Organic geochemistry of selected Upper Palaeozoic Kuantan Group sediments of East Pahang, Eastern Belt, Peninsular Malaysia

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A total of six outcrop samples comprising of four shales, a coaly shale and a limestone from the Upper Palaeozoic Kuantan Group collected from three different localities in East Pahang were analysed by means of organic petrological and geochemical methods. The purpose of this study was to discuss the use of biomarkers (or geochemical fossils) in assessing type of organic matter, maturity and depositional environments. The saturated hydrocarbons of these sediments were analysed using gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS). The petrographic study was performed using a photometry microscope in reflected white light and blue light excitation.

The mean vitrinite reflectance ($\%R_0$) for all the samples studied is in the range of 1.08%–1.13%, indicating that these sediments have reached a high level of thermal maturity (late oil-window maturation range). Both the 22S/22S+22R C_{32} hopane and 20S/20S+20R C_{29} sterane ratios had reached equilibrium, thus supporting the vitrinite reflectance data. This high maturity suggests the sediments have previously been buried to considerable depth, prior to being uplifted to their present position.

The GC fingerprints of the shales and coaly shale display a smooth high end-member distribution of n-alkanes extending beyond nC_{30}. A relatively lower abundance of n-alkanes is displayed by the limestone sample. Most of the samples show evidence of slight biodegradation as suggested by the presence of unresolved complex compounds and the loss of some of the lower molecular weight n-alkanes. The strong predominance of high molecular weight n-alkanes in the shales/coaly shale of the Charu and Sagor formations suggest significant input of higher land plant organic matter into these sediments. The distinction between the shales and the coaly shale samples is mainly based on petrographic observation and TOC (total organic carbon) content. The Panching limestone sample is dominated by nC_{17}–nC_{19} alkanes suggesting significant contributions of algal-derived organic matter. The lack of higher land plant-derived organic matter within the Panching limestone sample is evident from the low concentration of higher molecular weight n-alkanes compared to the Charu and Sagor sediments. The high Pr/Ph and Pr/nC_{17} ratios in the Charu and Sagor samples compared to the Panching limestone sample are likely to be associated with the source of the organic matter (i.e. higher land plant material) and is not indicative of the extent of anoxicity/oxicity of the depositional condition. No distinct variation is observed for the Ts/Tm ratio (generally considered to be associated with higher land-plant organic matter) among the samples studied suggesting this ratio may not be indicative of source input but are strongly influenced by the high thermal maturity attained by all of these samples. The high abundance of C_{24} tetracyclic terpanes could be associated with either higher land-plant, algae or microbial sources. The presence of significant marine influence is suggested by the high abundance of tricyclic terpanes in all of the samples studied.

Based on this study, although differences between the sediments within a particular formation could not be made, distinction can be made between the dominant type of organic matter that is present in the shales/ coaly shale compared to the limestone. The Charu and Sagor formations seems to have received substantial amount of land-derived organic matter that has been transported into the marine depositional setting, while the Panching Limestone is dominated by algal-derived organic matter and lacks higher plant material. Although high maturity, the samples are still within the oil-window range, suggesting these samples have not been too severely effected by thermal metamorphism or active tectonic activities of the Eastern Belt of Peninsular Malaysia.

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