that is of geotechnical concern. However, the offshore geology of the Tolo Harbour area indicates that marble subcrop may extend from Ma On Shan reclamation north and east toward Harbour Island. Therefore, in view of potential future development in this area, an extension of the Scheduled Area No. 4 offshore, or the delineation of a new Designated Area covering the offshore area, may be warranted.

5.2 Landslide Dating Study

Following the successful application of exposure dating using cosmogenic nuclides to natural terrain landslides in Hong Kong (Sewell & Campbell, 2004; Sewell et al., 2006), there is considerable potential to apply these new and improved dating techniques to landforms within the district. The scarps of several deep-seated landslides and debris lobes that are suitable for dating have already been identified, as well as several sites of rock and boulder failures. Some of these landslides may have been triggered by seismic events, and it would be particularly prudent to investigate whether a relationship exists between these relict natural terrain failures and recent activity along the mapped fault traces.

6. REFERENCES

Addison, R. (1986). Geology of Sha Tin. Hong Kong Geological Survey Memoir No. 1. Geotechnical Control Office, Civil Engineering Department, Hong Kong Government, 85 p.

Allen, P.M. & Stephens, E.A. (1971). Report on the Geological Survey of Hong Kong. Hong Kong Government Printer, 107 p. plus 2 maps.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Campbell, S.D.G. & Sewell, R.J. (1997). Structural Control and Tectonic Setting of Mesozoic Volcanism in Hong Kong. Journal of the Geological Society, London, Vol. 154, pp 1039-1052.

Campbell, S.D.G. & Sewell, R.J. (1998). A proposed revision of the volcanic stratigraphy and related plutonic classification of Hong Kong. Hong Kong Geologist, Vol. 4, pp 1-11.

Campbell, S.D.G., Sewell, R.J., Davis, D.W. & So, A.C.T. (2007). New U-Pb age and geochemical constraints on the stratigraphy and distribution of the Lantau Volcanic Group, Hong Kong. Journal of Asian Earth Sciences, Vol. 31, pp 139-152.

Cheung, P.C.T. & Shaw, R. (1993). SEAMAT Study: Final Report. Geotechnical Engineering Office, Civil Engineering Department, Hong Kong Government, 163 p.

Electronic and Geophysical Services Ltd. (EGS) (1991). Regional Gravity Survey of Hong Kong. Final Report: Job Number HK50190, Electronic and Geophysical Services Ltd., Hong Kong, 15 p.

Electronic & Geophysical Services Ltd. (EGS) (1993). Ma On Shan and Tolo Harbour Gravity and Magnetic Surveys. Final Report: Job No. HK69292, Electronic and Geophysical Services Ltd., Hong Kong, 34 p.

Electronic & Geophysical Services Ltd. (EGS) (1999). Tolo Channel and Mirs Bay. Marine Magnetic Survey. Final Report: Job No. HK141999, Electronic and Geophysical Services Ltd., Hong Kong, 5 p.

Field, B. & Smale, D. (1991). Petrological study of samples from Yuen Long and Ma On Shan, Hong Kong. Report No. 1991/16, DSIR Geology & Geophysics, Lower Hutt, New Zealand, 18 p.

Fletcher, C.J.N., Campbell, S.D.G., Carruthers, R.M., Busby, J.P. & Lai, K.W. (1997). Regional tectonic setting of Hong Kong: implications of new gravity models. Journal of the Geological Society, Vol. 154, pp 1021-1030.

Fletcher, C.J.N, Wightman, N.R., & Goodwin, C.R. (2000). Karst-related Deposits Beneath Tung Chung New Town, Hong Kong: Implications for Deep Foundations. In: Proceedings of the Engineering Geology Hong Kong 2000 Conference, Institution of Mining and Metallurgy, Hong Kong Branch, pp 139-149.

Frost, D.V. (1991). The geology of Ma On Shan and adjacent areas. British Geological Survey Technical Report WC/91/17, 28 p.

Fyfe, J.A., Shaw, R., Campbell, S.D.G., Lai, K.W., & Kirk, P.A., (2000). The Quaternary Geology of Hong Kong. Geotechnical Engineering Office, Civil Engineering Department, Hong Kong SAR Government, 209 p. plus 6 maps.

Geotechnical Control Office (GCO) (1986a). Sha Tin. Hong Kong Geological Survey Sheet 7, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Table of Contents
Table of Contents
Table of Contents

Geotechnical Control Office (GCO) (1986b). Hong Kong and Kowloon. Hong Kong Geological Survey Sheet 11, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Control Office (GCO) (1987). Hong Kong South and Lamma Island. Hong Kong Geological Survey Sheet 15, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Control Office (GCO) (1988a). Yuen Long. Hong Kong Geological Survey Sheet 6, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Control Office (GCO) (1988b). Tsing Shan. (Castle Peak). Hong Kong Geological Survey Sheet 5, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Control Office (GCO) (1989a). San Tin. Hong Kong Geological Survey Sheet 2, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Control Office (GCO) (1989b). Sai Kung. Hong Kong Geological Survey Sheet 8, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Control Office (GCO) (1989c). Clear Water Bay. Hong Kong Geological Survey Sheet 12, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Control Office (GCO) (1989d). Waglan Island. Hong Kong Geological Survey Sheet 16, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Control Office (GCO) (1991). Sheung Shui. Hong Kong Geological Survey Sheet 3, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Engineering Office (GEO) (1991). Silver Mine Bay. Hong Kong Geological Survey Sheet 10, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Engineering Office (GEO) (1992). Kat O Chau. Hong Kong Geological Survey Sheet 4, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Engineering Office (GEO) (1994). Tung Chung. Hong Kong Geological Survey Sheet 9, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Geotechnical Engineering Office (GEO) (1995). Shek Pik. Hong Kong Geological Survey Sheet 13, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Engineering Office (GEO) (1996a). Ma On Shan. Hong Kong Geological Survey Sheet 7-NE-D,C(Part), Solid Geology, 1:5,000 Series HGP5B, Hong Kong Government.

Geotechnical Engineering Office (GEO) (1996b). Cheung Chau. Hong Kong Geological Survey Sheet 14, Solid and Superficial Geology, 1:20,000 Series HGM20, Hong Kong Government.

Geotechnical Engineering Office (GEO) (2002a). Tung Chung Wan. Hong Kong Geological Survey Sheet 9-SE-A, Solid and Superficial Geology, 1:5,000 Series HG5, Hong Kong SAR Government.

Geotechnical Engineering Office (GEO) (2002b). Pok To Yan. Hong Kong Geological Survey Sheet 9-SE-B, Solid and Superficial Geology, 1:5,000 Series HG5, Hong Kong SAR Government.

Jones, N.S. (1996). The Geology and Sedimentology of Upper Palaeozoic and Mesozoic Sedimentary Successions in Hong Kong. British Geological Survey Technical Report WH/96/130R, British Geological Survey, United Kingdom, 48 p.

King, J.P. (1999). Natural Terrain Landslide Study - The Natural Terrain Landslide Inventory. GEO Report No. 74, Geotechnical Engineering Office, Civil Engineering Department, Hong Kong SAR Government, 127 p.

Lai, K.W., Liu, K.B., Yueng, K.C. Leung, C.F. & Wai, C.C. (1986). A Preliminary Study on the Geological Structure of Ma Sze Chau, Hong Kong. The Geography Bulletin, Hong Kong, Vol 16, pp 69-90.

Lee, C.M., Chan, K.W. & Ho, K.H. (1997). Palaeontology and Stratigraphy of Hong Kong: Volume 1. Science Press, Beijing, 206 p. plus 57 plates.

Lee, C.M., Chan, K.W. & Ho, K.H. (1998). Palaeontology and Stratigraphy of Hong Kong: Volume 2. Science Press, Beijing, 242 p. plus 81 plates.

Morton, A.C. (1988a). A Preliminary Assessment of the Potential Application of Heavy Mineral Analysis to Lithostratigraphic Problems in Hong Kong. British Geological Survey Technical Report WH/88/67R, British Geological Survey, United Kingdom, 16 p.

Morton, A.C. (1988b). Lithostratigraphic Assignment of Sandstone Samples from Hong Kong Using Heavy Mineral Data. British Geological Survey Technical Report WH/88/165R, British Geological Survey, United Kingdom, 10 p.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Morton, A.C. (1988c). Heavy Minerals in Sandstones from Hong Kong and their Lithostratigraphic Implications: III. British Geological Survey Technical Report WH/88/425R, British Geological Survey, United Kingdom, 7 p.

Morton, A.C. & Nancarrow, P.H.A. (1990). Petrographic Aspects of Sediments from the Yuen Long Area of Hong Kong. British Geological Survey Technical Report SS/90/10, British Geological Survey, United Kingdom, 8 p.

Ruxton, B.P. (1960). The Geology of Hong Kong. Quarterly Journal of the Geological Society of London, Vol. 115, pp 233-260.

Sewell, R.J. (1996). Geology of Ma On Shan. Hong Kong Geological Survey Sheet Report No. 5, Geotechnical Engineering Office, Hong Kong Government, 45 p.

Sewell, R.J. (1999). Geochemical Atlas of Hong Kong. Geotechnical Engineering Office, Civil Engineering Department, Hong Kong SAR Government Printer, 120 p.

Sewell, R.J. (2007). Geochemical data for Hong Kong stream sediments. Geological Report GR 1/2007, Geotechnical Engineering Office, Civil Engineering and Development Department, Hong Kong SAR Government, 274 p.

Sewell, R.J., Barrows, T.T., Campbell, S.D.G. & Fifield, L.K. (2006). Exposure dating (^{10}Be, ^{26}Al) of natural terrain landslides in Hong Kong, China. Geological Society of America Special Paper 415, pp 131-146.

Sewell, R.J. & Campbell, S.D.G. (1997). Geochemistry of coeval Mesozoic plutonic and volcanic suites in Hong Kong. Journal of the Geological Society, Vol. 154, pp 1053-1066.

Sewell, R.J. & Campbell, S.D.G. (2001). Geochemical Data for Hong Kong Rocks. Geological Report GR 4/2001, Geotechnical Engineering Office, Hong Kong SAR Government, 120 p.

Sewell, R.J. & Campbell, S.D.G. (2004). Report on the Dating of Natural Terrain Landslides in Hong Kong. Special Project Report SPR 1/2004, Geotechnical Engineering Office, Civil Engineering Department, Hong Kong SAR Government, 148 p.

Sewell, R.J., Campbell, S.D.G. & Davis, D.W. (1998). Three New U-Pb Ages from Igneous Rocks in the NE New Territories of Hong Kong and their Structural Significance. Hong Kong Geologist, Vol. 4, Geological Society of Hong Kong, pp 31-36.

Sewell, R.J., Campbell, S.D.G., Fletcher, C.J.N, Lai, K.W. & Kirk, P.A. (2000). The Pre-Quaternary Geology of Hong Kong. Geotechnical Engineering Office, Civil Engineering Department, Hong Kong SAR Government, 181 p. plus 4 maps.

Sewell, R.J., Darbyshire, D.P.F., Langford, R.L. & Strange, P.J. (1992). Geochemistry and Rd-Sr geochronology of Mesozoic granites from Hong Kong. Transactions of the Royal Society of Edinburgh (Earth Sciences). Vol. 83, pp 269-280.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Sewell, R.J. & Fyfe, J.A. (1995). Geology of Tsing Yi. Hong Kong Geological Survey Sheet Report No. 3, Geotechnical Engineering Office, Hong Kong Government, 43 p.

Sewell, R.J. & Kirk, P.A. (2002). Geology of Tung Chung and Northshore Lantau Island. Hong Kong Geological Survey Sheet Report No. 6, Geotechnical Engineering Office, Civil Engineering Department, Hong Kong SAR Government, 41 p.

Strange, P.J., Shaw, R. & Addison, R. (1990). Geology of Sai Kung and Clear Water Bay. Hong Kong Geological Survey Memoir No. 4, Geotechnical Control Office, Civil Engineering Department, Hong Kong Government, 111 p.

Wong, J.C.F. & Shaw, R. (2007). High-level Coastal Deposits in Hong Kong. Geological Report No. GR 2/2007, Geotechnical Engineering Office, Civil Engineering and Development Department, HKSAR Government, 44 p. plus 2 Appendices.

Wong, K.M. & Ho, S. (1986). Dolomitic Limestone in Tolo Harbour. Geological Society of Hong Kong Newsletter, Vol. 4, Geological Society of Hong Kong, pp 20-23.

Yuen, D.K.M. (1989). Discovery of an ammonite of probable Jurassic age near Yuen Long. Geological Society of Hong Kong Newsletter, Vol. 7, pp 49-51.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

LIST OF TABLES

Table of Contents
Table of Contents
Table of Contents

Table 1 - 1:20,000-scale HKGS Geological Map Updating Programme

Sheet No.	Name	Survey (Onshore* Offshore#)	Sheet Published	Priority for Map revision	Completion of 1st cycle of updating
7	Sha Tin	1983-84*#	1986	High	2004
11	Hong Kong & Kowloon	1984-85* 1985#	1986	High	2005
15	Hong Kong South & Lamma Island	1985-86* 1986#	1987	High (north) Low (south)	2005
6	Yuen Long	1984-87* 1986-87#	1988	High	2006
5	Tsing Shan (Castle Peak)	1984-86* 1986-87#	1988	High (east) Low (west)	2006
9	Tung Chung	1989-92* 1991-92#	1994	High (north) Low (south)	2007
10	Silver Mine Bay	1985-89* 1990#	1991	High (north) Low (south)	2007
12	Clear Water Bay	1986-87* 1988#	1989	High (west) Low (east)	2008
3	Sheung Shui	1988-89* 1989-90#	1991	Moderate	2008
2	San Tin	1985-86* 1986-87#	1989	Low	2009
8	Sai Kung	1986-88* 1988#	1989	Low	2010
13	Shek Pik	1992* 1992#	1995	Low	2011
14	Cheung Chau	1985-89* 1990-93#	1995	Low	2012
16	Waglan Island	1983-84* 1988-89#	1989	Low	2013
4	Kat O Chau	1989-90* 1989-92#	1992	Low	2013

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Table 2 - Summary of Geological Datasets Stored in the GIS Geodatabase

Dataset	Attribute	Description
Solid Units	Polygon	Areas of Main Solid Mapping Units
Faults	Line	Major Faults
Fold Axes	Line	Major Fold Axes
Metamorphism*	Polygon	Areas of Metamorphism and/or Alteration
Textures*	Polygon	Areas of Major Textural Features
Mineral Veins*	Line	Major Mineral Veins
Dykes*	Line	Major Dykes
Rock Samples	Point	Locations of samples in HKGS Collection
Fossils	Point	Fossil Locality
Minerals	Point	Economic Mineral Occurrence
Superficial Units	Polygon	Areas of Main Superficial Mapping Units
CLK Contours	Line	Contours on Base of Offshore Superficial Deposit
Hang Hau Isopachs*	Line	Thickness of Hang Hau Formation
Buried Channels*	Line	Locations of Offshore Channels
Alluvial Terraces	Line	Locations of Alluvial Terraces
NT Landslides*	Line	Locations of Landslide Debris Trails
Acoustic Turbidity	Polygon	Areas of Acoustic Turbidity
Reclamation/Fill Body	Polygon	Areas of Reclamation Fill
Marine Magnetic*	Polygon	Areas of Offshore Marine Magnetic Anomalies
Airborne Magnetic*	Polygon	Areas of Airborne Magnetic Anomalies
Gravity*	Polygon	Areas of Gravity Anomalies
Seismic Tracks	Line	Locations of Seismic Tracks
Seismic Profiles	Line	Profiles of Seismic Track Plots
Field Notes	Point	Locations of Original Field Notebook Entries
Field Sketches	Point	Scanned Portion of Field Notebook Sketches
Structure	Point	Locations of Structural Measurements
Field Data Map	Point	Scanned Portion of Field Data Map
Field Photos	Point	Scanned Field Photographs
Boreholes	Point	Locations of Interpreted Boreholes
High Res. Photos	Point	Locations of High Resolutions Photographs
Tunnel Geology	Line	Interpreted Tunnel Geology Profiles
WR-Geochemistry	Point	Locations of Analysed Whole Rock Samples
SS-Geochemistry	Point	Locations of Anaysed Stream Sediment Samples
Age Dating	Point	Locations of Dated Rock Samples
Heavy Minerals	Point	Locations of Analysed HM Samples
Scheduled Areas	Polygon	Outlines of Scheduled Areas
Designated Areas	Polygon	Outlines of Designated Areas
Former Mining Area	Point	Locations of Former Mine Areas
Former Mine Adit	Point	Locations of Former Mine Adits
Borrow Areas*	Polygon	Locations of Borrowed Material
Dumping Grounds*	Polygon	Locations of Dumping Grounds

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Table 3 - Onshore Classification Table

Map Sheet No. & Year	**Hillslope Deposits**	**Terrace Deposits**	**Fluvial Deposits**	**Anthropogenic Deposits**
Sheet 7 (1986)	Qd & Qt & Qdt & Qdl (P&H)	-----	Qa (P&H)	Qfs (H)
Sheet 11 (1986)	Qd & Qt & Qdt (P&H)	Qat (P&H)	Qa (P&H)	Qfs (H)
Sheet 15 (1987)	Qd & Qt & Qdt (P&H)	-----	Qa (P&H)	Qfs (H)
Sheet 5 (1988)	Qd & Qt (P&H) / Qpd (P)	Qpa (P)	Qa (H)	Qfs (H)
Sheet 6 (1988)	Qd & Qt (P&H) / Qpd (P)	Qpa (P)	Qa (H)	Qfs (H)
Sheet 2 (1989)	Qd (P&H) / Qpd (P)	Qpa (P)	Qa (H)	Qfs (H)
Sheet 8 (1989)	Qd & Qt & Qdt (P&H)	-----	Qa (P&H)	Qfs (H)
Sheet 12 (1989)	Qd & Qdt (P&H)	Qpa (P)	Qa (H)	Qfs (H)
Sheet 16 (1990)	Qd (P&H)	-----	-----	-----
Sheet 3 (1991)	Qd & Qt (P&H) / Qpd (P)	Qpa (P)	Qa (H)	Qfs (H)
Sheet 10 (1991)	Qd (P&H) / Qpd (P)	Qpa (P)	Qa (H)	Qfs (H)
Sheet 4 (1992)	Qd & Qt (P&H) / Qpd (P)	Qpa (P)	Qa (H)	-----
Sheet 9 (1994)	Qd & Qdt (P&H) / Qpd (P)	Qpa (P)	Qa (H)	Qfs (H)
Sheet 13 (1995)	Qd (P&H)	Qpa (P)	Qa (H)	Qfs (H)
Sheet 14 (1995)	Qd (P&H) / Qpd (P)	Qat (P&H)	Qa (H)	Qfs (H)

LEGEND

Symbol	**Age**	**Genetic Classification**		
		d	Debris flow deposits	Unsorted sand, gravel, cobbles and boulders; clay/silt matrix
Q	Quaternary			
H	Holocene	pd	(P) Debris flow deposits	Silt/sand, clayey with cobbles and boulders
P	Pleistocene			
P&H	Pleistocene & Holocene	t	Talus (rockfall) deposits	Gravel, cobbles and boulders; sparse finer-grained matrix
		dt	Mixed debris flow and talus	Mixed Qd and Qt
		dl	Slide deposits	Regolith and bedrock materials
		a	Alluvium	Clay/silt, sand and gravel
		at	Terrace deposits	Sand, gravel, silt and clay
		pa	(P) Terraced alluvium	Clay/silt, gravelly, sandy
		fs	Fill; sanitary fill	Natural earth and waste

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Table 4 - Offshore Classification Table

Map Sheet No. & Year	**Offshore Subcrops**	**Offshore Seabed**	**Offshore Littoral**	**Intertidal Deposits**	**Coastal Deposits**
Sheet 7 (1986)	Qa (P&H)	Qmm (H)	Qms (H)	Qams (H)	[Qms]
Sheet 11 (1986)	PCK	HHH elm & tbm	ms (H)	-----	Qb (H)
Sheet 15 (1987)	PCK	HHH elm & tbm	ms (H)	-----	Qb (H) Qbb & Qbr
Sheet 5 (1988)	QCK (P)	QHH (H)	ms (H)	-----	Qb & Qrb (H)
Sheet 6 (1988)	QCK (P)	QHH (H)	ms (H)	-----	Qb & Qrb (H)
Sheet 2 (1989)	QCK (P)	QHH (H)	ms (H)	Qam (H)	Qb & Qrb (H)
Sheet 8 (1989)	QCK (P)	QHH (H)	ms (H)	-----	Qb & Qbb (H)
Sheet 12 (1989)	QCK (P)	QHH (H)	ms (H)	-----	Qb & Qbb (H)
Sheet 16 (1990)	QCK (P)	QHH (H)	ms (H)	-----	Qb (H)
Sheet 3 (1991)	QCK (P)	QHH (H)	ms (H)	Qi (H)	Qb (H)
Sheet 10 (1991)	QCK (P)	QHH (H)	mss & msb (H)	Qi (H)	Qb (H) Qbb & Qrb
Sheet 4 (1992)	QCK (P)	QHH (H)	ms (H)	Qi (H)	Qb (H) Qbb & Qbs
Sheet 9 (1994)	QCK (P) QSW (P) ct (P&H)	QHH (H)	ms (H)	Qi (H)	Qb (H) Qbb & Qrb
Sheet 13 (1995)	QCK (P) QSW (P)	QHH (H)	ms (H)	Qi (H)	Qb (H) Qbb & Qbs
Sheet 14 (1995)	QCK (P) QSW (P)	QHH (H)	ms (H)	Qi (H)	Qb (H) Qbb & Qrb

LEGEND

Symbol	**Age**	**Genetic Classification**		
		mm	Marine mud	Clay/silt, shelly
Q	Quaternary	ms	Marine sand	Sand, shelly
H	Holocene	mss	Marine sand sheets	Sand, some gravel and mud
P	Pleistocene	msb	Marine sand banks	Sand, some gravel and mud
P&H	Pleistocene & Holocene	ams	Estuarine mud and sand	Clay/silt and sand
		am	Estuarine mud and sand	Clay/silt and sand
		i	Estuarine and intertidal	Mud and sand
		ct	Channel and transgressive	Sand, some gravel and silt
		a	Alluvium	Clay/silt, sand and gravel
		b	Beach	Sand
		bb	Boulder beach	Boulders/Cobbles and boulders
		br	Beach rock	Beach rock
		rb	Raised beach (Sh 2, 5 , 6, 14)	Sand
		rb	Back beach (Sh 9 & 10)	Sand
		bs	Back shore deposits (Sh 4)	Sand and gravel
		bs	Back beach deposits (Sh 13)	Sand
		Lithostratigraphic Formations		
		HH	Hang Hau	Dark grey marine mud
		CK	Chek Lap Kok	Clay, silt, sand and gravel
		SW	Sham Wat	Silty clay
		elm	East Lamma Channel Member	Marine mud
		tbm	Telegraph Bay Member	Marine mud

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Table 5a - Detrital Translucent Heavy Minerals in Sandstones from the Tolo Harbour, Yuen Long and Tai O Areas, Expressed As Frequency % of the 63-125μm Fraction (after Morton 1998a, 1998b, 1998c, and Morton & Nancarrow 1990)

SAMPLE	EAST	NORTH	SHEET	OLD CLASS-IFICATION	NEW CLASS-IFICATION	LITHOLOGY	AN	AP	CA	CR	CP	EP	GT	HC	MO	OP	RU	SA	SP	TO	ZR
CHINESE UNIVERSITY																					
HK4790	838100	831300	7NE	PTH	Jo_zt	SANDSTONE	0.5	46.0	R		3.0	29.0					5.0		0.5	1.5	14.5
HK4792	838200	832300	7NE	PTH	Jty_tt	TUFFACEOUS SANDSTONE		19.0				6.5					1.0			1.0	72.5
HK4789	838100	831300	7NE	PTH	Jo_zt	SANDSTONE	5.5	37.5	5.5			20.5					6.5			2.0	22.5
HK4788*	838800	831500	7NE	PTH	Jo_zt	SILTSTONE	6.5	25.5	1.0		0.5	7.0	0.5			0.5				27.0	31.0
SHAM CHUNG																					
HK3681	846600	833850	8NW	PTH	Jo_st	SANDSTONE AND SILTSTONE	0.5				0.5	5.0	0.5				6.5			2.5	84.5
HK3682	846610	833920	8NW	JTC	Jo_st	CONGLOMERATE		1.0			1.5	6.0	0.5				3.0				76.5
TAI O (Middle Jurassic age established by fossil evidence)																					
HK2812	802740	813060	9SW	Cmp	Jo_st	SANDSTONE	7.0					4.5	0.5		0.5		3.5			1.0	83.0
HK2810*	802780	813000	9SW	Cmp	Jo_st	SANDSTONE					0.5	8.0					4.5			17.5	69.5
YUEN LONG (Early to Middle Jurassic age tablished by fossil evidence)																					
AMMONITE SITE	821120	830350	6NW	JTC	Jo_st	SANDSTONE		0.5		0.5	3.0		2.5				1.0			3.0	89.5
CENTRE ISLAND (Permian age established by fossil evidence)																					
HK178	840900	833420	7NE	PTH	Pt_zt	BLACK SILTSTONE					R						25.0			R	75.0

Early to Middle Jurassic: Generally low tourmaline, low rutile (*moderate rutile)
Permian: High rutile
AN=Andalusite, AP=Apatite, CA=Calcic Amphibole, CR=Chromite, CP=Clinopyroxene, EP=Epidote, GT=Garnet, HC=Hercynite, MO=Monazite, OP=Orthopyroxene, RU=Rutile (includes anatase),
SA=Sodic amphibole, SP=Sphene, TO=Tourmaline, ZR=Zircon

Table 5b - Classification of Zircon Types by Colour and Morphology (after Morton 1998a, 1998b, 1998c, and Morton & Nancarrow 1990)

SAMPLE	EAST	NORTH	SHEET	OLD CLASS-IFICATION	NEW CLASS-IFICATION	LITHOLOGY	COLOURLESS			PURPLE			BROWN			TOTAL			ROUNDNESS INDEX
							E	S	R	E	S	R	E	S	R	C	P	B	
CHINESE UNIVERSITY																			
HK4790	838100	831300	7NE	PTH	Jo_zt	SANDSTONE	1	2	14	4	16	59		1	3	17	79	4	+71
HK4792	838200	832300	7NE	PTH	Jty_tt	TUFFACEOUS SANDSTONE		1	13	3	18	64		1		14	85	1	+74
HK4789	838100	831300	7NE	PTH	Jo_zt	SANDSTONE		3	8	1	3	9				11	13		+67
HK4788[1]	838800	831500	7NE	PTH	Jo_zt	SILTSTONE	3	16	11		6	10		1	2	30	16	3	+36
SHAM CHUNG																			
HK3681	846600	833850	8NW	PTH	Jo_st	SANDSTONE AND SILTSTONE	2	12	5	13	41	26		1		19	80	1	+16
HK3682	846610	833920	8NW	JTC	Jo_st	CONGLOMERATE	1	15	10	2	24	46		2		26	72	2	+53
TAI O (Middle Jurassic age established by fossil evidence)																			
HK2812	802740	813060	9SW	Cmp	Jo_st	SANDSTONE	3	7	3	8	42	34		2	1	13	84	3	+27
HK2810[1]	802780	813000	9SW	Cmp	Jo_st	SANDSTONE	10	33	11	1	18	21		6		54	40	6	+21
YUEN LONG (Early to Middle Jurassic age established by fossil evidence)																			
AMMONITE SITE[1]	821120	830350	6NW	JTC	Jo_st	SANDSTONE	2	55	14	1	21	4		3		71	26	3	+15
CENTRE ISLAND (Permian age established by fossil evidence)																			
HK178	840900	833420	7NE	PTH	Pt_zt	BLACK SILTSTONE	3	3	19		7	66	1		1	25	73	2	+82

E=Euhedral, S=Subhedral, R=Rounded, C=Colourless, P=Purple, B=Brown, Roundness Index=Rtot–Etot
Early to Middle Jurassic: Generally high proportion of rounded and subhedral purple zircon; moderate proportion of subhedral and rounded colourless zircon ([1]samples with C > P)
Permian: Generally high proportion of rounded purple zircon; moderate proportion of rounded colourless zircon

LIST OF FIGURES

Table of Contents
Table of Contents
Table of Contents

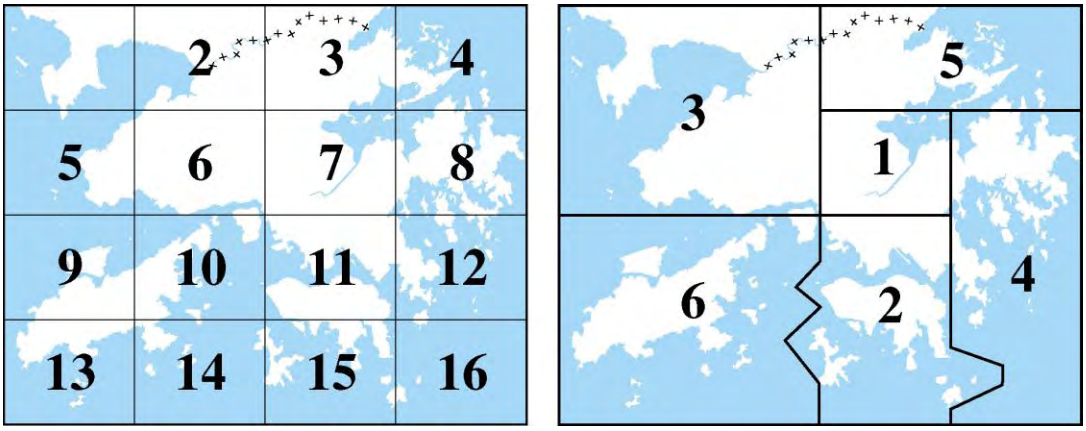

Figure 1 - Published First Edition Hong Kong Geological Survey 1:20,000-scale Geological Maps and Memoirs

Table of Contents
Table of Contents
Table of Contents
Table of Contents

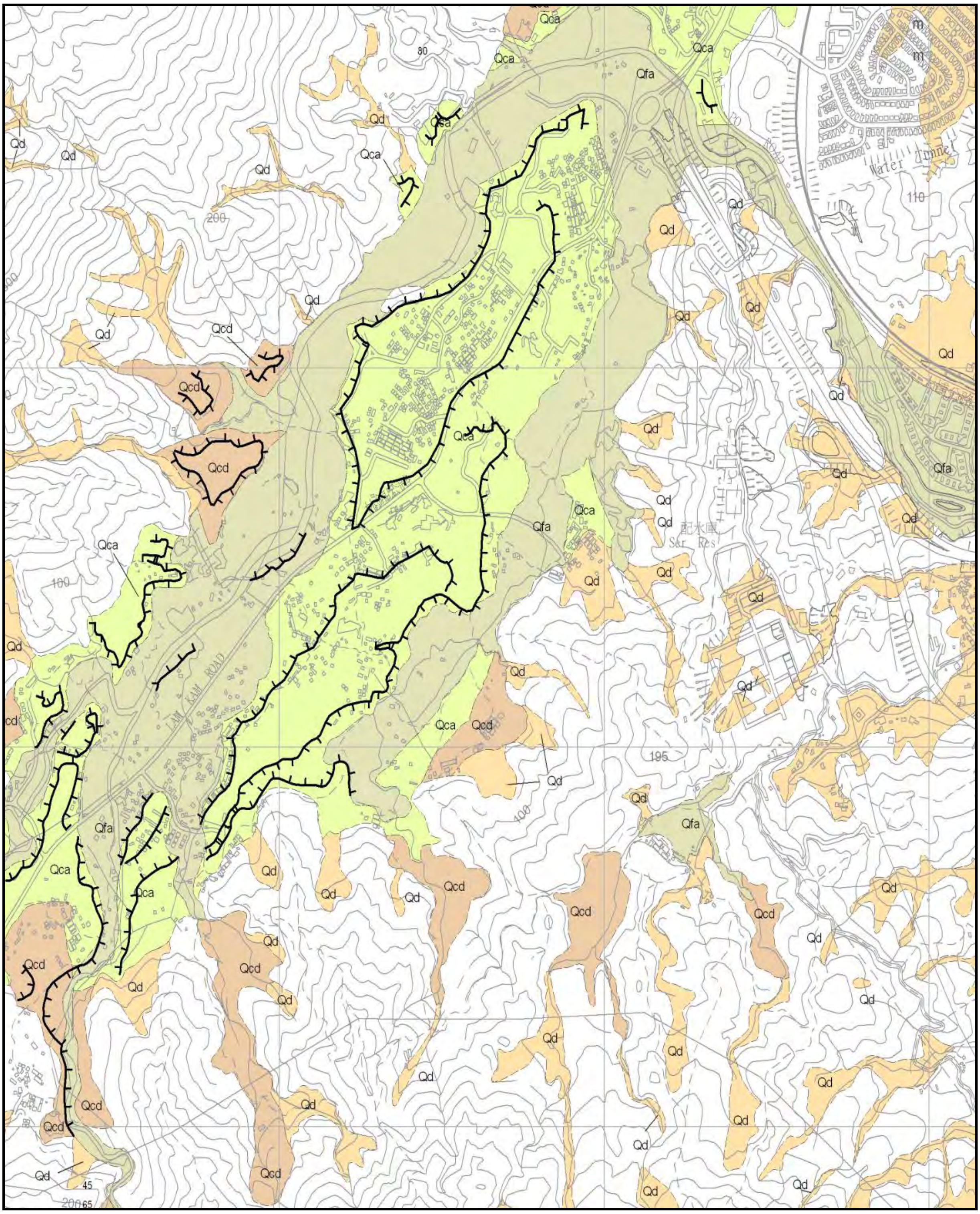

Figure 2 - Revised Distribution of Superficial Deposits Forming the Main River Terraces in the Lam Tsuen Valley

Table of Contents
Table of Contents
Table of Contents
Table of Contents

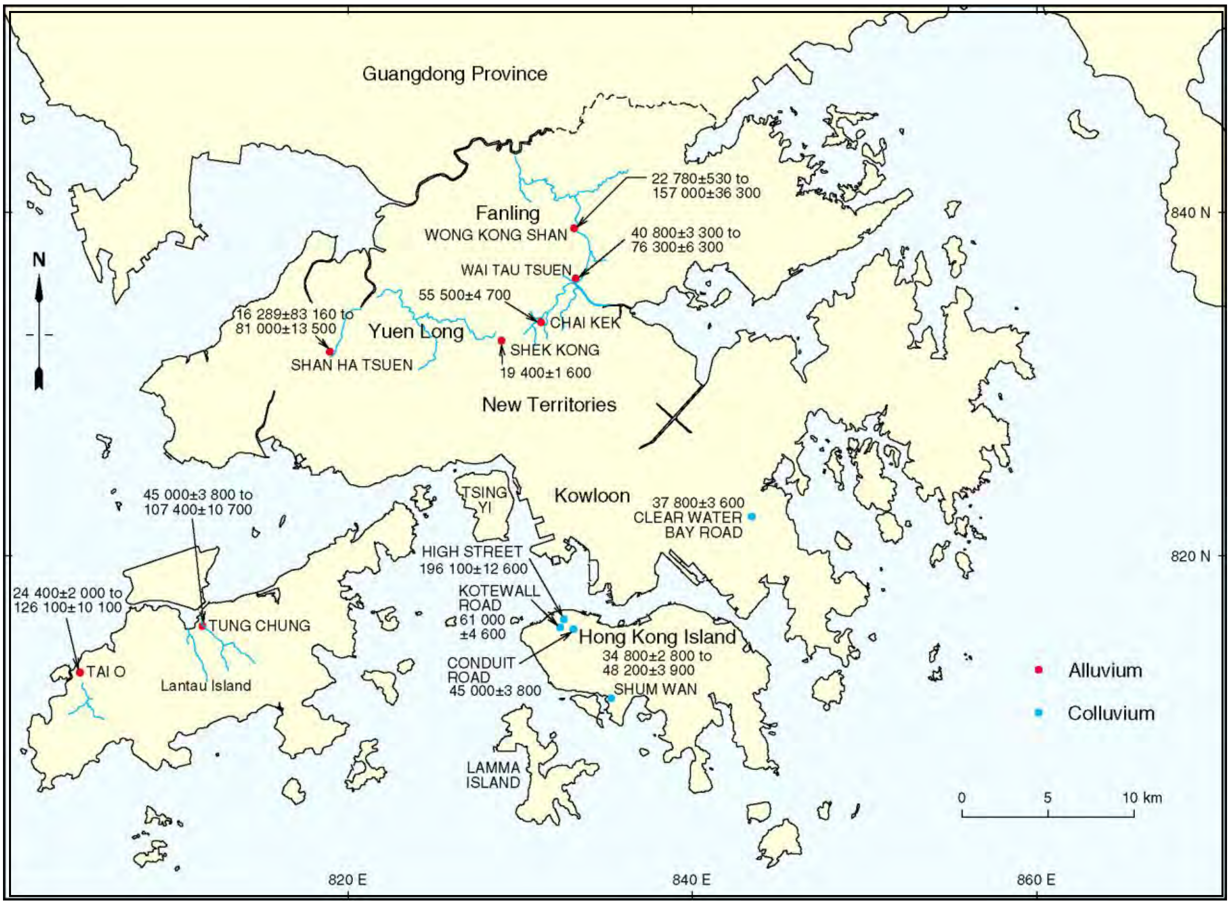

Figure 3 - Luminescene Age Data for Pleistocene Alluvial and Colluvial Deposits from Hong Kong (from Sewell et al. 2000)

Table of Contents
Table of Contents
Table of Contents
Table of Contents

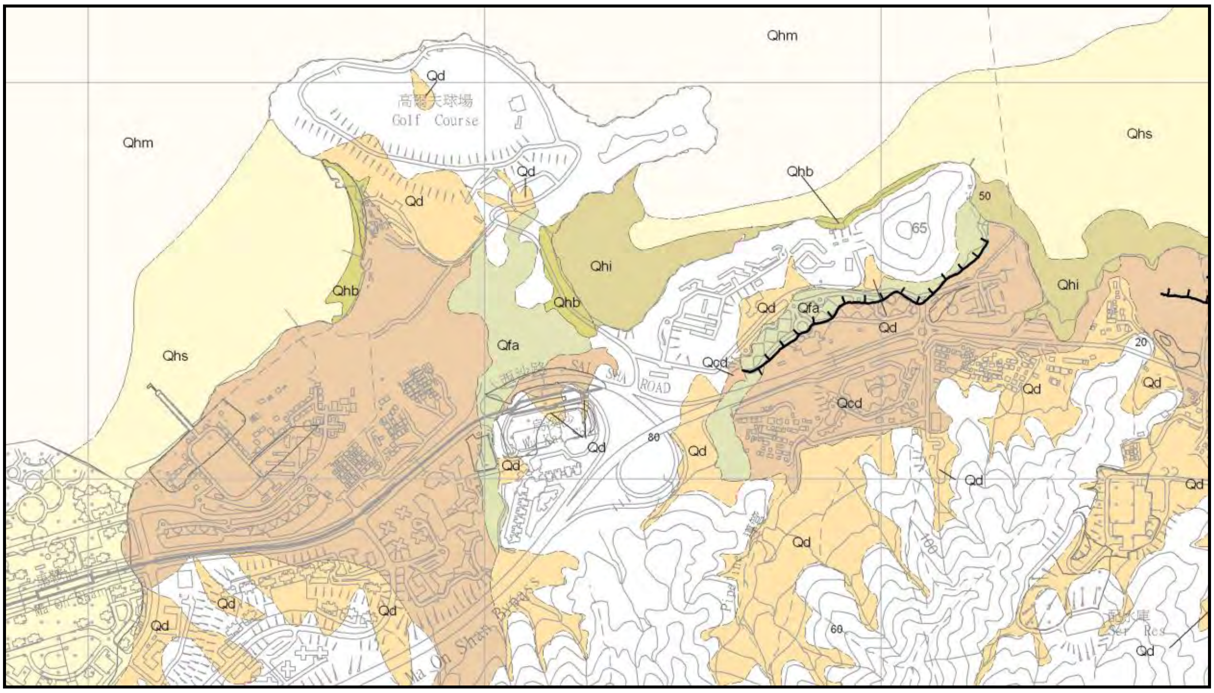

Figure 4 - Revised Stratigraphy and Boundaries of Intertidal Units in the Vicinity of Wu Kai Sha Tsui (8430 8330)

Table of Contents
Table of Contents
Table of Contents
Table of Contents

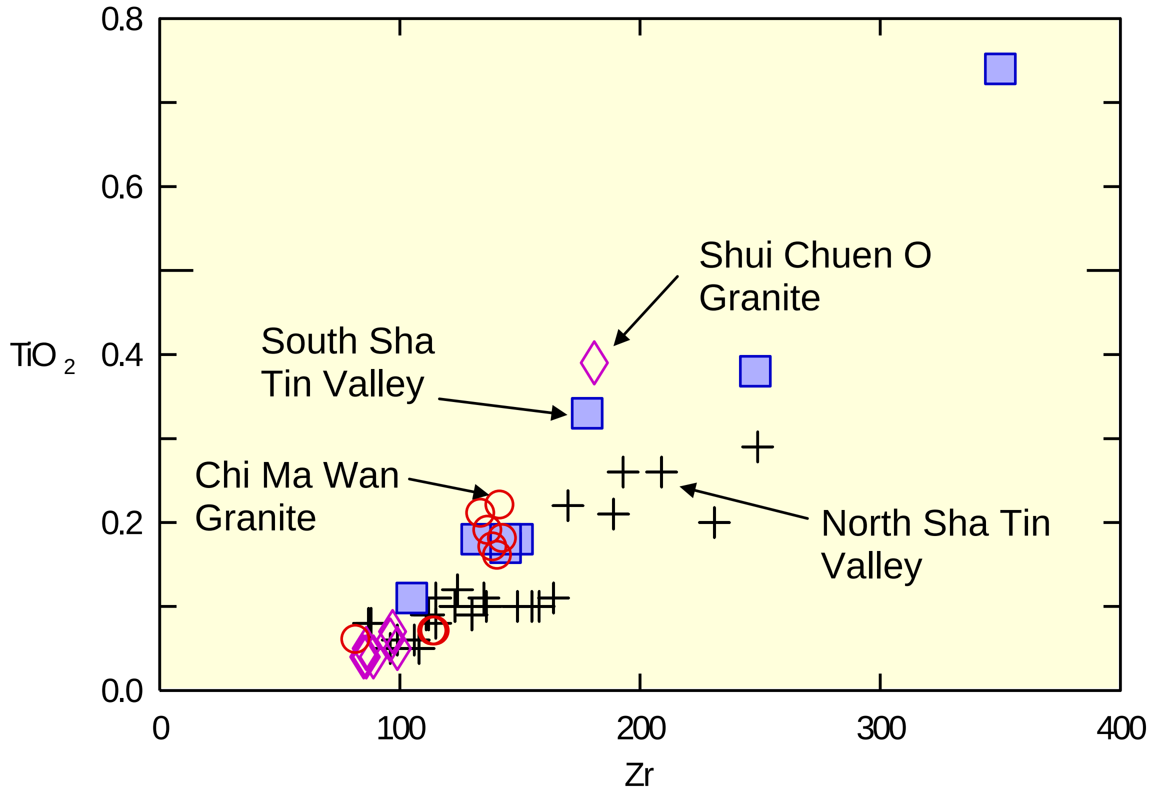

Figure 5 - TiO_2 versus Zr Plot for Granite Samples from the Sha Tin Valley Showing Slightly Higher TiO_2/Zr ratios of Granites Belonging to the Cheung Chau Suite

Table of Contents
Table of Contents
Table of Contents
Table of Contents

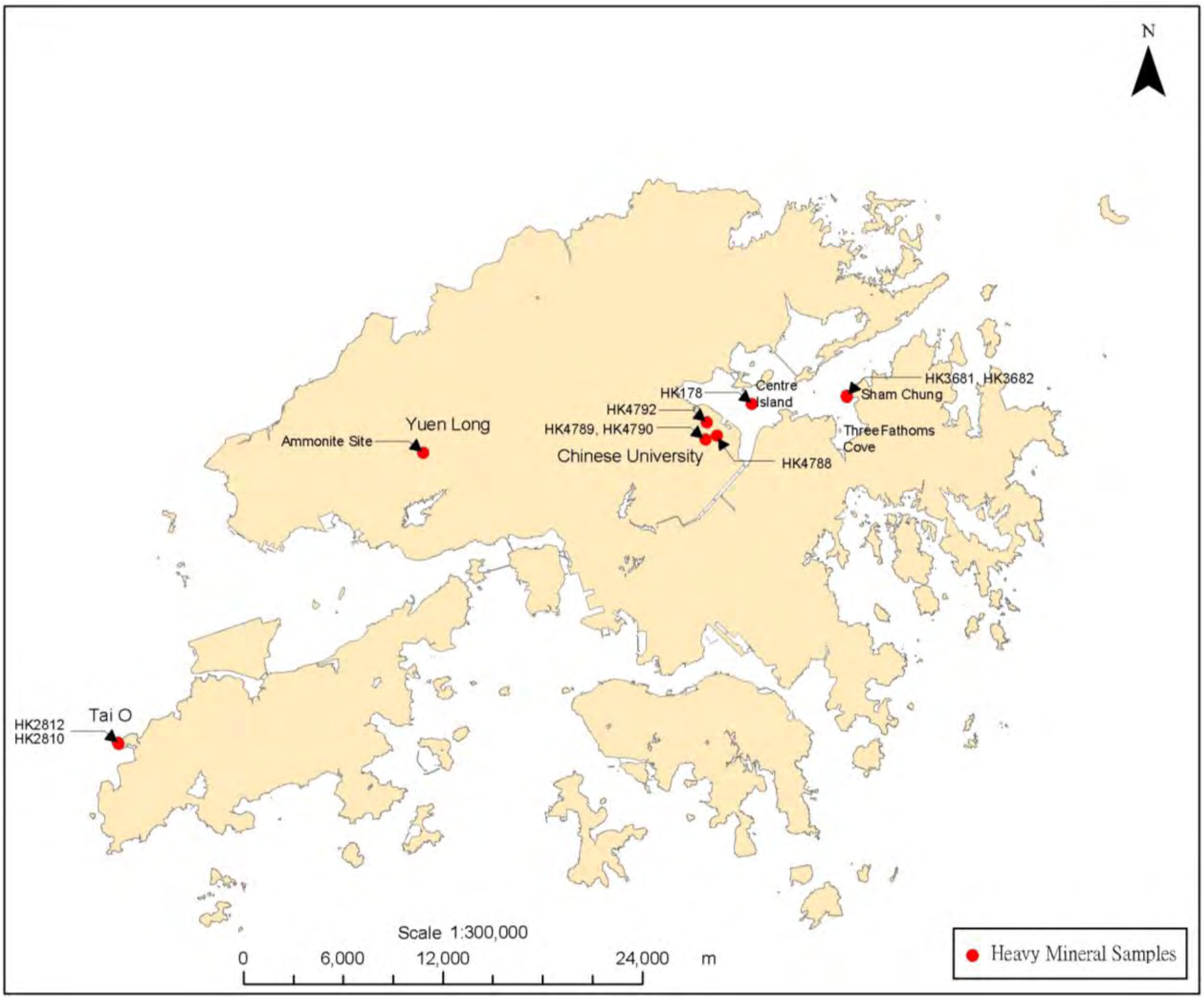

Figure 6 - Location Map of Heavy Mineral Sample Sites

Table of Contents
Table of Contents
Table of Contents

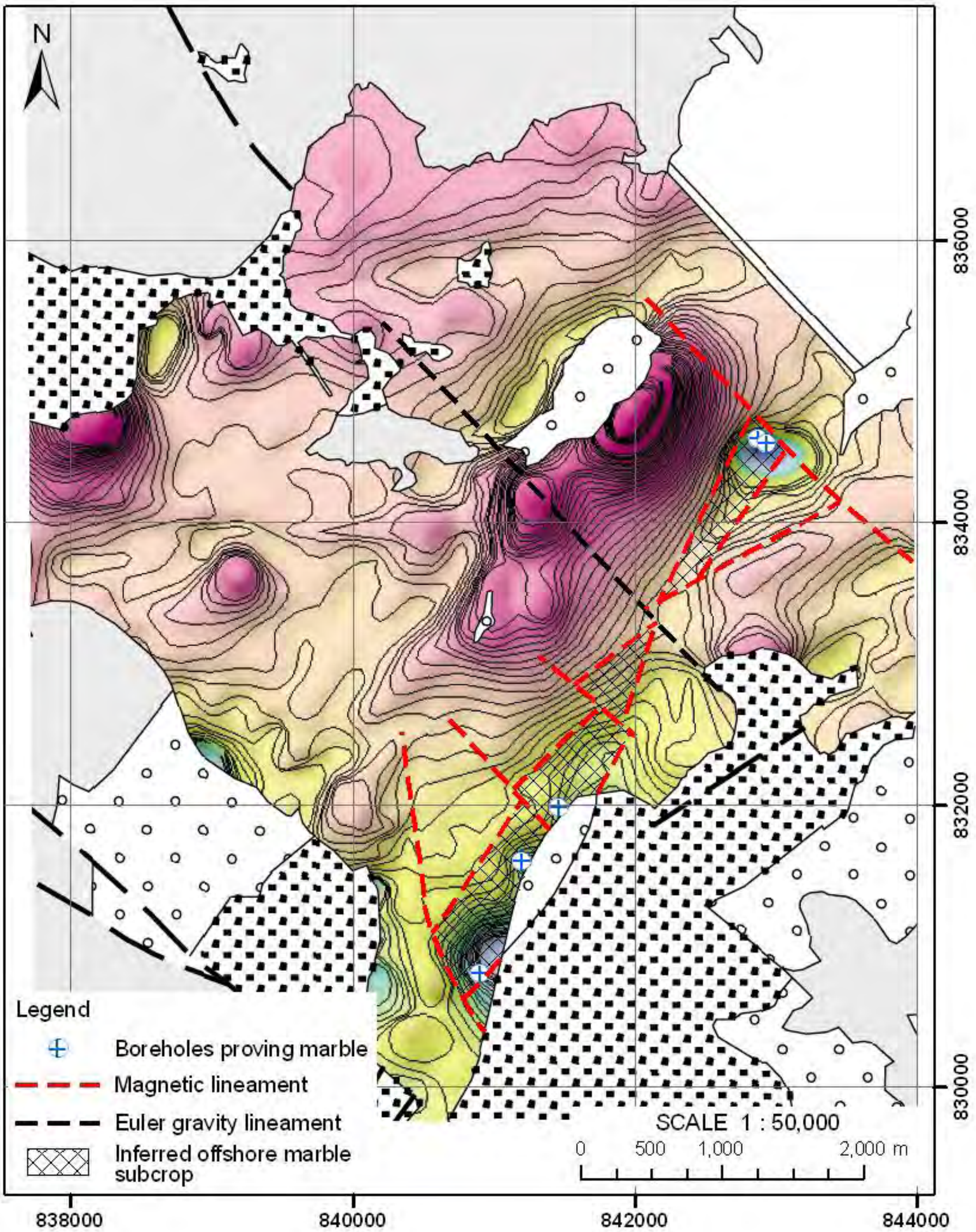

Figure 7 - Magnetic Anomaly Map for Tolo Harbour (after Sewell et al. 2000) Showing the Interpretation of Magnetic Lineaments Bounding the Ma On Shan Marble Offshore Subcrop. Euler lineaments after Fletcher et al. (1997)

Table of Contents
Table of Contents
Table of Contents
Table of Contents

LIST OF PLATES

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Plate 1 - Strongly Foliated Rhyolitic Hyaloclastite at Kwun Yum Shan

Table of Contents
Table of Contents
Table of Contents
Table of Contents

GEO PUBLICATIONS AND ORDERING INFORMATION
土力工程處刊物及訂購資料

A selected list of major GEO publications is given in the next page. An up-to-date full list of GEO publications can be found at the CEDD Website http://www.cedd.gov.hk on the Internet under "Publications". Abstracts for the documents can also be found at the same website. Technical Guidance Notes are published on the CEDD Website from time to time to provide updates to GEO publications prior to their next revision.

部份土力工程處的主要刊物目錄刊載於下頁。而詳盡及最新的土力工程處刊物目錄，則登載於土木工程拓展署的互聯網網頁 http://www.cedd.gov.hk 的"刊物"版面之內。刊物的摘要及更新刊物內容的工程技術指引，亦可在這個網址找到。

Copies of GEO publications (except maps and other publications which are free of charge) can be purchased either by:

writing to
Publications Sales Section,
Information Services Department,
Room 402, 4th Floor, Murray Building,
Garden Road, Central, Hong Kong.
Fax: (852) 2598 7482

or

- Calling the Publications Sales Section of Information Services Department (ISD) at (852) 2537 1910
- Visiting the online Government Bookstore at http:// www.bookstore.gov.hk
- Downloading the order form from the ISD website at http://www.isd.gov.hk and submit the order online or by fax to (852) 2523 7195
- Placing order with ISD by e-mail at puborder@isd.gov.hk

讀者可採用以下方法購買土力工程處刊物(地質圖及免費刊物除外):

書面訂購
香港中環花園道
美利大廈4樓402室
政府新聞處
刊物銷售組
傳真: (852) 2598 7482

或

- 致電政府新聞處刊物銷售小組訂購（電話：(852) 2537 1910)
- 進入網上「政府書店」選購，網址爲 http://www.bookstore.gov.hk
- 透過政府新聞處的網站 (http://www.isd.gov.hk) 於網上遞交訂購表格，或將表格傳真至刊物銷售小組（傳真：(852) 2523 7195)
- 以電郵方式訂購（電郵地址：puborder@isd.gov.hk)

1:100 000, 1:20 000 and 1:5 000 maps can be purchased from:

Map Publications Centre/HK,
Survey & Mapping Office, Lands Department,
23th Floor, North Point Government Offices,
333 Java Road, North Point, Hong Kong.
Tel: 2231 3187
Fax: (852) 2116 0774

讀者可於下列地點購買1:100 000，1:20 000及1:5 000地質圖：

香港北角渣華道333號
北角政府合署23樓
地政總署測繪處
電話: 2231 3187
傳真: (852) 2116 0774

Requests for copies of Geological Survey Sheet Reports, publications and maps which are free of charge should be sent to:

For Geological Survey Sheet Reports and maps which are free of charge:
Chief Geotechnical Engineer/Planning,
(Attn: Hong Kong Geological Survey Section)
Geotechnical Engineering Office,
Civil Engineering and Development Department,
Civil Engineering and Development Building,
101 Princess Margaret Road,
Homantin, Kowloon, Hong Kong.
Tel: (852) 2762 5380
Fax: (852) 2714 0247
E-mail: jsewell@cedd.gov.hk

For other publications which are free of charge:
Chief Geotechnical Engineer/Standards and Testing,
Geotechnical Engineering Office,
Civil Engineering and Development Department,
Civil Engineering and Development Building,
101 Princess Margaret Road,
Homantin, Kowloon, Hong Kong.
Tel: (852) 2762 5346
Fax: (852) 2714 0275
E-mail: wmcheung@cedd.gov.hk

如欲索取地質調查報告、其他免費刊物及地質圖，請致函：

地質調查報告及地質圖:
香港九龍何文田公主道101號
土木工程拓展署大樓
土木工程拓展署
土力工程處
規劃部總土力工程師
(請交:香港地質調查組)
電話: (852) 2762 5380
傳真: (852) 2714 0247
電子郵件: jsewell@cedd.gov.hk

其他免費刊物:
香港九龍何文田公主道101號
土木工程拓展署大樓
土木工程拓展署
土力工程處
標準及測試部總土力工程師
電話: (852) 2762 5346
傳真: (852) 2714 0275
電子郵件: wmcheung@cedd.gov.hk

MAJOR GEOTECHNICAL ENGINEERING OFFICE PUBLICATIONS
土力工程處之主要刊物

GEOTECHNICAL MANUALS

Geotechnical Manual for Slopes, 2nd Edition (1984), 300 p. (English Version), (Reprinted, 2000).

斜坡岩土工程手冊(1998)，308頁(1984年英文版的中文譯本)。

Highway Slope Manual (2000), 114 p.

GEOGUIDES

Geoguide 1	Guide to Retaining Wall Design, 2nd Edition (1993), 258 p. (Reprinted, 2007).
Geoguide 2	Guide to Site Investigation (1987), 359 p. (Reprinted, 2000).
Geoguide 3	Guide to Rock and Soil Descriptions (1988), 186 p. (Reprinted, 2000).
Geoguide 4	Guide to Cavern Engineering (1992), 148 p. (Reprinted, 1998).
Geoguide 5	Guide to Slope Maintenance, 3rd Edition (2003), 132 p. (English Version).
岩土指南第五冊	斜坡維修指南，第三版(2003)，120頁(中文版)。
Geoguide 6	Guide to Reinforced Fill Structure and Slope Design (2002), 236 p.
Geoguide 7	Guide to Soil Nail Design and Construction (2008), 97 p.

GEOSPECS

Geospec 1	Model Specification for Prestressed Ground Anchors, 2nd Edition (1989), 164 p. (Reprinted, 1997).
Geospec 3	Model Specification for Soil Testing (2001), 340 p.

GEO PUBLICATIONS

GCO Publication No. 1/90	Review of Design Methods for Excavations (1990), 187 p. (Reprinted, 2002).
GEO Publication No. 1/93	Review of Granular and Geotextile Filters (1993), 141 p.
GEO Publication No. 1/2000	Technical Guidelines on Landscape Treatment and Bio-engineering for Man-made Slopes and Retaining Walls (2000), 146 p.
GEO Publication No. 1/2006	Foundation Design and Construction (2006), 376 p.
GEO Publication No. 1/2007	Engineering Geological Practice in Hong Kong (2007), 278 p.
GEO Publication No. 1/2009	Prescriptive Measures for Man-Made Slopes and Retaining Walls (2009), 76 p.

GEOLOGICAL PUBLICATIONS

The Quaternary Geology of Hong Kong, by J.A. Fyfe, R. Shaw, S.D.G. Campbell, K.W. Lai & P.A. Kirk (2000), 210 p. plus 6 maps.

The Pre-Quaternary Geology of Hong Kong, by R.J. Sewell, S.D.G. Campbell, C.J.N. Fletcher, K.W. Lai & P.A. Kirk (2000), 181 p. plus 4 maps.

TECHNICAL GUIDANCE NOTES

TGN 1	Technical Guidance Documents

Table of Contents
Table of Contents
Table of Contents
Table of Contents