Ultradeep Resistivity inversions integrated to near-wellbore azimuthal LWD measurements for the successful delivery of geosteering objectives, a case from the Norwegian Continental Shelf.

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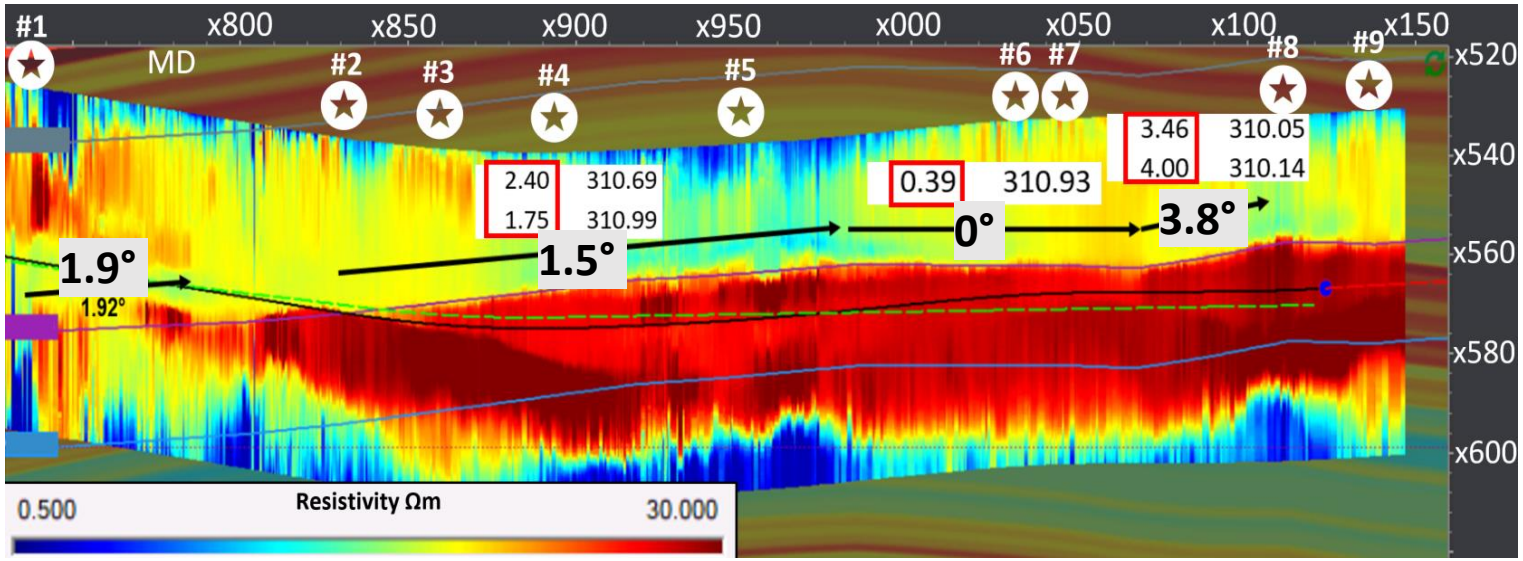
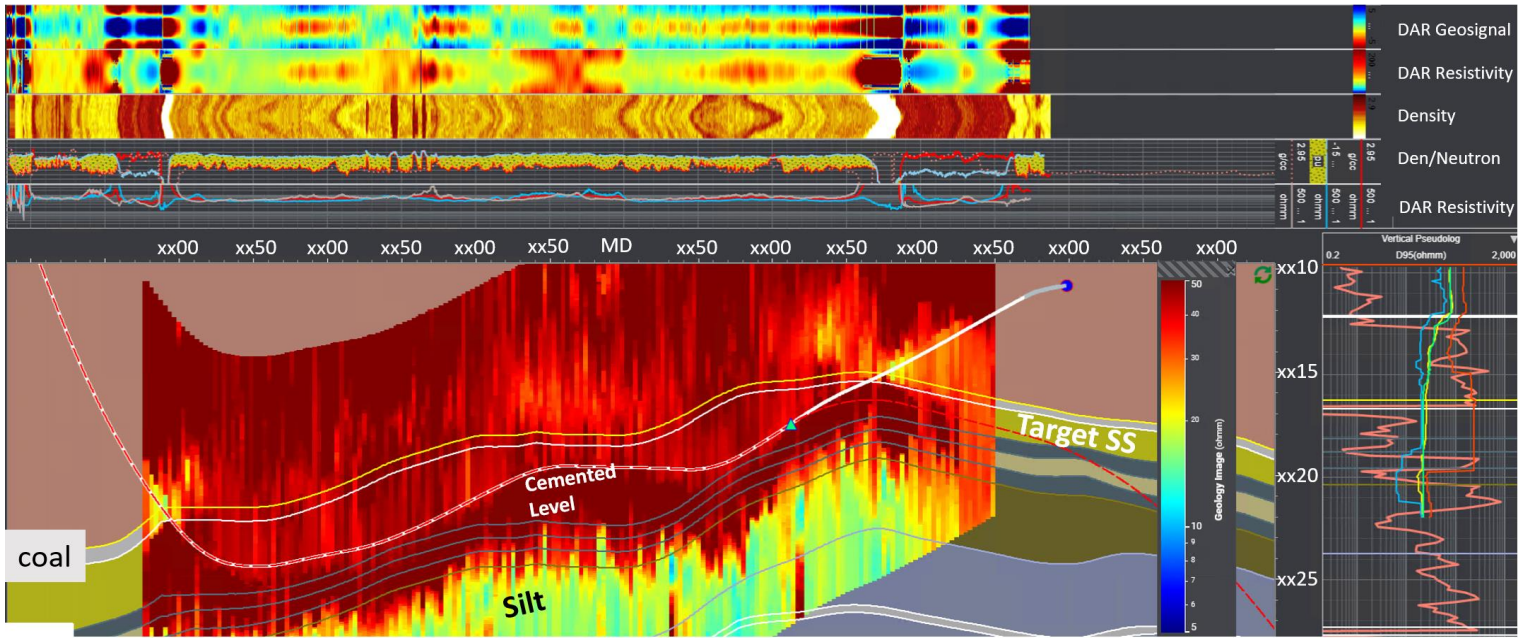
wintershall dea

HALLIBURTON

NFES

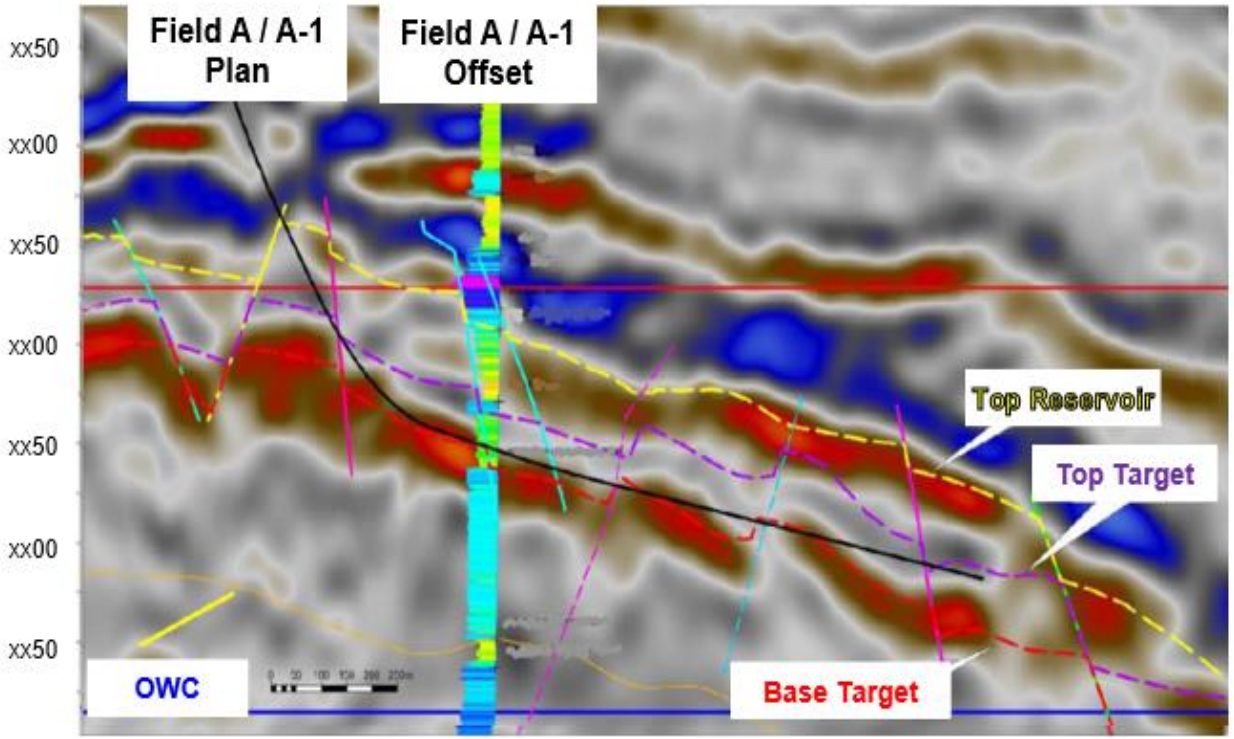
NORCE

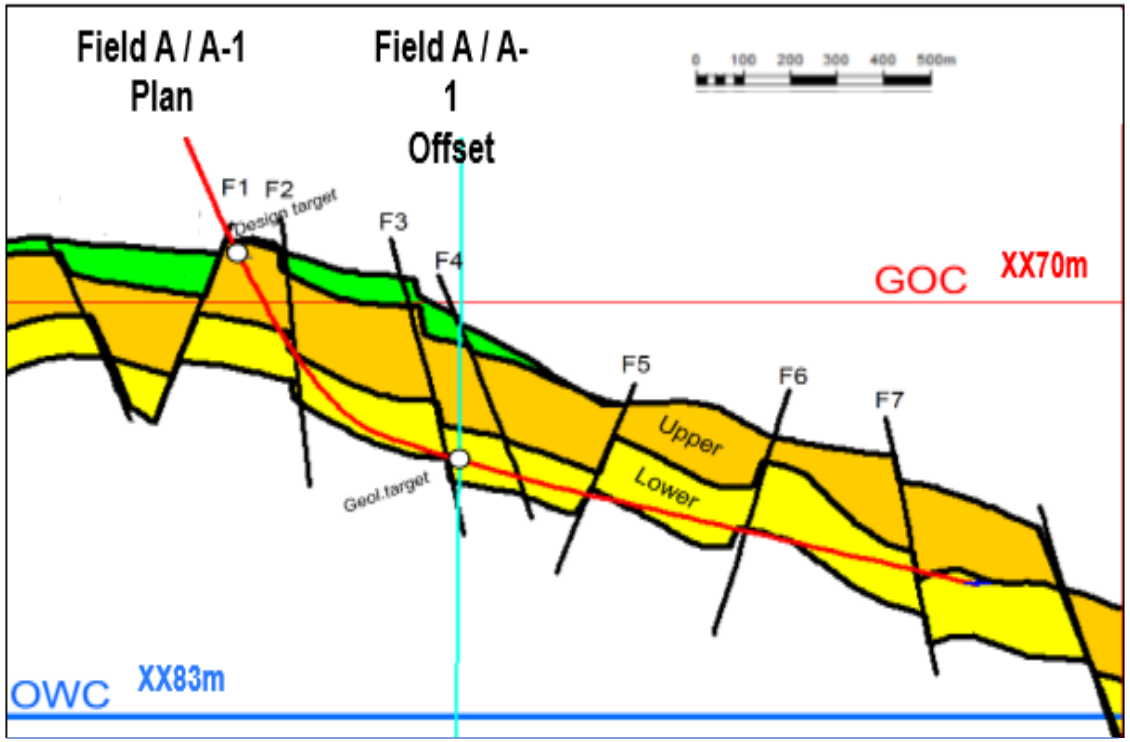




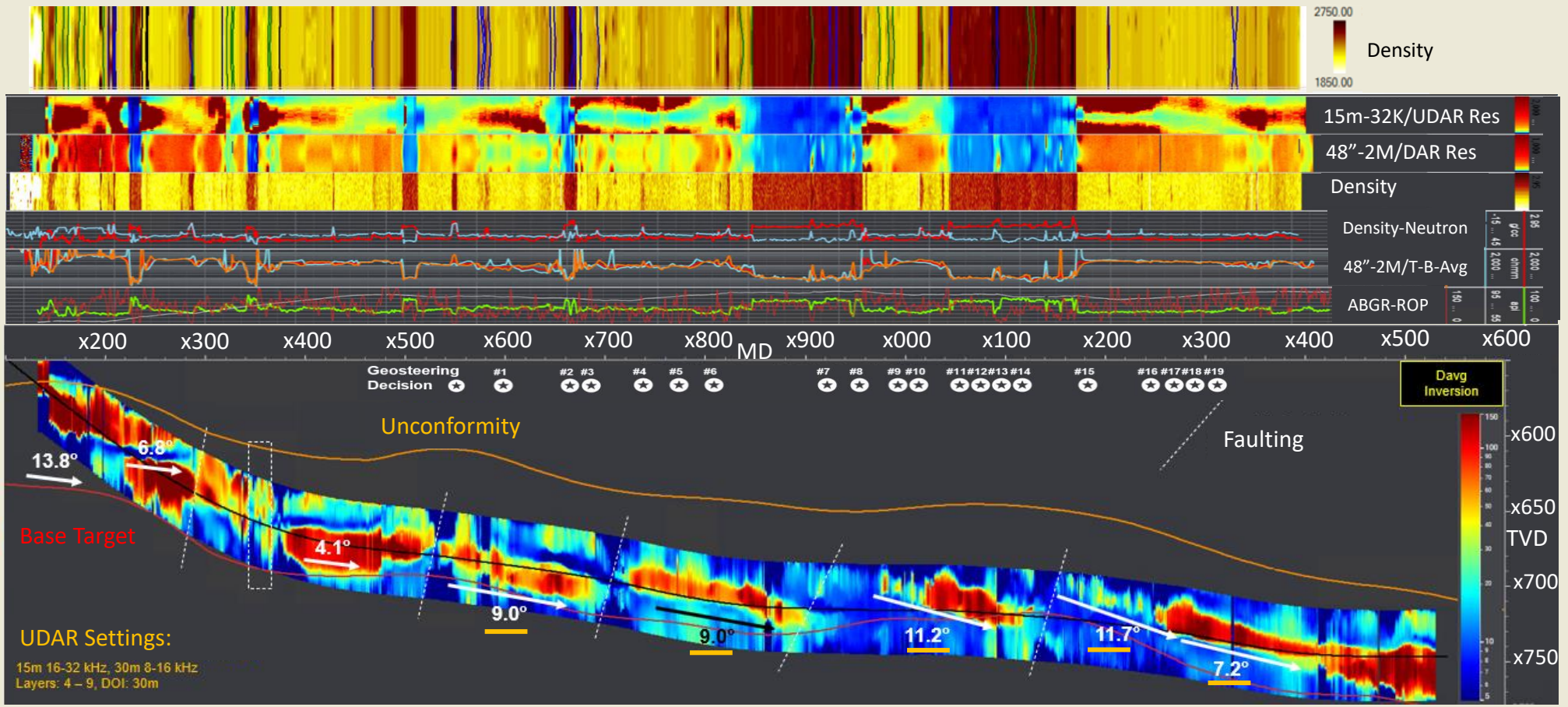
- 5 wells drilled in two adjacent fields of the NCS, Middle Jurassic sandstone reservoir.
- UDAR inversions used together with shallower LWD measurements during the drilling campaign.
- Various geosteering technique/tools involved in the geosteering workflow: UDAR inversions for boundary mapping, borehole images and dip-picking, correlation with pseudo-logs, “model-measure-optimize”, proactive and reactive geosteering.

Well A/A1

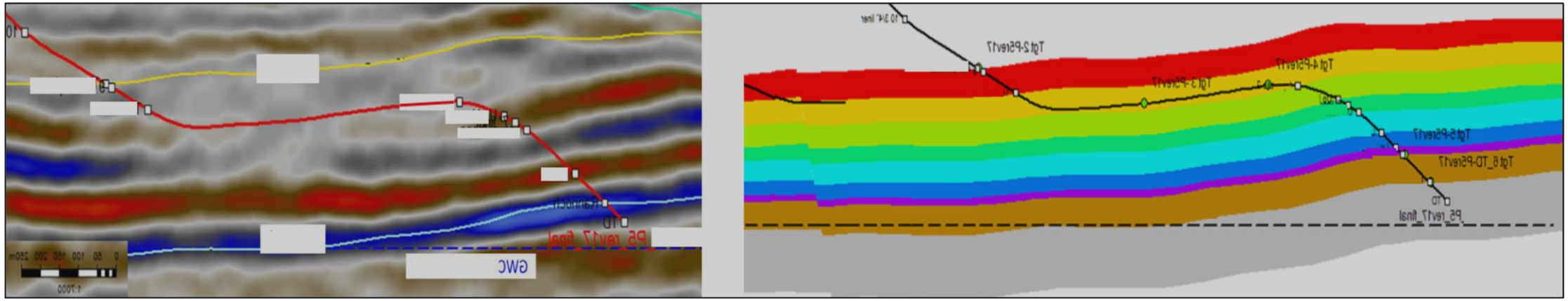

Field A / A-1 Plan
Field A / A-1 Offset
xx50
xx00
xx50
xx00
xx50
xx00
xx50
Top Reservoir
Top Target
OWC
Base Target

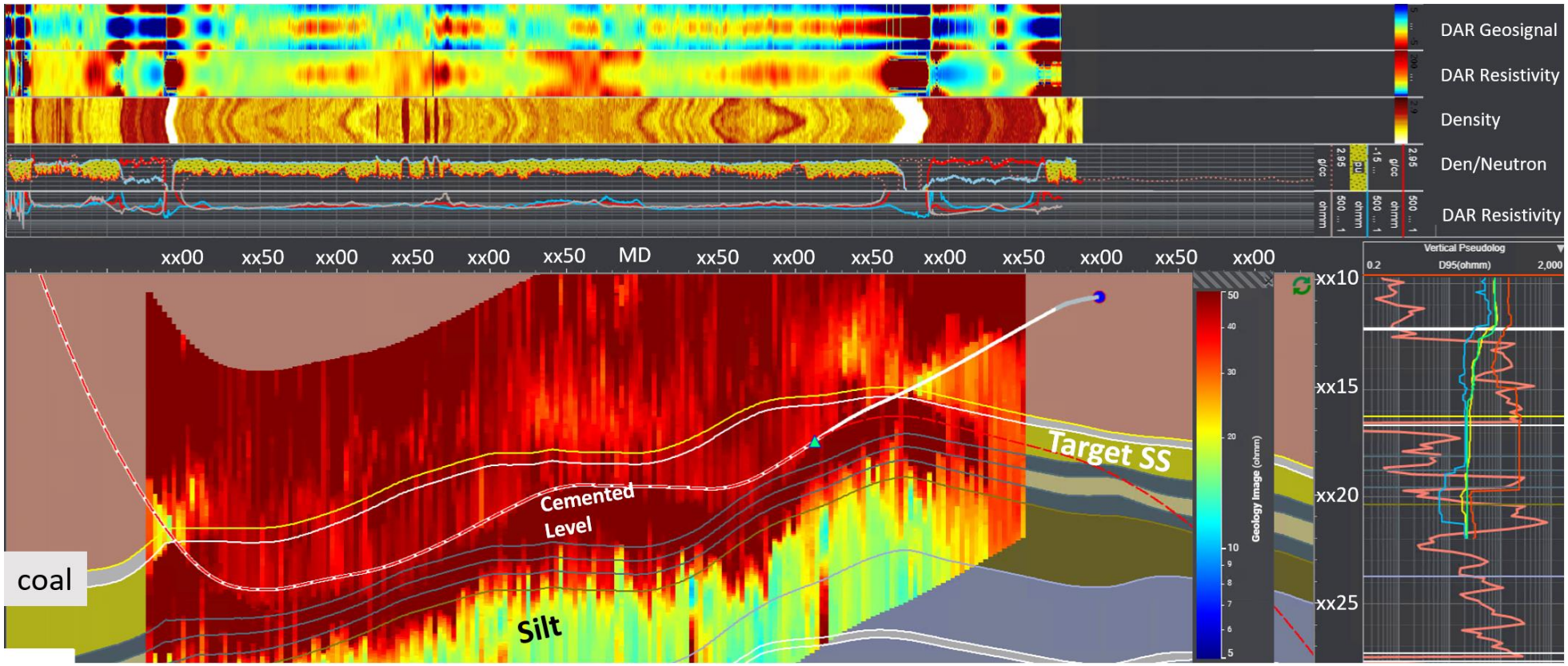

Field A / A-1 Plan
Field A / A-1 Offset
0 100 200 300 400 500m
F1 F2
Design target
F3
F4
GOC
XX70m
F5
F6
F7
Upper
Lower
Geol.target
OWC
XX83m

Well A/A1

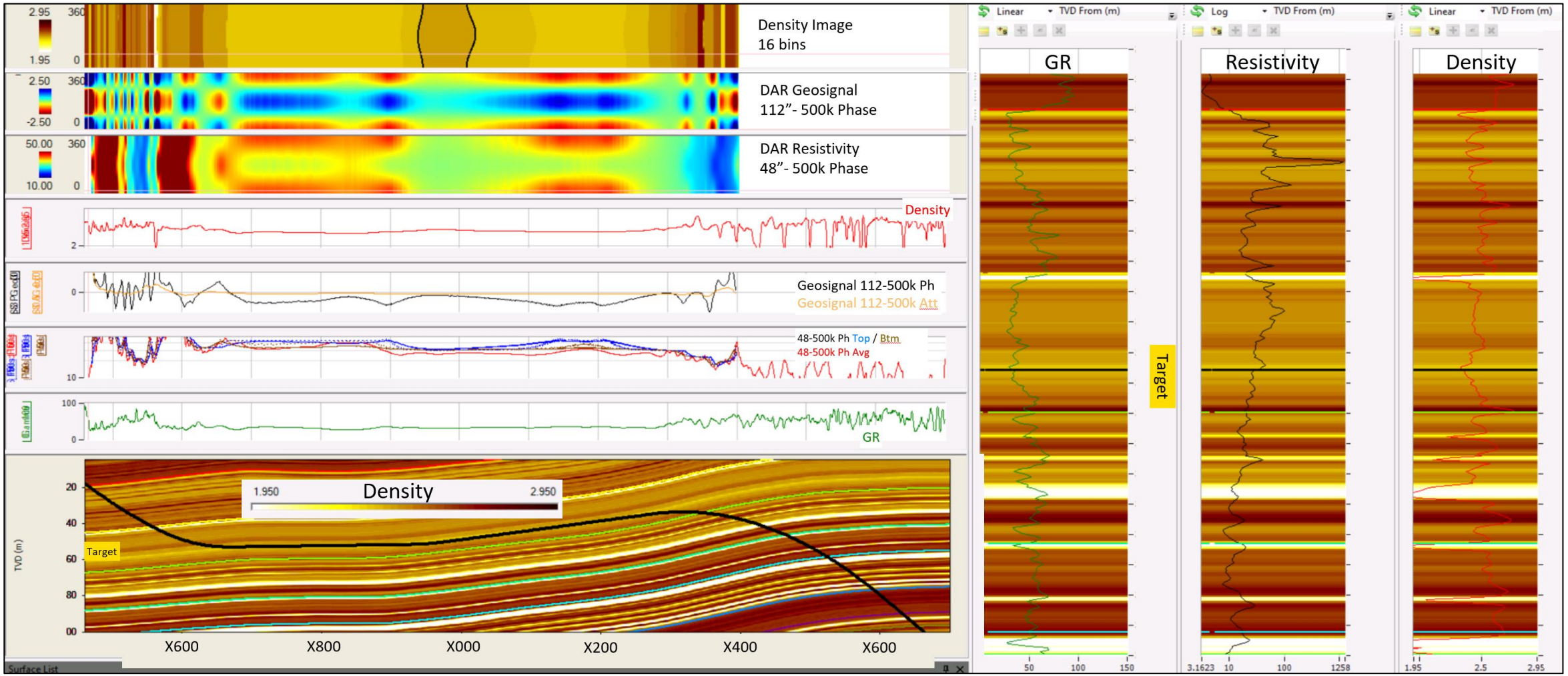

2750.00
Density
1850.00
15m-32K/UDAR Res
48”-2M/DAR Res
Density
Density-Neutron
48”-2M/T-B-Avg
ABGR-ROP
x200
x300
x400
x500
x600
x700
x800
MD
x900
x000
x100
x200
x300
x400
x500
x600
Geosteering Decision
#1
#2 #3
#4
#5
#6
#7
#8
#9 #10
#11#12#13 #14
#15
#16 #17#18 #19
Davg Inversion
Unconformity
Faulting
13.8°
6.8°
Base Target
4.1°
9.0°
9.0°
11.2°
11.7°
7.2°
x600
x650
TVD
x700
x750
UDAR Settings:
15m 16-32 kHz, 30m 8-16 kHz
Layers: 4 – 9, DOI: 30m
Top
*Wintershall Dea

Well B/B1

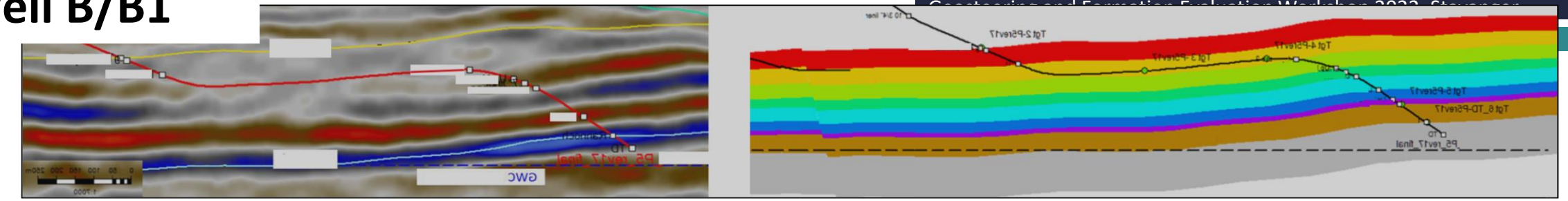


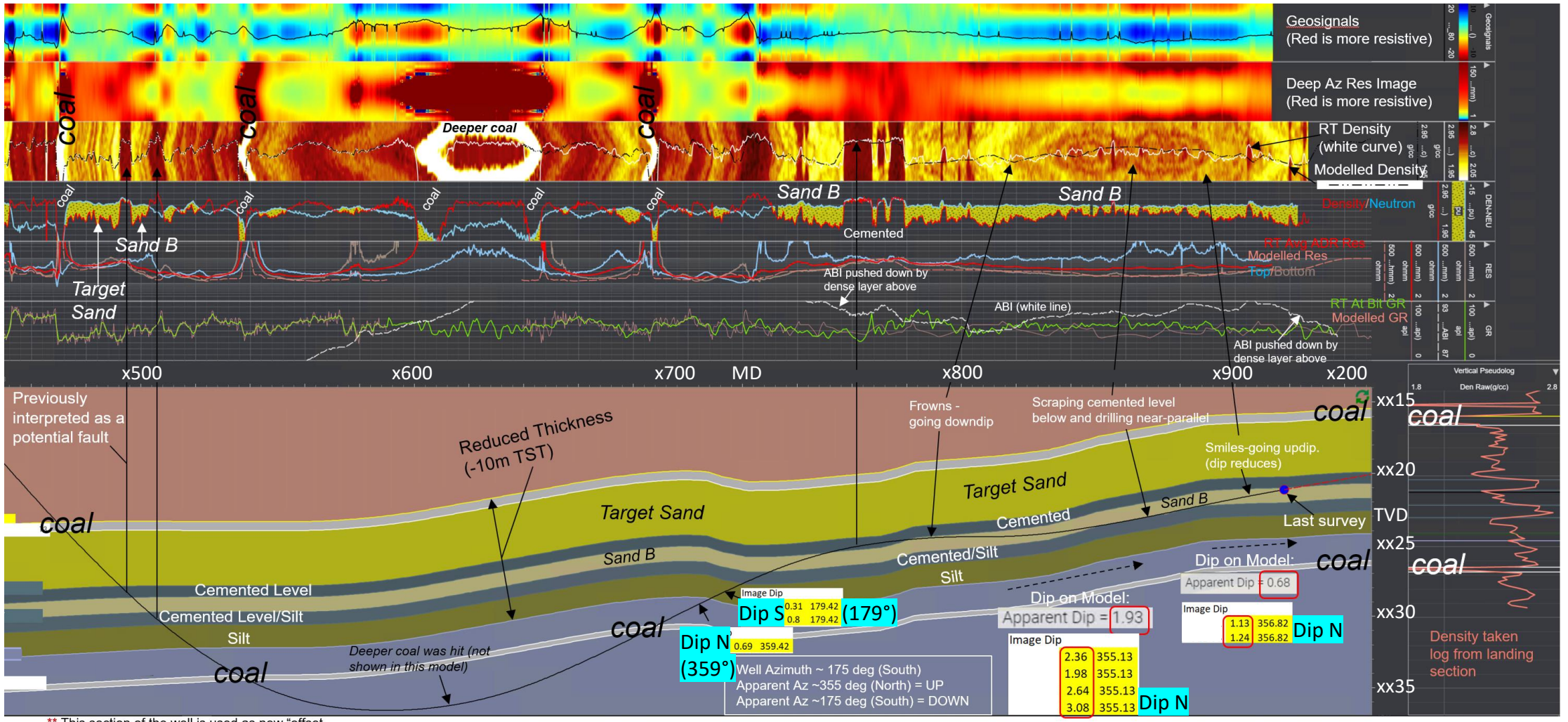

DAR Geosignal
DAR Resistivity
Density
Den/Neutron
DAR Resistivity
xx00
xx50
MD
Vertical Pseudolog
D95(ohmm)
0.2
2,000
xx10
xx15
xx20
xx25
Geology Image (ohmm)
Target SS
Cemented Level
coal
Silt

Well B/B1 - Prewell

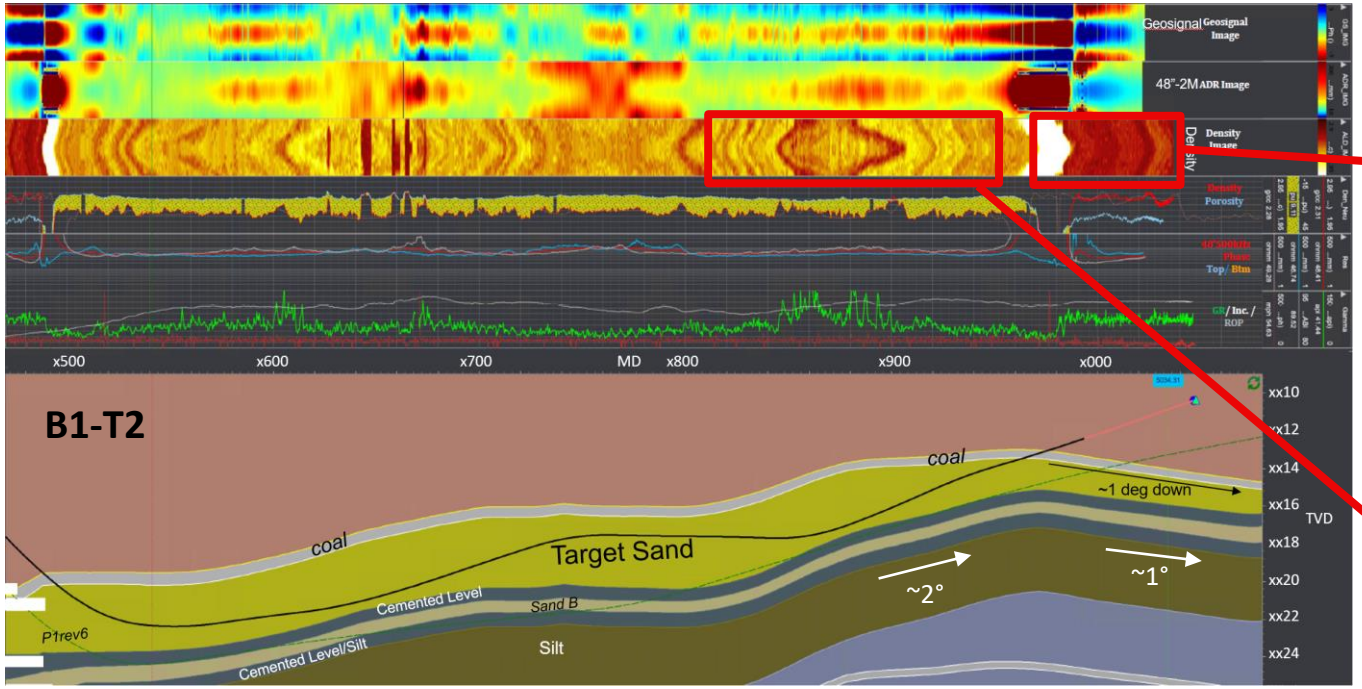


Well B/B1

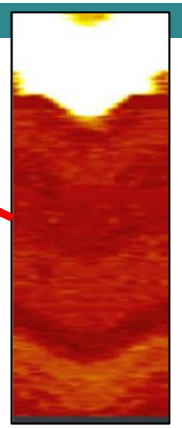




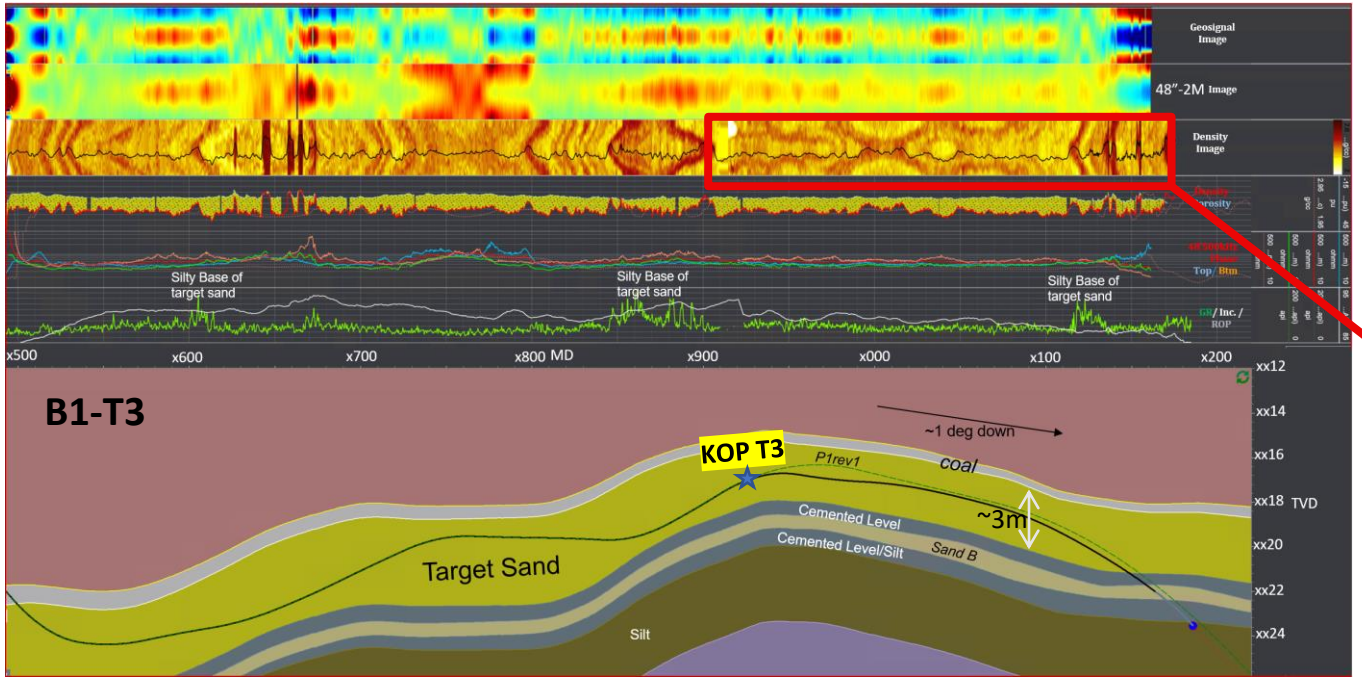
** This section of the well is used as new "offset well" to generate pseudo logs and adjust model



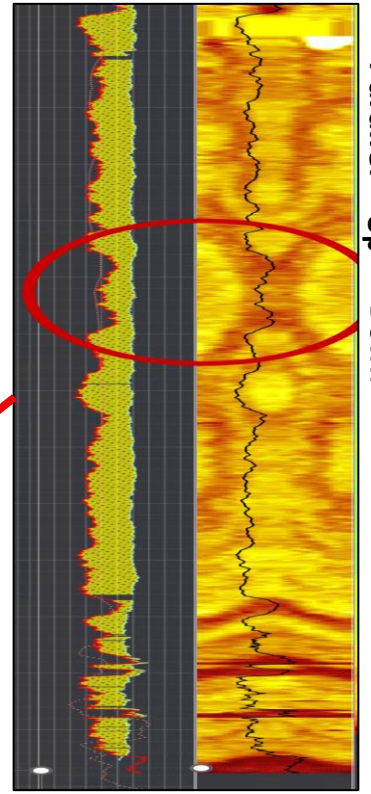
Ap Dip	Ap Az
0.89	175.4
1.04	175.4
1.26	176.4
1.38	173.55
1.36	173.03
0.74	172.44
0.81	172.44
1.14	172.44



Ap Dip	Ap Az
2.58	357.26
2.67	357.26
2.30	358.83
2.34	359.09
2.25	358.98
2.16	358.99
1.73	358.74
1.83	358.05

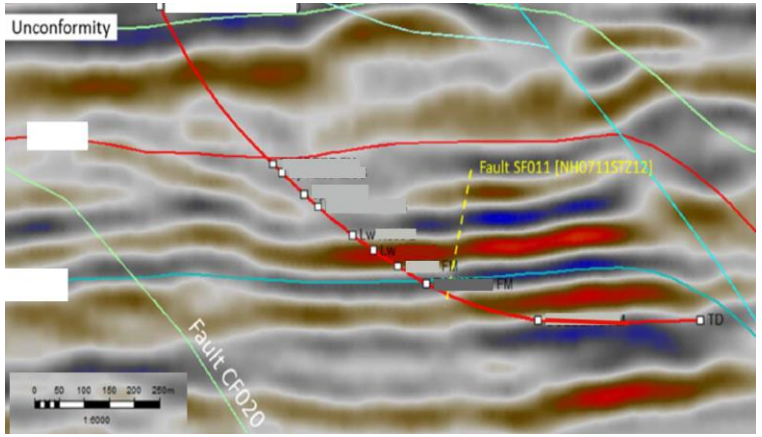


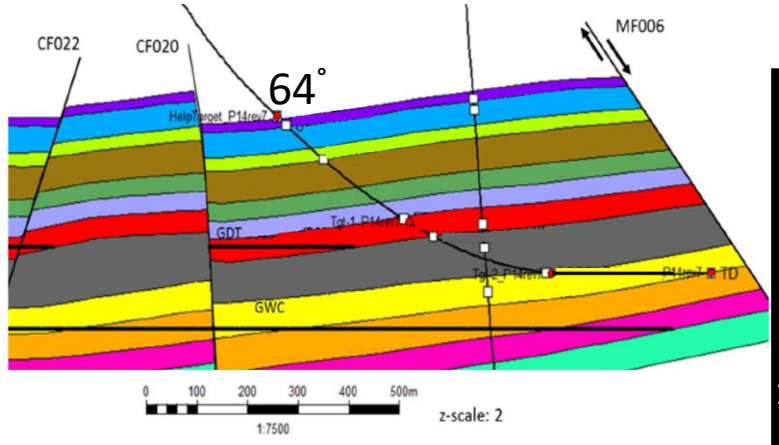
Ap Dip	Ap Az
1.36	187.34
0.13	184.97
0.28	179.89
0.56	179.89
0.24	179.89
0.2	176.81
0.26	176.81
0.11	176.81
0.18	176.81
0.16	179.31
0.96	359.31
0.7	359.31

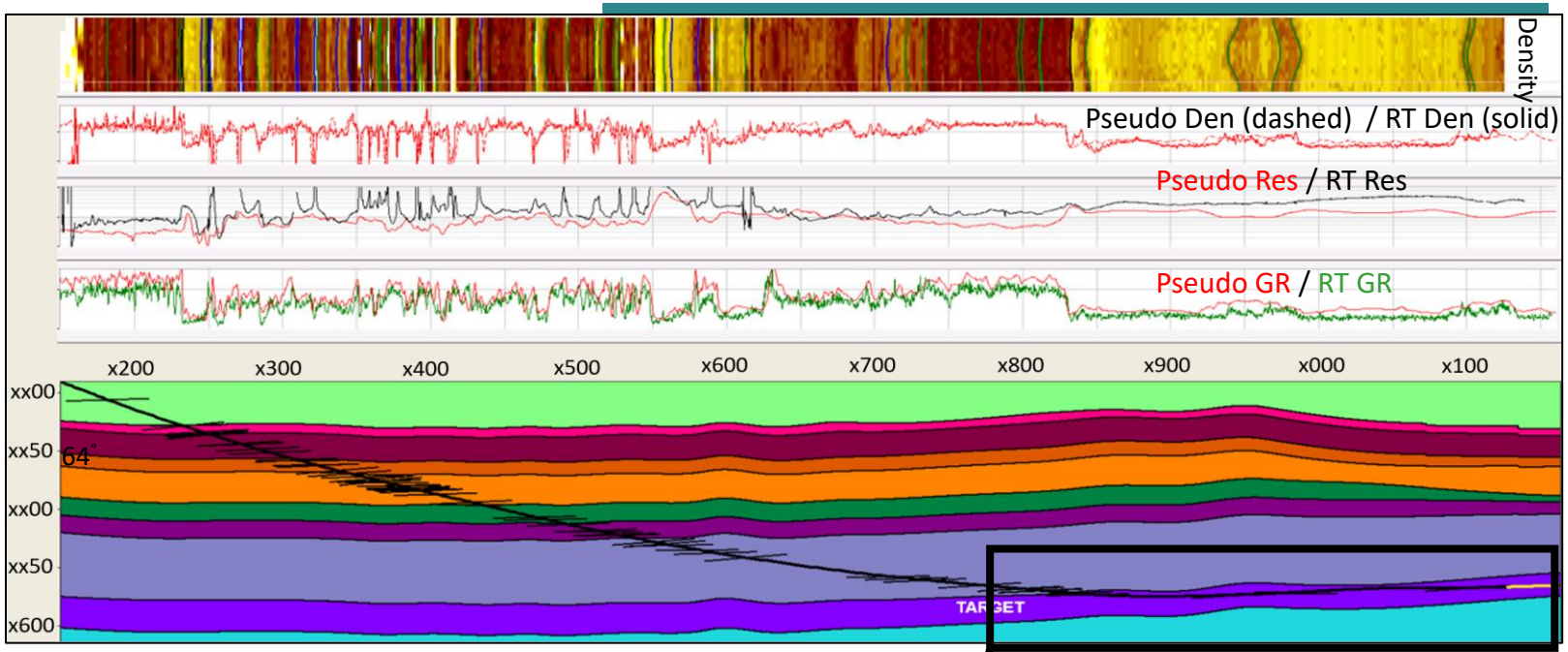


Parallel Up Down Parallel Down

Well B/B2

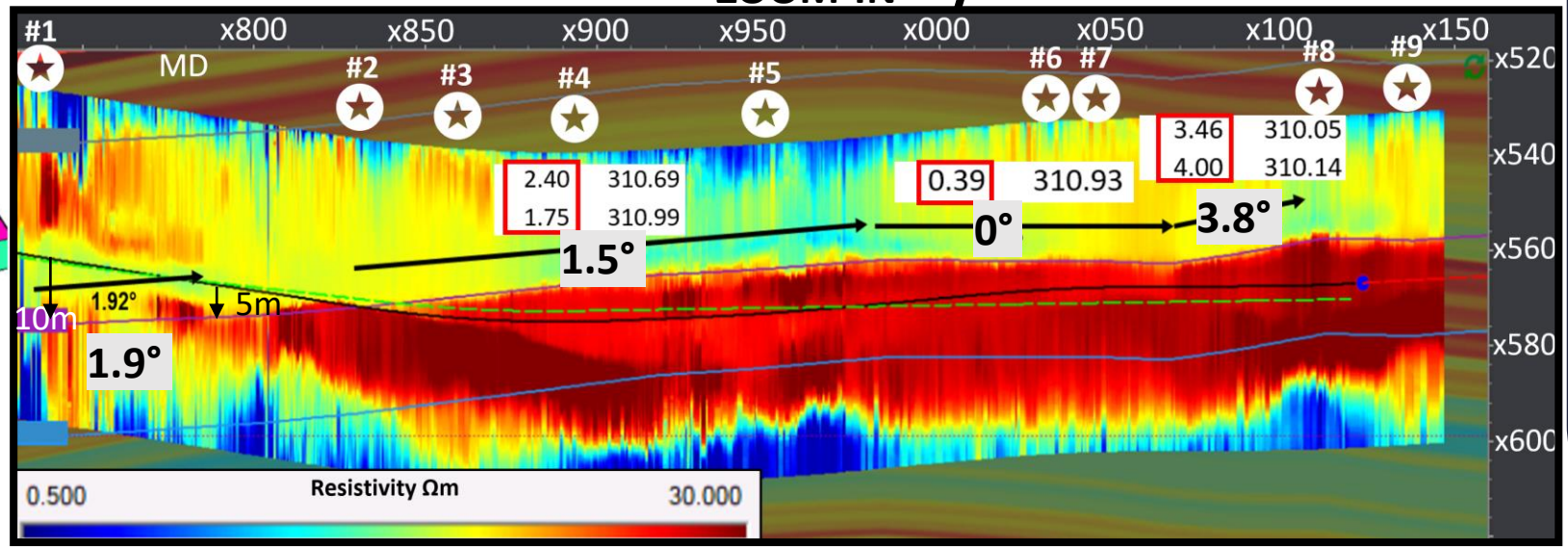




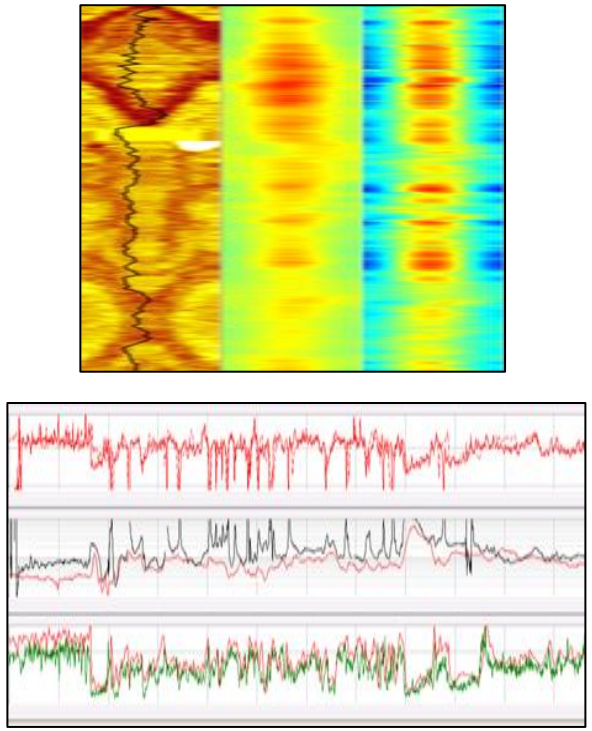


ZOOM-IN

ZOOM-IN



- Well log correlations and borehole imaging analysis are the cornerstones of high-angle/horizontal well interpretation. When used together with resistivity inversions these tools enhance our reservoir insight and improve confidence in our models.



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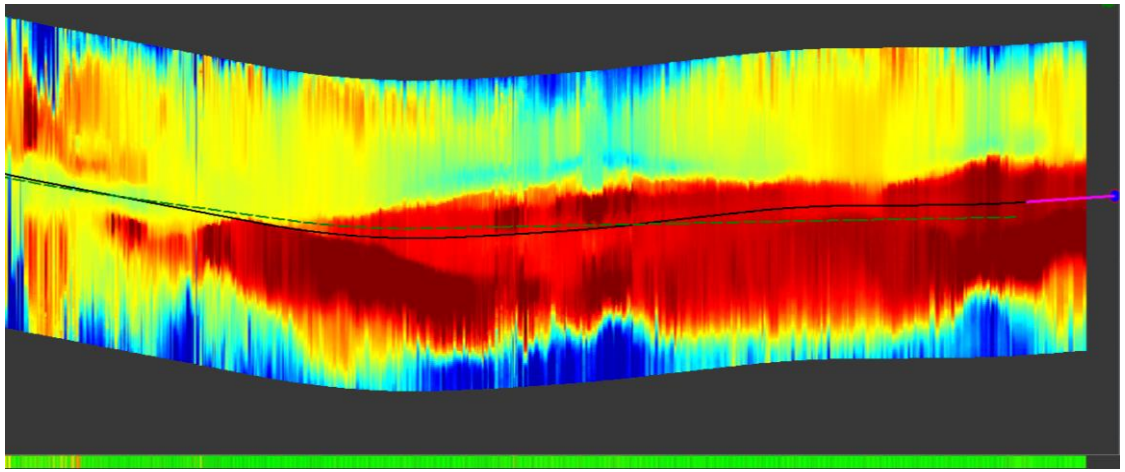

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THANK YOU