

Borehole imaging

Solutions

Our Company

Since the company's foundation in 1993, Advanced Logic Technology has grown to become a globally recognised leader in developing borehole logging **instruments, data acquisition & processing software.**

With more than 20 years of experience, ALT has built a solid reputation for the design and production of state of the art imaging tools.

Our data processing software WellCAD provides a framework for the daily work of thousands of people dealing with borehole data. WellCAD handles the entire data loading, log editing, analysis and presentation workflow.

Our instruments and software are used for

- Mining & Mineral exploration
- Oil & Gas
- Geotechnical projects
- Groundwater applications
- Geothermal



Our Technology

The Acoustic Borehole Imager records a 360° unwrapped 3D image of the borehole wall. The tool emits an ultrasonic beam towards the formation and records the amplitude and the travel time of the reflected signal. The amplitude record is representative of the impedance contrast between the rocks and the fluid. The travel time is used to determine accurate borehole diameter data which makes the tool ideal for borehole deformation description, stress field analysis and casing inspection. Sophisticated algorithms and real time processes are also implemented to extend the possible tool applications to casing thickness measurement, corrosion evaluation and measurement behind a PVC casing.

The Optical Borehole Imager produces a continuous, sharp, true color, 360° unwrapped digital image of the borehole wall in dry and water filled boreholes.

Both technologies use a built in high precision orientation package incorporating a 3-axis fluxgate magnetometer and 3 accelerometers for the orientation of the images to a global reference and determination of the borehole's azimuth and inclination. All tools are fully digital and can operate on standard wirelines. They can be combined with other logging tools in the QL product line to build tool strings or operated as standalone tools.



Acoustic Borehole Imager (ABI™)

QL40 ABI™ / ABI™40 GR



Technical specifications

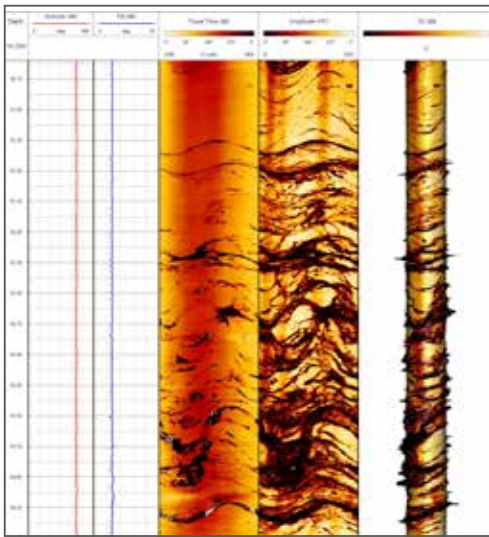
Diameter	40 mm (1.6")
Length (min/max)	1.62*/1.84 m** (63/72.4")
Weight (min/max)	6.7*/7.4 kgs** (14.7/16.3 lbs)
Max temp	70°C (158°F)
Max pressure	200 bar (2900 PSI)
Acoustic sensor	Fixed transducer and rotating focusing mirror
Focusing	Collimated acoustic beam
Frequency	1.2 MHz
Rotation speed	Up to 35 revolutions per second - automatic
Caliper resolution	0.08mm (0.003")
Deviation sensor	APS544-3 axis magnetometer - 3 axis accelerometer
Natural gamma sensor	Integrated (ABI40 GR) or in line sub (QL40 GR - QL40 GR CCL) 0.875" x 3" NaI (Ti) scintillation crystal

Operating conditions

Cable type	Mono, multi-conductor, coax
Compatibility	Scout / Opal (ALTlogger / Bbox / Matrix)
Digital data transmission	
Telemetry	Variable baudrate telemetry according to cable length/type & surface system
Logging speed	Variable - function of image resolution, borehole diameter, wireline and surface system model. e.g. 8m/min in 7" diameter borehole with 144 azimuthal resolution - 4mm vertical sampling rate @ 250kbps baud rate.
Centralisation	Required
Borehole fluid	Water, water based mud, brine, oil (oil based mud not applicable)
Measurement range	Open hole: up to 20" - depending on mud conditions Cased hole: 5" to 20" - minimum thickness 5 mm

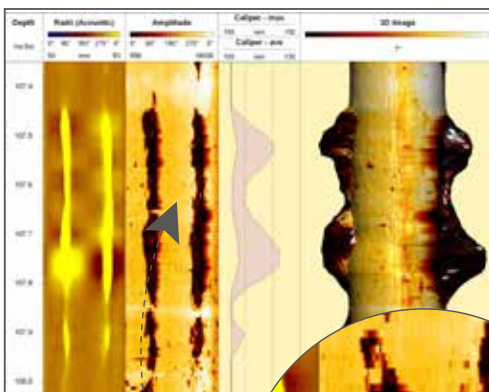
*QL40 ABI / **ABI40 GR





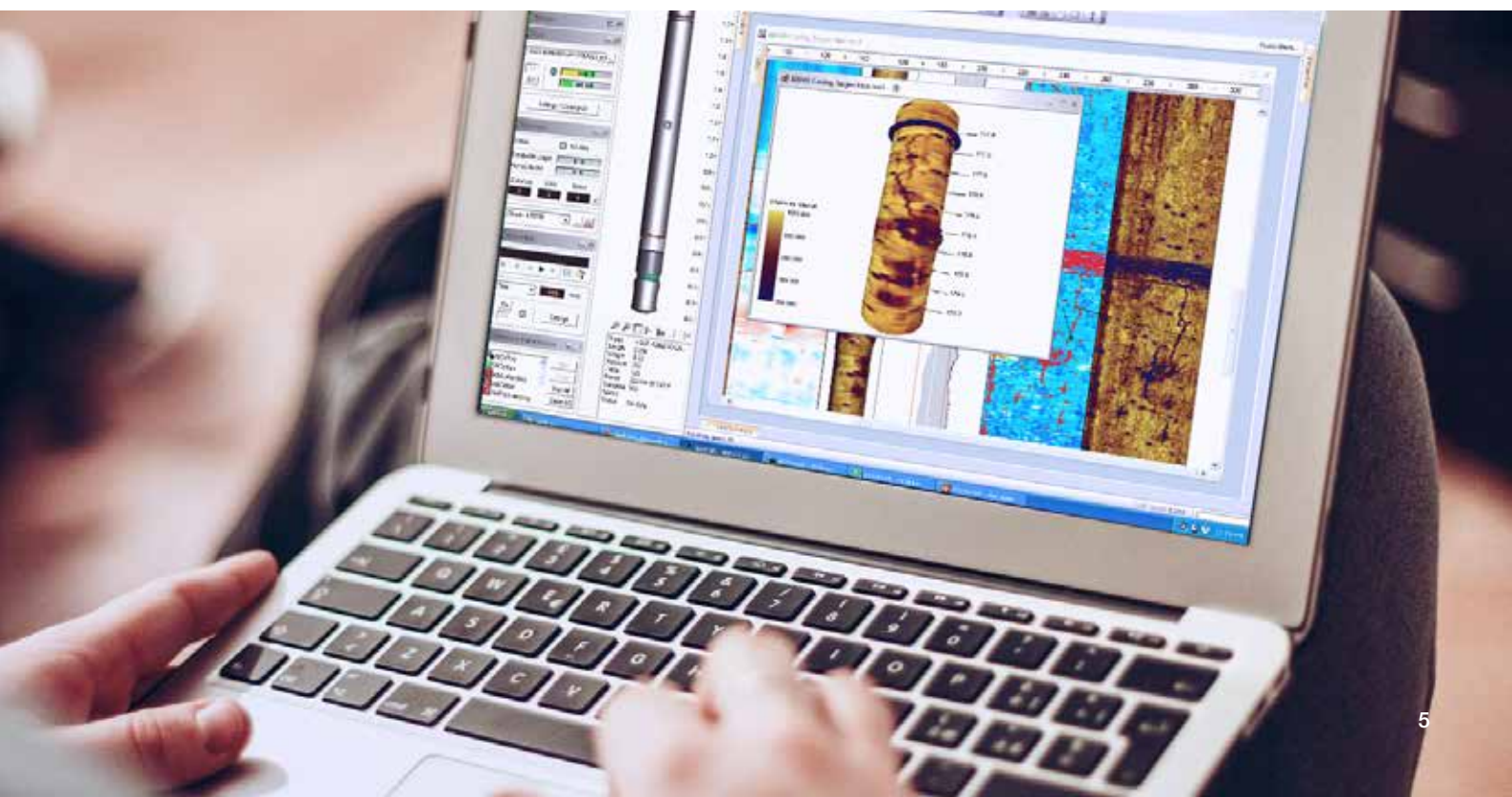
Open hole

- Detailed and oriented caliper and structural information
- Borehole deformation (stress field analysis)
- Fracture detection and evaluation
- Breakout analysis
- Lithology characterization (detection of thin beds, determination of bedding dip)
- Rock strength



Cased hole

- Casing inspection
- Inside & outside diameter
- Casing thickness & corrosion rate
- Scale & hole detection
- Casing wear & deformation
- Metal loss indicators



Optical Borehole Imager (OBI™)

QL40 OBI™ / OBI™40 GR



Technical specifications

Diameter	40 mm (1.6")
Length (min/max)	1.49*/1.93 m** (58.7/76.0")
Weight (min/max)	5.3*/7.4 kgs** (11.7/16.6 lbs)
Max temp	70°C (158°F)
Max pressure	200 bar (2900 PSI)
Optical sensor	1/3" high sensitivity CMOS digital image sensor
Color resolution	24 bits RGB true colors
Responsivity	5.48V/lux-sec
Light source	High efficiency LEDs
Azimuthal resolutions	120, 180, 360, 600, 900, 1800 points
Vertical resolution	User defined. Function of depth encoder vertical resolution
Deviation sensor	APS544-3 axis magnetometer - 3 axis accelerometer
Natural gamma sensor	Integrated (OBI40 GR) or in line sub (QL40 GR - QL40 GR CCL) 0.875" x 3" NaI (Ti) scintillation crystal

Operating conditions

Cable type	Mono, multi-conductor, coax
Compatibility SCOUT/OPAL	Scout / Opal (ALTlogger / Bbox / Matrix)
Digital data transmission	
Telemetry	Variable baudrate telemetry according to cable length/type & surface system
Logging speed	Function of image resolution and wireline electrical properties e.g: 6 m/min with 900 pixels azimuthal resolution, 2 mm vertical sampling rate @ 100 Kbps
Centralisation	Required
Borehole fluid	Dry, clear water filled
Measurement range	Up to 21"

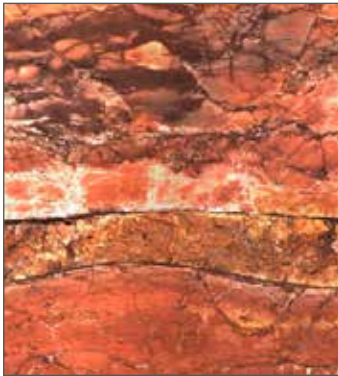
*QL40 OBI / **OBI40 GR





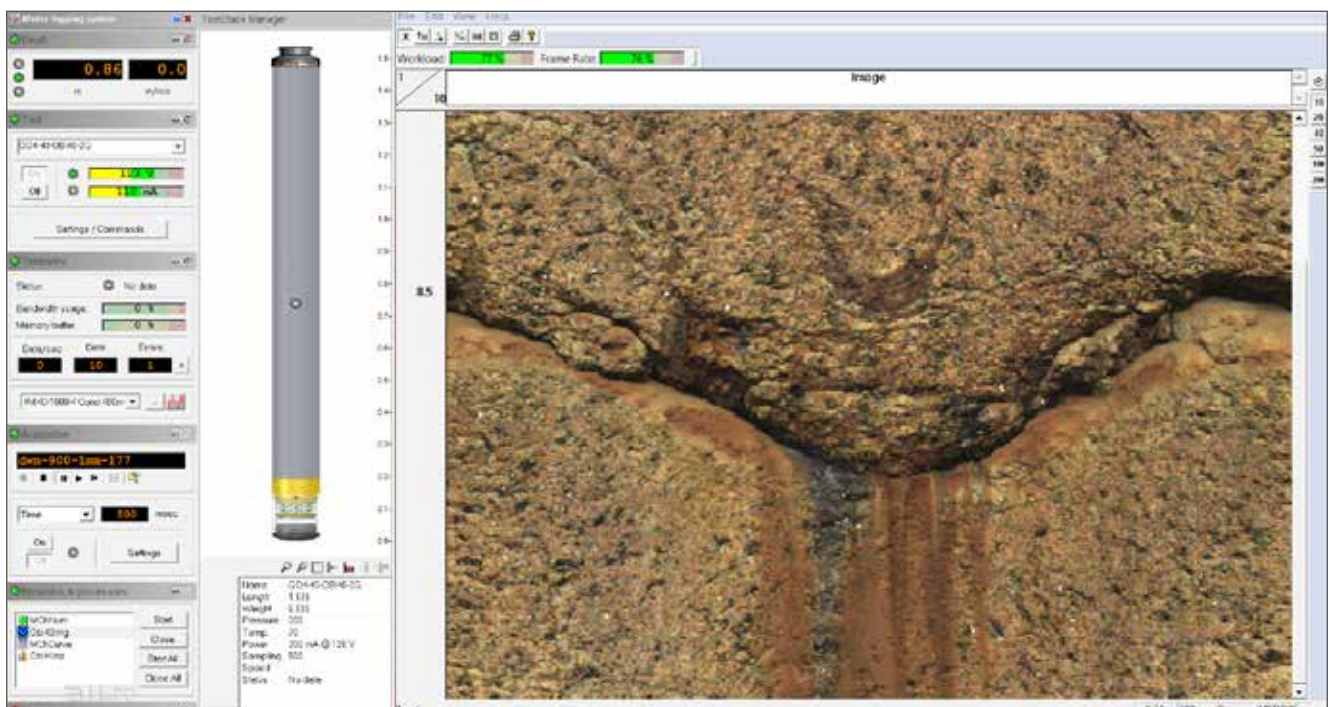
Open hole

- Detailed and oriented structural information
- Reference for core orientation
- Fracture detection and evaluation
- Breakout analysis
- Lithology and mineralogy characterization (detection of thin beds, determination of bedding dip)
- Rock strength



Cased hole

- Casing inspection (lateral view only)



Slimhole, High Temperature Acoustic Borehole Imager

QL43 ABI™



Technical specifications

Diameter	43mm (1 ¹¹ / ₁₆ "
Length	1.77 m (70")
Weight	10kgs
Max temp	Open hole 125°C (257°F) Cased hole 170°C (338°F) (in development)
Max pressure	700 bar (10160 PSI)

Field exchangeable acoustic head*

Acoustic sensor	Fixed transducer and rotating focusing mirror
Focusing	Collimated acoustic beam
Frequency	1.2 MHz - 0.5 MHz
Caliper resolution	0.08mm (0.003")
Deviation sensor	3 axis accelerometer (170°C) APS544-3 axis magnetometer - 3 axis accelerometer (125°C)

Operating conditions

Cable type	Mono, multi-conductor, coax
Compatibility SCOUT/OPAL	Scout / Opal (ALTlogger / Bbox)
Digital data transmission	
Telemetry	Variable baudrate telemetry according to cable length/type & surface system
Logging speed	Variable function of resolution, wireline and surface system
Centralisation	Required
Borehole fluid	Water, water based mud, brine, oil (oil based mud not applicable)

Field exchangeable acoustic head

QL43 ABI HEAD OHCO-L OPEN HOLE & CORROSION

Open hole up to 21" depending on borehole conditions
Corrosion 5½" x 15"
minimum of 5 mm thickness



QL43 ABI HEAD CO-S CORROSION SMALL PIPE DIAMETER

3" x 5½"
minimum of 3 mm thickness



QL43 ABI HEAD CO-XXS CORROSION 2⁷/₈ TUBING

2⁷/₈"
depending on borehole conditions with
a minimum of 3 mm thickness



QL43 ABI HEAD CE-L CEMENT **(in development)**

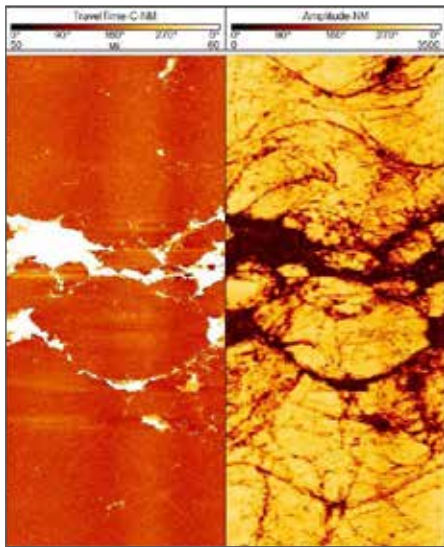
5½" x 15"



QL43 ABI HEAD CE-S CEMENT SMALL PIPE DIAMETER **(in development)**

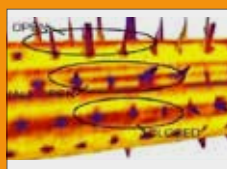
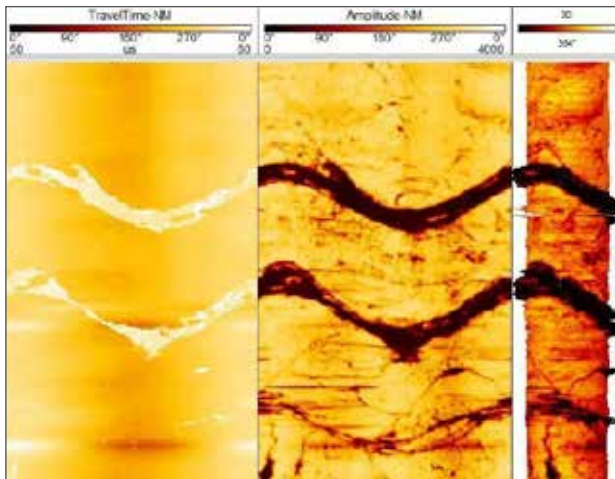
2⁷/₈" x 5½"





Open hole

- Detailed and oriented caliper and structural information
- Borehole deformation (stress field analysis)
- Fracture detection and evaluation
- Breakout analysis
- Lithology and mineralogy characterization (detection of thin beds, determination of bedding dip)
- Rock strength



Perforation position & aperture



Internal/external casing surface imager



Internal casing diameter



External casing diameter

Cased hole

Casing inspection

- Inside & outside diameter
- Casing thickness & corrosion rate
- Scale & hole detection
- Casing defects
- Casing wear & deformation
- Metal loss indicators

Cement evaluation (in development)

- Cement location
- Cement channeling

High Temperature Acoustic Borehole Imager

QL85 ABI™

Technical specifications

Diameter	85 mm (3 ³ / ₈ "")
Length	
with "inline" centralisers	5.2 m (205")
without "inline" centralisers	3.7 m (145")
Weight	150 kgs
Operational temp & pressure	See figure 1
Acoustic sensor	Fixed transducer and rotating focusing mirror
Focusing	Collimated acoustic beam
Frequency	1.2 MHz
Caliper resolution	0.08mm (0.003")
Deviation sensor	APS544-3 axis magnetometer - 3 axis accelerometer

Operating conditions

Cable type	Multi conductor recommended
Compatibility SCOUT/OPAL	Scout / Opal (ALTIlogger / Bbox)
Digital data transmission	
Telemetry	Variable baudrate telemetry according to cable length/type & surface system
Centralisation	Required
Borehole fluid	Water, water based mud, brine, oil (oil based mud not applicable)

Options

Centralisers	In-line 85 mm & 92 mm (OD versions)
Pressure housing	92 mm (OD version)
Fluid excluder (figure 2)	7.5" (OD version)

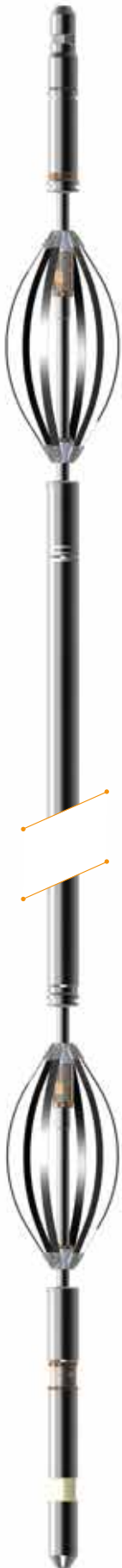
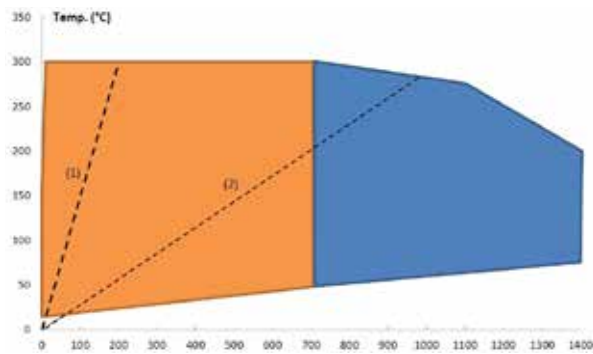


figure 2



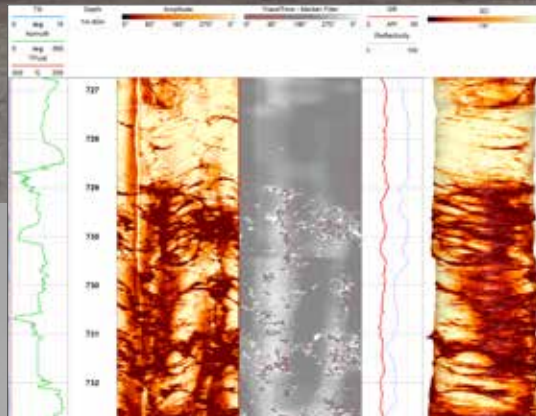
- (1) Geothermal gradient - hot spot
- (2) Geothermal gradient - common

Pressure (bar)

- Applicable for QL85-ABI with 85mm and 92mm pressure housing
- Applicable for QL85-ABI with 92mm pressure housing only

Open hole

- Detailed and oriented caliper and structural information
- Borehole deformation (stress field analysis)
- Fracture detection and evaluation
- Breakout analysis
- Lithology characterization (detection of thin beds, determination of bedding dip)
- Rock strength



Since the delivery of the first 2 systems to Sandia National Laboratories in 2005, the ABI85 has been deployed successfully in several geothermal fields including Iceland, New Zealand, Australia & Japan.

Publications

C.Massiot, D.D. McNamara, B.Lewis (2014) Processing and analysis of high temperature geothermal acoustic borehole image logs in the Taupo Volcanic Zone, New Zealand (Geothermics 53, 2015)

Wallis, McNamara, Rowland & Massiot (2012) « The Nature of Fracture Permeability in the Basement Greywacke at Kawerau Geothermal Field, New Zealand, Proceedings 37th Workshop on Geothermal Reservoir Engineering, Stanford University, January 30- February 1, 2012

Davatzes, N.C. and Hickman, S.H. (2010), "The Feedback Between Stress, Faulting, and Fluid Flow: Lessons from the Coso Geothermal Field, CA, USA", Proceedings World Geothermal Congress 2010, Bali, Indonesia.

WellCAD™

Advanced software toolbox for borehole image analysis

Data import

Borehole image data from a variety of tools including acoustic televiewer, optical televiewer, corescanned images, FMI, FMS, CAST, CBIL, UBI, STAR and Sondex MIT are supported.

Data processing

Before any form of analysis is performed, the data needs to be processed. This involves the creation of a reliable high quality image from raw tool measurements.

A number of processing options are available for enhancing the quality of the data.

These include :

- Bad trace interpolation
- Image normalization
- Despiking filters
- Centralize image
- Adjust brightness and contrast (for RGB logs)

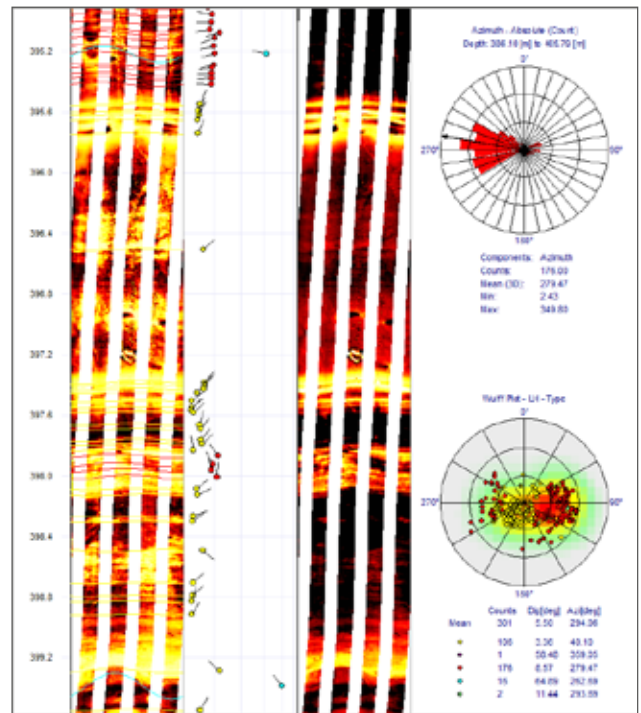
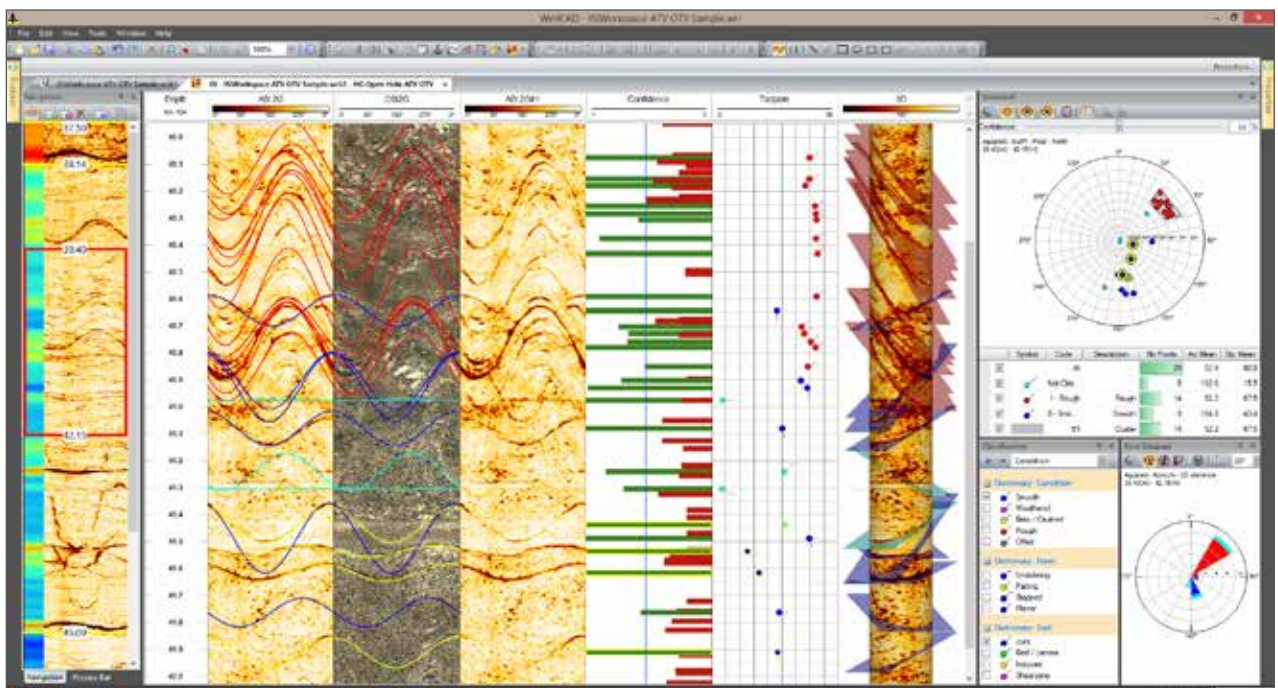
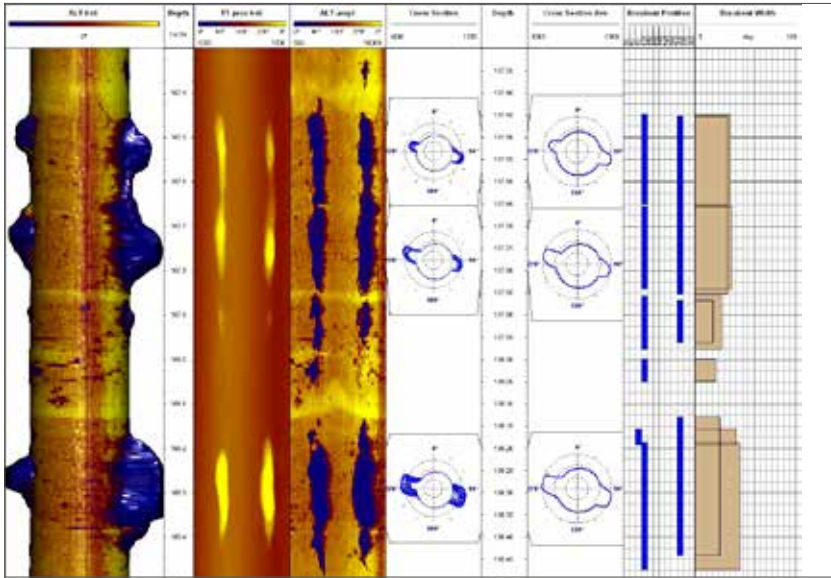


Image & Structure Interpretation (ISI) workspace **NEW**

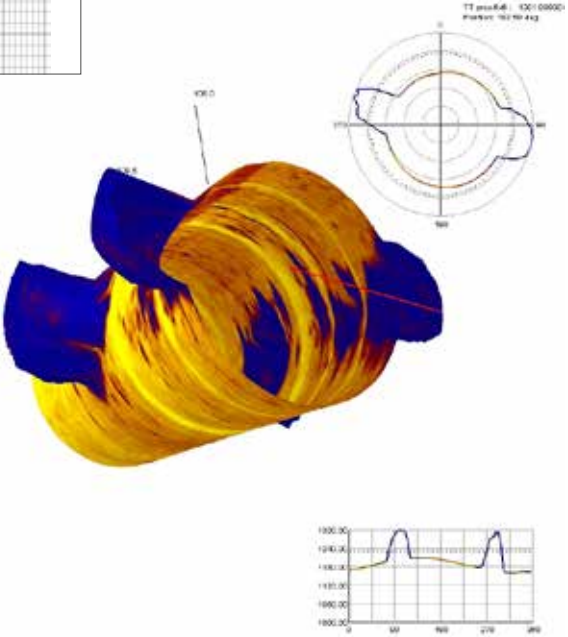




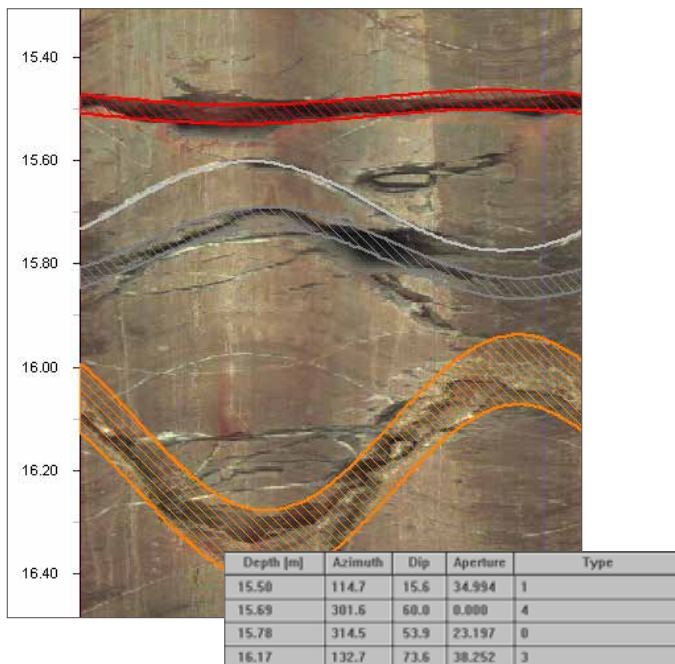
Acoustic televiewer breakout measurement

Data presentation

Data can be displayed as an image (user definable image color palette), as curves (shifted or stacked curves) or as 3D cylinder display (virtual core). Data can be visualized as 3D images using 3D borehole view (ideal to visualize breakouts, well deformation, pipe corrosion). Data can be oriented to North or Highside, or rotated by a user defined input (magnetic North to true North correction).

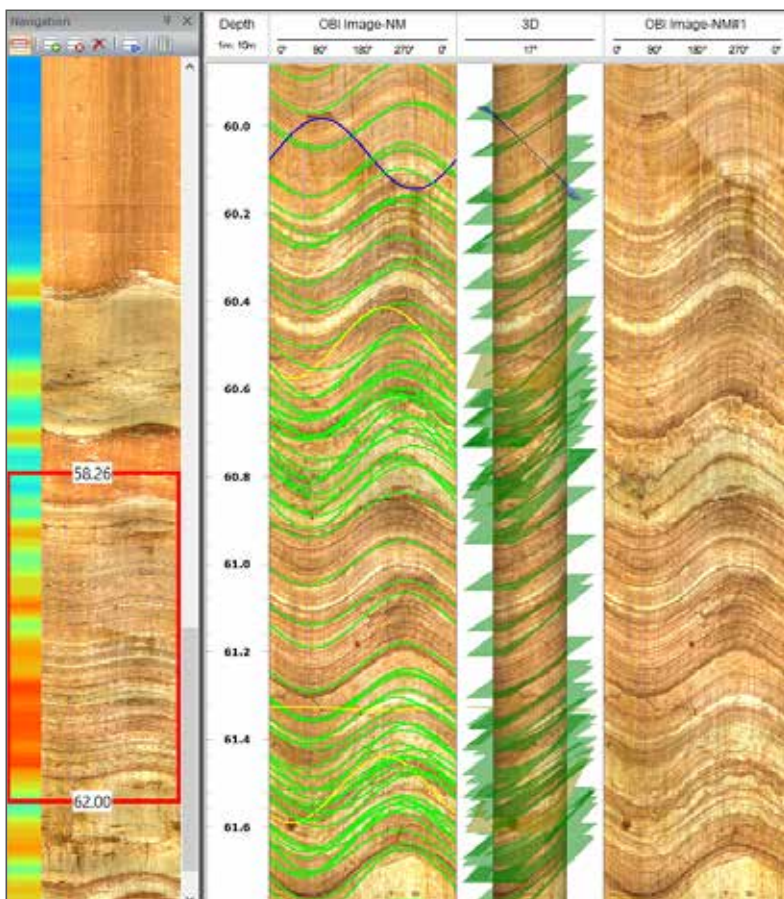
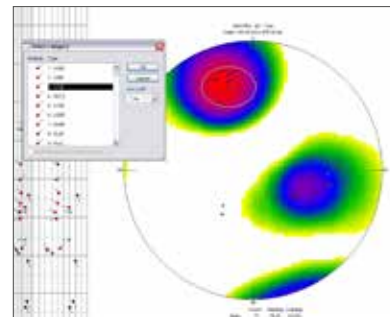


Data interpretation



- Any number of planar features can be interactively picked recording azimuth, dip values and aperture. Each pick can be qualified into user definable categories (ToadCAD). Picks can be displayed as sinusoid, tadpole or stick plot. Picking of linear features (e.g. breakouts, tensile fractures) is also possible.

Fully interactive structure interpretation including dips workspace with polar, rose and vector plots. The module includes specific processes such as, caliper calculation from traveltime images, extraction of curves indicating rock strength and reflectivity from images. ▼



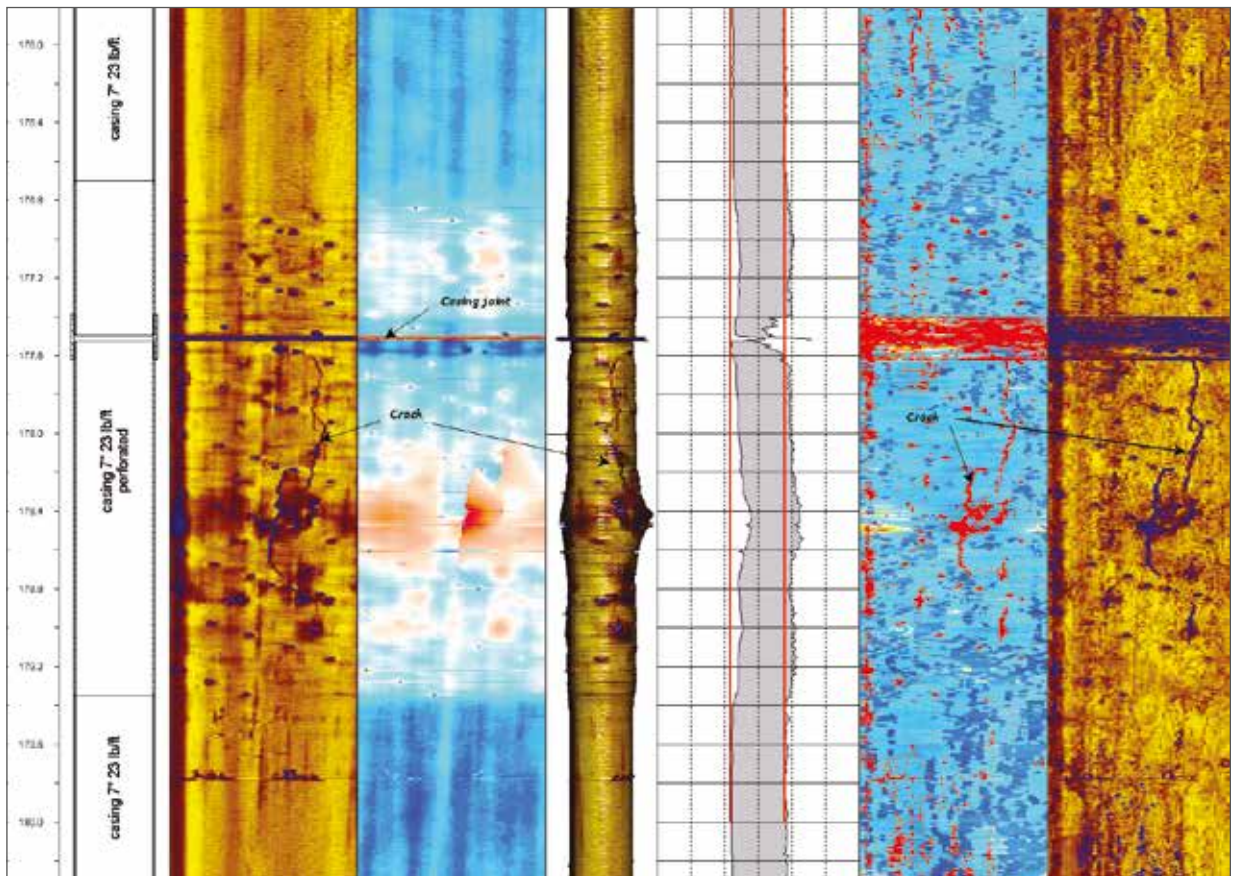
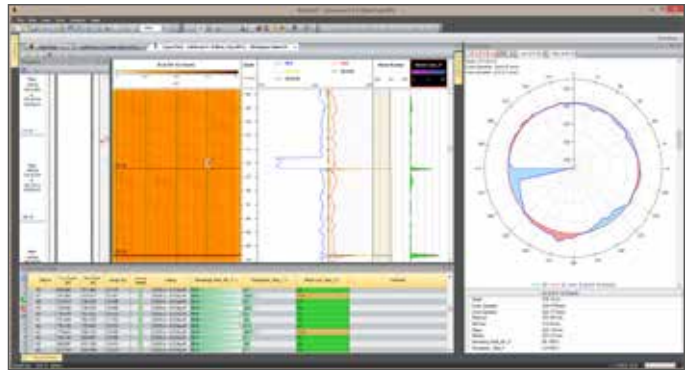
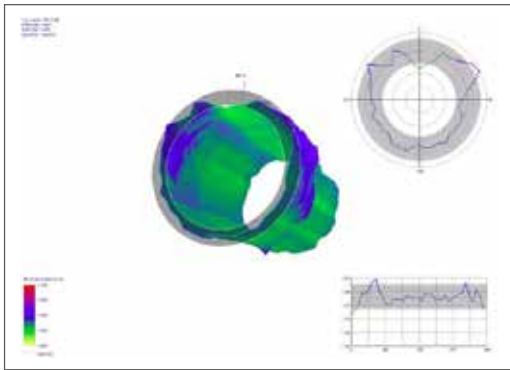
The new Image & Structure Interpretation (ISI) workspace combines manual and automated structure picking tools, sophisticated data visualization and a logical workflow into a powerful, built for purpose processing and interpretation platform.

- A navigation bar allows structuring the workload by zonation based on a structure complexity map and image data overview.
- Simultaneous picking of planar, linear and free hand features on multiple images is supported.
- The geologist controls the manual, semi-automatic and auto picks.
- Picking results are tagged with a confidence value and structural planes are displayed superimposed on to a virtual 3D core improving the data quality control.
- Real time conversion from apparent to true picks.
- Interactive stereonet algorithms to find similar or most representative picks enhance the interpreters control of the data and optimise the picking results.

Casing Integrity Workspace **NEW**

The casing integrity module opens the door to professional cased hole data interpretation and adds a workspace and processing options for multifinger caliper and ultrasonic televiewers to WellCAD.

- Raw log editing, linear and non-linear depth matching, splicing and merging.
- Shift correction, dead sensor correction, despiking and centralization options.
- Automatic pipe joint detection, interactive joint editing, graphical data presentation and joint analysis tables.
- Custom pipe grading classification.
- Determination of up to 35 statistical parameters derived per pipe section or at each depth.
- 2D cross section, vertical profile and 3D virtual well displays dynamically linked to the source data.
- Comprehensive and customizable reporting capabilities.
- Binary, ASCII data and graphic export (WCL, LIS, DLIS, LAS, CSV, XLS(X), JPG, PNG, TIF, ...).
- Free data viewer "WellCAD Reader".





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