



**i3 ENERGY**

# Relinquishment Report

Licence P.1987

Block 13/23d

UKCS

March 2021

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## 1. Licence Information

### Licence Information

Licence Number	P.1987
Licence Round	27th
Licence Type	Traditional
Block Number	13/23d

### Equity Holdings

Upon Award:

Dana Petroleum (E&P) Limited 100% (Operator)

Upon Relinquishment :

i3 Energy Limited 100% (Operator)

*i3 Energy confirms that OGA is free to publish this report and that all third party ownership rights have been considered and appropriately cleared for publication.*

## 2. Licence Summary

Licence P.1987 was relinquished as of 31<sup>st</sup> December 2020, the end of the second term of the licence.

Block 13/23d (Figure 1) was awarded to Dana Petroleum (E&P) Limited (Operator 100%) on 1<sup>st</sup> of January 2013, with an obligation to drill a well to a depth of 5,414ft (1,650,) TVDs to penetrate the Lower Cretaceous Captain Sandstone member on the 'Liberator' prospect.

This obligation was duly discharged by the drilling of well 13/23d-8, which spudded on 28<sup>th</sup> October and reached TD on 11<sup>th</sup> November of 2013. The well encountered 181ft TVT (gross) of Upper Captain Sandstone of which 169.5ft TVT was deemed to be net reservoir, the uppermost 22ft TVT of which was hydrocarbon bearing – the 'Liberator' discovery (see Figure 7).

The entire P1987 Licence was acquired from Dana by i3 Energy Limited on 28<sup>th</sup> December 2016 with an obligation to drill a further well within the licence, or to submit a Field Development Plan for the 'Liberator' discovery.

This obligation was duly discharged by the drilling of well 13/23c-11 which spudded on 8<sup>th</sup> November and reached TD on 25<sup>th</sup> November 2019. The well was drilled directionally from a surface location within block 13/23c (Licence P2358 – i3 Energy 100%) to a TD within block 13/23d to appraise the 'Liberator' discovery. The well encountered 202ft MT (153ft TVT) of good quality Captain Sandstone, all of which was water bearing.

## 3. Work Programme Summary

Upon acquiring Licence P1987, i3 Energy accepted a work programme of either –

1. Submitting a Field Development Plan for the 'Liberator' oil discovery or
2. Committing to drilling an appraisal well on the 'Liberator' discovery.

i3 Energy initially explored the option of developing 'Liberator' with a single horizontal production well to be drilled from, or adjacent to, the 'Blake' field template in block 13/24b but concluded, after discussions with Repsol-Sinopec ('Blake' Field operator) that a separate tie-back to the 'Bleo Holm' FPSO from a wellhead location within adjacent block 13/23c (also i3 Energy 100%) offered more capacity and security of service.

i3 Energy, following further discussions with Repsol-Sinopec, and after funding development feasibility and capacity studies, prepared a phase one development plan for a two well tie-back to the 'Bleo Holm' as a precursor to further appraising the western extension of the 'Liberator' closure within block 13/23c, which had been acquired by i3 Energy in the UKCS 30<sup>th</sup> Round of licencing.

In late 2019, i3 Energy commenced a three well drilling campaign in adjacent block 13/23c, two of which wells were designed as pilot wells for the phase one production well locations. The first of these, well 13/23c-9 penetrated a four-way-dip closed area within the overall 'Liberator' closure at an elevation predicted to be 80-100ft above the top of the hydrocarbon column encountered in the discovery well, 13/23b-8 (see figure 2).

Unfortunately, the upper of the two Captain sand sequences encountered in the discovery well was not present at this location and the lower sand was encountered below the area wide oil-water contact.

Immediately following this well, a thorough review of the seismic interpretation was conducted, and it was concluded that the TGS MF 10 3D data (see Figure 2), the interpretation upon which the location of the 13/23c-9 well had been based, was inadequate to resolve the distribution of the Captain Sandstone in this area, and that the 2018 reprocessing of the 2013 Polarcus PSTM data provided a significant uplift in resolution.

Accordingly, i3 Energy immediately acquired the TGS MF18 PSTM seismic data over both 13/23c and 13/23d (see Figure 6) and proceeded to remap the greater 'Liberator' closure to precede a review of the location of the second pilot hole to be drilled by well 13/23c-11.

The well was drilled in November 2019, from a surface location within block 13/23c to a TD location within 13/23d (see Figure 3) and encountered 202ft MT (153ft TVT) of high-quality Captain Sand below the area wide oil-water contact. LWD logs and evaluations of cuttings showed no evidence of hydrocarbons (see Figure 15).

As the well had failed to encounter hydrocarbons, and since the LWD data was of good quality, the planned wireline programme was curtailed and comprised a shear wave sonic run to complement the LWD data, and the acquisition of formation pressure data. Thereafter, the well was plugged and abandoned.

## **4. Database**

### **Seismic Data used in the interpretation of the Liberator area**

i3 Energy's initial seismic interpretation of 13/23d was carried out on 50 sq. km of the pre-stack time-migrated TGS-MF10 seismic dataset, considered to be the best quality available (at that time) over the Liberator field and, to the west, the 1996 Q13 Phase1 Western Geco survey, of similar quality. The interpretation was extended sub-regionally toward North, East, and South using HESS 1992 data and mega-merge Phoenix 3d data to the West (see Figure 4).

Upon the award of adjacent block 13/23c to i3 Energy (100%) an additional volume of TGS-MF10 data was acquired, which provided complete cover of 13/23d in addition to covering most of 13/23c (see Figure 5).

Upon the failure of well 13/23c-9 to encounter the Upper Captain Sand unit, which had been oil-bearing in the Liberator discovery well (13/23d-8), i3 Energy reviewed the TGS

MF18 PSTM reprocessing of the Polarcus 2013 data over both 13/23c and 13/23d and acquired an equivalent volume over both blocks (see Figure 6). Two years previously, the initial processing of the Polarcus data had been reviewed and, in that version, was not considered to be an improvement on the TGS MF10 data.

i3 Energy then proceeded to remap the greater 'Liberator' closure leading to the selection of the location of a second pilot hole to be drilled by well 13/23c-11.

### **Wells within Block 13/23d (P1987)**

The only well drilled within the licence area prior to its acquisition by i3 Energy is the Liberator discovery well, 13/23d-8, drilled by Dana Petroleum in 2013.

#### *Well 13/23d-8 - Petrophysical Analysis*

The wireline data inputs used for the analysis of the 13/23d-8 well were the Gamma Ray, Neutron, Density, Deep Resistivity (Laterolog) and Caliper curves (specific curve names GR, CNC, ZDEN, MLR4 and CAL). True vertical depth was calculated from the definitive deviation survey and no environmental correction or depth matching was applied.

The caliper indicates that the 8½" borehole was reasonably in gauge with no significant washout over the reservoir interval. The density correction was within acceptable limits until below the reservoir interval, so the density tool was used as the primary porosity determinant.

The following parameters have been used for the interpretation:

- True formation resistivity (Rt) taken as MLR4
- Matrix grain density assumed to be 2.65g/cc
- Resistivity of mud filtrate density measured as 0.0735 ohm.m at 62.3° F (WBM)
- Hydrocarbon correction applied, gas density assumed to be 0.5g/cc, oil density 0.8g/cc.
- 

The reservoir temperature was based on regional data giving a value of 143.5° F at 5300 ft tvdss and a temperature gradient of 1.9° F per 100 ft.

Formation water resistivity (R<sub>w</sub>) from the Pickett plot indicates an R<sub>w</sub> of 0.06 ohm.m at RF (0.14 ohm.m at 60° F)

- Cementation Exponent (m) assumed to be 2 and Saturation Exponent also assumed to be 2.

- Shale volume is calculated from the neutron density separation. Parameters picked on a zone-by-zone basis to remove hydrocarbon effect. Limestone stringers were manually removed from average calculations.
- Effective porosity was calculated using the density porosity and neutron porosity equation.
- The Archie equation was used to calculate the water saturation  $S_w$ .

*Cutoffs:  $Phi_e > 0.2$ ;  $V_{sh} < 0.5$ ;*

Zone Name	Top	Bottom	Top	Bottom	Gross	Net	N/G	Av Phi	Av Sw	Av Vcl
	MDBRT	MDBRT	TVDSS	TVDSS	TVD	TVD	v/v	v/v	v/v	v/v
Upper Captain Sandstone	5329.00	5512.00	5247.00	5429.60	182.60	178	0.97	0.28	0.86	0.042
Lower Captain Sandstone	5512.00	5646.00	5429.60	5563.60	134.00	93.8	0.70	0.27	0.98	0.081
Total Captain Sandstone	5329.00	5646.00	5247.00	5563.60	316.60	272	0.88	0.28	0.90	0.06

#### Pay SUMMARY

*Cutoffs:  $Phi_e > 0.2$ ;  $V_{sh} < 0.5$ ;  $S_w < 0.6$*

Zone Name	Top	Bottom	Top	Bottom	Gross	Net	N/G	Av Phi	Av Sw	Av Vcl
	MDBRT	MDBRT	TVDSS	TVDSS	TVD	TVD	v/v	v/v	v/v	v/v
Upper Captain Sandstone	5329	5352	5247	5270	23.00	23	1	0.31	0.38	0.03

The well encountered 23 feet of hydrocarbon column, 20 feet of oil below 3 feet of gas, at the top of 272 feet net (316' gross) interval of high-quality sands with petrophysical characteristics akin to those of the adjacent 'Blake' field. These (very clean) sands exhibit average porosities of 28% with a modestly decreasing trend from 31% at the top of the reservoir, to 26% at the base, in a similar way to the Blake field reservoir.

Oil, gas, and water samples were recovered and analysed. The PVT results showed a slightly under-saturated 30.5° API oil with a low GOR of 340 scf/bbl and 1.9 cP viscosity at a reservoir pressure of 2,300 psi.

## 5. Technical Work Undertaken

The TGS-MF10, Q13 Phase1 and Phoenix data seismic exhibit good signal to noise ratio, zero phase and good seismic-to-synthetic seismograms or VSP ties, while the HESS92 data has a lower signal to noise ratio and lower quality of well-seismic tie.

The seismic well tie between TGS-MF10-v 2012 pre-stack time migrated seismic data and Liberator and Blake wells is very good (see Figure 8), and the synthetic seismograms for all 6 sonic-density-check-shot equipped wells within the area of interest are very good.

The key horizons utilized for the Liberator subsurface description were - the base and the top of the K50 sequence which envelopes the target Captain sand. The base of the sequence, the top of the Valhall formation, is interpreted as a zero crossing. Conformable, in areas such as the Blake flank or the 13/23-1, and 13/29b-5 wells, in the Blake-Liberator channel area it becomes an erosional unconformity truncating underlying reflections (K38 to K36).

The top of the sequence is a peak, the picking of which is facilitated by the fact that the K50 interval is characterised by a 'distinct seismic facies' in contrast with the over and underlying sequences. While the K50 interval has high a signal to noise ratio, lower frequency, parallel reflections, and is trough dominated (due to a continuous increase in impedance toward the base), the overlying Rodby sequence has low signal to noise, a hummocky reflection pattern and exhibits some base lap onto the top K50 surface (see Figure 9).

The Liberator structure is clearly delimited on the time map, bordering the western limit of the 'Blake' channel system, and is also identifiable as abrupt dipping of the isochron due probably to the combined effect of steep morphology of the levee's western edge and to differential compaction (see Figure 10).

A robust time-depth conversion was obtained by identifying, and seismically picking, the boundaries of nine significant velocity changes and by performing a layer-cake time-depth conversion with constant interval velocity (see Figure 11).

The interval velocities were calculated from 13/23d-8 Liberator well VSP at the intersection between seismic horizons and the well path and not at the depth of the geological pick.

The method achieves a high degree of prediction at all 10 control wells, beside the Liberator discovery well 13/23d-8, and a very good spill point between 'Liberator' and the 'Blake' field to the east is achieved. No gridding or interpolation was required, and no residual corrections were applied to intermediate surfaces. The maximum error at the top of the Rodby was plus or minus 19 ft. The resulting depth structure map is shown in Figure 12.

The K50 isopach (Figure 13) illustrates the morphology of the Blake channel. As well as the sharp thinning demarcation of the limit of the channel, the isopach illustrates the internal architecture, the levee and thalweg distribution and, implicitly, the energy of the system. It is notable in the south-eastern part of the channel, where the channel is at its narrowest, that the sand-fill architecture consists of a large thalweg bordered by two levees - the south-westerly levee being thicker than that on the opposite margin. The twt isopach map also demonstrates that no channel sand has been encountered in wells within areas where the twt isopach is thinner than 40 ms.

This cut-off was used to demarcate the areas with low sand probability and, by removing them from the depth map and colouring the remaining closure above -5270ft TVDss (the Liberator and pre-production Blake Field oil-water contact), the initial structure map was



generated (Figure 2). This map was then used to select the location of the first 'Liberator' appraisal well, 13/23c-9.

Upon the failure of well 13/23c-9 to encounter the Upper Captain Sand unit, which had been oil-bearing in the Liberator discovery well - 13/23d-8, i3 Energy acquired the TGS MF18 PSTM reprocessing of the Polarcus 2013 data over both 13/23c and 13/23d (see Figure 6) and proceeded to remap the greater 'Liberator' closure leading to the selection of the location of a second pilot hole to be drilled by well 13/23c-11.

The revised 'Greater Liberator Closure' depth structure map arising from the re-interpretation, including the location of well 13/23c-11, is shown in figure 14. The well was drilled directionally from a location in adjacent block 13/23c to a bottom hole location within block 13/23d to penetrate a local four-way-dip closure within the larger 'Liberator' closure.

The well was drilled with the semi-submersible drilling unit 'Borgland Dolphin', was spudded on 8<sup>th</sup> November 2019, and reached TD on 25<sup>th</sup> November 2019.

The well encountered a 202ft MT (153ft TVT) interval of Captain Sand between 5712ft MD (5312ft 5914ft MD (5465ft TVDSS) of which 137ft TVT was determined to be net sand, giving a net/gross of 0.90. The net sand interval exhibited an average porosity of 27.3% and an average water saturation of 94.8%. (see Figure 15).

As the well had failed to encounter hydrocarbons, and since the LWD data was of good quality, the planned wireline programme was curtailed and comprised a shear wave sonic run to complement the LWD data, and the acquisition of formation pressure data. Thereafter, the well was plugged and abandoned.

Post well analysis, in conjunction with the seismic data, indicated that the Captain Sandstone encountered was indeed the equivalent to that encountered by well 13/23b-8 however, being deep to prognosis, it was water-bearing. There being no clear equivalent in this well, to the 'mid reservoir shale' encountered in 13/23b-8, it was initially uncertain as to which Captain sand (upper or lower) had been penetrated. However, the seismic tie and the pressure data suggest that the sands encountered are equivalent to the upper Captain sand unit.

The relationship between the Captain Sandstone intervals encountered in the 'Liberator' discovery well and the two i3 Energy wells is illustrated in the correlation section provided as figure 16.

## **6. Remaining Prospectivity**

Immediately following the drilling of 13/23c-11, a further reinterpretation of the Liberator closure was made, and the resulting map is shown in figure 17.

From this map it is immediately apparent that, within the confines of Block 13/23d, both the area of closure, and relief above the oil-water-contact (5270ft TVDss) of the ‘Liberator’ accumulation is very limited. There may still be scope for a horizontal production well extending south-eastward from the vicinity of 13/23d-8, but relief above the oil-water-contact is likely to be no greater than 45ft.

No pre-Cretaceous prospects were identified within 13/23d and, in any event, the hydrocarbon migration appears to have extended up into the Lower Cretaceous prior to entering block 13/23d.

i3 Energy will pursue the possibility of further appraising the ‘Greater Liberator’ area in block 13/23c to the west, where there are four-way-dip closed areas with (apparently) greater relief than in 13/23d. Were any of these closures to be filled to spill, there would then be the possibility of a stratigraphic trap to the south-west, where the Captain Sandstone pinches out onto the Barremian ‘Minos High’. This latter feature was named some years ago by British Gas (we believe) but was never drilled.

## 7. Resource Summary

Following the abandonment of well 13/23c-11, the whole of the greater Liberator area was re-interpreted and the current map is shown in figure 18 below.

Using a range around the petrophysical parameters previously noted in the analysis of well 13/23d-8, potential hydrocarbon volumes are provided for the ‘Liberator East’ sub-area - both total and on block 13/23d (Table 1).

Liberator East Volumetrics			Liberator East In Block Volumetrics		
Volume	STOIIP	Reserves	Volume	STOIIP	Reserves
Probabili	MMbo	MMbo	Probability	MMbo	MMbo
1	34.9	12.2	1	28.0	9.8
10	29.5	9.7	10	24.1	8.0
20	24.1	7.2	20	20.3	6.1
30	19.5	5.5	30	17.0	4.7
40	15.6	4.1	40	14.1	3.7
50	12.5	3.0	50	11.8	2.8
60	10.2	2.2	60	10.0	2.2
70	8.6	1.7	70	8.7	1.7
80	7.7	1.4	80	8.0	1.4
90	7.6	1.2	90	7.7	1.2
99	6.5	0.9	99	7.0	1.0

Table 1. Probabalistic Hydrocarbon Volumes for the Lower Cretaceous Captain Sandstone formation within the ‘Liberator East’ area in total and as ascribed to block 13/23d

## **8. Conclusions**

The results of the two wells drilled into what was termed by i3 Energy the 'Phase 1 Development Area' demonstrate the risk associated with attempting to accelerate projects by expending effort and cost upon development planning, and negotiations with an adjacent host, prior to appraisal drilling.

Both wells were drilled as pilot wells, into areas within the Liberator closure having the greatest mapped relief and, as such, were expected to be the locations of future horizontal production wells.

The disappointing result of 13/23c-9 could probably have been avoided by the earlier purchase of the TGS-MF18 PSTM dataset.

## **9. Figures**



Figure 1. Location of block 13/23d (Licence P1987)

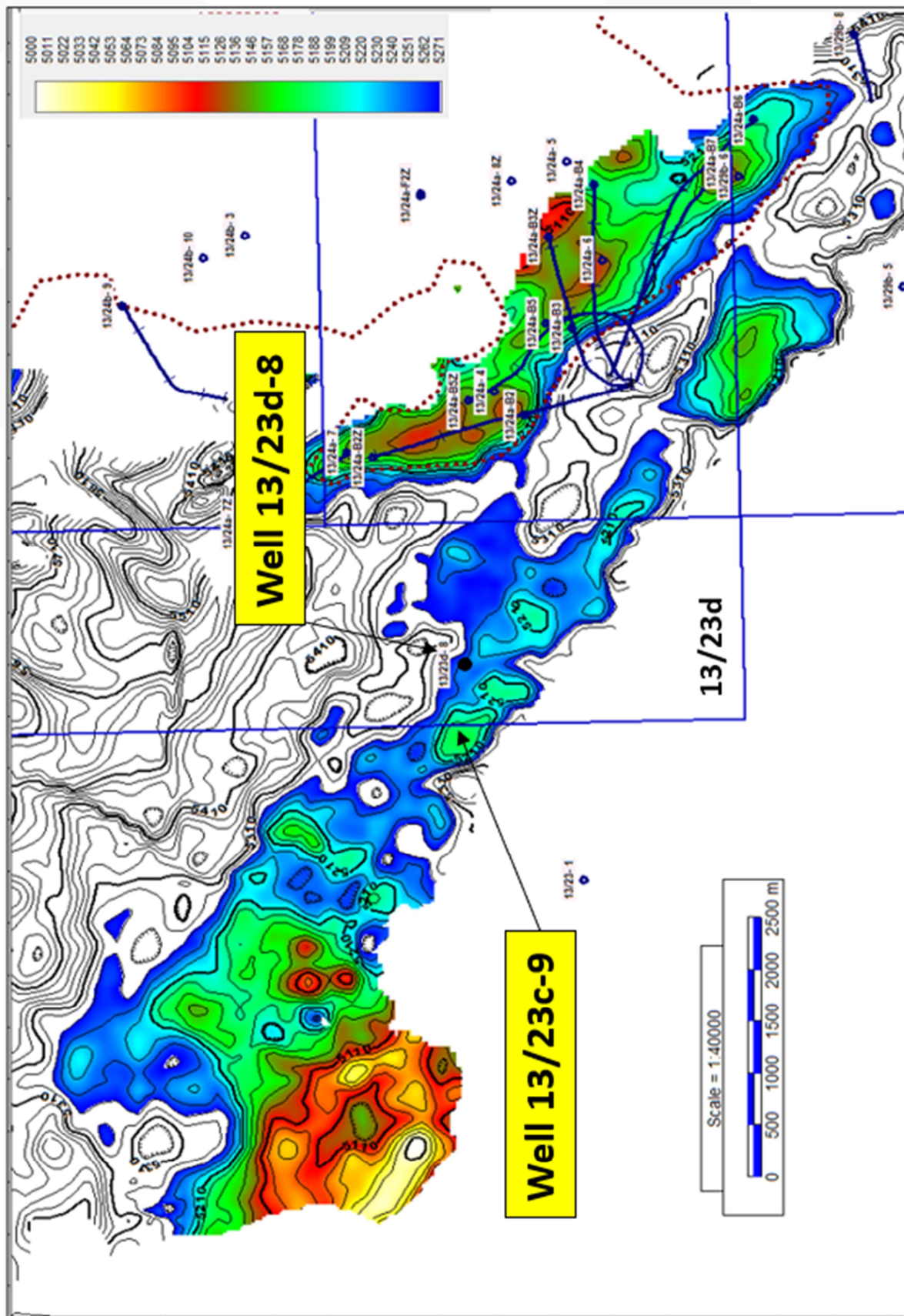


Figure 2. Initial Top Captain Sandstone Depth Structure. (coloured above 5270ft TVDSS)

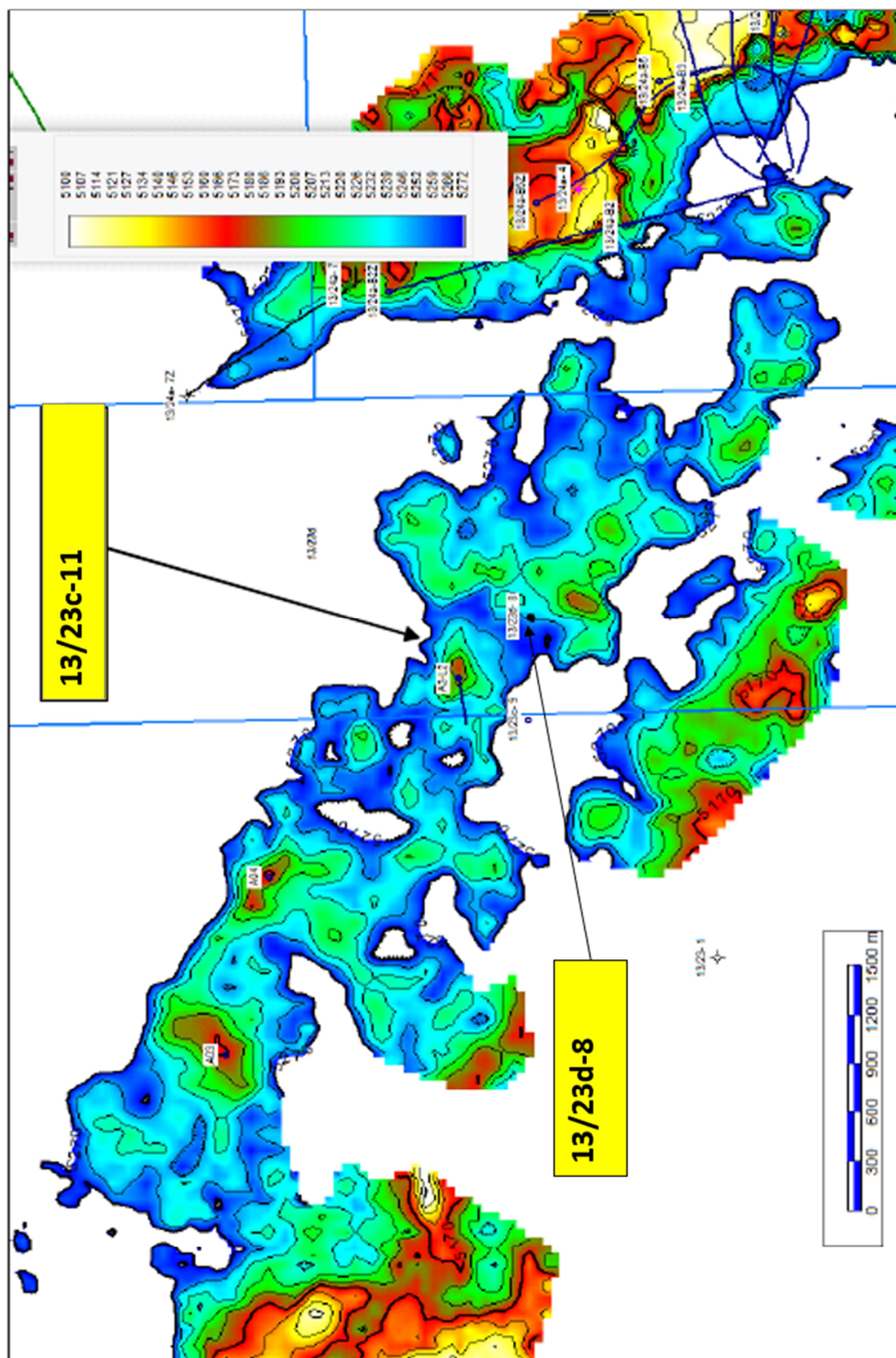


Figure 3. Revised Top Captain Sandstone Depth Structure. (coloured above 5270ft TVDSS)

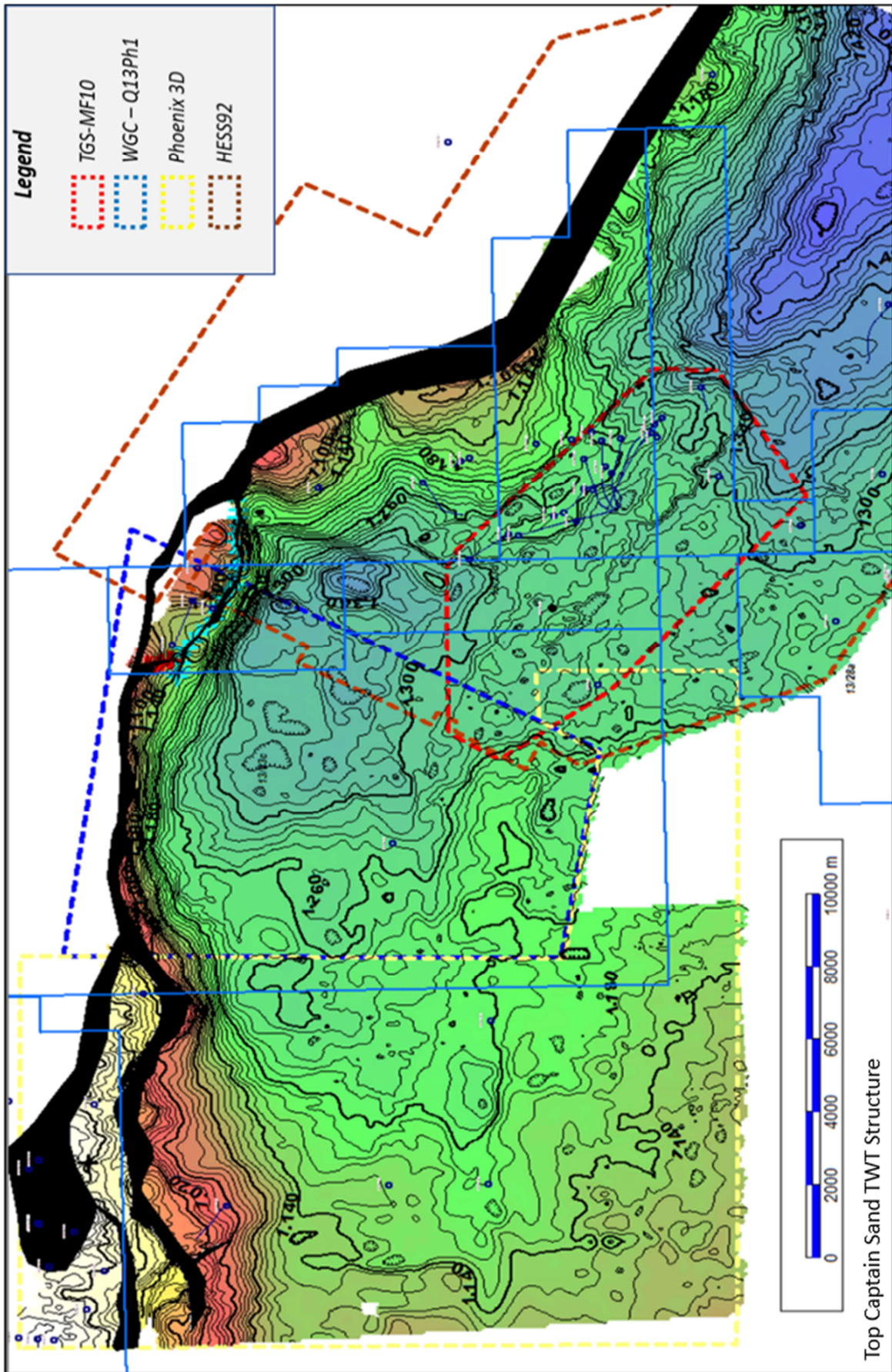


Figure 4. 3D datasets used in i3 Energy's initial interpretation of the 'Liberator' Area

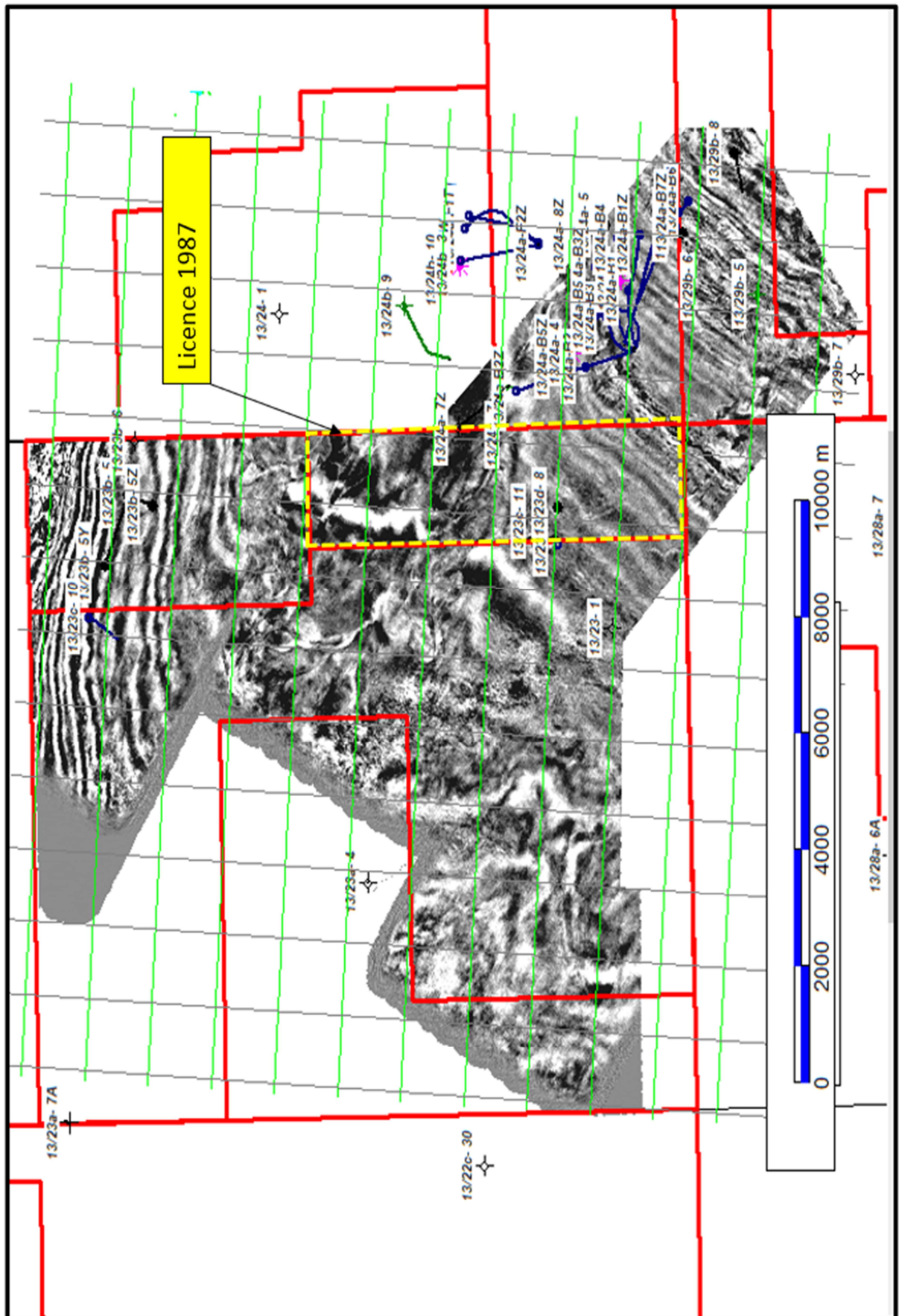


Figure 5. Increased area of the TGS MF10 3D Volume



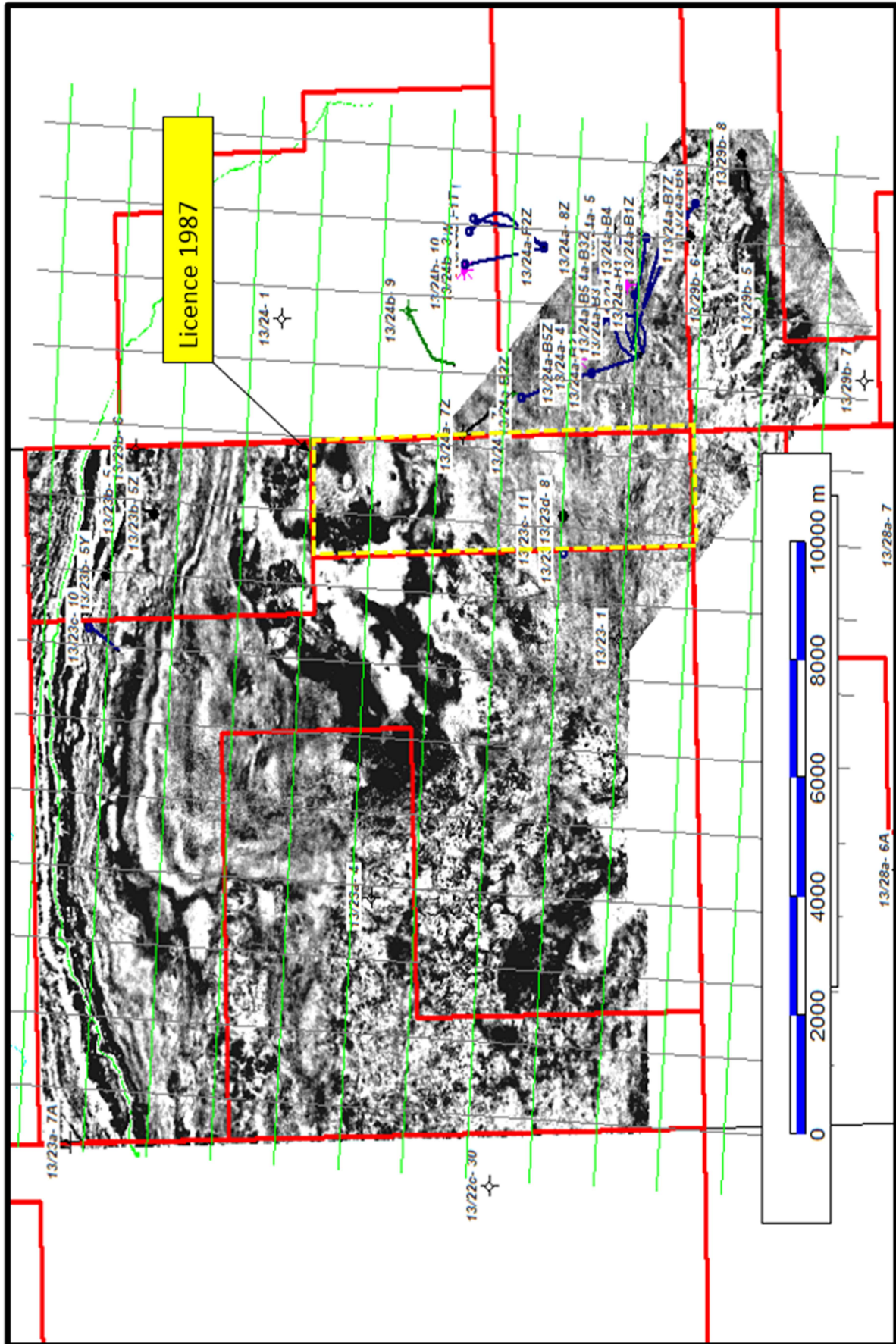


Figure 6. Area of the TGS MF18 PSTM seismic data

**Dana 13/23d-8**

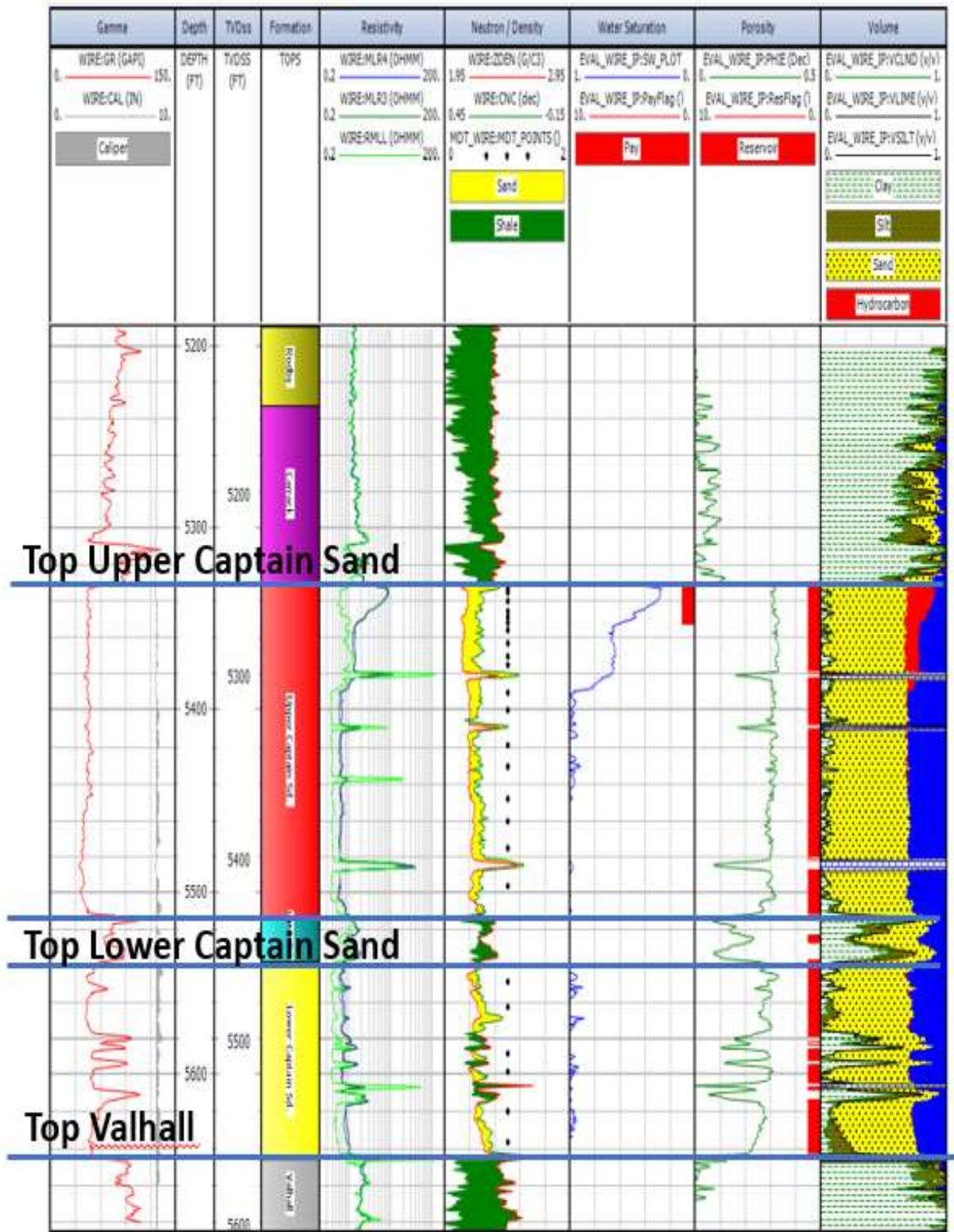


Figure 7 - 13/23d-8 Petrophysical Interpretation

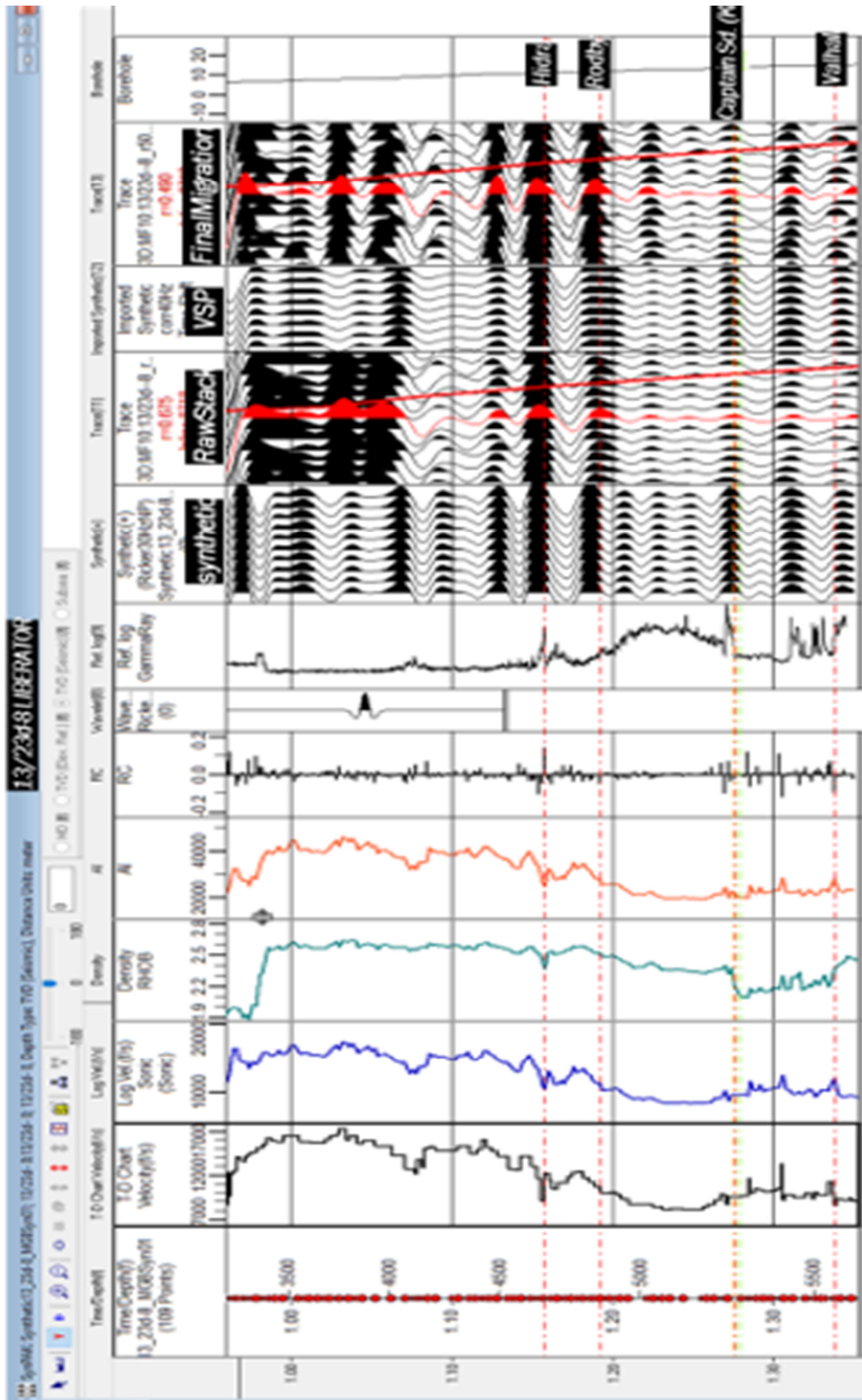


Figure 8. Well seismic tie for 13/23d-8 Liberato

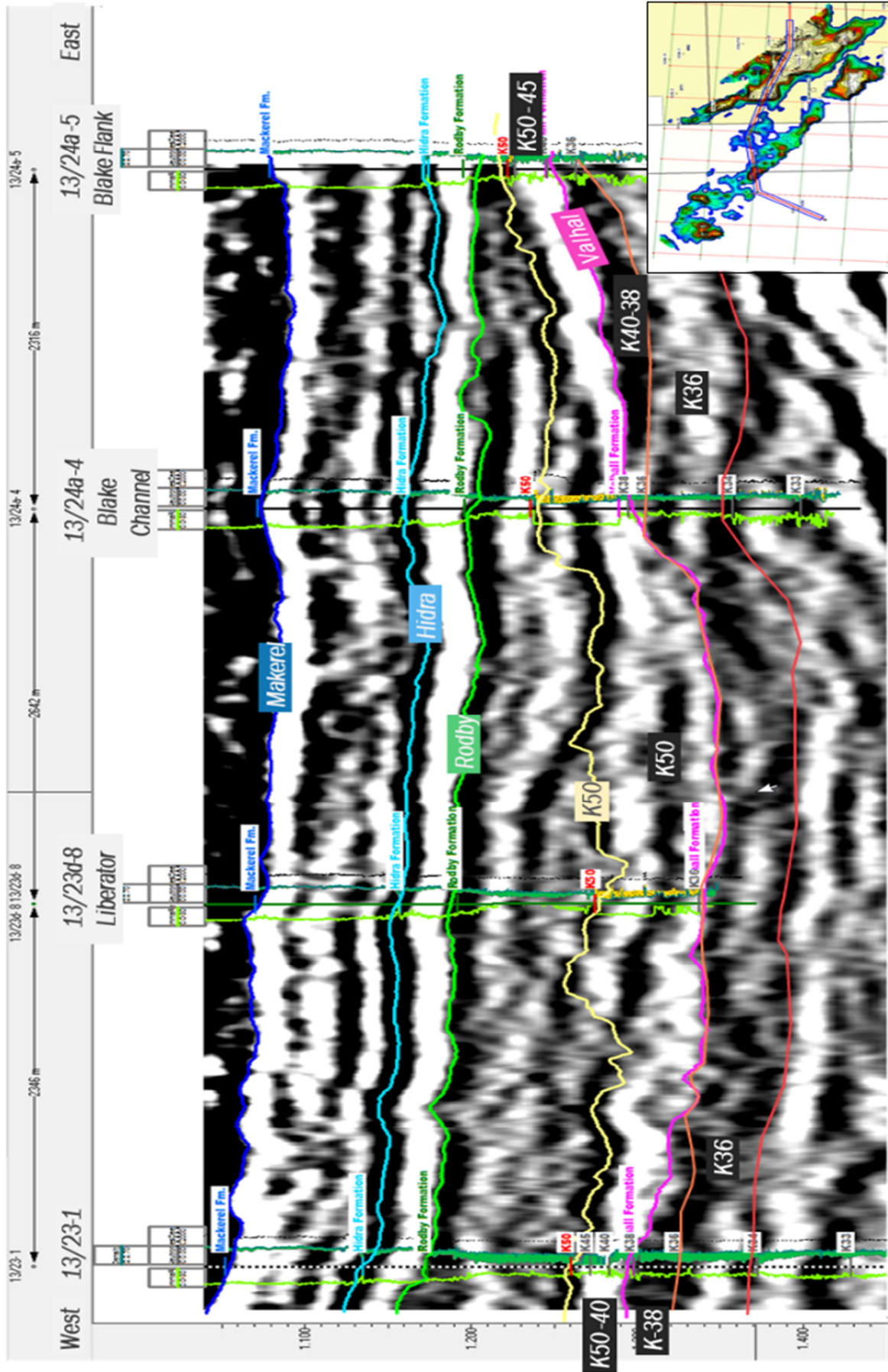


Figure 9. Seismic line through wells 13/23-1, 13/23d-8 (Liberator), 13/24a-4 (Blake) and 13/24a-5 (Blake Flank)

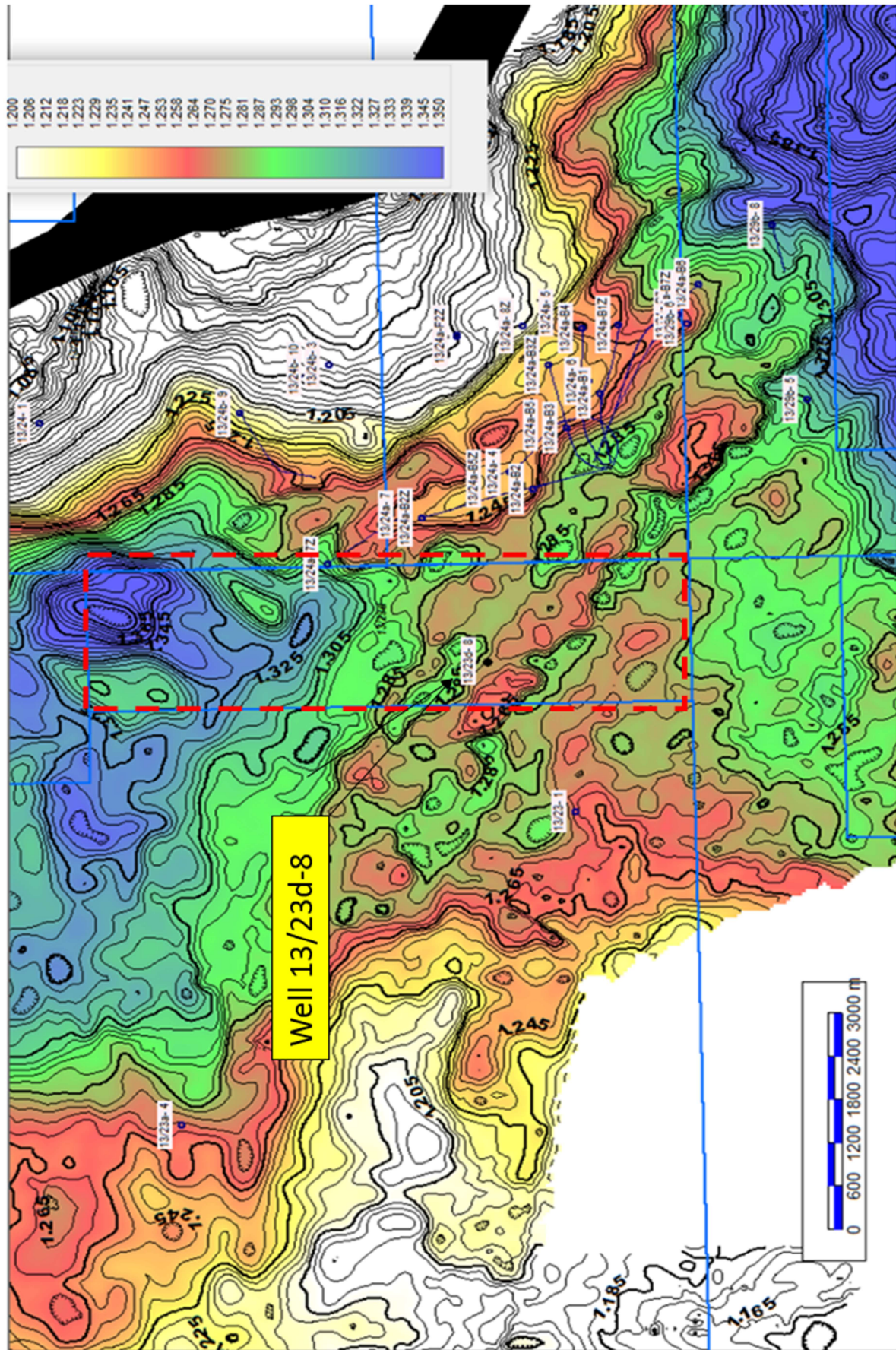


Figure 10. Top Captain Sand (K50) time structure map (contour interval = 0.005sec)

Unit	Interval Velocity (ft/s)
Water	5120
Shallow Channel	5800
Moray Group	$2357.1 * TWT + 4446.7$
Montrose Group	7600
Ekofisk	12500
Tor	15800
Mackerel	14100
Hidra	11600
Rodby	8740
K50	10020
Valhall	9860

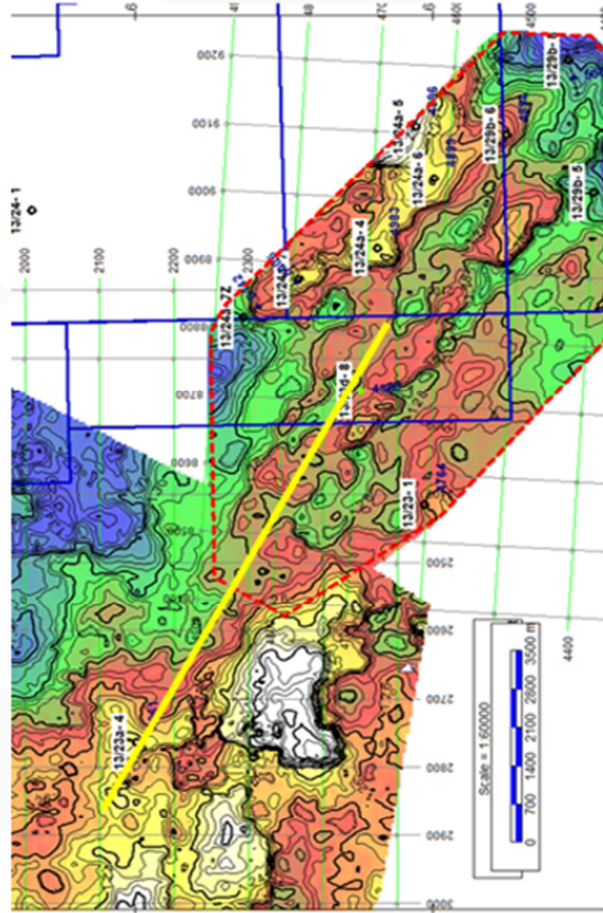
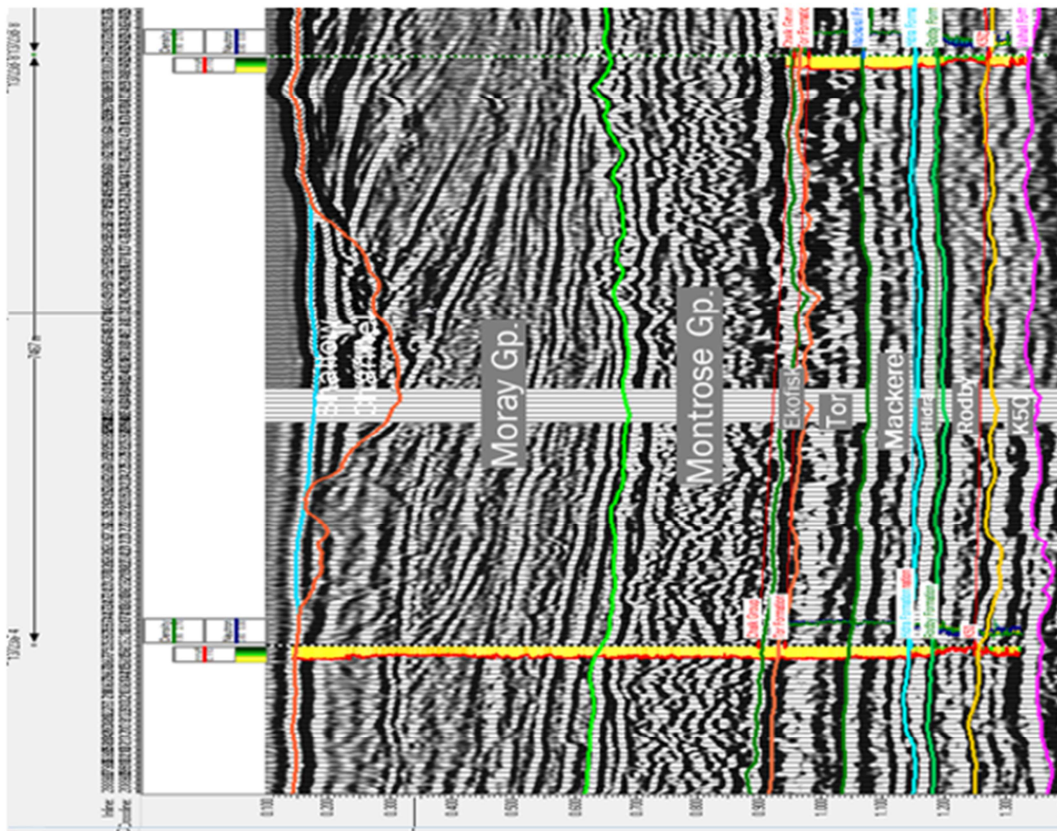


Figure 11. Time-depth conversion method

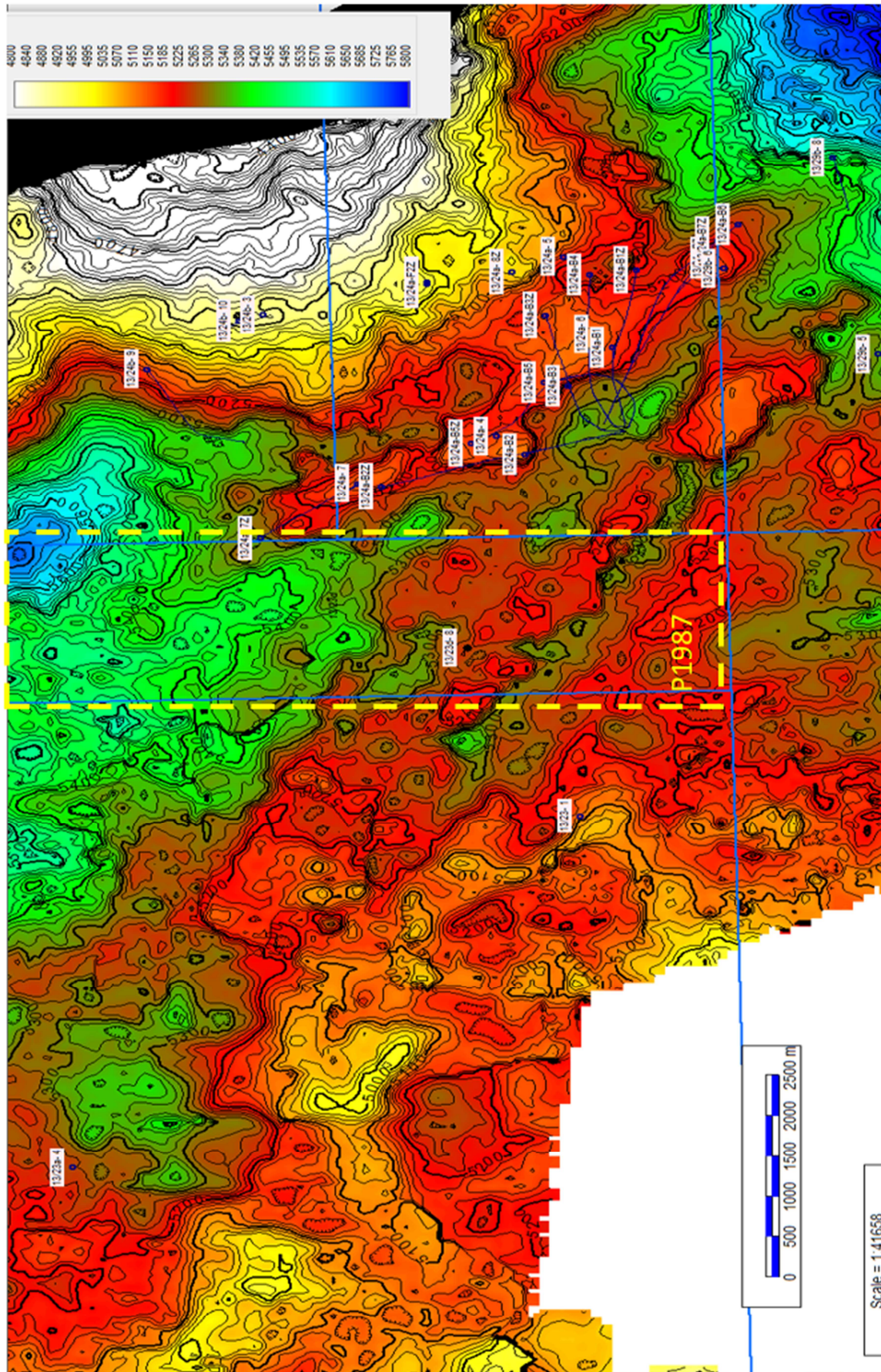


Figure 12. Top Captain Sand (K50) depth structure, TVDss ft. (Contour Interval = 20 ft)

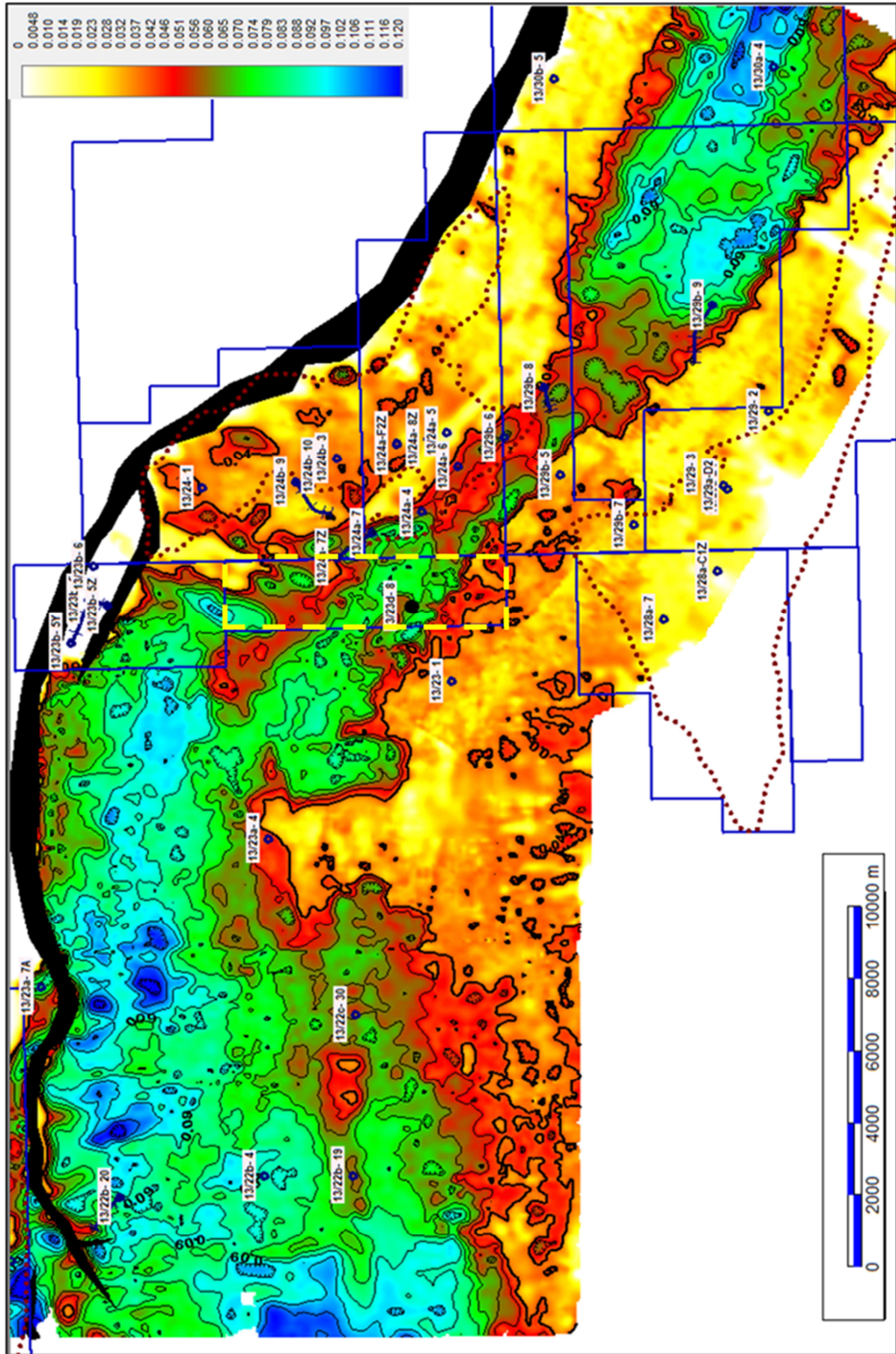


Figure 13 Top K50 to Valhall twt isopach (Contour Interval 10ms) Contours start at 40 ms



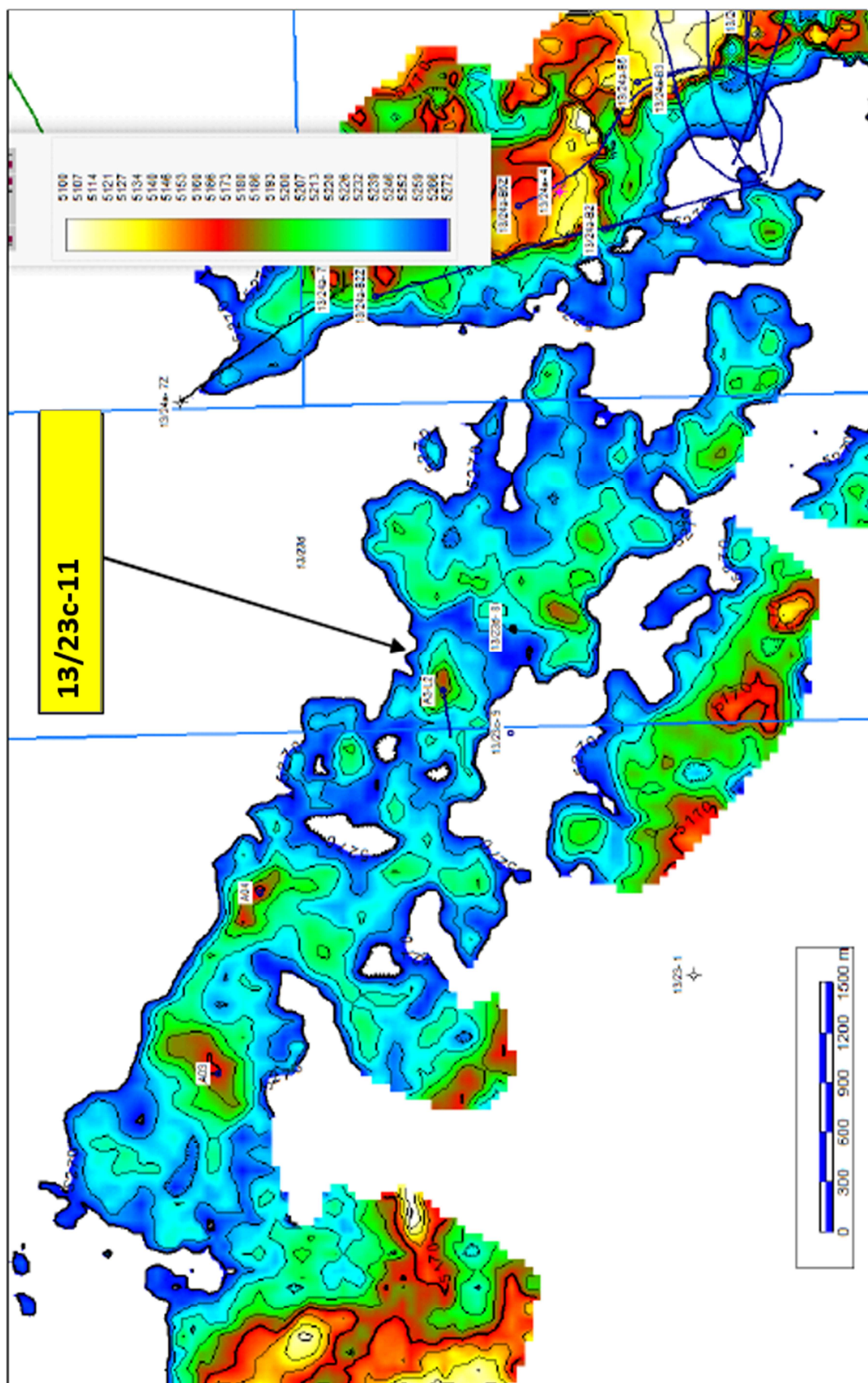


Figure 14. Revised Top Captain Sandstone Depth Structure. (coloured above 5270ft TVDSS)

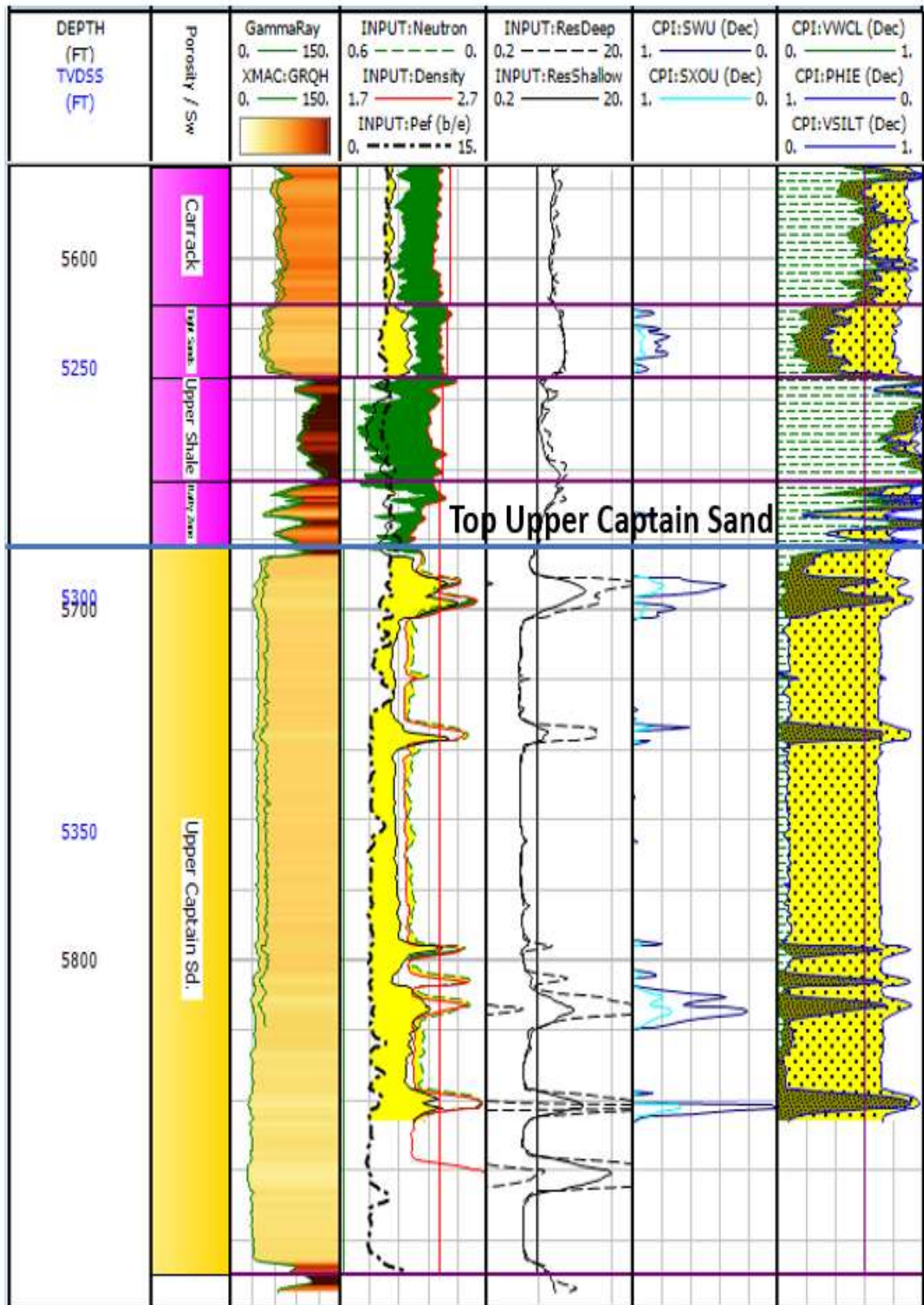


Figure 15. Well 13/23c-11 Petrophysical Interpretation

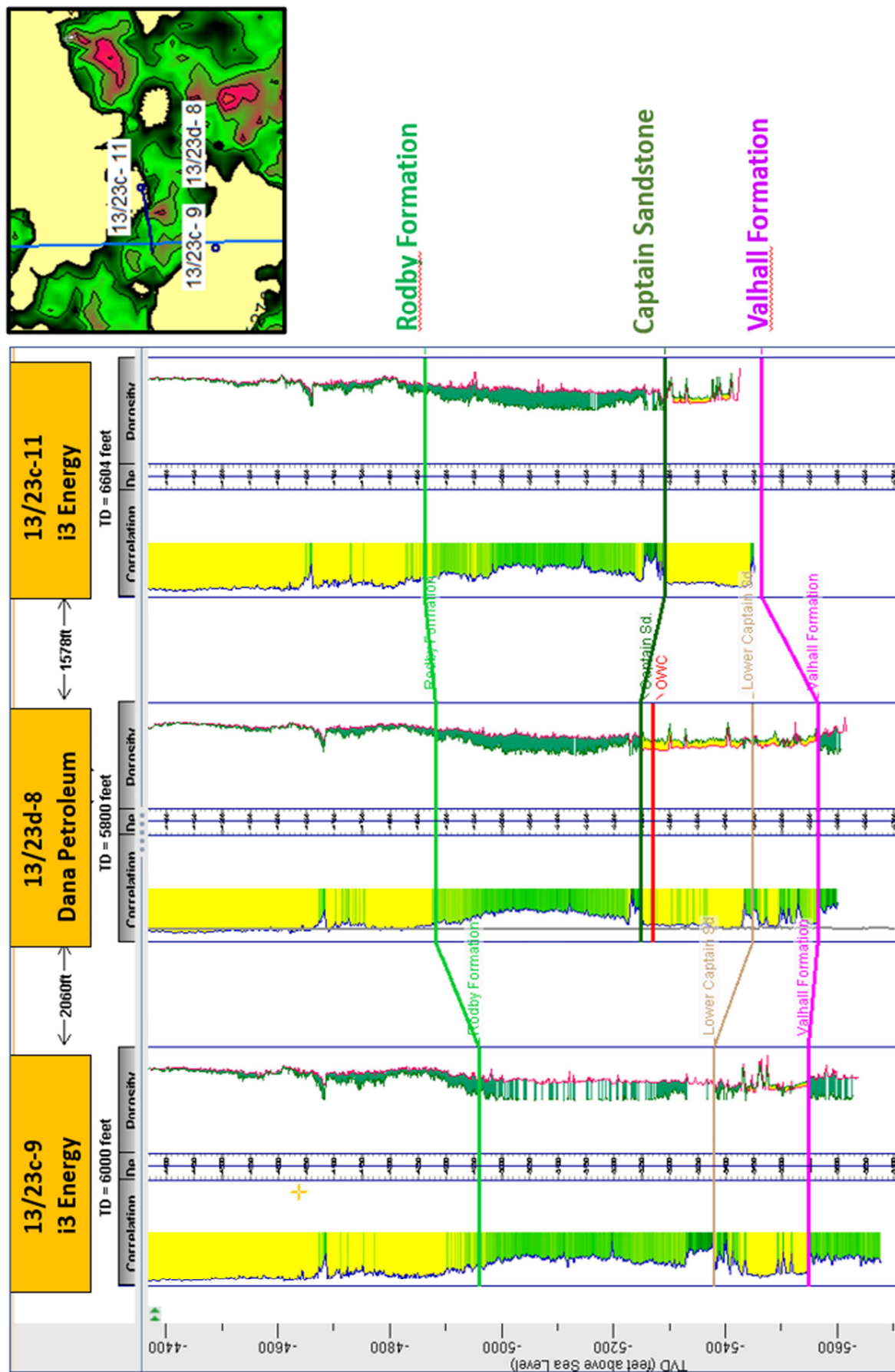


Figure 16. Liberator Wells Correlation Section (TVDss)

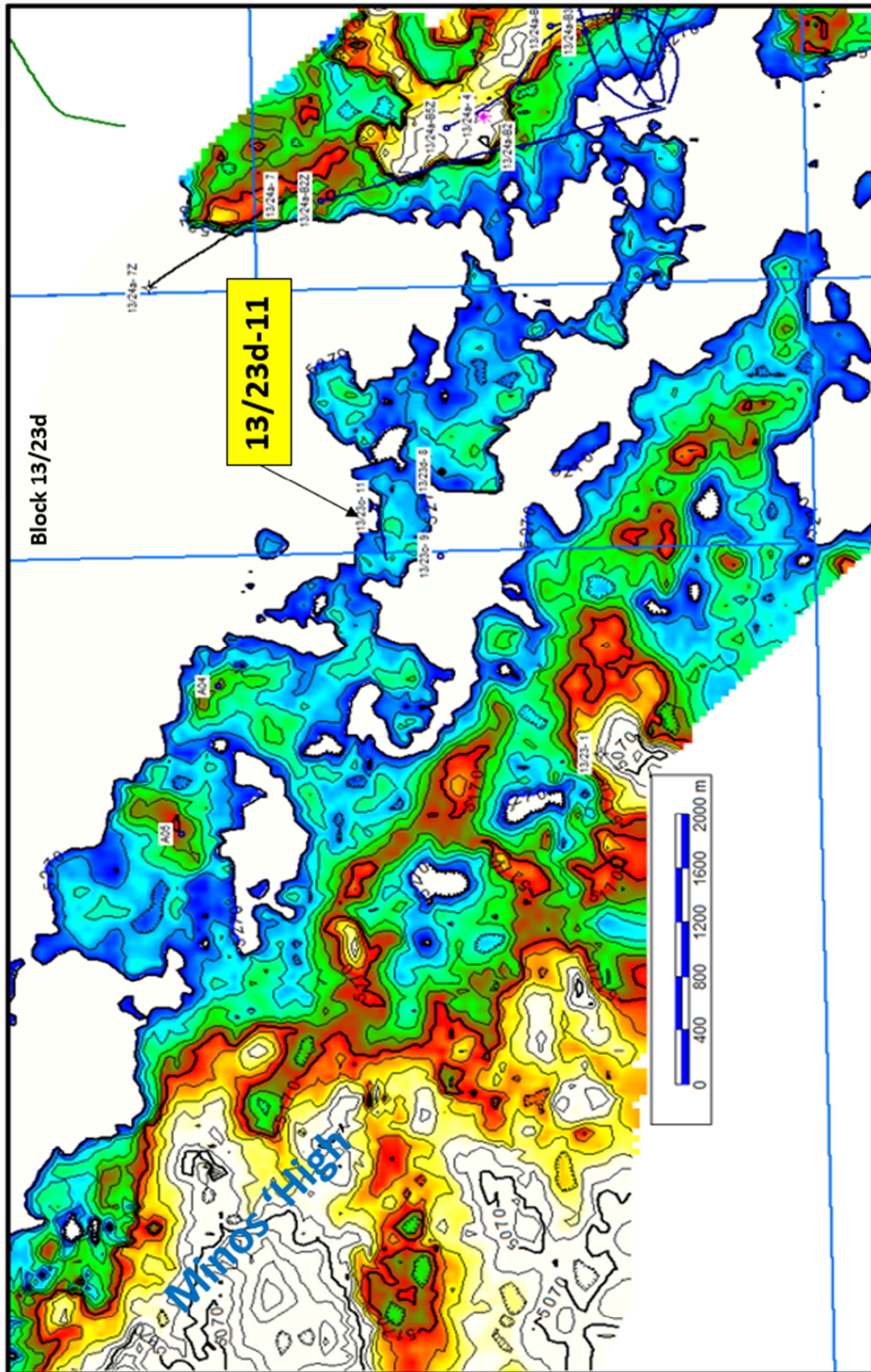


Figure 17. Post 13/23c-11 Revision of the Top Captain Sandstone Depth Structure.

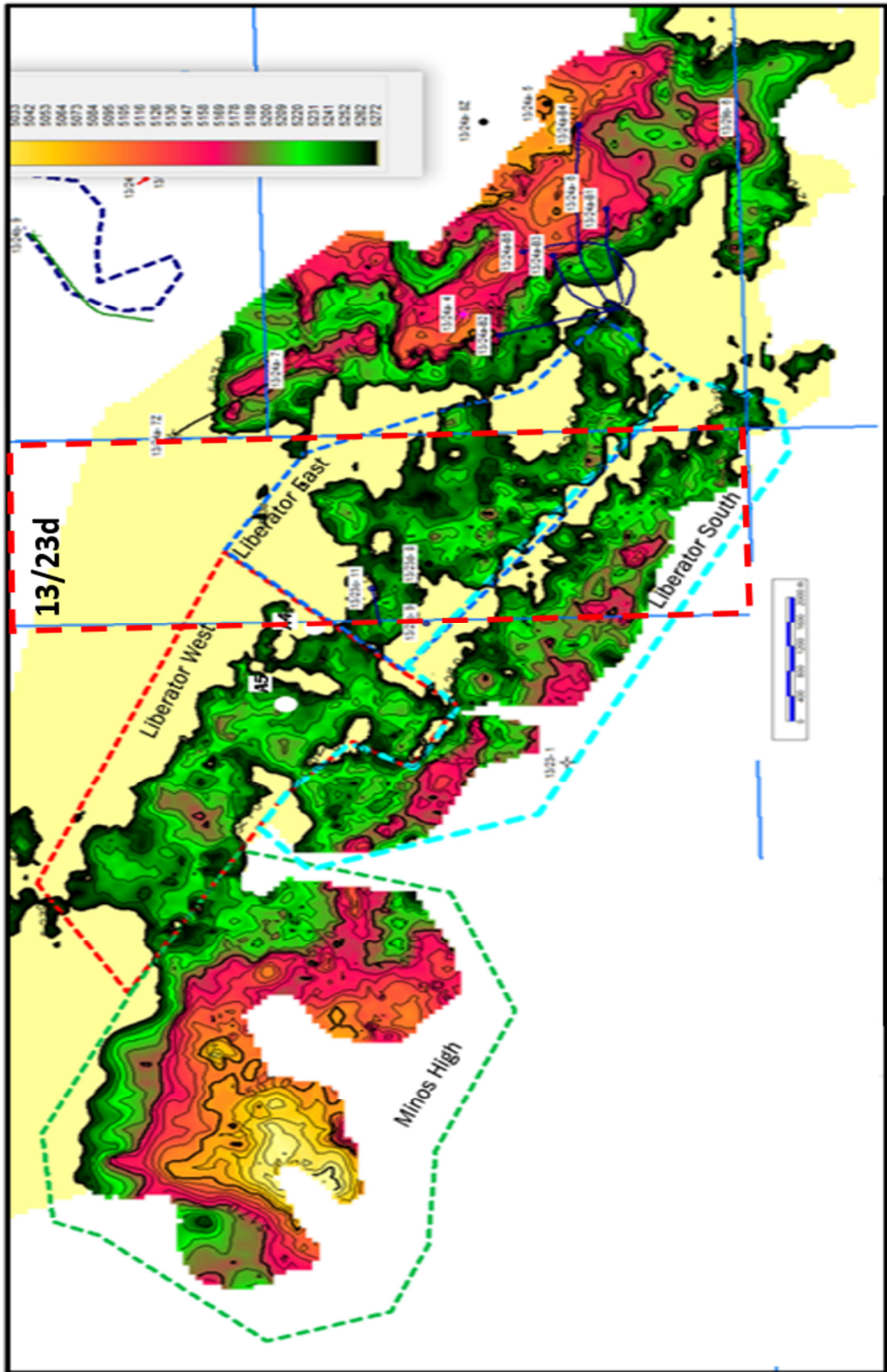


Figure 18. Top Captain Sandstone Depth Structure above the OWC (5270ft TVD<sub>ss</sub>)