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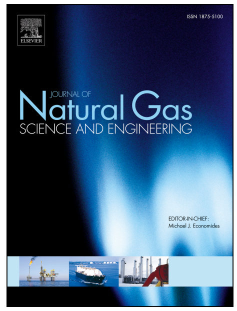

Effect of Adsorption and Permeability Correction on Transient Pressures in Organic Rich Gas Reservoirs: Vertical and Hydraulically Fractured Horizontal Wells

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Effect of Adsorption and Permeability Correction on Transient Pressures in Organic Rich Gas Reservoirs: Vertical and Hydraulically Fractured Horizontal Wells

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Abstract: A numerical model based on PEBI (Perpendicular Bisection) gridding was developed to study transient pressure responses in organic rich gas reservoirs by incorporating slippage corrected gas permeability and adsorbed gas effect. Parametric studies were conducted to investigate effects of slippage corrected permeability, gas adsorption, number of fractures, types of wells, and flow rate. Numerical simulation shows that gas desorption induces a radial flow regime and then a linear flow regime during early times for vertical wells. For the multistage fractured horizontal wells, gas desorption slows down the decrease rate of bottom-hole pressure, which is marked by a seeming flat line segment on the pressure curves. Its length depends on gas adsorption capacity, and its position depends on permeability and contact area between hydraulic fractures and reservoir, which can be used to estimate reservoir parameters such as permeability, ultimate adsorption capacity and length of hydraulic fractures. Based on these findings, a pressure interpretation procedure is established. Our findings lead to better understanding and interpretation of transient pressures in shale gas reservoirs.

Keywords: Apparent permeability; adsorption; slip; organic rich gas reservoirs

Introduction

Shale gas reservoirs have ultra-low permeability and gas transport mechanism includes slip, transition and Knudsen flow. These gas transport mechanisms and adsorption make the traditional Darcy flow law unsuitable to describe the flow in shale gas reservoirs. Simple Darcy law based analysis and interpretation of laboratory core tests yields significantly inaccurate values of permeability and diffusivity of gas in shales. Many researchers studied flow mechanisms and storage of shale gas (Javadpour, 2009; Civan, 2010; Civan et al., 2011; Civan et al., 2012;Freeman et al., 2011; Shabro et al., 2011). Recently, some researchers further studied the apparent permeability by incorporation of adsorption. Niu et al. (2014) studied the effect of gas accumulation near pore wall on the permeability correlation model and pointed that without considering gas accumulation, the permeability correction factor would be overestimated. Zhang et al.(2015) presented an apparent permeability formulation incorporating surface diffusion, which showed that surface diffusion had a great influence on total flux by accounting for 25% at low pressure, and became trivial at high pressure.

Based on shale-gas transport mechanisms and storage mechanisms, many researchers used analytical or semianalytical solutions to study the methods of production data and pressure data analysis for the wells in ultra-low permeability. Medeiros et al. (2008) proposed a semianalytical model incorporating the reservoir heterogeneity and hydraulic fracture for fractured horizontal wells. Medeiros et al. (2010) further studied production-decline characteristics in terms of