Upper Thermal Maturity Limit for Gas Generation from Humic Coals as Determined by Hydrous Pyrolysis

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Humic coal, with its dominance of Type-III kerogen, has long been considered a source of thermogenic natural gas. However, kinetic parameters for gas generation from coal based on various pyrolysis methods predict a wide range of thermal maturities in which gas generation occurs. Some kinetic parameters indicate that most natural gas generation is complete by a mean random vitrinite reflectance (Rm) of 2.0 %. Others indicate that only half of the gas potential of a coal is realized at a reflectance of 2.0 %Rm or higher. This discrepancy has significant implications in determining where and when in a basin the gas potential of a coal is no longer economical. Hydrous pyrolysis experiments were conducted on 44 coals ranging in rank from lignite through anthracite (0.3 to 5.4 %Rm) to address this issue. The coals were from Poland, Germany, Ukraine, and the United States. The experiments were conducted at 360°C for 72 hours, which under hydrous conditions only yield gas generation from kerogen and polar-rich bitumen, and not from the cracking of hydrocarbon-rich oils. The results indicate that more than 90% of the methane-generation potential of a coal is realized by a vitrinite reflectance of 2.0 %Rm, which suggests gas generation at higher thermal maturity levels will require other sources like the thermal cracking of oil.