CAYROS
group

# Borehole Geology Services

Technical Presentation

About Us

CAYROS - Borehole Geology Services is a consulting group that specializes in the processing and interpretation of high-resolution borehole image data from vertical and horizontal wells. We provide technical support for the exploration, exploitation and production of hydrocarbons.

We are staffed by highly trained and qualified professionals who provide high impact solutions for decision making in all stages of the petroleum business.
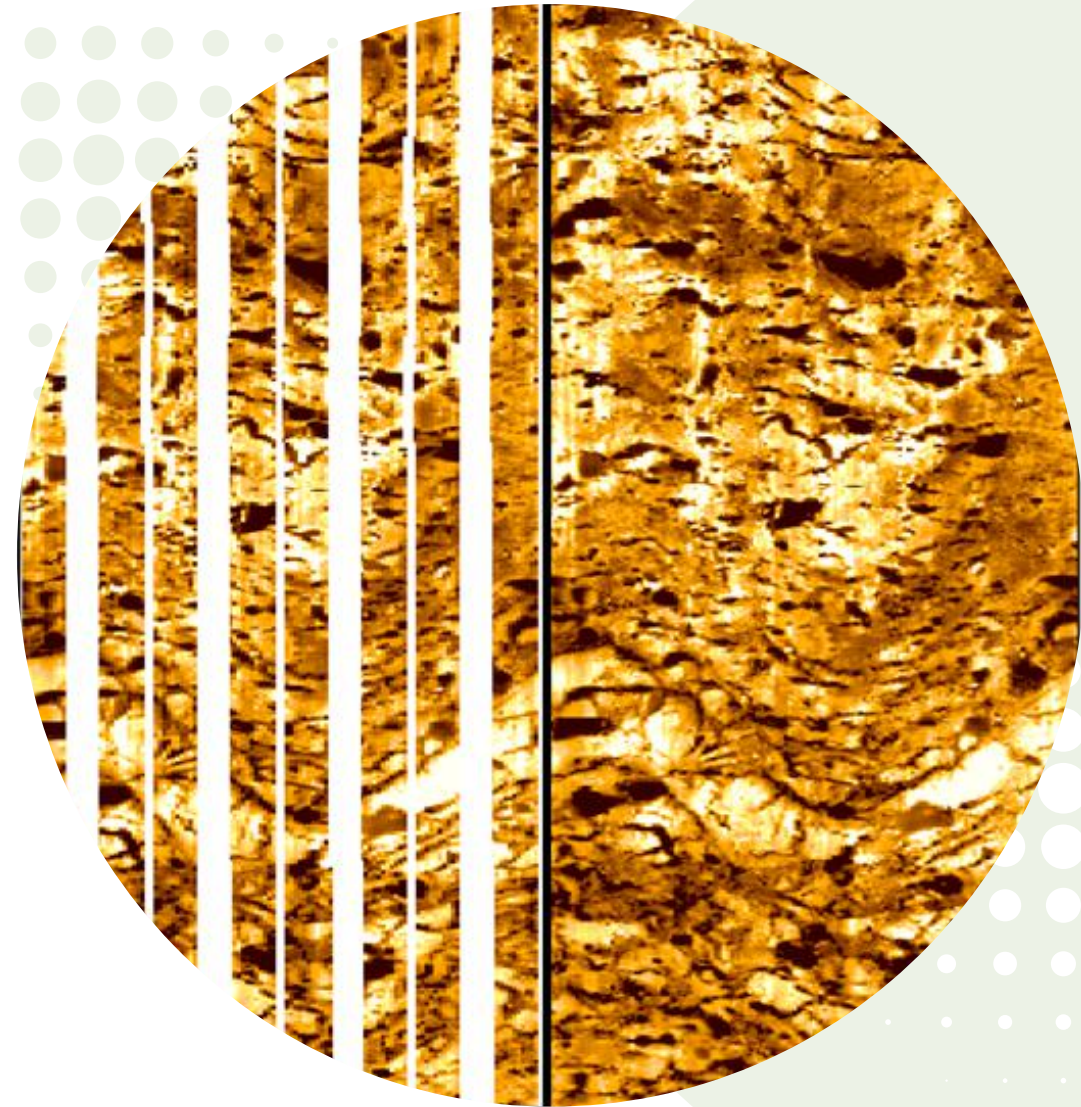
Team Leaders

Carmen has twenty-eight (28) years of industry experience. Educated and trained as a borehole geologist and petrophysicist, she has a B.S. degree in Geologic Engineering. Carmen started with Schlumberger in Venezuela in 1996 and since expanded her experience to Colombia, Trinidad and Tobago, Surinam, México, Bolivia, the Gulf of Mexico, USA, China, Tunisia, Oman and Kurdistan. Carmen is bilingual (English and Spanish) with extensive experience as a processor and interpreter of borehole image logs. In addition, she is an expert in advanced borehole image applications for unconventional and conventional reservoirs and mentoring.

Carmen Contreras
Head Borehole Geology

Helena is a multi-skilled professional with 30 years of industry experience. Educated and trained as a reservoir clastic sedimentologist and borehole geologist, she has a B.Sc. in Biology from Universidad Central de Venezuela and a M.Sc. in Geology from Stanford University. T Helena have worked constructing detailed depositional models for unconventional and conventional reservoirs in Venezuela, Trinidad, Mexico, Middle East, Argentina and the U.S. Her specialties include core facies analysis, calibration of image logs and standard log suites with core data, detailed sequence stratigraphic analysis, and integration of sedimentologic and stratigraphic data into depositional models.

Helena Gamero
Principal Geologist

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![CAYROS group logo]

What We Offer

01

Image processing

supporting all wireline imaging tools, in vertical and lateral wells, including EMI, FMI, OBMI, FMS, Earth Imager, XRMI, UBI, CBIL, STAR, RAB, ARI, DualOBMI and Quanta Geo
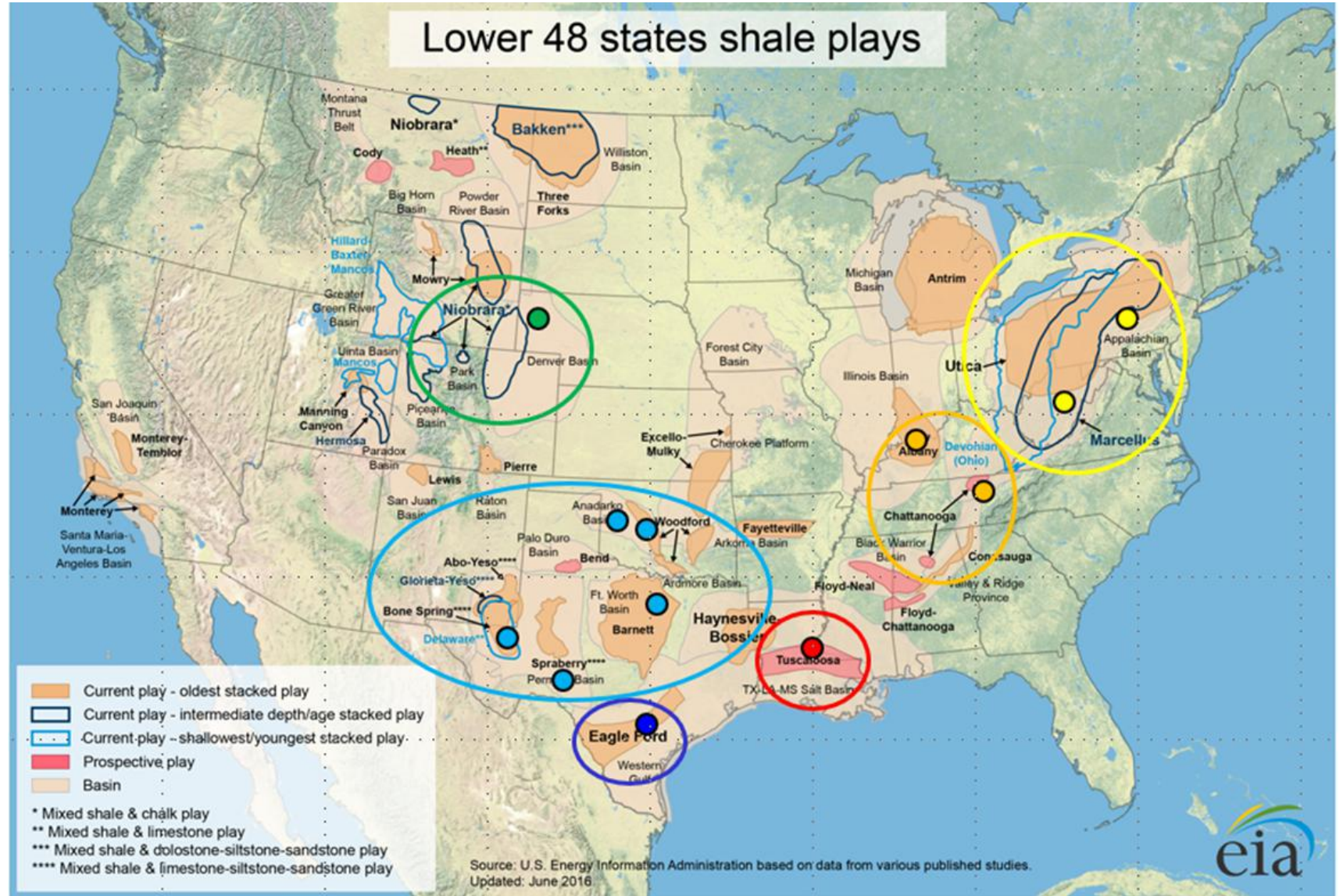

02

Interpretation services

focused mostly on bedding, sedimentary dips, textural and porosity analysis in Carbonates, faults, natural fractures and stress

a. Sedimentological analysis (determination of paleocurrent direction).
b. Support on field studies using core and image integration for reservoir description.
c. Facies and fracture characterization in lateral wells to help design better completions
d. Porosity analysis (especially useful in carbonates to generate secondary porosity calculation)
e. Lamination analysis to extract different scales of layering in to conventional and unconventional reservoirs
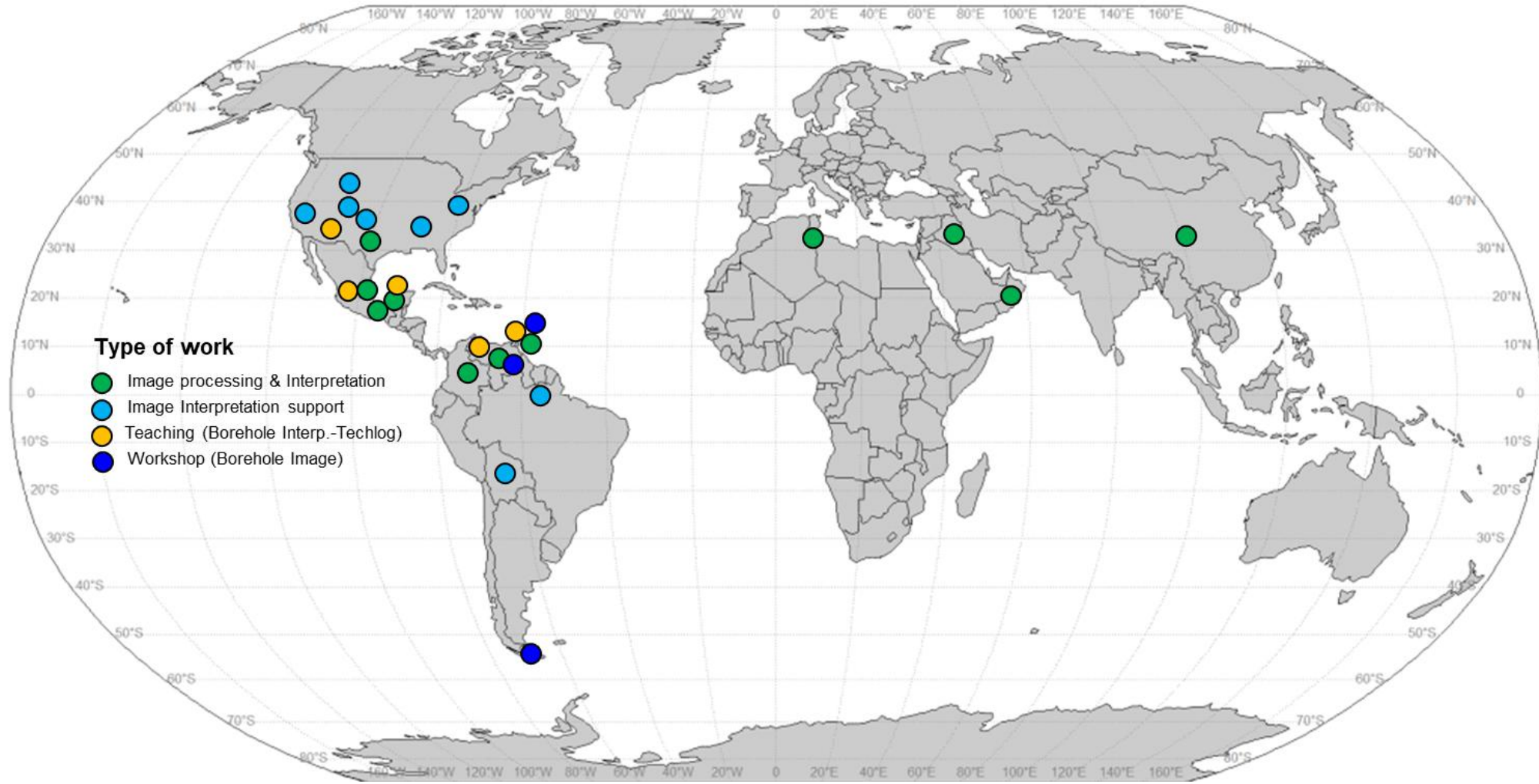f. Re-interpretation of legacy wells processed in GeoFrame or Techlog

US Basin and Field Experience

Experience:
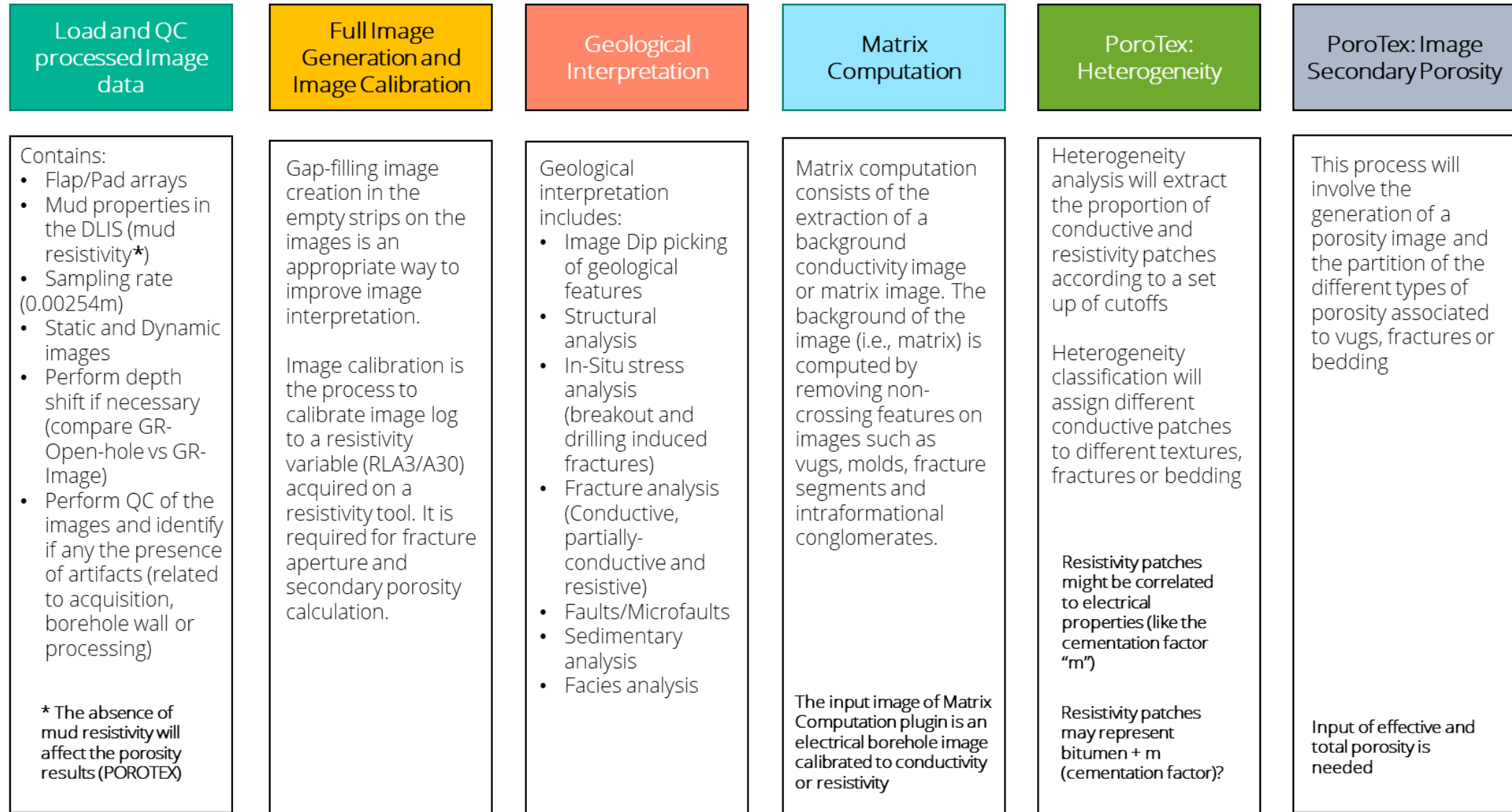
- 🟢 Niobrara & Denver Basin
- 🔵 Ft. Worth , Barnett, Bone Spring, Woodford, Anadarko, Spraberry & Permian
- 🟠 Albany, Chattanooga
- 🔵 Eagle Ford
- 🔴 Tuscaloosa
- 🟡 Marcellus & Appalachian

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Global Basin and Field Experience

Type of work
- Image processing & Interpretation
- Image Interpretation support
- Teaching (Borehole Interp.-Techlog)
- Workshop (Borehole Image)

Borehole Image Interpretation Workflow

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Load and QC processed Image data	Full Image Generation and Image Calibration	Geological Interpretation	Matrix Computation	PoroTex: Heterogeneity	PoroTex: Image Secondary Porosity

Contains:
- Flap/Pad arrays
- Mud properties in the DLIS (mud resistivity*)
- Sampling rate (0.00254m)
- Static and Dynamic images
- Perform depth shift if necessary (compare GR-Open-hole vs GR-Image)
- Perform QC of the images and identify if any the presence of artifacts (related to acquisition, borehole wall or processing)

* The absence of mud resistivity will affect the porosity results (POROTEX)

Gap-filling image creation in the empty strips on the images is an appropriate way to improve image interpretation.

Image calibration is the process to calibrate image log to a resistivity variable (RLA3/A30) acquired on a resistivity tool. It is required for fracture aperture and secondary porosity calculation.

Geological interpretation includes:
- Image Dip picking of geological features
- Structural analysis
- In-Situ stress analysis (breakout and drilling induced fractures)
- Fracture analysis (Conductive, partially-conductive and resistive)
- Faults/Microfaults
- Sedimentary analysis
- Facies analysis

Matrix computation consists of the extraction of a background conductivity image or matrix image. The background of the image (i.e., matrix) is computed by removing non-crossing features on images such as vugs, molds, fracture segments and intraformational conglomerates.

The input image of Matrix Computation plugin is an electrical borehole image calibrated to conductivity or resistivity

Heterogeneity analysis will extract the proportion of conductive and resistivity patches according to a set up of cutoffs

Heterogeneity classification will assign different conductive patches to different textures, fractures or bedding

Resistivity patches might be correlated to electrical properties (like the cementation factor "m")

Resistivity patches may represent bitumen + m (cementation factor)?

This process will involve the generation of a porosity image and the partition of the different types of porosity associated to vugs, fractures or bedding

Input of effective and total porosity is needed

Borehole Image processing and QC

Imaging Services Applied to:

- FMS, FMI, FMI-HD (SLB)
- OBMI, Dual OBMI (SLB)
- UBI (SLB)
- Quanta Geo (SLB)
- CBIL, Earth Image (Baker)
- EMI, CAST, OMRI (Halliburton)

Deliverables:

- QC Report
- 1:20 & 1:240 scale processed image log prints (PDF)
- Enhanced (processed) image log data in DLIS & XML

Benefits:

- Processed images are improvement over "raw" acquisition images and provide clearer feature recognition.
- Quick-turnaround enhanced quality images for operational decisions, such as MDT and MSCT.
- QC report provides quick image quality review & provides recommendations for further interpretation-based solutions.

Turnaround time (TAT):

- Standard TAT is 1-2 days (determined by image log length & image quality).
- Rush TAT arranged prior to operations can be completed in 24 hrs. after acquisition.

Primarily, computer processing of borehole image data is to convert the raw acquisition data into the best visual representation. The primary software to be used is Techlog developed by Schlumberger, which will support all imaging tools from main service companies, both wireline (WL) and logging while drilling (LWD).

Pre-processing is carried out in line with standard processing of borehole images. It includes several steps that can be summarized as follows. Resistivity measurements are first accurately positioned in depth using accelerometer measurements, button sensor responses are then harmonized to have similar gain and offset, for the last step of the pre-processing, called pad concatenation, the method computes the image geometry from accelerometer and magnetometer data and combines the different pad measurements into one single 2D calibrated image. Following this step, standard color mapping is applied to the 2D image, with the light and dark color palette corresponding to the calibrated resistivity range. Low and light color represents the most resistive response and high and dark color for the most conductive response.

Compared to the raw image, these images are significantly improved quality, and can be used for detailed interpretation. Images can be processed in rush time if required to provide input to further operations such as pressure, sampling and sidewall coring point selection.
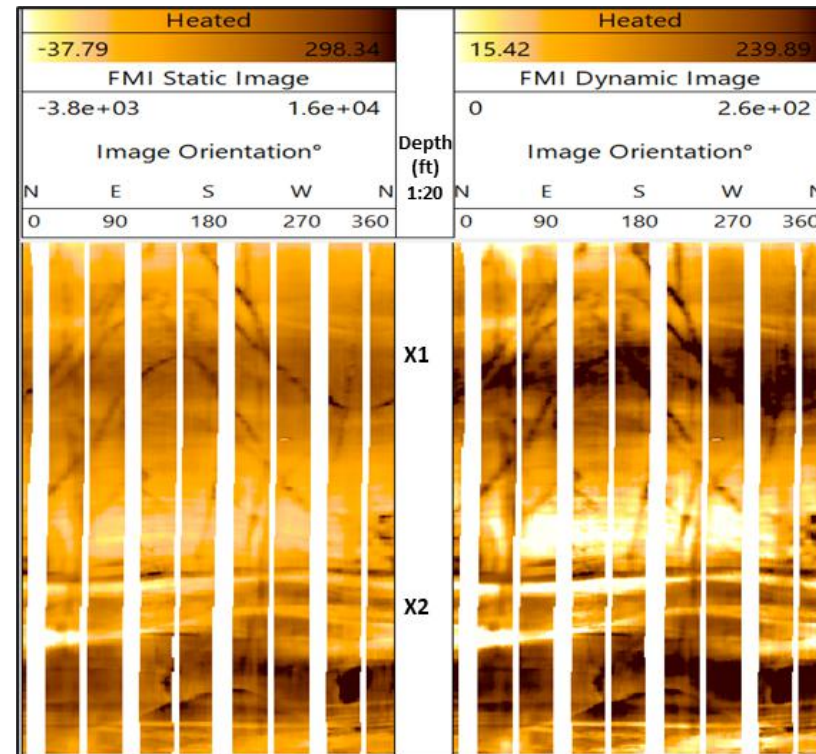
Imaging Services Applied to:

- FMS, FMI, FMI-HD
- Quanta Geo
- (Best results when BS ≤ 8.5in)

Deliverables:

- 1:20 & 1:240 scale standard processed & full image computed image log prints (PDF).
- Full Image computed image data (DLIS & XML).

Benefits:

- Full image provides better input for Matrix computation, textural and fracture analysis.
- Improved visualization of geological features, such as texture, fractures & bedding.

Turnaround time (TAT):

- Standard TAT is 1-2 days (determined by image log length & image quality).

Full Image Computation

Is a Techlog plug-in that automatically fills the empty zones of a borehole image. Most wireline imaging tools acquire data from pads / flaps on mechanical arms and therefore feature strips of missing information. This display by strips does not affect greatly the bed boundary picking but significantly complicates the delineation of texture and fractures especially for automated processing.

Full Image Computation for Techlog was developed for the purpose of filling gaps in images. It is a useful tool to reproduce complex textures with various orientations, such as vugs and fractures in carbonates. The result is a reasonable full-bore image with 360 deg of coverage

Full Image uses an algorithm from multi-point geostatistics (FILTERSIM), combined when needed with another algorithm (Inpainting). The combination of Inpainting with FILTERSIM leads to a robust and universal approach for full-bore reconstruction, regardless of the depositional environment. Results can then be used for more accurate automated textural and fracture analysis, and provide generally improved visualisation of many geological features (e.g., bedding, vugs, etc.)

Full bore image computation for textural analysis

Full bore image computation for planar bed analysis
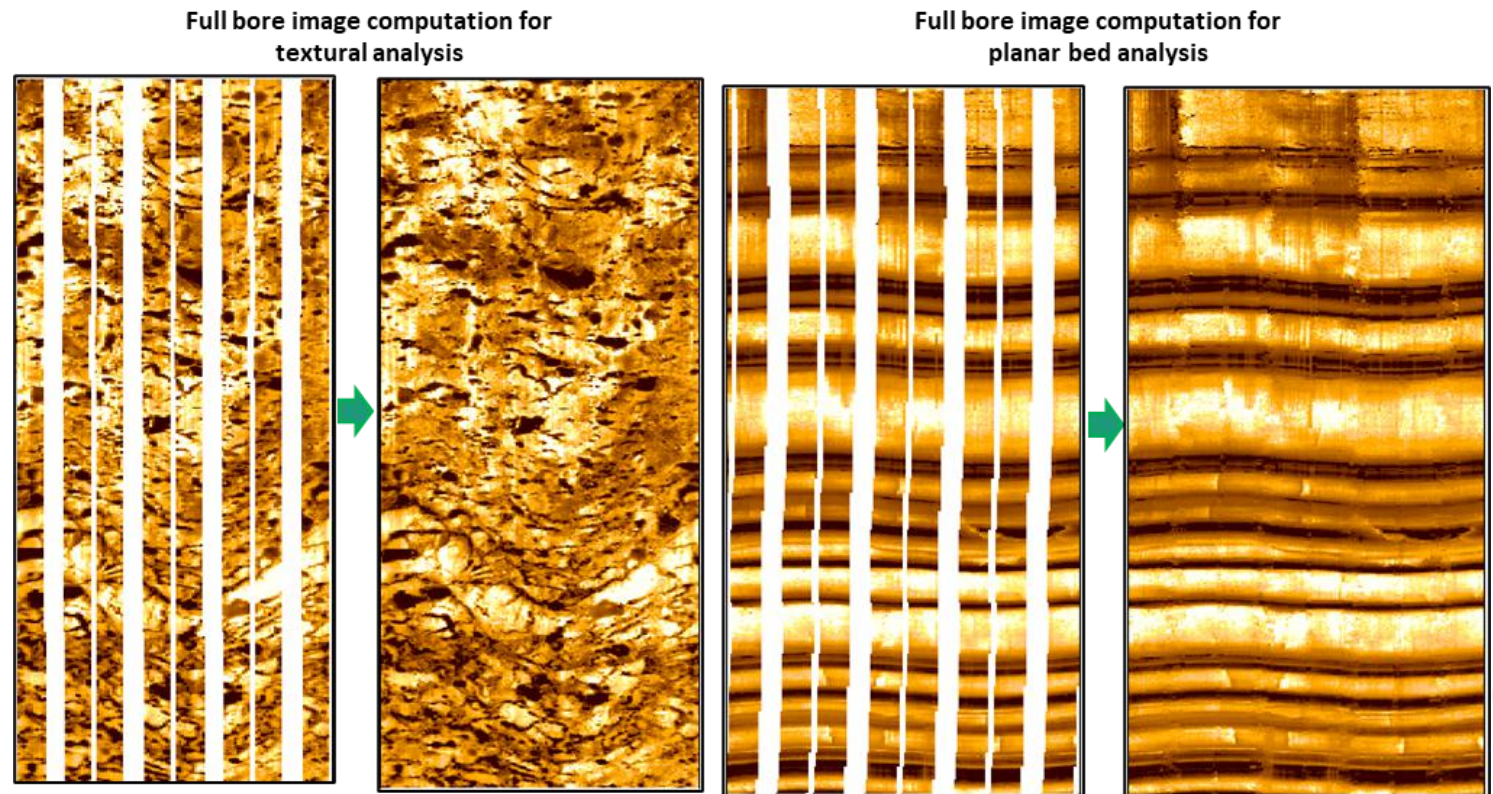
Imaging Services Applied to:

- FMS, FMI, FMI-HD (Image Calibration)

Deliverables:

- Resistivity calibrated FMI image (DLIS, XML) and high-resolution resistivity curves (LAS, DLIS, XML)

Benefits:

- Calibrated FMI image can be used in various advanced interpretation products requiring a calibrated electrical image.
- High (0.2in vertical) resolution resistivity channel for comparison with other resistivity tools.

Turnaround time (TAT):

- Standard TAT is 1 day.

Image Calibration

Image calibration consists in scaling the image into conductivity units using an external shallow resistivity log variable from another resistivity measuring tool. The method calculates automatically a best guess calibration using a series of linear regressions.

It produces a calibrated FMI image and extracts a single high resolution (0.2in vertical) resistivity channel (SRES), which can be used for direct comparison with other resistivity tools.

The main application of Image calibration is for advanced processing products which require a calibrated electrical image, such as and between others: Matrix Computation, Fracture Aperture analysis and Lamination Analysis. It produces a calibrated FMI image and extracts a single high resolution (0.2in vertical) resistivity channel (SRES), which can be used for direct comparison with other resistivity tools.

Image Calibration Plot
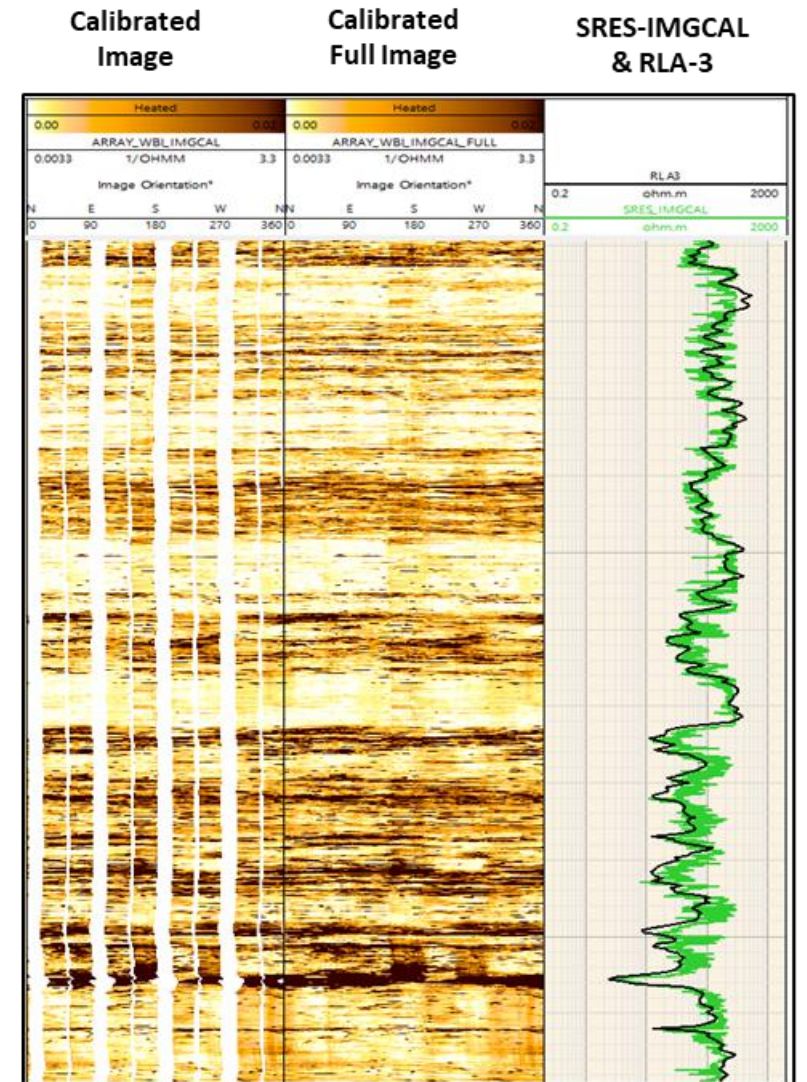
Interactive Dip Picking of Geological Features

Imaging Services Applied to:

- FMS, FMI, FMI-HD (SLB)
- OBMI, Dual OBMI (SLB)
- UBI (SLB), Quanta Geo (SLB)
- CBIL, Earth Image (Baker)
- EMI, CAST, OMRI (Halliburton)

Deliverables:

- Image Interpretation Summary Report in Power point format.
- 1:20 & 1:240 scale processed image & dip picking interpretation log prints (PDF).
- Dip sets in LAS, XLS , XML

Benefits:

- Identification and true dip orientation of all planar features visible on image log:
  - Structural bedding,
  - Sedimentary bedding
  - Faults & Fractures.
- Identification and true dip orientation of geomechanical features:
  - Borehole breakout,
  - Drilling induced fractures.
- Interpretation report providing summary statistics for all features identified.

Turnaround time (TAT):

- Standard TAT is 5-7 days (determined by image log length & image quality).
- Rush TAT with focus on specific features (e.g., stress orientation and fault identification) can be achieved in 24hrs after acquisition.

This is the first stage of image interpretation, and enables the identification, classification, and true dip orientation, of bedding planes, fractures, faults, drilling induced fractures, breakouts or any planar feature visible on the image log. This is achieved in Techlog software by placing sinusoids over planar features on the unwrapped oriented borehole image, with the true dip of these features automatically calculated and displayed as tadpoles. The orientation of geomechanical features for stress orientation is determined using breakout and induced fracture dip picking modes. The dip picking results can be used as inputs for more detailed structural, sedimentary or geomechanical interpretation workflows.

Along with a processed image & dip picking interpretation log print, a summary report in power point format is provided which summarises statistics for all features identified on the image log.
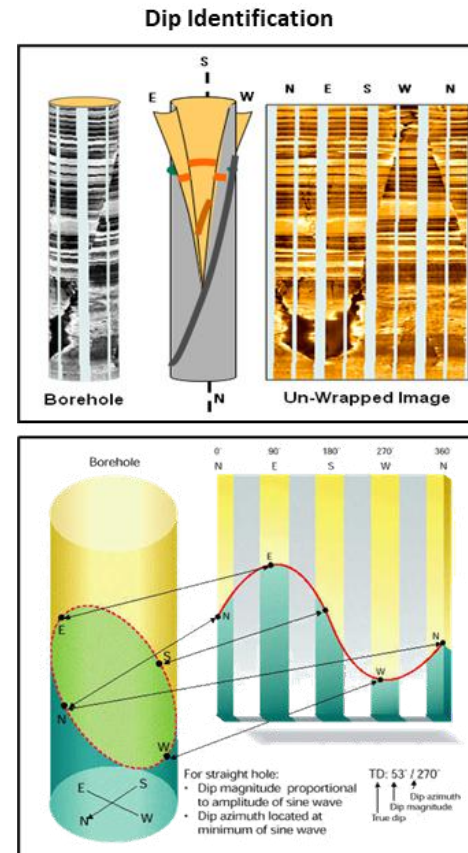
Dips are interactively picked (magnitude & azimuth) by fitting a sinusoid on the borehole images. User assigns dip to dip set based on geological criteria.
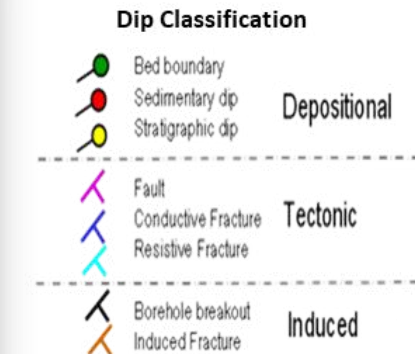
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Structural Analysis

Imaging Services Applied to:

- FMS, FMI, FMI-HD (SLB)
- OBMI, Dual OBMI (SLB)
- UBI (SLB), Quanta Geo (SLB)
- CBIL, Earth Image (Baker)
- EMI, CAST, OMRI (Halliburton)

Deliverables:

- Image Interpretation Summary Report in Power point format.
- 1:20 & 1:240 scale processed image & dip picking interpretation log prints (PDF).
- Dip sets in LAS, XLS, XML

Benefits:

- Identification and true dip orientation of all planar features visible on image log:
  - Structural bedding,
  - Faults & Fractures.
- Identification and true dip orientation of geomechanical features:
  - Borehole breakout,
  - Drilling induced fractures.
- Interpretation report providing summary statistics for all features identified.

Turnaround time (TAT):

- Standard TAT is 2-5 days (determined by image log length & image quality).
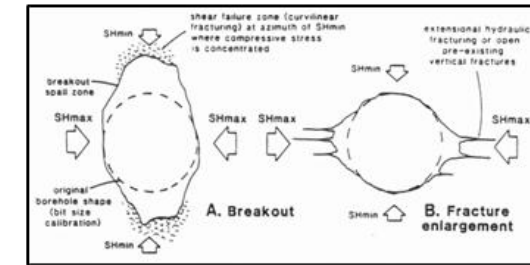- Rush TAT with focus on specific features (e.g., stress orientation and fault identification) can be achieved in 24hrs after acquisition.

Structural interpretation is one of the main applications of borehole electrical image data. Such data is an important input into structural analysis such as interwells correlation, cross-section construction and mapping. Stereoplots and azimuth frequency diagrams are helpful in accurately determining the structural dip and used wherever possible.

For the purpose of structural geology interpretation dips in non-deformed shale are preferentially used to determine structural dip. Caution is required since shale can be deposited on a depositional slope and may have experienced non-tectonic post-depositional deformation including slumping, sliding, respectively beneath and above sand bodies, compaction and drape.

Structural interpretation includes defining structural dip zones, magnitudes and azimuths; identifying any angular unconformities; identifying and determining the orientation of features with a tectonic origin including unconformities, folds, faults and fractures.
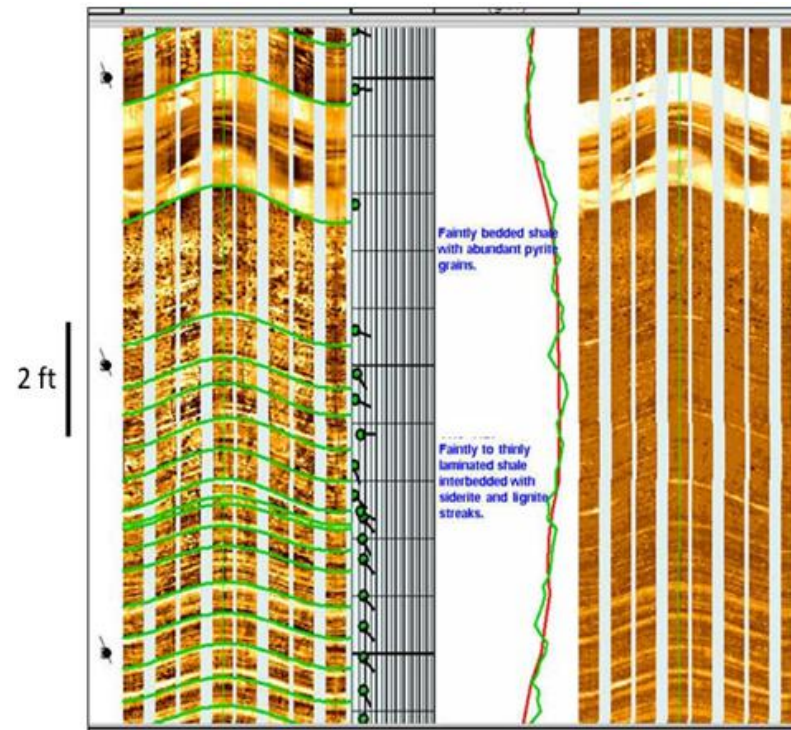
An example of bed boundaries interpreted on highly laminated shales and siltstones sequences. The green tadpoles represent the hand-picked bed boundaries (modified from Contreras and Gamero, 2000).
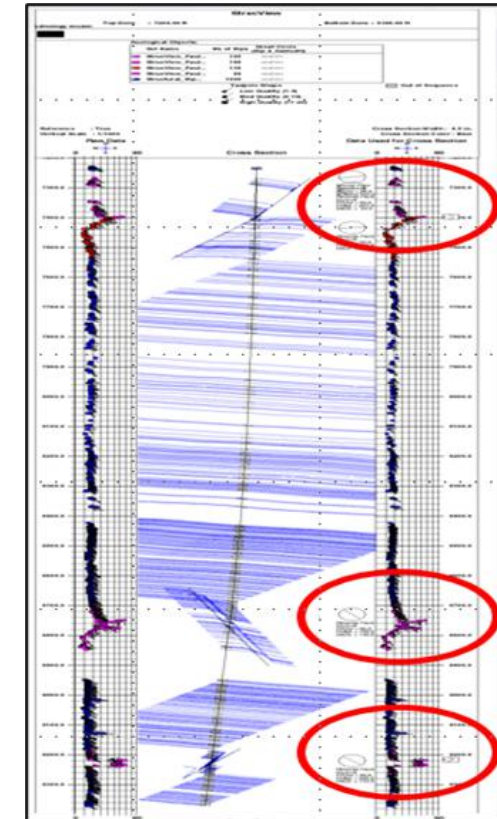
Structural analysis- Cross section

Imaging Services Applied to:

- FMS, FMI, FMI-HD (SLB)
- OBMI, Dual OBMI (SLB)
- UBI (SLB), Quanta Geo (SLB)
- CBIL, Earth Image (Baker)
- EMI, CAST, OMRI (Halliburton)

Deliverables:

- Image Stress Analysis Summary Report in Power point format including stereonets, Rose plot and hole shape information.
- 1:20 & 1:240 scale processed image & dip picking interpretation log prints (PDF).
- Dip sets for the Stress analysis data (Borehole Breakouts and Drilling Induced fractures) in LAS, XLS, XML

Benefits:

- Determination of regional minimum and maximum horizontal stress directions from Borehole Breakout and Drilling Induced Fractures.
- Hole ovalization from Hole Shape Analysis.
- Correlation with World Stress Map.

Turnaround time (TAT):

- Standard TAT is 2-5 days (determined by image log length & image quality).
- Rush TAT can be achieved <24hrs after acquisition.

The magnitude and orientation of stresses in the subsurface can affect borehole stability and other drilling or production properties. Borehole stress can cause rocks to fail in two modes, shear and tensile failure expressed as borehole breakout and drilling induced fractures. Stress analysis involves the analysis of stress related features identified on the borehole image, such as borehole breakout and drilling induced fractures. The orientation of these features is used to infer In-situ min and max horizontal stress directions in the vicinity of the borehole.

The analysis of drilling induced fractures and breakouts (considered here as stress-related indicators) provides not only the direction of the principal horizontal stress, but also calibration points for 1D and 3D mechanical earth models (MEM). In vertical wells the orientation of borehole elongation is aligned with the minimum horizontal stress. Similarly, the strike of drilling induced fractures is aligned with the maximum horizontal stress.

Borehole failure in two modes: (A) breakout, and (B) induced fractures (Contreras and Gamero, 2000).

Induced fractures evidenced by two vertical cracks, 180 degrees apart. Two types of drilling induced fractures: 5A: Tensile fractures and 5B: En-echelon fractures (modified from Etchecopar et al., 2013).
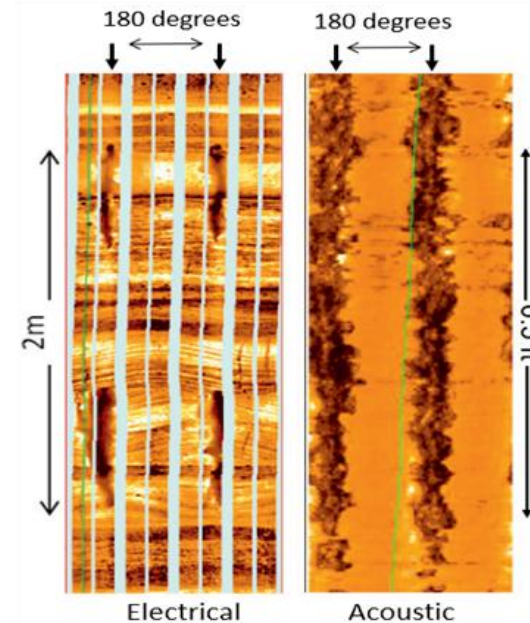
Examples of breakout evidenced by two-hole enlargements of similar width 180 degrees apart. Left: breakouts on an electrical image. Right: breakouts on an acoustic image (modified from Etchecopar et al., 2013).
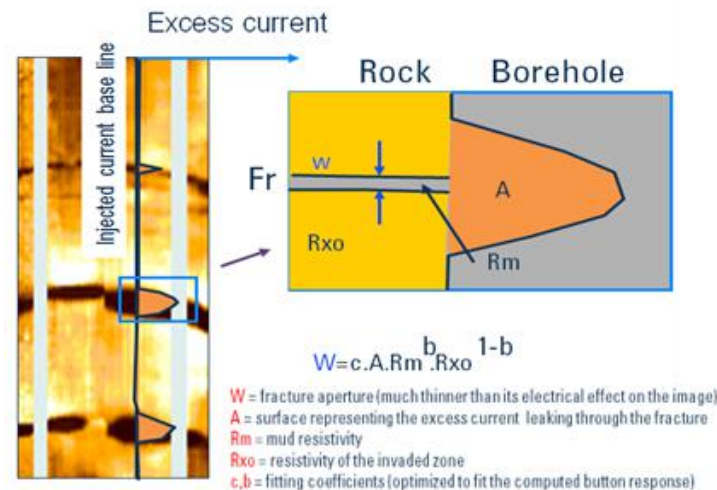
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Fracture Analysis

Natural occurring open fractures are very important to producibility in many carbonate and sandstone reservoirs. Fractures are planar features with no apparent displacement of blocks along their planes. Generally, they have a steep dip in tensional and wrench regimes. Whereas in compressional regimes, they may have high to low angle dips. Their aperture may be open, tight (closed) or filled with some minerals like clays, calcite, anhydrite, pyrite etc.

Fracture Analysis products include: fracture statistics, such as count, length and density, fracture morphology (fracture type); however, for an FMI image, it also uses the Luthi & Souhaite equation to compute fracture mean aperture, hydraulic aperture (providing an estimate of fracture flow potential) and porosity. Fracture porosity can be used in carbonate reservoirs for comparison with vuggy porosity, as part of overall secondary porosity calculations.
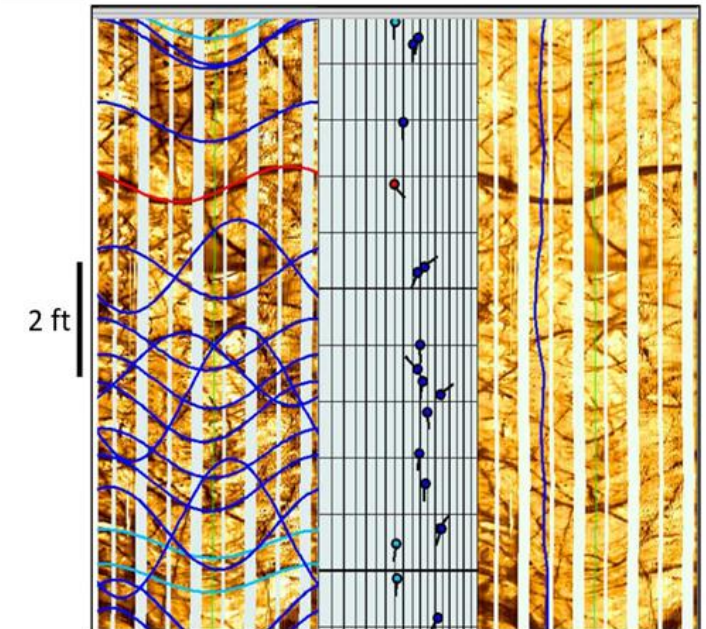

Fracture aperture display
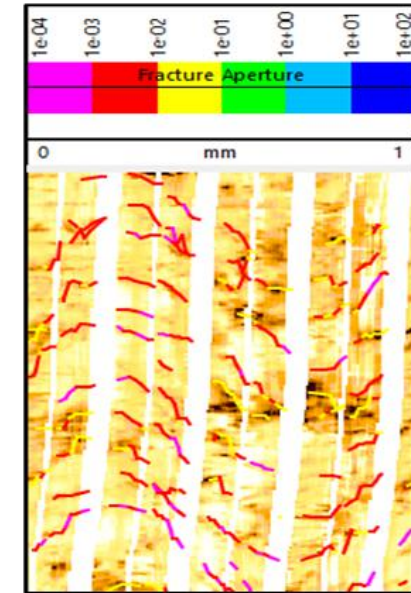
Fracture aperture calculation method

$$W = c \cdot A \cdot Rm^b \cdot Rxo^{1-b}$$

W = fracture aperture (much thinner than its electrical effect on the image)
A = surface representing the excess current leaking through the fracture
Rm = mud resistivity
Rxo = resistivity of the invaded zone
c,b = fitting coefficients (optimized to fit the computed button response)

(from Luthi and Souhaite, 1990)

- FMS, FMI, FMI-HD (SLB)
- OBMI, Dual OBMI (SLB)
- UBI (SLB), Quanta Geo (SLB)
- CBIL, Earth Image (Baker)
- EMI, CAST, OMRI (Halliburton)

Deliverables:

- Image Fault Analysis Summary Report in Power point format including stereonets and rose-plot information.
- 1:20 & 1:240 scale processed image & dip picking interpretation log prints (PDF).
- Dip sets for the Fault analysis data in XML, LAS/XLS format0

Benefits:

- Manual method of dip picking
- Input to discrete fracture network modelling and reservoir and completion quality evaluation.

Turnaround time (TAT):

- Standard TAT is 1-3 days (determined by image log length & image quality).

Fault Analysis

Structural breaks such as faults or unconformities are discernable from borehole electrical image data if there is an associated deformation (e.g., tilting, drag folding, etc.), which will be manifested as zones of dip rotation.

Sub seismic faults have features similar to fractures; the images on the two sides of the plane either have a different texture or aspect or display a loss of continuity between the two sides of the event. Small depth shifts between similar features on each side of an oblique event can indicate a microfault

Although dip patterns computed from dipmeter are useful for fault detection, borehole images are the best way to accurately recognize faults. The analysis of dips through stereographic projection permits recognition of patterns related to faults. Image analysis provides accurate orientation of the fault plane and determination of its dip.
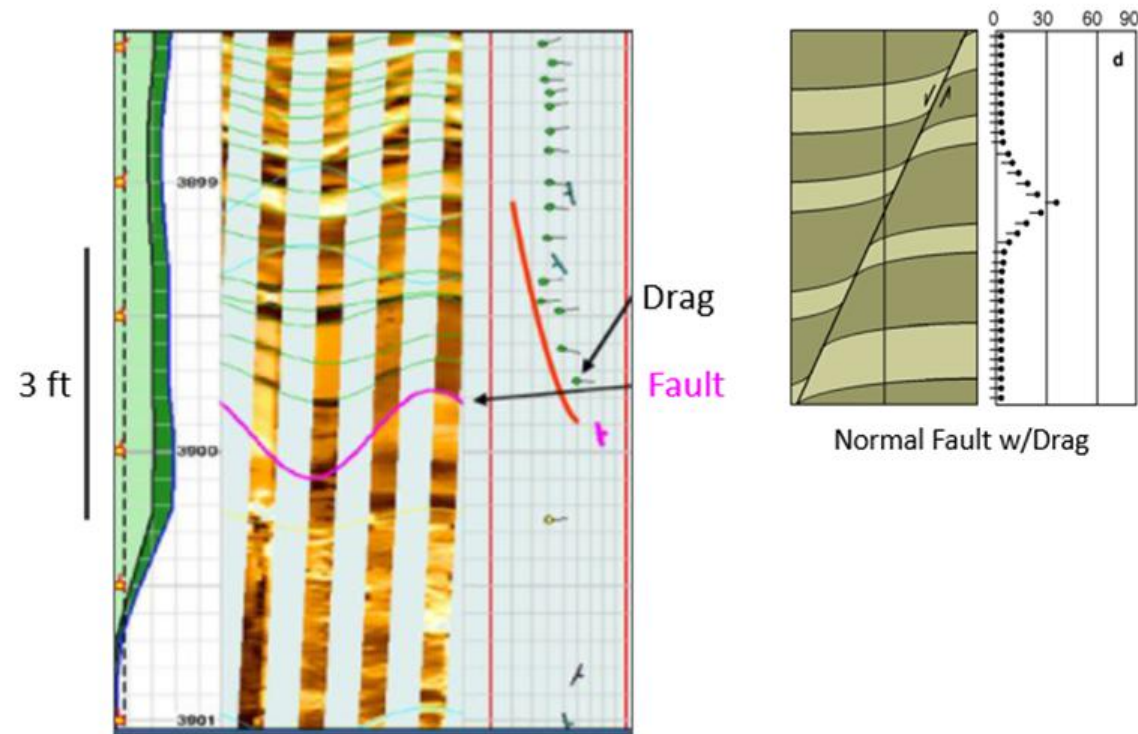
Example of a fault interpreted over an OBMI image. The fault is evidenced by a changing in dip magnitude associated to a dragging effect (modified from Kourta, 2010). The schematic view on the right shows the dragging above and below the normal fault.

Imaging Services Applied to:

- FMS, FMI, FMI-HD (SLB)
- OBMI, Dual OBMI (SLB)
- UBI (SLB), Quanta Geo (SLB)
- CBIL, Earth Image (Baker)
- EMI, CAST, OMRI (Halliburton)

Deliverables:

- Image Sedimentary Interpretation Report in power point format.
- Statistical analysis plots & rose diagrams.
- 1:20 & 1:240 scale processed image & dip picking interpretation log prints (PDF).
- Sedimentary facies, associations, Structural dip – removed Sedimentary Crossbed data (XML,XLS/LAS).

Benefits:

- Core to image calibration
- Generation of Depositional Model
- Paleocurrent and sand body determination.
- Key input to 3D facies model.

Turnaround time (TAT):

- Standard TAT is 5-7 days (determined by image log length & image quality).

Sedimentary Analysis

Optimizing reservoir recovery requires reliable sedimentological models. Borehole electrical imagery, integrated with selective conventional core data, constitutes a very powerful and effective technique for use in detailed reservoir characterization and further field development. Borehole images are used to identify sedimentary, biogenic and diagenetic structures as well as sand body orientations within a facies succession, which is of great value in interpreting depositional environments. Borehole images, when calibrated to core, can be useful for identifying image log criteria that can be used for interpreting image-based facies and facies associations.
It is important to highlight that borehole images provide paleocurrent determination, heterogeneity (textural) analysis and sand count analysis.
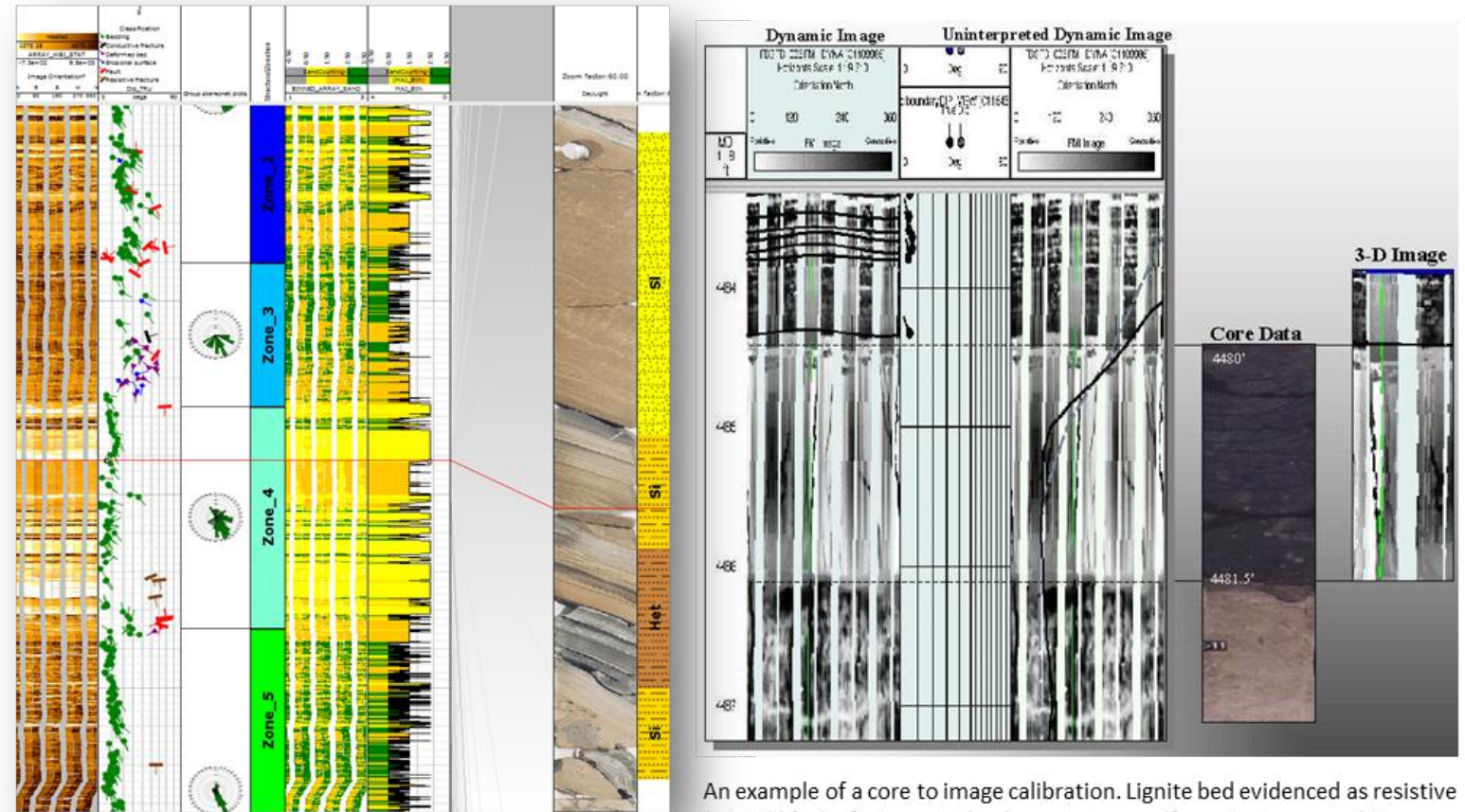
Data integration in Techlog

An example of a core to image calibration. Lignite bed evidenced as resistive (white) blocky features in the dynamic images (from Contreras and Gamero, 2000).

Imaging Services Applied to:

- FMS, FMI, FMI-HD (SLB)
- OBMI, Dual OBMI (SLB)
- UBI (SLB), Quanta Geo (SLB)
- CBIL, Earth Image (Baker)
- EMI, CAST, OMRI (Halliburton)

Deliverables:

- Image Facies Analysis Interpretation Report in power point format.
- 1:20 & 1:240 scale processed image & dip picking interpretation log prints (PDF).
- Sedimentary facies, associations, Structural dip – removed Sedimentary Cross bed data (XLS, LAS, XML).

Benefits:

- Image-based facies identification.
- Core to image calibration
- Generation of Depositional Model
- Paleocurrent and sand body determination.
- Key input to 3D facies model

Turnaround time (TAT):

- Standard TAT is 5-7 days (determined by image log length & image quality).

Facies Analysis

Individual image-based facies can be defined based on detailed description of lithology and sedimentary structures from core data and calibrate to borehole image logs. Individual image-based facies are descriptive terms only and should not be taken alone as indicators of depositional environment.

Figure below shows an example of core-and image-derived facies scheme based on an image to core calibration (Gamero et al., 2011). During the facies analysis process all image-based facies are interpreted based on the transport mechanisms during deposition. The vertical stacking of image-based facies constitutes a facies association generated by the lateral migration of the depositional environment.

TECHLOG provides infinite flexibility for defining your own image-based facies schemes. You can tailor existing schemes to your own needs or define entirely new ones; interactively point and click to define facies units. Display any supporting data with your facies display to enable you to quickly identify your units using facies as a discriminator e.g., cross plots, histograms, net pay computation, etc. Several different facies interpretations can also be performed in a well allowing geologists to compare different interpretations.

Facies	Core Photo	Image	Lithology	Sedimentary Structures	Origin
B1s	1"	1"	Clay chip conglomerates within a medium-grained sandstone matrix.	Clasts alignment	Bed-load transport from an overpassing quasi-steady turbulent flow, over a consolidated substrate.
B3s	1"	1"	Medium- to fine-grained sandstones.	Crude plane parallel stratification	Bed-load transport from an overpassing quasi-steady turbulent flow, over a consolidated substrate.
B2s	1"	1"	Medium- to fine-grained sandstones.	Asymptotic cross-stratification	Bed-load transport from an overpassing quasi-steady turbulent flow, over a consolidated substrate.

An example of a core to image calibration and facies analysis from Gamero et al 2011

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Matrix Computation

Imaging Services Applied to:

- FMS, FMI, FMI-HD, Inverted Quanta Geo (Matrix Computation)

Deliverables:

- Matrix conductivity image (DLIS & XML) and averaged conductivity channel (LAS, DLIS, XML)

Benefits:

- Removes non-cross features and computes matrix conductivity image which can be used for high resolution well correlation & sequence analysis and heterogeneity analysis.

Turnaround time (TAT):

- Standard TAT is 1 day.

Matrix computation consists of the extracting a background conductivity image or matrix image from a calibrated FMI image (or inverted Quanta Geo image) . The background of the image (i.e., matrix) is computed by removing non-crossing features on images such as vugs, molds, fracture segments, and intraformational conglomerates. The input image of Matrix Computation plugin is an electrical borehole image calibrated to conductivity or resistivity. An averaged matrix conductivity curve is also produced which can then be used for high resolution well correlation and sequence analysis.
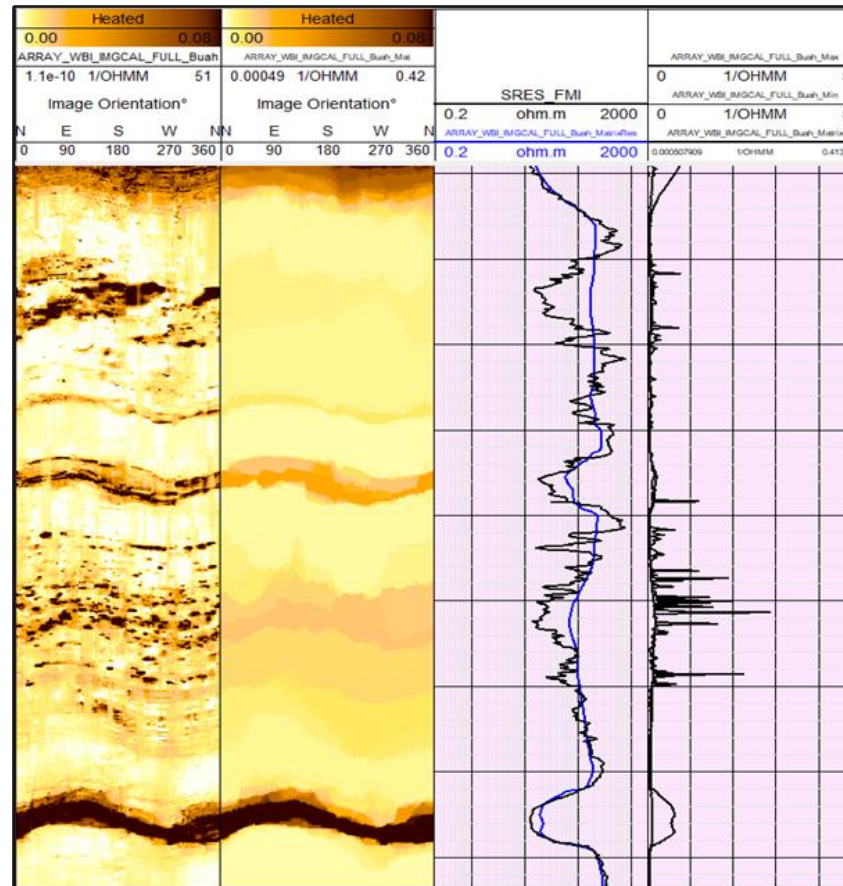
- Input FMI Full calibrated Image (1st track)
- Matrix image of the input FMI Full calibrated Image (2nd track)
- Matrix resistivity curve (in blue) (3rd track)
- Matrix, Max and Min conductivity (4th track)

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Imaging Services Applied to:

- FMI, FMI-HD
- Quanta Geo
- OBMI/Dual OBMI (limited use of PoroTex)

Deliverables:

- Image Porosity analysis Interpretation Report.
- Statistical analysis plots & rose diagrams.
- 1:20 & 1:240 scale processed image & dip picking interpretation log prints (PDF).
- Sedimentary facies, associations, pore space type outputs, secondary porosity (XLS, LAS, XML).

Benefits:

- Image-based facies identification.
- Core to image Calibration
- Generation of Depositional Model.
- Classification of different pore space types
- Generation of heterogeneity image summary curves
- Total image porosity computation and porosity spectrum
- Quantification of secondary (vuggy) porosity, types of pore space & flow potential
- Key input to 3D facies model.

Turnaround time (TAT):

- Standard TAT is 3-7 days (determined by image log length & image quality).

Textural and Porosity Analysis in Carbonates

Sedimentary analysis involves the identification of image-based facies by inspection of the texture and fabric of the image, in conjunction with the dip picking results, petrophysical data, mud-log and conventional core (if available). These image-based facies are then used to infer facies associations indicative of specific depositional environments, and then used to generate an overall depositional model. Image-based facies can also be "calibrated" with core-based facies and extended into non-cored intervals. Facies data can be used as a key input for a 3D facies model.

Many carbonate rocks have complex dual porosity systems with varying proportions of primary & secondary porosity. Heterogeneity analysis can be used to classify the different types of pore space: vug to vug, isolated, connected to fractures, aligned at bed boundaries, or within rock matrix. The contribution of these different pore types to the total porosity of the formation is quantified in addition to the geometric information of delineated pore space. In addition, the porosity image, porosity spectrum and the connectedness of the different types of porosity can be quantified.
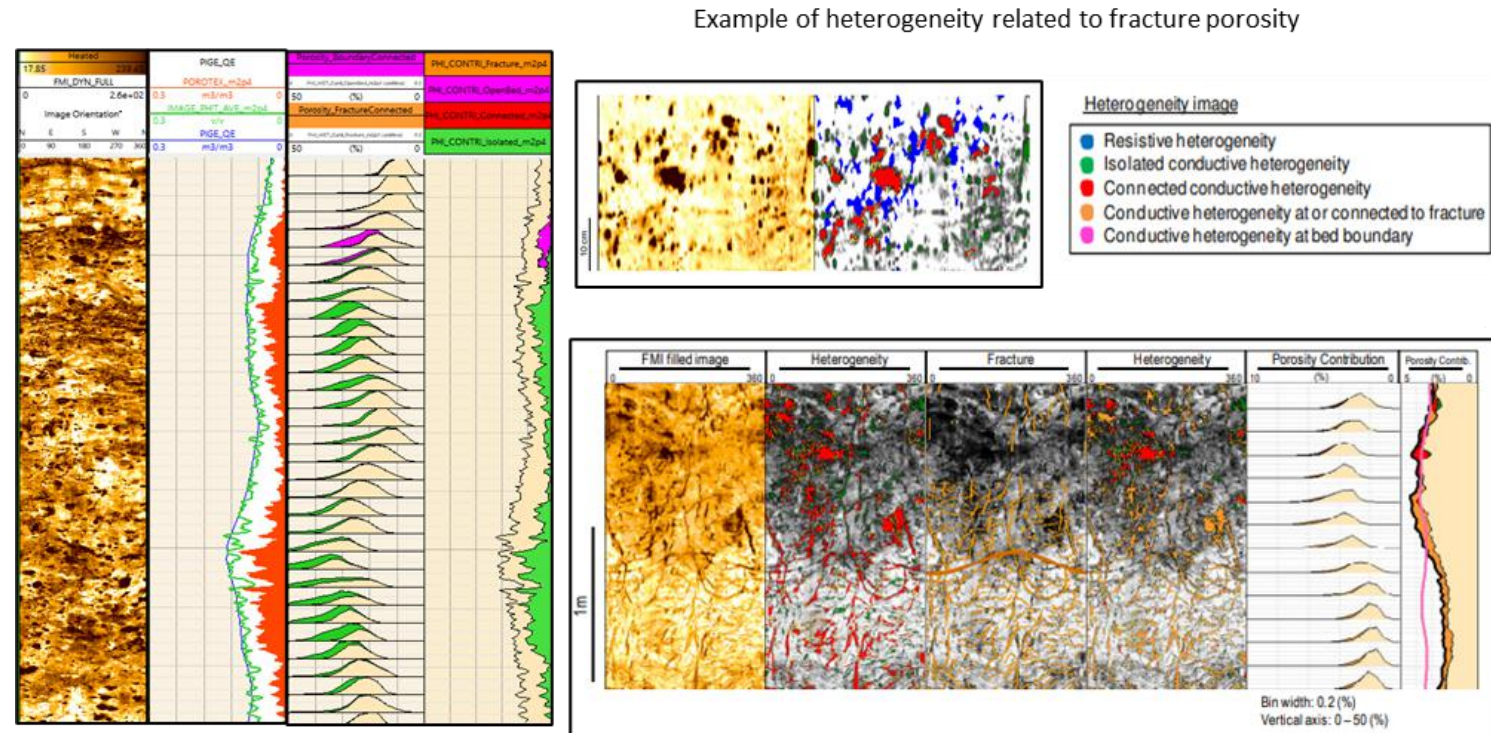
An example of secondary porosity classification in carbonates (from Tetsushi et al., 2013).

Selected References

BOREHOLE GEOLOGY SERVICES

☐ Contreras, C. C., and H. Gamero, 2000, High-resolution borehole images as powerful reservoir characterization tools: Transactions of the GSTT 2000 SPE Conference, Port of Spain, Trinidad 10–13 July, 2000, http://www.gstt.org/publications/transactions_of_gstt_2000_spe.htm (accessed July 2010).

☐ Etchecopar, A., Yamada, T. and P. Cheung, 2013, Borehole images for assessing present day stresses, Soc. Geol. France, t. 184, no 4, pp. 307 – 312.

☐ Gamero Diaz, H., C. Contreras, N. Lewis, R. Welsh, and C. Zavala, 2011, Evidence of shelfal hyperpycnal deposition of Pliocene sandstones in the Oilbird Field, southeast coast, Trinidad: Impact on reservoir distribution, in R. M. Slatt and C. Zavala, eds., Sediment transfer from shelf to deep water – Revisiting the delivery system: AAPG Studies in Geology 61, p. 193-214.

☐ Kourta, M., 2010, Combined Acoustic & Resistivity Borehole Imaging Review of Interpretation Results Well: E17a-A3 Gaz de France - Suez – Netherlands OBMI UBI Amplitude UBI: https://slideplayer.com/slide/13378956/

☐ Luthi, S. M and P. Souhaite, 1990, Fracture apertures from electrical borehole scans. GEOPHYSICS 55: 821 – 833.

☐ Techlog . https://www.software.slb.com/products/techlog/techlog-geology/wellbore-imaging

☐ Yamada, T., Quesada, D., Etchecopar, A., Le Nir, I., Delhomme, J., Russel-Houston, J., and Putra Perdana , T, 2013, Revisiting Porosity Analysis from Electrical Borehole Images: Integration of Advanced Textural and Porosity Analysis

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