Updating of Hong Kong Geological Survey 1:20,000-scale Maps

Major Findings and Revisions Map Sheet 15 - Hong Kong South and Lamma Island

GEO Report No. 355

J.C.F. Wong & R. Shaw

Geotechnical Engineering Office
Civil Engineering and Development Department
The Government of the Hong Kong
Special Administrative Region

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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.

Raymond WM Cheung
Head, Geotechnical Engineering Office
March 2022

Foreword

This report describes major new findings and significant revisions to Hong Kong Geological Survey 1:20,000-scale Geological Map Sheet 15 – Hong Kong South and Lamma Island, undertaken between 2005 and 2009. The work was carried out by the Geological Survey Section of Planning Division 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 site-specific information, and advances in geological knowledge, since the previously published map of 1987 was first surveyed. Updating of Sheet 15 has been implemented on a GIS platform using a standard GIS template, and the map will be made available for promulgation in ArcReader format.

Mr J C F Wong, the senior author of the report, managed the update of Map Sheet 15, in which he was supported principally by Dr R Shaw. Dr R J Sewell provided an overall review of the updated map and of this report. Technical support was provided by Geological Survey staff.

(K C Ng)
Chief Geotechnical Engineering/Planning

Abstract

In view of the vast amount of site-specific information, and geological knowledge, gained since the first edition 1:20,000-scale geological maps were surveyed and published by the Geotechnical Engineering Office (GEO) between 1986 and 1996, the Geological Survey Section of the Planning Division, GEO has implemented a programme to update the existing 1:20,000-scale geological maps and to release them in both printed and digital form. This will make these geological maps more accessible to the public, and more useful to engineers and planners.

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

Geological Map Sheet 15 - Hong Kong South and Lamma Island, surveyed between 1984 and 1985 and published in 1987, is the second of fifteen 1:20,000-scale geological maps to be updated. The map updating programme gives priority to urban areas. Reliability of the geological maps will be improved after incorporation of the vast amount of new site-specific information that has accumulated, and advances in the understanding of the geology of Hong Kong, since the published maps were first surveyed.

The key findings and revisions to Map Sheet 15 are described in this report. They include: revision of the nomenclature, reinterpretation of onshore and offshore superficial deposits, revised intertidal and backshore deposits and boundaries, updated interpretation of magmatic and volcanic events, and improved accuracy of the locations of concealed major faults and rock type boundaries. In addition, a major improvement to the existing map is the introduction of a solid geology only GIS layer, which depicts the first interpretation of the offshore solid geology based on updated onshore geology, and offshore geophysical and borehole data. Furthermore, additional GIS layers of geological and related information have been compiled.

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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 1.1). The first edition of Hong Kong Geological Survey Map Sheet 15 (hereafter, Sheet 15) - Hong Kong South and Lamma Island, updated by this report, was published in 1987 (GCO, 1987) 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).

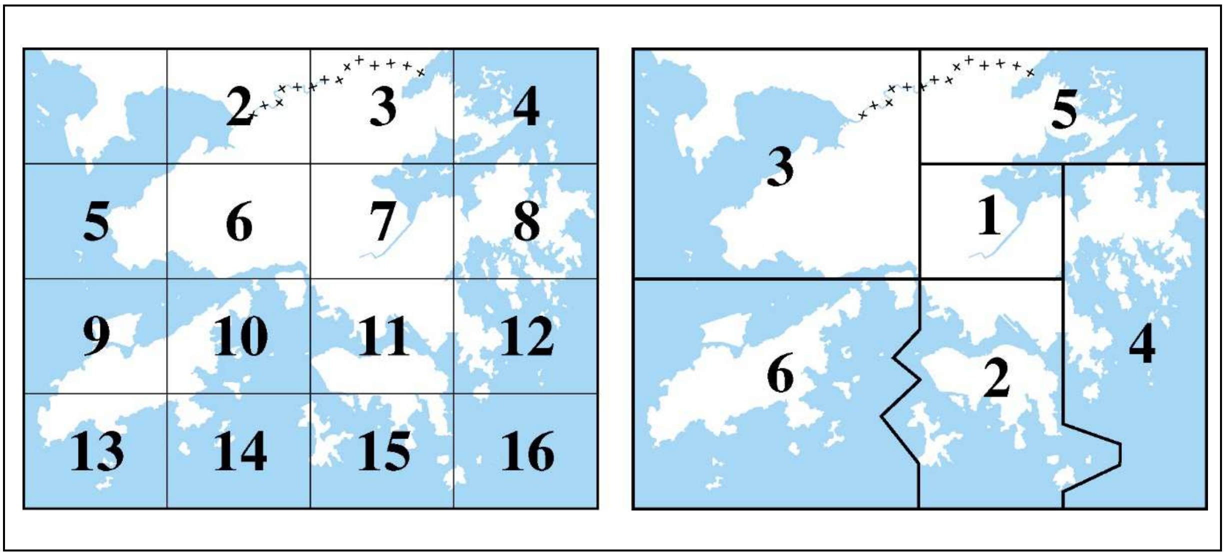


Figure 1.1 Published First Edition Hong Kong Geological Survey 1:20,000-Scale Geological Maps and Memoirs

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 1.1). 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.

Table 1.1 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

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.

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 ArcGIS Multiple layers of geological information (Table 2.1) 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 15 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.

Table 2.1 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

3 Data Sources

The primary data sources for the geological map Sheet 15 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 from the Enhanced Natural Terrain Landslide Inventory (ENTLI), seismic lines and selected scanned traces (Cheung & Shaw, 1993, HKGS archive), and reclamation histories, have also been added to the Geodatabase. Magnetic data used in the map update have principally come from existing onshore and offshore surveys and interpretations (EGS, 1997, 1999a, 1999b; IGGE, 2000; Cosine Limited, 2000), and the summary in Sewell et al (2000).

3.1 Marine Magnetic Survey

Since 1991, the GEO and other parties have utilised marine magnetic surveys for geological applications, such as infrastructure ground investigations and geological mapping. Existing magnetic survey data from several disparate surveys were compiled, levelled and processed in a study commissioned by GEO (Cosine Limited, 2000), to produce a magnetic anomaly map for Hong Kong. The resulting map was published in Sewell et al (2000).

Magnetisation of rocks derives mainly from traces of iron, occurring either as small grains of the oxide magnetite or in the rock-forming ferromagnesian silicate minerals, such as the amphiboles, pyroxenes, and iron-bearing micas. Although rock magnetisation is normally very weak in small samples, it can amount to a significant and measurable magnetic effect in large volumes of rock. Importantly, magnetic minerals in weathered rocks are likely to be depleted leading to negative magnetic anomalies (EGS, 1999b).

Using magnetic susceptibility measurements of selected rock samples (Table 3.1), it was possible to correlate broad magnetic anomalies on the marine magnetic survey map with the various major rock units. Moreover, weathering associated with fault zones can be detected by marked linear magnetic anomalies. Using these criteria, the magnetic survey results provided a valuable resource for interpreting the offshore solid geology of Sheet 15.

Table 3.1 K_{MAX} Values of Rock Units within Sheet 15 District in the Hong Kong Rock Collection

Rock Unit		No. of Samples	Min K_{MAX}	Max K_{MAX}	Median K_{MAX}	Average K_{MAX}
Hok Tsui Rhyolite	Jkh	1	0.63	0.63	0.63	0.63
D'Aguilar Quartz Monzonite	Kld	32	0.02	0.82	0.505	0.49688
Mafic Dykes	b	11	0.01	1.2	0.4	0.42364
Unclassified Quartzphyric Rhyolite Dykes	rq	14	0.01	1.2	0.14	0.30571
Sok Kwu Wan Granite	Kls	24	0.01	1.9	0.285	0.35167
Yim Tin Tsai Formation	Jty	15	0.02	0.83	0.25	0.316
Shan Tei Tong Rhyodacite	Jke	9	0.03	1	0.1	0.29778
Ap Lei Chau Formation	Kra	28	0.01	1.3	0.22	0.28571
Unclassified Feldsparphyric Rhyolite Dykes	Rf	2	0.1	0.47	0.285	0.285
Tai Po Granodiorite	Jmt	9	0.01	0.75	0.18	0.26556
Lantau Granite	Jml	5	0.03	0.32	0.11	0.162
Po Toi Granite	Jkp	23	0.01	1.3	0.07	0.12739
South Lamma Granite	Jkl	8	0.01	0.73	0.045	0.1225

4 Major Findings and Revisions to Map Sheet 15 - Hong Kong South and Lamma Island

Based on a desk study review of all available geological information for the area covered by Map Sheet 15, including an aerial photograph interpretation (API), a review of borehole records, and limited field checking, the following key revisions have been made.

4.1 Rock Nomenclature

On the first edition of the HKGS 1:20,000-scale geological map sheets (GCO, 1986a, b; GCO, 1987; GCO, 1988a, b; GCO, 1989a, b, c & d; GCO, 1991; GEO, 1991; GEO, 1992, GEO, 1994; GEO, 1995; GEO, 1996), the volcanic, sedimentary and metamorphic rocks were assigned to litho-stratigraphical formations, whereas the intrusive rocks were classified largely on the basis of grain size. Following detailed petrological, geochemical and geochronological analyses, a volcanic formation- and pluton-based nomenclature has now been adopted for the major extrusive and intrusive geological units in Hong Kong. This revised classification was first employed on the 1:100,000-scale geological map (Sewell et al, 2000), which adopted the new formation and pluton names for all mappable units. In order to rectify the inconsistencies among the 1:20,000-scale maps, and to align the nomenclature with the 1:100,000-scale geological map, both a formation or pluton name, and rock type descriptor describing the dominant lithology have been assigned to all geological units on the updated maps, except for those units that are undifferentiated. Thus, on the GIS platform, it is possible to depict lithologies only, or stratigraphical and plutonic nomenclature only, or both.

4.2 Superficial Geology

4.2.1 Quaternary Stratigraphy

On the first edition of Sheet 15 (GCO, 1987), the onshore superficial deposits were grouped as either Holocene, or Pleistocene and Holocene in age, whereas the offshore deposits were grouped as either Holocene or Pleistocene (Table 4.1). Because it has not been possible to reclassify the onshore superficial deposits, due to a lack of age dating or other diagnostic criteria, this same grouping is essentially retained on this updated version of Sheet 15. However, minor revisions have been made to the boundaries of the predominantly colluvial deposits following API and borehole interpretation.

Table 4.1 Previous and Revised Nomenclature of Map Sheet 15 (Sheet 1 of 4)

Superficial Deposits					
Age		Genetic Classification (Strange & Shaw, 1986)		Revised Genetic Classification and Named Divisions (Based on Fyfe et al, 2000)	
Quaternary	Holocene		Fill (Made-ground)		Fill
				Fanling Formation	Alluvium (Qfa)
			Beach deposits - Sand (Qb) Beach deposits - Boulders (Qbb) Beach deposits - Beach Rock (Qbr)	Hang Hau Formation	Beach deposits - Sand (Qhb) Beach deposits - Boulders (Qhbb) Beach deposits - Beach Rock (Qhbr) Backshore deposits (Qhbs) Intertidal deposits (Qhi) Marine mud (Qhm) Marine sand (Qhs)
		Hang Hau Formation	Mainly dark grey marine mud (HHH) East Lamma Channel Member - marine mud (elm) Telegraph Bay Member - marine mud (tbm) Marine sand (ms)		
	Pleistocene and Holocene		Alluvium (Qa) Debris flow deposits (Qd) Talus (rock fall) deposits (Qt) Mixed debris flow and talus deposits (Qdt)		Colluvium (Qd) Talus (rockfall) deposits (Qt) Mixed colluvium and talus deposits (Qdt)
	Pleistocene	Chek Lap Kok Formation	Alluvium (PCK)	Chek Lap Kok Formation	Alluvium (Qca)

Table 4.1 Previous and Revised Nomenclature of Map Sheet 15 (Sheet 2 of 4)

Volcanic Rocks					
Age		Genetic Classification (Strange & Shaw, 1986)		Revised Genetic Classification and Named Divisions (Based on Sewell et al, 2000)	
Mesozoic	Early Cretaceous	Tai Mo Shan Formation	Coarse ash crystal tuff (JTM)		Coarse ash crystal tuff (Krd_cat)
		Shing Mun Formation	Fine ash to coarse ash tuffs, tuff-breccia and tuffite (JSM) Eutaxite (e)	Che Kwu Shan Formation	Crystal-bearing fine ash vitric tuff (Krc_fvt) Crystal-bearing fine ash eutaxitic vitric tuff (Krc_e)
		Ap Lei Chau Formation	Fine ash vitric tuff (JAC) Eutaxite (e) Coarse ash tuff (ca) Tuff-breccia and pyroclastic breccia (tb) Sandstone (s) Mudstone and siltstone (m)	Ap Lei Chau Formation	Tuff-breccia (Kra_tb) Coarse ash crystal tuff (Kra_cat) Crystal-bearing fine ash vitric tuff (Kra-fvt) Crystal-bearing fine ash eutaxitic vitric tuff (Kra_e) Tuffaceous sandstone (Kra_st) Tuffaceous siltstone (Kra_zt) Tuffaceous mudstone and siltstone (Kra_mzt)
	Middle Jurassic	Yim Tin Tsai Formation	Coarse ash crystal tuff Fine ash tuff (JYT)	Yim Tin Tsai Formation	Lapilli lithic-bearing coarse ash crystal tuff (Jty_cat) Lapilli lithic-bearing fine ash crystal tuff (Jty_fat) Tuffaceous sandstone (Jty_st)

Table 4.1 Previous and Revised Nomenclature of Map Sheet 15 (Sheet 3 of 4)

Intrusive Rocks					
Age		Genetic Classification (Strange & Shaw, 1986)		Revised Genetic Classification and Named Divisions (Based on Sewell et al, 2000)	
Mesozoic	Early Cretaceous		Fine-grained granite (gf) Fine- to medium-grained granite (gfm) Medium-grained granite (gm)	Sok Kwu Wan Granite	Fine-grained biotite granite (Kls_gf) Fine- to medium-grained biotite granite (Kls_gfm) Medium-grained biotite granite (Kls_gm)
			Fine-grained quartz syenite (sqf) Medium-grained quartz syenite (sqm)	Tei Tong Tsui Quartz Monzonite	Porphyritic fine- to medium-grained quartz monzonite (Klt_mq)
			Fine-grained quartz syenite (sqf) Medium-grained quartz syenite (sqm) Quartz trachyte (tq) Feldsparphyric rhyolite (rf) Quartzphyric rhyolite (rq)	D'Aguilar Quartz Monzonite	Porphyritic fine- to medium-grained quartz monzonite (Kld_mq) Quartz latite dykes (Kld_lq) Feldsparphyric rhyolite dykes (Kld_rf) Quartzphyric rhyolite dykes (Kld_rq)

Table 4.1 Previous and Revised Nomenclature of Map Sheet 15 (Sheet 4 of 4)

Intrusive Rocks					
Age		Genetic Classification (Strange & Shaw, 1986)		Revised Genetic Classification and Named Divisions (Based on Sewell et al, 2000)	
Mesozoic	Late Jurassic		Fine-grained granite (gf) Fine- to medium-grained granite (gfm) Medium-grained granite (gm) Coarse-grained granite (gc)	Po Toi Granite	Fine-grained biotite granite (Jkp_gf) Fine- to medium-grained biotite granite (Jkp_gfm) Medium-grained biotite granite (Jkp_gm) Coarse-grained biotite granite (Jkp_gc)
			Fine-grained granite (gf) Fine- to medium-grained granite (gfm)	South Lamma Granite	Fine-grained biotite granite (Jkl_gf) Fine- to medium-grained biotite granite (Jkl_gfm)
			Feldsparphyric rhyodacite (rdf) Feldsparphyric rhyolite (rf) Quartzphyric rhyolite (rq) Aplite (ap)	Shan Tei Tong Rhyodacite	Feldsparphyric rhyodacite dykes (Jke_rdf) Feldsparphyric rhyolite dykes (Jke_rf) Quartzphyric rhyolite dykes (Jke_rq) Aplite dykes (Jke_ap)
			Quartzphyric rhyolite (rq)	Hok Tsui Rhyolite	Quartzphyric rhyolite dykes (Jkh_rq)
	Middle Jurassic		Fine-grained granite (gf) Fine- to medium-grained granite (gfm) Medium-grained granite (gm) Coarse-grained granite (gc)	Lantau Granite	Fine-grained biotite granite (Jml_gf) Fine- to medium-grained biotite granite (Kml_gfm) Medium-grained biotite granite (Jml_gm) Coarse-grained biotite granite (Jml_gc)
			Granodiorite (gd)	Tai Po Granodiorite	Porphyritic fine- to medium-grained granodiorite (Jmt_gd)

Important improvements have been made with regard to interpretation of the offshore superficial deposits. Regional boomer seismic surveys had not been carried out in the district when the 1987 map was compiled, so the offshore interpretation relied solely on pinger survey records. Because pinger surveys only achieve shallow penetration, the records lack resolution, and hence reliability, at depth. Consequently, no offshore cross-sections were constructed, but inset diagrams showing generalised Hang Hau Formation isopachs and contours on the surface of the Chek Lap Kok Formation were instead included. Subsequently, during the Territory-wide SEAMAT surveys (Cheung & Shaw, 1993), boomer surveys were completed across the district. These records were used to compile isopachs of the Hang Hau Formation and isopachs of the total superficial deposits that are depicted on the current map. Following refinements to the offshore seismic stratigraphy (Fyfe et al, 2000), the uppermost Tseung Kwan O and underlying Pok Liu members of the Hang Hau Formation are now recognised. The Pok Liu Member, which only occurs as a subcrop below the Tseung Kwan O mud blanket, is characterized on seismic profiles by a strong basal reflection filling complex patterns of minor channels eroded into the pre-Hang Hau Formation erosion surface (Figure 4.1). Figure 4.2 shows the extent of the Pok Liu subcrop in the district. Further, it has been determined that the Telegraph Bay and East Lamma members of the Hang Hau Formation, which were first depicted on Sheet 11 (GCO, 1986b) and described in Memoir No. 2 (Strange & Shaw, 1986), have only a limited extent, being localised erosional phenomena that cannot be directly correlated with major phases of deposition and erosion elsewhere in Hong Kong waters. Consequently, these two members are no longer considered to be distinct lithostraptigraphical units, so they have been omitted from the revised map.

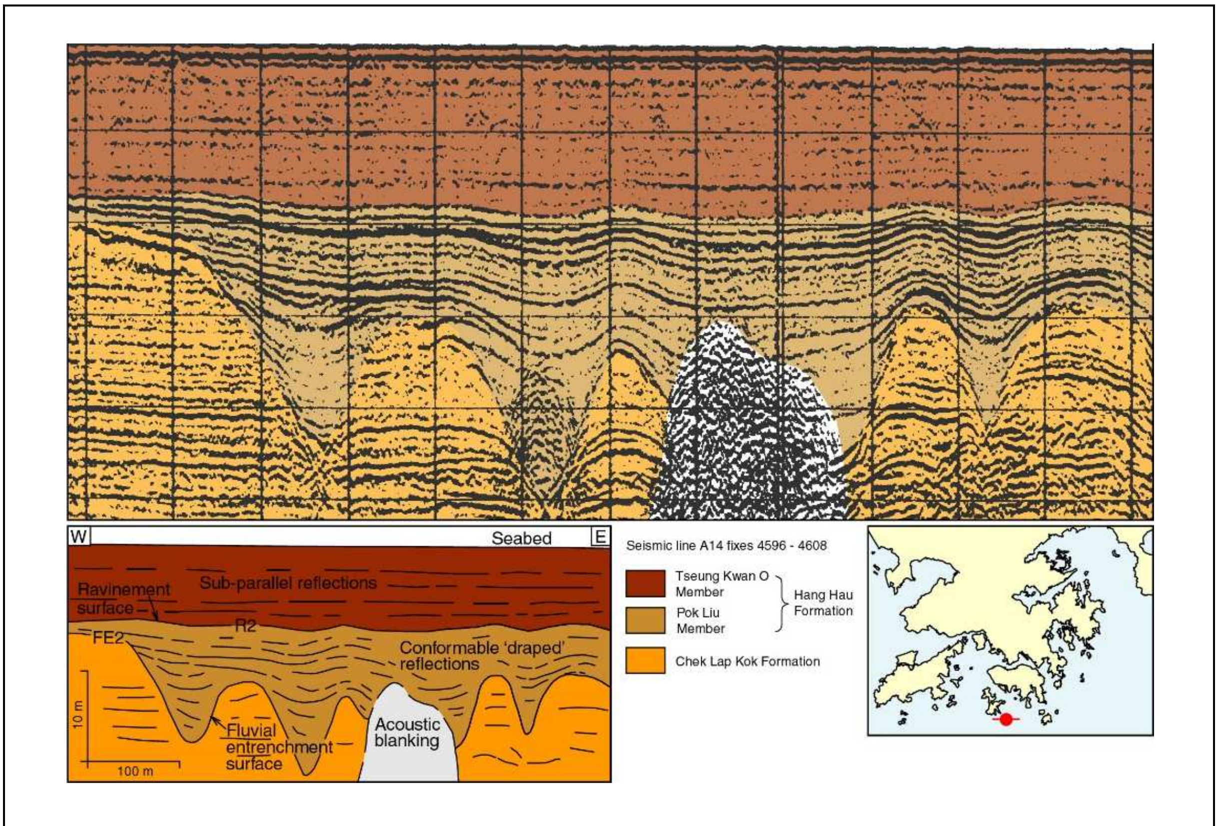


Figure 4.1 Profile Showing Conformable Reflection Pattern in the Pok Liu Member Draping Over Interfluves (from Fyfe et al, 2000)

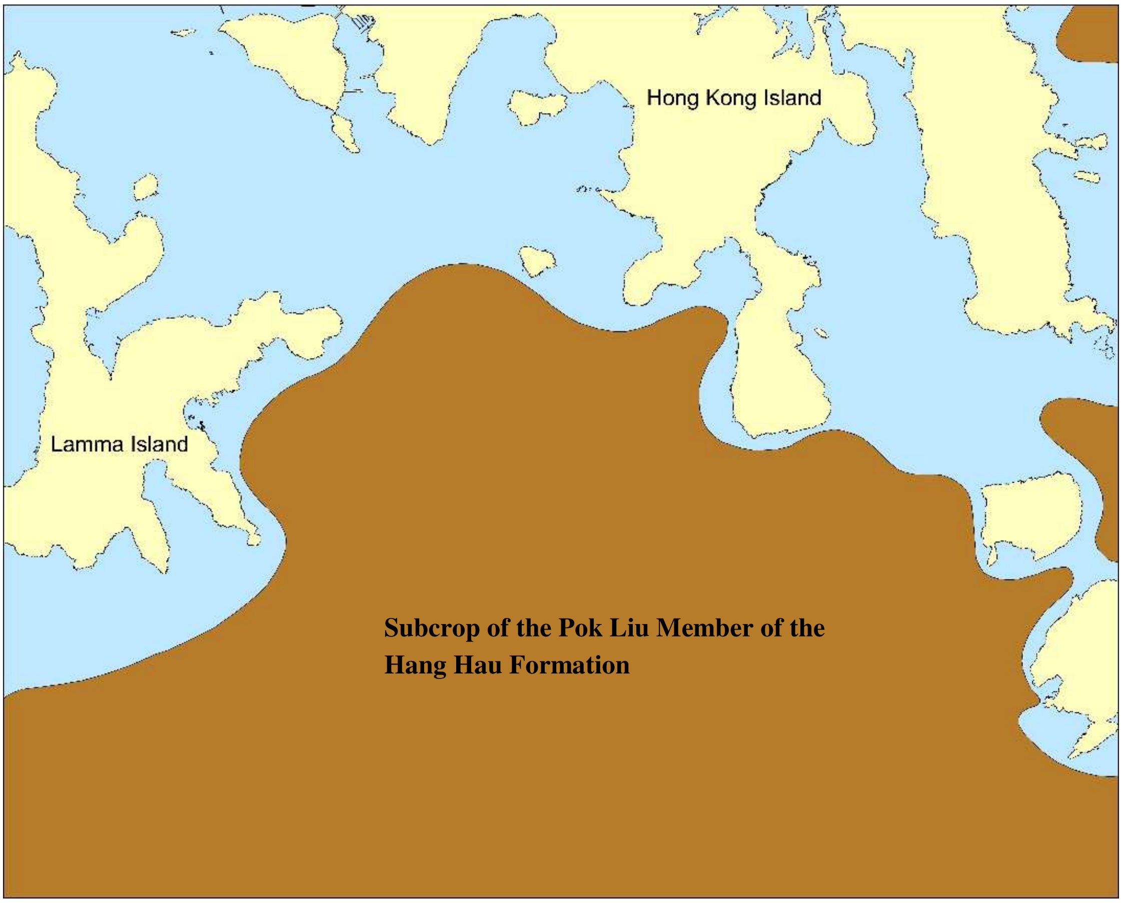
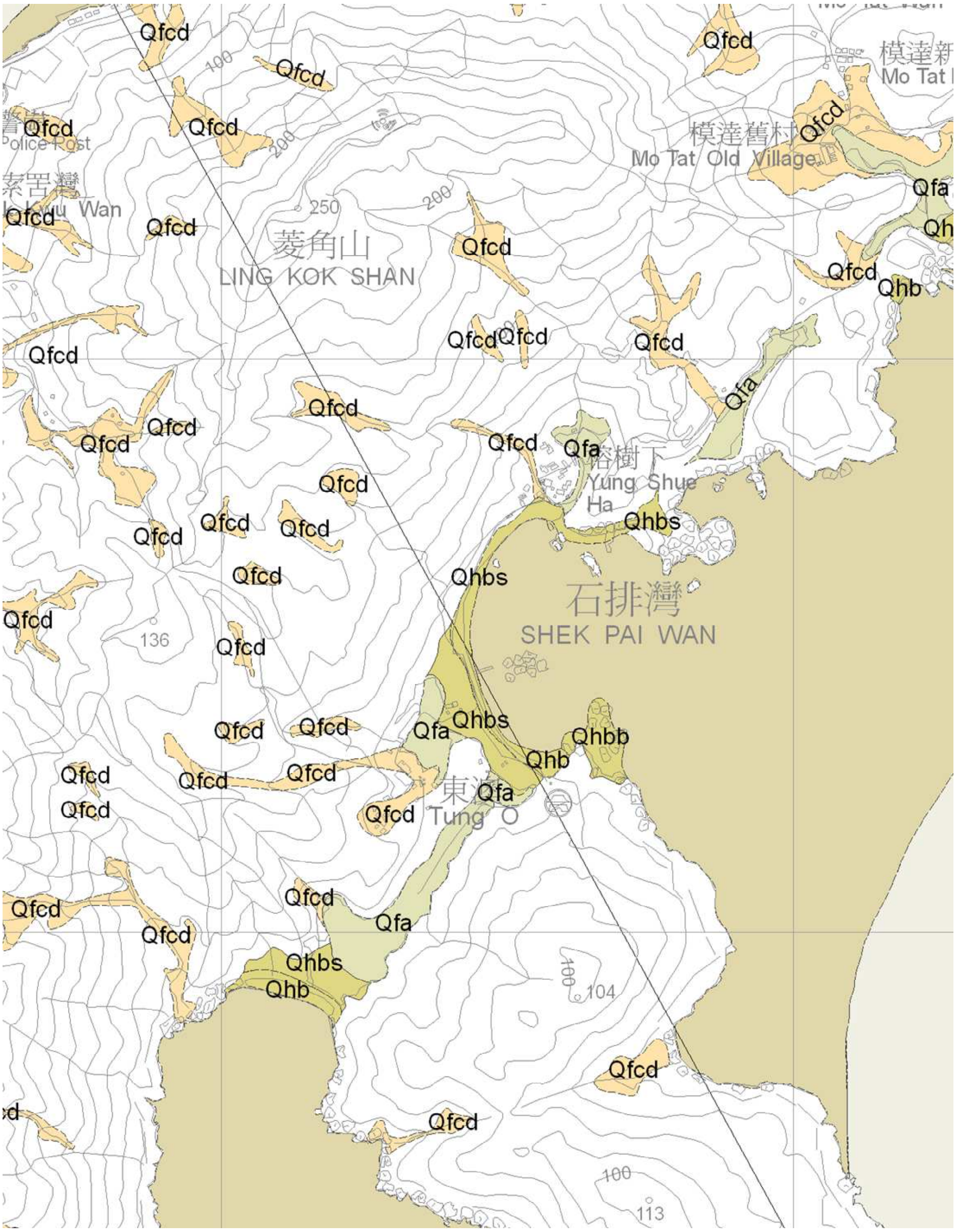


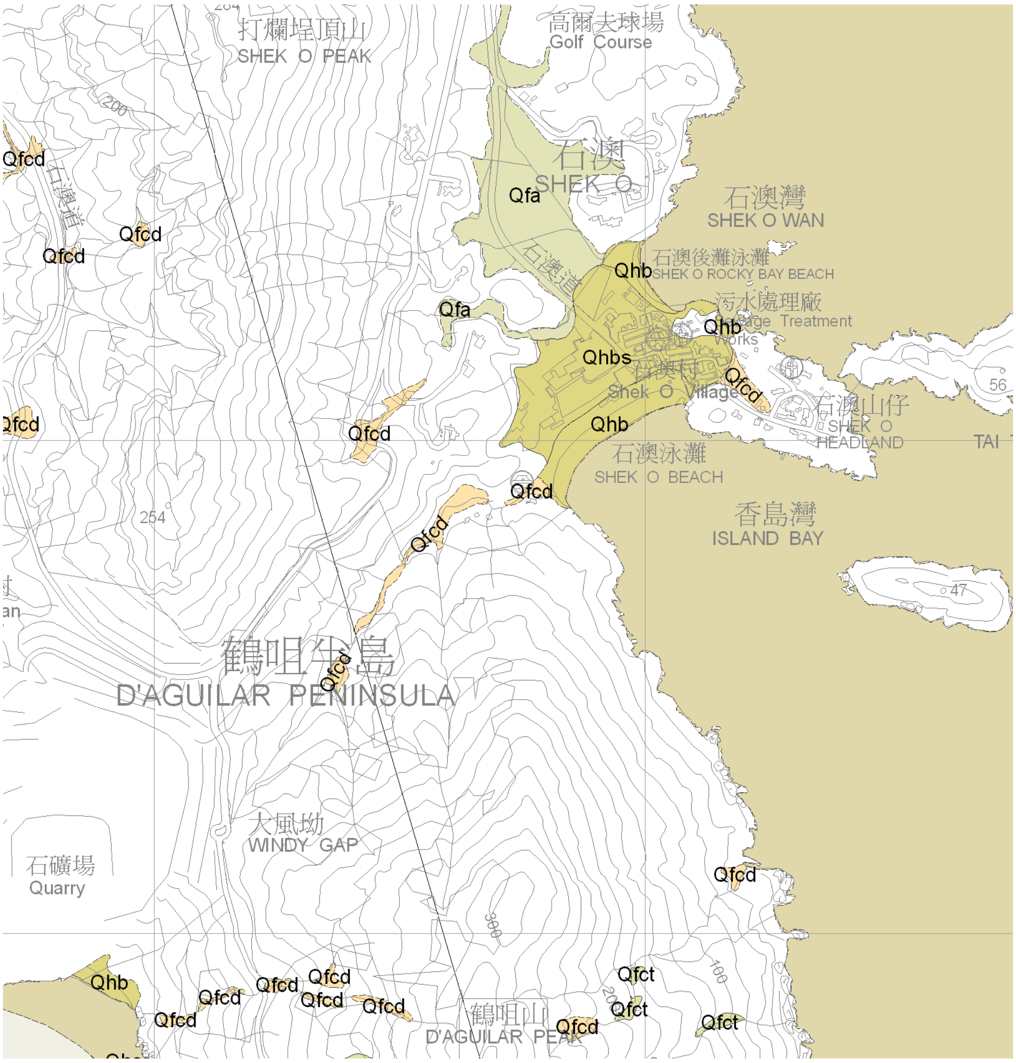
Figure 4.2 Extent of the Subcrop of the Pok Liu Member of the Hang Hau Formation in the District

Possible storm beach deposits, up to elevations of about 11 mPD, were identified on the eastern coast of Lamma Island by Strange and Shaw (1986). A recent review of the 1:20,000-scale map sheets and accompanying memoirs (Wong & Shaw, 2007) revealed that a variety of terms, including "backshore beach deposits", "back beach deposits", "storm beach deposits", and "raised beach deposits" were used to describe high level coastal deposits that have been identified behind and above active contemporary beaches. Because all of these terms have a genetic implication, and because there is no unequivocal evidence to support the particular mechanisms of formation of the mapped features, Wong and Shaw (2007) recommended that a non-genetic term be used for the deposits until further investigations are completed. Thus, the term "backshore deposits" (Qhbs) is used on the revised map as a collective term for all high level coastal deposits. Re-classified backshore deposits at Lamma and Shek O are shown on the updated map (Figures 4.3 & 4.4).



(Scale: 1:10,000)

Figure 4.3 Revised Distribution of Superficial Deposits Forming the Backshore Deposit (Qhbs) on Lamma Island



(Scale: 1:10,000)

Figure 4.4 Revised Distribution of Superficial Deposits Forming the Backshore Deposit (Qhbs) at Shek O

4.2.2 Reclamation History

The first edition of Sheet 15 (GCO, 1987) showed the sequence of development of the coastal reclamations up to 1986. Since then, there has been substantial reclamation at Ap Lei Chau. Aerial photograph interpretation, supplemented by information from topographical maps, was used to define the limits of reclamations completed since the original map was compiled. These are shown on the revised map.

4.3 Solid Geology

Interpretation of the solid geology of the offshore area of Sheet 15 has not previously been attempted. The solid geology map presents the first interpretation of the offshore geology, which is based on interpolation from the updated onshore geology combined with the marine magnetic anomaly map and borehole information. This forms a separate layer in the GIS.

4.3.1 Yim Tin Tsai Formation and Tai Po Granodiorite

Interpretation of the magnetic susceptibility data (Table 3.1) confirmed that the Yim Tin Tsai Formation (U-Pb zircon age of 164.5±0.2 Ma; Davis et al, 1997) and the Tai Po Granodiorite (U-Pb zircon age of 164.6±0.2 Ma; Davis et al, 1997) have higher K_{MAX} values than the surrounding granitic intrusions of the Po Toi and Lantau granites on Hong Kong and Lamma islands, respectively (Table 3.1), which can consequently produce positive magnetic anomalies. Three local zones of positive magnetic anomaly have been identified, namely around Round Island off Repulse Bay, southwest Stanley, and Lo So Shing Beach, Lamma Island on the residual magnetic anomaly map (EGS, 1999b). These zones of positive magnetic anomaly correlate well with mapped onshore outcrops. Field relationships suggested that both the Yim Tin Tsai Formation and Tai Po Granodiorite were intruded by later plutons on northern Lamma Island and on southern Hong Kong Island. Thus, both units have been interpreted as roof pendants on Map Sheet 15.

Interpretation of offshore borehole information to the north and northeast of Lamma Island revealed that the area is underlain predominantly by the Yim Tin Tsai Formation, with local intrusions of the Sok Kwu Wan Granite and Tei Tong Tsui Quartz Monzonite.

4.3.2 Hok Tsui Rhyolite

The Hok Tsui Rhyolite was first defined by Sewell et al (2000) for a swarm of northeast-trending quartzphyric rhyolite dykes at Cape D'Aguilar. U-Pb zircon age dating results revealed that the rock unit has an age of 151.9±0.2 Ma (Sewell et al, 2012). This age is consistent with the field relationship, as this unit is observed to intrude older rocks of the Yim Tin Tsai Formation and Tai Po Granodiorite.

4.3.3 Po Toi Granite, Lantau Granite and So Kwu Wan Granite

The Po Toi Granite was first defined by Sewell et al (2000) to include granite outcrops on Po Toi Island and Stanley and D'Aguilar peninsulas forming a subcircular pluton centred on the southeastern tip of Hong Kong Island. It was considered to be coeval with fine-grained granite in the vicinity of So Kwu Wan in the northern part of Lamma Island. Recent U-Pb age dating results (Sewell et al, 2012) have revealed that the granite on Po Toi Island has an age of 146.4±0.2 Ma and therefore belongs to the Kwai Chung Suite. Although undated, field relationships on Po Toi Island indicate that coarse-grained granite in the south of the island occurs as large stoped blocks within the Po Toi Granite. The coarse-grained granite on Po Toi Island is, therefore, tentatively assigned to the Lantau Granite. Field relationships on Stanley and D'Aguilar peninsulas (Strange & Shaw, 1986) indicate that the granite there intrudes D'Aguilar Quartz Monzonite and therefore is likely to belong to the Lion Rock Suite. Accordingly, the granite on Stanley and D'Aguilar peninsulas has been assigned to the So Kwu Wan Granite.

4.3.4 Ap Lei Chau Formation

The boundaries of different lithologies of fine ash vitric tuff and eutaxitic fine ash vitric tuff within the Ap Lei Chau Formation have been refined following borehole interpretation. Scattered small outcrops of coarse ash crystal tuff (Figure 4.5; BSG, 1990) within the formation have been identified at Ap Lei Chau and Shek O. These outcrops have been inferred to occur as layers. Their orientations were interpreted on the basis of flow fabric orientations identified nearby. The locations of fold axes and faults at Ap Lei Chau and Wong Chuk Hang, and a sequence of tuffaceous sandstone and siltstone at Lei Tung Estate, Ap Lei Chau, have been updated based on the findings of Franks et al (1999), a study that was carried out at a larger scale of 1:5,000.

Figure 4.5 Coarse Ash Crystal Tuff in the Ap Lei Chau Formation, Based on BSG (1990)

4.3.5 Che Kwu Shan Formation

On the original Sheets 11 and 15 (GCO, 1986b; GCO, 1987), the volcanic rocks in the area south of Chai Wan to Tai Long Wan were assigned to the Jurassic Shing Mun Formation. Subsequently, based on general stratigraphical relationships, trace element geochemistry, petrographical interpretations, and high precision U-Pb zircon age-dating, the volcanic rocks in this area were re-grouped as the Cretaceous Che Kwu Shan Formation (Sewell et al, 2000).

The offshore extension of this formation has been based largely on extrapolation from the onshore outcrops in Sheet 15 district, and on the findings during updating of the adjacent map Sheet 11 (Tang et al, 2014), where more borehole information is available.

4.3.6 Mount Davis Formation

Review of borehole records during the updating of Sheet 11 (Tang et al, 2014) has revealed the presence of subcrops of the Mount Davis Formation in the offshore area to the west of Pok Fu Lam. However, there is no similar borehole information in the Sheet 15 district. As a result, the subcrops identified on Sheet 11 have been extended to the offshore area west of Ap Lei Chau on Sheet 15.

4.3.7 Tei Tong Tsui Quartz Monzonite

New onshore and offshore quartz monzonite intrusions, overlain by superficial deposits, have been identified in drillhole records in the northwest part of Ap Lei Chau. These newly discovered quartz monzonite subcrops occur as dyke-like bodies that are aligned parallel or sub-parallel to the onshore outcrops of quartz monzonite in the Wong Chuk Hang and Shouson Hill areas.

There are no U-Pb age data available for the Tei Tong Tsui Quartz Monzonite. However, based on the geochemical correlation with the Clear Water Bay and High Island formations, Sewell et al (2000) estimated that the age of the unit was approximately 140 Ma.

4.3.8 D'Aguilar Quartz Monzonite

The D'Aguilar Quartz Monzonite is the name given to quartz monzonite stocks that crop out in the southern part of Hong Kong, and on Lamma Island (Sewell et al, 2000). They intrude the Yim Tin Tsai and Ap Lei Chau formations.

The magnetic susceptibility values, K_{MAX}, have revealed that the quartz monzonite unit generally has higher magnetic susceptibility than the surrounding Sok Kwu Wan Granite (Table 3.1). Consequently, the D'Aguilar Quartz Monzonite dykes can be expected to record more positive magnetic anomalies than the Sok Kwu Wan. The magnetic interpretation (Cosine Limited, 2000) depicted zones of linear positive magnetic anomalies in the offshore areas east of Lamma Island. There they can be correlated with borehole information and onshore outcrops of the D'Aguilar Quartz Monzonite at Mo Tat on the island. Offshore extensions of the mapped onshore dykes have thus been inferred.

In addition, the extent of the quartz monzonite stock mapped at Ma Hang, Stanley has been modified from borehole records.

4.3.9 Offshore Quartz Monzonite

Apart from the elongated zones of positive magnetic anomalies described in Section 4.3.7 above, similar zones of positive magnetic anomalies have also been identified in the offshore areas east of Luk Chau, south of Repulse Bay, Chung Hom Kok and Stanley. However, only limited drillhole data are available to confirm the presence of quartz monzonite beneath marine deposits at the anomalous zones east of Luk Chau, and south of Repulse Bay. There were no drillhole records at the other two anomalous zones south of Chung Hom Kok and Stanley. Thus, whether these zones representing rock with higher magnetic susceptibility exists as subcrops beneath marine superficial deposits, or as intrusive bodies within the country rock requires further investigation. Nevertheless, these zones of positive magnetic anomalies have been interpreted as quartz monzonite dykes, based on the similar magnetic characteristics with those with borehole proof.

4.3.10 Minor Intrusions

A number of minor intrusions, including mafic, quartzphyric rhyolite, feldsparphyric rhyolite, quartz trachyte, and aplite dykes, and pegmatite were mapped in different parts of the district by Strange and Shaw (1986). Among these minor intrusions, only the quartzphyric rhyolite dykes at Cape D'Aguilar and rhyodacite dykes at southern Lamma Island have been dated (Sewell et al, 2012). They have been assigned to the Hok Tsui Rhyolite and Shan Tei Tong Rhyodacite, respectively. The remaining dykes remain undated and unassigned (Sewell et al, 2000).

With respect to the undated and unassigned dykes, some of them are probably associated with named units in their vicinity and have been grouped accordingly on the updated map, such as:

(1) The northeast trending quartz latite (formerly, quartz trachyte) dyke on the southern Stanley Peninsula, which appears to be a fine-grained variant of a D'Aguilar Quartz Monzonite dyke nearby;

(2) The northwest trending feldsparphyric rhyolite, quartzphyric rhyolite, and aplite dykes on and near Tau Chau, off South Bay, which are apparently variants of the D'Aguilar Quartz Monzonite dyke with an identical orientation near South Bay; and

(3) The easterly trending aplite, feldsparphyric and quartzphyricrhyolite dykes on southern Lamma Island, which appear to be variants of the Shan Tei Tong Rhyodacite dykes.

The pegmatite outcrop north of D'Aguilar Peak has been represented by ornamentation, rather than as a dyke on the original map.

Minor basic intrusions on the original Sheet 15, previously termed "basalt", are now classified as mafic dykes following subsequent work which has revealed a range of compositions from basaltic andesite to andesite.

4.4 Structural Geology

4.4.1 Faults

The trends of the main fault sets in the Sheet 15 district vary from northeast to east-northeast, and northwest to north-northwest. In general, the main faults in the district coincide with negative topographical features, most probably related to preferential weathering and erosion.

Strange and Shaw (1986) inferred a north-northwesterly trending East Lamma Channel Fault along the East Lamma Channel between Hong Kong Island and Lamma Island. Alternatively, Campbell and Sewell (1997) suggested that the feature was probably a volcanotectonic structure on the grounds that the Ap Lei Chau Formation and Kowloon Granite do not occur to the west. In the absence of an obvious magnetic anomaly or lineament along the channel, Sewell et al (2000) refer to the fault informally as the 'East Lamma Channel fault'. However, a drillhole, approximately 80 m to the west of the inferred fault, exhibits several fractured zones, which might be indications of shearing (Drillhole no. II/AN-LQ/T3 in GIU Report No. 18315). Thus, the presence of a geological feature, whether it be a fault or volcanotectonic structure cannot be ruled out. In this connection, the 'East Lamma Channel fault' inferred in Sewell et al (2000) has been introduced in the updated Sheet 15.

4.4.2 Accurate Location of Major Faults

Zones of unusual deep weathering and/or brecciation encountered in a large number of boreholes in the western part of Ap Lei Chau have been interpreted as faults. The borehole information has assisted in the extension of two northeast-trending onshore faults on the island. The findings of Franks et al (1999) with regard to the locations of faults or photolineaments in the Aberdeen and Ap Lei Chau areas have been incorporated in Sheet 15.

EGS (1997) and Cosine Limited (2000) identified a number of marine magnetic lineaments in the offshore area that are probably indicative of discontinuities in the bedrock. Therefore, those marine magnetic lineaments that can be correlated with identified or inferred onshore faults have been depicted as faults. The remaining marine magnetic lineaments, where persistent, have been depicted on the map as a Magnetic Lineament (ML).

4.4.3 Folds

Allen and Stephens (1971) noted the occurrence of folding in the volcanic strata of western Hong Kong, but the location of fold axes was first delineated by Strange and Shaw (1986), based on the attitudes of eutaxitic banding, or of sedimentary layers within the volcanic formations. The fold axes in the Ap Lei Chau and the formerly Tai Mo Shan (now Mount Davis) formations to the north of the valley along Wong Chuk Hang Road are generally northwesterly trending, whereas those in the Ap Lei Chau Formation to the south are predominantly west-northwesterly trending. Franks et al (1999) concluded that the zone dividing the two fold axis orientations was a major fault or shear zone, and these findings have been incorporated in the updated Sheet 15.

5 Further Studies

5.1 East Lamma Channel Fault

Further drilling and geophysical investigations are recommended to elucidate the character of the inferred East Lamma Channel Fault. These studies will provide improved understanding of the structural geology and tectonic evolution of the area.

5.2 Geochemistry of the Po Toi Granite

Strange and Shaw (1986) described complex intrusive relationships among coarse-grained, medium-grained, fine- to medium-grained, and fine-grained granite lithologies on the Po Toi Islands. Although Sewell et al (2000) grouped all these lithologies within the Po Toi Granite, it was noted that megacrystic lithologies in the south and east were possibly different from equigranuilar fine- to medium-grained lithologies in the north and west. Therefore, it is recommended that further geochemistry and age dating of these rocks be carried out in order to confirm genetic relationships. In addition to providing useful updates to Geological Map Sheet 15, these new data will provide information about the geology in the southeastern part of Hong Kong to assist with updating of Geological Map Sheet 16.

5.3 Late-stage Felsic Dykes

Compared with the Hok Tsui Rhyolite at Cape D’Aguilar, and the Sha Tei Tong Rhyodacite on Lamma Island (Sewell et al, 2000), relatively little information is known about the feldsparphyric rhyolite, quartzphyric rhyolite, and fine-grained granite dykes scattered across different parts of the district. Accordingly, these minor intrusions have been grouped as “undifferentiated” and further work is recommended in order to understand their tectonomagmatic history.

5.4 Age Dating

Several major and minor intrusive bodies in Sheet 15 remain undated by radiometric techniques. Therefore, it is recommended that priority be given to dating the Lantau Granite, Sok Kwu Wan Granite, and various felsic dykes in order to allow further interpretation of pluton emplacement and tectonic history.

5.5 High Level Coastal Deposits

Bearing in mind the potential damage that could result from storm surge, it is recommended that backshore deposits should be systematically mapped and that they are considered in future coastal engineering and urban planning projects. Further field work, including field inspection, levelling, stratigraphy, and sedimentological studies, should be carried out to verify the detailed distribution and sedimentary characteristics of these valuable indicator deposits. For example, on Map Sheet 15, the newly mapped backshore deposits at Shek O and Lamma have been incorporated on the updated map.

6 References

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

Bachy Soletanche Group (1990). *CESD Term Contract GC/89/03 Works Order No. PW 7/2/27.60 Ground Investigation: Hong Kong Island South, Shek O and Repulse Bay, Sewerage and Sewage Disposal,* 3 p. plus appendices.

Campbell, S.D.G. & Sewell, R.J. (1997). Structural control and tectonic setting of Mesozoic Volcanism in Hong Kong. *Journal of the Geological Society,* Vol. 154, pp 1039-1052.

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

Cosine Limited (2000). *Merging of Datasets and Generation of Offshore Magnetic and Geological Maps - Hong Kong SAR Marine Area*. Cosine Limited, 13 p.

Davis, D.W., Sewell, R.J. & Campbell, S.D.G. (1997). U-Pb dating of Mesozoic igneous rocks from Hong Kong. *Journal of the Geological Society*, Vol. 154, pp 1067-1076.

Electronic & Geophysical Services Ltd. (EGS) (1997). *Strategic Sewage Disposal Scheme Stage II Preliminary Project Feasibility Study Geophysical Survey*. Final Report Job No. HK144799, Electronic and Geophysical Services Ltd., Hong Kong, 46 p. plus 6 appendices and 49 drawings.

Electronic & Geophysical Services Ltd. (EGS) (1999a). *Cheung Chau, Lamma Island and the Po Toi Islands Marine Magnetic Survey*. Final Report Job No. HK136898, Electronic and Geophysical Services Ltd, Hong Kong, 42 p.

Electronic & Geophysical Services Ltd. (EGS) (1999b). *Additional Data Interpretation Geophysical Survey*. Final Report Job No. HK145599, Electronic and Geophysical Services Ltd, Hong Kong, 15 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, The Government of the Hong Kong Special Administrative Region, 209 p. plus 6 maps.

Franks, C.A.M., Campbell, S.D.G. & Shum, W.W.L. (1999). *Assessment of Geological Features Related to Recent Landslides in Volcanic Rocks of Hong Kong Phase 2B - Aberdeen Study Area*. GEO Report No. 67, Geotechnical Engineering Office, 114 p.

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, 1 map.

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, 1 map.

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

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, 1 map.

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, 1 map.

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, 1 map.

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, 1 map.

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, 1 map.

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, 1 map.

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, 1 map.

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, 1 map.

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, 1 map.

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, 1 map.

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, 1 map.

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

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, 1 map.

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, 1 map.

Institute of Geophysical and Geochemical Exploration (IGGE) (2000). *Eastern Hong Kong Waters Marine Magnetic Survey.* Final Report. Institute of Geophysical and Geochemical Exploration MLR, PRC, Hong Kong Office, 52 p.

Sewell, R.J. (1999). *Geochemical Atlas of Hong Kong.* 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, 274 p.

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, The Government of the Hong Kong Special Administrative Region, 181 p. plus 4 maps.

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

Sewell, R.J., Davis, D.W. & Campbell, S.D.G. (2012). High precision U-Pb zircon ages for Mesozoic igneous rocks from Hong Kong. *Journal of Asian Earth Sciences*, Vol. 43, 164-175.

Strange, P.J. & Shaw, R. (1986). *Geology of Hong Kong Island and Kowloon. Hong Kong Geological Survey Memoir No. 2*. Geotechnical Control Office, Hong Kong, 134 p.

Tang, L.K. & Lee, C.W. (2014). *Updating of Hong Kong Geological Survey 1:20,000-scale Maps Major Findings and Revisions Map Sheet 11 - Hong Kong and Kowloon*. GEO Report No. 300, Geotechnical Engineering Office, 29 p.

Wong, J.C.F. & Shaw, R. (2007). *High-level Coastal Deposits in Hong Kong*. Geological Report GR 2/2007. Geotechnical Engineering Office, 51 p.

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