Depositional palaeoenvironment determination based on organic facies characterization — A case study of the Batu Arang coal-bearing sequence

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The Tertiary sequence at Batu Arang, Selangor, is the only reasonably well exposed (albeit transiently!) non-marine coal-bearing sedimentary succession in Peninsular Malaysia and thus has been the subject of a number of studies by various group of workers such as mining engineers, geophysicists, geotechnical engineers

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as well as sedimentologists. In this study, an organic petrological and organic geochemical approach has been undertaken with the aim of refining the palaeoenvironmental interpretation within the broad fluvio-lacustrine depositional setting of the coal-bearing sequence.

Based on the organic-richness of the sediments studied, three main rock types were identified i.e. shale with TOC of < 20%, carbargilite with TOC in the range of 20 to 49% and coal with TOC ≥ 50%. The coals are hypautochthonous in origin as evident from the finely detrital organic constituents, higher mineral matter content than truly autochthonous coal, and the presence of the subaquatically formed microlithotype durite, as well as the occurrence of alginite-bearing carbonaceous shale and carbargilite associated with the coal. The coal seams are not believed to have been deposited within lake or open water swamps as suggested by earlier workers. This is based on the absence of alginite in the coal whereas alginite is dominant in the shale and carbargilite samples, thus suggesting a dryer environment of deposition for the coals. Coals in the palaeo-river valley at Batu Arang, being abundant in vitrinite with common occurrence of inertinite, particularly sclerotinite, are interpreted here as peat-swamp deposits of an alluvial flood plain depositional setting.

Two different algal assemblages are present in the shales and carbargilites i.e. the *Botryococcus*-derived telalginite and the *Pediastrum*-derived lamalginite. These are fresh water green algae and their occurrence in high abundances suggests, with little doubt that the shales were deposited in a freshwater lacustrine depositional setting. The carbargilites were probably deposited within smaller ponds or flood basins situated within a swampy alluvial plain on which peats, that formed coals, accumulated.

Based on the organic geochemical data, it is possible to envisage the depositional condition of these different sub-environments. The reducing condition of deposition of the shale is, to some extent, indicated by the low pristane/phytane ratios of 0.8 to 1.5. This is supported by the high TOC and HI values. Slightly higher pristane/phytane values of 1.4 to 2.5 possessed by the coal and carbargilite samples reflect a relatively less reducing/more oxidising conditions of deposition indicative of an alluvial plain setting.