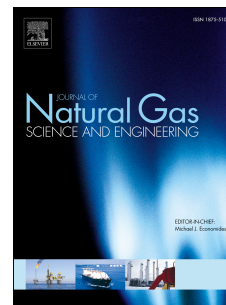


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A method for evaluating gas saturation with pulsed neutron logging in cased holes

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Abstract: Tight gas reservoirs have been one of the most important field of gas exploration and development, and the dynamic monitoring of gas saturation is of great significance to the adjustment of oilfield development scheme. Pulsed neutron logging technology plays an important role in the evaluation of gas saturation in cased holes. The low porosity of tight gas reservoir presents a new challenge to the application of pulsed neutron logging technology. In order to further investigate the measurement information of pulsed neutron logs to improve the performance of gas saturation measurement, the Monte Carlo numerical simulation method is used to study the gas saturation responses of different parameters obtained by the pulsed neutron-gamma logging instrument with an extra gamma-ray detector added. The results show that the capture count ratio measured by the instrument is mainly affected by changes in the hydrogen index of the formation. The ratio of pure inelastic gamma rays is more sensitive to the variation of formation density. When the porosity of the reservoir is fixed, the gas layer has a low hydrogen index and low density relative to the water layer. By combining the response characteristics of the two ratios, a new gas saturation evaluation parameter (GSEP) is proposed to evaluate gas saturation. The new method displays a higher gas sensitivity compared with the conventional ratio method and macroscopic capture cross section (Sigma) method. In addition, the response characteristics of GSEP in different well logging environments are also studied. It displays GSEP is less affected by the variation of the formation water salinity and clay contents compared with the Sigma method. At last, field examples are presented to validate the effectiveness of the proposed method.

Key words: Gas saturation; Pulsed neutron; Neutron-gamma rays; Well logging; Cased holes

1. Introduction

As the exploration and development of tight-gas reservoirs continues, the demand of low cost means to evaluate gas content via cased-hole logging becomes more urgent. Pulse neutron logging technology has been widely used to evaluate the oil and gas saturation behind casing(Zett et al. 2012, Zhang et al. 2013, Jacobson et al. 2015, Alkhasov et al. 2015, Nardiello

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