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Hybrid Drill Bit Technology Significantly Improves Build Up Rate Capabilities Of Multiple RSS Tools

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Summary

With an objective to shorten directional intervals, operators place greater demand on higher build up rates. The section just before the pay zone involves the most intensive directional work, pushing rotary steerable systems to their capability limits. This paper focuses on a particular interval of hard and soft interbedded carbonates that provides a significant challenge for conventional Polycrystalline Diamond Compact (PDC) bits to provide consistent build up rate and good borehole quality on rotary steerable systems. Throughout the paper we demonstrate the engineering process of designing a bit to increase build-up rate capabilities of rotary steerable systems and improving drilling efficiency through interbedded carbonate formations.The optimized hybrid bit and BHA combination eliminated drilling vibrations in intervals where extreme vibrations were witnessed with conventional PDC bits, significantly increasing drilling efficiency. Improved torsional stability reduced the load on the directional tools improving the ability to achieve the required doglegs. In softer shale where RSS with conventional PDCs had to control parameters while using maximum steer force to achieve target dog legs of 7°/100ft, the hybrid bit was able to achieve 10°/100ft while utilizing only 70% of the steer force. The hybrid technology proved to be successful with both push-the-bit and point-the-bit RSS systems.

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Hybrid bits have proven to be a solution to problems and limitations of conventional PDC and roller cone bits in directional drilling. Based on recent refinements in the drilling mechanics of hybrid bits to further improve their interaction with directional drilling systems, engineering selected this emerging technology to overcome the challenges in this particular application.

The engineering process involved reviewing the critical issues of this application to assure a sound solution. This included:

- Current build up rates versus Rotary Steerable Systems (RSS) steering capability.
- Vibrations generated by conventional PDC bits being deployed in the field.
- Specific cutting structure, depth of cut limiters and gauge requirements for different RSS drive types.
- Formation strength analysis.
- Parameters used in drilling the section.
- Roller cone insert and PDC interaction of the hybrid bit with the formation and how formation deformation generated by one interacts with the other.
- Roller cone insert design aimed specifically at carbonate formation drilling

Various hybrid bit and Bottom Hole Assembly (BHA) combinations were evaluated with a drilling response simulator to review the build-up rate capabilities and the bit and BHA interaction. The best combination was then successfully trialed on several wells, proving significant improvement compared to current performance with conventional PDC bits.

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