A New Gas Identification Method Based on Neutron Gamma Logging

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ABSTRACT

Tight gas reservoir with complex matrix mineralogy, detrital clays and great heterogeneity, is one of crucial items of unconventional reservoir. An amount of achievements are received in the research of it. But most of them focus on the new well logging method such as RPM, NMR and MAC logging, etc. Some attention ought to be paid to excavate the applying of conventional well logging method in the exploration of tight gas reservoir. According to response sensitivity analysis and simulating, a new method based on neutron gamma logging is presented to identify gas reservoir in tight sandstone. Neutron gamma logging, whose count rate is sensitive to the development of gas reservoirs, is usually used to indicate gas reservoirs. However, its count rate is greatly affected by two factors: porosity and chlorine. The reservoir with different porosities has different gamma count rate, and the chlorine, with a larger capture cross-section than water and gas, may cause the increase of gamma count rate in high formation water salinity reservoir. All of these make it hard to correctly indicate the development of gas reservoirs. In order to study the logging response of gas saturation and the effect of influential factors in tight sandstone reservoirs, a computational model is built using Monte Carlo N-Particle Transport (MCNP) Code and the simulating result reveals that the count rate of gamma increases systematically with the increase in gas saturation and formation water salinity, but decreases with porosity. A new gas identification chart is then released according to the simulating result. To begin with, a new parameter $\Delta NG1$ was defined as $\Delta NG1=\Delta NG/\Phi$ which means difference count rate of neutron gamma logging value in unit porosity between target layers and mudstone layers, where ΔNG was defined as $\Delta NG=NG-NG0$, which means difference count rate of neutron gamma logging value between target layers (NG) and mudstone layers(NG0). Then $\Delta NG1$ was set as the X axis of the gas identification chart and formation water salinity was set as the Y axis, and points of layers appear in different parts of this chart depending on their gas saturation and water salinity. We have applied this new chart to process log data from two wells in an oilfield, the result shows that the new gas identification chart, based on neutron gamma logging, can effectively eliminate the influence of porosity and formation water salinity, works well in the identification of tight gas reservoirs.