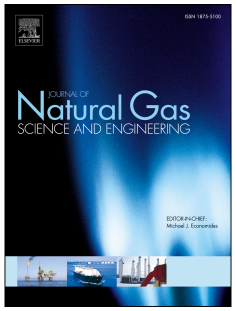

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Analysis method of pulse decay tests for dual-porosity cores

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Abstract： Homogeneous models are typically used to analyze the results of pulse-decay tests for low permeability cores. However, this poses a problem because some samples are dual-porosity media with microcracks/macropores and micropores. In this study, numerical simulations were conducted and the results showed that the pulse decay curves of the dual-porosity models are different from those for the homogeneous model. The results indicated that the volumes of the upstream and downstream vessels play an important role in identifying dual-porosity media and the early time and late time are mainly influenced by the storativity ratio and interporosity flow coefficient, respectively. A pressure derivative method was proposed in this work in order to identify dual-porosity media at the early time and distinguish the interporosity flow models. This method is applicable for vessel volumes within one-tenth to ten times the pore volume. The proposed method was verified against the experimental data of other researchers.

Keywords: pulse decay test; transient dual-porosity model; pseudosteady-state dual-porosity model; permeability

1. Introduction

Steady and transient methods are typically used to determine the permeability of rock cores. For low permeability rocks, the pulse decay method (which is a transient method) has become the mainstream method to determine the permeability of rock cores because it is much faster compared with the steady-state method. This method was proposed by Brace et al. (1968) to test the permeability of granite. The method was established based on the assumption that the elastic storativity of the core is negligible compared to those of the vessels. Since then, the pulse decay method has garnered much attention from other researchers because of its superior capability. Many analytical solutions were developed for various simplified conditions (Bourbie and Walls, 1982; Walder and Nur, 1986; Kwan et al., 1988). Hsieh et al. proposed a general analytical solution using a type curve matching method (Hsieh et al, 1981; Neuzil et al., 1981). Asymptotic solutions of pressures at early and late times were developed based on these analytical solutions and a number of linear fitting methods