High-Resolution LWD Images Help Optimize Completions

Quality data guides placement of packers and inflow control devices in highly fractured carbonate formations in horizontal oil wells

**CHALLENGE**
Acquire information needed to design horizontal well completions that will mitigate undesired water and gas breakthroughs in highly fractured carbonate formations.

**SOLUTION**
Use high-resolution borehole images with MicroScope 475* high-resolution resistivity- and imaging-while-drilling service and adnVISION475* azimuthal density neutron service.

**RESULTS**
- Acquired quality data for advanced geological interpretation of carbonate formations without affecting rig time.
- Delivered petrophysical and geological interpretation within 12 hours.
- Saved rig time by avoiding unsuccessful logging trips.

**Acquire data in highly fractured carbonate formations**
To prolong dry oil production in depleting supergiant Cantarell field offshore Mexico, PEMEX conducted a campaign to drill horizontal wells and horizontal reentries with lateral sections 300 to 700 m long. These sections are typically drilled with 6 1/2-in bits in hard carbonate formations and, due to the significant pressure drop in the mature reservoir, there often is severe mud loss or even no mud return to surface.

The most recent of these horizontal wells have openhole completions that incorporate inflow control devices (ICDs) to improve well performance and enhance reservoir management by mitigating undesired water or gas breakthroughs. Properly designing these completions requires accurate fracture identification and quantification and permeability estimation along the horizontal section. In the 300-m horizontal section of one of the wells, an attempt to acquire borehole images for fracture identification and quantification using wireline imaging tools run on drillpipe was unsuccessful.

**Record high-quality borehole images on wiper trip**
PEMEX was able to acquire this essential information on the wiper trip using MicroScope 475 and adnVISION475 services. Those images and logs were downloaded, sent to a Schlumberger data processing center for interpretation, and the results delivered to PEMEX within 12 hours. The high quality of the borehole images and openhole logs allowed detailed geological interpretation. Integrating the image interpretation with petrophysical analysis allowed optimum placement of 18 ICDs and 9 openhole packers for successful completion of the well. Fewer ICD modules were allocated closer to the heel and for intervals with higher fracture density.

**MicroScope 475 images enabled fracture identification and analysis to allow optimal placement of inflow control devices and openhole packers.**

Integrating image interpretation with petrophysical analysis allowed optimum placement of 18 ICDs and 9 openhole packers for successful completion of this well.
**CASE STUDY:** Borehole images used to optimize completions in wells with highly fractured carbonate formations

The completion design for the second well relied entirely on interpretation of MicroScope 475 images and LWD data acquired during the wiper trip.

The MicroScope 475 borehole images allowed identification of natural conductive fractures, vugs, dips, and drilling-induced fractures in the carbonate rocks. These rocks were challenging to interpret from an image log because of their irregular fabric as compared to other rock types, such as shales and sandstones. In the adnVISION475 caliper log, two zones with severe washouts were identified, the first of which was deemed responsible for preventing the drillpipe-conveyed wireline tools from reaching TD.

On the next well in the campaign, no wireline run was planned—the completion design relied entirely on interpretation of MicroScope 475 images and LWD data acquired during the wiper trip. Six openhole packers were set, and 21 ICD modules were used to optimize the production profile along the full length of the well’s horizontal lateral.

**High-quality LWD data saves rig time**
MicroScope 475 service provided quality borehole images that permitted individual formation features, such as natural and drilling-induced fractures, beds, and vugs, to be identified and analyzed for optimization of the completion design and placement of ICDs and openhole packers. In addition, the use of LWD tools minimized the risk of logging a horizontal section in a severe-loss environment and saved rig time by avoiding unsuccessful logging runs.

Contact your local Schlumberger representative to learn more.