# AFR™ Sensor Helps Major Operator Isolate Problematic Shale Formation, Saving Valuable Rig Time

## THE AFR AT-BIT RESISTIVITY MEASUREMENTS DETERMINE OPTIMAL CASING POINT

PAPUA NEW GUINEA

### CHALLENGES

- Accurately selecting the casing point in the uppermost portion of a fractured carbonate reservoir above a total loss transition zone in a 12-1/4-inch hole
- Isolate the reactive and overpressurized shale above

### SOLUTION

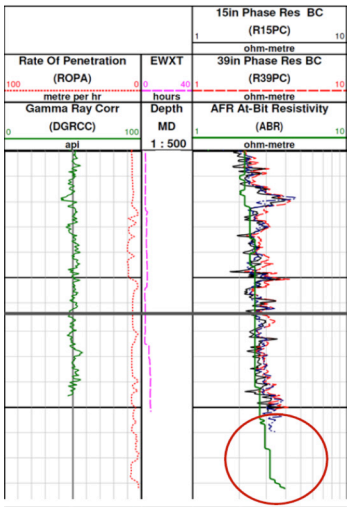
Utilize real-time at-bit resistivity (ABR) measurements from the AFR™ sensor to geostop in the uppermost section of the reservoir

### RESULTS

- The ABR measurement successfully detected the top of the fractured carbonate reservoir, and the casing point was selected above the total loss transition zone.
- The casing was run to depth, isolating the problematic shale above.
- There was no downtime associated with setting the casing too deep or too shallow.

### OVERVIEW

In the Antelope field, Total needed to accurately pick the 9-5/8-inch casing point in the uppermost portion of a fractured carbonate reservoir above a total loss transition zone, while being able to isolate the reactive and over-pressurized shale above the reservoir. The Sperry Drilling team utilized at-bit resistivity (ABR) measurements from the AFR™ azimuthal focused resistivity sensor to successfully set the casing shoe without any down time.




*The At-bit resistivity (ABR) measurements from the AFR™ sensor successfully detected the top of the fractured carbonate reservoir, and the casing point was selected to be above the total loss transition zone.*

### SELECTING CORRECT CASING POINT IS CRUCIAL IN TOTAL LOSS ZONES TO MINIMIZE NPT

Due to the differing pressure regimes between the shale and the reservoir, accurately picking the 9-5/8-inch casing shoe depth was crucial to the success of this well. If the 12-1/4-inch hole section was drilled too deep into the reservoir, it would have encountered total mud losses, which could potentially lead to an underground blowout. If the casing shoe had been set too shallow, a section of the shale would have been exposed below the shoe. This shale is both chemically and mechanically unstable, and deteriorates with time. The need to prevent this shale from sloughing and swelling could potentially have required an unplanned 7-inch liner to be run. To add more complexity to the challenge, the geological depth uncertainty at the top of the reservoir was as much as 984 feet (300 meters) because of poor seismic resolution.

### AT-BIT-RESISTIVITY FROM AFR™ SENSOR IS RECOMMENDED SOLUTION FOR REAL-TIME GEOSTOPPING

The Sperry Drilling team recommended that the customer use the real-time ABR measurement from the AFR sensor to "geostop" in the uppermost section of the reservoir. The AFR sensor is primarily a high-resolution borehole-imaging and compensated laterolog resistivity tool, but, in this case, the tool was used primarily for its ABR measurement.

To make the ABR measurement, the AFR tool sends current down the bottomhole assembly (BHA), through the bit and into the formation. By measuring the current, the AFR tool can calculate the resistivity of the formation around the bit and the lower BHA. With the ABR data, the operator has an early indication of when the bit enters into a different formation.

Even with 984 feet (300 meters) of uncertainty in the pre-well seismic model, the at-bit resistivity (ABR) measurement successfully detected the top of the fractured carbonate reservoir, and the casing point was picked above the total loss transition zone.

## ABR SOLUTION PROVES OPTIMAL FOR DETERMINING CORRECT CASING POINT, SAVING OPERATOR COSTLY POTENTIAL RIG TIME

During this operation, the ABR data was pulsed up in real time together with other formation evaluation data. When the real-time logs indicated that the well was approaching the top of the reservoir, the rate of penetration was controlled, ensuring that high-quality, real-time data was available, and allowing for accurate correlation with offset well data and correct identification of the optimal casing point.

Even with 984 feet (300 meters) of uncertainty in the pre-well seismic model, the ABR data successfully detected the top of the fractured carbonate reservoir, and the casing point was picked above the total loss transition zone. The casing was run to depth, isolating the problematic shale above the reservoir, and saving Total potential downtime associated with setting the casing at the wrong depth.

www.halliburton.com

Sales of Halliburton products and services will be in accord solely with the terms and conditions contained in the contract between Halliburton and the customer that is applicable to the sale.

H01224 12/16 © 2016 Halliburton. All Rights Reserved.

HALLIBURTON