

Multiple phase deformational structures in the Tg. Balau, Tg. Lompat and Tg. Siang areas, Desaru Johor, Peninsular Malaysia

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The well exposed metasedimentary rock of probable Permo-Carboniferous age (e.g. Tjia 1987, 1989; Chakraborty & Metcalfe 1984), along the coastlines of Tg. Balau, Tg. Lompat and Tg. Siang, clearly recorded evidences for multiple phase deformation. Although complexly deformed, the existence of various interesting and classical examples of geological structures (Tajul Anuar Jamaluddin, 1996), rendered these areas vital in the understanding of the deformation history of this part (if not the entire) of the Eastern Belt of Peninsular Malaysia.

From the structural superposition and geometrical relationships, at least three phases of deformation (D_1 , D_2 , and D_3) can be distinguished. D_1 structures, although rarely encountered, are commonly represented by closed to isoclinal folds (F_1), associated with slaty and schistose cleavage (S_1) which are axial planar to the folds (F_1). S_1 cleavages also are usually parallel to the bedding planes (S_0).

D_2 structures are predominant in the study area and their general strike is NNW-SSE. D_2 deformation is represented by various kind of folds (F_2) ranging from closed to isoclinal, upright to recumbent folds which commonly show Z-asymmetrical shape. S_2 cleavage is commonly found in zonal or discrete crenulation cleavage. D_2 is also characterised by *en-echelon* periclinal folds or cleavage-transected folds, suggestive of dextral transpressive deformation. The D_2 pervasive shear zones are characteristically zones of sub-vertical, semi-ductile to ductile shear zones with dextral sense of shear striking NNW – parallel to the present sandy beach coastlines amongst the interrupted capes along the coast of southeastern Johor.

D_3 deformation is relatively mild and being represented by steeply plunging single or conjugate kink bands, chevron folds and localised subvertical warping. They are sub-perpendicular to the general strike of the D_1 and D_2 structures. F_3 folds are commonly associated with minor strike slip faults.

Timing of deformation is difficult to constraint due to lack of palaeontological information. However, from regional correlation (Mustaffa Kamal Shuib *et al.*, *this volume*), D_1 deformation was probably commenced as early as mid Permian. While the D_2 transpressional deformation probably occurred in Late Triassic and its structural association may be best explained by invoking model of positive flower structure. D_3 is more localised in character and probably represents strike-slip deformation of Post-Cretaceous.