

Study of real-time LWD data visual interpretation and geo-steering technology

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Abstract: LWD (logging while drilling) data has been used to explore complex subtle reservoirs by real-time visual interpretation and geo-steering. The method comprises of computer communication, well log data processing, formation recognition, reservoir modeling and model updating in real time. We studied the key technologies related to real-time LWD data visual interpretation and geo-steering and developed computer software with Chinese intellectual property rights covering the following important aspects: 1) real-time computer communication of well site LWD data; 2) visualization of geological model and borehole information; 3) real-time interpretation of LWD data; 4) real-time geological model updating and geo-steering technology. We use field application examples to demonstrate the feasibility and validity of the proposed technologies.

Key words: LWD (logging while drilling), real-time, visualization, interpretation, geo-steering

1 Introduction

LWD (logging while drilling) technologies have been undergoing rapid development along with the wide use of high-angle well directional drilling technology to develop thin and subtle oil and gas reservoirs. LWD is used not only in formation evaluation when wireline logging is unavailable, but also for geo-steering into complex reservoirs to control the down-hole drill tool to hit the desired geological targets (Saikia, 2013; Swire et al, 2013; Liu et al, 2013).

LWD technology has made great progress in the last decade, LWD nuclear (Mickael et al, 2002; Wheeler et al, 2012) and electrical (Rosthal et al, 1995; Bazara et al, 2013) tools can now obtain measurement results that are comparable to those of wireline logging tools. Besides, the LWD response, being measured while drilling, is closer to the true formation value than the later wireline logging obtained after drilling. Great success has also been achieved in sonic LWD technologies (Tang et al, 2010) and NMR (Heaton et al, 2012). Schlumberger, Halliburton and Baker Hughes have made remarkable achievements in the LWD field. The Vision and Scope (www.slb.com/services/drilling/mwd_lwd.aspx) series of Schlumberger LWD tools are examples of LWD technology evolution. For their LWD service, these companies also provide reservoir evaluation and geo-steering

software related to the tool hardware, together with drilling engineering control software, making their service more competitive (Shao et al, 2010).

The high service price and technological monopoly of those international companies limit the wide use of LWD technology, especially in low-budget situations. Therefore research into real-time LWD data visual interpretation and geo-steering technology with Chinese intellectual property rights is of great importance. For this purpose, the authors studied the key technology and developed corresponding software. Field application examples were used to demonstrate the feasibility and validity of the proposed software.

2 Real-time reception of LWD data at well site

Real-time reception of LWD data in the field sets the foundation for the implementation of real-time interpretation and geo-steering.

2.1 Standard format of WITS

In general, domestic and international LWD ground control systems can provide a real-time data port for sending data to a third party, with a logical data recording structure. The international WITS (Well Information Transform Standard) format structure is widely utilized. The WITS format is consistent with the POSC (Petro-technical Open

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