

## Advanced Technology Solutions in Deep Water

# Halliburton technology helps Cobalt International Energy save more than USD 10 million in presalt carbonates

Location: Angola

### Overview

Cobalt International Energy chose Halliburton to provide openhole wireline services for their deepwater presalt exploration wells in Angola. Halliburton’s cutting-edge technology and close collaboration helped Cobalt save more than USD 10 million. The versatile, flexible, and customized RDT™ tester with its various probe configurations helped avoid multiple pressure testing and sampling runs in each well. These wells were logged at water depths of 5000 ft or more with state-of-the-art 7-conductor Extra-Extra High-Strength (EEHS) cable that has a 30,000-lb breaking strength resulting in the prevention of many fishing jobs. The large-dimension rotary sidewall cores retrieved with the Xaminer™ Coring Tool with high recovery rates complemented the conventional coring program. A collaborative approach with the Formation and Reservoir Solutions (FRS) teams, along with efficient and timely logistical support from Halliburton, enabled Cobalt to make faster decisions and save expensive rig time.



| CHALLENGES  | SOLUTIONS  | RESULTS   |
|---|--|---|
| <p><b>Hard, complex formations</b><br/>Presalt carbonates have complex distributions of pore geometries and reservoir quality. The wide range of permeabilities makes it challenging to collect fluid and rock core samples. Also, complications from fishing operations are costly and in extreme conditions may result in losing the well</p> | <p><b>Customized and state-of-the-art tools</b><br/>Halliburton customized its RDT tester configuration and Xaminer Coring Tool bits for each well logged. The EEHS cable was mobilized to run multiple tools in combination runs through complex lithologies and deep wells</p> | <p><b>Reduced sampling time and prevented fishing jobs</b> The RDT tester reduced multiple runs compared to another provider. The Xaminer Coring Tool ensured a high core retrieval rate, and the 30,000-lb breaking point of the EEHS cable prevented many fishing jobs on these wells</p>       |
| <p><b>Logistical support and data confidentiality</b> The job was being performed in Angola, a logistically challenging country with the log data end user based in Houston</p>   | <p><b>Planning and fast interpretation turnaround time</b> Halliburton began planning for the job and allocating resources even before its actual award. For maintaining data confidentiality, a secure and dedicated data exchange and posting system was put in place</p>      | <p><b>Collaboration and quick decision making</b> The planning helped meet the tight schedule deadlines. The petrophysical interpretation’s fast turnaround time along with the real-time availability of the FRS team helped create a close collaboration between Cobalt and FRS Halliburton</p> |
| <p><b>Subsurface seismic imaging in a deepwater sparse-well environment</b><br/>Accurate prestack depth migration (PSDM) image is required in a complex geologic setting for better image of the subsurface</p>   | <p><b>Walkaway VSPs</b> Halliburton performed customized walkaway Vertical Seismic Profiling (VSP) acquisition and processing</p>  | <p><b>Interdependence of velocity and anisotropy</b> – The complex walkaway VSPs helped understand the velocity-anisotropy interdependence resulting in validation of the parameters used in the PSDM of the surface seismic data</p>   |

Halliburton helped Cobalt save more than USD 10 million by avoiding potential fishing operations by acquiring the pressures and fluid samples in the same run and collecting the reservoir data required for quick decision making.

SAVED MORE THAN  
**USD 10 MILLION**

***CUSTOMIZED AND FLEXIBLE***

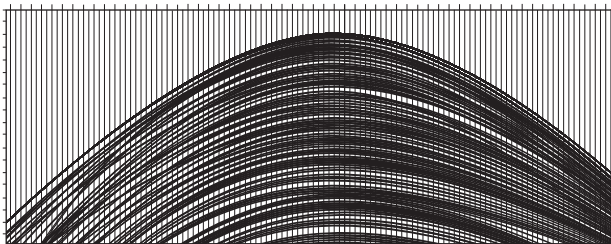
# RDT PROBE CONFIGURATIONS

The RDT tool with customized configurations and multiple probes collected low contamination samples in a single run in the complex presalt carbonates.

## State-of-the-Art Deepwater Deployment of Extra-Extra High-Strength (EEHS) Cables

Halliburton's Extra-Extra High-Strength (EEHS) cables with 30,000 lb of breaking strength and over 18,000-lb pulling capability without capstan, along with electric wireline jars, prevented at least four fishing jobs.

## Reduced Uncertainty *Improved Reservoir Understanding*



Halliburton Borehole Seismic Services helped acquire complex walkaway VSPs. This resulted in improved understanding of the velocity-anisotropy interdependence, which in turn validated the parameters used for the prestack depth migration (PSDM) processing of the surface seismic data.

## MORE THAN

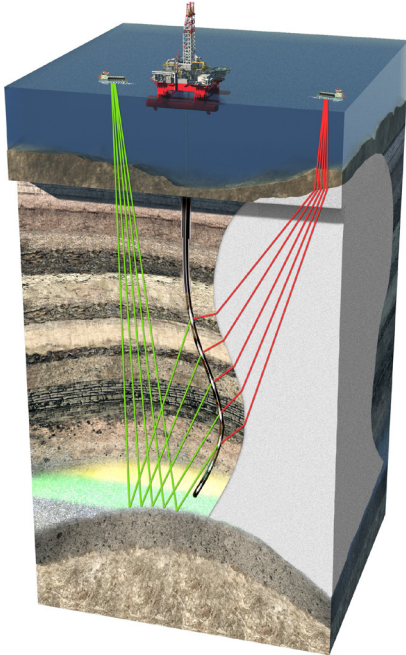
# 3X VOLUME

OF PREVIOUS-GENERATION SAMPLES

The Xaminer Coring Tool delivered samples that are more than three times the volume of previous-generation samples. The quality of the samples and the flexibility in their transportation helped Cobalt get core analysis done for timely and effective decisions.

## Series of deepwater, presalt exploration wells offshore Angola

Cobalt International Energy hired Halliburton to provide openhole wireline services for their deepwater presalt exploration wells in Angola. The services included a comprehensive openhole logging suite consisting of formation pressure testing and sampling, rotary sidewall coring, and borehole seismic, among others. These wells were logged at water depths of 5000 ft or more.



*The data from the VSP improved reservoir knowledge and enabled optimal well placement and field planning.*



*RDT tester oval pad*

### Logistical and communication challenges

Halliburton began planning for the job and allocating resources even before its actual award to overcome the tight service delivery schedule and the logistical challenges in Angola. The acquired data had to be shared between teams in Angola and Houston while maintaining utmost confidentiality. To achieve this, a secure and dedicated data exchange and posting system was put in place.

### Extra-Extra High-Strength (EEHS) cables with high breaking strengths

No operator likes a fishing job, especially in their deepwater exploration wells. Conveying tools on wireline in reservoirs under salt layers adds a different dimension and complexity to successful conveyance. The EEHS cable has a breaking strength of 30,000 lb and a pulling capability beyond 18,000 lb without a capstan. In the first four wells, this high-endurance cable, along with the electric wireline jars and electrically releasable cable head, saved Cobalt at least four fishing jobs and several hours of rig time.

### Complex walkaway VSP improves reservoir understanding

Subsurface seismic image becomes increasingly critical, especially in a deepwater sparse-well environment. Many elements of signal enhancement, such as maximizing frequency bandwidth or attenuating multiples, contribute to a better image of the subsurface. The complex walkaway VSPs helped understand the interdependence of velocity on anisotropy resulting in improved subsurface image processing. Halliburton coauthored two technical papers with Cobalt addressing these challenges. The papers were presented at SEG (Denver 2014) and EAGE (Amsterdam 2014).

### Customized Xaminer Coring Tool collects hundreds of cores from multiple zones

Halliburton, based on their experience from the first well, customized the bit and collar of the Xaminer Coring Tool to increase the core recovery rate. A total of 395 sidewall core samples were taken from four wells with a recovery rate of 97 percent. The Xaminer Coring Tool provides samples that are 1.5 in. in diameter and 2.1 in. in length, more than three times the volume of previous-generation samples. The quality of the samples and the flexibility in their transportation helped Cobalt get core analysis done for timely and effective decisions.

### **Versatile RDT tester customized for each job**

The challenges to formation evaluation, including hydrocarbon identification, are multifold. Complex distributions of pore geometries and reservoir quality are present in these presalt formations. The versatile Halliburton RDT™ tester was configured for each job to determine fluid types and permeability to derive solutions with a higher level of reservoir understanding. Flexible and combinable probe configurations helped the RDT tester accomplish all the testing and fluid sampling requirements in the same run

### **Fast turnaround time for quick decision making**

Fast turnaround time in processing and data interpretation established a close collaborative relationship between Cobalt and Halliburton. The FRS teams worked closely with Cobalt's asset team to deliver integrated solutions that assisted Cobalt in evaluating their complex reservoirs and making effective and timely decisions that saved rig time.

### **People, processes, and customizable technologies save USD 10 million**

Altogether, the people, processes, and technologies deployed by Halliburton for Cobalt International Energy saved an estimated USD 10 million in rig days. The savings came from eliminating unnecessary runs, minimizing the time between runs, collecting effective fluid and rock samples, and fast turnaround time of processed data and integrated solutions delivered by Halliburton FRS teams.



*Halliburton's collaborative approach with Cobalt allowed faster and reliable decisions.*



*Xaminer Coring Tool*