Significance of the geology and geochemistry at Teluk Ewa, Langkawi

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The Teluk Ewa area is located in the northern part of Langkawi Island. The area is underlain by the late Cambrian Machinchang Formation, Ordovician to early Devonian Setul Formation and the late Triassic igneous intrusion of the Bukit Sawar Granite. The rocks in the area have undergone regional and contact metamorphism and these have significantly changed the texture and mineralogy of the rocks.

The Machinchang Formation is the oldest rock in the area and consists of two different units, namely:

a) Arenaceous Unit — quartzite and metasiltstone
b) Argillaceous Unit — filit, metamudstone and metatuff

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These units occur in the field as interbedded layers with thicknesses varying from a few centimetres to two metres. The beddings strike nearly north-east, ranging from 008° to 080°, with the dip angle between 07° to 56° to the east and west. From the petrography study, the source of the sediments for this formation might be igneous, sedimentary and metamorphic. The depositional environment for the Machinchang Formation is believed to be deltaic, as shown by the occurrence of sedimentary structures such as cross bedding, cross lamination and parallel lamination.

The Setul Formation, conformably overlying the Machinchang Formation, experienced regional as well as low grade contact metamorphism. The formation is found as interbedded layers with thicknesses ranging from 1 m to 5 m, striking from 014° to 041° with dip angles ranging from 018° to 043° to the east and west. The Setul Formation consists of three main facies, namely:

a) Argillaceous Facies — calcareous slate, calc-silicate hornfels and skarn.
b) Carbonaceous Facies — tremolite-scapolite marble and phlogopite-scapolite marble.
c) Calcareous Facies — calcareous sandstone.

Petrography study shows the occurrence of the minerals like tremolite, phlogopite and diopside which formed due to the alteration of rocks rich in Mg and Ca composition during the metamorphic process. Fluorine metasomatism in the skarn rock gave rise to minerals like vesuvianite and fluorite minerals. Log stratigraphy studies on the detrital unit area shows that the deposition of calcareous, argillaceous and carbonaceous facies were probably controlled by the sea level changes or by the vertical tectonic activities such as subsidence and uplift with low depositional energy.

The Bukit Sawar Granite in the area can be divided into two units based on grain size and textures:

Unit 1 — medium-grained porphyritic biotite adamellite.
Unit 2 — fine-grained tourmaline adamellite.

Based on the geochemical study, the granitoid can be classified as S-type, peraluminous and the occurrence of biotite and muscovite minerals from the petrography study supports this conclusion. Petrographic and geochemical studies also show that the emplacement of granitoid was mesozonal. In terms of age, Unit 2 is younger than Unit 1.

Structural study shows that bedding in the Machinchang and Setul Formations have experienced tectonic deformation phases. Both are subjected to the NW to SE forces that resulted in the two folding phases of the Machinchang Formation and the more open folding of the Setul Formation. The negative lineament study shows a connection between the lineaments and the set of joints in the study area, indicating three sets of joints oriented dominantly in the 040° to 050°, 060° to 070° and 310° to 320° directions. The formation of veins in the study area was influenced by these sets of joints.

Geochemical study of the Setul Formation limestones shows almost all the area contain an average MgO percentage of less than 3% and this is suitable for use as raw materials in the Portland cement industry. However, at some localities which contain beds of calc-silicate hornfels, tremolite-scapolite marble and phlogopite-scapolite marble with minerals like tremolite, diopside, phlogopite and dolomite, higher MgO values were recorded. The high average SiO_2 chemical composition occurrences at certain localities are believed to be due to the occurrence of calc-silicate hornfels, marble with chert nodules and quartz veins and the host rock with quartz and muscovite minerals associated with barite veins.