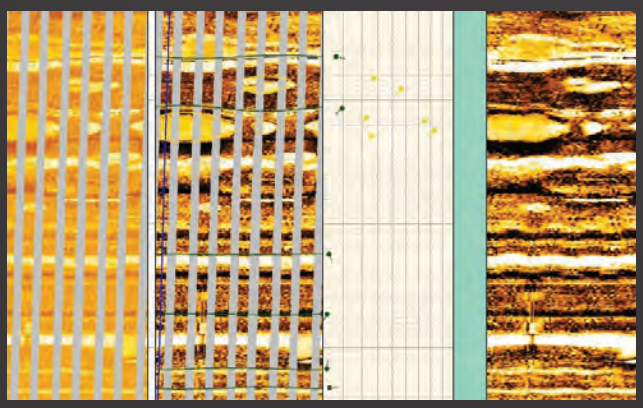
FORMATION EVALUATION



# Compact™ Oil-Base Mud Microimager

Delivering vivid, high-definition formation images in wells drilled with oil-base mud

Weatherford®

# Vivid geologic detail in oil-base mud

## Visualize unconventional reservoir structures with high-definition images of your horizontal wells.

Though oil-base muds (OBMs) help you drill a more stable unconventional wellbore, they can prevent conventional microresistivity imagers from bringing formation clarity.

The Compact™ oil-base mud microimager (COI) provides vividly detailed images of OBM-drilled wells, including horizontal and deviated wellbores. The slim, 4.1-in. (104-mm) COI tool uses eight pads to provide high-quality, fullbore images in wells that no other imager can log.

Using an integrated memory sub and launched with our unique Assure™ system of 10 tool-conveyance methods, the tool can log wells with or without wireline.

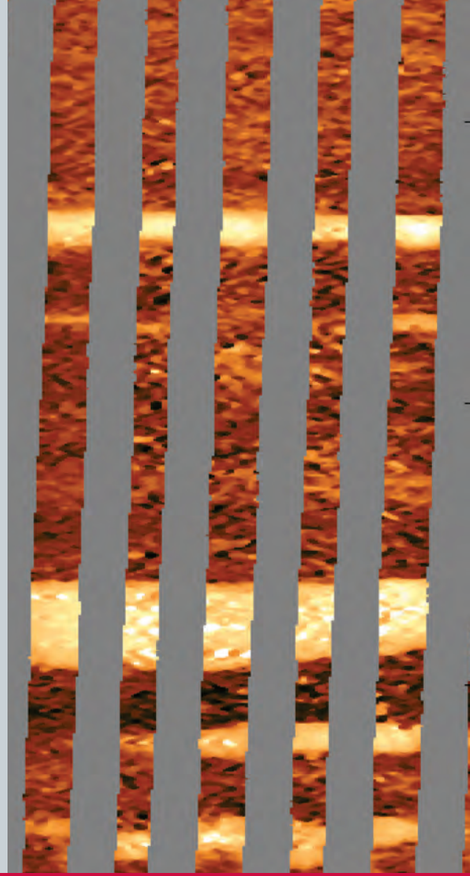
The analysis of the COI image provides a detailed picture of structural, stratigraphic and depositional geology around the wellbore. Together with our patented Reveal 360 post-processing technique, the COI image leads to a better reservoir characterization and reduces uncertainty.

### The Compact Oil Imager Advantage

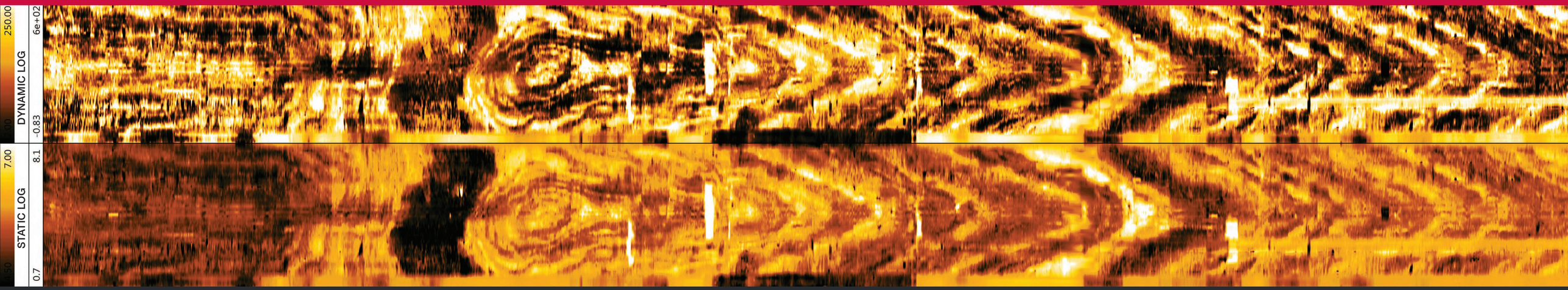
- Delivers high-definition, 360° wellbore images in OBM-drilled wells, including horizontal wells
- Deploys through tough hole conditions, including narrow, horizontal, and highly deviated wells
- Uses a proprietary speed-correction process to provide sharper images
- Contacts the borehole wall directly, which negates the need for mud-cake measurement correction
- Uses two sets of four pads to provide optimal borehole coverage
- Offers full combinability with other Compact tools
- Deploys via wireline or with any of the 10 Assure conveyance methods

### Unconventional Production Applications

- Optimizes frac treatments through fracture identification, which reduces treatment costs and maximizes stage productivity
- Combines with other Compact tools to provide brittleness and total organic carbon (TOC) data, which supports treatment-pressure adjustments and the ability to eliminate unproductive zones
- Provides six independent caliper measurements for precise completion design, which helps to ensure proper packer placement



## Horizontal well image with Reveal 360 image processing



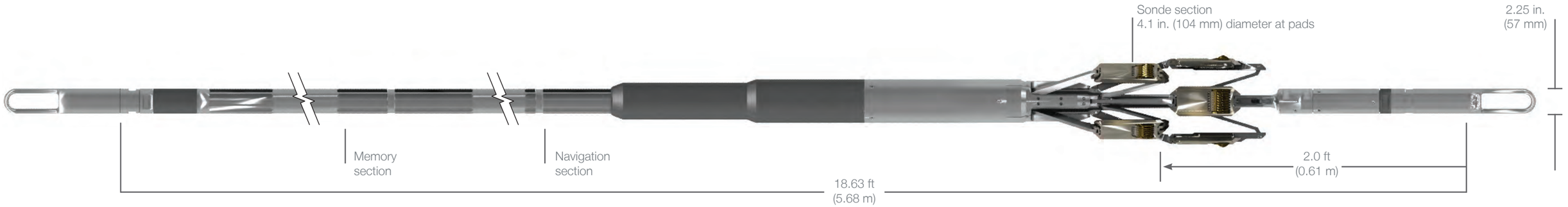
# How the Compact oil-base mud microimager works

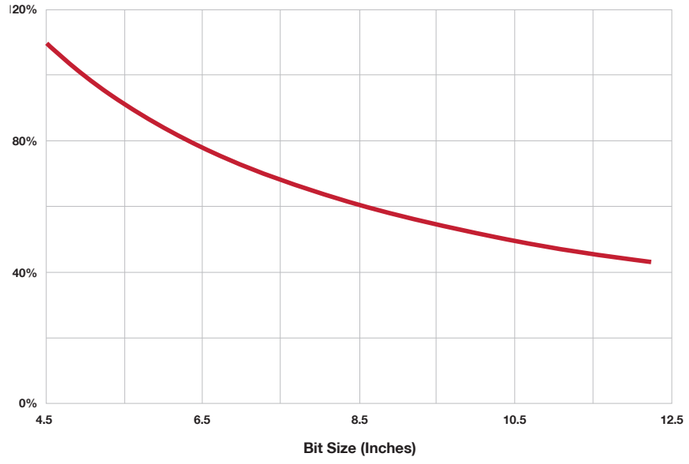
Whether visualizing complex structures, detecting dips and fractures, or evaluating thin beds, the COI tool provides advanced image processing using a reliable and proven measurement system.

- Each of the eight pads is gimballed to provide optimal borehole contact.
- Each pad includes newly designed blades that cut through the mud cake to make direct contact with the borehole wall.
- Each blade features a unique measurement system that maintains electrical stability within the mud during resistivity measurements.
- The upper four arms are crosslinked to centralize the tool, even in horizontal wells.
- The lower four arms provide independent caliper measurements.
- The six independent caliper measurements and the integrated navigation package help to ensure accurate borehole geometry logs.
- The memory sub records all high-resolution data.

## COI Features and Benefits

| Features | Advantages | Benefits |
|---|---|---|
| Eight pads with 72 measurement electrodes | Optimal borehole coverage | Improved geological interpretation |
| Measurement electrodes contact the borehole wall directly | Eliminates the need for mud-cake measurement correction | High-definition image regardless of OBM properties |
| Pads are gimballed and pad pressure can be selected | Excellent borehole contact even in horizontal wells | High-definition image in rugose and horizontal wells |
| High dynamic range measurement electronics | Delivers measurement in wide range of formation resistivities | High-definition image in different formations |
| Integrated flash memory | Data is recorded into memory independently from the data communicated on wireline | Data assurance and reliability |
| 6 independent caliper measurements and integrated navigation | Delivers accurate borehole-geometry data | Precise completion design and packer placement |
| Assure™ conveyance | Deploys in tough hole conditions, including narrow, horizontal, and highly deviated wells | Improved operational efficiency and reliability |
| Uses a proprietary speed-correction process | Sharper images | Improved geological interpretation |
| Reveal 360 processing | Full bore images | Confident decision making in complex reservoirs |




*4.1-in. COI coverage map*

## COI Technical Specifications

| Measurement specifications | |
|---|---|
| Tool | COI 4.1 |
| Data | Microresistivity imaging, borehole geometry, multiarm caliper |
| Logging speed | 2,000 ft/hr (600 m/hr) |
| Measurement range | Tilt: 0° to 180°<br>Azimuth: 0° to 360°<br>Microresistivity: no practical limit |
| Vertical resolution | 0.4 in. (10 mm) microresistivity |
| Axial resolution | 0.2 in. (5 mm) microresistivity |
| Accuracy | Caliper: ± 0.2 in. (5 mm)<br>Deviation: ± 0.1°<br>Azimuth: ± 5° |
| Depth of investigation | 0.5 in. (12.7 mm) nominal for microresistivity |
| Borehole fluids | Oil-, diesel-, and synthetic-based muds |

| Mechanical specifications | |
|---|---|
| Maximum outer diameter | 4.10 in. (104 mm) |
| Length | 18.63 ft (5.68 m) |
| Weight (in air) | 141 lb (64 kg) |
| Maximum temperature | 302°F (150°C) |
| Maximum pressure | 15,000 psi (103 MPa) |
| Maximum borehole diameter | 13 in. (330 mm) |
| Minimum borehole diameter | 4.6 in. (117 mm) |

# Reveal 360™ Image Processing and Services

Delivering 360° wellbore imaging and removing the blind spots from your wellbore images

**8 1/2-in. well-image reconstruction is**

**96%**

**accurate**

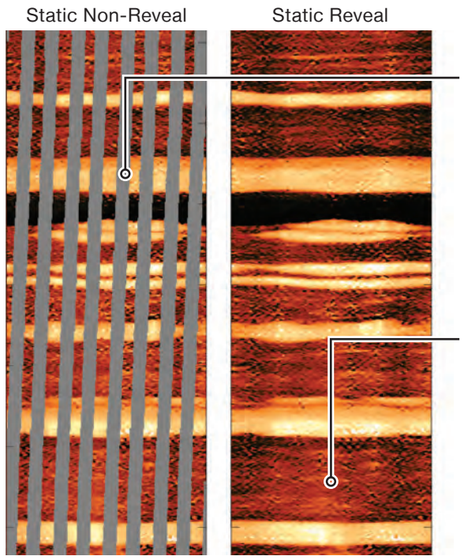
**for 40% coverage loss**

**12 1/4-in. well-image reconstruction is**

**92%**

**accurate**

**for 60% coverage loss**




## Standard

The COI has a total of 72 knife blade electrodes distributed over eight pads, providing excellent borehole coverage. The knife blades are designed to cut through the mud cake and provide high vertical resolution measurements.

## Reveal 360

Patent-pending, dynamic digital-imaging technology environmentally normalizes wellbore images and removes gaps between the pads for a complete 360° view.

## Get the full picture

You depend on wellbore images to provide detailed structural, stratigraphic, and depositional information. But even using the most advanced imaging tools, you may only see between 50 and 70 percent of your wellbore. The rest is missed because of gaps between the pads of the wireline tool.

Reveal 360 image processing gives you a complete picture of your wellbore regardless of bit size. Our patented new processing technique reconstructs gaps in wireline logging images, replacing missing data with values consistent with the structural and textural information in the measured parts of the image. Even in clastic rock formations with a wide variety of sedimentary and structural features, the technique produces images that are nearly identical to full-coverage images.

### How the Reveal 360 technique works

Reveal 360 processing decomposes the measured sections of the wellbore into sparse representations of their morphological components using dictionaries of multiscale, multi-orientation transforms—a technique known as morphological component analysis. These representations are then reconstructed using information from the dictionaries to fill in gaps in data.




## A Flexible Approach

- Delivers 360° well imaging with no blind spots
- Provides unbiased and reproducible estimates of the nonmeasured parts of images
- Enables automated pattern recognition algorithms that are typically challenged by gaps in data
- Reconstructs a broad range of attributes including partial and full sinusoids and textural elements
- Offers compatibility with all Weatherford Compact™ and standard wireline wellbore-imaging tools

For more information regarding the Compact oil-base mud microimager (COI) as well as other products and services offered by Weatherford, please visit **weatherford.com.**

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