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欠压实超压层自然电位测井响应机理研究

张冲¹, 毛志强², 匡立春³, 张健^{3*}

1. 长江大学油气资源与勘探技术教育部重点实验室, 湖北荆州 434023;
2. 中国石油大学(北京)油气资源与探测国家重点实验室, 北京 102249;
3. 中国石油新疆油田分公司, 新疆 克拉玛依 843000

SP log response mechanism in undercompaction and overpressure formation

ZHANG Chong¹, MAO Zhi-Qiang², KUANG Li-Chun³, ZHANG Jian^{3*}

1. Key Laboratory of Exploration Technologies for Oil and Gas Resources of Ministry of Education at Yangtze University, Hubei Jingzhou 434023, China;
2. State Key Laboratory of Petroleum Resource and Prospecting, China University of Petroleum, Beijing 102249, China;
3. CNPC Xinjiang Oilfield Branch, Xinjiang Karamay 843000, China

摘要

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摘要 以欠压实超压层为研究对象, 利用双水模型和热动力学理论, 推导了欠压实超压泥质砂岩、泥岩的薄膜电位方程, 分析了压实作用对薄膜电位造成的影响以及欠压实超压泥质砂岩储层自然电位的响应特征。理论研究表明: 压实作用对泥岩薄膜电位影响显著, 对于盐水泥浆, 泥岩薄膜电位随压实系数的变大而增加, 淡水泥浆条件下, 泥岩薄膜电位随压实系数的变大而降低; 压实作用对阳离子交换容量较低的泥质砂岩的影响较小; 泥质砂岩阳离子交换容量对薄膜电位的影响远大于压实作用; 欠压实作用使得泥岩的自然电位基线发生偏移, 导致欠压实超压泥质砂岩自然电位异常幅度较正常压实泥质砂岩低。这一理论研究成果对于认识欠压实超压地层自然电位测井响应规律及识别欠压实超压泥质砂岩储层具有参考价值。

关键词: 欠压实 超压 自然电位 响应机理

Abstract: This study is focused on undercompaction and overpressure formation, the equations of the membrane potential for overpressure shale and shaly sandstone are developed by dual water model and thermodynamics theory. The effect of compaction to membrane potential and the response characteristic of SP log are analyzed. It is showed that the compaction has significant effect on membrane potential of shale. Under invasion of filtrate with high salinity, the membrane potential of shale increases as compaction coefficient increases. In drilling condition of fresh water mud filtrate, the membrane potential of shale decreases when compaction coefficient increases. The effect of compaction on the membrane potential of shaly sandstone with low Q_v is not significant. The membrane potential of shaly sandstone is affected more by Q_v than by compaction. The base-line of SP in shale interval is shifted by undercompaction and the SP anomaly magnitude in shaly sandstone with undercompaction and overpressure is lower than that of the normal compacted formation. The research has very important reference value on understanding SP log response mechanism and identifying oil lay in undercompaction and overpressure formation.

Keywords: Undercompaction Abnormal pressure Spontaneous potential Response mechanism

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About author: 张冲, 男, 1983年生, 博士, 2010年于中国石油大学(北京)获博士学位, 主要从事岩石物理、测井资料处理与解释方面的教学与科研工作。E-mail: zhangc012@yangtzeu.edu.cn

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