

December 2015

P.1933 RELINQUISHMENT REPORT

**UKCS BLOCKS 205/23A, 205/24A,
205/25A, 205/28A, 205/29A**

1 Licence Information

- Licence number: P.1933
- Expiry date: 31/12/18
- Area: 494.4 km² (post 2014 relinquishment)
- Working interests: Parkmead 43% (Op), Atlantic Petroleum 43%, Dyas UK (14%)
- Licence round: 27th
- Licence type: 6 year Frontier
- Blocks: 205/23a, 24a, 25a, 28a, 29a

P.1933 is located in the West Shetland Basin (Fig. 1 & 2) extending onto the Rona Ridge, to the north-east of the Solan field and south-west of the Clair field.

2 Licence Synopsis

P.1933 was awarded to Parkmead 43% (operator), with partners Atlantic Petroleum 43%, and Dyas UK 14% as a 6 year Frontier licence in 2013, consisting of 6 blocks: 205/23, 24, 25, 28, 29, & 30. A partial relinquishment was made in 2014 which reduced the area from 1237.2 to 494.4 km² and 5 part blocks. The original 27th round licence application was based on the prospectivity of the Cretaceous sandstones, onlapping onto the Rona Ridge. Regionally hydrocarbons are present in reservoirs ranging from Lewisian to Eocene in age (Fig. 3).

Having completed the licence work programme, the reprocessed 2D seismic data in combination with the results from geological studies did not sufficiently de-risk the Eddystone prospect to drillable status. As no further economically viable prospectivity was identified on the acreage, the JV agreed to relinquish the licence effective 30th November 2015.

3 Work Programme Summary

The commitment work programme consisted of the following:

- Obtain 1045 km of 2D seismic data
- Drill or drop well to 2500m or 100m below the Top Lower Cretaceous, whichever is shallower.

4 Database

There is one 3D survey covering part of the licence acreage, namely the AT953D Arco survey (this survey was also reprocessed as part of the Fugro Terracube dataset), as well as several legacy 2D surveys (Table 1), of which AR205-93 provides the most local coverage (Fig. 4). Parkmead has access to all of the released wells in the area; key offset wells are listed in Table 2.

Table 1: Seismic data

Contractor	Survey	vintage	Status	Comments
PGS	AT95 (3D)	1995	Proprietary	ARCO
Horizon	AR205-93 (2D)	1993	Proprietary	BP
Western	ST (2D)	1979	Spec	Western
HGS	WB93 (2D)	1993	Spec	Western
Geco	NSDP (2D)	1984	Spec	Western
CGG	WSD-92 (2D)	1992	Spec	Spectrum
CGG	Various merged 2D	2014	Spec	Reprocessed PSTM of various 2D surveys

Table 2: Key offset Well Data

Well	Year	TD (m)	Operator	Comments
205/20-1	1974	2046	Elf	Small Lower Cretaceous heavy oil discovery found on the SE flanks of the Rona Ridge
205/20-2	1994	3085	BP	P&A Oil shows in Rona Sandstone.
205/23-1	1975	2800	Mobil	P&A Dry - Unsuccessful test of Jurassic stratigraphic trap.
205/23-2	1998	884	ARCO	P&A Gas with oil shows - Bombardier gas discovery in Rona Sandstone situated on the Rona Ridge. Drilled as an analogue for the Clair Field.
205/24-1	2006	1227	Hurricane	P&A Dry – Wellington exploration well drilled on 3-way dip and faulted structure at Rona sandstone level on SE flanks of Rona Ridge. Well failed due to ineffective fault seal.
205/25-1	1977	2601	Phillips	P&A Dry – no effective seal, abundance of sand encountered.
205/26a-4	1991	2959	Amerada Hess	P & A Oil – Successful appraisal of the Triassic Strathmore discovery. Also Discovered the Solan Field in younger Solan Sandstone, tested at 2080bopd.
205/26a-5z	1992	3077	Amerada	P&A Oil – Solan Appraisal, flowed at 204bopd.
205/27a-1	1982	2702	Shell	P&A Dry – drilled as an analogue to the Clair Field. Encountered Triassic directly beneath Quaternary.
205/27-2	1997	2654	Suncor	P&A Oil Shows in tight Rona Sandstone and Lower Cretaceous sands.
205/30-1	1974	2195	Sovereign	P&A Dry – tested a 3-way dip and fault bound structure on west of the Spine fault. Well failed due to ineffective fault seal.
206/16-1	1995	4036	Conoco	P&A Dry – unsuccessful test of Lower Cretaceous combined structural-stratigraphic trap on western edge of the Spine Fault.

Oil has been discovered in the Paleocene Vailla sandstones to the west; e.g. Foinaven, Schiehallion, Loyal and Suilven (Fig. 1 & 2). Oil has also been encountered in Triassic and

Jurassic reservoirs in the East Solan Basin (Strathmore, Solan and Mustard). There is also a sub-commercial gas discovery on the licence, Bombardier (205/23-2) in Jurassic Rona sandstones (Fig. 5). The gas is deemed to be of mixed thermogenic/ biogenic origin due to its high methane content.

5 Exploration Activity

The licence group undertook a series of geological studies; geochemistry, biostratigraphy, petrophysics and maturity modelling, in order to establish the existence of an effective petroleum system in the West Shetland Basin. The seismic obligation was met by the purchase of several legacy 2D surveys (listed in Table 1, highlighted in Fig. 4). The 2D data was then reprocessed using PrSTM performed by Fugro Geospec (latterly CGG). Angle stacks were created in order to assess any amplitude anomalies observed on the dataset. A portion of the Fugro Terracube (merged and reprocessed) 3D dataset was also purchased over Block 205/23, this data was not included in the P.1933 reprocessing project.

6 Prospectivity Update

A review of the Cretaceous prospectivity was undertaken to assess the exploration potential. The structural framework of the West of Shetlands region (Fig. 2) shows that P.1933 is situated in on the Rona Ridge and the West Shetland Basin (WSB). The WSB is a Mesozoic half-graben with a thick Cretaceous sedimentary section bound to the north-west by the Rona Ridge and the south-east by the Shetland Spine Fault. Seismic interpretation of the P.1933 data has been completed at several stratigraphic intervals from Seabed to Basement.

6.1 Cretaceous Potential

The main reservoir targets in the WSB are Cretaceous sandstones of Aptian to Turonian age, with secondary targets of Jurassic-Triassic age. Tertiary reservoirs are either absent or deemed too shallow to be effective. Discoveries in the West of Shetland region tend to be combination structural/ stratigraphic traps, with regional dip to the north-west, and elements of reservoir pinch-out in other directions. The prospects identified in the WSB are opposite to this with the Cretaceous reservoir pinching-out onto the Rona Ridge towards the north-west.

The upper Jurassic Kimmeridge Clay formation is the main source rock West of Shetland, with discoveries predominantly made in the Faroe-Shetland Basin. Structurally, the Rona Ridge blocks hydrocarbon charge from the Faroe-Shetland Basin towards the south-east and into the WSB. It is therefore necessary that the KCF located within the WSB is mature to provide charge to any potential prospects located in the area. In the WSB the KCF source rock interval dips to the north-east to give a potential source kitchen in Block 206/16 and is buried beneath thick Cretaceous sediments (~3000m) in the licence area itself. Shetland Group mudstones (Fig. 3) constitute the main top-seal in the area. Lateral seal must be defined by pinch-out, sand-shale juxtaposition or fault seal.

6.1.1 Eddystone Prospect

The Eddystone prospect is located mainly on Block 205/24 (Fig. 6) and is delineated by bright seismic amplitudes near the base of the Upper Cretaceous (Fig. 7). To date no well has penetrated this amplitude anomaly. The prospect is divided into west and east zones by a reverse cross-fault (Fig. 6). The nearest well is 205/24-1 (up-dip) which encountered older Cretaceous sediments (Fig. 6 & 8) and recent biostratigraphic analysis (Fig. 9) has shown that the Aptian-Turonian age Eddystone target interval is missing in this well, proving that it pinches out up-dip i.e. the younger Eddystone marker terminates before this well is reached (Fig. 8). To the north-east the amplitude anomaly dies out down-dip, (Fig. 7) and to the south-west the event on-laps an inverted high that separates the West Shetland and Solan basins.

There are several issues with the Eddystone prospect:

- The original defined Eddystone prospect is likely to be split into two features (Fig. 10). This would increase the need for more wells to prove and produce the discovery, and may reduce overall recoverable volume. This is reflected in the resource and risk summary and is reflected in the volumetric case for two areas; Eddystone West and Eddystone East (Fig. 6 & 10).
- Seismic data analysis reveals no AVO anomalies attributed to the Eddystone marker or any other intervals on the available licence dataset.
- The Eddystone anomaly is an increase in acoustic impedance (“hard kick”) rather than a decrease (“soft kick”), the latter of which could indicate the presence of hydrocarbons.
- The “hard” seismic response (Fig. 8 & 11) is considered to be caused by a limestone present above the sandstone (Fig. 12), in which case AVO fluid effects in underlying sands would be hard to demonstrate.
- Good reservoir quality sands locally (Fig. 12), but carbonate cements are abundant in Cretaceous sandstones regionally and present a reservoir quality risk.
- No shallow gas is observed and the potential gas chimney interpreted on some seismic lines is considered to be a zone of poor seismic imaging caused by interference between the shallow and rugose seabed and Tertiary markers (Fig. 11).
- Difficulties arise with lateral and bottom seal on the Eddystone prospect given the large volume of sand in the pre-Aptian lower Cretaceous section locally (Fig. 9 & 12). Tables 3 & 4 detail the prospective resources for Eddystone West and East.

Table 3: Eddystone West Prospective Resource volume

Deterministic					
Eddystone West	Units	Low	Med	High	Mean
Crest	m		1000		
Area	km ²	18.5	41.4	88.0	
Gross Reservoir Thickness	m	20.00	30.00	40.00	
Shaping Factor		1.00	0.85	0.70	
GRV	10 ⁶ m ³	370	1057	2464	1313
N/G	dec	0.25	0.40	0.55	0.40
Net Reservoir Thickness	m	5	12	22	
porosity	dec	0.15	0.20	0.25	0.20
So (1-Sw)	dec	0.50	0.60	0.70	0.60
Boi	rb/stb	1.10	1.20	1.30	0.12
STOIP	mmbbls	40	266	1147	330
Recovery Factor	dec	0.20	0.30	0.40	0.30
Reserves	mmbbls	8	80	459	99
Probabilistic					
Eddystone West	Units	P90	P50	P10	Pmean
STOIP	mmbbls	104	289	618	332
Reserves	mmbbls	28.3	83	192	100

Table 4: Eddystone East Prospective Resource volumes

Deterministic					
Eddystone East	Units	Low	Med	High	Mean
Crest	m		1500		
Area	km ²	22.9	33.8	55.9	
Gross Reservoir Thickness	m	20.00	30.00	40.00	
Shaping Factor		1.00	0.85	0.70	
GRV	10 ⁶ m ³	458	862	1565	968
N/G	dec	0.25	0.40	0.55	0.40
Net Reservoir Thickness	m	5	12	22	
porosity	dec	0.15	0.20	0.25	0.20
So (1-Sw)	dec	0.50	0.60	0.70	0.60
Boi	rb/stb	1.10	1.20	1.30	1.20
STOIP	mmbbls	49	217	729	244
Recovery Factor	dec	0.20	0.30	0.40	0.30
Reserves	mmbbls	10	65	292	73
Probabilistic					
Eddystone East	Units	P90	P50	P10	Pmean
STOIP	mmbbls	104	220	416	244
Reserves	mmbbls	28.1	64	131	73

6.1.2 Bombardier Discovery

The Bombardier discovery (205/23-2) was drilled in 1998 by ARCO to test a potential analogue to the Clair Field also situated on the Rona Ridge. The well encountered dry gas

with minor oil shows in Jurassic Rona Sandstone that sits directly on fluvial Triassic sediments, which in turn lie unconformably on granitic basement.

A gross gas column of 26.6m was encountered, with gas down to the base of the reservoir at 676m tvdss. If a gas gradient is extended from the RCI pressure points down to hydrostatic water gradient then a FWL of 762m is interpreted. Reservoir properties are good with an average porosity of 20% and average gas saturation of 70% (Table 5), however the discovery is deemed to be sub-commercial based on the current mapped volumes and development costs.

Previous studies by ARCO (Huizinga et al., 1999) concluded that it was not feasible to determine if a down-dip oil leg was present due to sampling limitations.

Table 5: Bombardier Contingent Resource Estimate

Units	Input	ML
m ss	Crest	650
m ss	Spill Point (FWL from pressure data)	762
m	Column	112
km ²	Area	12.7
MM m ³	GRV	225
%	N/G	37
%	Porosity	20
%	1-Sw	70
	GEF	113
%	Recovery	50
Bcf	GIIP	46.5
Bcf	Resources	23.3

7 Additional Studies

High resolution biostratigraphic data was purchased from Ichron, and used to generate stratigraphic correlations for the area (Fig. 12 & 13). Along with the seismic picks generated from the reprocessed dataset, the biostratigraphic well picks were used in a basin modelling study, undertaken on behalf of the licence group by Applied Petroleum Technology (APT, 2015). New vitrinite reflectivity and spore colouration analysis from wells 205/20-2 and 206/16-1 was used to calibrate the burial history model as well as a number of 1D pseudo wells. The model also included ~750m of basin inversion of the Oligocene-Miocene interval. The results of the study demonstrated that the Kimmeridge Clay has reached early oil maturity at the 205/20-2 location and at least full oil maturity in the deepest parts of the West Shetland basin (206/16), with oil generation and charge taking place from the early Tertiary. Oil charge terminated during Oligo-Miocene inversion of the basin. Parts of the basin are cool at present day, meaning that there is a local risk of biodegradation.

8 Resource and Risk Summary

A summary of the resource volumes are shown below in Tables 6. The main risks for the prospect are reservoir quality and the presence of an effective seal (particularly lateral seal), giving an overall risk factor of 14-19% as shown in Tables 7 and 8.

Table 6: Resource and Risk Summary

Prospect / Discovery	P L D	Level	Unrisked Oil Resources (mmbbl)			Unrisked gas Resources (bcf)			Pg	Risked P50
			P90	P50	P10	P90	P50	P10	%	MMboe
Eddystone West	P	Cretaceous	28	83	192	-	-	-	14	11.6
Eddystone East	P	Cretaceous	28	64	131	-	-	-	19	12.2
Bombardier	D	Jurassic	-	-	-	-	23	-	100	23

Table 7: Eddystone West Risk Factors

Charge	Source	0.90
	Migration	0.70
Reservoir	Presence	0.50
	Quality	0.90
Trap	Geometry	0.70
	Seal	0.70
COS		0.14

Table 8: Eddystone East Risk Factors

Charge	Source	0.90
	Migration	0.80
Reservoir	Presence	0.60
	Quality	0.90
Trap	Geometry	0.70
	Seal	0.70
COS		0.19

9 Conclusions

Full interpretation of the reprocessed 2D seismic data has been completed and despite some uplift in data quality, the main prospect (Eddystone) has not been markedly reduced in risk. In combination with the results from geological studies it has not been possible to sufficiently de-risk the prospect to drillable status. No other economically viable prospects have been identified. It is therefore recommended that the acreage be relinquished.

10 Clearance

The Parkmead Group confirms that the OGA is free to publish this report and that all third party ownership rights have been considered and appropriately cleared for publication purposes.

11 References

Applied Petroleum Technology UK Limited (2015) License P1933 (Bombardier Field and Eddystone Prospect), West Shetland Basin, UKCS. Thermal maturity, 1-D thermal modelling and provision of non-proprietary geochemical database.

Huizinga B., Holba A., Harvey M., and Bone R. (1999) Geochemical Evaluation of Gas and Residual Oil Shows From Bombardier 205/23-2. ARCO British Ltd.

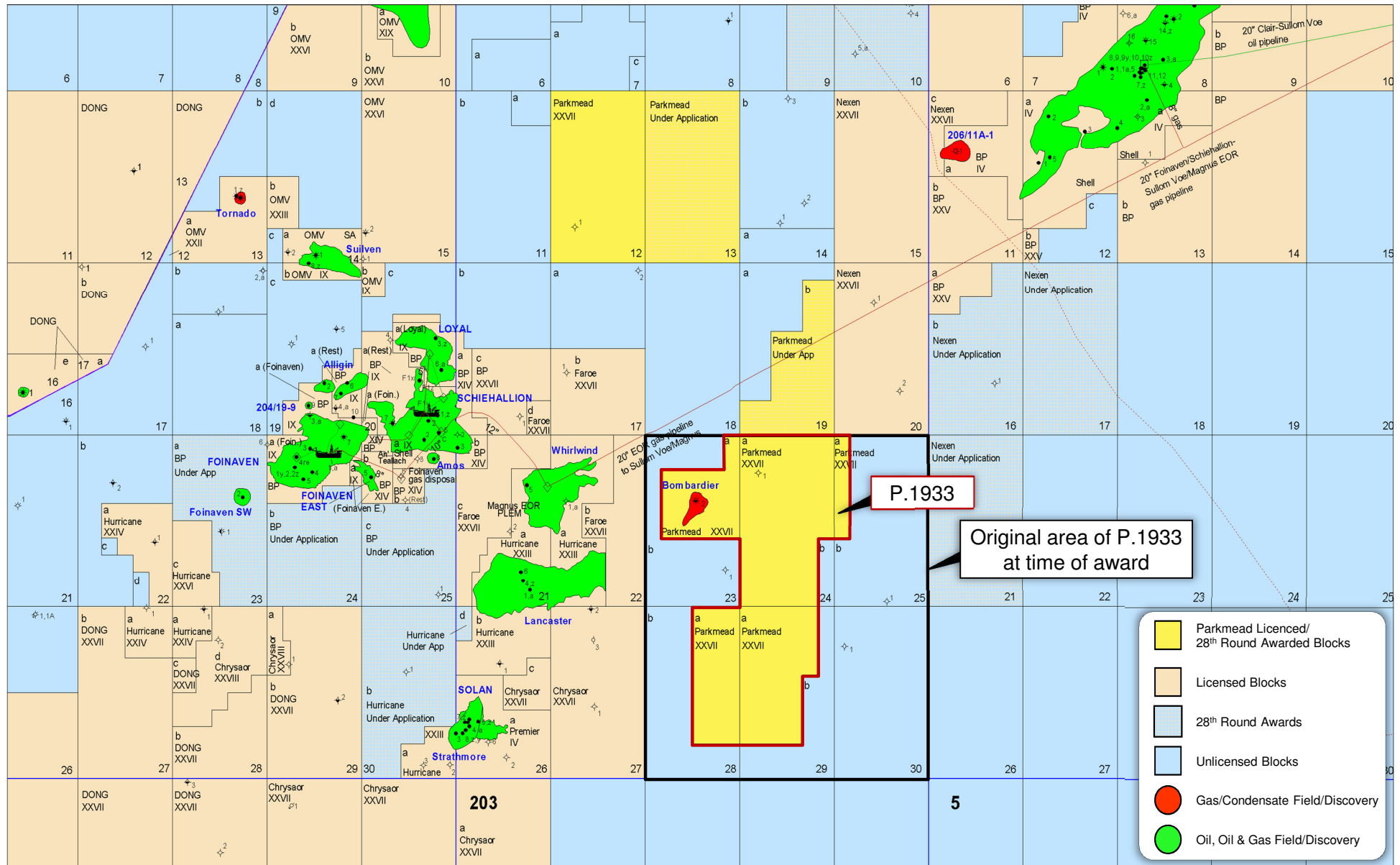


Figure 1: Location Map

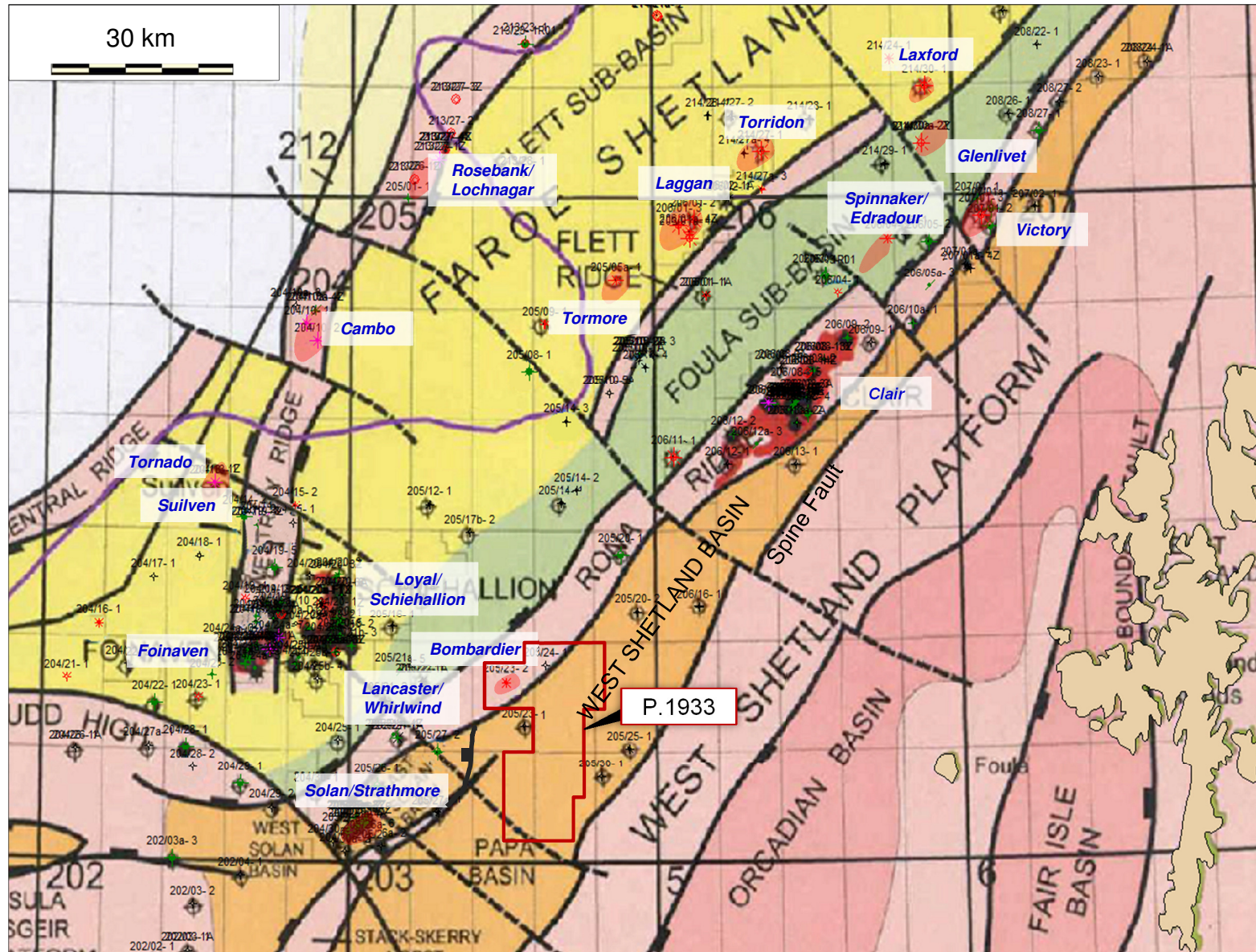


Figure 2: Structural Framework (Modified after Loizou, 2003)

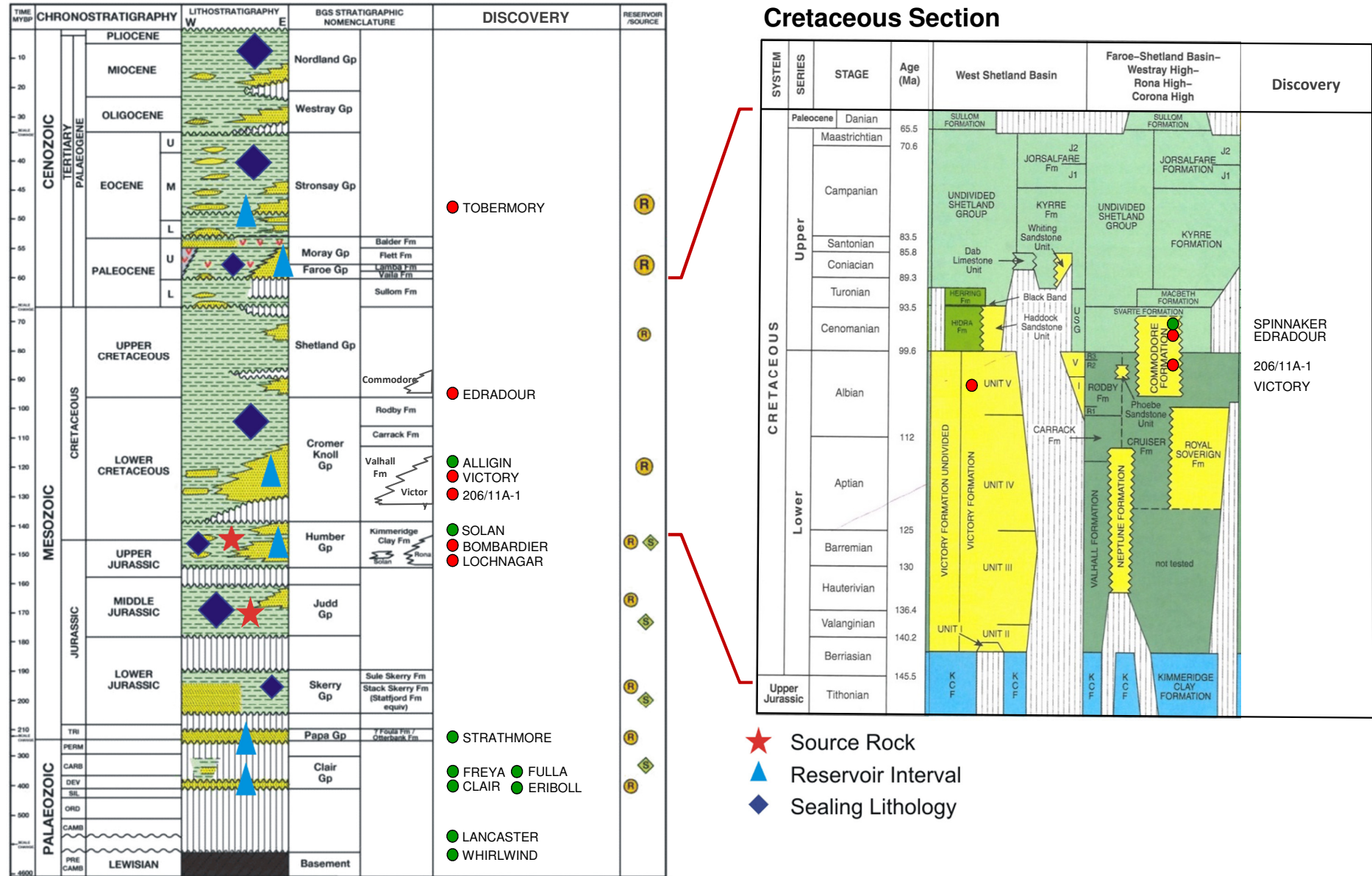
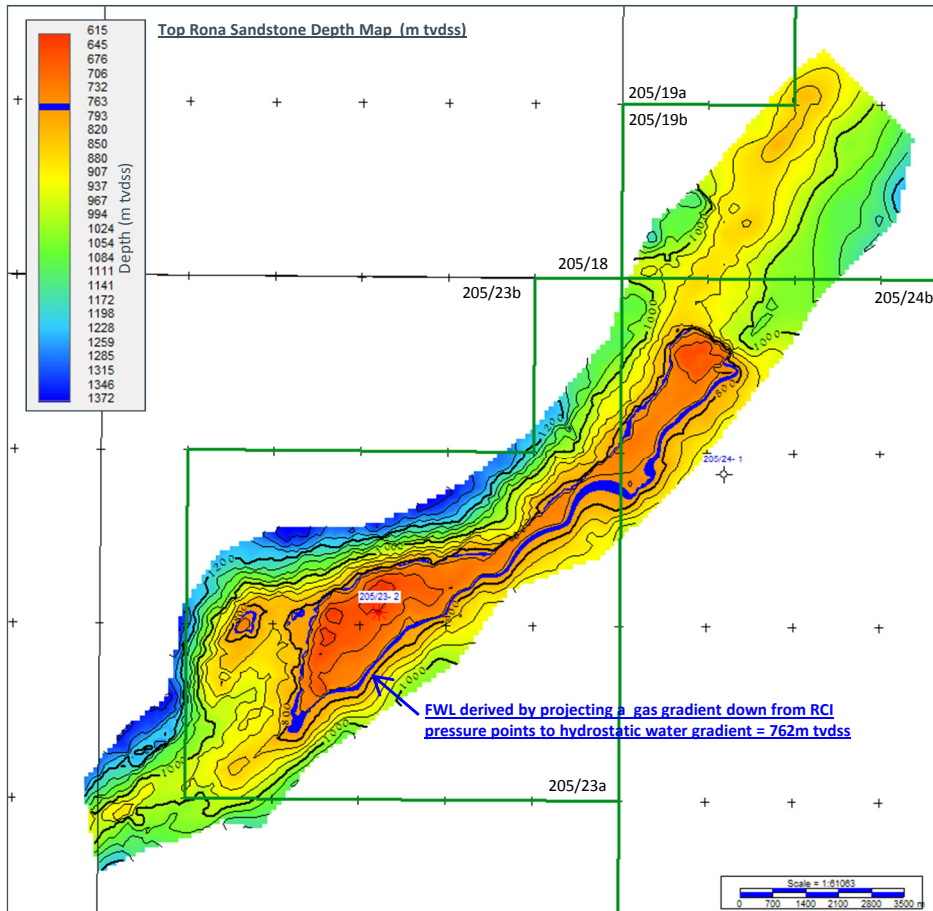


Figure 3: Stratigraphy (Modified after Ritchie, 2011)

- Discovered 1998 by ARCO 205/23-2
- Drilled to test Clair Field analogue feature along Rona Ridge
- Sub commercial very dry gas discovery in Jurassic Rona Sandstone
- 26.6m gas column (GDT base of reservoir), 20% Ø, 70% Sg, 37% NTG
- Residual oil ~ 22api shows reported



Gas Compound	205/23-2 MDT (vol %)
Methane (C ₁)	97.93
Ethane (C ₂)	0.25
Propane (C ₃)	0.10
Butanes (n+C ₄)	0.11
Pentanes (n+C ₅)	0.06
Hexanes plus (C ₆₊)	0.05
Carbon Dioxide (CO ₂)	0.08
Nitrogen (N ₂)	1.38
Helium	0.014
Argon	0.023
Hydrogen (H ₂)	nd
Total	16

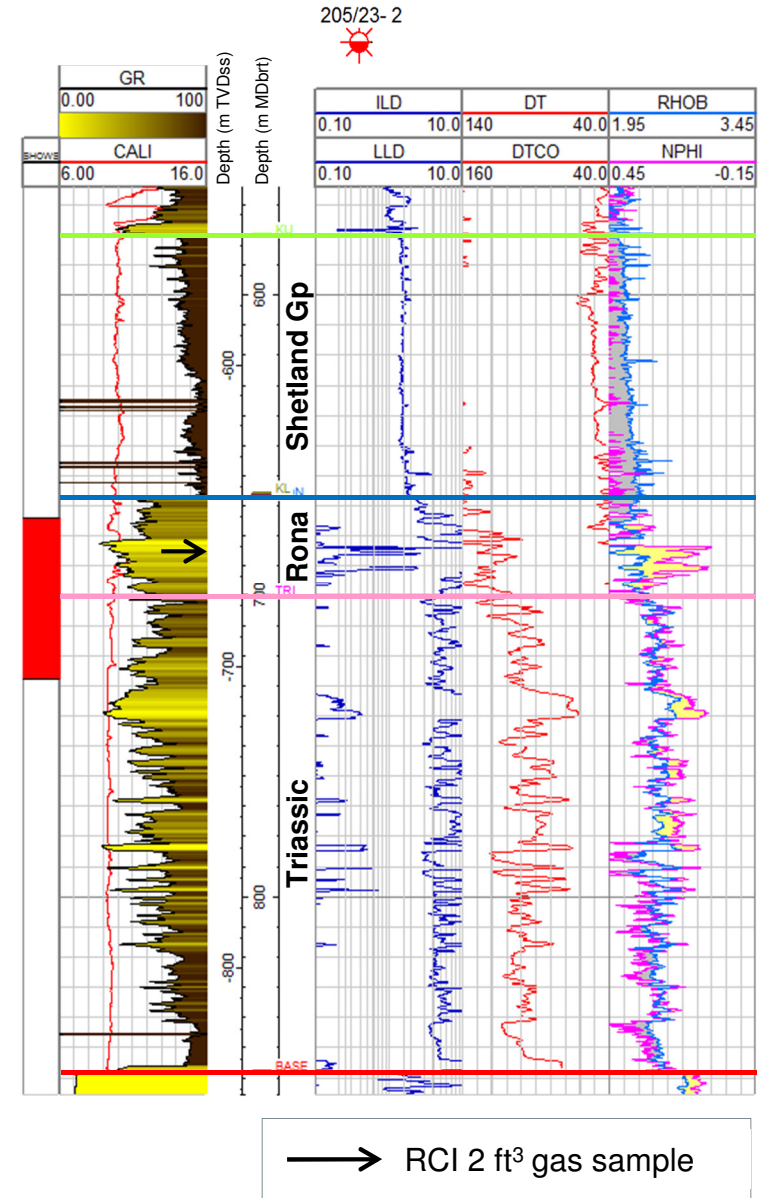


Figure 5: Bombardier Discovery Summary

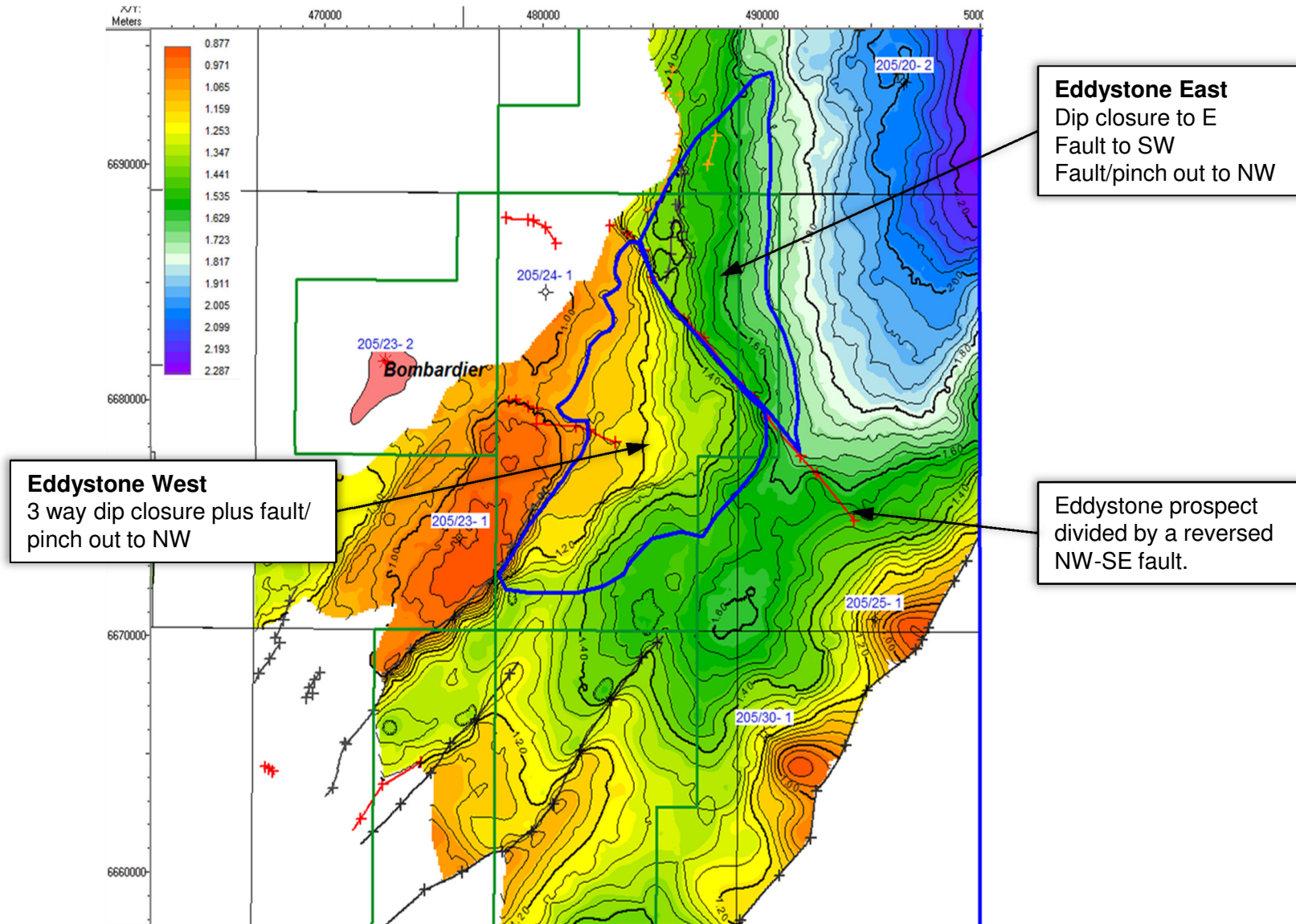


Figure 6: Eddystone – Turonian Limestone TWT Structure

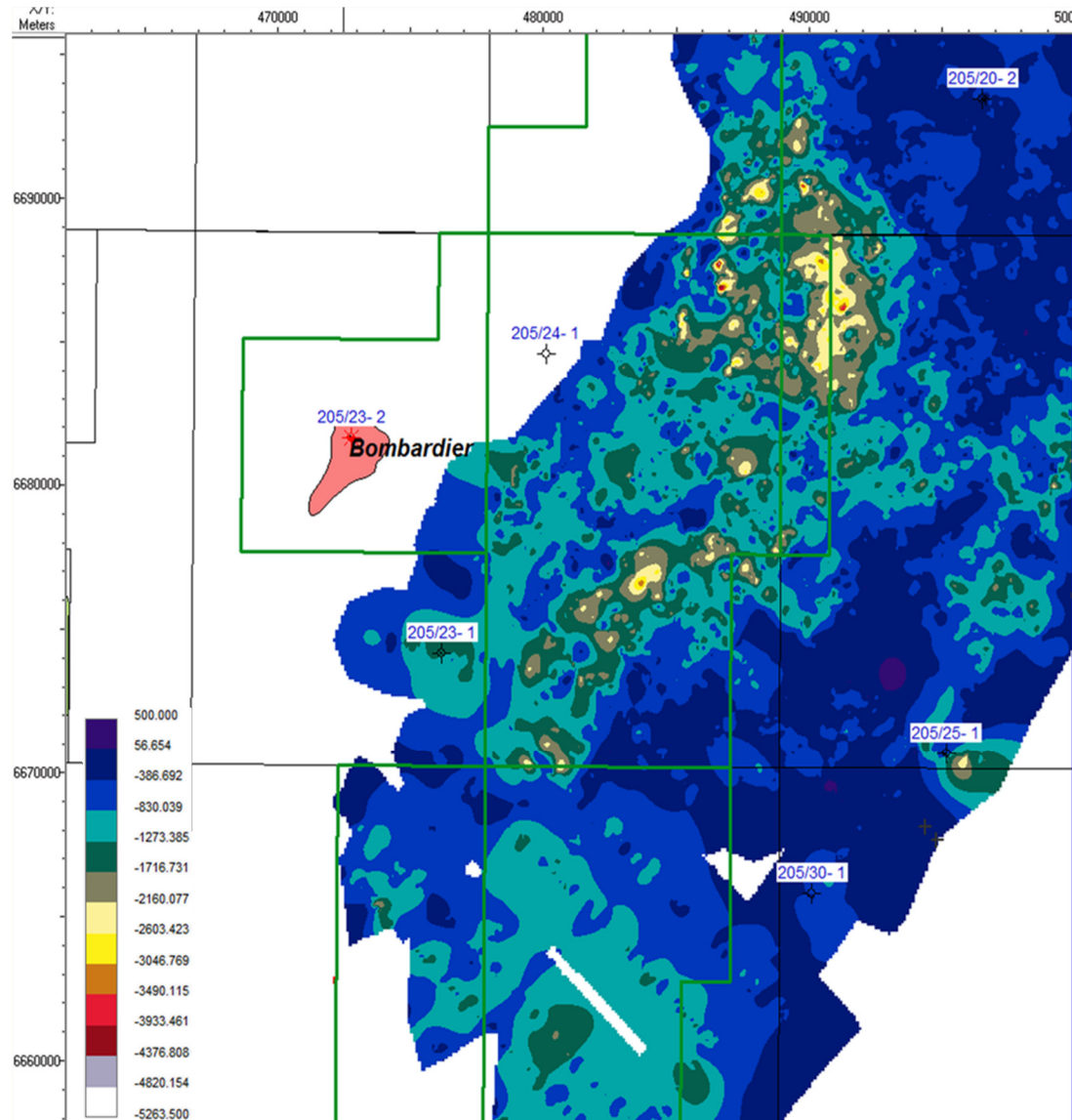


Figure 7: Eddystone – Turonian Limestone Amplitude

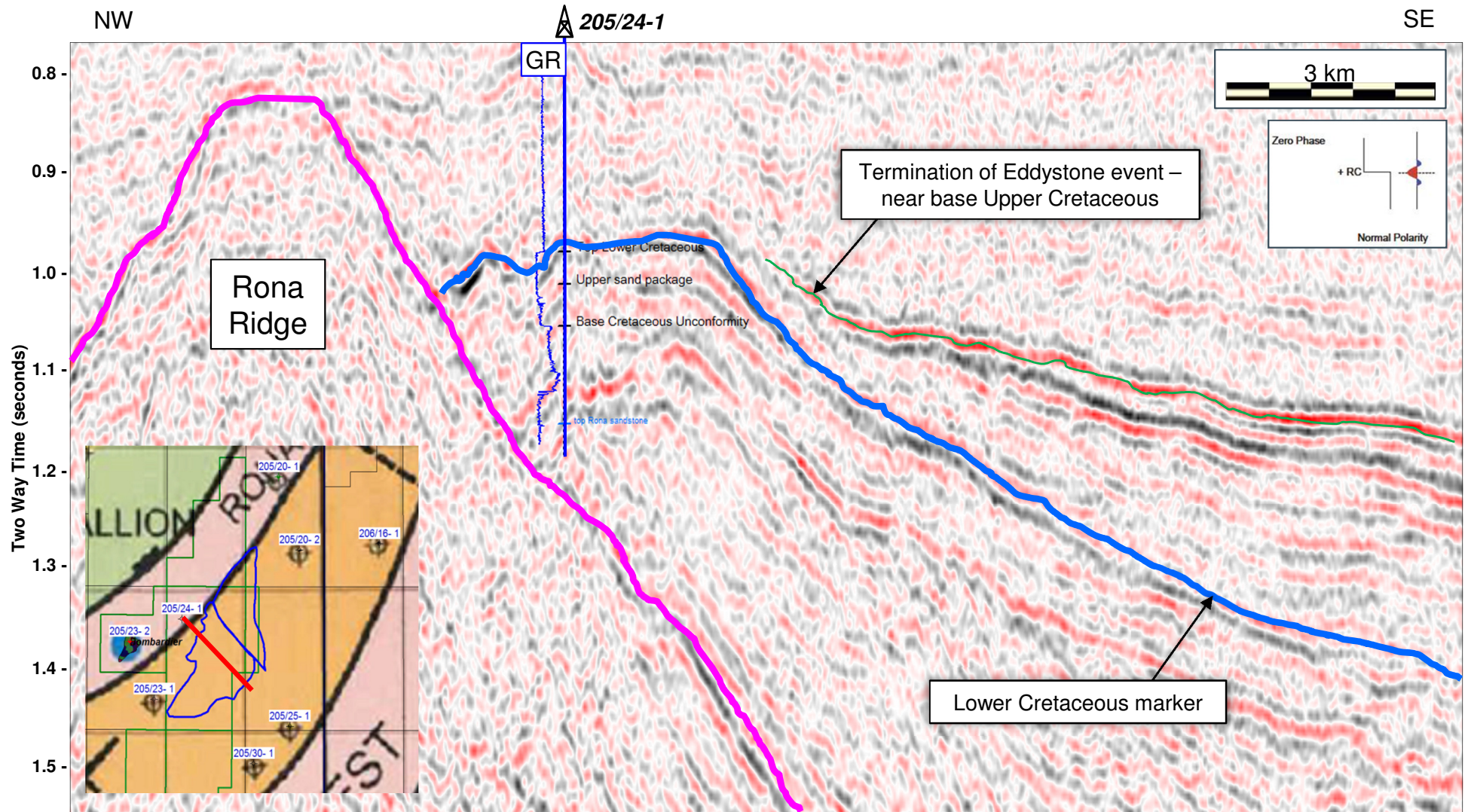


Figure 8: Eddystone Prospect

(2D Seismic Line AR205-93-34 Amplitudes – Proprietary BP Owned Line)

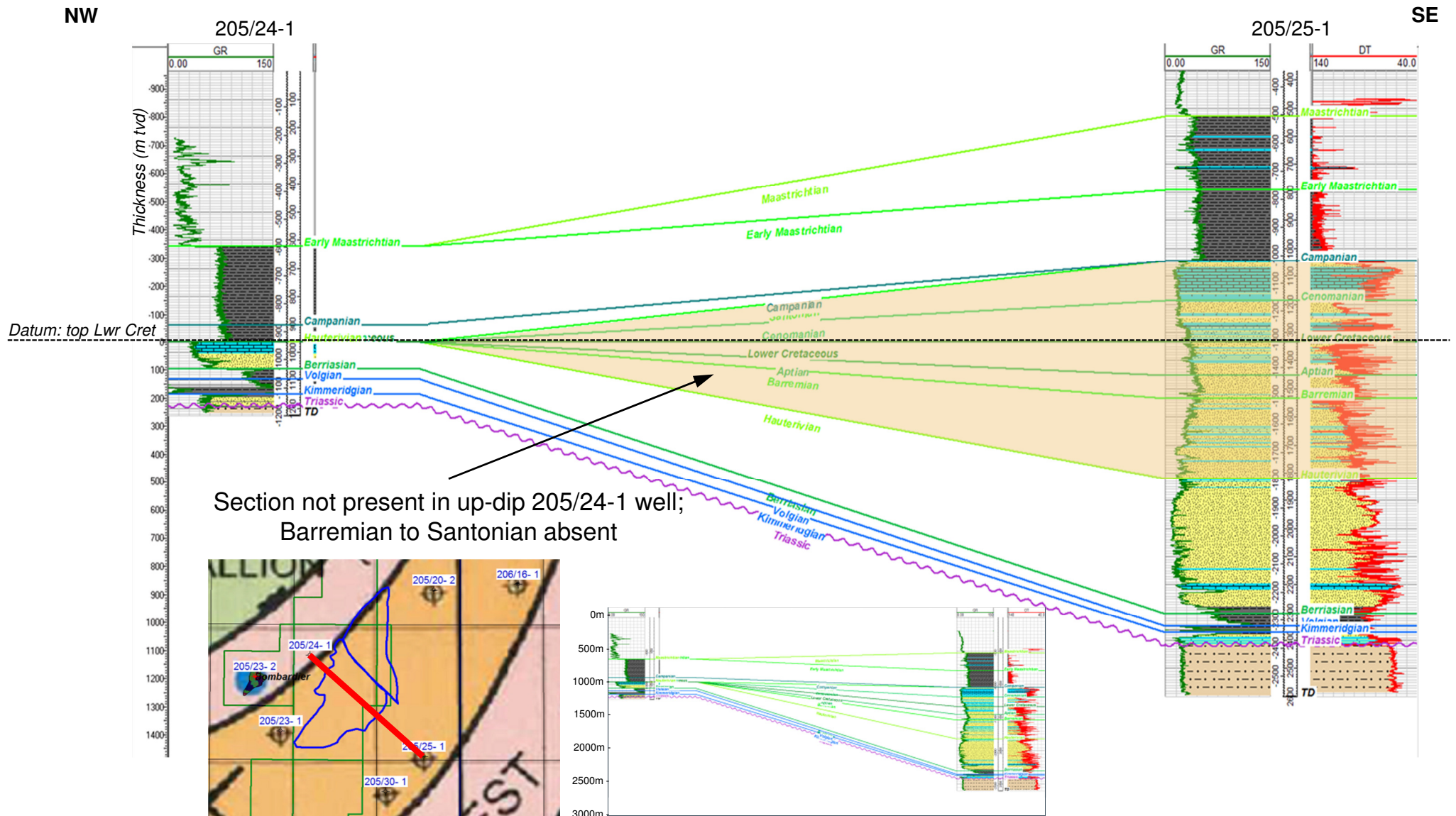


Figure 9: Well Correlation

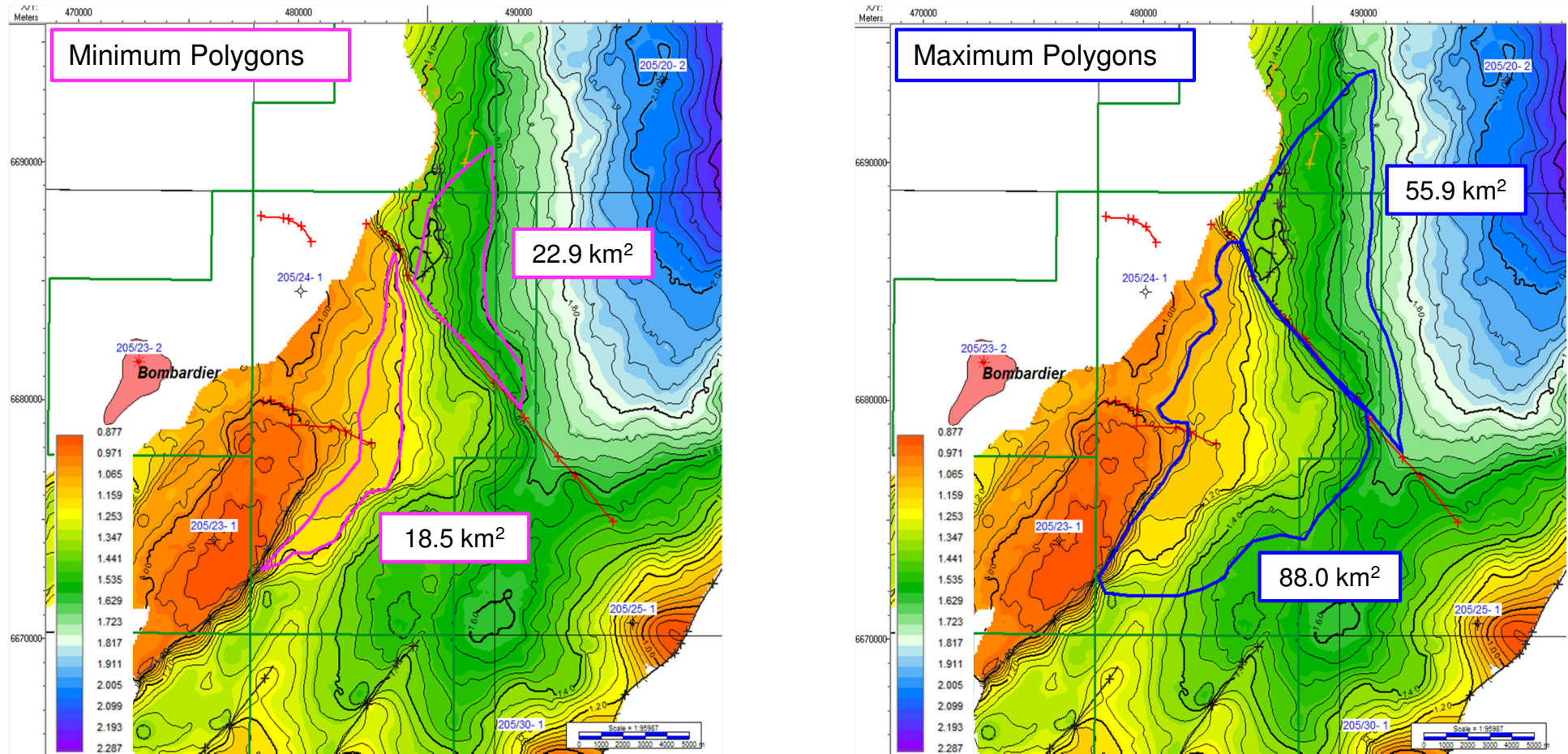


Figure 10: Eddystone West and East

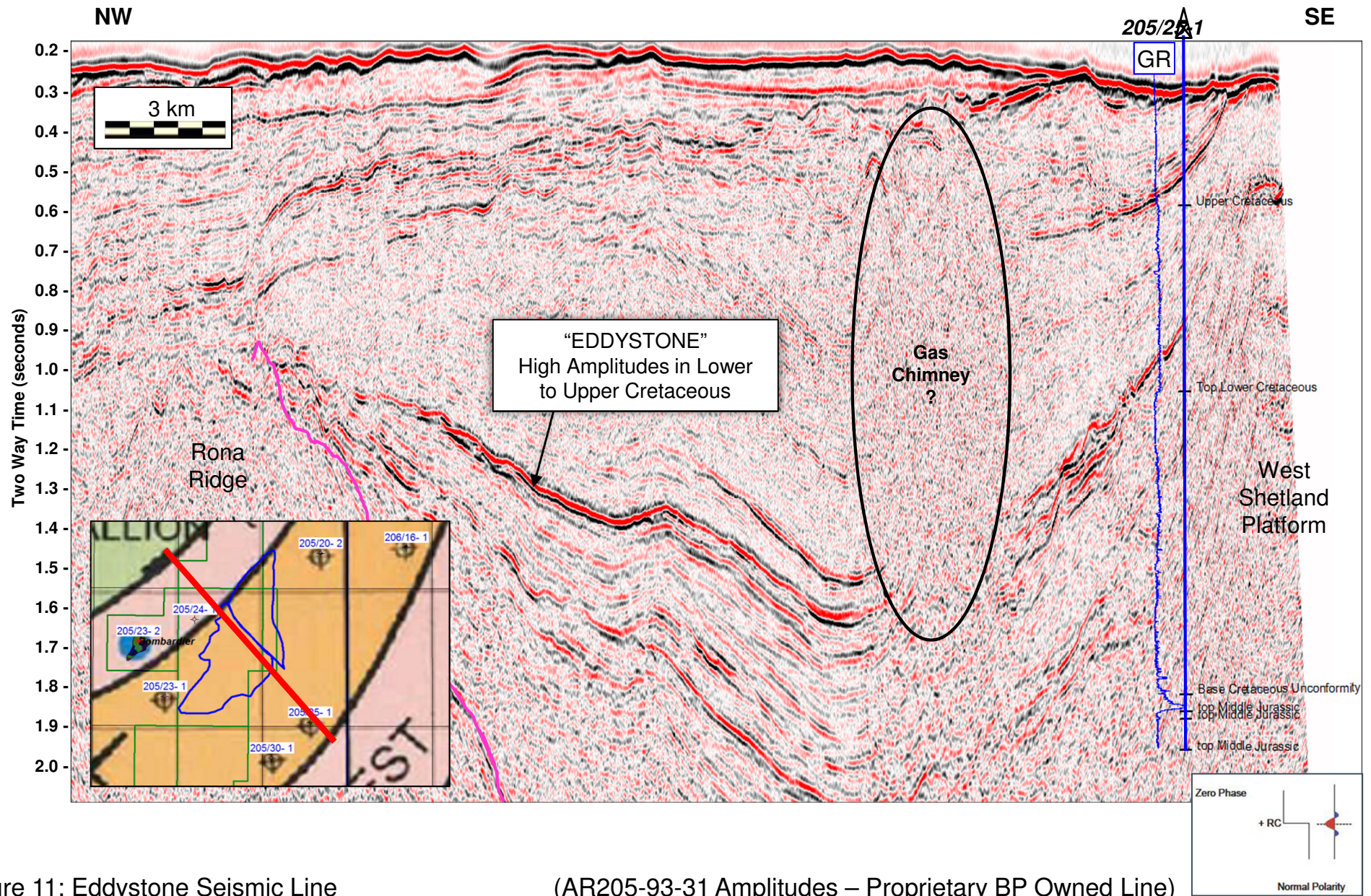


Figure 11: Eddystone Seismic Line

(AR205-93-31 Amplitudes – Proprietary BP Owned Line)

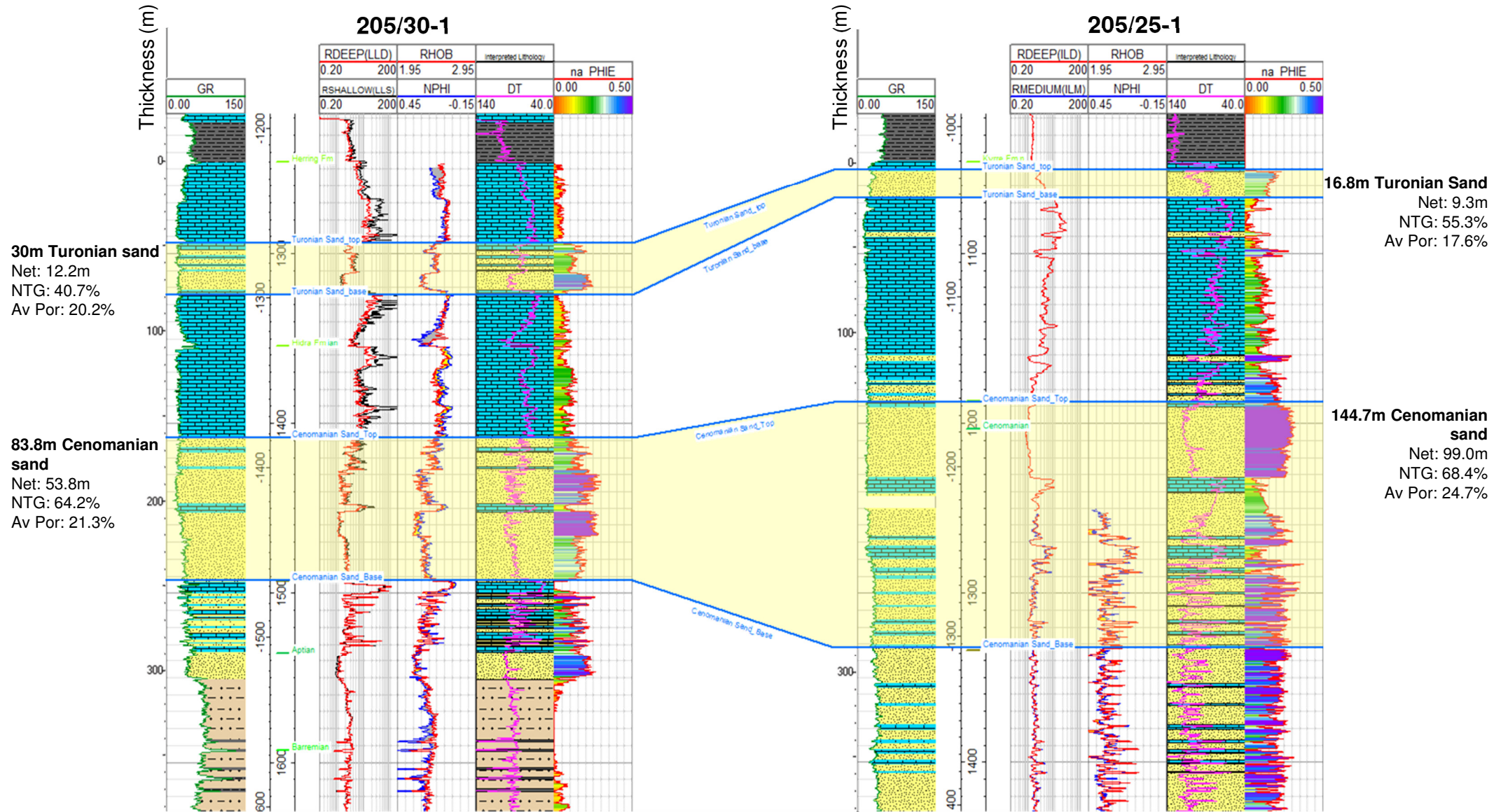


Figure 12: Well Section – Reservoir quality

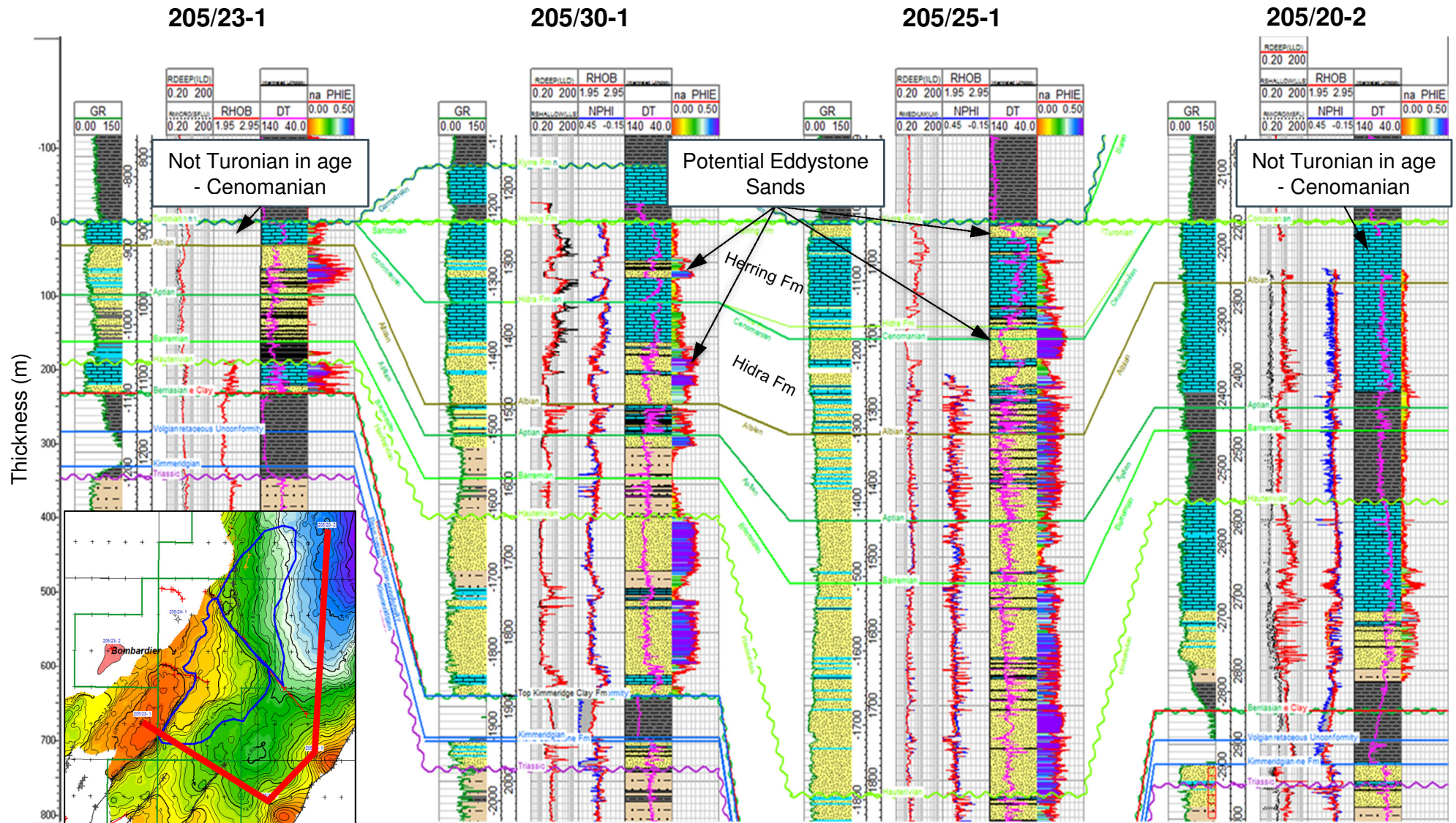


Figure 13: Well Section

Datum: Base Shetland Gp (top Turonian/Cenomanian)