INFLUENCE OF DEPOSITIONAL ENVIRONMENT ON THE PETROLEUM POTENTIAL OF TERTIARY INDONESIAN COALS

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Evaluation of geochemical, petrological and palynological data from over 500 Tertiary coal and carbonaceous outcrop samples from fifteen basins in Western Indonesia has led to a better understanding of depositional controls on the petroleum potential of deltaic sequences (Figure 1). Peat deposition peaked during two periods, associated with early Eocene-Oligocene rifting and transgression, and late Miocene-Pliocene regional regression. The resulting coals are significantly more hydrogen-rich than their Palaeozoic counterparts, with hydrogen indices (HI) of 250-400 mg HC/g C, and atomic H/C ratios of 1.0-1.3 when immature. Palynological data suggest that the majority of these coals were formed in freshwater environments, beyond the reach of marine influence. Palaeogene peat forming floras were dominated by palms with fern understorey, or shrubby open vegetation marginal to lakes, whereas Neogene peats were formed largely from mixed angiosperm and palm woodland. The low incidence of fusinite in all of the studied samples signifies an ever wet climate, in which forest fires were largely absent. The Paleogene coals are typically mineral-rich, and were deposited in rheotrophic marginal lacustrine environments. Higher inertinite abundance in the Neogene coals, and a paucity of bituminite and alginite macerals suggests drier conditions, due to a more seasonal climate and/or the development of meso-ombrotrophic (raised) mires in a regressional regime.

On the whole, the Palaeogene seams are more hydrogen-rich than the Neogene seams, implying that transgressive systems tracts produce more oil-prone coals. The volume of deltaic petroleum associated with the Neogene systems of Borneo is, however, comparable to or greater than that of Palaeogene systems in the region (e.g. Northwest Java), and geological factors must combine with source character to determine the prospectivity of such deltaic sequences. As recognised previously, there is a systematic increase in HI with increasing rank, peaking at a Tₘₐₓ of c. 430°C (e.g. Sykes and Snowdon, 2002). This leads to an underestimation of the petroleum potential of coals at low rank. The increase in HI is accompanied by a systematic decrease in S₁/TOC ratios and concomitant disappearance of some maceral species, particularly suberinite and resinite, implying low maturity mobilisation of labile resins and waxes, and assimilation into the coal matrix with increasing diagenesis. Differences in the peat forming flora may also partly account for the better oil potential of the Palaeogene coals. Although there is little difference in the visible percentage of resins in the Eocene and Mio-Pliocene coals, the general absence of terpenoids and proliferation of paraffin waxes in pyrolysates of the former suggests a different type of resin in those seams.