



## Lost Circulation Materials / WellSET™ Wellbore Strengthening Treatment

### WellSET® wellbore strengthening treatment prevents losses in severely depleted sandstone reservoirs

Location: Angola

#### Overview

The operator needed to drill a deviated water injector well through two depleted sandstone reservoirs, with sub-pressures of 150 bar and 50 bar, respectively. The depleted zones were separated by a thick shale section 300 m long. Tested at 120°C (248°F), the bottom hole circulating temperature was 71°C (160°F).

#### Halliburton's Solution

The Baroid team recommended a WellSET® treatment to strengthen the wellbore against lost circulation. This would be the first WellSET application in Angola. The Critical First Well process was put into action, beginning with extensive modeling using the DFG™ WellSET module. This helped determine the maximum expected fracture sizes generated while drilling these reservoirs, and the lost circulation materials (LCMs) that would be optimal for the wellbore strengthening formulation. In this case, the calculated fracture size was around 868 microns. To verify the effectiveness of the treatment, lab testing of the stress cage formulation was conducted using an 800-micron slotted disk.

The operator required a 100% acid soluble treatment in order to minimize damage to the reservoir of this injector well. Based on the DFG WellSET outputs, a customized drilling fluid was developed and tested in the lab. The system was evaluated under reservoir conditions, using specifically designed slotted disks to assess the LCM package efficiency.

Pre-planning was critical in Angola, where logistics are a daily problem and it can take four months to bring in products.

The recommended BARACARB® sized ground-marble LCM was sent offshore in big bags in order to facilitate mixing, and the customized drilling fluid was prepared at the liquid mud plant. The WellSET wellbore strengthening materials would be added at the rigsite to avoid particles settling on the boats during transportation to the rig.

The large particles used to seal off the fractures generated in this treatment required specialized testing equipment and procedures to assess the system rheology while drilling.

The two reservoirs had differing expected fracture apertures, so preparations for drilling each zone were also different. This included modifying the solids control equipment to prevent the removal of all the treatment from the system.

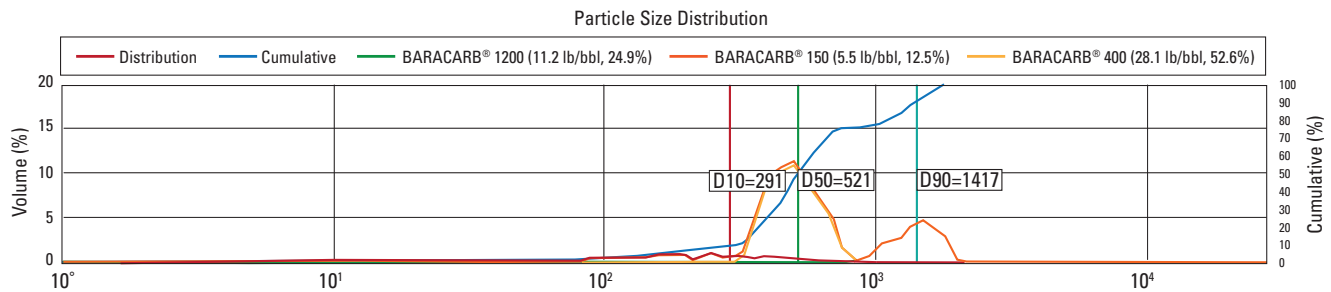
CHALLENGE	SOLUTION	RESULTS
Drill a deviated water injector well through highly depleted sandstones reservoirs.	WellSET® wellbore strengthening modeling and customized drilling fluid formulation helped seal off loss zones.	The target injection zone was reached successfully with no losses or differential sticking.

## CASE STUDY: WellSET® treatment helps operator avoid losses while drilling severely depleted

For example, the shakers were equipped with API 10 screens until the first reservoir had been drilled, since this was the most depleted zone. In preparation for a wiper trip, the crew installed API 80 screens to remove all coarse materials and excess BARACARB 1200 LCM. Before commencing drilling in the second reservoir, the shakers were dressed with API 40 screens to maintain at least the 400-micron cutpoint. Flow rates ranged from 1,500 lpm to 1,700 lpm with the booster pump at 2,400 lpm.

The proposed wellbore strengthening formulation was as follows:

Product	Concentration – ppb (kg/m <sup>3</sup> )
BARACARB® 150	5.6 (16.1)
BARACARB 400	28.1 (80.4)
BARACARB 1200	11.2 (32.2)
Total	45 (128.7)



### Economic Value Created

The section was drilled in 147 hours at an average penetration rate of 8 m/hr (26.2 ft/hr). The well reached total depth with zero losses and no stuck pipe incidents, allowing the safe delivery of the pressure support injector well as planned by the operator.