

March 16, At the Borehole Scale Discussion Sessions

Borehole Imaging and Evaluation

Discussion Leader: David Lawrence, Reservoir Characterization Manager, Abu Dhabi Gas Development Company

Questions

1. What new advances in Borehole Imaging technology would you like to see?
2. What future directions in Borehole Imaging application do you see as important?

1. Desired New Advances in BHI Measurement Technology

LWD

- Multiple Depths of Investigation
 - Image invasion profile (and beyond)
 - Geological features in near well bore and away from borehole (compare)
- Maximum vertical resolution
- Less sensitivity to (stick / slip) drilling dynamics
- Acoustic while drilling
- Invasion profiling (Oil Based Mud)

Shallow versus Deep Readings

- Ultra-shallow
 - High Frequency Dielectric
 - High vertical / azimuthal frequency for pore geometry characterization
- Deep Reading
 - Detection & extent of faults / fractures away from borehole
 - Dipole Sonic
 - Acoustic Array
- Deep-reading Sigma for Sw evaluation

Lithology vs. Fluid Detection

- Porosity measurement away from the invaded zone
- High resolution caliper (or Transit Time Imaging)
- High resolution (vertical and azimuthal) density
- Need to get down to pore scale in all measurements (increased vertical and lateral resolution)

2. Borehole Imaging Applications – Future Directions

Reservoir Heterogeneity & Fluid Properties

- More use of 3D volume information in near wellbore due to depth of investigation to characterize

- Grain size / textural variations
- Poroperm characteristics
- Characterization of diagenesis / cementation (requires higher resolution)
- Characterization of pore geometry / connectivity
 - Down to pore system scale => relies on integration with other tools / data
 - Currently can image larger vugs only
- Tool combinations and recommended to identify
 - Multiple pore system scales
 - Wireline, NMR, core
 - Data / tool integration
 - Move away from working in “single tool domains”
 - Need tools that can measure pore system and fluid systems, not just matrix (e.g. sonic-based measurements)
- Data integration is the key to success!! Cannot use BHI data in isolation.

Fault / Fracture Identification + Seismic Integration

- Acoustic array data:
 - Useful tool for bridging ‘scale’ gap between borehole & seismic
 - Need to work more on reducing noise content:
 - Improve processing routines
 - Understand acquisition issues
- Cross-well seismic – allows significant improvement in vertical resolution
- Methodology for upscaling from borehole acoustic data to seismic needs to be improved
- Azimuthal shear wave imaging – not just 2D lines to understand 3D volume and potentially image fluid front advance
- Reconcile different scales of observation (BH to seismic)
- Need better understanding of fracture connectivity, productivity by integrating all available dynamic data