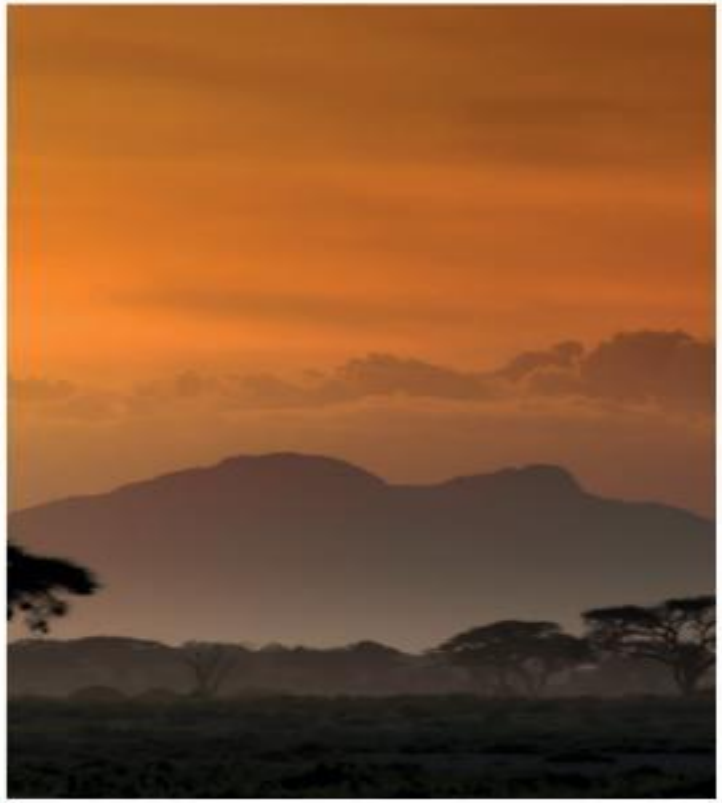




SPE INWELL MONITORING & SURVEILLANCE SEMINAR 2019

Transforming data to barrels

2 October 2019, Aker Solutions, Dyce

Data quality assurance methods for improved distributed temperature sensing (DTS) data Management

Iko Oguche

TENDEKA

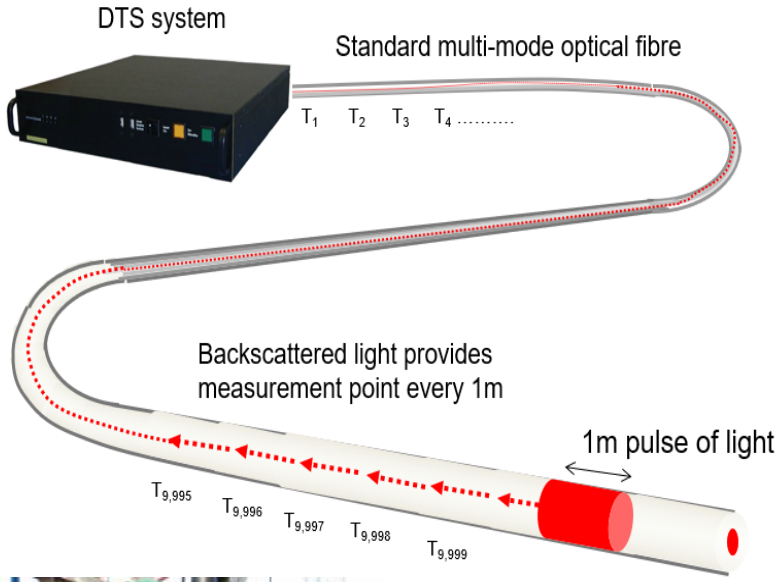
RESULTS ACROSS YOUR RESERVOIR

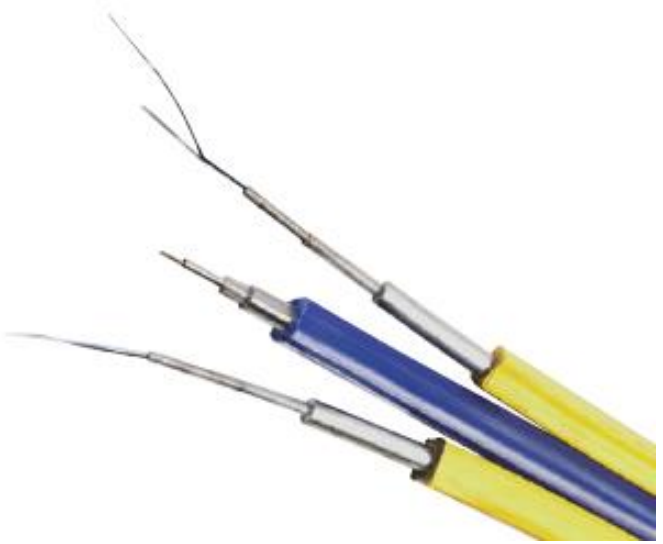
Presentation Outline

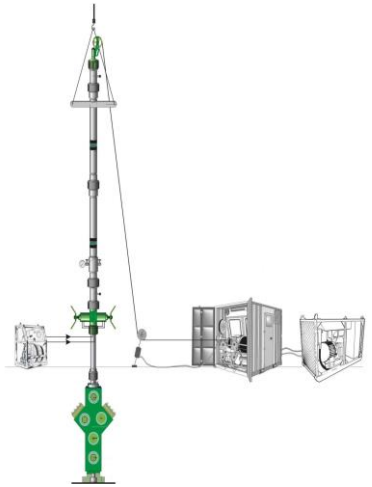
- DTS principles and Background
- Importance of good quality data
- Factors that can affect data quality
- Correction methods & lessons that could be learnt
- Data management system solution

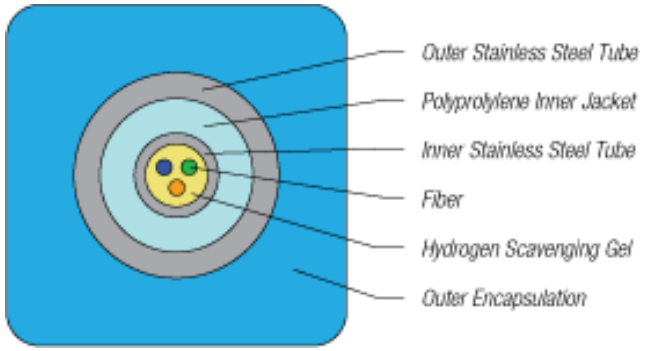
The Fibre is the Sensor

- **Distributed measurement**
- **Core components**
  - Surface acquisition unit
  - Optical fiber
- **Depth resolution**
  - From about 0.35m
- **Temperature resolution**
  - Cab better than 0.01°C (no post processing)
- **Temperature Range**
  - Up to 700 °C
- **Range**
  - Up to 100km
- **No electronics or moving parts in monitoring zones**
- **Deployment**
  - Permanent (Attached to production tubing)
  - Intervention

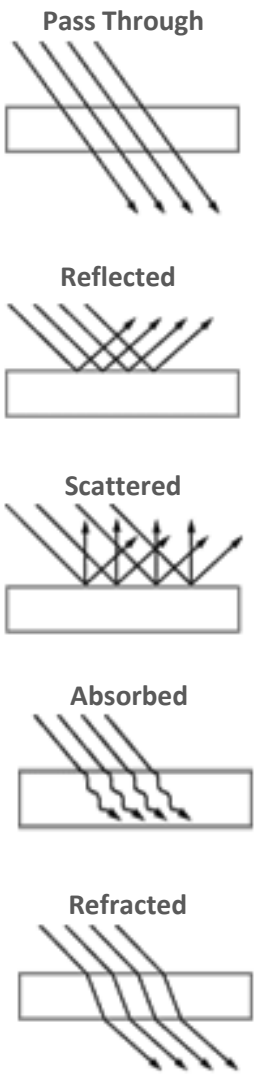


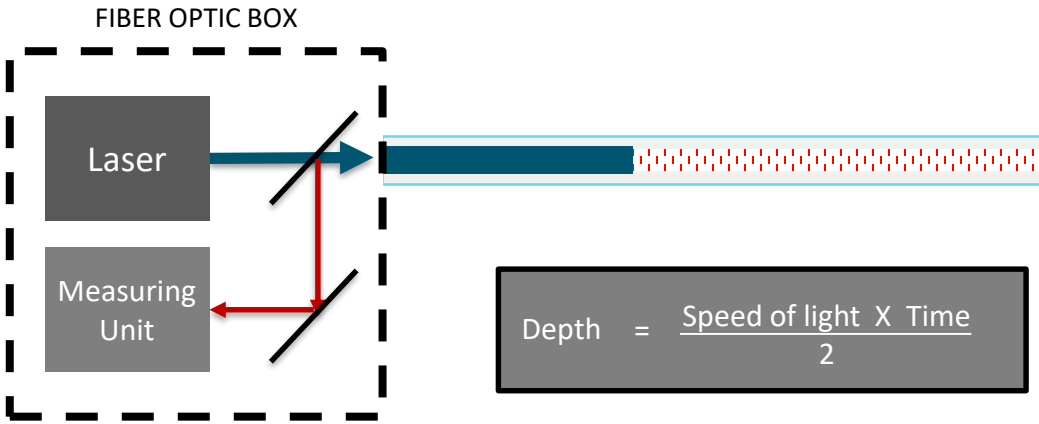


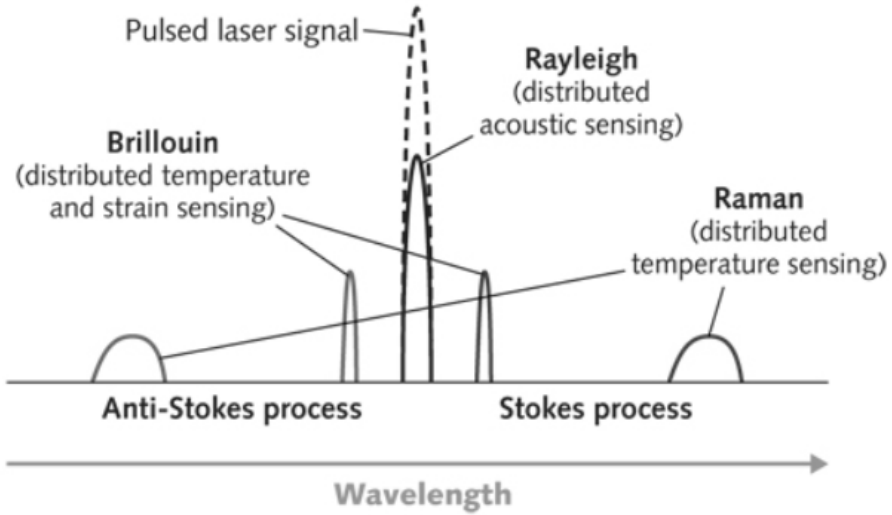




Temperature From Light



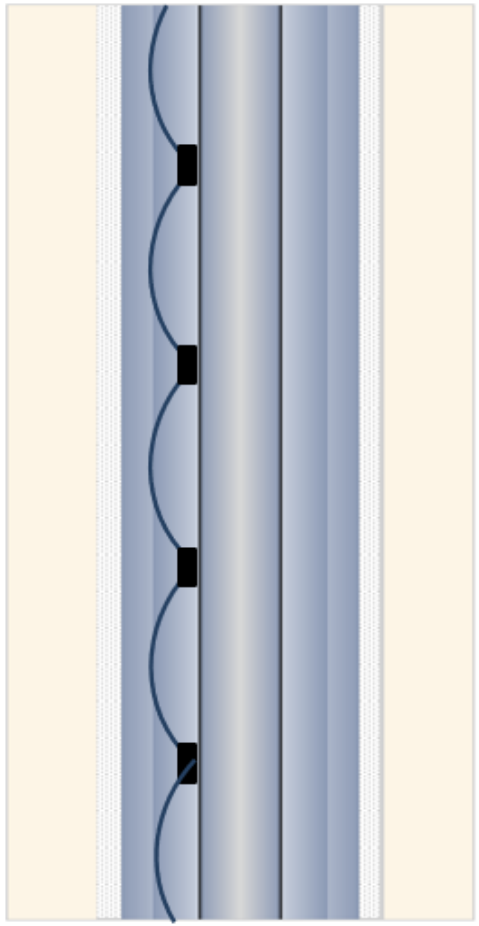


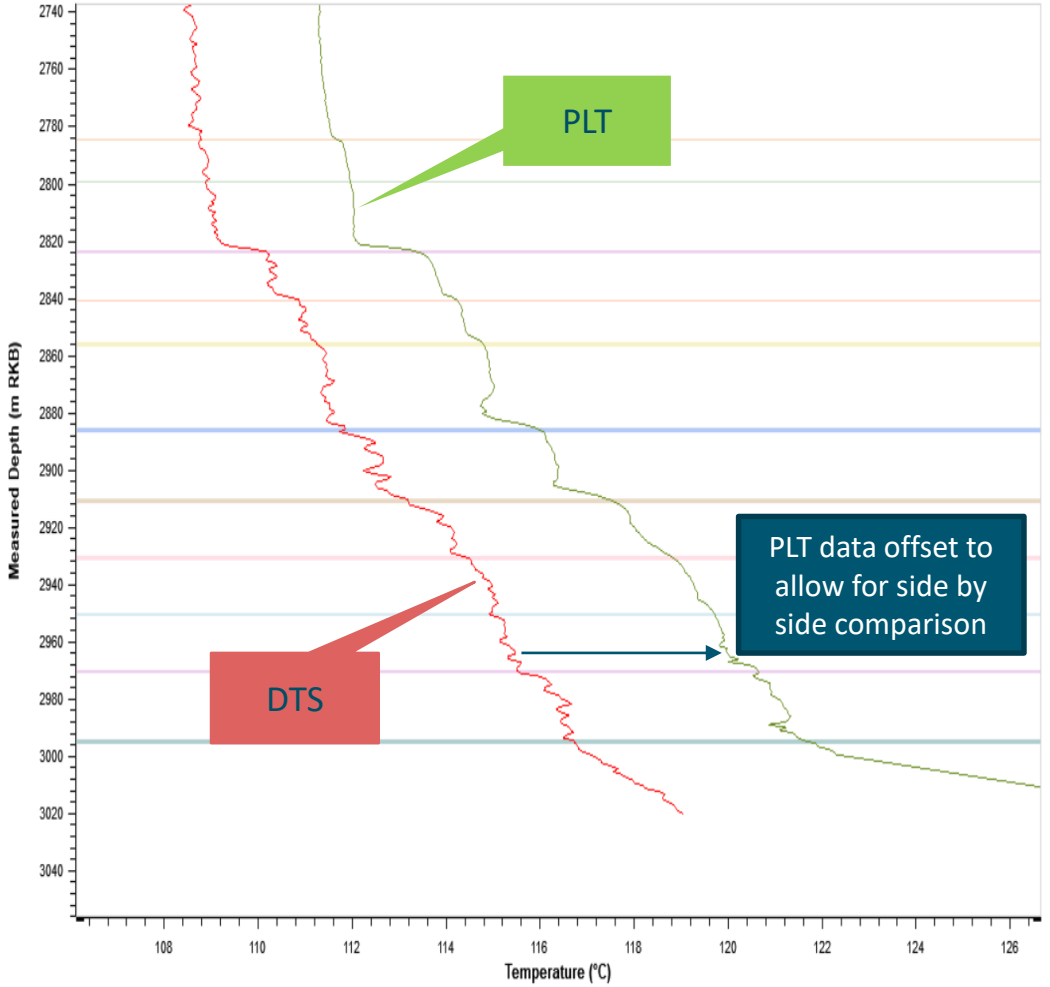


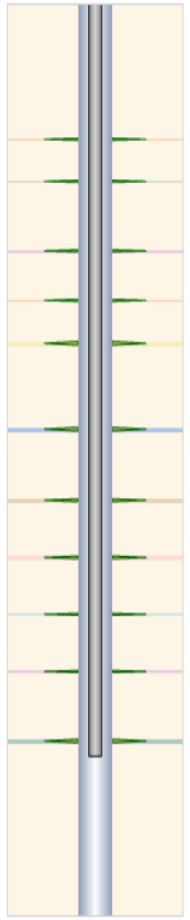
- Pulsed Laser travels through fiber
- Back-scattered light returns to fiber optic box
- Back-scattered light is processed to get useful information (Temperature, Strain, Sound)
- Raman (DTS) – Temperature Measurement (0.01˚C)
- Brillouin (DTSS) – Strain and Temperature (0.5 ˚C)
- Rayleigh (DAS) – Acoustic measurement

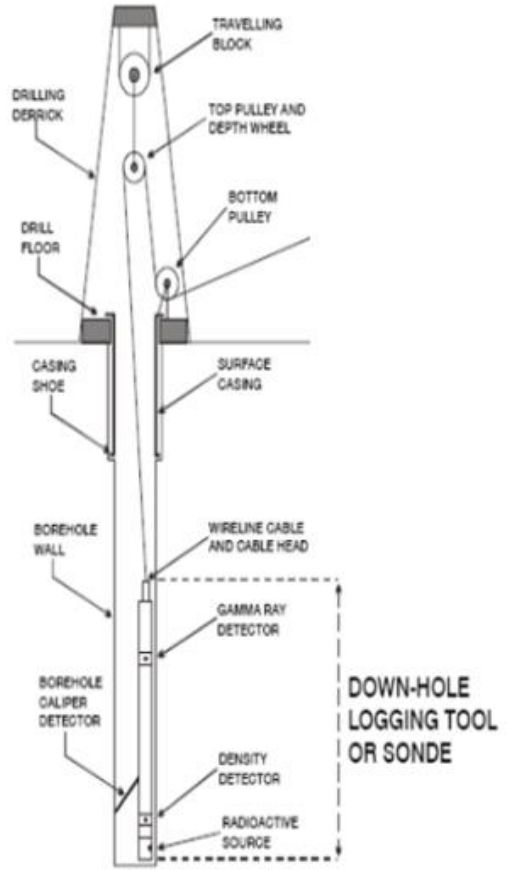
Zrelli Amira, Mohamed Bouyahi, Tahar Ezzedine '*Measurement of Temperature Through Raman Scattering*' AWICT 2015

DTS vs PLT



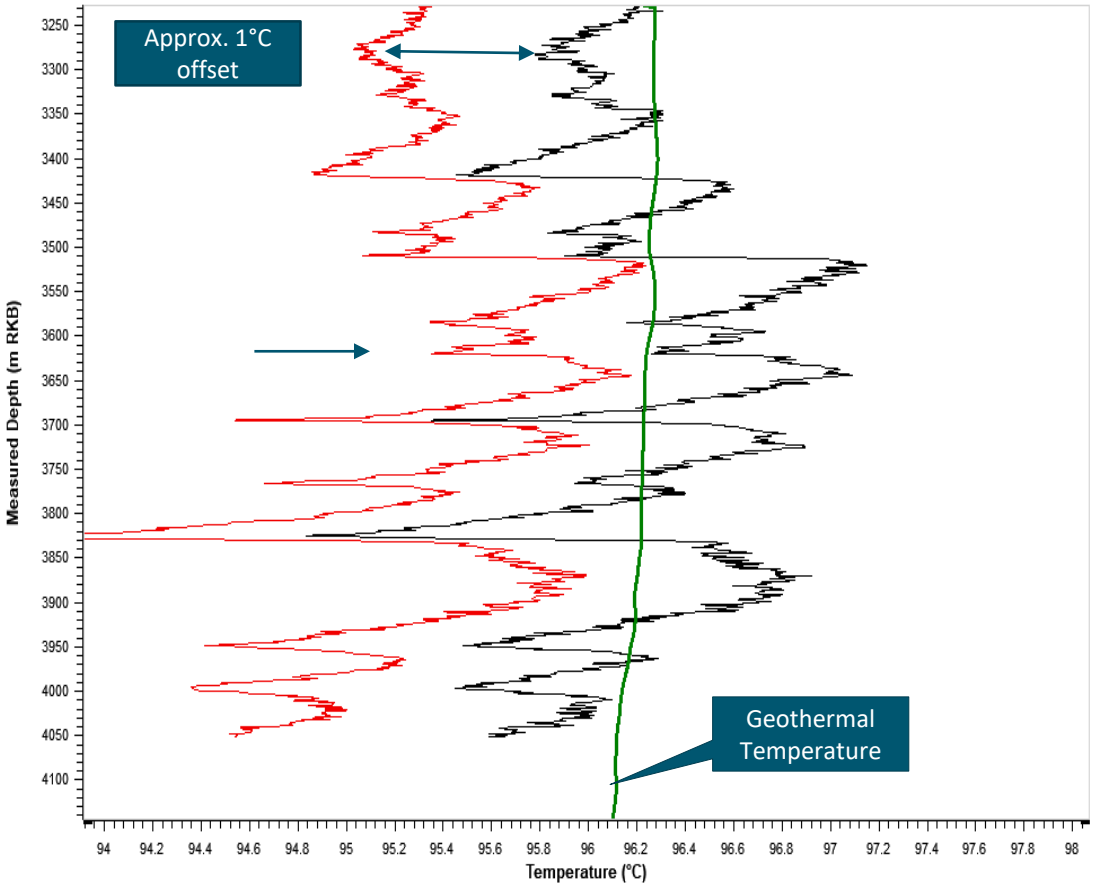

PLT
DTS
PLT data offset to allow for side by side comparison
Measured Depth (m RKB)
2740
2760
2780
2800
2820
2840
2860
2880
2900
2920
2940
2960
2980
3000
3020
3040
108
110
112
114
116
118
120
122
124
126
Temperature (°C)



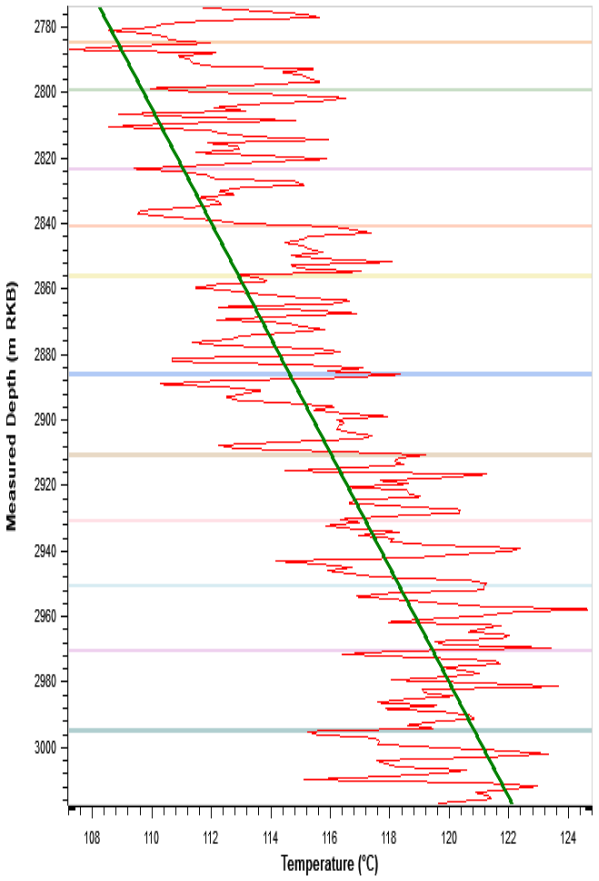

TRAVELLING BLOCK
DRILLING DERRICK
TOP PULLEY AND DEPTH WHEEL
BOTTOM PULLEY
DRILL FLOOR
CASING SHOE
SURFACE CASING
BOREHOLE WALL
WIRELINE CABLE AND CABLE HEAD
GAMMA RAY DETECTOR
BOREHOLE CALIPER DETECTOR
DENSITY DETECTOR
RADIOACTIVE SOURCE
DOWN-HOLE LOGGING TOOL OR SONDE

Data Quality Matter!

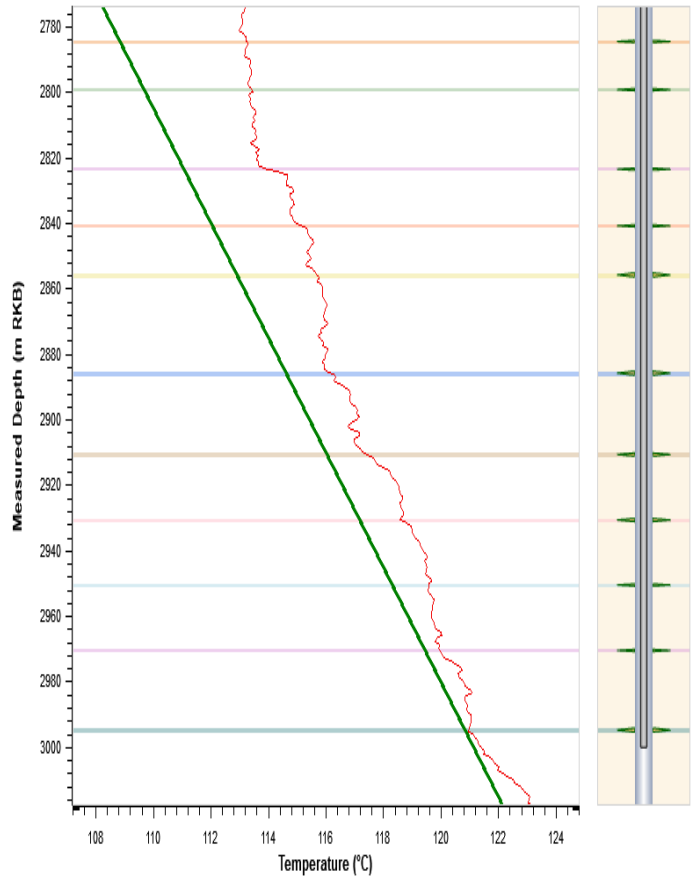
Temperature Offset



Data Noise

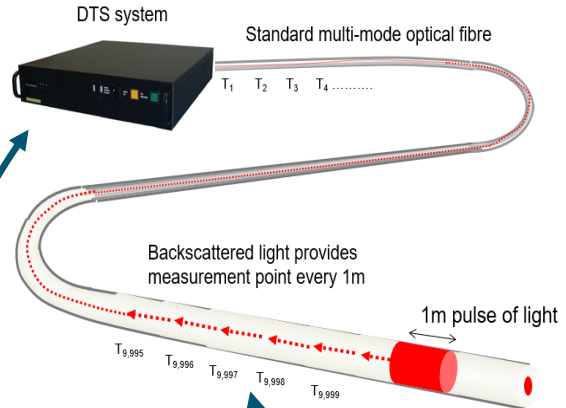


10s readings
1 trace



1 hour reading
1 trace

Different ways Things can go Wrong



$T = Temperature$

$z = depth$

$\alpha = attenuation\ (dB\ loss)$

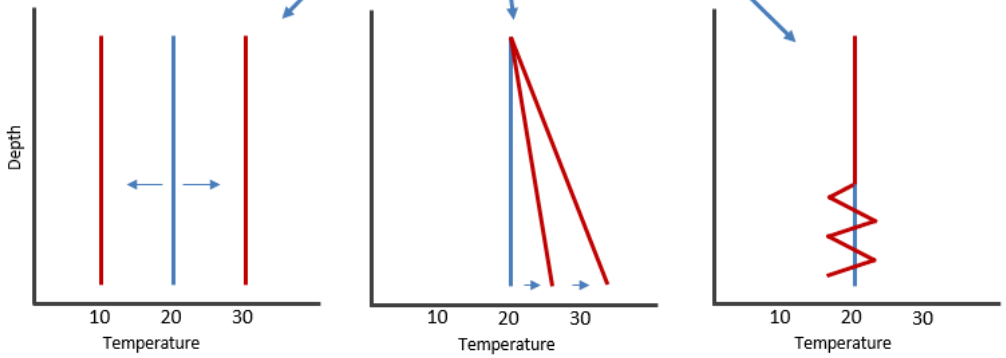
$I^{+} = Stokes$

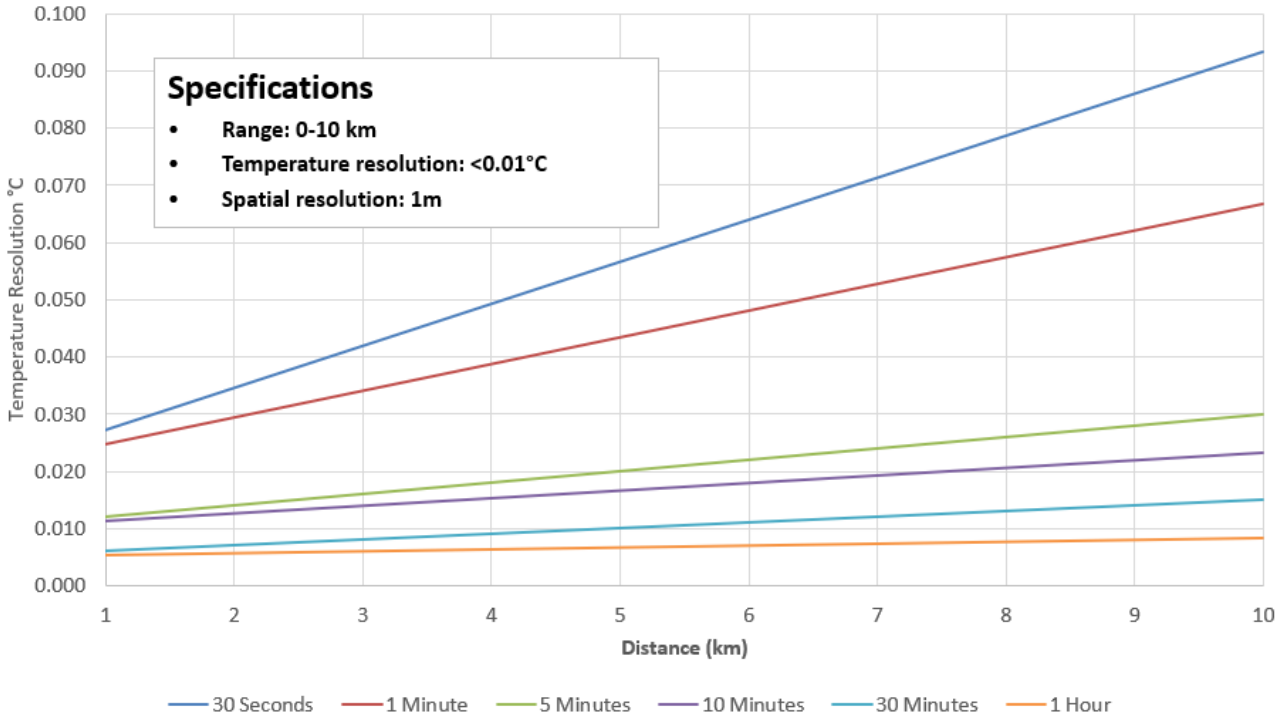
$I^{-} = AntiStokes$

$C^{+} = Stokes\ constant$

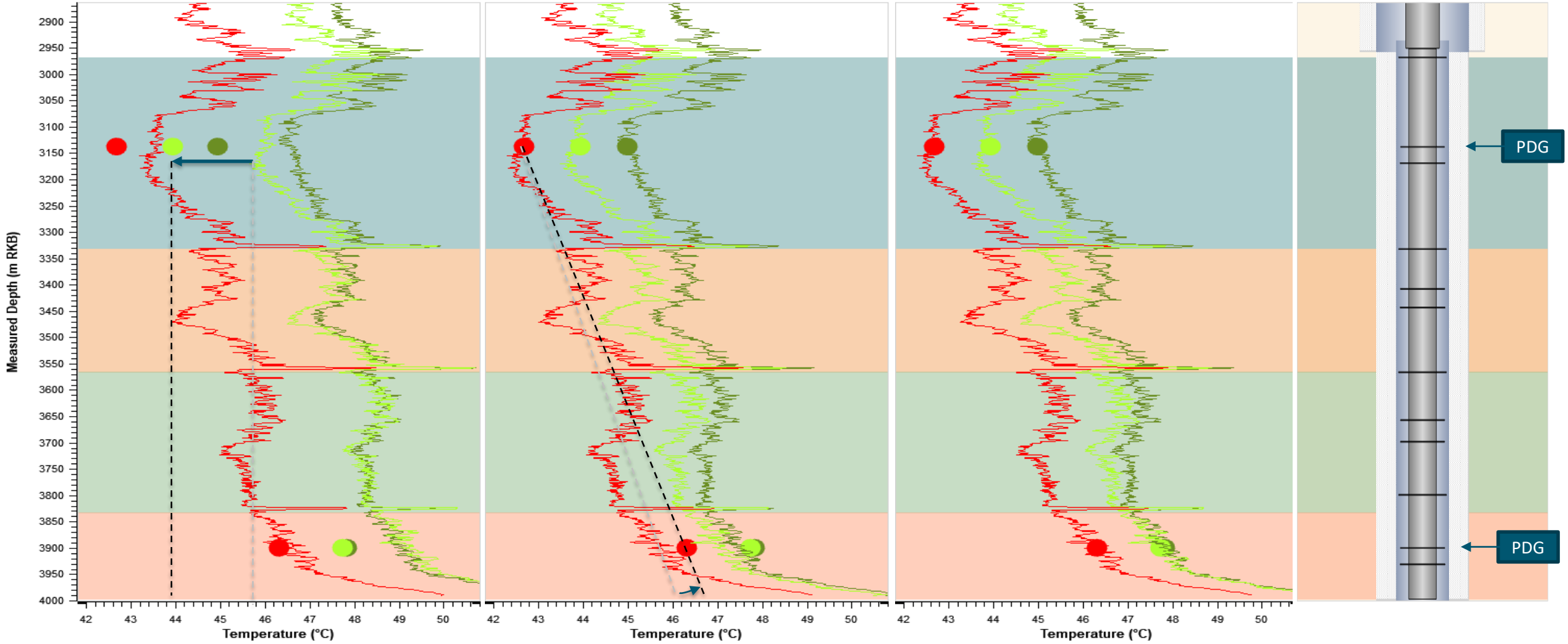
$C^{-} = anti\ stokes\ constant$

$$T_{(z)} \cong T_{ref}\left(1 + \frac{\Delta\alpha z}{\ln\left(\frac{C^{+}}{C^{-}}\right)} + \frac{ln\left(\frac{I^{+}(z)}{I^{-}(z)}\right)}{\ln\left(\frac{C^{+}}{C^{-}}\right)}\right)$$

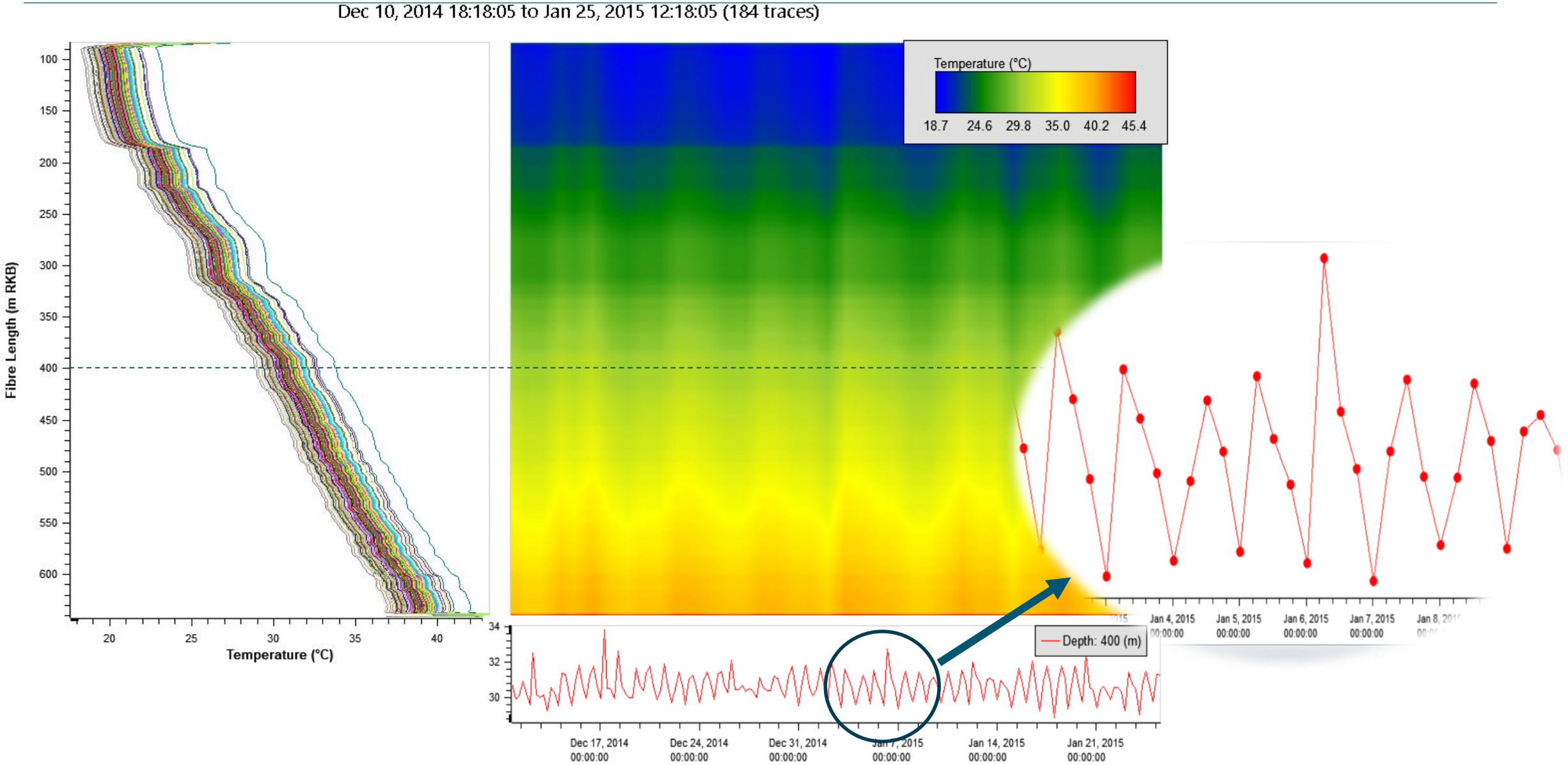




Case 1: Pairing DTS with Other Downhole Data

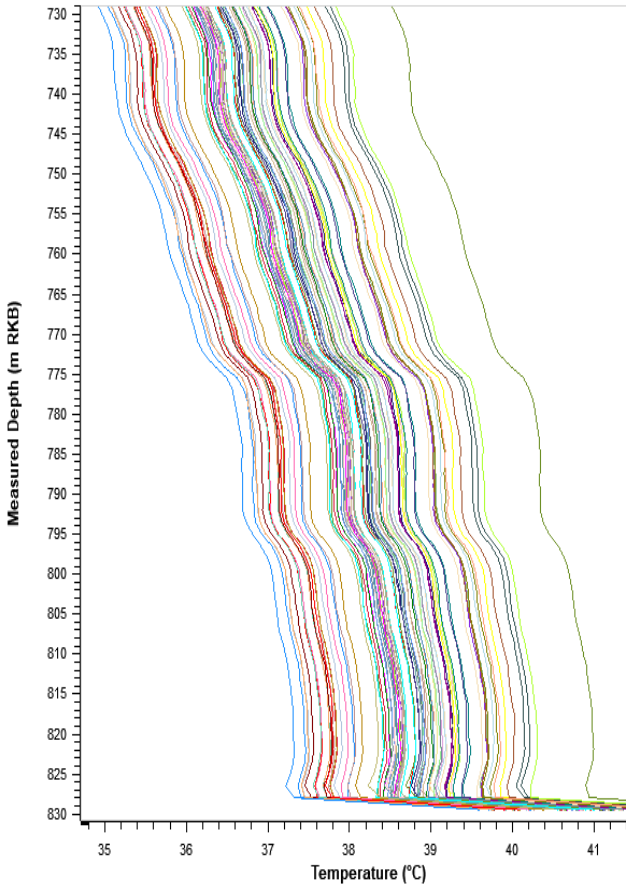


Case 2: Smarter Completion

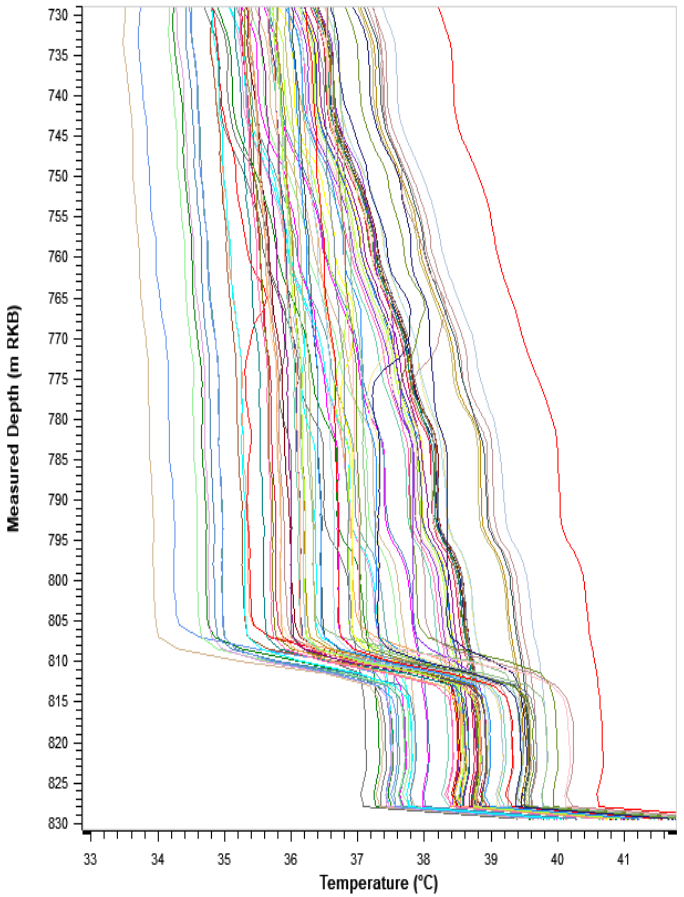


Case 2: Smarter Completion

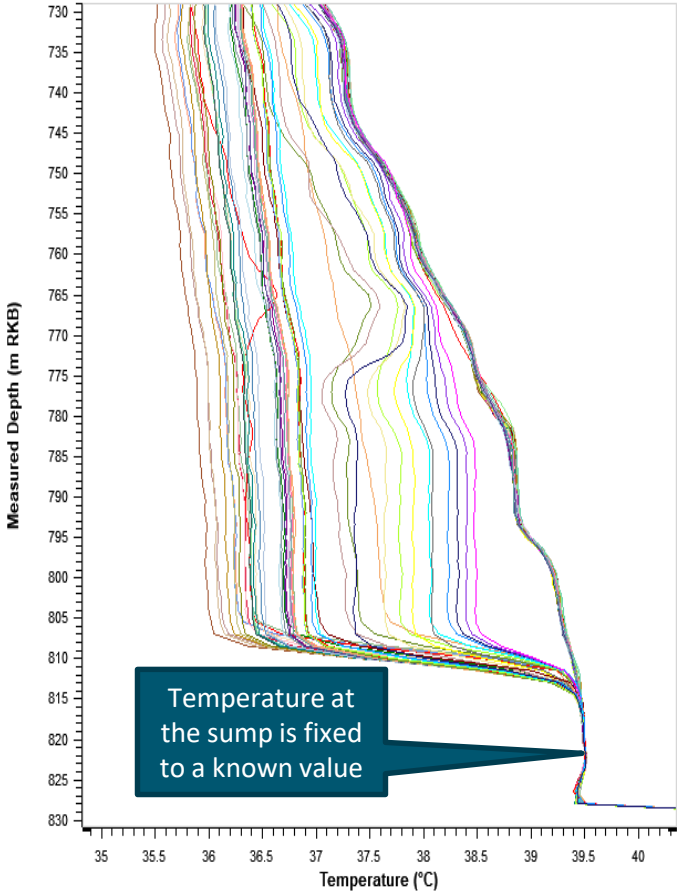
Shut-in Traces

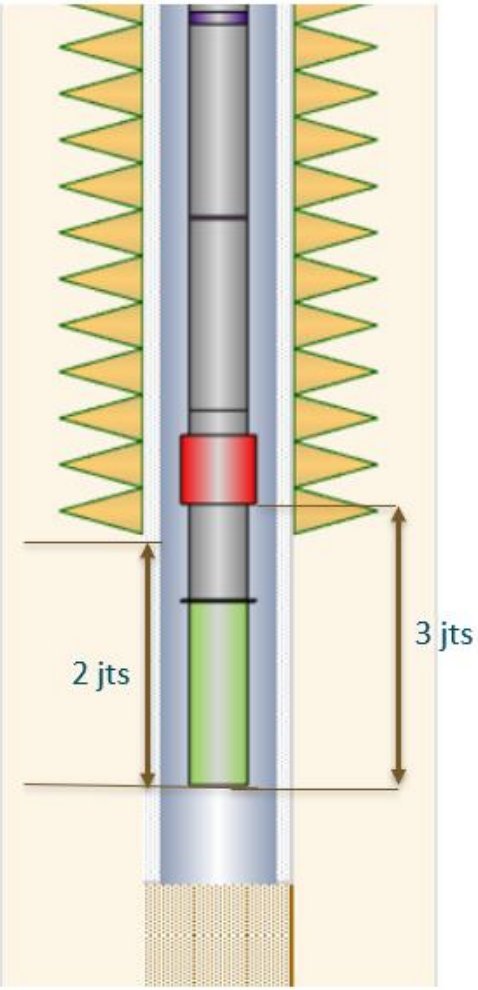


Shut-in + Production Traces

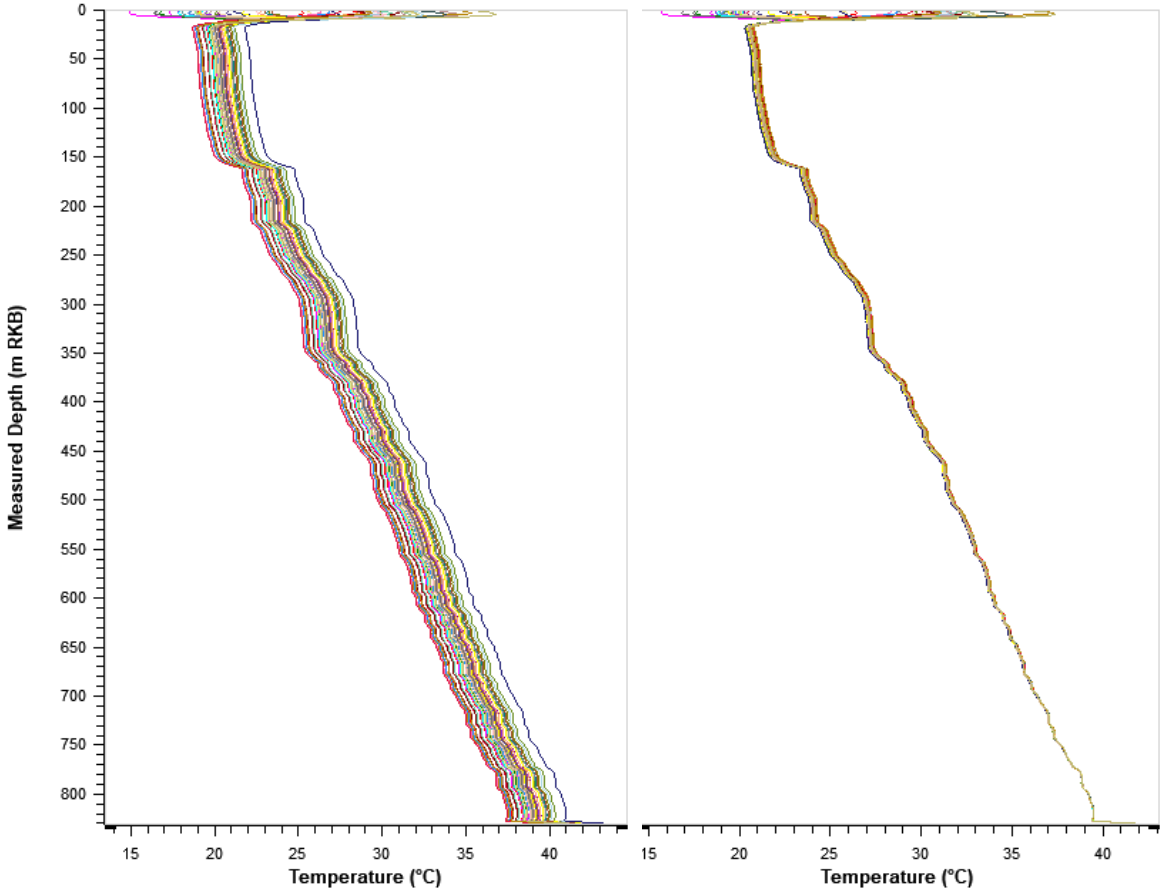


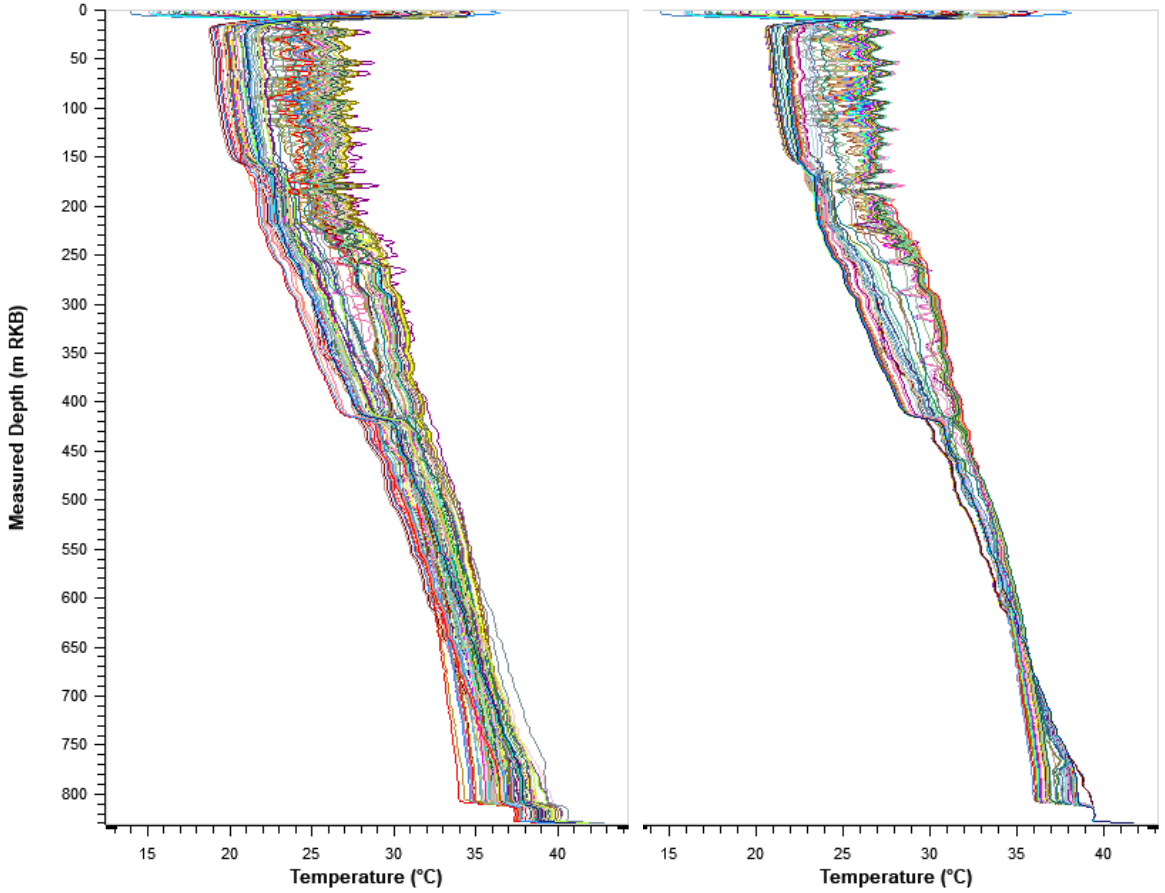
Corrected Traces



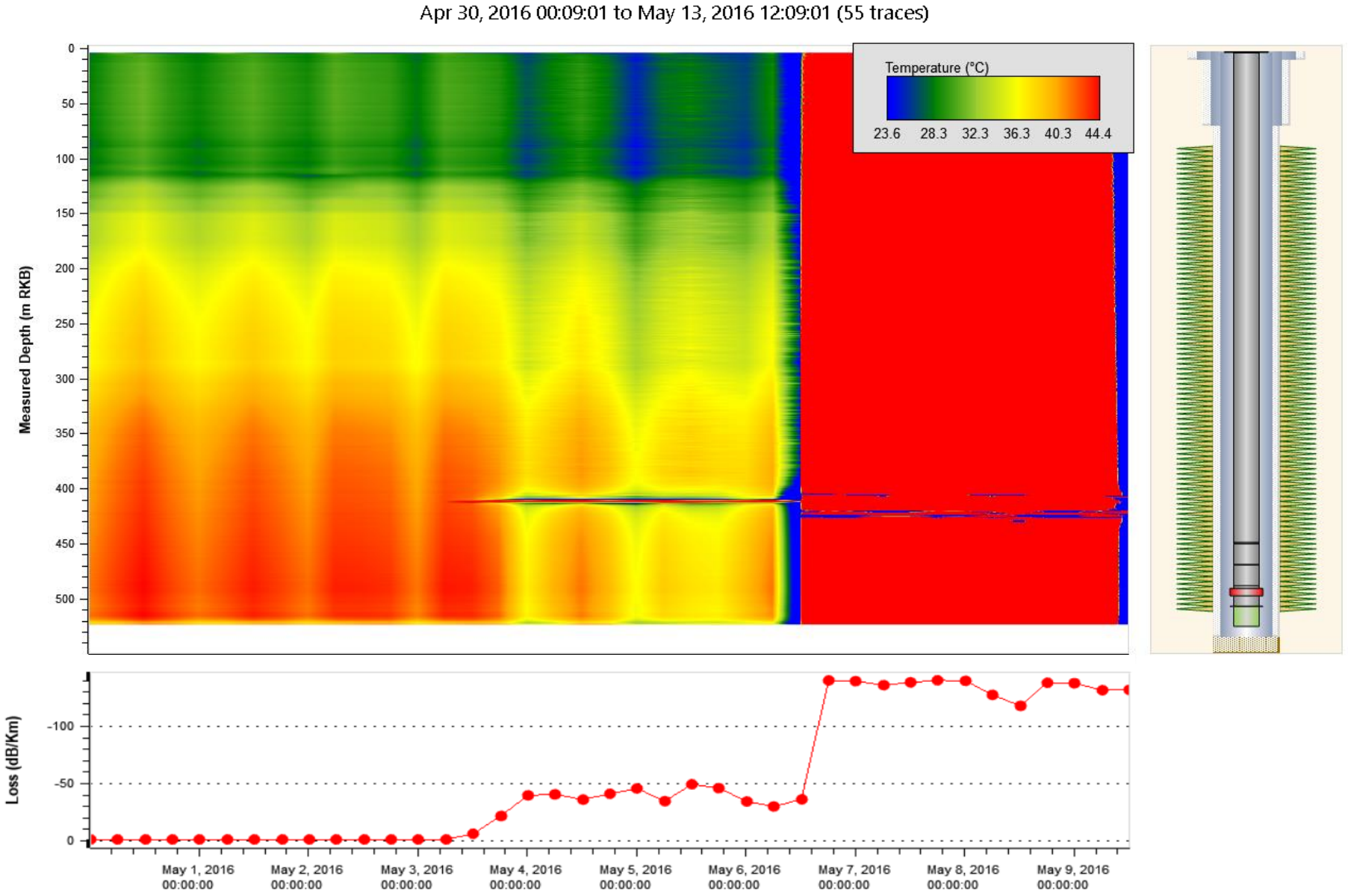


Case 2: Smarter Completion

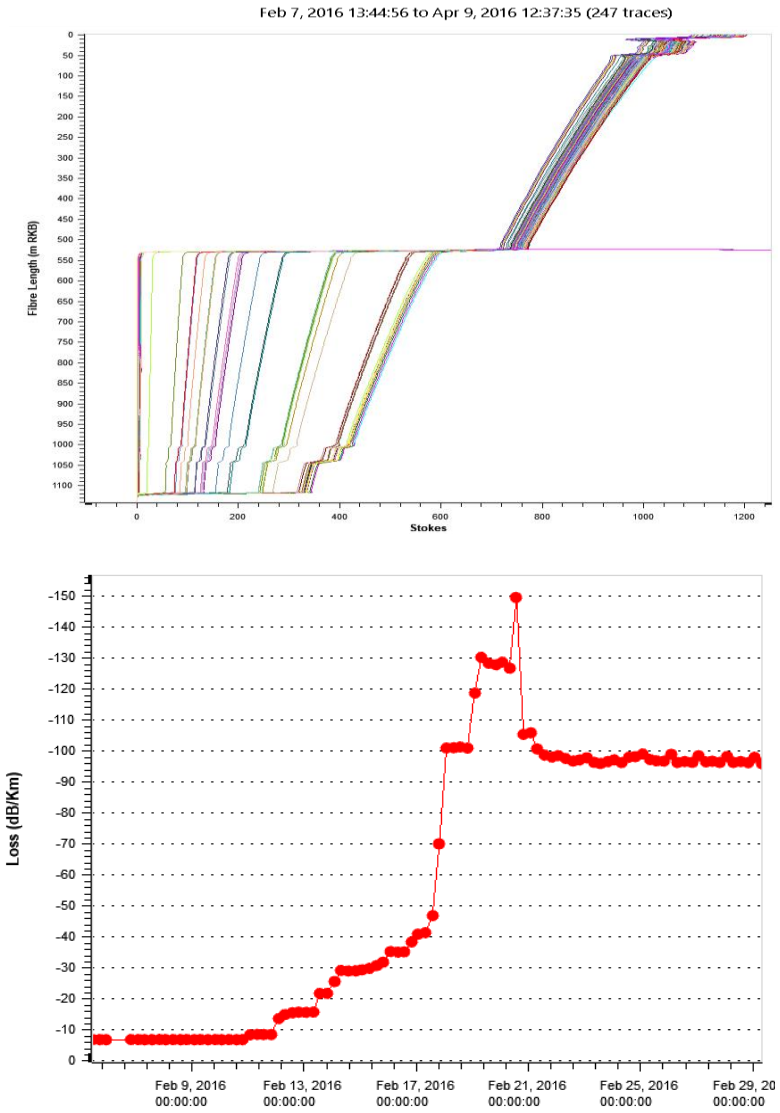


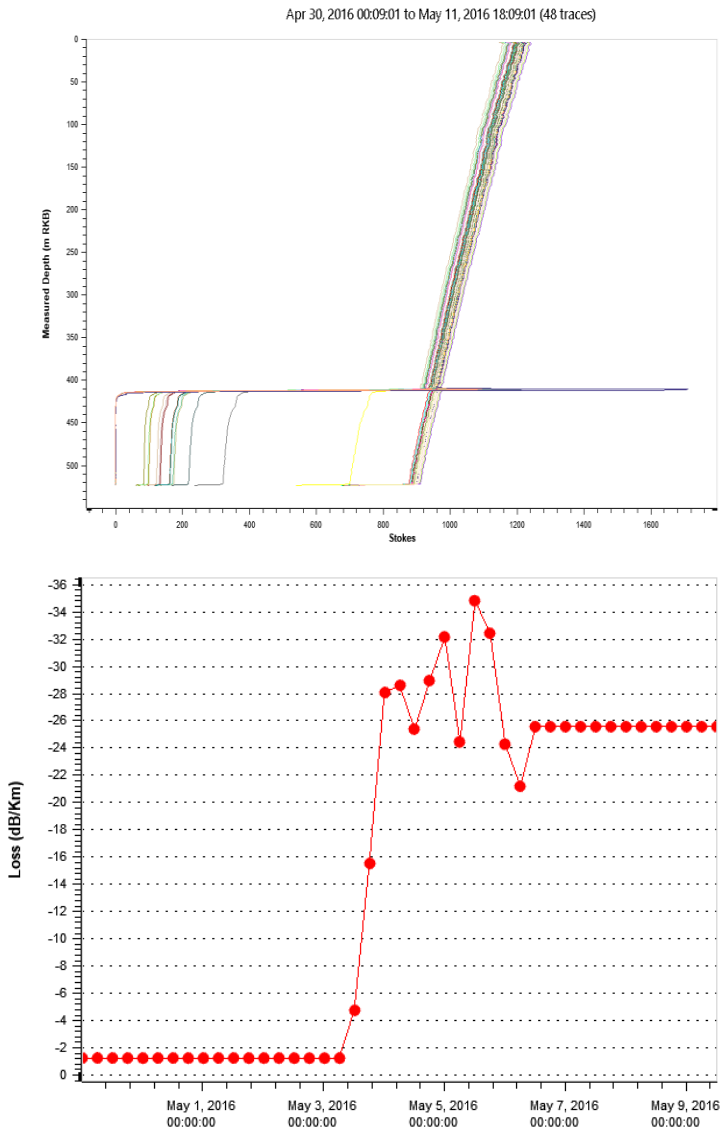


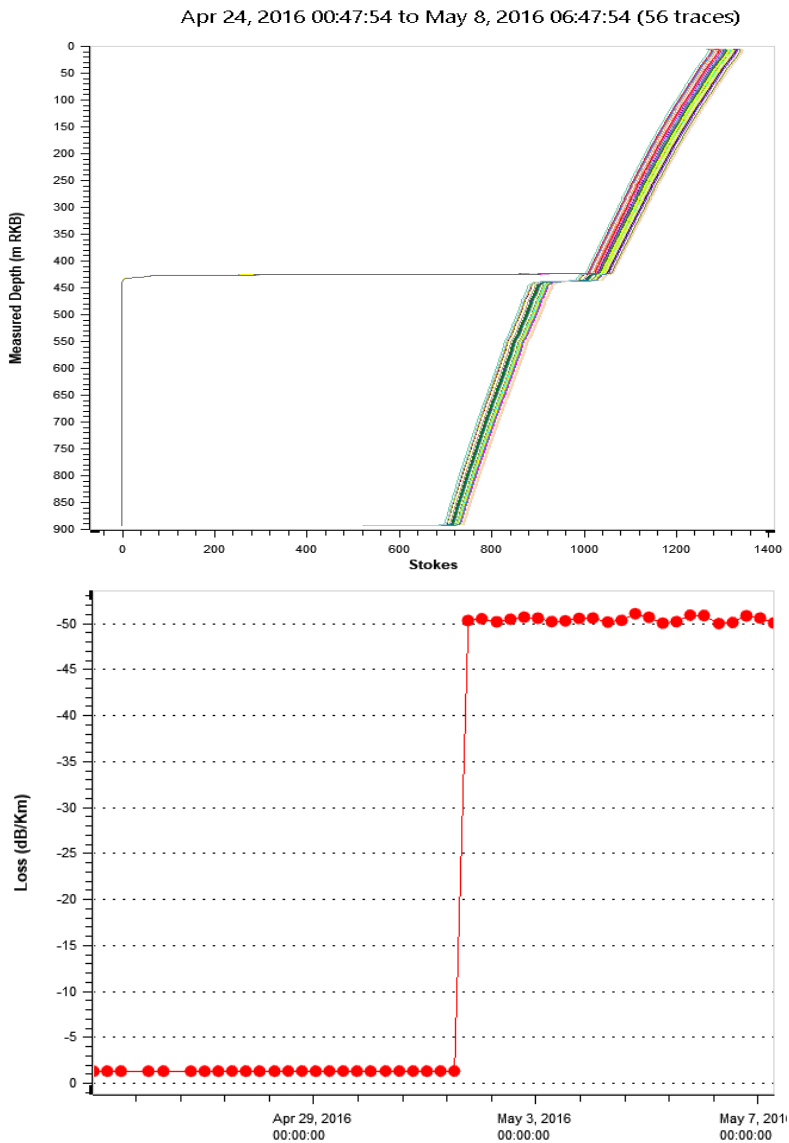
Case 3: Fiber failure



Case 3: Fiber Failure Modes

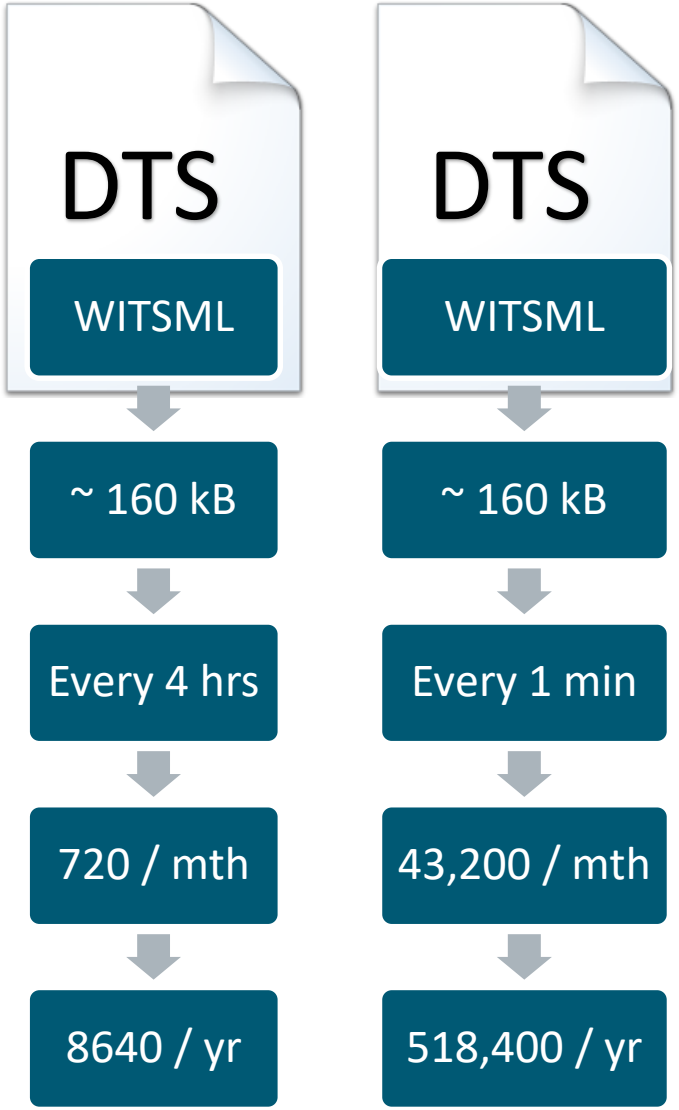






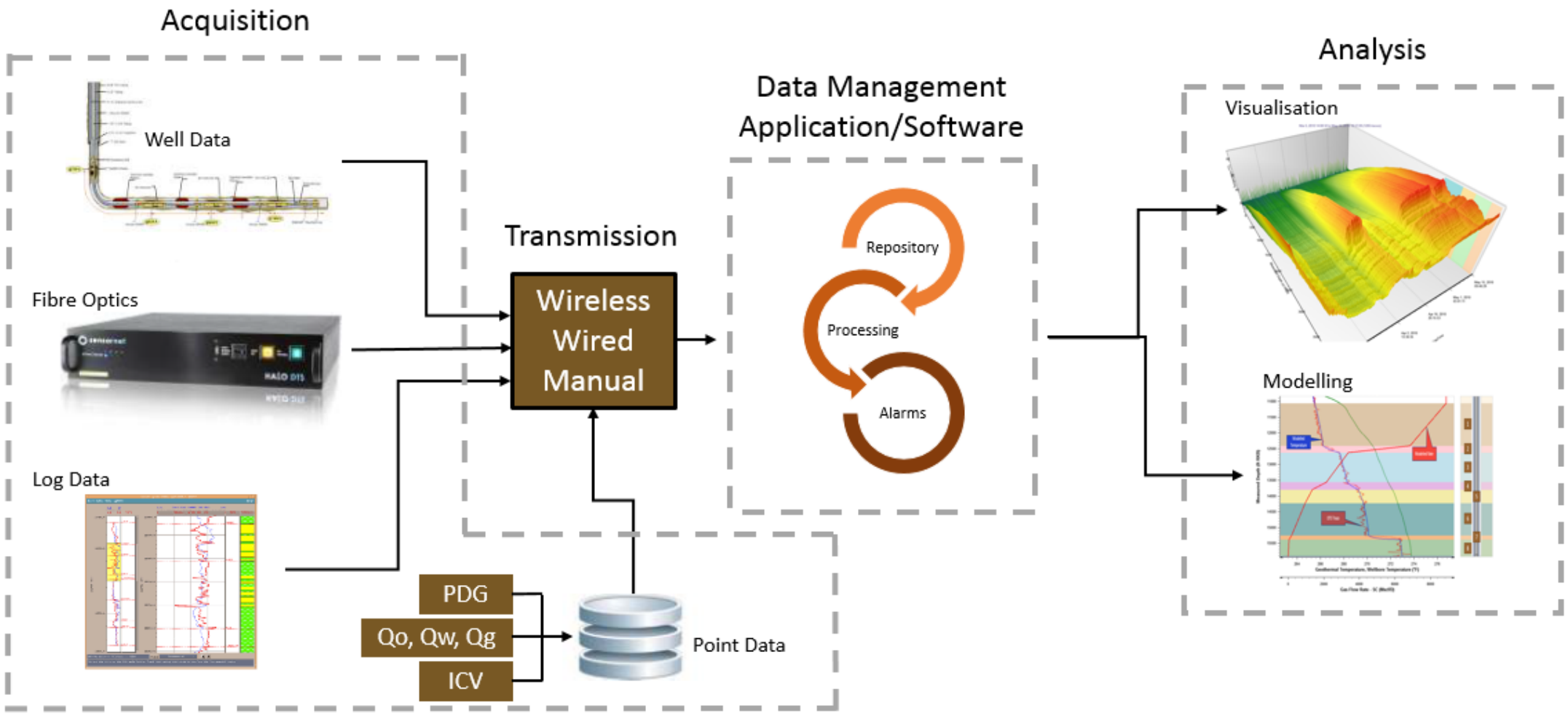
Big data

Wells 35	Pipelines 0	DTS Fibers 45
Point Devices 0	Folder Sources 1	FTP Sources 32
HTTP Sources 4	Enabled Schedules 1	Disabled Schedules 11



- Data centres are here to stay
- Large amount of data can be generated
- Data quality monitoring is necessary
- Going through these data can be time consuming
- Shortage of skilled workers

Data Management System



Automation Example

Source Rules

Home > Repository > Sources > Source Rules

Confidence Rules

Confidence rules determine how data will be processed when being imported from a source. For the data to be classed as valid every rule must pass.

NOTE: If a confidence rule type does not exist in the data (eg Reverse Stokes) and is specified as a rule, the rule will be ignored.

Confidence Rules

Add Confidence Rule

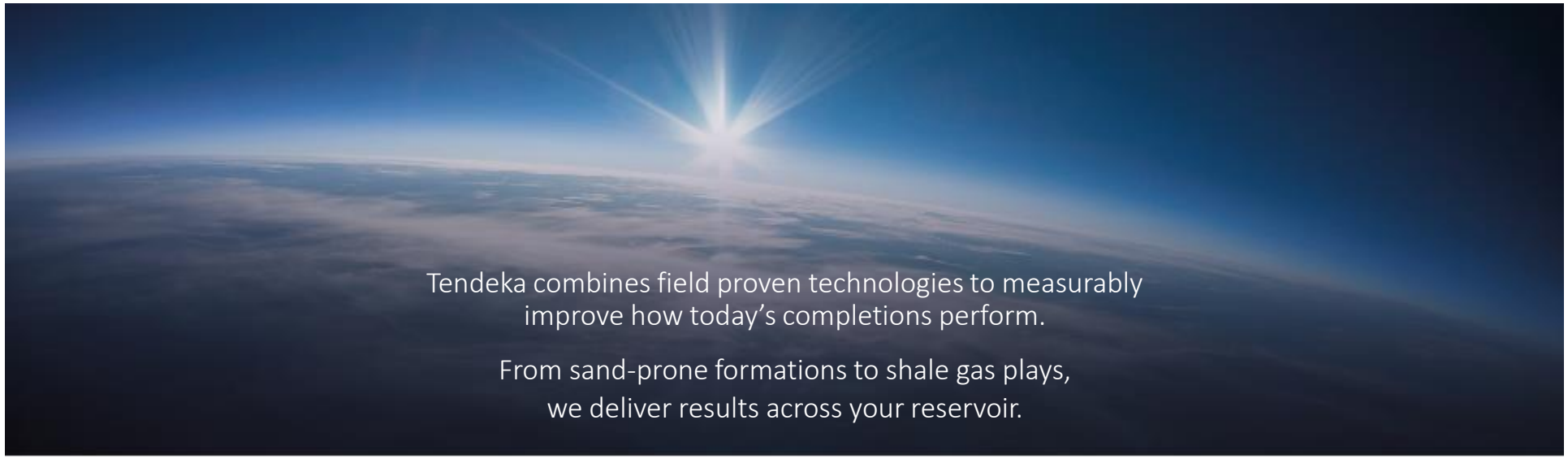
Top Depth (m)	Bottom Depth (m)	Data Type	Operator	Value	Actions
0	3000	Temperature (degC)	Greater Than (>)	0	Edit Delete
0	3000	Temperature (degC)	Less Than (<)	300	Edit Delete
0	3000	Anti-Stokes	Greater Than (>)	0	Edit Delete
2000	3000	Stokes	Not Equal To (!=)	0	Edit Delete

Showing 1 to 4 of 4 entries

Conclusion

- Data issues will come up at some point
- Understand your well
- Data health check
- Have a global approach
- Automation is the way forward

Thank you…Questions?



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