Hydrocarbon source potential of Tertiary oil shale (cannel coal), shale and siltstone of eastern Chenor, Penyu basins, Pahang, Malaysia

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Abstract

Malaysia and Asian region have a number of petroleum-bearing sedimentary basins commonly associated with coal and carbonaceous shale strata. Shales are the common source rocks of conventional petroleum resources whilst coal although a source for conventional liquid hydrocarbons, are more widespread as unconventional resources, such as cannel coal and coal bed methane (CBM). Coals within the oil & gas producing provinces of Malaysia and SE Asian region in general are known to be oil-prone. However, with the inevitable decline in conventional petroleum, remaining hydrocarbons will be more difficult to find and more expensive to develop. Set against the backdrop of world energy consumption projected to increase 49% by 2035, alternative sources of energy are being sought. Petroleum geoscientists are exploring unconventional source/reservoir systems such as the oil shale, tight sand, coal bed methane and fractured basement. In this study, oil shale/cannel coal, shale and siltstone which are an importance sedimentary facies for hydrocarbon exploration in the eastern Chenor, Pahang have been investigated using organic geochemical and petrological methods as well as Micro-CT, SEM (Scanning Electron Microscope).

The Tertiary sediments of eastern Chenor show a general trend of low thermal maturity based on vitrinite reflectance measurements (<0.5 $\%R_o$) and T_{max} (<435^oC). Organic petrological studies revealed that analysed oil shales and shales are rich in liptinite macerals (>20 vol. %) such as aliginite (Botryococcus algae), sporinite, cutinite and amorphous organic matter indicating oil-prone Type I and Type II kerogens. Pyrolysis data also show a trend from predominant oil-prone Type I and II kerogens to a mixed oil and gas-prone Type II-III kerogens within the studied samples except for the siltstones samples which have low HI value indicating no potential for hydrocarbon generation. The EOM result shows that all the oil shale samples possess excellent values for the bitumen/EOM and hydrocarbon (HC) content. The studied shale samples have very good petroleum potential. However, analysed siltstones show poor to fair petroleum potential based on for the bitumen/EOM and hydrocarbon (HC) content. This is supported by plots of TOC content versus extractable organic matter (EOM) and hydrocarbon yields versus TOC content commonly used in estimating the hydrocarbon generative potential of the source rocks.

Keywords: Organic-rich shale; organic geochemistry; organic matter quantity; unconventional hydrocarbon source rock; kerogen type