Case study: Colombian Foothills

Baker Hughes 3D bit drilling simulation software optimizes Kymera, offering higher ROPs and lower cost-per-foot

An operator in the Colombian foothills faced challenges while drilling a 14¾-in. well section with standard polycrystalline diamond compact (PDC) bits. The abrasive and interbedded Carbonera C5 and C6 formations consisted of sandstone, siltstone, and claystone, with unconfined compressive strengths ranging from 5 to 25 Kpsi. These conditions generated significant torque and vibrations that quickly dulled the bits, leading to low rates of penetration (ROPs) and requiring 4 to 5 PDC bits to drill the interval.

Baker Hughes introduced its Kymera™ hybrid drill bit to address these challenges. Kymera bits combine roller cone and PDC cutting elements to minimize vibrations, improve drilling efficiency and extend run length in difficult applications like the Carbonera. Compared to PDC bits, the hybrid improved average distance drilled by 17%. Torque variation was reduced by 46%, and the mechanical specific energy reduced by 44% (Figure 2).

The Kymera bits also demonstrated superior durability, experiencing better dull grades compared to PDC bits and avoiding damaged-beyond-repair conditions.

While the Kymera hybrid bit clearly improved drilling efficiency, Baker Hughes wanted to optimize results for this project. Working with the customer, Baker Hughes engineers set bit design objectives to increase ROP and improve the reliability of the bearing and seal. The engineers used the Baker Hughes proprietary 3D Tetrahedron™ bit drilling simulation software , which uses an advanced model to accurately simulate downhole drilling conditions for more optimized bit designs (Figure 1). By providing both full bit response and individual cutting element analysis, 3D Tetrahedron bit drilling simulation affords more informed design decisions, shorter development cycles, and reduced need for costly lab or field testing.

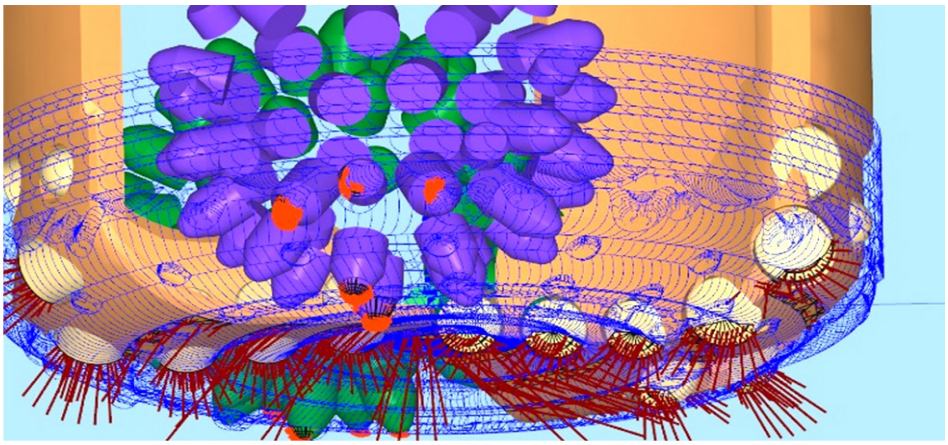

Figure 1: Baker Hughes 3D Tetrahedron™ bit drilling simulation software simulates downhole drilling for improved bit designs.

Challenges

- Abrasive, interbedded formations leading to high torque and vibrations with PDC bits
- Excessive bit damage required multiple trips to replace dulled bits
- Low penetration rates increased drilling time and lowered operational efficiency

Results

- Drilled 50% greater distance
- Improved ROP by 39%
- Decreased torque by 15% for smoother drilling and reduced bit damage
- Effective bearings and seals with extended run lengths
- Delivered 23% lower cost-per-foot well construction costs

Based on this modeling work, the operator selected a new, optimized Kymera hybrid design that increased bit aggressiveness while maintaining torsional stability and durability. The new design also improved load balance between the bit's PDC and tungsten carbide insert cutting elements for enhanced bearing and seal reliability.

In the next well, the operator selected the optimized Kymera drill bit for the 14¾-in. section. The new design drilled 50% more footage at 39% higher ROP compared to the PDC average. When compared to the baseline Kymera design, the optimized bit drilled 26% more footage at 33% higher ROP (Figure 3). It was also pulled with effective bearings and seals. The optimized Kymera bit significantly enhanced drilling performance and reduced cost-per-foot well construction costs by 23%.

The superior drilling results and comprehensive cost savings convinced the operator that a Kymera bit, optimized with 3D Tetrahedron bit drilling simulations, is the clear choice for their drilling challenges in the difficult Carbonera formation.

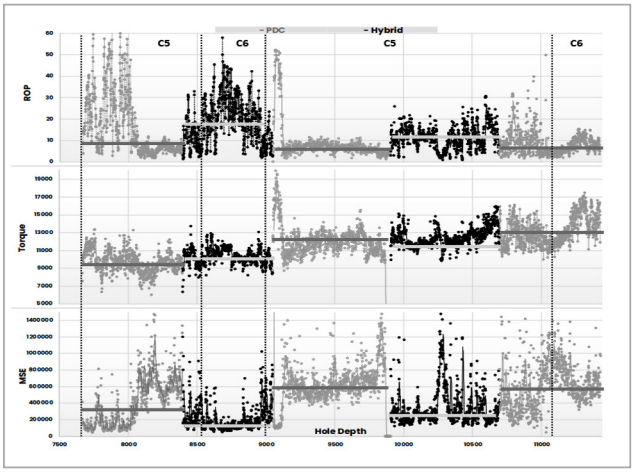

Figure 2: Compared to PDC bits, the non-optimized Kymera™ hybrid bits still delivered major improvements to ROP, torque, and MSE while drilling the 14¾-in. section in the Carbonera C5 and C6 formations (horizontal lines are median data).

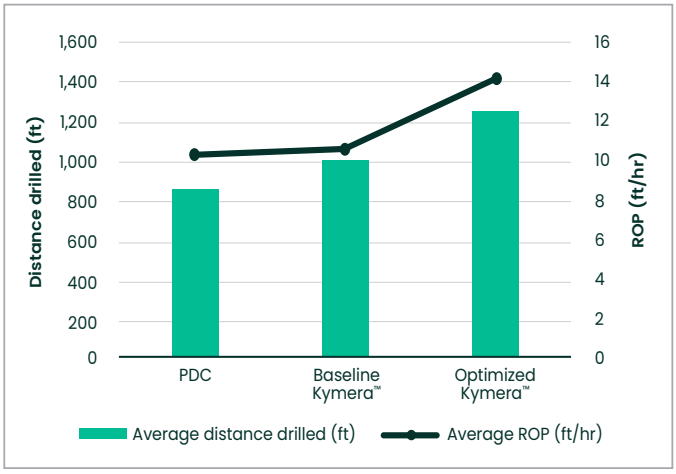

Figure 3: The optimized Kymera design delivered sizable improvements in both footage drilled and average ROP compared to PDC offsets and the non-optimized Kymera™ baseline in the 14¾-in. section in Carbonera C5 and C6 formations.

Baker Hughes

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