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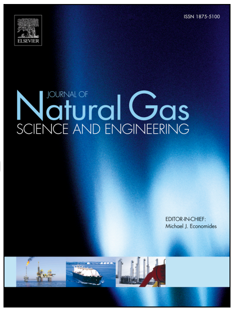

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Direct Estimation of the Fluid Properties and Brittleness via Elastic Impedance Inversion for Predicting Sweet Spots and the Fracturing Area in the Unconventional Reservoir

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Abstract Fluid identification and the level of brittleness estimated from seismic data play an extremely important role in unconventional reservoir characterization and development. Based on the theory of porous media and the AVO theory, a new elastic impedance equation is derived that includes the effective pore-fluid modulus as the fluid indicator and the product of the Young's modulus and density as the brittleness estimation factor. By comparing the accuracy of different models, the new elastic impedance equation is verified to meet the requirements of small and medium angles of incidence. Next, an elastic impedance inversion method based on a Bayesian framework is established that directly extracts the fluid identification information and the brittleness evaluation information, avoids the cumulative error of the indirect method, and improves the accuracy of the calculation results. Based on a model test, the direct estimation method is found to make full use of the strong anti-noise ability and practicability of the elastic impedance inversion; in addition, the application of real data demonstrates that the proposed inversion method has high accuracy and strong reliability.

Keywords: unconventional reservoir, fluid identification, brittleness evaluation, pre-stack seismic inversion, sweet spots prediction, fracturing area optimization

1. Introduction

Currently, the reserves of unconventional oil and gas resources are huge (Buyanov and Vladimir, 2011; Jia C. et al, 2012; Zhao and Ting, 2008). However, most of the resources are difficult to use at the level of the existing development technology; moreover, the speed and degree of the scale of the development promotion depend heavily on the support of exploration and development technology progress (Qin et al., 2012). The rock mechanics