

Brazil

CORING

Dramatic core recovery rate saves Petrobras USD 1 million

The Halliburton Xaminer™ coring tool retrieved 71 sidewall core samples out of 72 attempts in one run.

High recovery rate helps Petrobras achieve objectives while saving 24 hours of deepwater-drillship time.

Overview

While drilling an exploratory well in Brazil’s presalt Santos Basin, Petrobras asked Halliburton to perform a complete openhole logging job. The logging program consisted of a full suite of services, including coring. The client wanted approximately 172 core samples. Halliburton promised that it could retrieve at least 30 samples per run. Normally, collecting this many samples would have taken six runs. However, in this case, Halliburton was able to recover 71 large-diameter (1.5 in.) samples on just one of the runs, more than double the anticipated rate. Prejob planning, numerous tool improvements, including the shape of the bit, tool configuration, and real-time monitoring account for the dramatic increase in the success rate, which set a new world record. The dramatic recovery rate saved two deepwater runs that, in turn, saved at least a day of deepwater-drillship time. Between costs for the ship and the crew, the time saved is estimated to be worth more than \$1 million.



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The 6300-m exploratory well was offshore in Brazil’s Santos Basin.

CHALLENGE	SOLUTION	RESULT
<p>Familiarity with field This was an exploratory well drilled from a ship. Even though Halliburton had performed logging and coring services in the Santos area, it was unfamiliar with the properties of wells in this particular field.</p>	<p>Studying comparable presalt fields To get a better feeling for the challenges it would encounter, Halliburton studied other presalt fields, then modified its tools, pressure settings, bits, and their configuration. Halliburton also brought backup tools.</p>	<p>Saved 24 hours in deepwater On one run, Halliburton collected a world-record 71 large-diameter cores out of 72 attempts, more than doubling what it promised. This saved the client at least 24 hours of deepwater-drillship time valued at more than \$1 million.</p>
<p>Extremely hard formation Halliburton encountered an extremely hard formation that produced very high wear on the bit. This resulted in poor core recovery. Halliburton collected only 24 and 20 samples respectively on the first two runs.</p>	<p>Strategy and tool configuration Halliburton suggested coring soft formations first, then coming back to harder formations. To get samples from those, Halliburton also suggested configuring the tool to collect 1-in. (not 1.5-in.) cores. The client agreed.</p>	<p>Record recovery rate On the third run, Halliburton collected 71 samples from softer formations, a world record. On the fourth, Halliburton went back to the harder formation and collected enough 1-in. samples to satisfy the client’s need.</p>



Petrobras asked Halliburton to collect 172 sidewall core samples from a deepwater exploratory well offshore Brazil.

6 RUNS ANTICIPATED

Halliburton initially expected the job would take six runs – an average of 30 samples per run. Halliburton was using the third generation of its Xaminer™ Coring Tool – outfitted with a 1.5-in. bit. Halliburton also brought two additional Xaminer Coring Tools outfitted with 1-in. bits as backups.



71 SAMPLES IN ONE RUN SET WORLD RECORD

Halliburton, using its Xaminer Coring Tool, collected 71 1.5-in. core samples in one run, setting a new world record.

ONLY 4 RUNS NEEDED

As a result of the record third run, at the end of the fourth run, the client had 161 core samples. They deemed this sufficient to give them the knowledge they needed.



The client was able to dispense with the fifth and sixth runs, saving a full day. Estimated savings on the deepwater drillship and crew were at least \$1 million.

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The challenge of the unknown

In recent years, Halliburton has made dramatic improvements to its sidewall coring tools. The Halliburton Xaminer™ Coring Tool can withstand temperatures up to 400°F (204°C) and pressures up to 25,000 psi. The third-generation Xaminer Coring Tool can retrieve core samples that are 1.5 in. in diameter and 2.4 in. in length, making them more than three times the volume of the smaller 1-in. samples collected by first-generation tools. Tool reliability and recovery rates have also improved.

All of these capabilities would be tested by Petrobras while drilling an exploratory deepwater well offshore Brazil in the Santos Basin. The project was in 2000 m of water, and the well itself was another 4300 m beneath the seabed.

Large number of rotary sidewall core samples needed

The client requested Halliburton to perform a complete openhole logging job – its first in this particular field. Only a small number of wells in this important area had been logged – all by a competitor. The logging program consisted of a full suite of services including quad combo; mineral analysis; magnetic resonance; six fluid samples and numerous pretests; resistive and acoustic imaging; borehole seismic; and 172 rotary sidewall core samples.



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Halliburton's Xaminer Coring Tool can be configured to collect either 1- or 1.5-in. cores.

Strategy and backup plans developed for coring

Because it had little familiarity with this particular field, Halliburton offered the customer the ability to run the Xaminer Coring Tool with a 1.5-in. bit, but also volunteered to have onboard a second Xaminer Coring Tool prepared with a 1-in. bit in case of poor recovery with the first tool.

The latter is better suited for very hard formations. Before beginning the job, Halliburton's research indicated a high likelihood of encountering such rock. To preserve the bit, Halliburton recommended avoiding hard formations in the first runs, but the customer declined to follow that recommendation.

First and second runs result in less than average recovery; third sets world record

On the first run into the hard formations, 24 samples were collected before bit wear prevented the tool from continuing. On the second run, only 20 samples were retrieved before the same problem developed. For the third run, the customer agreed to follow Halliburton's recommendation and focus on softer formations. The result: 71 samples were retrieved in a single run, a world record. Of these, 69 were full size and accepted by the customer, making the recovery rate 97 percent. For the fourth run – to collect the remaining samples from the hard formation – Halliburton recommended using the tool configured for 1-in. samples – the best choice for that type of rock.



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1.5-in. cores have three times the volume of 1-in. cores, facilitating better analysis.

Ultimate success

In the harder rock with the 1-in. bit, Halliburton recovered another 46 core samples on the fourth run. That brought the total of cores retrieved to 161. Of those, 113 were large and 48 were regular diameter (1 in.) cores. At this point, Petrobras had 161 of the 172 cores it originally requested – 94 percent.

Saving two runs, 24 hours, and a million dollars

Rather than go into the well a fifth time to collect the 11 remaining cores, Petrobras felt it had enough to get the information needed. They decided to dispense with the last two planned runs. This saved a minimum of 24 hours. At the prevailing rates for drillships and crews, that saved them at least one million dollars. Halliburton, on its first try, exceeded the performance of a competitor that had previously worked in this field.

Keys to success

The keys to achieving this performance were exceptional planning and tool preparation. Knowing that it could encounter the hard formations, Halliburton came prepared with the right tools for the job. Halliburton not only brought two Xaminer™ Coring Tool tools prepared for different types of rock, it also customized the tools to accommodate an extra large tube in the mandrel section. This enabled the collection of more than 60 large samples in one run – a capability that most third-party tools do not have.

Continuous improvement

To improve tool reliability and recovery rates, Halliburton also modified pressure settings, timings, and bit shape. Additionally, Halliburton added real-time monitoring capabilities to the tool. Constant modifications based on previous experience have improved tool performance dramatically. In just two years, between 2012 and 2014:

- Average operating hours without a tool failure increased from 34 to 193
- Average number of cores retrieved before a tool failure increased from 54 to 391
- Runs in hole – recovering only 15 cores or less – decreased from 49 percent to 12 percent

As a result, the Halliburton Xaminer Coring Tool experienced no failures involving lost time in an exploratory well in all of 2014.

Undamaged samples help produce better analysis

Halliburton developed the Xaminer Coring Tool to provide undamaged samples, without the microfractures typically found in percussion cores. This and the large sample size facilitate more accurate core analysis. The concept of a tool that could recover large sidewall core samples originated in Brazil – the same country where this world record was set.



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For the record run, Halliburton configured its Xaminer™ Coring Tool with an extra-long mandrel, which easily held 71 1.5-in. core samples.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

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