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Conquering the Challenges of Directional Drilling Through Salt

Deepwater Gulf of Mexico presents plenty of opportunity to drill through salt; Schlumberger meets the related challenges with technology and experience.

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The Gulf of Mexico (GoM) continues to provide great opportunity with associated challenges for oil and gas development. The huge subsurface salt structures that characterize the GoM are responsible in part for trapping hydrocarbons and creating huge new prospects, but present new and unique drilling challenges, especially for directional drilling.

Schlumberger and two of its client-operators are meeting these challenges with a combination of technology, expertise and experience, totaling more than 100,000 ft (30,480 m) of deepwater drilling through salt. The challenges being addressed include traditional pre-drill and real-time directional

issues—which take on added complexity when drilling through salt—and also go beyond to include post-drilling phases including casing and cement design for managing salt loading and ensuring long-term wellbore viability.

Deepwater economics dictate that fewer subsurface drill centers are being used in field development. This results in longer step-out wells and higher kickoff points, often occurring in extensive salt bodies. Salt drilling presents operators with many drilling challenges that are not completely understood. Adding directional components magnifies the issues of traditional salt drilling and introduces new challenges that require different approaches to ensure success.

Problems with salt

By its nature, salt can creep or deform, and this presents a host of potential geomechanical risks including areas of tectonic instability, rubble zones, tight-hole drilling

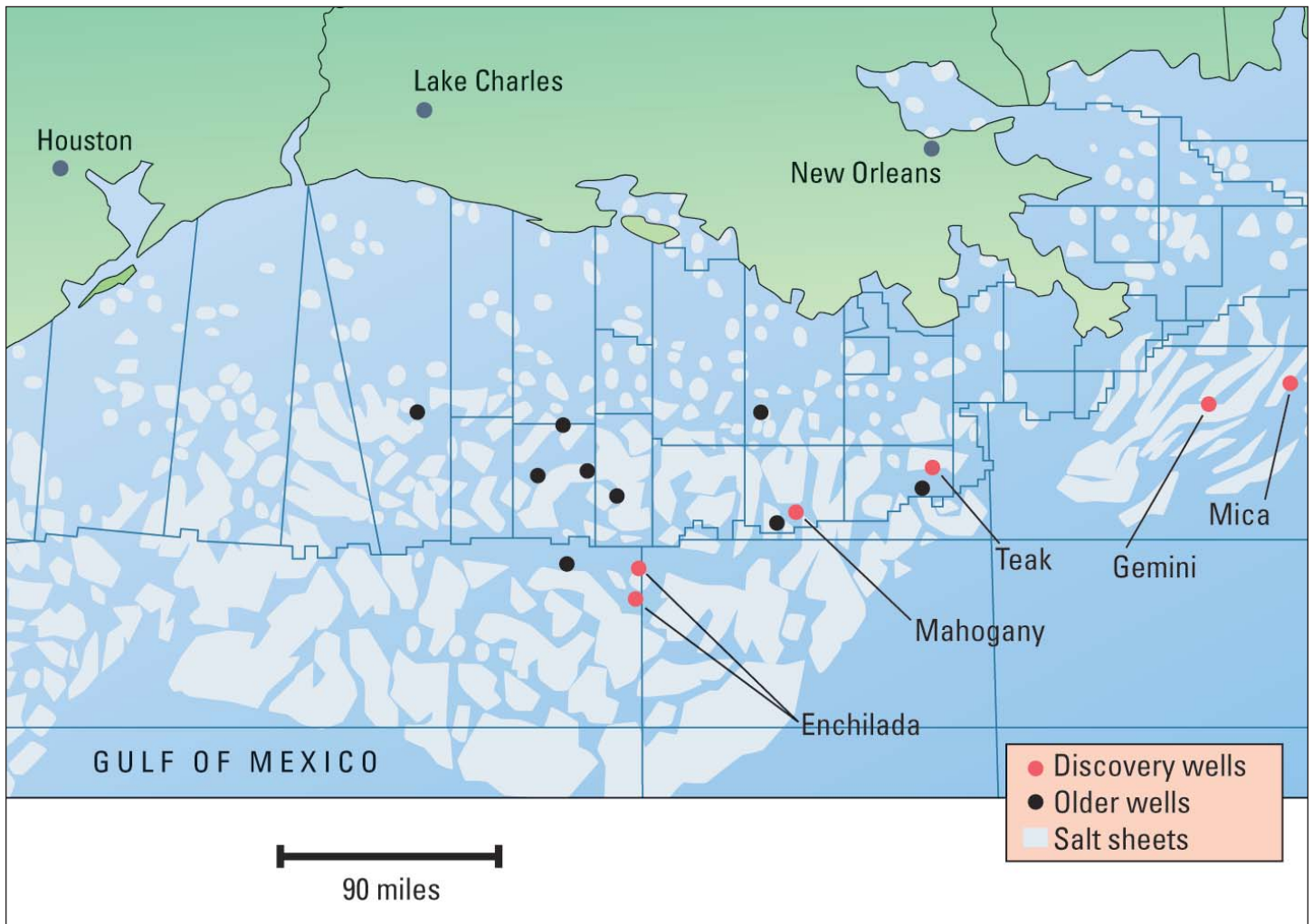
conditions and long-term casing deformation. Some salt bodies may display a natural tendency to build and/or walk. However, this behavior can greatly vary depending on drilling location in the salt structure, increasing complexity when planning directional wells.

Drilling through salt also includes problems with hole geometry, entry and exit of the salt structure, inclusions in the salt, nearby tar zones, and shock and vibration.

Meeting the challenges

Analysis of operator case studies reveal that key variables contributing to successful directional drilling in salt include hole size and geometry, bottomhole assembly (BHA) configuration, under-reamer selection, wellbore trajectory and directional control, and careful consideration of all geomechanics for pre-drill planning, but particularly for casing design and cementing issues.

Through its experience, analysis of operator case studies and



Schlumberger is developing best practices to improve drilling performance and lower technical risks while drilling through salt.
(Graphic courtesy of Schlumberger)

application of enabling technologies, Schlumberger has developed some insights to improve performance when directional drilling through salt:

Rotary steerable system (RSS) assemblies achieve the best results, showing improvements in directional control, rate of penetration (ROP) and hole quality. RSS combined with motors delivers higher torque and RPM at the bit and can improve ROP over extended salt intervals.

Geomechanical properties must be considered in the directional design. For example, salt exits should be planned across a tangent section and at a flat or low dipping

area of the salt base to mitigate known geomechanical issues that pose greater risk when exiting a salt structure.

Plan wells with low dogleg severity (<2.0deg/100ft). This approach ensures that if steering is required to counteract salt tendency, the assembly has enough capability to drill the desired trajectory.

Use polycrystalline diamond compact (PDC) bits. A bit with PDC cutters is inherently more stable and achieves better results in salt. Ensure bits are matched with the under-reamer to avoid inducing shock from incompatible bit-reamer combinations.

Real-time monitoring of salt

drilling parameters, including shock and vibration (either at the rig or from remote centers) can optimize drilling performance, extend BHA life and potentially avoid problems. ■

This article is based on IADC/SPE 112669-PP, "Challenges of Directional Drilling through Salt in Deepwater Gulf of Mexico." To learn more about directional drilling, visit Schlumberger booth 1101 or hear this presentation during the Deepwater I session on Wednesday, March 5, from 8 a.m. to 10 a.m.