Drill down vertically to a shale zone, take a turn and head into the bed laterally and, presto, completion is a slam-dunk. Right? Not necessarily. These unconventional formations can, and usually do, create a host of problems for the drillers and others. In fact, stuck bottomhole assemblies and lost wells occur with more frequency than you would think.

It’s been commonplace to consider only reservoir quality and completion quality in deciding where to land a lateral in these type reservoirs – but drilling quality is now becoming a key part of the mix. And that entails integration of the disciplines and incorporation of geomechanics.

"By integrating geomechanics and drilling engineering disciplines, operators have been able to understand recent failures, allowing them to plan and manage risks moving forward," said AAPG member Jason Sitchler, senior geoscientist for Schlumberger Petrotechnical Services in Denver.

Unmanageable reservoir instability problems are not unusual when drilling unconventional shale wells. To deal with this challenge, Sitchler and his fellow technical whizzes developed a new rapid mechanical earth model (rapid MEM) workflow to enable operators to quickly make the big decisions for drilling the laterals after acquiring the needed geological info in the vertical pilot hole.

With the rapid MEM, there’s no lost rig time given that this process is finalized prior to drilling the lateral or sidetrack.

Direct Communication

As part of the rapid MEM, Sitchler and his team are employing a whole new risk-based approach to geomechanics dubbed “depth of failure” – and seeing some impressive results.

“In the past, the black and white answer from a geomechanics perspective would say you’re either going to be drilling with the safe mud weight needed to cause the borehole to be stable – or not,” he said. “For the driller, that’s not a useful answer. “What we’ve done with ‘depth of failure’ is look beyond the initiation of failure at the borehole,” Sitchler noted. “Now we predict where failure might occur at some depth beyond the borehole wall and quantify how much material would cave in because of drilling conditions.

“The way stresses are oriented in a lot of basins, borehole breakouts will concentrate on the sides of the wellbore in a horizontal,” he said. “Because the well is not caving from the top, this is not necessarily disastrous for the well. “Once these breakouts along the sides start getting worse and you’re getting further from stability, then the roof of the horizontal wellbore starts collapsing, and you get a runaway situation leading to wellbore failure.

“There’s a small cushion where you can keep the bottomhole pressure above to manage instability, and you should be ok.”

The geomechanics team members tailor the rapid MEM so that they communicate directly with the drilling engineers, who have models and software that allow them to take results from the geomechanics and determine the key drilling parameters affecting the pressure downhole.

Sitchler described a project where the mud properties and drilling practices had caused instability in the borehole.

“In two attempts to drill a horizontal well, this operator lowered the equivalent bottomhole pressure by swabbing when they pulled the drillstring out of the hole,” Sitchler said, “causing the borehole to cave in and
collapse. This root cause was determined through the rapid MEM process incorporating the depth of failure concept.

“To avoid this,” he said, “they pumped out a portion of the borehole to keep the bottomhole pressure high enough to prevent collapse.”

Other Concerns

Before you rush in to raise the mud weight when you see the borehole beginning to cave, be aware that other things can go wrong.

Sitchler mentioned another well where the operator had increased the mud weight to try to stabilize the hole. The process created fractures, and the well began relinquishing mud into the formation and ultimately was lost. In this case the solution determined through drilling engineering was to alter the mud properties to manage ECD (equivalent circulating density) loads.

Depending on the project, Sitchler said the outcome of geomechanics analysis has determined:
  - Where and how to land the well.
  - Safest mud weight to use.
  - Changes necessary to manage swab and ECD loads for both drilling and casing operations.

“Our goal from the combined geomechanics and drilling engineering is to find the stability window you can work with,” Sitchler said, “to successfully drill the well.

“In the past, with a single well geomechanics model, we had the mindset of monitoring mud weight in and out of the borehole, rather than combining geomechanics with sound drilling engineering principles.

“The difference with this approach is that we’re merging these disciplines through open communication, accounting for depth of failure,” he said, “and doing so a lot faster than we used to, using a rapid MEM.

“I can’t overstate the need for good communication,” Sitchler emphasized, “between all parties involved.”

APG member Jason Sitchler is co-author of the paper “New Approach to Geomechanics Solves Serious Horizontal Drilling Problems in Challenging Unconventional Plays,” which will be presented at 1:55 p.m. Monday, Aug. 12, as part of the inaugural Unconventional Resources Technology Conference.

URTeC will be held Aug. 12-14 in Denver.
The paper is part of a session titled “Unconventional Geomechanics.”
The paper will be presented by Shannon Higgins-Borchardt, a geoscientist engineer for Schlumberger PetroTechnical Services based in Denver.
Other co-authors are the late Anthony Krepp, who was with the K&M Technology Group for Schlumberger, The Woodlands, prior to his recent death, and Marcelo Frydman, a geomechanics program manager in the geomechanics group of Schlumberger Brazil Research and Geoengineering Center, Rio de Janeiro, Brazil.