

Chapter 7

Superficial Sediments

Classification and Distribution

The sediment classification scheme used on the 1:5 000 maps series is primarily facies- and material-related. The symbols on the maps comprise a prefix to indicate the age of the sediments, followed by superscripted lower-case letters to indicate environment of deposition and upper-case letters to indicate material. Ages of the sediments are Pleistocene (Qp), Holocene (Qh) and Quaternary undivided (Q). The environments of deposition seen in the district (Figure 10) are alluvial (a), beach (b), estuarine (e), intertidal (i) and marine (m). The materials are debris from debris flow (Df), sand (S) and mud (M).

The lithostratigraphic units used in the 1:20 000 map series are the same as those in the 1:5 000 series.

Superficial sediments are found mostly in the low-lying ground and offshore areas, although debris flow deposits generally occur on the higher ground, filling small valleys. Downslope, these deposits may have been reworked by fluvial processes, and the distinction between debris flow and alluvium is difficult to define. Many of the superficial deposits in the larger valleys have been disturbed by cultivation.

The offshore superficial deposits of Hong Kong comprise three formations; the Chek Lap Kok Formation, the Sham Wat Formation and the Hang Hau Formation. These have been identified on the lithological, palaeontological and geotechnical evidence from borehole cores and on seismic character from shallow seismic reflection records (James, 1993).

Only the Chek Lap Kok and Hang Hau formations have been recognised in this area, although superficial deposits which are thought to be older than the Chek Lap Kok Formation have been identified in one small locality. These have been termed the pre-Chek Lap Kok Formation deposits (James, 1993).

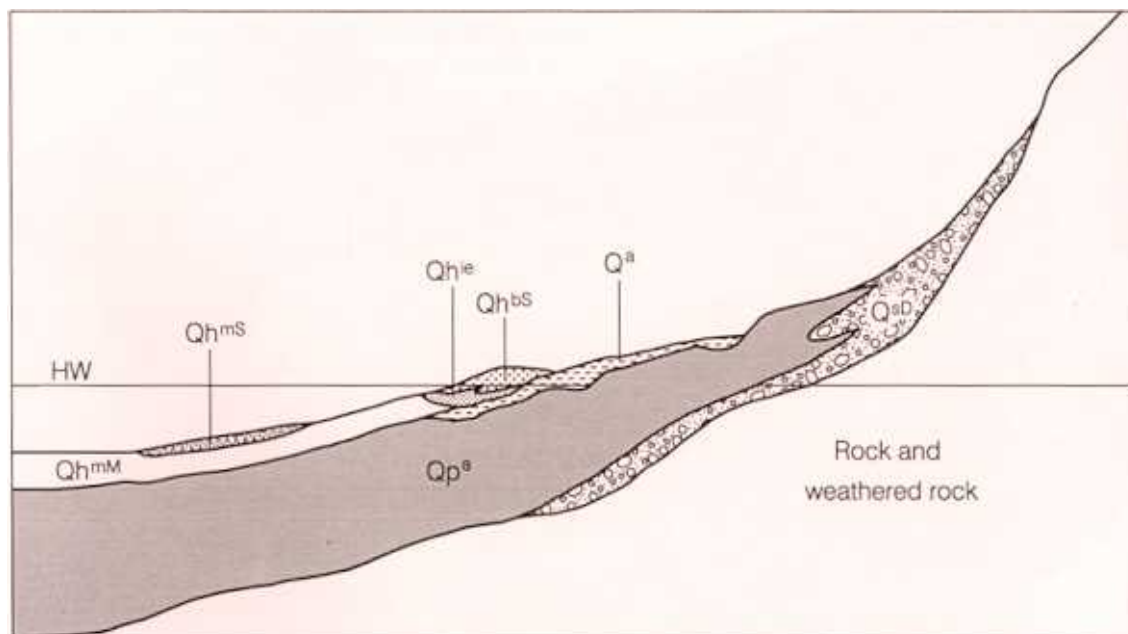


Figure 10 - Schematic Section Showing the Relationship between Superficial Deposits and the Different Environments of Deposition

Qp = Pleistocene; Qh = Holocene; Q = Quaternary (undivided);
a = alluvial; b = beach; e = estuarine; i = intertidal; m = marine;
Df = debris flow; S = sand; M = mud; HW = high-water level

Although superficial deposits occur extensively offshore, especially to the northwest and southeast of Lantau Island (Figure 6), the area at the Kap Shui Mun channel (2400 2230) and around Ma Wan (2600 2350) comprises one of the largest expanses of exposed rock at the sea bed in Hong Kong territorial waters. The rock-floored sea bed is an area where tidal currents attain velocities greater than 1.0 m s^{-1} . The lack of superficial sediments in this area is primarily attributable to non-deposition of sediments because of the strong currents rather than erosion of superficial sediments which may once have covered these areas.

To the west and south of Kap Shui Mun, current velocity decreases and sedimentation has occurred. Sand banks and sand sheets were formed initially, but further west and south, with decreasing current strength, the sea bed becomes a mud blanket. The sand banks have been extensively dredged and the sand used as fill material for reclamations.

Onshore Sediments

Debris Flow Deposits

Debris flow deposits consist of locally derived material, which has flowed downslope during periods of high rainfall. Debris flow deposits commonly form aprons on the middle to lower slopes of the high country (Plate 14) and may grade into alluvium at the foot of shallow valleys. They comprise a structureless, silt, clay and sand matrix with embedded subangular fragments of weathered country rock. The colour of the matrix varies from yellowish brown, through brownish grey to pink; white kaolin streaks and spots are common. The rock fragments generally show a weathered rind.

Alluvial Sediments

Alluvial deposits of the district are generally thicker and more widespread than debris flow deposits. They were laid down in the Quaternary period and comprise clays and silts with interbedded sands and gravels. The sands and gravels are commonest towards the base of the sequence.



Plate 14 - Terraced Paddy Fields Formed on a Large Debris Flow Deposit at Ngau Kwu Long (15850 16750)

The alluvial deposits were laid down under various conditions of deposition. During periods of active erosion of nearby hills, coarse arenaceous material was deposited proximally to the source area. At other times, a quieter environment existed, allowing silts and muds to be laid down on the flatter areas of the coastal plain.

Offshore Sediments

Pre-Chek Lap Kok Formation Deposits

These deposits infill a small depression or channel about 300 m by 500 m in an area (1954 2251) north-west of Yam O Wan. The deposits have been identified solely on their seismic character and comprise relatively strong reflectors which tend to be parallel to the base of the unit. They are synclinal in form in the depression and more horizontal at its margin.

The deposit has a maximum thickness of about 15 m and at its deepest point reaches a depth of 50 m below Principal Datum (PD). The deposit lies directly on rock and is overlain by sediments of the Chek Lap Kok Formation. From its seismic character, the lithology of the sediment is inferred as being coarse rather than fine-grained.

Chek Lap Kok Formation

The formation is diverse and variable in terms of its physical, lithological and seismic character. Throughout the area, apart from where it rests on the small outcrop of pre-Chek Lap Kok Formation deposits, the formation lies directly on rock. It occurs extensively both north and south of Lantau Island.

North of Lantau Island the extent and thickness of the formation is controlled by the form of the underlying rock surface and the network of channels which have been cut into its upper surface. One large E-W-oriented channel north of the Brothers and Yam O Wan has reduced the thickness of the Chek Lap Kok Formation to less than 10 m. South of the Brothers the formation can be up to 27 m thick, although it is generally 15 m to 20 m. Around the Brothers its thickness is governed by highs within the relatively flat rock surface as well as north-south trending channels incised into its upper surface. Closer to the coast the sediments thin to less than 10 m. The maximum recorded depth for the formation is -46 mPD but its base mainly lies between -30 and -45 mPD.

South of Lantau Island an extensive area of acoustic turbidity (Figure 11) masks much of the superficial deposits seen on seismic records. The masking makes any calculations on the extent, thickness and depth of the sediments from seismic reflection records impossible. Within Penny's Bay (2200 2030), Chek Lap Kok Formation sediments are relatively thin, less than 5 m, with the base of the formation lying at depths of -15 to -25 mPD. The formation remains thin to the west of Penny's Bay towards Discovery Bay. To the east and southeast of Penny's Bay the formation becomes thicker as the rock surface shelves away from the coast and attains a maximum thickness of over 20 m where the rock surface is deeper than -50 mPD.

The sediments of the Chek Lap Kok Formation are a mixture of deposits including clay, silt, sand and gravel with extensive changes in lithology both laterally and vertically throughout the formation. Consolidation and other processes mean that the clays have unconfined compressive strengths from 30 to 90 kPa, firmer than the marine clays of the overlying Hang Hau Formation. Oxidised sequences occur within the formation and can be found in clays and sands. They have been noted at the top of the formation and at depth.

The complexity evident in the lithological character of the formation is mirrored in its seismic character. A typical diagnostic seismic style or character is not apparent. Relatively short, laterally impersistent, truncated bounding reflectors and channel forms are common, with background seismic tone and internal reflectors displaying great variability.

Hang Hau Formation

The Hang Hau Formation (Strange & Shaw, 1986), with the exception of areas of rock and littoral sand (undivided), underlies most of the sea bed. It forms a blanket of generally clayey silt over all the underlying superficial deposits and rock subcrops, with an unconformity at its base.

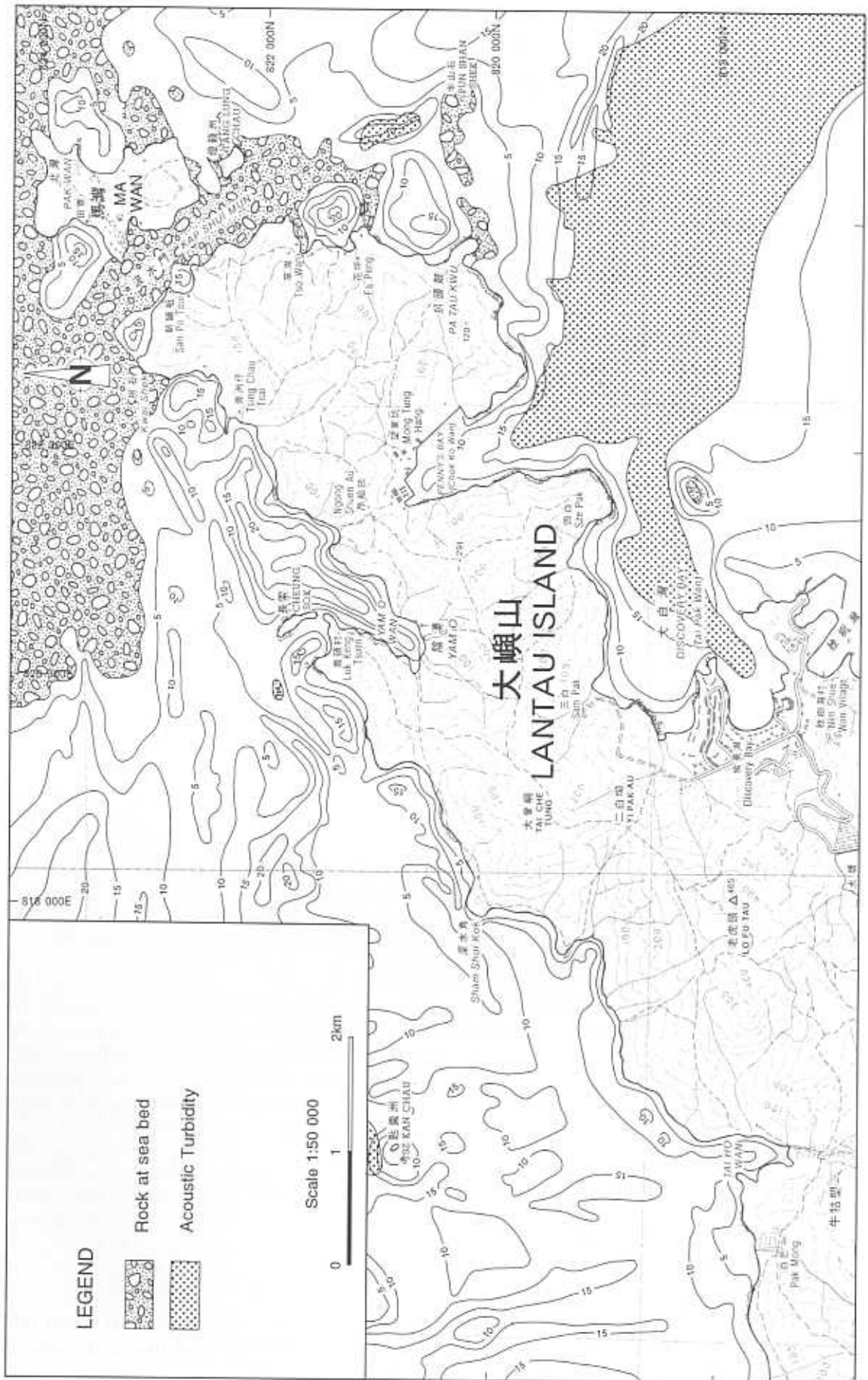


Figure 11 - Distribution and Isopachs in Metres of the Hang Hau Formation

There are a number of areas where the formation exceeds 20 m in thickness (Figure 11). For example, in the southeast where acoustic turbidity masks much of the formation on seismic records. Within this masked zone it could possibly exceed 25 m in thickness with depths greater than -35 mPD. North of Lantau Island the thicker sequences of the formation infill a deep channel within Yam O Wan (2070 2130) to a maximum depth of over -22 mPD, and also infill a number of channels south of the Brothers to depths of -25 mPD. The formation also forms a number of bar like features, over 20 m thick, on the margins of the E-W-oriented tidal channel running from the Brothers to Kap Shui Mun. The control on the extent and thickness of the formation is both the form of its basal surface and the tidal current regime in the area.

The formation generally consists of very soft to soft, greenish grey (5GY 4/1 - 5/1) clayey silt. Undrained shear strengths range from less than 3 to 20 kPa. Disarticulated and articulated bivalve shells are relatively common. Comminuted shell debris ranging in size from less than 0.1 to 20 mm occurs within the matrix and is sometimes seen to be concentrated in thin beds and lenses. Silt and fine sand lenses also occur regularly throughout the sequence. Some sand and gravel may occur at the base of the formation. The formation also includes silty sand which formed sand banks up to 15 m thick which, before dredging, lay to the west and south of Kap Shui Mun (Choot, 1988).

The seismic character of the formation is predominantly horizontal to sub-horizontal, moderate to low amplitude reflectors with a well-developed high amplitude reflector at its base. The reflectors tend to infill depressions and channels with little or no indication of truncation and overlap. However, in the area of the sand banks and at Kap Shui Mun, high-angled, foreset reflectors are common, as well as truncated seismic reflectors cut by erosion.

The formation is an estuarine to marine sequence with most of the sediment derived from the Pearl River. Some of the sands at the base of the formation, especially beneath the channel from the Brothers to Kap Shui Mun are probably associated with the marine transgression which occurred during the rise in sea level following the low sea level of the last glaciation. However, the muddy sediments, which form the bulk of the formation, appear to have been deposited in water depths similar to those of the present day.

The formation is of Holocene age. The oldest radiocarbon date for the formation in Hong Kong is 10,060 years BP. There is some evidence that the main pulse of muddy sedimentation began in the area at about 8000 years BP. A borehole near Chek Lap Kok yielded a maximum age of 7960 years BP for the base of the formation (James, 1993) and another borehole at Junk Bay gave an age of 8,080 years BP (Strange and Shaw, 1986).

The acoustic turbidity which masks much of the features on seismic records to the south of Lantau Island (Figure 11), making seismic interpretation impossible in these areas, is due to gas within sediments absorbing and/or scattering the acoustic pulse from a seismic source. This creates zones of chaotic reflectors on seismic records, obliterating the response from features within the sediments such as bedding, erosion surfaces and the base of superficial deposits.

Weathering

Differential weathering among the different rock types exerts an important geomorphological control within the district. For example, in the north of the district, the highest peaks are generally capped by volcanic rocks or feldsparphyric rhyolites. These are more resistant to weathering than the host granites. In places where the protective cover of volcanics has been removed, or the feldsparphyric dykes are less dense, the exposed granitic country rocks weather more rapidly, producing areas of sharply lower relief. An example of this is given by the area around Wo Sheung Au west of Discovery Bay where screens of weathered granite form topographic lows between ridges of more resistant feldsparphyric rhyolite dykes (Plate 15).



Plate 15 - Discovery Bay Golf Course Formed in a Topographic Low of Weathered Lantau Granite between Resistant Ridges of Feldsparphyric Rhyolite Dykes (17230 16140)