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Relationships between Organic Material and Thermal Maturity Derived from Coal and C-Shale Samples

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ABSTRACT

The purpose of this study is to characterize the relationship between organic material and thermal maturity during the process of evaluation of hydrocarbon potential. Samples studied include Miocene high volatile bituminous coal and coaly shale collected from outcrops and exploration wells in Hsinchu-Miaoli area, NW Taiwan, density centrifuge separated macerals, bituminous coal and anthracite from China, in addition to Woodford and Green River oil shale from the United States. Maceral composition analysis, elemental analysis, vitrinite reflectance measurement and Rock-Eval pyrolysis were performed for evaluation. The results of study show that: 1) coal samples from the Shiti Formation (middle Miocene) exhibit more vitrinite and less mineral matter contents than samples from the Nanchuang Formation (upper Miocene); H% is increased in exinite-enriched maceral mixtures with density < 1.25 g cm^{-3}, after density centrifuge separation. 2) A positive linear correlation between Tmax and Ro illustrates both Rock-Eval pyrolysis and vitrinite reflectance can be used as indicators of thermal maturity. 3) From the plot of H/C ratio vs. vitrinite reflectance, even though the depositional environments were different in Taiwan and China, their organic micelles exhibit a similar trend in the process of thermal maturation. As a whole, the curve has a turning point at Ro = 0.5% and H/C = 0.1 (atomic ratio 1.2) in this study. 4) A rather good correlation between S2 and TOC of samples studied indicates the contribution of S2 from TOC. 5) The highest HI occurred in certain maturities (Tmax and Ro) of samples studied, and not in the stages of less maturity or over-maturity. 6) Two different linear trends were observed in the cross plot of S1 vs. S2. Field outcropped shale or C-shale exhibits a steeper slope compared to that of coal samples which can be attributed to the compositional difference in their organic material. 7) A rather strong positive correlation for H% vs. S2 illustrates the contribution of H-containing macerals, especially exinite. As a result of this study, we expect to promote evaluation techniques for HC exploration; for instance, the development or improvement of evaluation methods for source rocks, reservoirs, structural evolution, and thermal maturity. Evaluations are expected to give more detail regarding local conditions, and be better quantified and more accurate.

Key words: Organic material, Thermal maturity, Coal

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1. INTRODUCTION

Evaluation of hydrocarbon potential is one of the most important aspects of oil exploration (Dow 1974). Its precision relates to the prediction of locations and reserves of prospect areas and the outcome of exploration projects (Magoon and Dow 1994). A hydrocarbon reserve can be generated by a proper combination of good source rock, depositional and tectonic structures, and thermal maturation (Otis and Schneidermann 1997). Therefore, "Material" and "Maturity" (M & M) of the hydrocarbon are the two important topics in evaluation.

The purpose of this study is to characterize the relationships between organic material and thermal maturity. 42 samples studied include Miocene high volatile bituminous

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