

Integrated BHA Solution Reduces Drilling Time by 18 Days in Vertical Exploration Well, Onshore Indonesia

Operator cuts rig costs by USD 2.67 million in 8½-in section

CHALLENGE

Improve drilling performance and reduce NPT in the 8½-in section of a vertical exploration well despite rig limitations, narrow mud-weight window, and hard-to-drill formations.

SOLUTIONS

- Use i-DRILL* engineered drilling system design and IDEAS* integrated drillbit design platform to select combination of BHA components, bit, and drilling parameters.
- Deploy a PowerDrive Xceed* ruggedized rotary steerable system (RSS) and a PDC bit from Smith Bits, a Schlumberger company, with the sonicVISION* sonic-while-drilling service, geoVISION* imaging-while-drilling service, and TeleScope* high-speed telemetry-while-drilling service.

RESULTS

- Reduced section drilling time 18 days compared with previous well.
- Saved USD 2.67 million in rig costs.
- Increased average on-bottom ROP more than 47%.



Improve drilling performance in challenging section

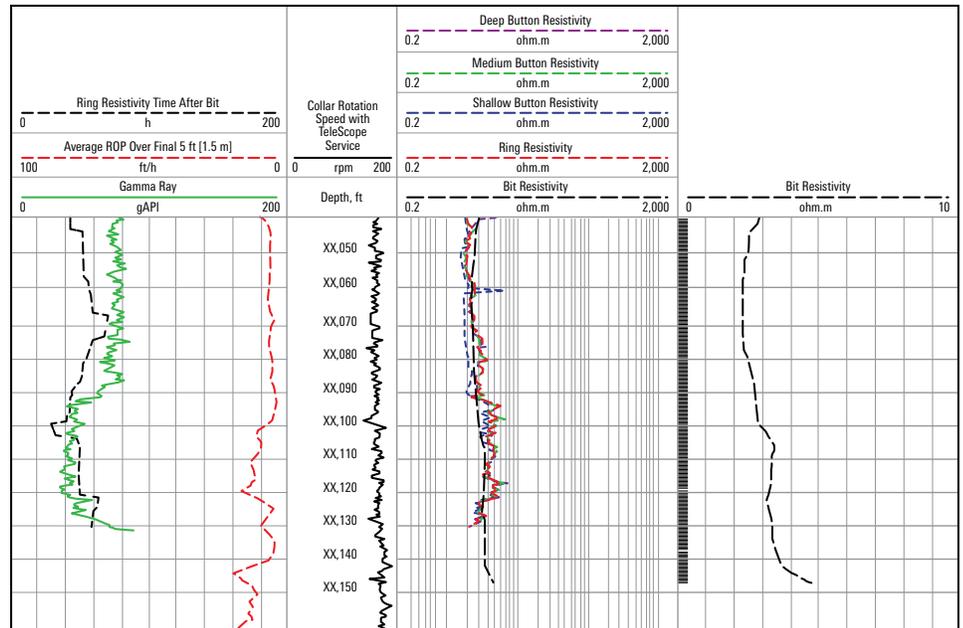
An operator had encountered a number of challenges in the 8½-in hole section of a vertical exploration well in the Lofin field on Seram, an island in eastern Indonesia. The mud motor BHA drilling the section got stuck, and the hole had to be sidetracked. In addition, the high mud weight used to control overpressure while drilling through a shale layer led to circulation losses when penetrating the fractured carbonates at the top of the target Manusela Formation. Further challenges included a collapse on the shale layer after experiencing heavy losses with a high mud weight in the carbonate layer as well as difficulty running the 7-in liner.

The plan for the next vertical exploration well — intended to evaluate reserves in the Lofin field — called for drilling the 8½-in hole section through the same formations as the previous well. The operator wanted a different result this time and asked Schlumberger to recommend ways to improve drilling performance and reduce NPT in the section.

Select BHA components, bit, drilling parameters, and MLWD technologies

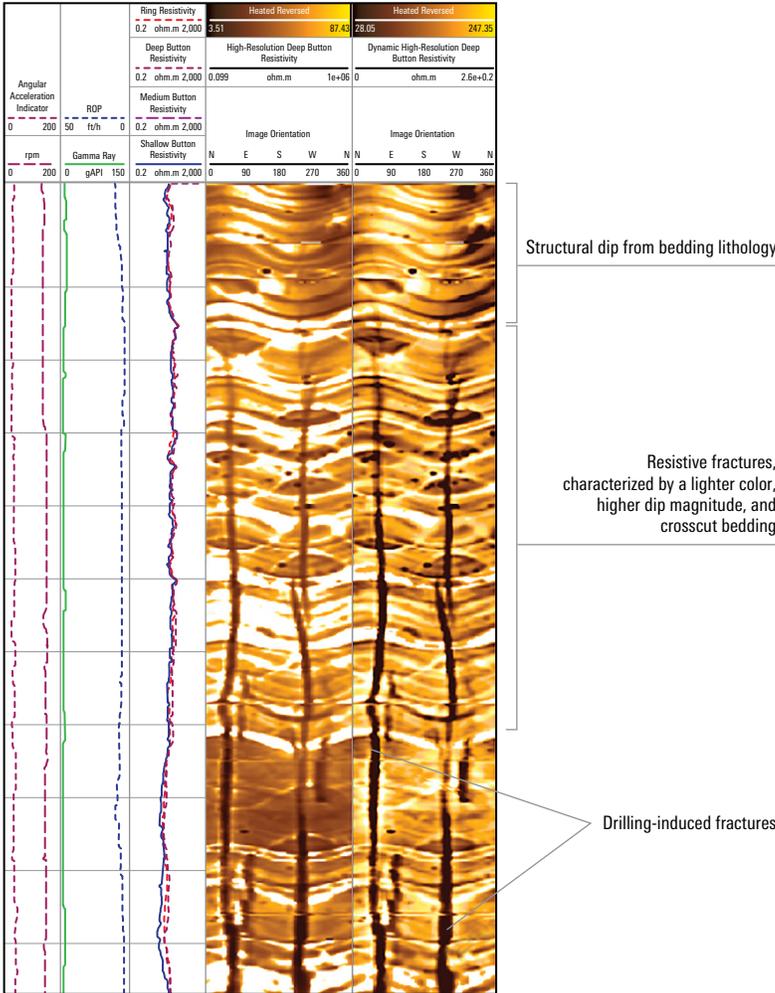
Engineers from Schlumberger and Smith Bits used i-DRILL design and the IDEAS platform to identify the BHA components, bit, and drilling parameters most suitable for this section in the well. Additional analysis outside of the design and platform capabilities took into account hydraulics needs for tool operation and hole cleaning and the limited capacity of the rig’s mud pumps, which could only support standpipe pressure (SPP) up to 4,700 psi [32.4 MPa].

Because that SPP was too low to accommodate the large pressure drop that a mud motor or push-the-bit RSS would produce, the PowerDrive Xceed RSS was selected to provide trajectory control. Predictive modeling in the IDEAS platform indicated that teaming a Smith Bits MDSi716LUBPX PDC bit with the PowerDrive Xceed RSS would minimize stick/slip and maximize drilling stability and ROP.

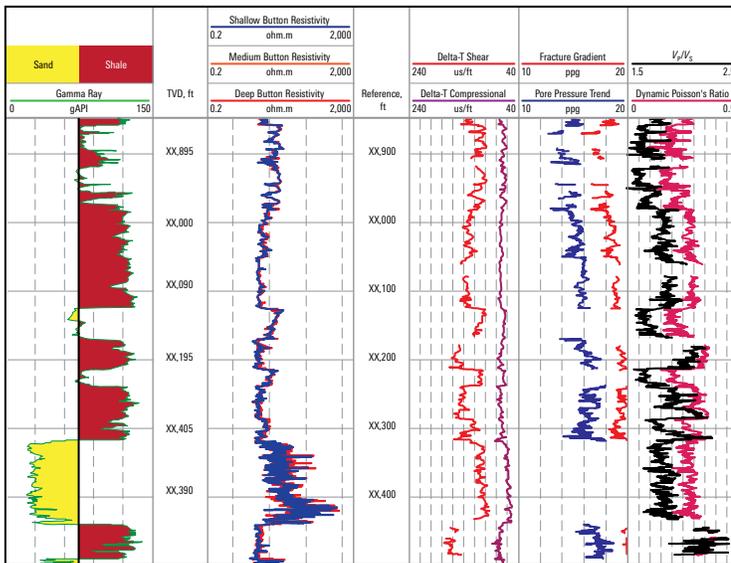


In the well, when an increase in the geoVISION service’s bit-resistivity reading indicated entry into the fractured carbonate at the top of the Manusela Formation (15,145–15,149 ft), drilling was stopped, entry was confirmed by a cuttings check, and the 7-in liner was set.

CASE STUDY: Operator reduces rig costs USD 2.67 million and saves 18 drilling days, onshore Indonesia



Early identification of fractured carbonate at top of target Manusela Formation by geoVISION service resistivity imaging facilitated geostopping.



Pore pressure calculation derived from sonicVISION service compressional slowness helped maintain adequate mud weight. The mud weight was lowered from 17.5 lbm/galUS to about 17.3 lbm/galUS when crossing from shale into fractured interbedded limestone.

Schlumberger also recommended using real-time MLWD to acquire the information needed to maintain mud weight within a narrow window, reduce the risk of circulation losses, and identify the casing point. These objectives were achieved using the sonicVISION, geoVISION, and TeleScope services in combination.

Real-time pore pressure, compressional, and shear measurements from the sonicVISION service enabled the drilling team to keep mud weight within the narrow margin between formation pressure and the fracture gradient of the lithology encountered. Near-bit resistivity images from the geoVISION service helped the team identify the casing point at the top of the target Manusela Formation and geostop the BHA before it penetrated the fractured carbonates any farther. This avoided the large circulation losses experienced in the previous well.

While drilling the shale layer, the team adjusted mud weight to 17.5 lbm/galUS based on the pore pressure trend calculated using sonicVISION service compressional slowness measurements. To minimize potential losses when crossing fractured interbedded limestone, mud weight was lowered to about 17.3 lbm/galUS—still safely above formation pressure. Drilling was geostopped when an increase in the geoVISION service's bit-resistivity reading indicated entry into the top of the target formation. A cuttings check confirmed the entry, and the 7-in liner was set.

Reduce drilling time and rig costs

Drilling the 2,445-ft [745-m] interval in the 8½-in hole section of the well with a mud motor BHA took four runs and 40 days. The BHA with a PowerDrive Xceed RSS and Smith Bits PDC bit drilled the 8½-in hole section—a 28% longer interval at 3,130 ft [954 m]—in just two runs and 22 days. The integrated approach yielded a reduction of 18 days and USD 2.67 million in rig costs.

Average on-bottom ROP was 10.38 ft/h [3.16 m/h] in the well compared with 7.04 ft/h [2.15 m/h] in the previous well, an increase of more than 47%. Footage drilled per circulating hour tripled from 2.41 ft [0.73 m] to 7.24 ft [2.21 m] over the two wells. The smoother wellbore drilled with the PowerDrive Xceed RSS and Smith Bits PDC bit enabled the 7-in liner to be run without the bit trip that had been required in the previous well.

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