The Controlling Factors and Quantitatively Assessing Modeling of Adsorbed Shale Gas: A Case Study of the Upper Triassic Yanchang Formation, Ordos Basin, Central China

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ABSTRACT

Adsorbed shale gas is critical to the evaluation and optimization of shale-gas exploration. Most previous studies focused on qualitative description of single factors and did not produce quantitative models to estimate gas content based on many factors. Thus, this study discusses the buildup of a multiple-factor model for estimating the adsorbed shale-gas volume. To select the controlling factors and build a quantitative model for continental shale gas, we chose the shale in the Upper Triassic Yanchang Formation in the Ordos Basin as target. All samples were from the Chang 7 and Chang 9 Members and a series of experiments was conducted, including isothermal adsorption experiment, total organic carbon (TOC) content analysis, Rock-Eval pyrolysis, X-ray diffraction (XRD) and petrophysics experiments. We analyzed the shale samples for their TOC, vitrinite reflectance (Ro), mineralogy, porosity, permeability, specific surface area (SSA), water saturation, temperature and pressure. Subsequently, regression analysis was used to establish the correlation of each parameter with the adsorbed shale gas. Based on the correlation results, the major controlling factors are TOC, clay content(C), porosity (Ø), SSA, and pressure (P). These parameters were used to build a quantitative model by Statistical Product and Service Solution (SPSS) software. The adsorbed-gas volume is expressed as a function. $V = 0.551*TOC - 0.441*SSA + 1.257*Ø - 0.0313*P - 0.0372*C + 2.692$, with $R2 = 0.9329$. In fact, each parameter has its own reason for becoming the controlling; TOC is the key factor because it is the starting material for gas generation and it can also provide nanopores for gas adsorption; authigenic clay minerals fill the pores and reduce the space for gas storage; porosity can provide the storage space; SSA is influenced by all above factors; and pressure can change the proportions of the free and adsorbed gas. The quantitative model built by these parameters for the Yanchang Formation can guide future exploration of continental shale gas.