Chapter 2
Outline of Geology

The district is situated in a structurally complex Palaeozoic sedimentary basin surrounded by Mesozoic granitic and volcanic rocks (Figures 4a & 4b). Carboniferous rocks predominate but are largely concealed by superficial deposits of the Quaternary period. Post-Jurassic regional metamorphism has affected most strata, and local contact or thermal metamorphism is evident surrounding the granitoid intrusions (Table 2).

Palaeozoic sedimentary rocks of the district occupy a northeasterly curving but irregular belt up to a maximum of 4 km wide. This fault-bounded basin extends northwards into Shenzhen and Guangdong, and south through Tuen Mun. The oldest rocks in Hong Kong are of Devonian age (Bluff Head Formation) but have not been proved in the present district. Carboniferous strata are divided into two formations; a lower calcareous Yuen Long Formation, and an upper clastic Lok Ma Chau Formation (Langford *et al*, 1989) probably separated by an unconformity (Frost, 1989b), but both belonging to the San Tin Group. The lowest known strata comprise the Long Ping Member, which consists largely of over 300 m of grey to dark grey, finely crystalline marble; the base of this succession has not been seen, but a few kilometres to the northeast, in China, Carboniferous marble is known to rest on Devonian strata. The Long Ping Member of the Yuen Long Formation passes up into the Ma Tin Member by intercalation and interbedding of pale grey to white marble. The Ma Tin Member is some 200 m in thickness and its subcrop occurs beneath much of urban Yuen Long. The Lok Ma Chau Formation subcrop occupies a large proportion of the low-lying ground between Tuen Mun and Mai Po. It is divided into an upper Tai Shek Mo Member and a lower Mai Po Member. The Mai Po Member, some 500 m thick, comprises metamorphosed argillaceous limestones, mudstones (carbonaceous in places), siltstones and sandstones. The upper Tai Shek Mo Member forms the arenaceous top to the Carboniferous and contains some conglomerate horizons. It crops out on the high ground northeast of Lok Ma Chau and is calculated to be over 300 m in thickness.

The volcanic rocks belong to the Repulse Bay Volcanic Group of Upper Jurassic to Lower Cretaceous age. These comprise mainly the Tuen Mun Formation in this district, dominated by andesitic lava and tuff. A distinctive sequence of interbedded tuffite and marble-bearing breccia, designated as the Tin Shui Wai Member, occupies a large area in the southwest of the district.

The sedimentary and volcanic rocks of the district are intruded by granite and granodiorite. The granodiorite is the oldest of the major intrusions and forms large irregular sheet-like masses within the volcanics, marginal to the main basin, as well as smaller intrusions within the Carboniferous sedimentary rocks near the Yuen Long urban area. The granites form the major plutons to the south and west. They are mostly fine- and medium-grained. Associated dykes intrude both the igneous and sedimentary sequences of the district. The basic dykes were probably intruded in the Tertiary era although no age dating of these rocks has been undertaken in the present study.

The geological structure of the district is dominated by northeast-trending elongate, curving dislocations showing both normal and reversed throws. This structure, termed the Tuen Mun-Lo Wu Fault Zone, has origins probably as old as the Caledonian Orogeny (Silurian) judging by the structural alignments. Reactivation of movement along old lines of weakness has occurred in post-Carboniferous times. Folding was probably the first deformation to affect the strata in the Hercynian Orogeny (Carboniferous-Permian) followed by intense faulting and later metamorphism which masked the earlier structures and resulted in a dominant northwesterly dipping foliation. The faults commonly occur over a broad zone comprising a plexus of parallel or subparallel dislocations. There is much evidence of lateral movement along partings lubricated by clays and micas. Dykes may in places occupy the fault zones. The dominant fault direction trends northeastwards, and these lines of weakness have been dislocated by later smaller movements at right-angles, resulting in offsets to the major fault lines.

The complex pattern of the solid geology in the district is buried to depths from 20 to 80 m by superficial deposits of Late Tertiary to Quaternary age. The superficial deposits comprise mostly well-sorted clays, silts, sands and gravels and debris flow deposits. Debris flow material commonly masks and partially fills valleys in the hilly areas, and spreads out downslope forming large fans.

The Pleistocene and Holocene alluvial deposits are generally overlain by Holocene marine deposits (Hang Hau Formation). These marine muds and sands are limited to the northern area, marginal to Deep

Table 2 - Solid Rocks and Superficial Deposits of the District

Era	Period	Genetic Classification or Named Division		Principal Materials
Superficial Deposits				
QUATERNARY	Holocene	Fill; sanitary fill		
		Hang Hau Formation		Mud
		Marine sand		Sand
		Estuarine deposits		Silt and clay
		Beach deposits		Sand
	Holocene and Pleistocene	Alluvium		Clay, silt, sand and gravel
		Debris flow deposits		Silt and sand with boulders
	Pleistocene	Terraced alluvium		Clay, silt, sand and gravel
		Debris flow deposits		Silt and sand with boulders
		Chek Lap Kok Formation		Clay, silt, sand and gravel
Volcanic and Sedimentary Rocks				
MESOZOIC	Upper Cretaceous	Kat O Formation		Sedimentary breccia
	Upper Jurassic	Repulse Bay Volcanic Group	Tai Mo Shan Formation	Coarse ash crystal tuff
			Shing Mun Formation	Tuff, tuff-breccia and tuffite
			Ngau Liu Member	Crystal and vitric tuff
			Tuen Mun Formation	Meta-andesite lava
			Tin Shui Wai Member	Metatuff-breccia with clasts of marble
	Lower Jurassic	Tolo Channel Formation		Sandstone and siltstone
PALAEOZOIC	Carboniferous	San Tin Group	Lok Ma Chau Formation	Metasandstone and metasiltstone
			Tai Shek Mo Member	Metasandstone and metaconglomerate
			Mai Po Member	Metasiltsone, graphite schist and phyllite
			Yuen Long Formation	Marble
			Ma Tin Member	White marble
			Long Ping Member	Dark grey marble
Major Intrusive Rocks				
MESOZOIC	Upper Jurassic	Granite Granodiorite		
Minor Intrusive Rocks				
TERTIARY	Palaeocene	Andesite Basalt and gabbro		
MESOZOIC	Upper Jurassic	Feldsparphyric and quartzphyric rhyolite Aplite and fine-grained granite Pegmatite		

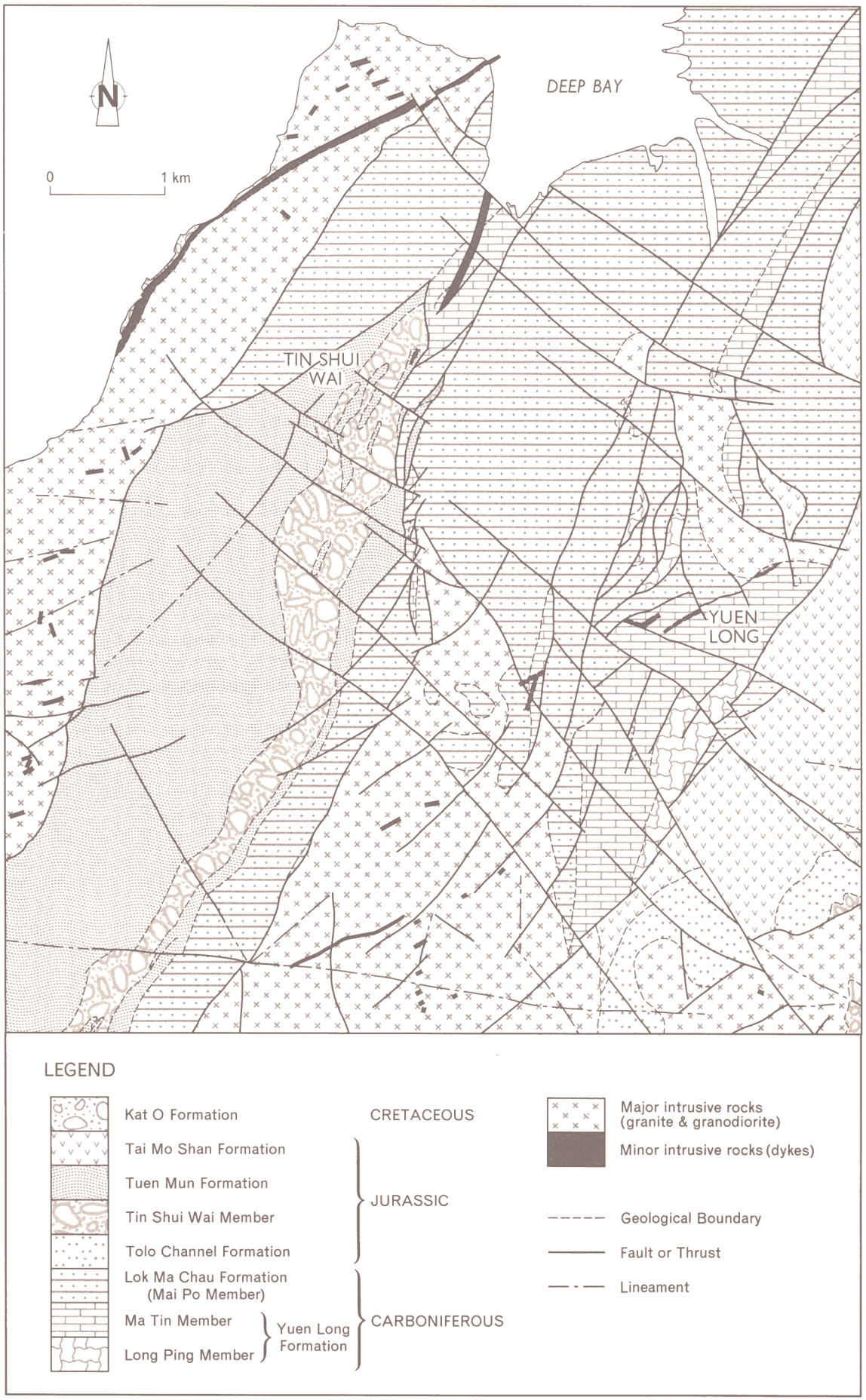

Figure 4a - Generalised Solid Geology, Yuen Long

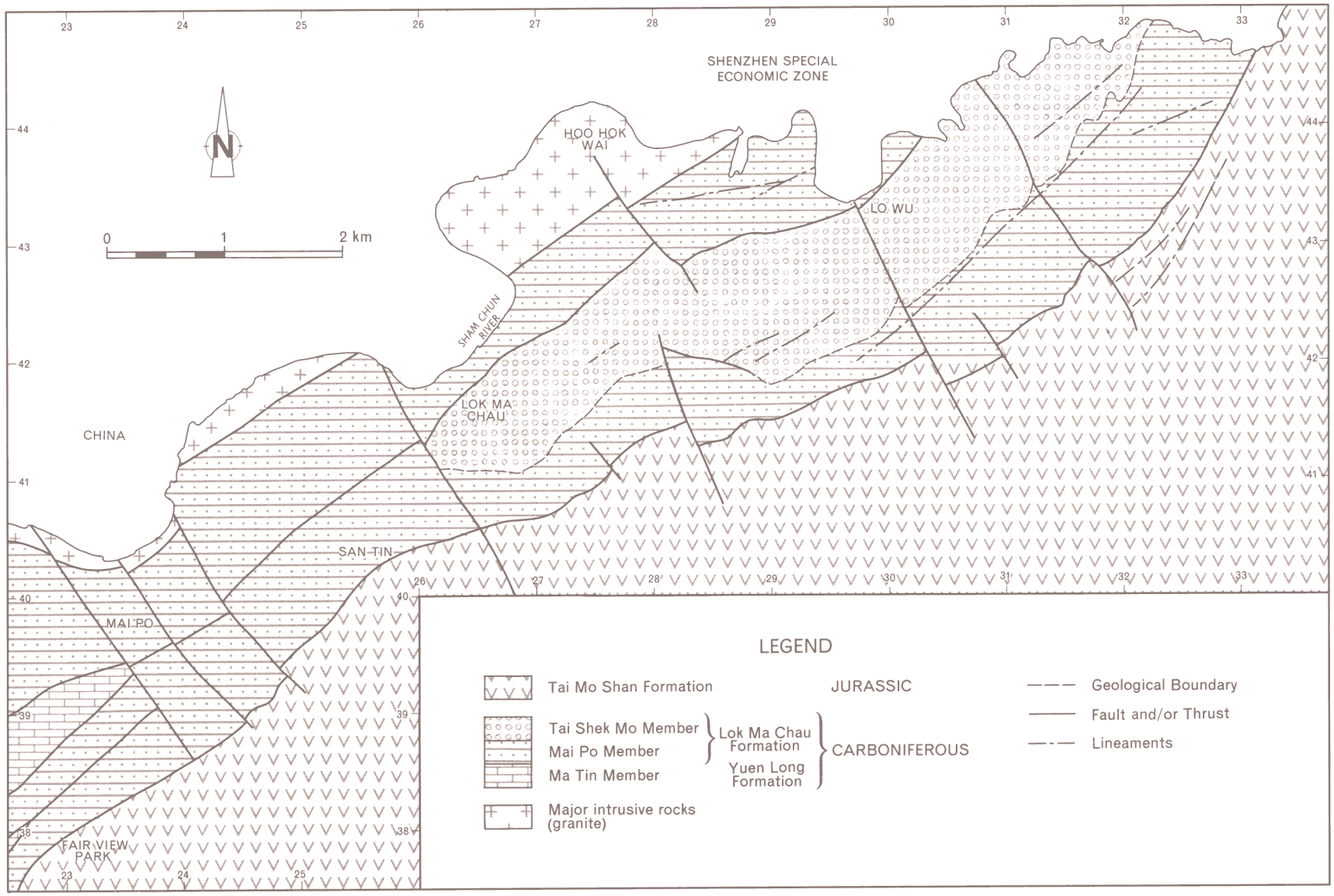

Figure 4b - Generalised Solid Geology, Lok Ma Chau

Bay, and do not extend south of Yuen Long town. Beach deposits of sand usually form in front of alluvial deposits in coastal embayments. Much of the urban area of the district has been covered by fill, usually comprising weathered granite or sands and silts. More recently, sand dredged in Deep Bay has been pumped into the low-lying areas of Tin Shui Wai to create platforms for new town development.

A regolith or zone of weathered rock occurs over most of the district (Plates 5 & 6). The effects of weathering vary depending upon the topographic setting, the lithology and on the structure of the strata. The most deeply weathered rocks are those of volcanic origin, particularly where associated with faulting. Completely weathered rocks are present at depths exceeding 100 m. The sub-aerial surface of marble is particularly prone to chemical weathering. Acidic rainwater, by downward percolation through joints and fissures, dissolves the calcium carbonate and produces a zone of weathering known as epikarst. This zone, which may be 30 m in thickness, produces karstic features with a very irregular surface in profile comprising numerous widened solution joints, slots, overhangs and other solution phenomena including cavities. Cavities also occur at greater depths down to about -100 mPD, with some filled by clays, silts and sands.

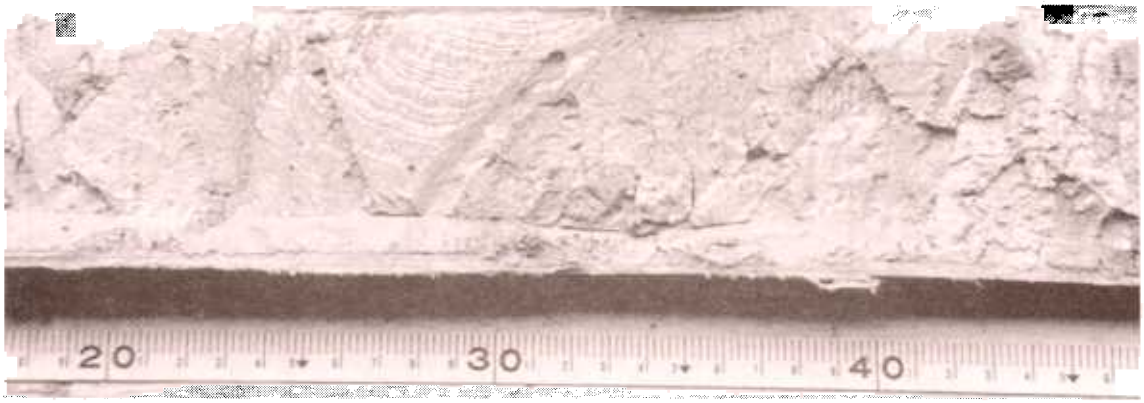

Plate 5 - Highly to Completely Weathered Metasiltstone of the Mai Po Member Showing Liesgang Rings in Ferruginous Concretions; BGS17, 52.90-53.90 m

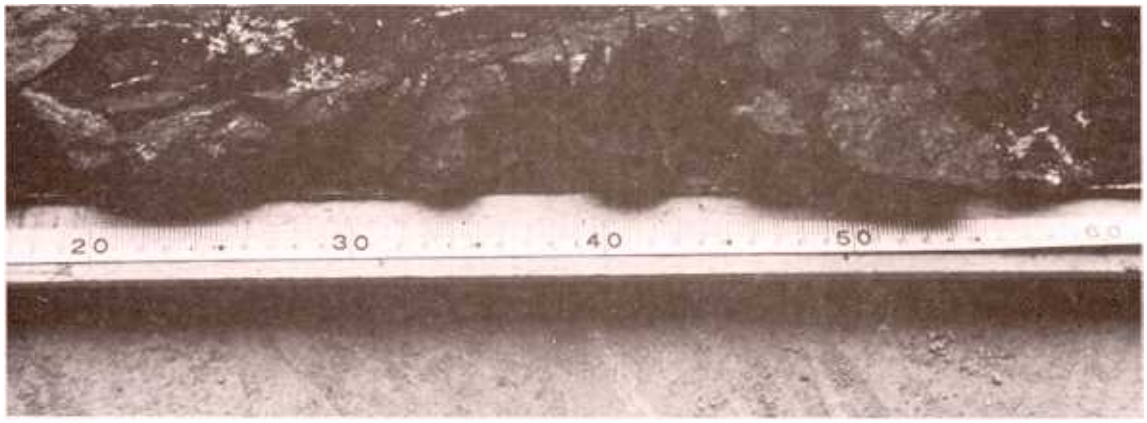

Plate 6 - Highly to Completely Weathered Metasiltstone of the Mai Po Member Showing Secondary Growth of Manganese Dioxide (Pyrolusite); BGS17, 42.90-43.90 m