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TITLE: Title: Advanced pyrolysis data and interpretation methods to identify unconventional reservoir sweet spots in fluid phase saturation and fluid properties (API gravity) from Drill Cuttings and Cores

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ABSTRACT BODY:

Abstract Body: Abstract

Understanding the EUR and producibility of unconventional reservoirs depends on, among other factors: 1) distinguishing hydrocarbons present as a producible fluid phase saturation from those in the sorbed state that are not producible; and 2) reservoir fluid properties such as API gravity. We present geochemical techniques that address both issues. Analysis was performed on cores from the Marcellus and Burkett Formations of USA together with cores from Mexico's Pimienta Formation, using the HAWK pyrolysis instrument's Petroleum Assessment Method (HAWK-PAM) and advanced pyrolysis plots that model sorbed versus total oil yields. For HAWK-PAM, a ramp rate of 25°C/min is utilized to generate 5 petroleum peaks; 4 on Oil Fractions and 1 on kerogen. Each isotherm has its Tmax temperature. The related peaks correspond to saturates, aromatics, resins and asphaltenes (SARA) categories; C1-C5, C6-C7, C8-C14, C15-C40 and Kerogen (plus any C40+). 12 Marcellus cores had an average oil fraction yield of 8 mgHC/g at a kerogen Tmax (a proxy for maturity) of 462°C and 4 Burkett cores averaged 7 mgHC/g at a maturity of 466°C. 3 Pimienta cores had 2 to 6 mgHC/g at a maturity of 448 to 455°C. We used HAWK-PAM to evaluate the samples oil content, SARA composition and to predict its API gravity. Current results indicate that oil fractions sum of at least 3 mgHC/g rock is a necessary - but not sufficient – condition for a formation to be an unconventional liquids reservoir with significant fluid phase saturation ("mobile oil"). HAWK-PAM enables prediction of API gravity from cuttings and cores using a linear correlation of API gravity to a derivative of HAWK peaks with R^2 = 0.91. Pimienta cores calculate 35, 28 and 33^{o}API. In order to separate the oil in the rock samples into sorbed versus producible fluid phase states, we then analyzed the HAWK results using t!Ps' advanced pyrolysis plots that model sorbed versus total oil yields. The saturation log and Caterpillar' plots for the Marcellus well highlight zones of fluid phase saturation that are potential targets for liquids production along with the Marcellus gas stream. The combination of HAWK-PAM and t!Ps' interpretation plots can identify storage and producibility sweet spots in unconventional reservoirs, quantifying the presence and composition (API) of liquid hydrocarbons, providing an accurate Tmax maturity proxy and distinguishing zones of fluid phase saturation "mobile oil" from sorbed oil in cuttings and cores.

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