A Comparative SEM Study of Pore Types and Porosity Distribution in High to Low Porosity Samples from Selected Gas-Shale Formations

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ABSTRACT

Scanning electron microscopy (SEM) is utilized to determine the relative role of the inorganic matrix material in the reservoir character of gas-producing siliceous mudstones. Field Emission Environmental scanning electron microscopy (FE-ESEM) of argon-ion milled samples compares the distribution of pores down to the nanometer-scale within both the organic particles present and within the surrounding inorganic matrix of high to low porosity mudstones. Samples were selected from suites of conventional core samples from the Barnett (Mississippian), Haynesville (Upper Jurassic), and Marcellus (Middle Devonian) shales based on results of routine core analysis (crushed porosity), mineralogy, and total organic carbon (TOC). Previous studies of the Barnett Shale by the Bureau of Economic Geology at the University of Texas indicate that porosity within the Barnett Shale consists predominantly of nanometer-scale intraparticle pores within organic material present in strata that are thermally mature. Based on other studies, high porosity values within the Haynesville and Marcellus shales also generally correlate with higher TOC. The size and abundance of pores within matrix material of high and low porosity samples are semi-quantitatively compared to determine if matrix porosity varies significantly. SEM backscatter imagery, elemental mapping, and secondary imagery are combined with general petrologic studies to determine any correlations of porosity distribution with both organic and inorganic constituents.

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