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PNN测井方法的蒙特卡罗模拟结果研究

张锋[1],徐建平[2],胡玲妹[2],修春红[2],孙建孟[1]

1 中国石油大学（华东）地球资源与信息学院，东营 257061;2 大港油田测试公司，大港 300280

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摘要 PNN（脉冲中子-中子）测井是利用He-3管记录热中子时间谱，通过获取地层宏观吸收截面来确定含水饱和度的方法.本文利用蒙特卡罗方法（MCNP-4C）模拟了不同地层水矿化度、孔隙度、饱和度和井眼等条件下的热中子时间谱，研究了地层宏观吸收截面与地层水矿化度的关系，从理论上确定PNN测井适合的地层水矿化度范围约为10～100 g/L，在地层水矿化度为50 g/L时适于测井的孔隙度下限约为10%.井眼流体不同，地层的热中子计数率不同，但对地层宏观吸收截面影响较小.利用远近探测器热中子计数比值可以确定孔隙度，并提出了根据不同岩性和饱和度的地层宏观吸收截面与孔隙度的交会图来评价骨架、含水饱和度以及确定油层、水层和气层的方法.PNN测井方法在低地层水矿化度、低孔隙度地层比其他方法具有优势.

关键词 PNN测井, 地层水矿化度, 孔隙度, 饱和度, Monte Carlo模拟

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Monte Carlo simulation result for the pulsed neutron-neutron logging method

ZHANG Feng[1], XU Jian-Ping[2], HU Ling-Mei[2], XIU Chun-Hong[2], SUN Jian-Meng[1]

1 Faculty of Geo resources and Information，China University of Petroleum，Dongying 257061，China;2 Well Testing Company of Dagang Oilfield，Dagang 300280，China

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Abstract Pulsed neutron-neutron logging is a method that can determine watersaturation by means of the formation macroscopic absorption cross section according to thermal neutron time spectra by using He-3 neutron detector. In this paper，the thermal neutron time spectrums under the conditions of different formation water salinity，porosity，saturation and borehole were simulated by using the Monte Carlo method. The relationship of formation macroscopic cross section and water salinity was studied. It is concluded that the suitable formation water salinity of the PNN logging is about 10 g/L to 100 g/L，and the suitable porosity minimum is about 10% when th
e formation water salinity measures up to 50 g/L in theory. The formationmacroscopic absorption cross section was less affected by borehole fluid although thermal neutron count rate is different. The porosity can be determined by using the thermal neutron count ratio of two different spacing detectors. The evaluation method of matrix and water saturation is put forward according to the crossplot of formation macroscopic absorption cross section and porosity under the condition of different lithology and saturation，and then the oil，water and gas reservoir can be identified by the PNN logging. As a whole the PNN logging method is preferable the low salinity and porosity to the other ways to determine the remaining oil saturation.

Key words PNN logging Formation water salinity Porosity Saturation Monte Carlo simulation

通讯作者:
张锋 zhfxy_cn@hdpu.edu.cn
作者个人主页: 张锋[1];徐建平[2];胡玲妹[2];修春红[2];孙建孟[1]