Characteristics of Successful Shale Resource Plays, North America

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ABSTRACT

Shale resource plays can be either shale-gas or shale-oil. These reservoirs are typically very tight with low porosity and ultra-low permeability values in the nanodarcy range. Successful shale-gas and shale-oil plays in North America are variable in geological age, depositional sequence, organic richness, thermal maturity, kerogen type, and mineralogy among a few key parameters. One key characteristic is whether the system is a pure shale-gas system or a hybrid shale-gas where mixed lithofacies are present.

While assessing shale gas-in-place (GIP) and estimated ultimate recoverable (EUR) in order to assess the economic viability of these plays, it is important to understand the basic features of these systems. One important characteristic is gas type, i.e., whether biogenic or thermogenic, and if the latter, its thermal maturity for a specific kerogen type, organic richness, residual oil saturation, and mineralogy. Biogenic and low maturity thermogenic shale-gas systems will typically have much lower EURs than high thermal maturity shale-gas systems. To demonstrate these differences various shale-gas systems are compared including the Barnett, Fayetteville, Haynesville, New Albany, and Antrim shale-gas systems. The goal of this comparison is to identify geochemical variations in shale-gas systems yielding different production results.

Such geochemical characteristics as organic richness, generation potential, thermal maturity, residual oil saturation, type of gas, are important to understand as well as free vs. adsorbed gas, GIP and EUR, mineralogy, rock mechanical properties, porosity-permeability, and depositional sequence. A key factor from a geochemical viewpoint is accurately interpreting thermal maturity using all available data ranging from vitrinite reflectance, RockEval Tmax, gas composition, and carbon isotopes to kerogen conversion and products formed at a given thermal maturity or conversion level. Geochemical risk factors can be assessed from these data if integrated and interpreted correctly.

Shale resource plays may also be oil plays and these have also proven to be successful. These plays are also quite variable also with variations in system types: (1) highly fractured shales, (2) tight, mixed lithofacies, and (3) tight shales. A comparison of Monterey, Bakken, and Barnett shale-oil systems is used to illustrate these differences.

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