Borehole Image Analysis and Intro to Geosteering[1]

Course Synopsis

Upon the completion of this course, the participants will be able to *plan, supervise and check validity* of borehole image acquisition with LWD and Wireline instruments. They will be able to perform fundamentals of the wellbore image *processing and interpretation* and visualize results. The participants will be able to function as a *structural geology member*[2] of Geosteering team and be able to operate Schlumberger *Techlog,* advising drillers and other specialists on the well trajectory for optimal reservoir penetration. Special attention is dedicated to the operations' efficiency and capability to automate and document the image analysis process.

The course *presumes* basic practical knowledge of Schlumberger *Techlog* and *Petrel* software.

During practical exercises, participants will be required to perform an end-to-end image processing and structural interpretation over *PETRONODE* sample/training dataset composed of basic electric logs and wellbore electric image. Client-provided datasets may be also considered for the course if available (prior confirmation is required).

DAY 1

- Introductions & Safety
- Wellbore images as part of integrated formation evaluation
- Wireline dipmeters and imagers: electric/galvanic, electric/induction, ultrasonic
- LWD imagers: density, electric/galvanic, electric/induction, GR
- Advantages and disadvantages of various tools and techniques
- *Techlog* refresher: loading and accessing data
- Q&A.

DAY 2

- Image quality control: gains/saturation, resolution, tool artifacts
- Using *Techlog* histograms for image quality control and image equalization
- Image quality control: directional sensors
- Using *Techlog* cross-plots for image quality control
- Image quality control: calipers
- Using *Techlog* log plots (layouts) for image quality control
- Tool speed corrections

1 For practical exercises, Client should provide students' workstations installed with either educational or commercial license *Schlumberger Techlog* (versions 2010 or higher). As minimum, *WBI* and *Python* modules are required.

2 This course is not intended to and *does not qualify* as a Driller Well Control Course or Directional Engineer Collision Prevention Course.

- Tool tilt corrections
- Image normalizations and other image processing techniques
- Q&A.

DAY 3
- Drilling artifacts: “threads”, “keysitting”, breakouts, tensile fractures
- Advanced image processing: flattening and gap removal
- Advantages and dangers of advanced image processing
- Introduction to dip geometry
- True dip and azimuth vs apparent dip and azimuth
- Dip presentations: sinusoids and tadpoles
- Dip statistics: Rose Diagrams, Stereonet Plots, Cumulative Dip Plots
- Automated dip picking: MSD algorithm.
- Manual feature picking in *Techlog*
- Basic Geomechanics answers from wellbore images
- Q&A.

DAY 4
- Feature classification and interpretation
- Bedding
- Cross-bedding
- Erosional surfaces and discontinuities
- Fractures, fissures and cleats
- Faults and displacement
- Non-plane features (concretia, fossils etc)
- Conductive minerals on electric images (“halo” effect)
- Finalizing and presenting your Structural Interpretation
- Q&A.

DAY 5
- Setting up Geosteering project[3]
- Geosteering roles. Your role as structural geologist in Geosteering project
- Well collisions, stuck pipe and well control (brief review)
- Specific techniques: bent assemblies, adjustable stand-off tools, rotary steerable tools
- Advantages and limitations of drilling techniques
- Specific LWD tools for Geosteering: sensor position and other considerations
- Pilot hole information handling
- Planning the lateral and landing a well into the target formation
- Dealing with imperfect landings
- Formation following
- Dealing with uncertainty
- Dealing with unexpected geological events (eg unexpected faults)
- Dealing with formation exits
- Q&A.

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3 At Client request, Geosteering chapters may be substituted with 1D Mechanical Earth Model.