DEVELOPMENT OF PERMIAN VOLCANICLASTICS-LIMESTONE SUCCESSION AT GUA BAMA, PAHANG DARUL MAKMUR

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Late Permian volcanic and volcaniclastic facies interfingering with minor limestone were reported to be ubiquitous from the Padang Tengku to the Terengan catchment areas (Mohd. Shafeea Leman, 1993). Within this region, Gua Bama represents the largest existing carbonate outcrop. This hill is composed of poorly bedded to massive limestone. Fossils found within the limestones near Gua Sai and in Gua Bama were reported to be of probable Carboniferous age (Procter, 1972). Our investigation shows that the limestone sequence at Gua Bama is underlain by stratified volcaniclastics. The latter is characterized by crystal tuffs which become more calcareous towards the base of the limestone. The presence of radiolarian tests and crinoid plates in the volcaniclastics indicate that these strata were accumulated in marine waters. Volcanic activity in the region is believed to have been relatively quiescent during the accumulation of the limestone judging from the lack of tuffaceous materials within the limestone beds.

The Gua Bama limestone is marked by the development of a massive calcareous breccia at its base. Overlying it are mudstones and wackestones generally containing crinoid plates and calcareous algal remains. The common algal constituents are dasycladaceans and *Tubiphytes*. Two levels of organic encrustations are also observed. The skeletal remains of the encrustations are especially prone to silicification and the identity of the organisms could not be determined. The algal components of the encrustations are mainly *Tubiphytes* and thin laminites. Traces of other skeletal remains were observed but generally the majority of them could not be identified due to varying degrees of obliteration by neomorphism and dolomitization. Colaniellids (foraminifers) were among the better preserved microfossils observed. Their occurrences indicate that the age of the Gua Bama limestone is Late Permian.

Depositional environment of the Gua Bama limestone can be inferred from the biotic components present, in particular, the calcareous algae. Present-day distribution of dasycladaceans indicate that these taxa inhabit tropical to subtropical, shallow marine environments such as shelf lagoons or mudbanks. By analogy, Upper Paleozoic dasycladaceans were inferred to have occupied similar niches (Wilson, 1975; Flugel, 1977). *Tubiphytes* is another algae reported to be a common and important constituent of Upper Paleozoic organic buildups on shelfs (Wilson, 1975; Flugel, 1977). Therefore, based on the algal components, the Gua Bama limestone can be inferred to have been deposited on a shallow tropical shelf during Late Permian. The presence of mudstone and wackestone facies in the limestone further indicates that the environment was relatively protected. The relative thinness of the organic encrustations shows that no sizeable organic buildups were developed in the section studied. Thus, it seems highly likely that the Gua Bama limestone developed as a mudbank. The underlying volcaniclastics must have acted as a shelf shoal that allows the accumulation of the carbonates.

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Upper Permian limestones are now known to be more widespread and they appear to be concentrated within the northern part of the Central Belt (i.e. North Pahang and South Kelantan). The spatial distribution of these limestone bodies with volcanics/volcaniclastics may imply a genetic relationship between the two facies. Our findings at Gua Bama indicate clearly that an appropriate thickness of volcaniclastics was the preferred substrate for the accumulation of carbonate sediments. It is thus conceivable that similar volcaniclastics-carbonate successions may have been formed and it remains to be seen whether a more detailed study of the carbonate bodies outcropping within the region may yield more examples.