

CHAPTER 3
GENERAL GEOLOGY

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3.1 The Older Schist Series (Silurian-Ordovician)

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3.1 Lithology

Outcrops of weathered rocks were found along the Seremban-Mambau-Siliau, and Siliau-Rantau-Seremban, roads and along the sole railway track from Seremban to Siliau. Some of these outcrops also clearly expose partial weathering profiles and the residual soils developed over the bedrock.

On the basis of field investigations, as well as the review of previous work, two main lithological units have been identified to be present in the study area, i.e. the Older Schist Series and the Younger Schist Series.

3.1.1 The Older Schist Series (Silurian-Ordovician)

This unit covers about 40% of the study area (ref. Fig. 3.1) and is found in the northern and western parts i.e. to the north of Kampung Kuala Sawah and along

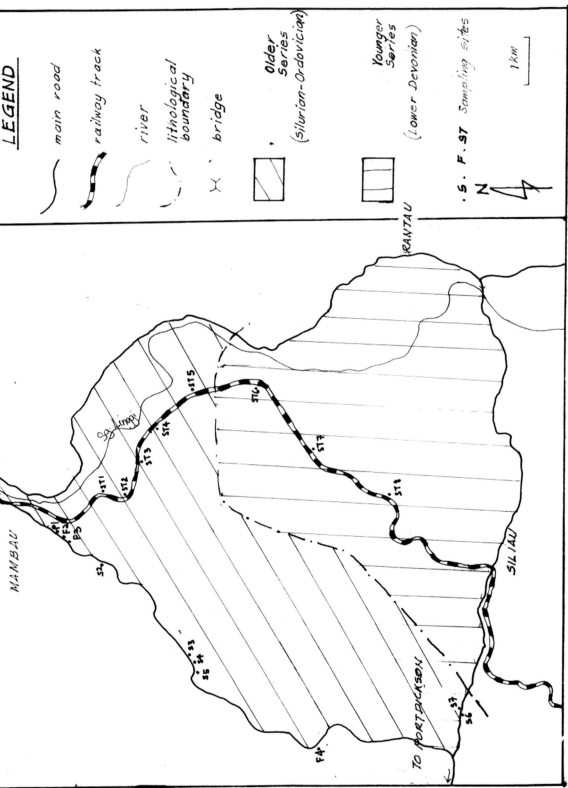


Figure 3.1 Geological map showing the distribution of existing lithological units and the location of the sampling stations

the Seremban-Mambau-Siliau road. It comprises two sub-units namely the minor highly foliated, dark to very dark grey, graphite, and quartz-graphite-mica schists (Plates 3.1, 3.2, 3.3 & 3.4) and the major highly foliated, light greenish to grey quartz-mica schist intercalated with quartz schist (Khalid, 1972) (Plates 3.5 & 3.6). The dark to very dark grey schist is considered to be of a Silurian age, whilst the green to grey schist is of a Pre-Silurian age (Khalid, 1972). These two major and minor subunits can be summarized as:

- i) Quartz schist, quartz-muscovite schist and quartz-muscovite chlorite-biotite schist, with or without tourmaline which is a Dinding Formation equivalent (Gobbett, 1964 from Khalid, 1972)- the major unit
- ii) Graphite, quartz-graphite and quartz-graphite-muscovite-chlorite-biotite schist with or without sulphide bands which is an equivalent of the Hawthornden Formation (Gobbett, 1964 from Khalid, 1972) - the minor unit

The Dinding Formation equivalent is grey-apple green in colour and is often stained to a rusty appearance by iron oxide. It is highly crenulated, contorted and foliated with very steep dips. The Hawthornden Formation equivalent is dark grey to almost black in colour. It is highly crenulated and tightly folded with common overturned folding and beddings which dip steeply. Sunthralingam (1977) however, has grouped both these lithological units under one single unit, Unit A which was found to be similar to the Pilah Schist of the Kuala Pilah area (Khalid, 1973).

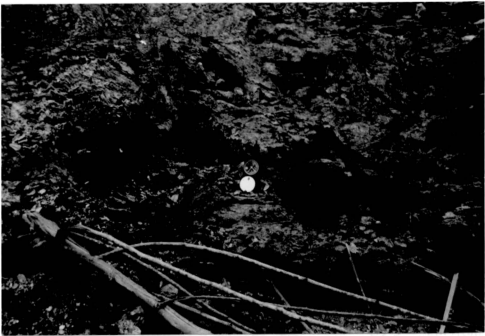


Plate 3.1 Graphite lenses in crenulated quartz-grapitic-mica schist outcropping along the railway line
(Location : ST 1 - 3km from Mambau)

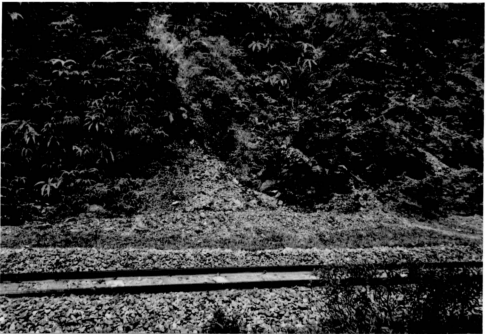


Plate 3.2 Light greenish weathered quartz -graphitic-mica schist outcropping along the railway line
(Location : ST 2 - 4km from Mambau)



Plate 3.3
Weathered graphitic
schist exposed on
embankment along
the railway line
(Location :
ST 3 – 5km from
Mambau)



Plate 3.4 Weathered graphitic schist outcropping along the railway line
(Location : ST 6 - 9km from Mambau)



Plate 3.5 Highly crenulated and foliated light greenish grey quartz-mica schist exposed along the Rantau-Seremban road
(Location : 8km from Rantau)



Plate 3.6 Brownish (due to secondary iron oxides) green quartz-mica schist outcropping along the railway line
(Location : ST 5 - 7.5km from Mambau)

3.1.2 The Younger Schist Series (Lower Devonian)

This unit covers 60% of the study area (ref. Fig. 3.1) and is found in the central, eastern and southern parts i.e. to the south of Kampung Kuala Sawah, covering the stretch across the Siliau-Rantau-Kuala Sawah road and about 60% of the railway track which includes the central and southern stretches. This younger unit consists of immature to moderately mature sandstone (Plate 3.7 & 3.8) with minor intercalation of light grey shale (Plate 3.9). It is variably metamorphosed to metaquartzite and slate or phyllite (Plate 3.10). Relative to the Older Schist Series, the Younger Schist Series is less buckled and crenulated with less steeper beddings. This series is whitish grey to grey in colour and is often stained by iron oxides.

This Younger Series has been classified as Unit B by Sunthralingam (1977) and is correlated with the Kenny Hill Formation of the Kuala Lumpur area (Khalid, 1973).

3.2 Petrology of the lithological units

3.2.1 The Older Schist Series

Thin sections of the major quartz-mica schist subunit of the Older Schist Series in the study area show interlocking elongated quartz crystal ranging from 24-



Plate 3.7
Light grey to whittish,
highly weathered
metaquartzite found
exposed along the
railway line
(Location : ST 7
11km from Mambau)



Plate 3.8 Blocks of light grey to whittish, weathered metaquartzite exposed along the railway line
(Location : ST 8 - 13km from Mambau)

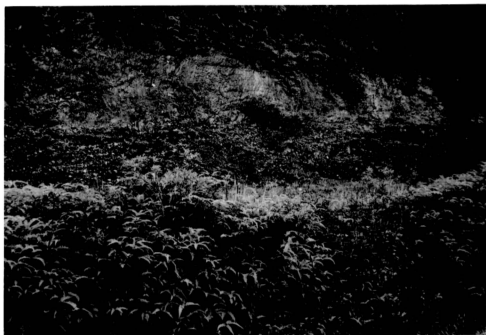


Plate 3.9 Cut slope of moderately matured sandstone (light bands) with minor intercalation of light grey shale (darker bands) (not in-situ) at the bottom
(Location : 3km from ST 8)

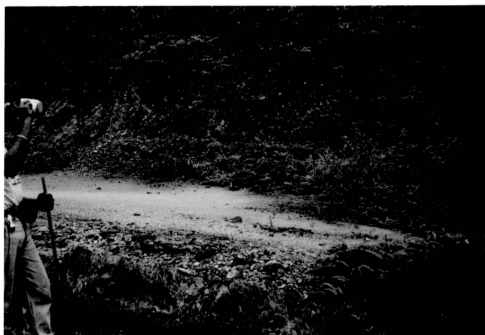


Plate 3.10 Variably metamorphosed metaquartzite, slate and phyllite
(Location : 5km from ST 8)

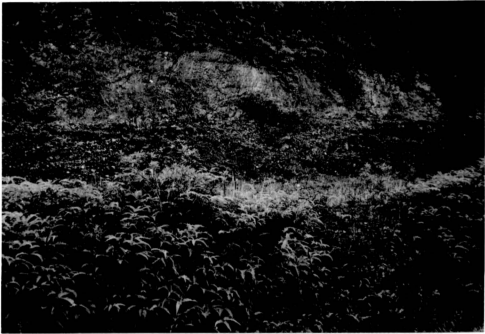


Plate 3.9 Cut slope of moderately matured sandstone (light bands) with minor intercalation of light grey shale (darker bands) (not in-situ) at the bottom
(Location : 3km from ST 8)

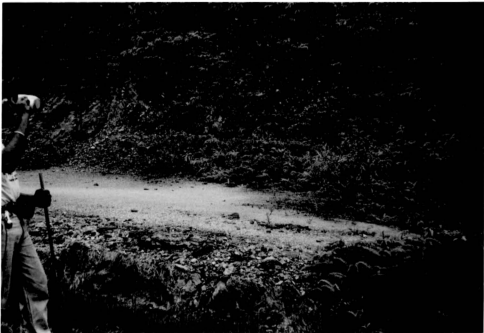


Plate 3.10 Variably metamorphosed metaquartzite, slate and phyllite
(Location : 5km from ST 8)

100 μm size that occur between parallelly aligned biotite and muscovite flakes of 20 μm to 50 μm size. The parallel alignment of the micas gives the rock its well-defined foliation. Quartz lenses of less than 1mm in size are also found parallel to the biotite and muscovite flakes. Biotite also occurs in clusters of bigger and better defined crystals than those which make up the groundmass. They are strongly pleochroic and green in colour. They are usually associated with zircon crystals (60 μm) and opaque to reddish brown iron oxyhydrates (80-150 μm).

Quartz and minerals such as microcline and albite are also found as large (0.4-2.6 mm) individual grains. The coarse quartz crystals are strongly undulose with crenulated and embayed boundaries in angular or round shape. Most of the microcline crystals show polysynthetic twinning though some may appear cloudy due to the effect of sericitization (Zauyah, 1986). The foliation curves around these small augen phenoclasts. On the other hand, most of the albite crystals present exhibit albite twinning.

Thin sections on the minor graphite and quartz-graphite-mica schist subunit of the Older Schist Series show narrow, ptygmatic and discontinuous quartz lenses paralleling the schistosity (Khalid, 1973). Graphite can be seen interspersed amongst these lenses.

Other minor minerals present are chlorite and tourmaline. Chlorite occurs as veins parallel to or cutting the foliation. The prismatic tourmaline crystals generally

found in alignment with the schistosity are pale yellow in colour with bluish pleochroism. Often these crystals are found fractured.

3.2.2 The Younger Schist Series

Thin sections of the Younger Schist Series show that this rock type is composed of 70%-80% poorly to moderately well sorted quartz clasts. These clasts are suspended in finer quartz-sericite-chlorite matrix and are usually strained with a general subangular and elliptical shape. Most of these clasts have interlocking sutured boundaries. Chert is rarely present (Khalid, 1973) and accessory muscovite occur in poorly defined trains (Khalid & Derksen, 1971).

3.3 Structural Geology Of The Study Area

The structural geology of the study area has been determined by carrying out aerial photo interpretations as well as incorporating information from previous research in the state of Negeri Sembilan.

Aerial photo interpretation and data from previous work indicates the presence of four major fault trends that have affected the rocks of the study area. They

are N-S trending tension fault (Shu, 1971) and wrench faults of NW-SE, NE-SW and ENE-WSW trends (Khalid, 1973).

These faults are found in the field with the NW-SE and NE-SW faults, marked by the quartz reefs and veins found in Seremban (Khalid & Derksen, 1971). Quartz reefs and veins with NW-SE and N-S trends are also found in the Kuala Kelawang area. Aplites and pegmatites found in the general area also show a dominant NW-SE trend (Shu, 1971). Towards the east of the state of Negeri Sembilan, medium grained granite and quartz diorite are found exposed in a stock trending NW-SE.

The Older Series, which has experienced intense folding, forms a series of asymmetrical and overturned anticlines and synclines with an axial trend along NW-SE (Khalid, 1973 & Sunthralingam, 1977). The presence of discontinuities and highly crenulated lenses in the quartz-mica schist suggest that this series could have undergone a more complex tectonic history.

The Younger Series, which rests unconformably on the Older Series, is less severely folded though it has experienced post-unconformity compression (Khalid, 1973; Sunthralingam, 1977).

3.4 Correlation

The Older Schist Series (Unit A, in Sunthralingam, 1977) of the study area, which is similar to the Pilah Schist, is made of quartz-mica schist with intercalated quartz schist and quartz-graphitic schist are lithologically and structurally similar to the Dinding and Hawthornden Formations respectively. These then continue southward into Sheet 112 and 113 where they are grouped under the Mixed facies by Rishworth, 1963 (quoted in Khalid, 1972).

The Younger Series (Unit B, in Sunthralingam, 1977) in the study area is lithologically similar to the Kenny Hill Formation which is of Lower Devonian age. A slight variation in texture is noted in the Kenny Hill Formation though, where it is relatively better sorted and contains less matrix. This variation is mainly due to the fact that the metaquartzite member is closer to shoreline and therefore is better sorted and more matured. When traced into Malacca, it appears 'arenaceous' and 'argillaceous' rocks as stipulated by Rishworth, 1963 (quoted from Khalid, 1972)

3.5 Brief Geological History Of The Study Area

The Older Series and the Younger Series of the study area as well as the Lower Palaeozoic rocks in the vicinity have been subjected to major episodes of acidic intrusions which occurred during Upper Triassic-Lower Jurassic and Middle

Cretaceous (Khalid, 1973). These rocks have experienced several episodes of faulting extend over the Tertiary period in four major trends of variable distances. These were the ENE-WSW possible wrench fault, the NE-SW dextral wrench fault, the NW-SE sinistral wrench fault and the N-S tension fault.