Gulf of Mexico report:

- 2010 well forecast
- Imaging, drilling subsalt
- Lower Tertiary potential, risks

Record-setting expandable tubular installation

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Gulf of Mexico map
To achieve optimal BHA design and performance, all parties must understand each other’s concerns, and work together to identify the appropriate solution.
ting structure inevitably causes vibration. To minimize underreamer vibrations while using a rotary steerable drilling assembly, engineers should use the maximum number and diameter of drilling collars allowed for the hole size, while maintaining safe operations. The heavier the BHA, the better the weight distribution between bit and underreamer, and the fewer incidents.

- **Manage drilling parameters in real-time through transitions.** Drilling through salt, the bit often encounters inclusions or sections having different properties – harder or softer. Due to the distance between components, at these transition points the bit and underreamer will be shearing different formations and generating uneven forces on the BHA. To mitigate shock and vibration, it is vital to manage drilling parameters in real-time until both tools return to a homogeneous formation.

### Drilling the subsalt section with hole openers

The second set of recommendations applies to optimizing directional drilling with hole openers below salt. The majority of subsalt runs today are directional. To avoid premature termination of a run, the following three best practices aim to ensure underreamer durability in the typically harder, more abrasive subsalt section. Unlike the previous recommendations, operators have not yet widely implemented these.

- **Again, manage drilling parameters in real-time.** As the drill bit transitions from salt to sediments below salt, it is critical to manage drilling parameters in real-time. While the bit can penetrate a hard stringer relatively unscathed, when the underreamer reaches the same formation its cutters can wear out in less than two minutes – indicated by loss of torque – unless weight on bit and revolutions per minute (RPM) are adjusted.

- **Run an expandable stabilizer above the underreamer in directional holes.** Due to gravity, using conventional pass-through stabilizers above and below the underreamer can increase radial load on the cutting blocks, causing premature damage. To better centralize the underreamer in directional holes, use an expandable stabilizer above and a standard stabilizer below.

- **Maximize wear resistance of underreamer blocks and cutters.** Due to current manufacturing constraints, underreamer blocks are still made of steel, whereas the matrix body of a typical subsalt drill bit is made of tougher tungsten carbide. In hard/abrasive formations below salt, reinforce the underreamer body with hard-facing, using wear-resistant polycrystalline diamond compact (PDC) cutters in both bit and underreamer, and perhaps adding limiters behind the PDCs.

### What’s the payoff?

As noted above, prior to implementing these best practices, increasing tool/BHA shock and vibration were recorded when introducing expandable concentric underreamers in deepwater salt/subsalt drilling. In 2004, for example, 24% of underreaming runs in the GoM had a negative impact on BHA performance due to suboptimal practices. Applying the recommendations outlined in this paper has reduced the incident rate to 8% by the end of 2007.

While many underreamer dynamics unknowns remain, successful BHA performance depends on the careful integration of bit and underreamer technology, and appropriate drilling practices. BHA success must be measured as a system. These recommendations have proven effective in the GoM.

### Authors’ note

This article is based on paper AAD 2009NTCE-09-02: The Evolution of Hole Opening while Drilling Practices to Enlarge Salt and Subsalt Sections in the Gulf of Mexico, and was originally presented at the 2009 AAD American Association of Drilling Engineers in New Orleans, Louisiana, March 31, 2009.