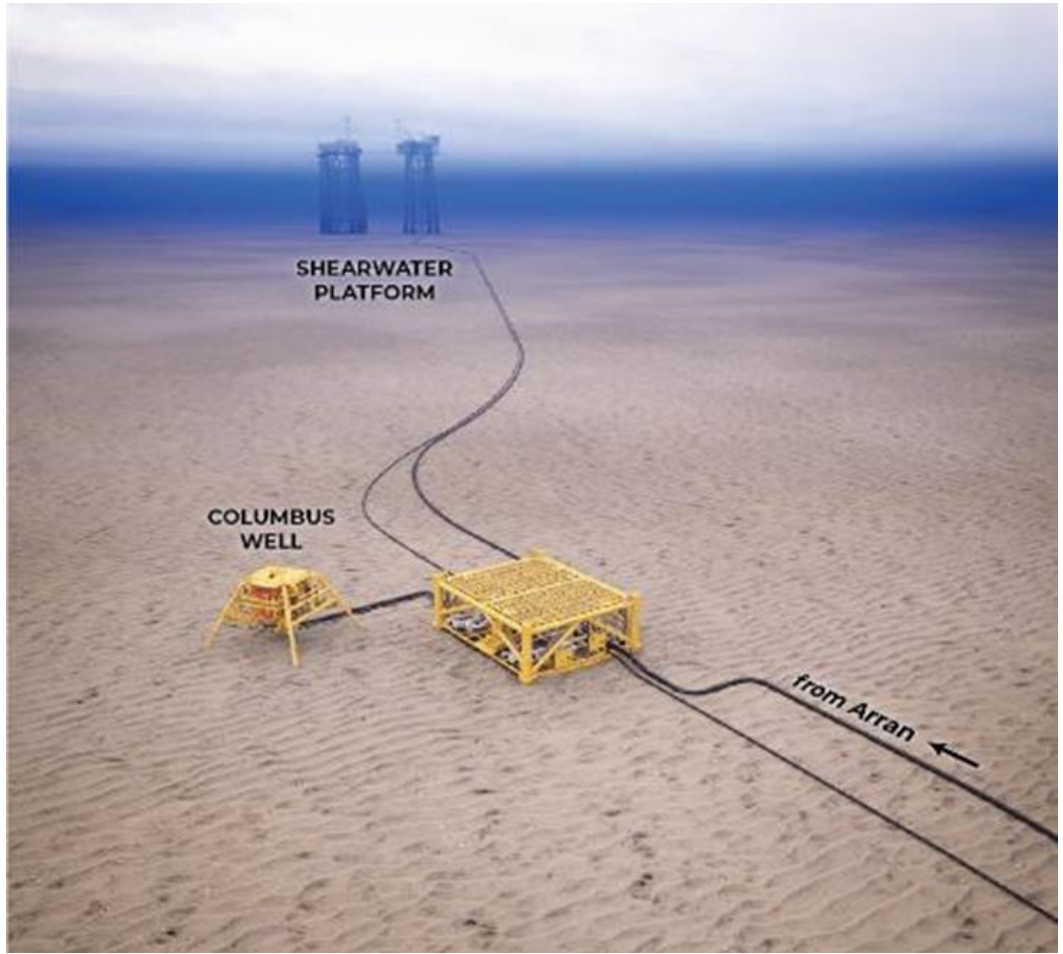
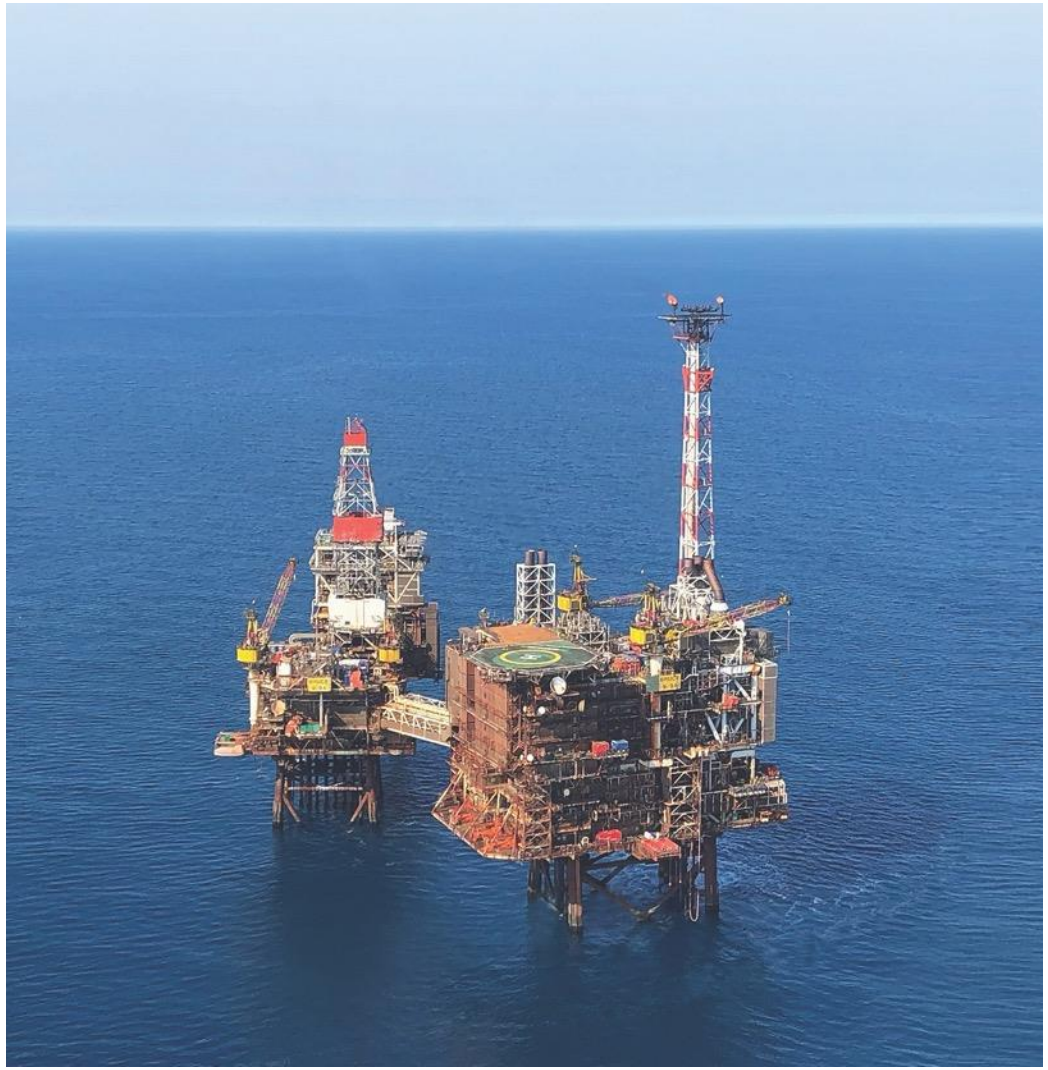
Use of GeoSphere HD in a low resistivity contrast Forties Reservoir to optimise drilling of the Columbus Field development well.

Robert Trythall, Stuart Hignett, Angus Ritchie – Serica Energy
Mike Bower – Schlumberger D&M

11th May 2022





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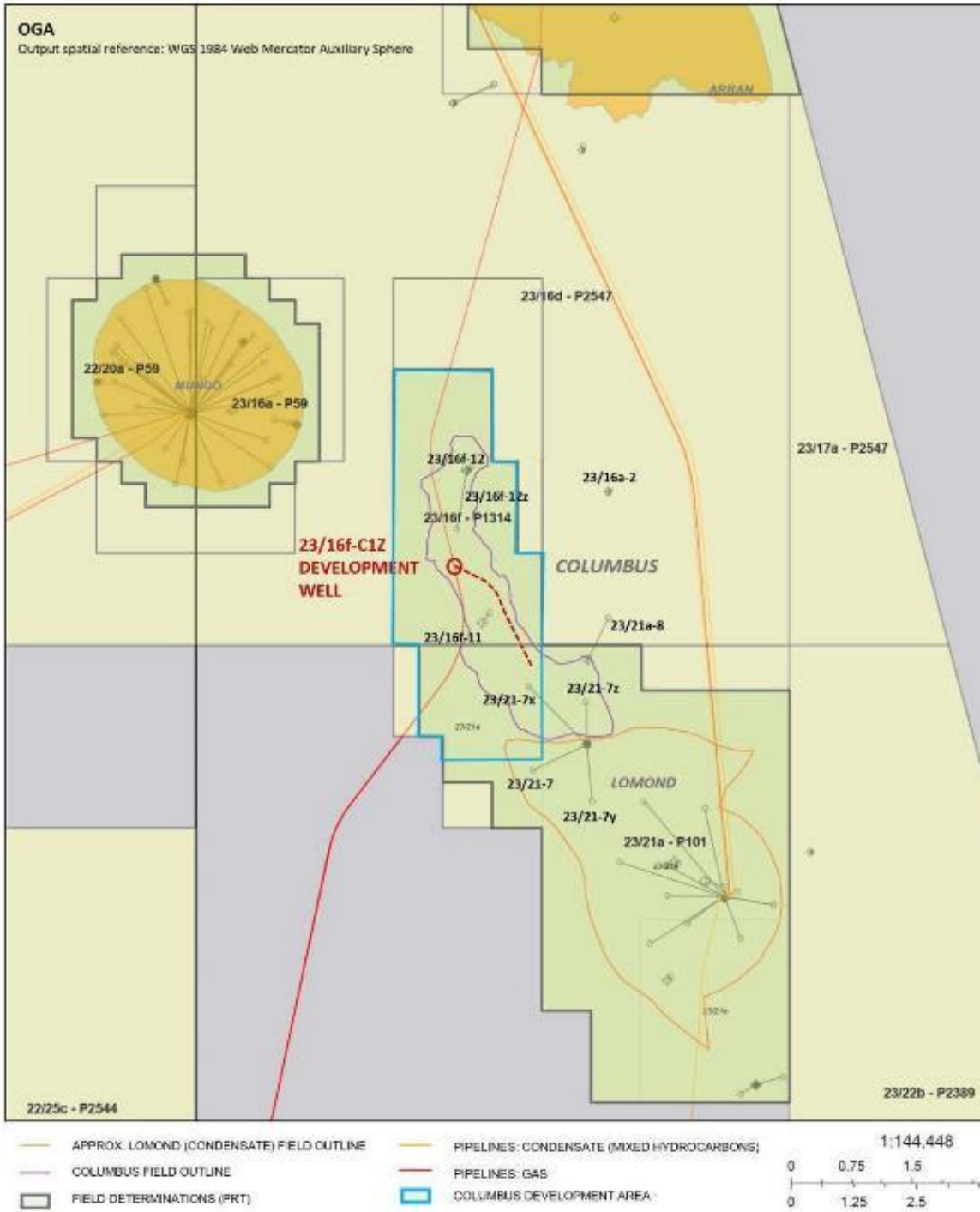
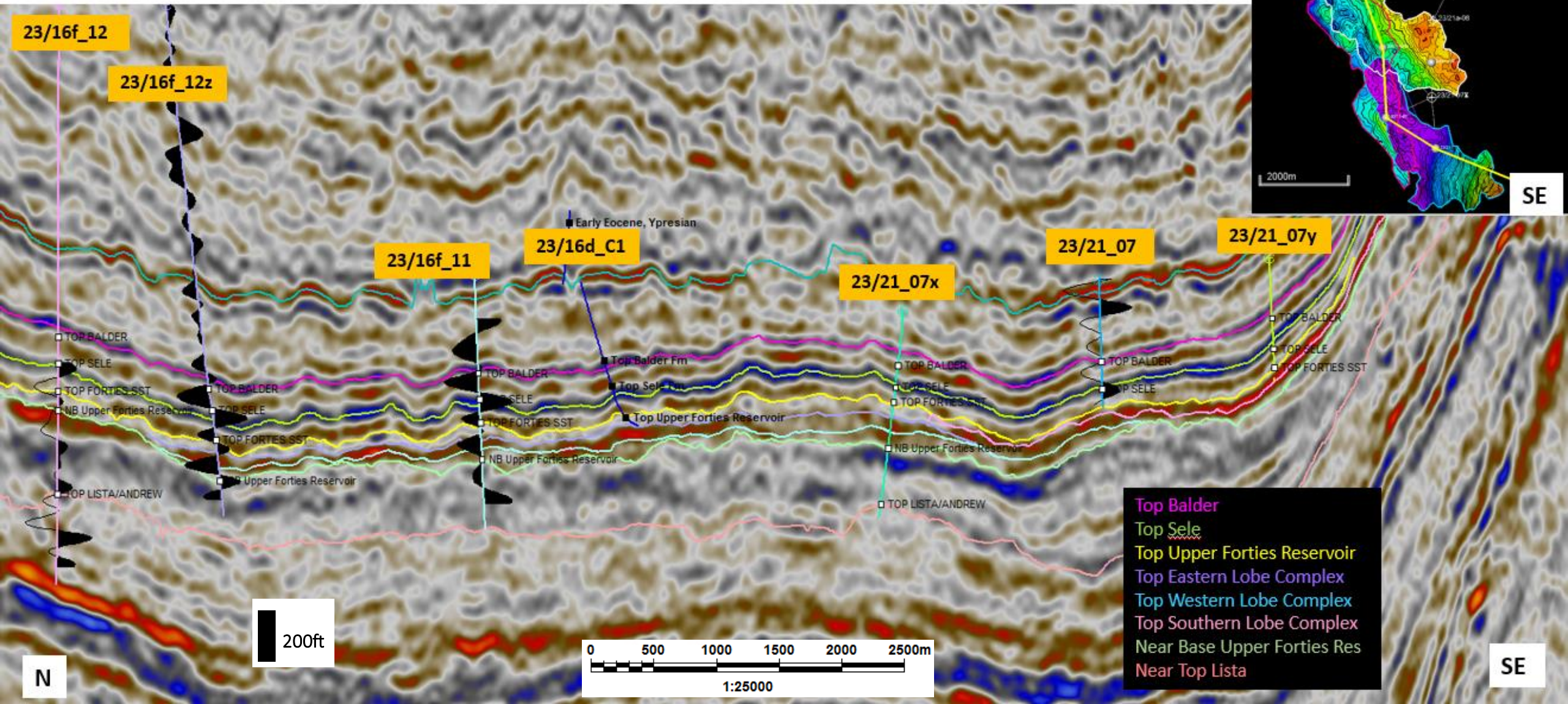
Columbus Field Development

- Licence P1314 (block 23/16f) and P101 Columbus Subarea (block 23/21a).
  - Partnership – Serica Energy, Tailwind Energy, Waldorf Production
- Upper Forties Sandstone Member (T75) reservoir.
- Located in the saddle between Mungo to the NNW and Lomond to the SSE.
- Combination structural and stratigraphical trap, pinching out against the Jaeren High to the east.
- Discovered in 2006 by exploration well 23/16f-11 (Serica).
- Appraised by wells 23/16f-12 & -12z in 2007 (Serica) and 23/21-7 & -7x in 2008 (BG Group).
- FDP submitted in 2018.
- Contains 88bcf GIIP (mid case) with a CGR of 38bbls/MMscf.
- Development well 23/16f-C1 & C1z drilled and completed March-July 2021 using the Maersk Resilient.
- The 5,000ft long horizontal reservoir section completed with sand screens.
- Tied into the Arran pipeline and produced via Shearwater.
- First gas 24th November 2021, with well rate constrained to 32MMscf/d.

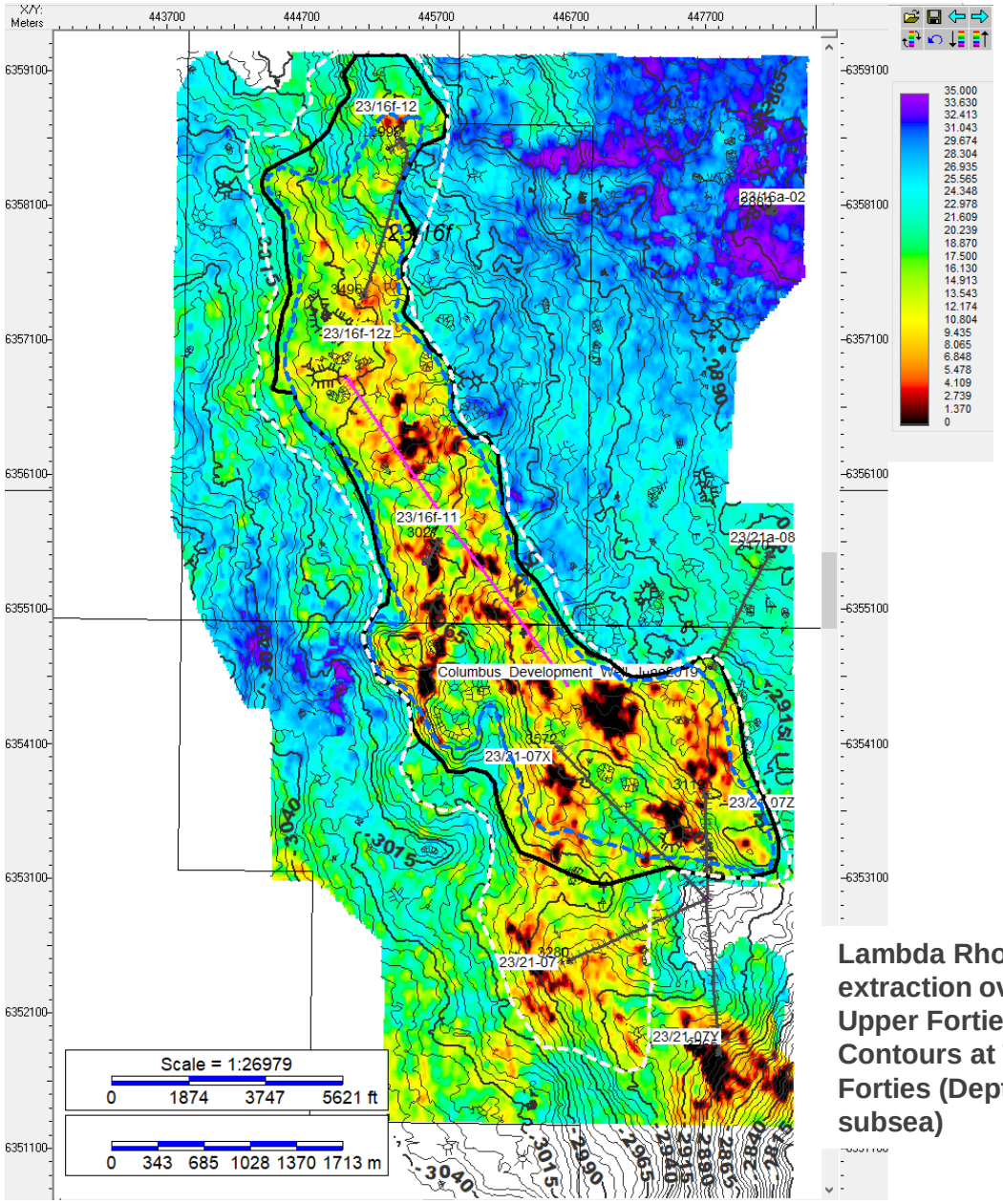


Well To Seismic Calibration

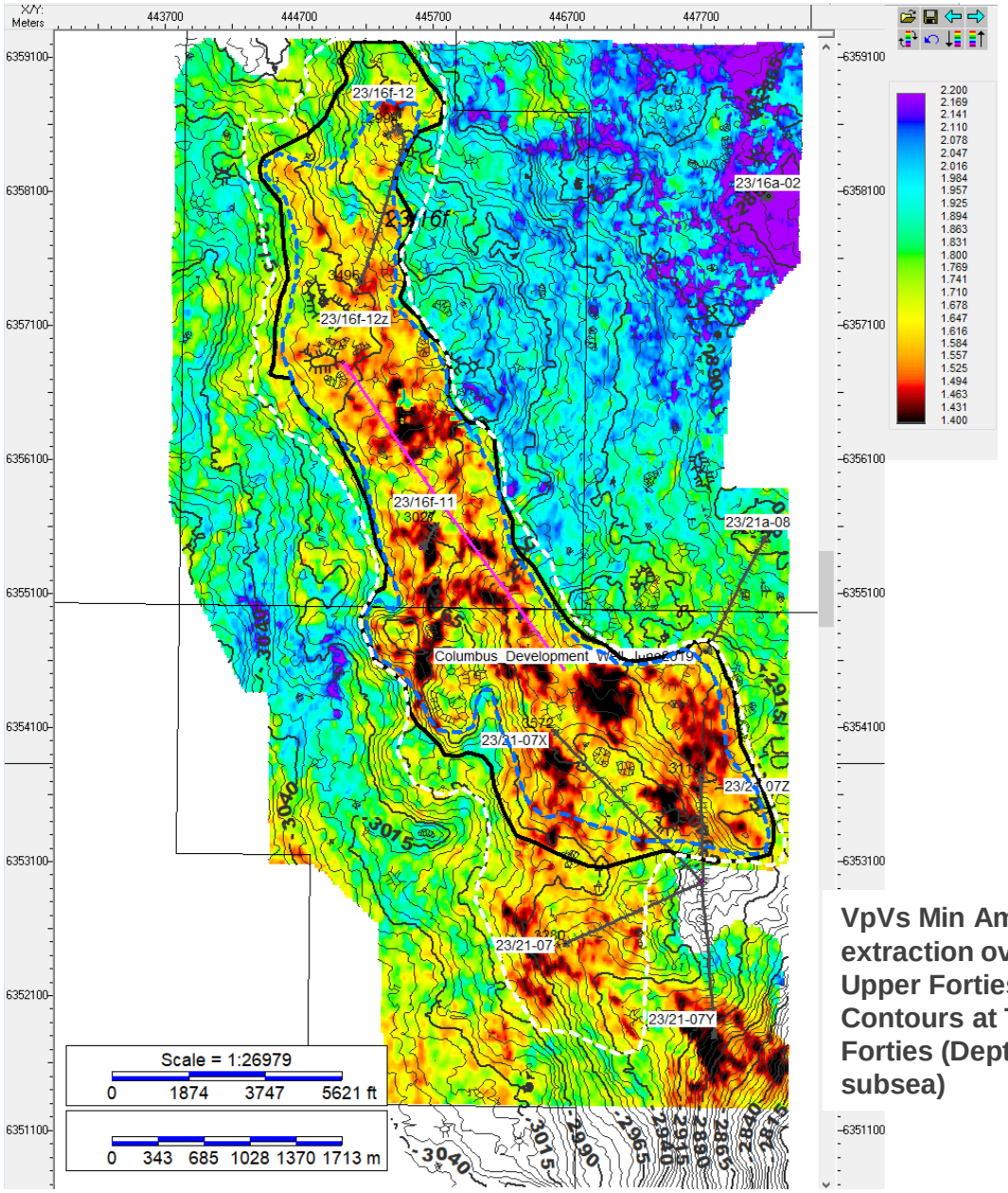
N-SE section: TWT, 12-22deg PSTM Stack



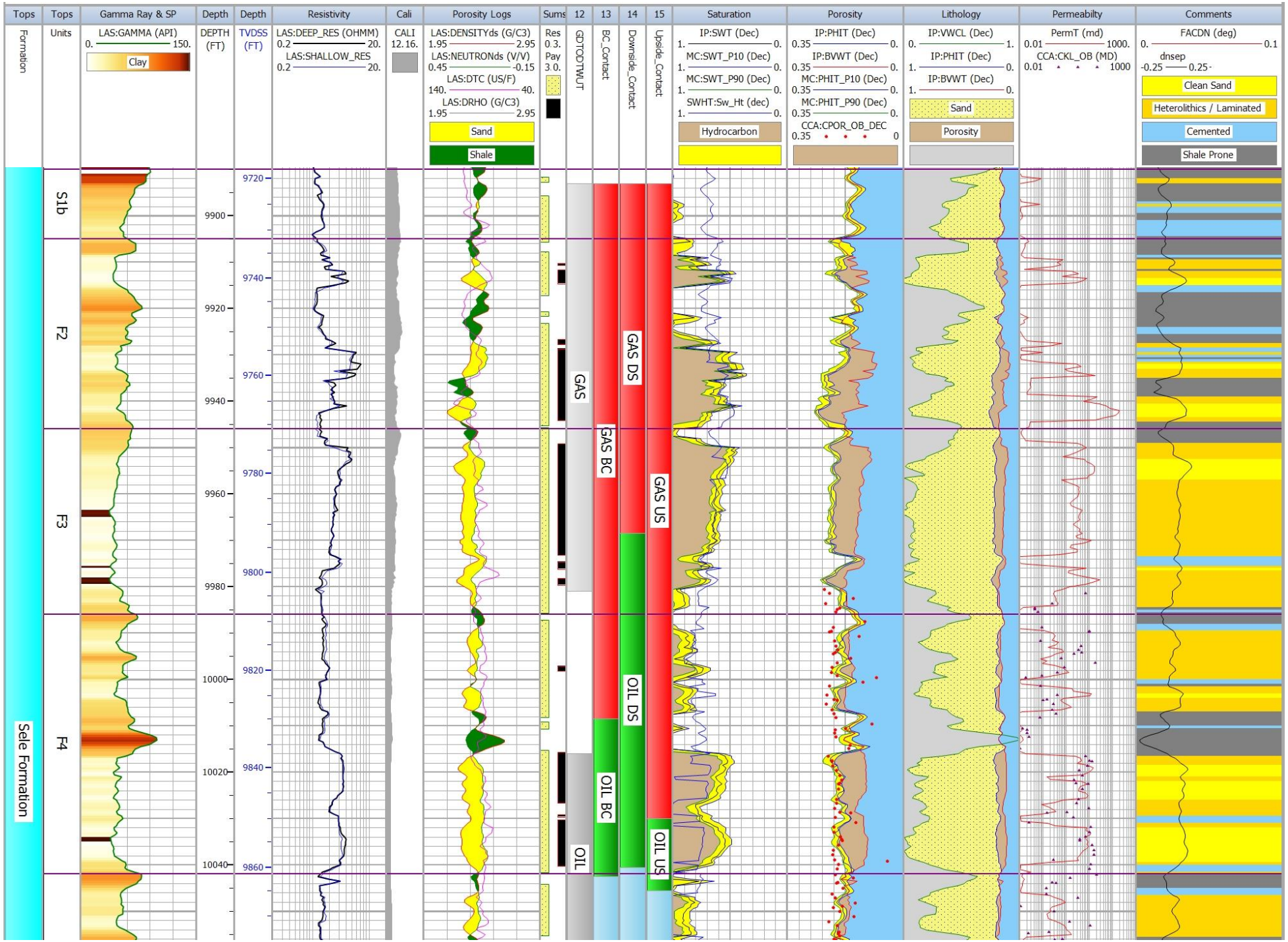
Columbus Seismic Inversion Attribute Extractions



Lambda Rho Min Amp. extraction over the Upper Forties Inteval; Contours at Top Forties (Depth, subsea)



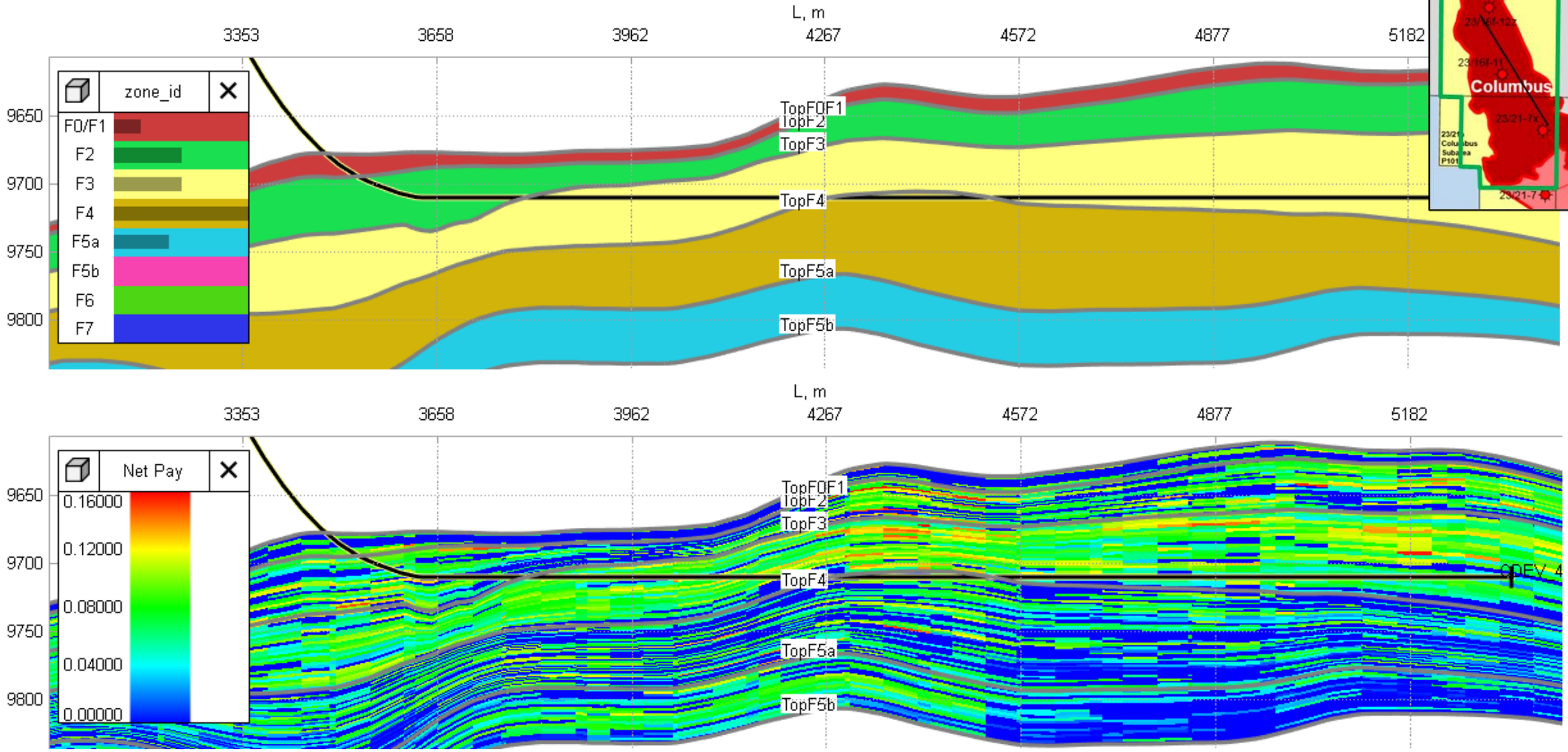
VpVs Min Amp. extraction over the Upper Forties Inteval; Contours at Top Forties (Depth, subsea)



Well 23/16f-11 CPI

- Low resistivity contrast between mudstones and gas bearing sandstones.
- High water saturation.
- Uncertainty over GOC and OWC.
- High porosity but low permeability.

Pre-drill Trajectory



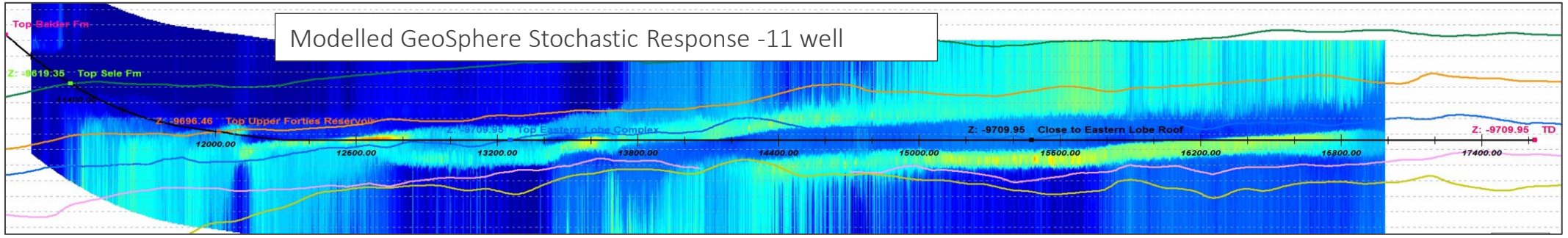
- Well drilled NNW to SSE at constant depth 9,710ft TVDss, giving sufficient stand-off from the water leg (uncertainty).
- Optimised to stay in the F3 zone as much as possible, but will also cross cut stratigraphy.

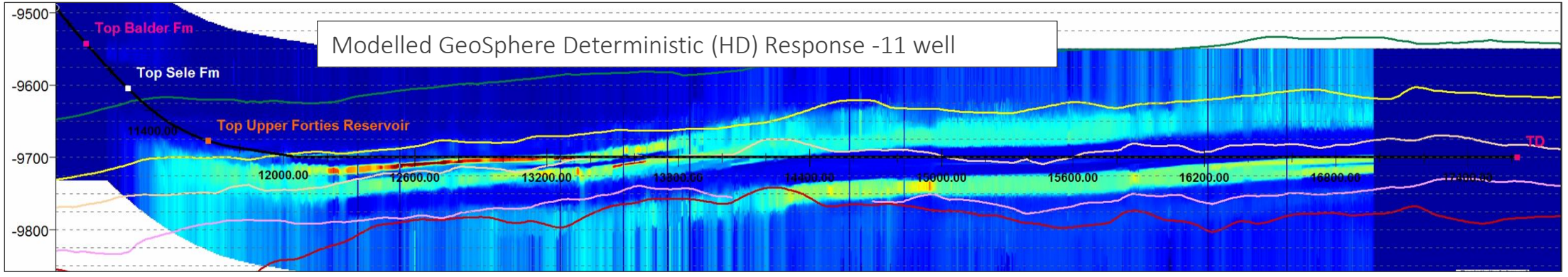
Columbus Development - Challenges

- Pre-drill a number of challenges were identified for the Columbus development well.
- Reservoir:
  - Comprises distal and marginal Forties Fan, with offset-stacked terminal lobe elements onlapping the Jaeren High. The reservoir is a complex mix of thinly bedded and strongly horizontally layered sandstones, siltstones and mudstones.
- Petroleum systems/contacts:
  - Columbus has had a complex charge history. Each E&A well drilled into Columbus has encountered a gas condensate with different contacts, with or without a thin oil rim and residual oil zone.
- Petrophysics:
  - Low resistivity contrast is a key challenge for Geosteering.
  - Mainly caused by high levels of bound water trapped in small pores, combined with relatively resistive mudstones and cements. There is also a variable salinity gradient observed across the Field.
  - Potential perched water zones – adds complexity to the saturation profile.
- Seismic:
  - Due to thin-bed reservoir, tuning effects and variable hydrocarbon type meant seismic inversion probability volumes were only used tentatively and were not relied upon as primary driver for well-planning
- The initial plan was to drill the development well at a single 5,000ft long horizontal depth, with a suitable stand-off from water.
- However, it was considered if the well could be geo-steered using Ultra Deep Resistivity Imaging (despite low resistivity contrast) and wellsite palynology.

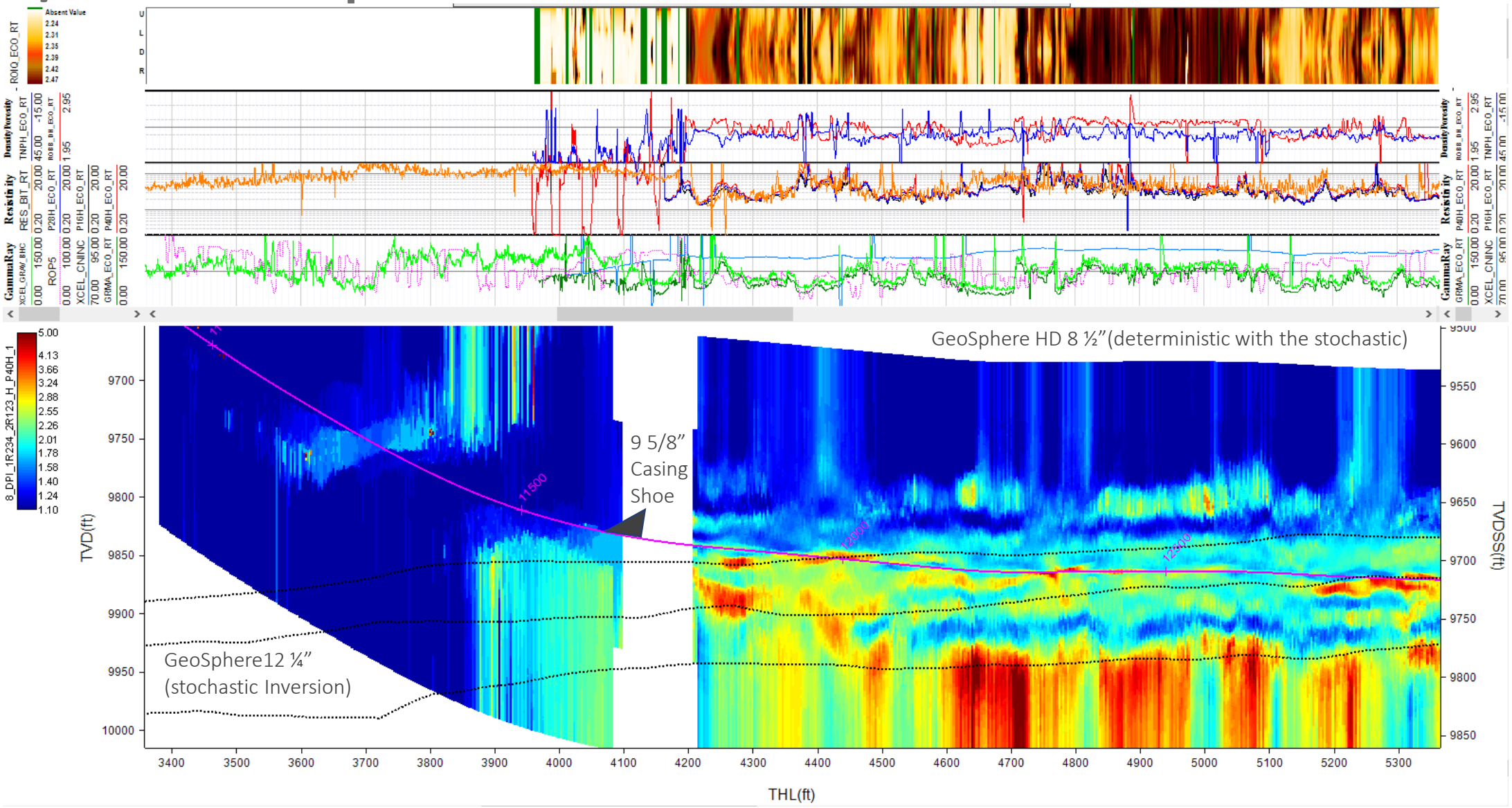
Detailed Trajectory Planning - GeoSphere

- Early in the well planning it was recognized that Ultra-Deep Resistivity had the potential to improve the ability to penetrate better quality sand packages.
  - There were concerns about limited resistivity contrast
  - Differing views within the team – Independent third party assurances sought
- Decision taken to model the likely response using the Schlumberger GeoSphere tools
  - Modelled successfully, despite the low resistivity contrast
  - 23/16f-11, -12z and 23/21-7x wells provided assurance during modelling
- Some concerns (Dog Leg Severity related) around pro-actively steering/chasing sands



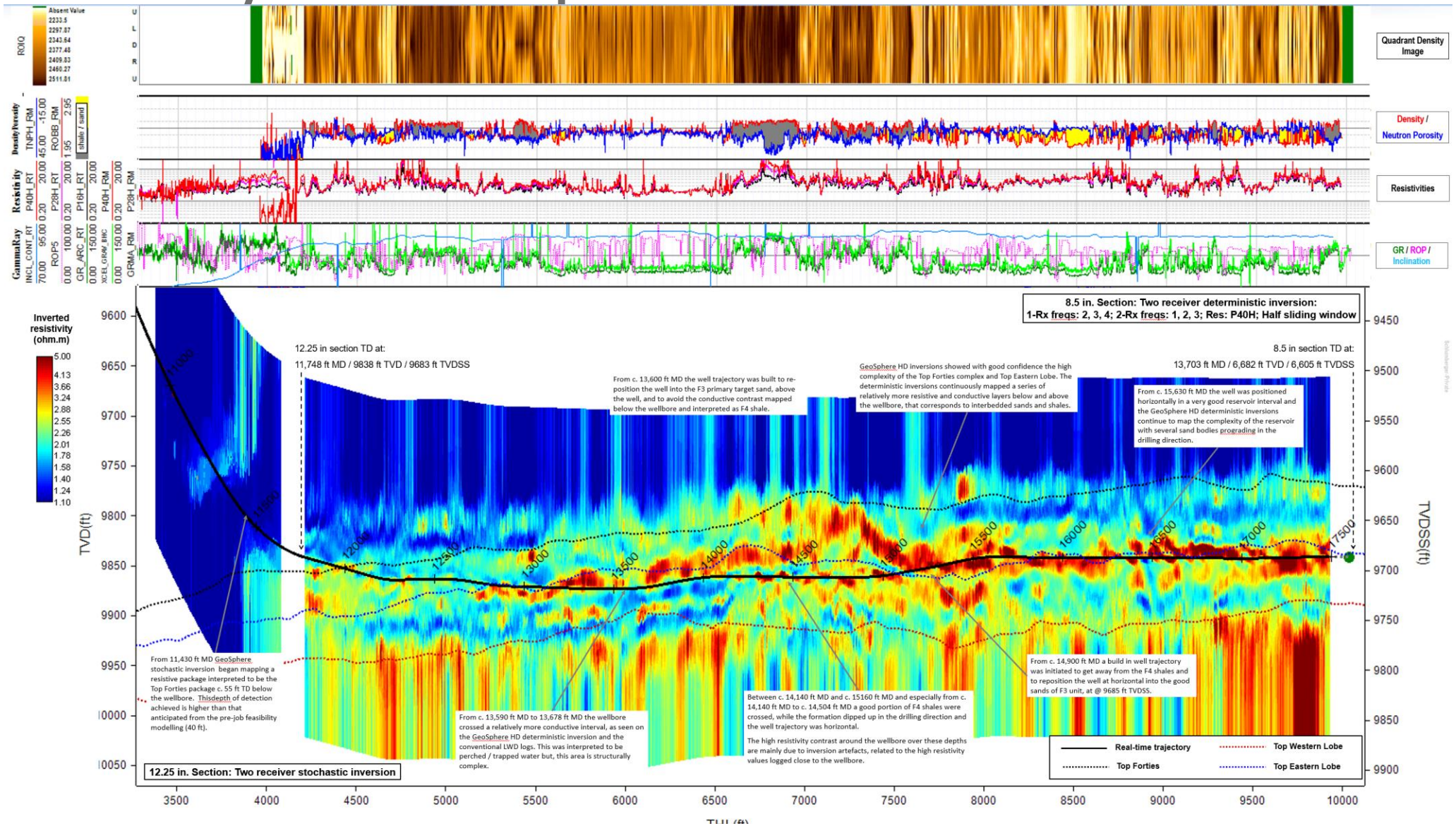


23/16f-C1 GeoSphere 12 ¼” Land Out Control



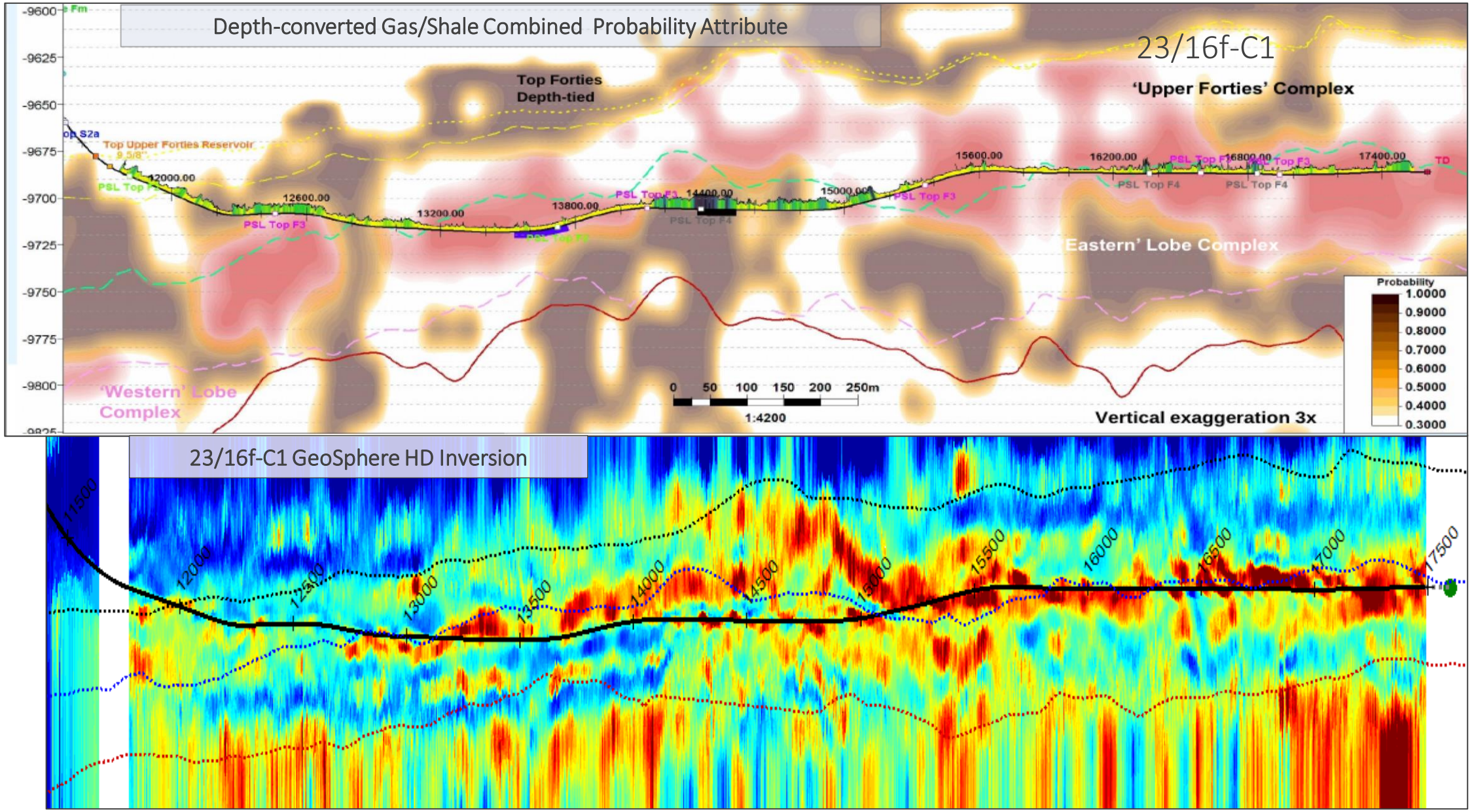
- GeoSphere used to verify correct structural setting vs. Forties Sands (warmer colours) below well path on final approach.
- Confirmation started ~300ft MD prior to 9 5/8” casing point. No trajectory adjustment necessary.
- Good result in a relatively low contrast environment

Columbus 23/16f-C1 GeoSphere HD Results



- Planned reservoir section drilled, mainly in sands (warmer colours), Better sands towards toe of well and in Zone F3 rather than F4.
- Trajectory maintained shallower than pre-plan had suggested (followed sands), some shale sections encountered (grey shading).
- LWD image data proved invaluable in structural interpretation.

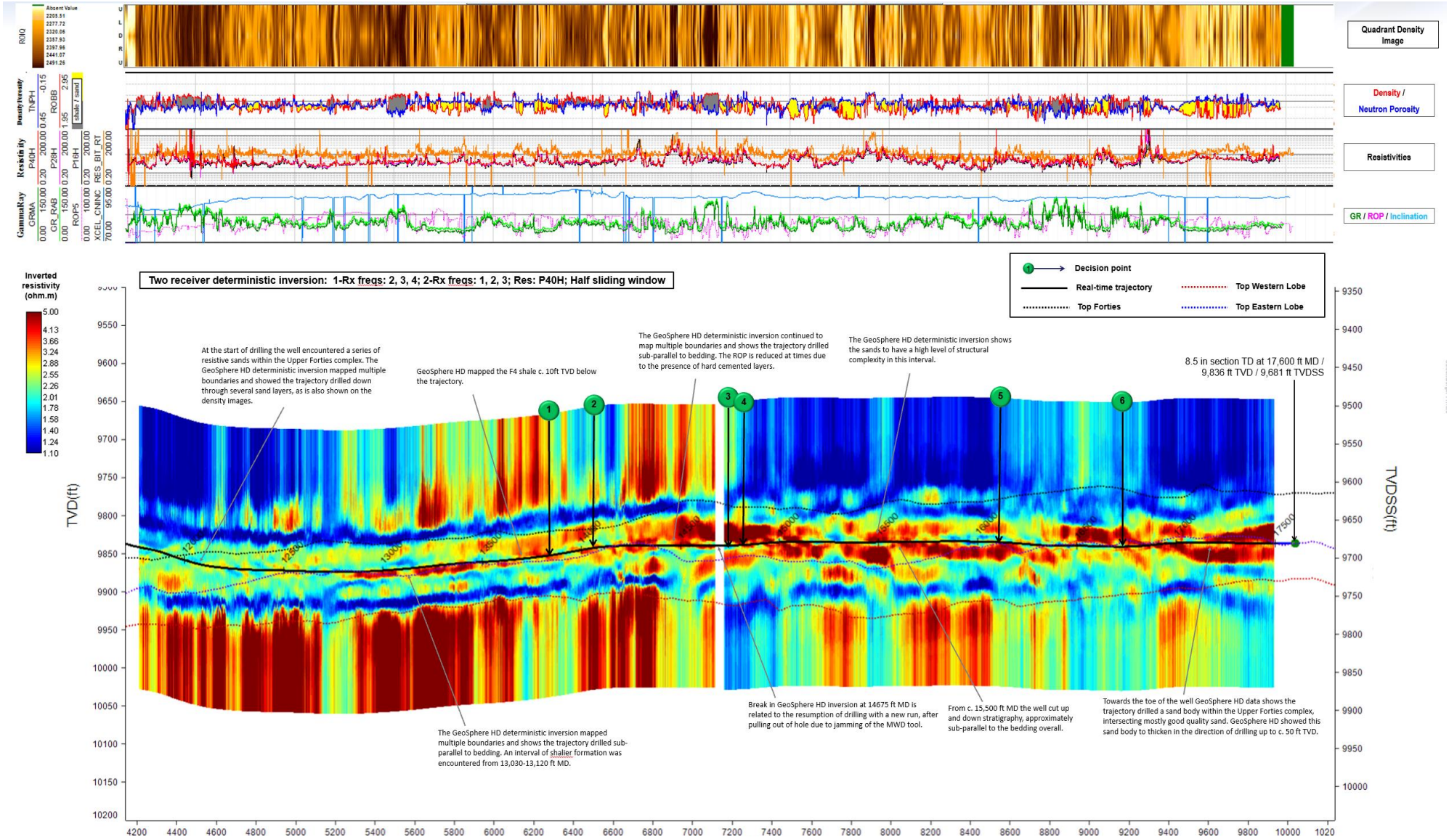
Comparison of Seismic Probability Volumes vs. GeoSphere HD



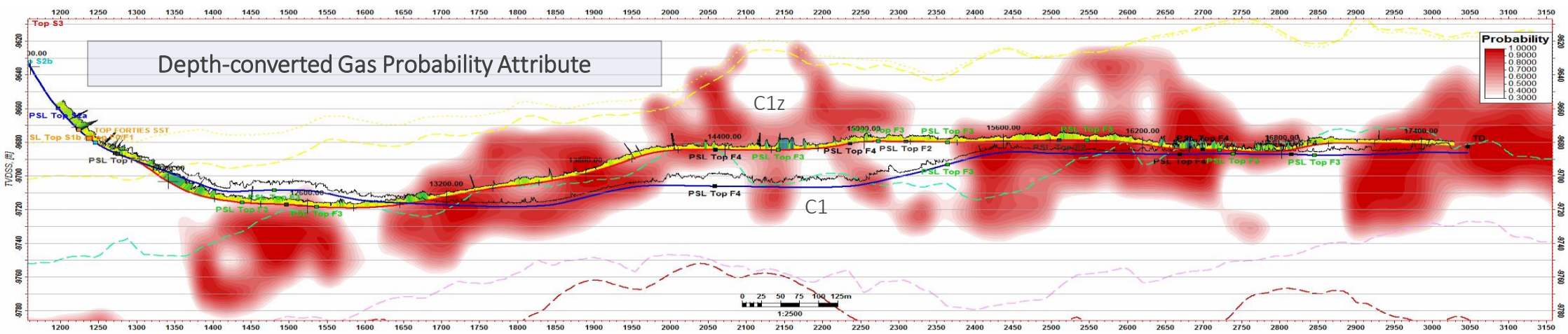
Columbus 23/16f-C1z sidetrack

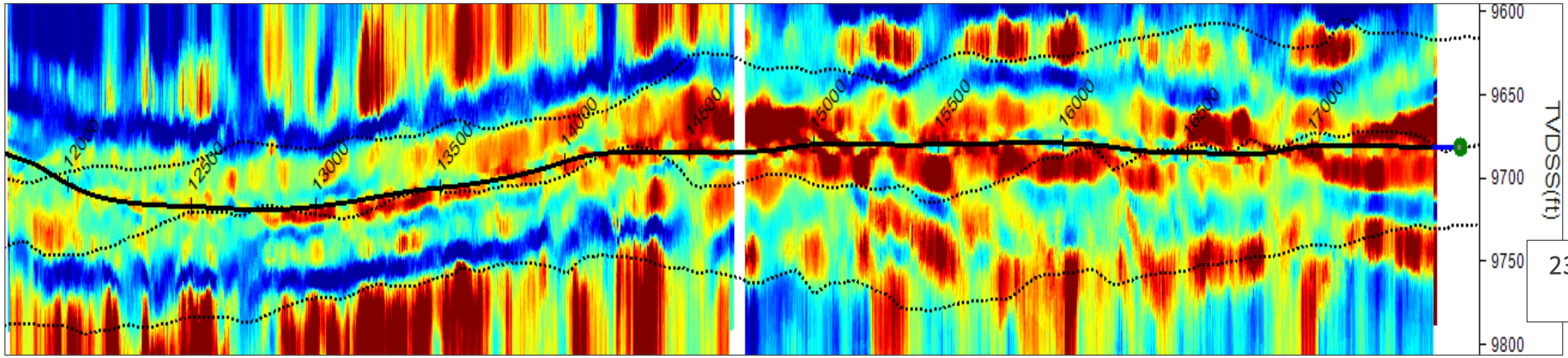
- The sandscreen completion in C1 got stuck in the older F4 mudstone section in the middle of the well.
  - No instability encountered while drilling or during clean-up.
  - Had to sidetrack and drill C1z.
- Gave an opportunity to integrate GeoSphereHD with the seismic probability volumes, and plan a better trajectory for C1z.
  - Drilled deeper initially to pick up better heel sands
  - Thereafter climbed shallower than C1 to avoid mid-section F4 Zone mudstones
  - Drilled and remained within F3 Zone sandstones. Overall, the C1Z bore successfully tracked better quality sands
  - Overall Increased net sand penetration
    - C1: Net Sand 3,692ft and N:G of 63%
    - C1z: Net Sand 3,796ft and N:G of 65%
  - Mainly avoided the (F4) shale sections, also avoided higher water saturation zones
- LWD failure mid-section required trip.
  - Sensor-receiver combination changed mid-well due to bit trip. Visible on curtain section (next slide)

Columbus 23/16f-C1z Sidetrack GeoSphere HD Results

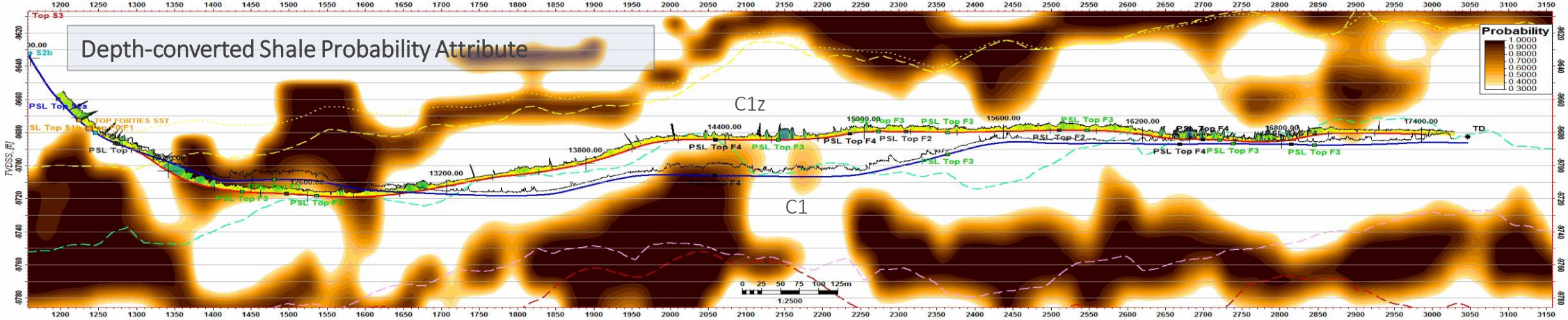


- Re-planned reservoir section targeting sands (warmer colours)
- Trajectory was shallower than main bore, avoided shale sections (grey shading)
- Successful use of GeoSphere HD for optimal sidetrack planning

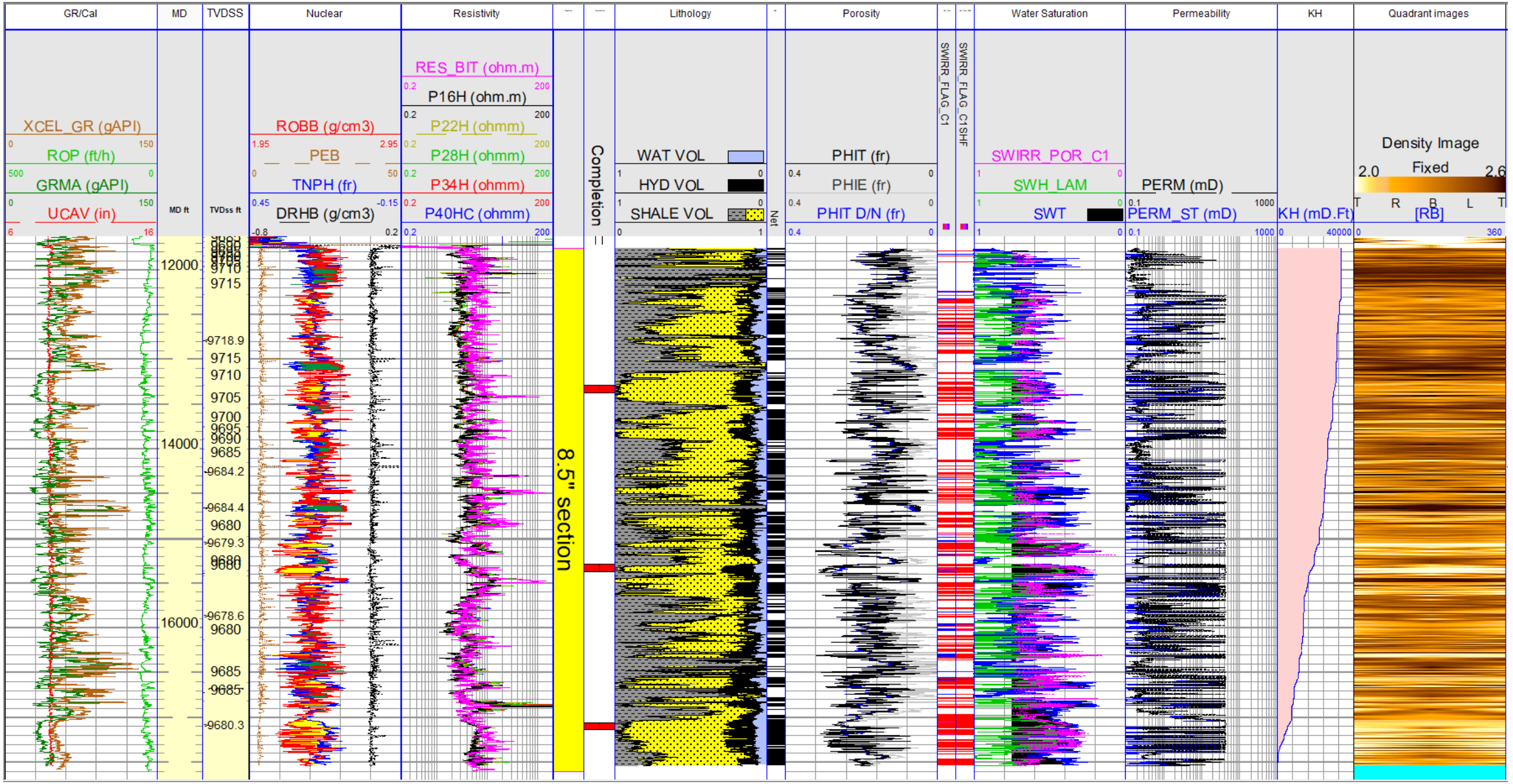




23/16f-C1z GeoSphere HD Inversion



Well 23/16f-C1z CPI Results



- Net sand 3,797ft, Net Pay 3,267ft, PHIT 19.4% (net), SWT 48%, KL 33,600 mDft
- Pre-drill minimum net sand 2,500 ft, min KL 2,500 mDft (target 4,600ft and 13,000 mDft)

Columbus 23/16f-C1&C1z GeoSphere HD Lessons Learned

- GeoSphere HD (Stochastic / Deterministic HD) in 8½" hole successfully met its objectives.
  - Stochastic – 1 receiver, reliable closer to the well for detail.
  - Deterministic – 2 receivers, more detail further from the well and more "geological".
- Confirmed the C1 land-out of the 12¼" hole into the Upper Forties and confident 9 5/8" casing shoe pick.
  - Provided appropriate heads up of approaching Upper Forties reservoir
- Facilitated optimisation in the C1 well bore
  - Flagged early on, that the C1 trajectory needed to stay shallow early in section.
  - Better younger F2 and F3 Zone sands were able to be targeted.
  - Wellsite palynology identified that mudstones at the top of the deeper F4 Zone had been encountered.
  - Prior to C1 completion issues, it had been recognised as desirable to avoid long shale sections
- Developed a calibration between the GeoSphere and the pre-drill seismic attribute (gas/shale/water) volumes which gave an idea of the targets going forward in the C1 well
  - C1 well was optimised shallower than planned, yet still penetrated mudstone, proved problematic during running completion.
- C1z sidetrack was planned using C1 Geosphere inversion curtain.
  - Shallow placement with shale avoidance was enabled by this service.
- Good operational integration enabled between subsurface, wells and Schlumberger teams.