

# Chapter 3

## Palaeozoic Sedimentary Rocks

### San Tin Group (Carboniferous)

#### Classification and Distribution

Metasedimentary rocks are exposed in one small area of the district (Sheet 10-NW-C); Tsz Kan Chau (Reef Island) to the north of Lantau Island. They form part of a steeply northeast-plunging syncline with western and eastern limbs defined by The Brothers islands (Tai Mo To and Siu Mo To respectively) to the north of the Tsz Kan Chau.

The metasedimentary rocks have lithological and palaeontological similarities with the main outcrop of Carboniferous rocks in the northwest New Territories (Langford *et al.*, 1989) and have been assigned to the San Tin Group (Langford *et al.*, 1995). The San Tin Group comprises two formations; the older Yuen Long Formation (Lee, 1985) and younger Lok Ma Chau Formation (Williams, 1943). Only the Lok Ma Chau Formation is exposed in the district although an extensive subcrop of marble, correlated with the Yuen Long Formation, has been proved by boreholes to the south and east of this island (NS1/14460, NS3/14460, T8/3/13951, M7/29998, M11/29998, DH4/30023, DH6/30023).

#### Lok Ma Chau Formation

##### *Mai Po Member*

The Lok Ma Chau Formation comprises two members; the older Mai Po Member consisting of metamorphosed siltstone, fine-grained sandstone and carbonaceous siltstone, and the younger Tai Shek Mo Member consisting of metamorphosed sandstone and conglomerate. The rocks exposed at Tsz Kan Chau have been assigned to the Mai Po Member. Langford *et al.* (1995) previously assigned metasedimentary rocks outcropping on the coast between Tai O and San Shek Wan to the Mai Po Member of the Lok Ma Chau Formation. However, these rocks have since been reclassified as the Middle Jurassic Tai O Formation (Sewell *et al.*, 2000) on the basis of new fossil discoveries (Ng *et al.*, 1997).

At the southeastern end of Tze Kan Chau (1588, 2085), the sediments are composed of buff to brown, cross-bedded (units 10s of mm), pebbly coarse sandstone and laminated fine quartz sandstone with sparse intercalated beds (0.5 – 1 m) of dark grey to black, massive to poorly laminated graphitic siltstone (Plate 1). Andalusite crystals are well-formed in the sandstone beds indicating that the succession has been contact metamorphosed. To the northwest, the sediments grade upward into buff to reddish brown, massive fine-grained quartz sandstone which dips steeply (65 – 70°) to the northwest. The succession is considered to overlie stratigraphically marble of the Yuen Long Formation found in offshore boreholes to the east, and to have a minimum thickness of 300 m (Langford *et al.*, 1995).

#### Yuen Long Formation

##### *Ma Tin Member*

The Yuen Long Formation consists of dark grey and white marble, and has been described principally from the Yuen Long area in the northwest New Territories. Frost (1992) divided the formation into two members: the lower Long Ping Member is a dark grey marble with complex internal structure, whereas the Ma Tin Member is a massively-bedded white marble. The marble encountered in offshore boreholes is predominantly white and is assigned to the Ma Tin Member. Solution features have been encountered in three of the boreholes: NS1/14460 at -54mPD; DH4/30023 at -59mPD and -62mPD; and DH6/30023 at -65 mPD. These features are karst-related cavities, up to 6 m across, and are commonly infilled with brown sandy silt.

Sediments of the Lok Ma Chau Formation are considered (Lai *et al.*, 1996) to have been deposited in a tidal swamp or fluvial–deltaic environment. The presence of small-scale cross-bedding in the fine-grained sandstones suggests shallow water conditions whereas intercalated carbonaceous material may indicate neritic conditions. Marble of the Yuen Long Formation is considered (Frost, 1992; Sewell *et al.*, 2000) to have been originally a pure to slightly impure limestone.



Plate 1 - Steeply-dipping and Deformed, Fine-grained Metasandstone and Carbonaceous Metasiltstone of the Lok Ma Chau Formation Exposed on Tsz Kan Chau (1588 2085)

### **Tolo Harbour Formation (Permian)**

Metasedimentary rocks and their weathered products have recently been identified (Gillespie *et al.*, 1998; Kirk, 2000; Fletcher *et al.*, 2000) in boreholes in the vicinity of Tung Chung New Town. The rocks were provisionally named as the “Tung Chang Formation” (Lee *et al.*, 1998), but have since been tentatively correlated with the Tolo Harbour Formation (Sewell *et al.*, 2000). These rocks comprise metamudstone, metasandstone, marble, skarn, calcsilicate rock and quartzite and occur as large (up to 350 m across), isolated blocks within the medium-grained Lantau Granite (Middle Jurassic). In some of the largest metasedimentary blocks, fossiliferous limestone is preserved and has yielded an Early Permian fossil assemblage, including the fusulinid foraminifers *Schwagerina callosa* and *Schwagerina* spp, and the rugose coral *Rugosachusenella hutiensis* (Lee *et al.*, 1998).

The metasedimentary rocks are well-bedded with lithologically distinct bands of skarn, calc-silicate, and rare magnetite-rich rock, usually no more than a few metres thick. Marble, up to 60 m thick, is known from one of the largest metasedimentary blocks. In the weathered state, the metasedimentary rocks are variably altered depending on the characteristics of the parent rock. Quartzite, metasandstone, calc-silicate and siliceous skarn are largely resistant to weathering whereas marble, impure marble and carbonate-bearing siliceous rocks are highly susceptible. Commonly, the carbonate-rich rocks have been dissolved by oxidizing waters to leave an insoluble residue of silt and clay minerals. Cavities are often formed and many of these have subsequently been infilled with superficial deposits.