Oil & Gas Note

08 October 2018

Union Jack Oil***

UJO LN **$72.9m**

0.09p **(0.64p)**

West Newton Accretive at All Levels

NAV:	$mm
Core	13.3
Appraisal & Development	40.9
Exploration	18.6
Total	**72.9**
Per Share	0.64p
From Current Price	611%

Stock Data	
Ticker	UJO LN
Share Price:	0.09p
Market Cap:	£7.8mm
EV:	£5.9mm

Price Chart

In Brief

The Company's farmin to Connaught Oil & Gas' interest in PEDL 183 not only generates significant value for UJO but also bolsters its appraisal and exploration portfolio. We estimate that the Transaction will add $7.12m (0.06p) after taking the associated cost estimates into account. The current market "worth" is $31.4mm (0.28p), which is 0.43x the valuation of $72.9mm (0.64p).

West Newton Brings a Range of Positives

The Company has agreed to farm into the PEDL 183, taking 16.665% Working Interest on a 1.50:1.00 Paying Interest/Working Interest basis (the "Transaction"), i.e. the Company pays 25% of the costs of drilling and completing the West Newton – 02 ("WN-02") well. No back costs are to be included, but the Company will assume its share of the operator's allocated licence costs on an ongoing basis in proportion to its Working Interest.

WN-02 Drilling Brings Near Term Activity

The Company's farmin partners have scheduled WN-02 to spud in 1Q'19, which adds to the Company's existing activity slate, which also includes Biscathorpe. While Wressle is many investors' focus, we believe that West Newton's prospectivity provides a counter-balance, not just to the Company's valuation, but its work programme too.

Transaction Adds to the Overall Valuation

While we estimate that the obligation costs could amount to $2.86mm, which is comprised of $1.76mm of well related costs and $0.23mm of JV costs. These costs, however, are more than offset by the value that is created by the consolidation of the Contingent and Prospective Resources into the portfolio. Our estimates suggest that this transaction adds $16.4m (0.14p) to the valuation, which when applying the average NAV multiple of 0.43x suggests a net market uplift of $7.05m (0.06p).

Increasing Balance to the Portfolio

While the main target for the WN-02 is the appraisal of the Kirkham Abbey Shoal, the deeper prospectivity on the Cadeby Reef, as well as the other prospects in the project hopper, such as Ellerby and Spring Hill, add additional targets to the Company's wider portfolio.

Valuation $72.9mm (0.64p)

We have valued Union Jack Oil's assets at $72.9mm (0.64p) using DCF valuation methodology, which is some 611% above the current share price; the un-risked valuation is $438.2mm (3.84p). We have also assessed the impact of a number of key variables such as gas price, SPE PRMS category and whether the development of the West Newton discovery. Given the market $NAV_{(D)}$ multiple of 0.43x, suggesting a fair market value today of $31.3mm (0.28p), implying the shares, post the Transaction should be trading 211% above the current share price.

YE Dec (£mm unless stated)	2017	2018E	2019E	2020E
Production (mm boe)	6.30	14.50	21.23	19.52
EBITDA	(0.74)	(0.40)	(0.20)	3.36
Net Income	(0.76)	(0.49)	(0.35)	2.32

Source: SP Angel

Research

Zac Phillips
+44 20 3470 0470
zac.phillips@spangel.co.uk

Corporate Broking

Richard Redmayne
+44 20 3470 0470
richard.redmayne@spangel.co.uk

Sales

Richard Parlons
+44 20 3470 0472
richard.parlons@spangel.co.uk

Jonathan Williams
+44 20 3470 0471
Jonathan.williams@spangel.co.uk

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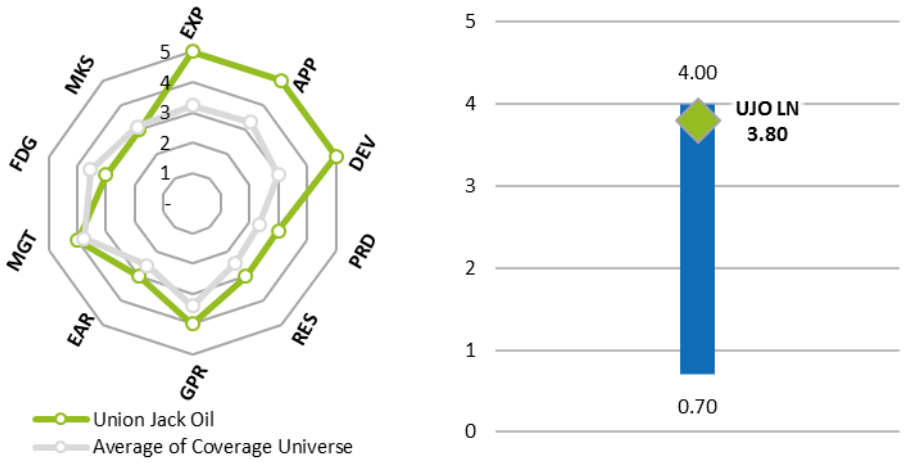
SP Angel Company Scorecard

Figure 1 – SP Angel Scorecard

Category	5-Star Rating	Comment
Exploration ("EXP")	✪✪✪✪✪	The farmin to PEDL183 has substantially increased the Company's exploration portfolio. Not only has the number of prospects increased, but the size too.
Appraisal ("APP")	✪✪✪✪✪	With the Biscathorpe and West Newton appraisal wells scheduled for the next six months, the Company's activity is continuing to increase.
Development ("DEV")	✪✪✪✪✪	Wressle is the sole development asset currently, and it continues to await approval. We believe that the appeals route will be the sole way in which the asset is developed, leading to our estimate of a first production date of 2020.
Production ("PRD")	✪✪✪✪✪	The Company has limited production currently (Keddington & Fiskerton). However, we believe this will be addedd to in the near-term as Wressle is granted approval, either from the council, or upon appeal by the UK Government.
Reserves ("RES")	✪✪✪✪✪	With Contingent Resources already consolidated on Wressle, once the commissioning of Wressle is approved, these will be reclassified as Reserves; the producing assets of Keddington and Fiskerton have not been assessed for Reserves and are currently unclassified.
Geopolitical Risk ("GPR")	✪✪✪✪✪	Local councils have undermined the UK government's attempts to maintain interest in UK onshore oil and gas. Legislative changes have been undone by the protracted planning programmes, which has been unduly influenced by environmental activists. Consequently, we have downgraded its attractiveness on a global scale. Outlook Negative.
Earnings ("EAR")	✪✪✪✪✪	While the Company enjoys the benefits of production at Keddington & Fiskerton, the consolidation of Wressle will represent a step change in earnings.
Management ("MGT")	✪✪✪✪✪	The management has established a track record of negotiating meaningful positions in highly prospective locations. While small, the current management team meets the current requirements.
Funding ("FDG")	✪✪✪✪✪	The Company has sufficient funding for its near to medium term work programmes, including Biscathorpe and West Newton.
Market Support ("MKS")	✪✪✪✪✪	While support for management has remained positive, the repeated rejection of Wressle planning approval has undermined the share price.
Overall ("OVR")	✪✪✪✪✪	**The Company's current exploration and appraisal programme is well balanced, and benefits from the interest in the potential of its portfolio. With further material upside possible, the Company is well positioned to take advantage of the current investment environment.**

5-Star Rating



Source: SP Angel Data

Valuation – $72.9mm (0.64p)

We have valued UJO's assets at $72.9mm (0.64p) using DCF valuation methodology; the un-risked valuation is $438.2mm (3.84p).

Summary

SPA has used discounted cash flow ("DCF") based net asset value ("NAV") as its primary valuation tool as it allows the study of a range of key influential valuation factors on a company's asset portfolio. However, the market's assessment of a company's worth must also be considered. Consequently, we have valued Union Jack Oil using not only NAV but also assessed its market "worth" using P_{BEST} Contingent and Prospective Resources market multiples and the "see-through" of Hibiscus (summarised in Table 1 and Figure 2).

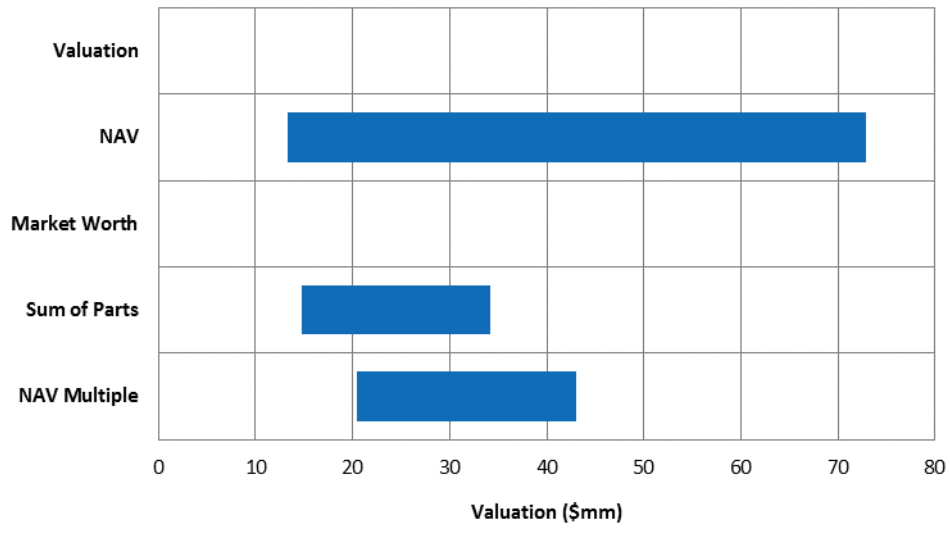
Table 1 – UJO Valuation Summary

Valuation Method	Market average	Company Multiplier	Implied Value ($mm)	Implied Value (p/share)
Valuation				
$NAV_{(D)}$ (Page 5)				
Mid Cycle	-	-	72.9	0.64
Near Cycle	-	-	37.7	0.33
Market Worth				
Sum of Parts Valuation (Page 7)	-	-	34.2	0.30
NAV multiple (Page 12)				
+1 Standard Deviation	0.28x		20.4	0.18
Average	0.43x	$72.9mm	31.3	0.28
+1 Standard Deviation	0.59x		43.0	0.38
Average	**-**	**-**	**32.2**	**0.29**

Source: Bloomberg and SPA data

Figure 2 – Tornado Valuation Summary

UJO's valuation across all methodologies ($mm)



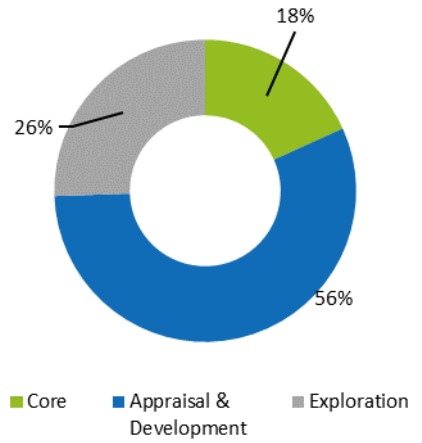
Source: SPA Data

NAV Valuation

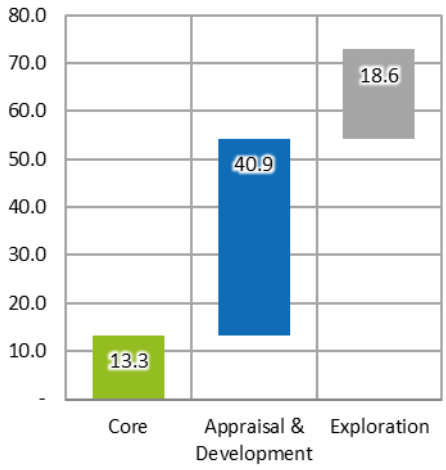
In valuing Union Jack Oil, we have adopted a discounted cash flow ("DCF") valuation methodology, the principal valuation technique used by the Oil & Gas industry to value production and appraisal assets. Subsequent to this, where applicable, expected monetary value ("EMV") was then applied to arrive at a risk-adjusted value. The valuation of the Company's assets is summarised in Figure 3 and Table 3.

Figure 3 – NAV Summary

Percentage of Risked NAV



$mm



Source: SPA Data

Table 2 – Summary of Valuations

Parameter	Mid Cycle	Near Cycle	Comment
Oil Price	SPA Curve	Forward Curve	Forward curve as at 5th October 2018
Portfolio:			
Producing	✓	✓	**Mid Cycle:** All assets in the portfolio. The Company only has producing assets included in this valuation.
Development	✓	×	
Appraisal	✓	×	**Near Cycle:** Comprised of the valuation contribution of cash generating fields net of balance sheet liabilities
Exploration	✓	×	

Source: SPA data

Table 3 – NAV(D) Valuation Summary

Field	Hydrocarbons mm boe		NAV ($mm)		($/boe)		(p/share)	
	Unrisked	Risked	Unrisked	Risked	Unrisked	Risked	Unrisked	Risked
Core								
Keddington & Fiskerton	0.09	0.09	1.3	1.3	15.0	15.0	0.01	0.01
Wressle	1.87	1.87	13.4	10.3	7.1	5.5	0.12	0.09
Balance Sheet Items	-	-	1.7	1.7	-	-	0.01	0.01
Core NAV	**1.96**	**1.96**	**16.3**	**13.3**	**-**	**-**	**0.14**	**0.12**
Appraisal & Development								
Biscathorpe	3.09	0.92	100.4	29.6	32.4	9.6	0.88	0.26
Kirklington	0.11	0.05	3.3	0.7	30.9	6.9	0.03	0.01
Dukes Wood	0.48	0.12	13.2	1.7	27.7	3.5	0.12	0.01
West Newton	8.14	2.26	43.2	9.0	5.3	1.1	0.38	0.08
Appraisal & Development NAV	**11.82**	**3.34**	**160.0**	**40.9**	**13.5**	**3.5**	**1.40**	**0.36**
Exploration								
North Kelsey	1.32	0.16	37.2	4.2	28.2	3.2	0.33	0.04
Louth	0.31	0.06	12.5	2.2	40.7	7.0	0.11	0.02
North Somercotes	0.38	0.07	4.2	0.6	10.8	1.6	0.04	0.01
Holmwood	0.44	0.07	5.3	0.8	12.3	1.8	0.05	0.01
Broughton North	0.09	0.02	1.3	0.2	14.7	2.0	0.01	0.00
West Newton	23.34	3.03	77.5	3.0	3.3	0.1	0.68	0.03
Ellerby	12.49	2.40	29.6	2.3	2.4	0.2	0.26	0.02
Spring Hill	11.07	2.13	28.4	2.1	2.6	0.2	0.25	0.02
Shale	22.81	1.19	65.7	3.2	2.9	0.1	0.58	0.03
Exploration NAV	**72.24**	**9.13**	**261.8**	**18.6**	**3.6**	**0.3**	**2.29**	**0.16**
Total NAV	**86.02**	**14.44**	**438.2**	**72.9**	**5.1**	**0.8**	**3.84**	**0.64**

Source: SPA Data

Table 4 – Summary of Risking Factors used to Determine NAV

Asset Types	Traditional CoS Range	Comment
Exploration	0 – 25%	With the addition of the West Newton licences, there has been a quantum shift in the size of the Company's exploration targets. The Company now has eight exploration targets, excluding its shale positions.
Appraisal	25 – 55%	The addition of West Newton to the appraisal portfolio is a significant milestone, not least because of at 0.58mm bbl & 184bcf, its size (5.48mm boe net to UJO), effectively doubles its existing 2C Contingent Resources.
Development	55 – 85%	With Wressle effectively in hiatus at the production stage, the Company has nothing at the development stage. However, a successful test on one of Biscathorpe or West Newton, allied with a more supportive planning environment in these assets' locations, means that they are likely to be swiftly migrated into development.
Production	85 – 100%	While Keddington and Fiskerton are the only assets in production, Wressle is awaiting approval before the delivery of first oil. We currently estimate that the appeals process and final approval will precipitate Wressle commissioning in 2020.

Source: SPA data

Peer Group Market Worth

SPA has conducted a review of E&P companies worldwide, limiting its comparison to those with similar profile to UJO. In conducting peer group valuation, SPA has looked at the most appropriate method s, whether on a namely per daily flowing barrel, per barrel of Reserves, or Resources. Using these methods implies an average valuation of $32.2mm (0.29p), 222% ahead of the current market value. We summarise the valuation methods in (Table 5).

Table 5 – UJO Peer Group Summary

Valuation Metric	Market average	UJO multiplier	Implied Value ($mm)	Implied Value (p/share)
Sum of Parts Valuation (Page 7)	-	-	34.3	0.29
Per Daily Flowing Barrel (Page 7)				
Liquids Rich	*$36,872/bpd*	*12bpd*	*0.4*	*<0.00*
Gas Rich	*$19,678/boepd*	-	-	-
2P Reserves (Page 9)				
Liquids Rich	*$6.87/bbl*	*1.9mm boe*	*12.8*	*0.11*
Gas Rich	*$3.89/boe*	*5.5mm boe*	-	-
Resources (Page 11)				
2C Contingent Resources				
Liquids Rich	*$3.78/boe*	-	-	-
Gas Rich	*$1.15/boe*	*11.8mm boe*	*13.6*	*0.12*
P_{50} Prospective Resources	*$0.08/boe*	*72.2mm boe*	*5.8*	*0.05*
Cash	-	-	*1.7*	*0.01*
NAV multiple (Page 12)	0.43x	$72.9mm	31.3	0.28
Average	**-**	**-**	**32.2**	**0.29**

Source: SPA data

Sum of Parts

With a portfolio that has a combination of contributory elements, it is difficult to say with certainty how much of the valuation contribution is provided by each category (flowing barrels, Reserves, Resources, etc.). However, given the number of companies in the market that have operations at various stages of operation alone, it is possible to imply a market value. We summarise this is in Table 6.

As can be seen in Table 6, the sum of parts valuation is broadly in line with the market valuation. However, this does not take in to account the pending development of Wressle, following the completion of the appraisal programme.

Per Daily Flowing Barrel

SP Angel's review of global E&P company valuations provides a useful guide as to the market worth of production (Figure 4). We have averaged the data for those companies with production by the key international exchanges, and while this data suggests that each barrel of production can trade in excess of $100,000/bpd, eliminating valuations above $70,000/bpd results in a value of $36,872/bpd for liquids rich streams and $19,678/boepd for gas rich streams. We believe to be more representative of a fair market "worth."

On this basis, and using UJO's net production of 12bpd, implies a valuation of $0.4mm (Figure 5).

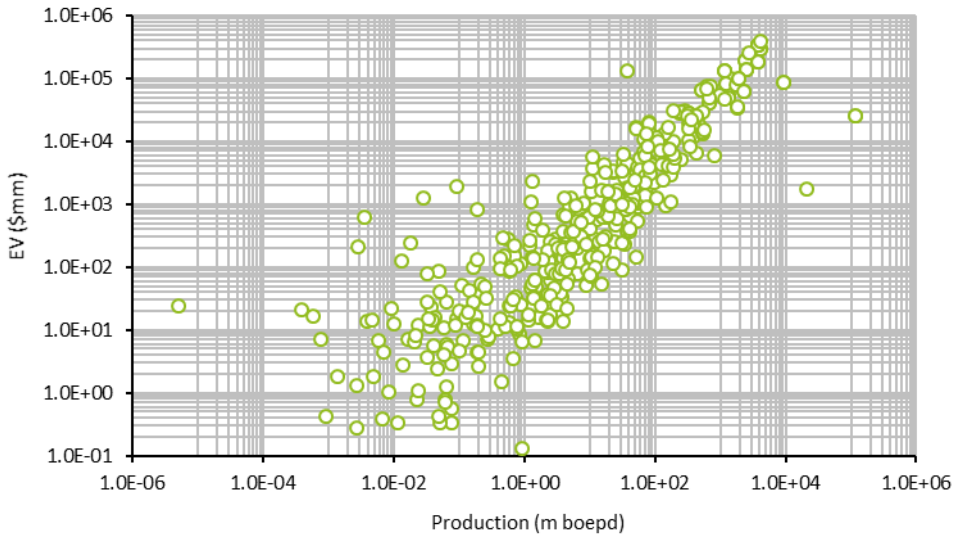
Table 6 – Sum of Parts Valuation

Metric	Comment	Market Average	UJO Multiplier	Implied Value ($mm)	Implied Value (p/share)
Per Daily Flowing Barrel (Page 7)	Currently the Company's production is limited to Keddington & Fiskerton. However, we anticipate Wressle to be online by the close of 2020.				
Liquids Rich		$36,872/bpd	12bpd	0.4	<0.00
Gas Rich		$19,678/boepd	-	-	-
2P Reserves (Page 9)	While Keddington & Fiskerton Reserves are uncategorised (currently), Wressle is the sole contributor. The outlook remains buoyant as the onshore portfolio and healthy Contingent Resources means reclassification could be swift.				
Liquids Rich		$6.87/bbl	1.9mm bbl	12.8	0.11
Gas Rich		$3.54/boe	-	-	-
Resources (Page 11)	Both West Newton and Wressle contain significant Contingent Resources. The sanction of Wressle Phase II will add further volumes to the portfolio.				
2C Contingent		$3.78/boe	-	-	-
Liquids Rich		$1.15/boe	11.8mm boe	13.6	0.12
Gas Rich		$0.08/boe	72.2mm boe	5.8	0.05
P_{50} Prospective					
Cash	-	-	-	1.7	0.01
Total	-	-	-	**34.3**	**0.29**

Source: SPA Data
§ - SPA Estimate from OGA data historical production and reserves

Figure 4 – EV per Daily Flowing Barrel

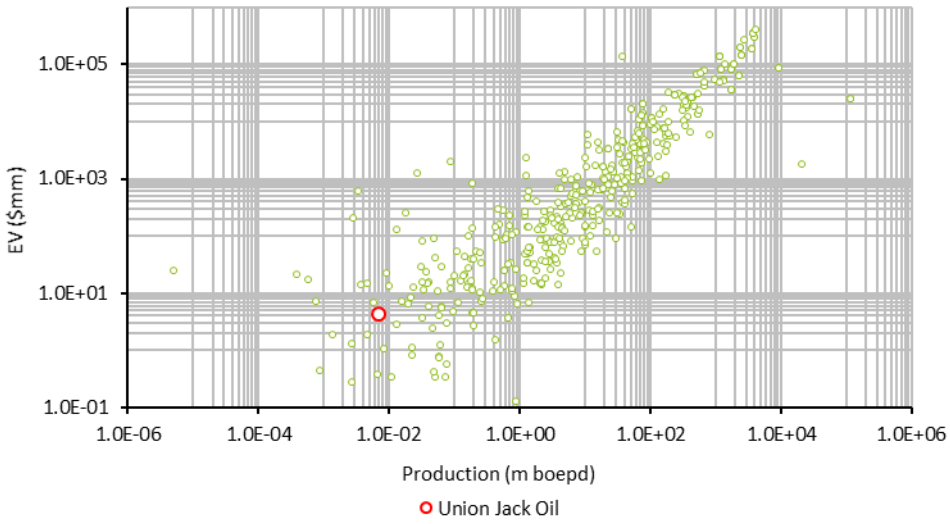
Variation in EV with Barrels of Production



Source: Bloomberg & SP Angel data

Figure 5 – EV per Daily Flowing Barrel (Union Jack Oil)

Variation in EV with Barrels of Production – UJO Highlighted



Source: Bloomberg & SP Angel data

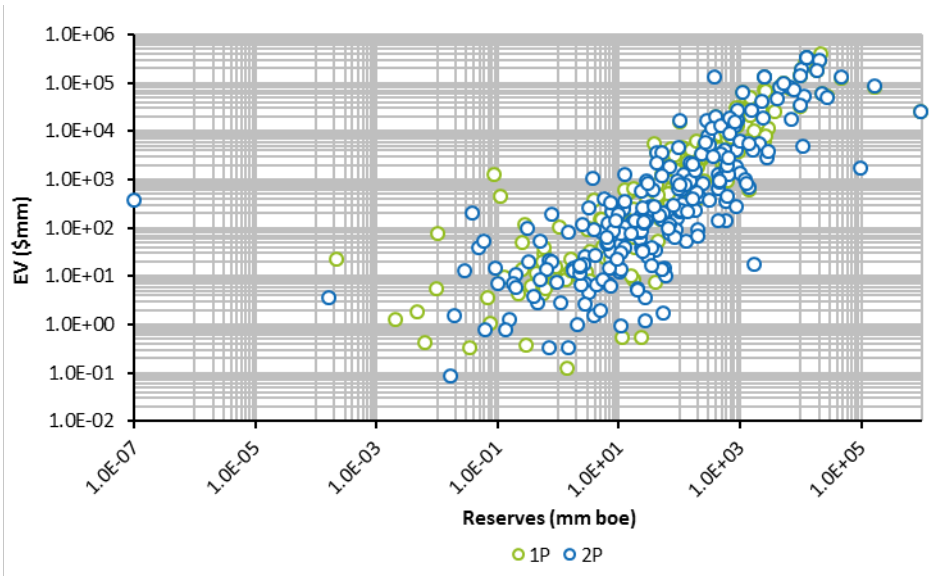
2P Reserves

SP Angel's review of global E&P company valuations worldwide provides a useful guide as to the market worth of each barrel of Reserves, whether P1 or 2P, limiting our sample to those companies that have reported Reserves according to SPE PRMS guidelines.

We have averaged the data for those companies with 2P Reserves (Figure 6), by exchange, and while this data suggests that in London 2P barrels trade at value in excess of $15.0/2P bbl, excessively high or low valuations (1.25/2P bbl > $25.0/2P bbl), results in a value of $6.87/$P_{50}$ bbl for liquids rich Reserves, and $3.89/$P_{50}$ bbl for gas rich Reserves, which we believe to be more representative of a fair market "worth."

Figure 6 – EV per 2P Barrel of Reserves

Variation in EV with P1/2P Barrel of Reserves

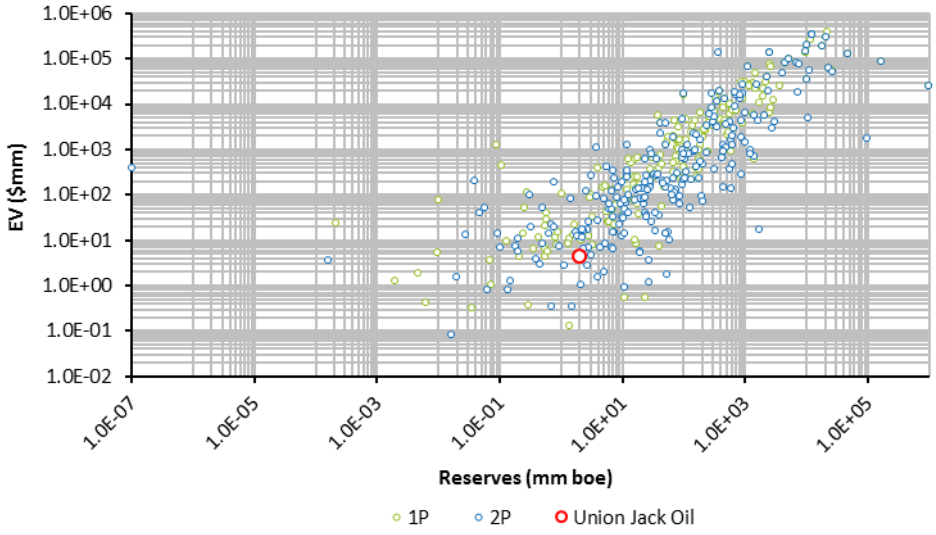


Source: Bloomberg & SP Angel data

On this basis, and using UJO's 2P Reserves of 1.9mm bbl, implies a valuation of $12.8mm (Figure 7). We believe that once the appraisal programme has been successfully completed on Biscathorpe, that there will be a significant reclassification of what we currently classify as P_{50} Prospective Resources into 2P Reserves.

Figure 7 – EV per 2P Barrel of Reserves (Union Jack Oil)

Variation in EV with P1/2P Barrel of Reserves UJO Highlighted



Source: Bloomberg & SP Angel data

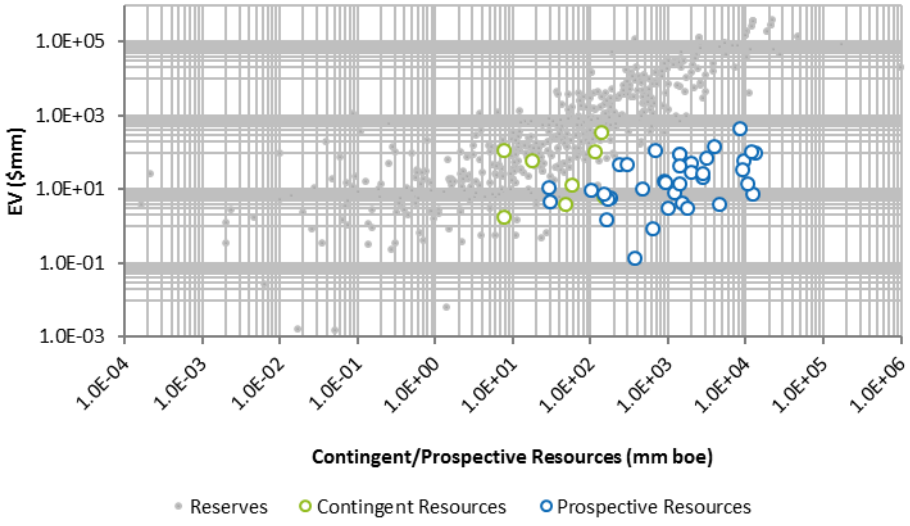
2C/P_{50} Contingent/Prospective Resources

SP Angel has conducted a review of E&P companies worldwide, limiting its comparison to companies that have reported their respective Contingent and Prospective Resources according to SPE PRMS guidelines.

We have averaged the data for those companies (Figure 8) by exchange for Contingent and Prospective Resources. Eliminating excessive valuations, Contingent Resources trade at \$3.78/2C boe for liquids rich Contingent Resources, and \$1.15/P_{50} boe for gas rich Contingent Resources; Prospective Resources trade at \$0.08/P_{50} boe.

Figure 8 – EV per Barrel of Contingent/Prospective Resources

Variation in EV with Contingent (2C)/Prospective (P_{50})

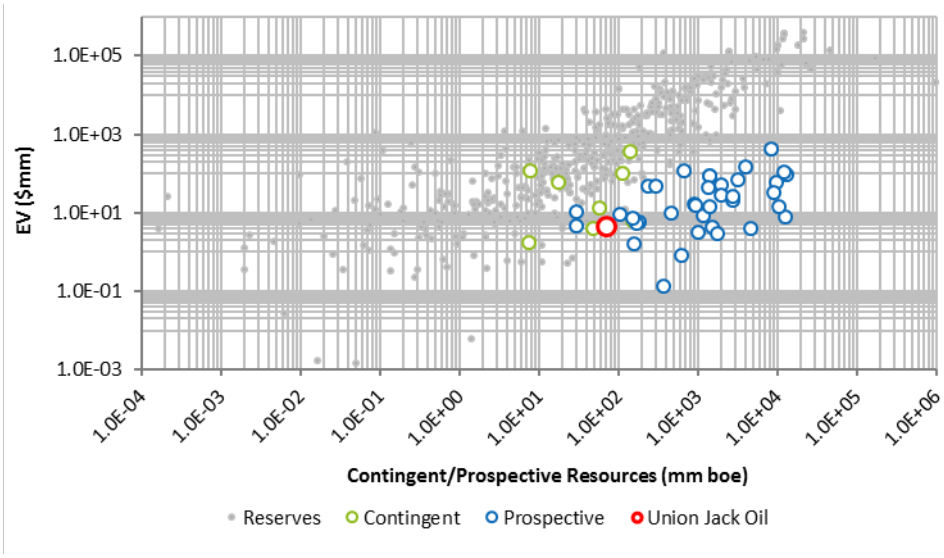


Source: Bloomberg & SP Angel data

The Company is currently trading at an EV of \$7.7mm (Figure 9), but using UJO's 2C Contingent Resources of 11.8mm boe (gas rich) and P_{50} Prospective Resources of 72.2mm boe, implies a valuation of \$19.4mm (0.17p); this comparison is illustrated in Figure 10.

Figure 9 – EV per Barrel of Contingent/Prospective Resources (Union Jack Oil)

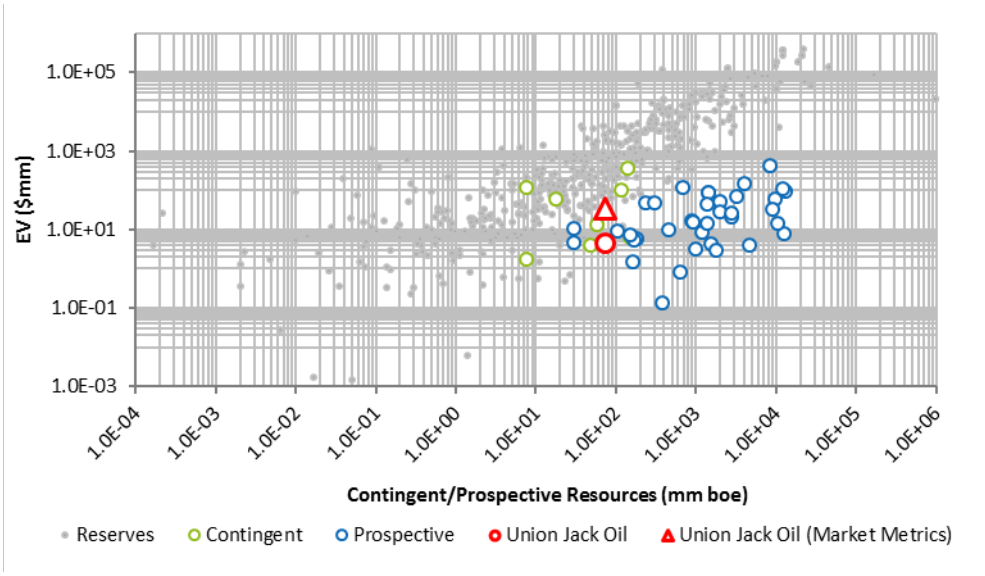
Variation in EV with Contingent (2C)/Prospective (P_{50}) – UJO highlighted



Source: Bloomberg & SP Angel data

Figure 10 – EV per Barrel of Contingent/Prospective Resources (Union Jack Oil Comparison)

Comparison of UJO's current compared with the its implied valuation using market metrics



Source: Bloomberg & SP Angel data

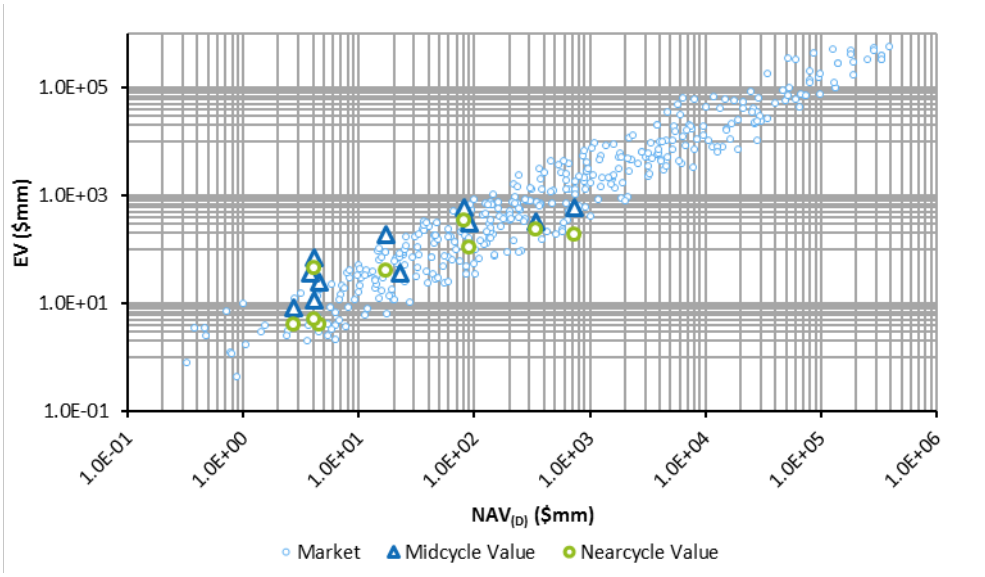
While we accept the exploration programme carries risks, and there is a need to fund the Company's next stage of development, we do not believe that the "excess" discount between the current market value and the market metric implied "worth" to be a fair reflection of the risks in the portfolio, especially as the portfolio is now overwhelmingly weighed towards appraisal type risk.

NAV Multiple

All Oil & Gas companies trade at a discount to the DCF derived net asset value ("NAV"). Per the basis of this comparison, SPA utilises the total NAV, which includes the risk-adjusted NAV is for exploration and appraisal assets. If we look at the average NAV trading multiple for companies that SP Angel Maintains NAV valuations on, the average NAV multiple is 0.43x (Figure 11).

Figure 11 – EV to $NAV_{(D)}$

Variation in EV with $NAV_{(D)}$ for select companies



Source: Bloomberg & SP Angel data

We believe that given that the Company is sufficiently funded for its work programme for the next 18 months, UJO, given the high proportion of relatively lower risk appraisal and development risk in its portfolio, deserves a multiple between the 0.43x observed by the market and the market worth derived by the sum of Parts analysis. The implied market "worth," based on SPA's valuation is summarised in Table 7.

Table 7 – NAV Valuation/Market Worth Summary

Category	NAV Multiple	Implied Value	
		$mm	p/share
Lower	0.28	20.4	0.18
Average	0.43	31.3	0.28
Upper	0.59	43.0	0.38

Source: Bloomberg & SP Angel data

Sensitivity Analysis

SPA has assessed the impact of that a number of parameters have on the Company's value. While we study the impact of oil prices as a matter of course, we have also assessed the impact of a range of other technical and non-technical valuation drivers.

In assessing the value of the Company using DCF valuation, we have recognised all of the key parameters that we believe impact the valuation, not only the oil price but others such as (i) discount rate; (ii) SPE PRMS Assessment Category; and (iii) the Technical to Commercial Success Rate; the results are summarised in Table 8.

Table 8 – Summary of Sensitivity Analysis

Sensitivity Analysis	Comment	Base Case	Page
SPE PRMS Assessment Category	As would be expected there is an increasing value with increasing volumetrics.	P_{BEST}	14
Oil & Gas Prices	Given the high proportion of oil in the portfolio, it is not surprising that the variation in oil price has a more profound effect on the overall valuation than gas prices.	SPA Curve	15
Discount Rate	Given the fact that the assets are based in stable countries, and the Company's management can deliver its development programme effectively, we consider the base discount rate of 10% to be a fair reflection of the business.	10%	18
Technical to Commercial Success Rate	Valuation increases proportionally with higher technical to commercial success rates.	50%	20

Source: SPA Data

SPE PRMS Assessment Category

Given the probabilistic nature of assessing potentially recoverable hydrocarbons from an undrilled prospect, there will always be a range of uncertainty. The SPE PRMS system provides guidance as to how best to address this range of uncertainty.

We have assessed the Company's value over the range ascribed by the SPE PRMS system, namely P_{90}, P_{50} and P_{10}, as well as P_{BEST}, which is a measure of the volumetrics based on the skewness of the standard SPE PRMS probability distribution. We summarise our estimates in Table 9.

Table 9 – Variation in $NAV_{(D)}$ with SPE PRMS Assessment Category

	Hydrocarbons				NAV			
Scenario	mm boe		($mm)		($/boe)		(p/share)	
	Unrisked	Risked	Unrisked	Risked	Unrisked	Risked	Unrisked	Risked
$1P/1C/P_{90}$	26.2	5.1	99.7	16.7	3.8	0.6	0.87	0.15
$2P/2C/P_{50}$	61.1	11.4	333.8	53.0	5.5	0.9	2.92	0.46
C_{BEST}/P_{BEST}	86.0	14.4	438.2	72.9	5.1	0.8	3.84	0.64
$3P/3C/P_{10}$	178.9	27.5	934.8	156.8	5.2	0.9	8.19	1.37

Source: SP Angel Data
NOTE: Base Case Assumptions used for all other parameters

It is no surprise that there is an increase in value with increasing Prospective Resources. This is attributable to 2 main factors (i) that the ultimate Reserve base that will be produced from is larger, which in turn precipitates a higher NPV in dollar terms; and (ii) the proportion of investment that is required, on a per barrel basis, to bring an asset into production falls

significantly with increasing size, i.e. there are economies of scale to be had with larger projects.

Oil & Gas Prices

The current oil price is being buffeted by competing and often contradictory pressures, with a stronger price supported tight supply/demand balance, increased risk in the system, from the ongoing tensions in the Middle East and North Africa, specifically Libya, and the rising geopolitical tension with Russia. However, this is counterbalanced to some extent by the continued weakness in the outlook for economic growth in the Eurozone, uncertainty as to where growth will go in Asia, specifically China, and more recently, the conflicting economic data from the US.

There is also the impact that US' energy self-sufficiency has not only on the demand side but the supply side too. Recent rig figures indicate that the decline in production is likely, due to the need for constant intervention to maintain production, coupled with the aggressive decline rates in unconventional fields. However, the longer-term prognosis indicates that there may well be a situation where there is an oversupply in the US market and that the Federal Energy Regulatory Commission ("FERC"), will license this excess production.

Despite this, and the fact that the current price is at ~$85/bbl, we continue to believe that our outlook for the oil price (long-run average ~$75/bbl) is a fair reflection of the relative balance of the oil price drivers. As well as analysing the impact of a number of price decks (flat nominal prices), we also provide three representative price profiles; these are described in Table 10.

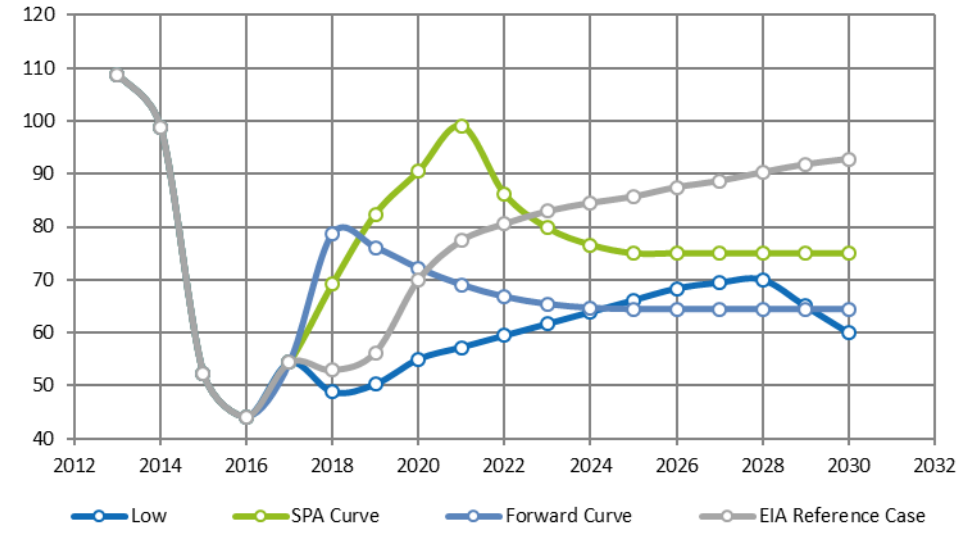
Table 10 – Oil & Gas Price Profiles

Scenario	Oil Price (Figure 12)	Gas Price (Figure 13)
Low Curve	Under this scenario, we believe that there is a muted recovery in demand, and rather than waiting for wholesale improvements in the supply/demand balance, producers initiate projects as soon as there is any sustained strengthening in price from these levels. This has the effect of dampening the oil price recovery (in comparison to our base case), reducing the peak oil price (to $70/bbl), pushing it further out (from 2019 to 2028) and more importantly, substantially reducing the long-term oil price ($56.5/bbl versus $72/bbl).	With the gas price, however, we believe that there is a divergence between European and US gas pricing. Under this scenario, we believe that US gas pricing will face similar patterns to the oil price, given the relatively low reliance on imports. The European market will trade higher than the US gas price, but that as the proportion of imports grows, the pricing power will cede from lower cost domestic production and trade upwards. Consequently, we believe that the stagnation in European gas prices will be shorter lived, recovering immediately and peaking at $7.49/mcf in 2022, and a more modest decline from the long-term price from the Base Case ($6.00/mcf versus $8.08/mcf).
SPA Curve (or Base Case):	The current oil price environment will persist for the near term, but that beyond the summer it will start to improve, ending the year in the region of $80/bbl, before responding to the prevailing supply side environment. In the medium to longer term, and depending on GDP, we believe that the supply side of the equation will become more acute, and continue to drive prices up, peaking in 2020 at ~120/bbl	Our estimate for the Henry Hub ("HH") price is expected to trade at $3.0/mcf in 2018 rising to $3.2/mcf in 2019 then rising to $4.5/mcf and remaining at that level from 2026. Our estimate for the Europe's National Balance Point ("NBP") price is expected to trade at $7.1/mcf in 2018 rising to $9.2/mcf by 2022 before falling back to $8.5/mcf in 2028 onwards.
High Curve	Under this scenario, not only does demand grow significantly, but supply is limited by producers who do not sanction "world scale" projects until futures prices demonstrate a sustained recovery. Under this scenario, we believe that there will be a sustained strengthening in prices, led by supply-side limitations. Under this scenario, oil prices will peak at ~$165/bbl in 2022 before settling at a higher long-term price ($105/bbl versus $75/bbl).	For both the US and European prices, we assume that the principal of thermal equivalency is maintained with the oil price, in that the price profile observed under this scenario for oil, is reflected in the gas price profiles for the differing regions, albeit from a different base.
Forward Curve Nominal:	Forward oil prices provided by Bloomberg from the International Commodity Exchange ("ICE"), London, as of 5th October 2018, which declines from ~$85/bbl to ~$67/bbl in 2026. This oil price sensitivity then assumes flat nominal oil prices thereafter.	Forward gas prices were provided by Bloomberg, with NBP pricing by the IPE (as at 5th October 2018) trading at between 70p and 51p (per therm) over the period to June 2025, varying with demand seasonally. Similarly, Henry Hub is trading between $3.50/mcf and $2.44/mcf over the period to December 2030, seasonal variation excepted. This price scenario then assumes flat nominal gas prices for both Henry Hub and NBP thereafter.
EIA Reference Case (Annual Energy Outlook 2015)	The Brent spot oil price averages $63 per barrel in 2018. After 2018, the Brent price increases, reaching $80.7 per barrel in 2022 and onwards to $117/bbl in 2050.	The Henry Hub spot gas price averages $3.4/mcf 2018. After 2018, the price increases, reaching $4.3/mcf in 2022 and onwards to $5.8/mcf in 2050. For non-US prices, we assume that the premium that European prices are a better proxy for international markets that Henry Hub, as the European Markets are more internationally influenced by the higher reliance on imports. We have averaged the five-year historic premium and applied it to the EIA Reference Case throughout the forecast period.

Source: Bloomberg & SP Angel Data

Figure 12 – Oil Price Profiles

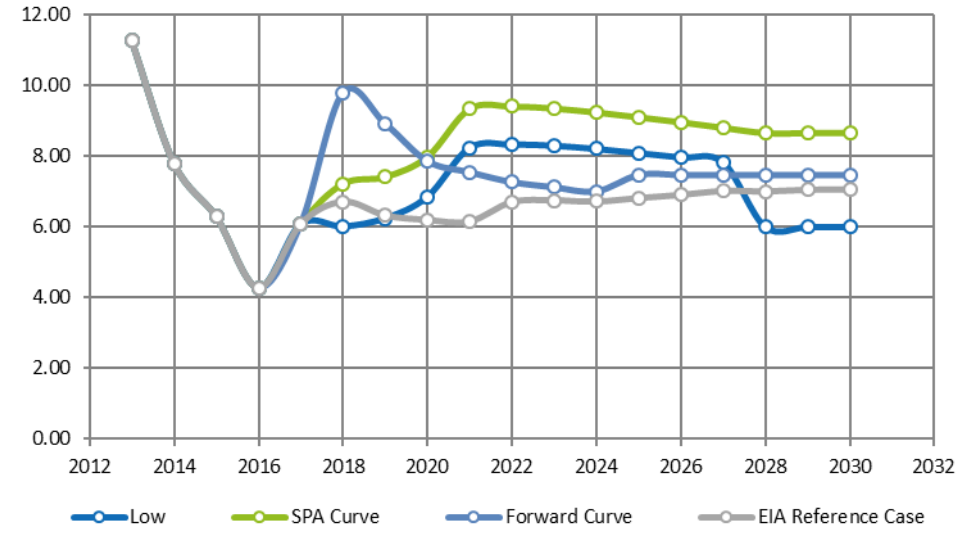
$/bbl



Source: Bloomberg EIA & SP Angel Data

Figure 13 – Gas Price Profiles

$/mcf



Source: Bloomberg EIA & SP Angel Data

The impact that variations in both the gas price and oil price have on Risked $NAV_{(D)}$ is summarised in Table 11 ($mm) and Table 12 (p/share). Table 11 and Table 12 highlight that the value of the Company is more sensitive to changes in the oil price than the gas price. This is to be expected, given that the production portfolio is dominated by future oil production, as opposed to gas.

Table 11 – Impact of Variation in Oil & Gas Price on $NAV_{(D)}$ ($mm)

		Gas Price Scenario				
		Low	SPA Curve	High	Forward Curve	EIA Reference Case
Oil Price Scenario	Low	43.5	63.7	99.8	41.9	62.6
	SPA Curve	50.2	72.9	108.9	48.9	71.8
	High	62.7	85.7	121.7	61.7	84.6
	Forward Curve	40.9	61.2	97.3	39.4	60.2
	EIA Reference Case	43.8	65.2	101.3	42.3	64.1

Source: Bloomberg & SP Angel Data
NOTE: Base Case Assumptions used for all other parameters

Table 12 – Impact of Variation in Oil & Gas Price on $NAV_{(D)}$ (p/share)

		Gas Price Scenario				
		Low	SPA Curve	High	Forward Curve	EIA Reference Case
Oil Price Scenario	Low	0.38	0.56	0.87	0.37	0.55
	SPA Curve	0.44	0.64	0.95	0.43	0.63
	High	0.55	0.75	1.07	0.54	0.74
	Forward Curve	0.36	0.54	0.85	0.35	0.53
	EIA Reference Case	0.38	0.57	0.89	0.37	0.56

Source: Bloomberg & SP Angel Data
NOTE: Base Case Assumptions used for all other parameters

Discount Rate

In assessing the value of an oil company's asset, we start with a basic discount rate of 10% which is the typical discount rate adopted by the O&G industry to determine the unrisked economic value of the Oil & Gas in the ground. In determining an overall risked $NAV_{(D)}$. However, we also need to take account of two additional risk premia by adding to the basic discount rate an assessment of (i) Geopolitical Risk; and (ii) Business Execution Risk.

The assessment of Geopolitical and Business Execution Risks are difficult to quantify as it is subjective and varies from person to person and at what point in time it is applied. It is a subjective assessment of a management's ability to execute its business plan effectively in the face of operational, political, environmental and other exogenous factors.

For example, experienced management with a solid track record in a benign onshore location near infrastructure will have a lower risk premium than an identical asset operated by less experienced management, in a country with a hostile government in an offshore setting where there is no infrastructure. The overall discount rate is a product of the base discount rate, Geopolitical Risk and Business Execution Risk. Our estimate of these risks and our comments are provided in Table 13.

Table 13 – Base Case Summary of Geopolitical Risk

Country	Value	Outlook	Comment
United Kingdom	0.50%	Negative	While the tax regime has been in flux for some years, and past changes have been regressive, recent changes to the fiscal terms have generally been supportive and promoted investment. However, this offsets to some extent the excessive interference from local planners and environmental activists. Consequently, we believe that the United Kingdom carries 0.50% geopolitical risk premium and has a Negative outlook.

Source: SPA data

Table 14 – Base Case Summary

Risk Parameter	Value	Comment
Geopolitical Risk	Country dependent	See Table 14
Business Risk	-	We believe that the Company is adequately staffed for its current portfolio, with an adequate skill set. However, success in any of its UK based assets will necessarily require an increase in staffing levels.
Base Discount Rate	10.00	-
Overall Discount Rate	**10.00 – 10.25%**	-

Source: SPA estimates

Given the impact that discount rate has on value, we have provided a ready reckoner (Table 15 and Table 16) which details the impact of the variation in the contribution that the component risk premia or discounts have on the base case Risked NAV.

Table 15 – Impact of Variation in Risk Premium on $NAV_{(D)}$ ($mm)

		Business Risk Premium						
		(3.0%)	**(2.0%)**	**(1.0%)**	**-**	**1.0%**	**2.0%**	**3.0%**
Geopolitical Risk Premium	**(3.0%)**	92.0	87.8	84.1	80.8	77.9	75.3	72.9
	(2.0%)	87.8	84.1	80.8	77.9	75.3	72.9	70.7
	(1.0%)	84.1	80.8	77.9	75.3	72.9	70.7	68.7
	-	80.8	77.9	75.3	72.9	70.7	68.7	66.9
	1.0%	77.9	75.3	72.9	70.7	68.7	66.9	65.2
	2.0%	75.3	72.9	70.7	68.7	66.9	65.2	63.6
	3.0%	72.9	70.7	68.7	66.9	65.2	63.6	62.2

Source: SP Angel estimates
NOTE: Base Case Assumptions used for all other parameters

Table 16 – Impact of Variation in Risk Premium on $NAV_{(D)}$ (p/share)

Geopolitical Risk Premium \ Business Risk Premium	(3.0%)	(2.0%)	(1.0%)	-	1.0%	2.0%	3.0%
(3.0%)	0.81	0.77	0.74	0.71	0.68	0.66	0.64
(2.0%)	0.77	0.74	0.71	0.68	0.66	0.64	0.62
(1.0%)	0.74	0.71	0.68	0.66	0.64	0.62	0.60
-	0.71	0.68	0.66	0.64	0.62	0.60	0.59
1.0%	0.68	0.66	0.64	0.62	0.60	0.59	0.57
2.0%	0.66	0.64	0.62	0.60	0.59	0.57	0.56
3.0%	0.64	0.62	0.60	0.59	0.57	0.56	0.54

Source: SP Angel estimates
NOTE: Base Case Assumptions used for all other parameters

Technical to Commercial Success Rate

Once a hydrocarbon accumulation is intersected there is still a need to appraise the discovery to ascertain individual reservoir and hydrocarbon production criteria. Whether a discovery ultimately becomes commercial is dependent on a number of key factors, notably (i) hydrocarbon (oil or gas, or combination of both); (ii) recoverable volume; (iii) drainage per well; (iv) drive (expansion, gas, for support, etc.); and (iii) production rate.

In addition to these subsurface specific factors, there is also a need to take into account certain topside factors, such as whether the asset is onshore or offshore, whether there is a readily available market for the hydrocarbon produced, distance to market and more importantly a means to get it there.

While the global average (onshore and offshore) is ~33%, we estimate that the average for onshore UK is 50% due to the ready availability of suitable completion technology and requisite infrastructure.

We recognise that this is a judgement based on our experience and empirical data based on exploration worldwide, and as such may be too conservative. Consequently, we have assessed the impact that varying the technical to commercial chance of success has on the overall valuation of the Company; this analysis is summarised in Table 17 ($mm) and Table 18 (p/share).

Table 17 – Impact of Variation in Oil Price and COS_C on $NAV_{(D)}$ ($mm)

Technical to Commercial Success rate (CoS_C) \ Oil Price ($/bbl)/Price Scenario	1P/1C/P_{90}	2P/2C/P_{50}	P_{MEAN}/C_{BEST}/P_{BEST}	3P/3C/P_{10}
100.0%	24.4	101.1	139.4	299.8
80.0%	21.3	81.8	112.8	242.6
65.0%	19.0	67.4	92.8	199.7
50.0%	16.7	53.0	72.9	156.8
45.0%	15.9	48.2	66.2	142.5
40.0%	15.1	43.7	59.6	128.1
35.0%	14.4	39.4	52.9	113.8

Source: SPA Data

Table 18 – Impact of Variation in Oil Price and COS_C on $NAV_{(D)}$ (p/share)

Technical to Commercial Success rate (CoS_C)	Oil Price ($/bbl)/Price Scenario			
	1P/1C/P_{90}	2P/2C/P_{50}	P_{MEAN}/C_{BEST}/P_{BEST}	3P/3C/P_{10}
100.0%	0.21	0.88	1.22	2.63
80.0%	0.19	0.72	0.99	2.12
65.0%	0.17	0.59	0.81	1.75
50.0%	0.15	0.46	0.64	1.37
45.0%	0.14	0.42	0.58	1.25
40.0%	0.13	0.38	0.52	1.12
35.0%	0.13	0.34	0.46	1.00

Source: SPA Data

The West Newton Transaction

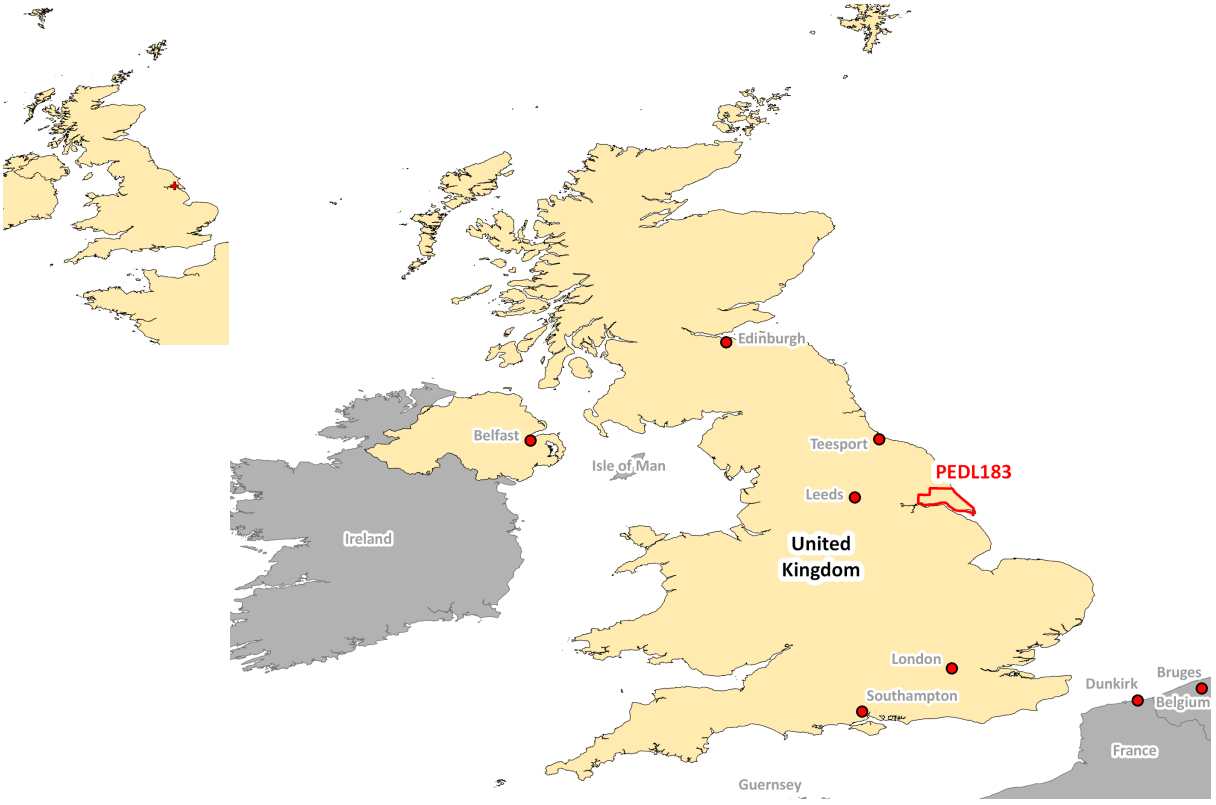
UJO has farmed in to Connaught's PEDL183 on a 1.5/1.0 Paying Interest (25%) / Working Interest (16.665%) basis. UJO will be able to consolidate 5.5mm boe of Contingent Resources and 40.5mm boe of Prospective Resources, which net of obligation costs (~$2.86mm) the means that the Transaction is immediately value accreting by 0.06p.

Summary

UJO has agreed to farm into Connaught Oil & Gas' ("Connaught's") interest in PEDL 183 (the "Licence"), which is located in north-east England (Figure 14). The Company will earn a 16.665% Working Interest on a 1.50:1.00 Paying Interest/Working Interest basis; Connaught's interest is held by its wholly owned subsidiary, Rathlin Energy (UK). On this basis, the Company will be liable for 25% of the costs of drilling the West Newton – 02 ("WN-02") well (the "Transaction").

Figure 14 – PEDL 183 – Location

PEDL 183



Source: OGA, ESRI & SPA data

While no back costs are included, the Company will assume its share of ongoing costs in accordance to its Working Interest (16.665%). In completing the transaction, the Company has assumed 25% of the well costs and its share of the associated licence costs; these are summarised in Table 19.

Table 19 – West Newton Obligations

Item	Gross	Value	Net
Well Costs‡ (£mm)	4.59	25.0%	1.15
Complete & Test	2.21	25.0%	0.55
Operator Costs (£mm)	0.80	16.665%§	0.13
Licence Costs (£mm)	0.60	16.665%§	0.10
Contingency (£mm)	0.82	-	0.19
Total (£mm)	**9.02**	**-**	**2.13**
($mm)	**12.18**	**-**	**2.87**
p/share	*0.11*	-	*0.03*

Source: SPA Data
‡ - Drill, Complete & Test – estimated as at 31st August 2018
§ - 16.665%

On completion of the Transaction, UJO consolidates ~5.5mm boe of Contingent Resources and 40.5mm boe of Prospective Resources (Table 20), which we value at $16.4mm (0.14p); see Table 21 (Page 24) for more details.

Of this, we estimate that $7.05mm (0.06p) should be immediately translated in to "worth," reflected in the Company's market valuation, which is reflective of the proportionately greater contribution from the higher value Contingent Resources ($1.15/2C boe for gas rich streams) within the PEDL183; the contribution each element makes is summarised in Table 22 (Page 24).

Table 20 – UJO Net Licence 2C/P_{50} Volumetrics

Asset	Contingent Resources			Prospective Resources		
	Liquids (mm bbl)	Gas (bcf)	Total (mm boe)	Liquids (mm bbl)	Gas (bcf)	Total (mm boe)
West Newton	0.1	31	5.5	19.6	15	22.2
Ellerby	-	-	-	4.4	30	9.7
Spring Hill	-	-	-	5.7	16	8.6
Total	**0.1**	**31**	**5.5**	**29.7**	**62**	**40.5**

Source: Company, Deloitte, & SPA Data

While a number of prospects and leads exist in the Licence, at differing locations and horizons, the transaction is based on the funding of the WN-02 appraisal well. The WN-02 well will also test the deeper Reefal structure in the Cadeby (Figure 21).

Transaction Valuation

We have in assessed the potential impact of the Transaction on the Company's valuation and market worth using peer-based market metrics, as well as the more in-depth valuation process undertaken as part of the assessment of the $NAV_{(D)}$. Our results are summarised in Table 21.

Table 21 – Transaction Valuation

Field	Hydrocarbons mm boe		NAV ($mm)		NAV ($/boe)		NAV (p/share)	
	Unrisked	Risked	Unrisked	Risked	Unrisked	Risked	Unrisked	Risked
Appraisal & Development								
West Newton	8.14	2.26	42.7	8.9	5.2	1.1	0.38	0.08
Appraisal & Development NAV	**8.14**	**2.26**	**42.8**	**8.9**	**5.3**	**3.9**	**0.38**	**0.08**
Exploration								
West Newton	23.34	3.03	77.5	3.0	3.3	0.1	0.68	0.03
Ellerby	12.49	2.40	29.6	2.3	2.4	0.2	0.26	0.02
Spring Hill	11.07	2.13	28.4	2.1	2.6	0.2	0.25	0.02
Exploration NAV	**46.90**	**7.57**	**135.6**	**7.5**	**2.9**	**0.2**	**1.19**	**0.07**
Total NAV	**55.04**	**9.83**	**178.4**	**16.4**	**8.1**	**4.1**	**1.57**	**0.14**

Source: SPA Data

In addition to this, we have also assessed the potential impact of the Transaction on the company's market value. In doing this, we have averaged the data for those companies with production by the key international exchanges; we describe this process in greater detail in *Peer Group Market Worth* (Page 7).

The consolidation of the Transaction immediately adds $7.05mm (0.06p) to the Company's market worth, assuming the market average of 0.43x is applied to the NAV, which is supported by the market "worth" assessment of the consolidated Contingent and Prospective Resources; these are summarised in Table 22.

Table 22 – Transaction Potential Market Worth

Valuation Metric	Market Average	UJO multiplier	Implied Value ($mm)	Implied Value (p/share)
Resources Valuation	-	-	7.11	0.06
2C Contingent Resources (See Page 7 for more details)				
Liquids Rich	*$3.78/boe*	-	-	-
Gas Rich	*$1.15/boe*	*5.5mm boe*	*6.31*	*0.06*
P_{50} Prospective Resources (See Page 7 for more details)	*$0.08/boe*	*46.9mm boe*	*3.68*	*0.03*
Obligations (Table 19)	-	-	*(2.87)*	*(0.03)*
NAV multiple (Page 12)	0.43x	$16.4mm	7.05	0.06
Average	**-**	**-**	**7.08**	**0.06**

Source: SPA Data

As can be seen in Table 23, even at the $1C/P_{90}$ scenario, the Company experiences an immediate uplift in both value, as suggested by DCF methodology, and market "worth," as suggested by the assessment of Contingent and Prospective Resources using market multiples.

Table 23 – Net Transaction Impact

Item	1C/P_{90}	2C/P_{50}	3C/P_{10}
Net Market Worth	0.05	0.09	0.16
Obligations	(0.03)	(0.03)	(0.03)
Net Transaction Benefit	**0.02**	**0.06**	**0.14**

Source: SPA Data
‡ - Drill, Complete & Test – estimated as at 31st August 2018
§ - 16.665%

Location

PEDL[1] 183 covers an area of approximately 176,000 acres and is located onshore Northeast England (Figure 15), within an area nominally identified as the Humber Basin, which is located in the UK onshore sector of the Anglo-Dutch Basin (Figure 17).

Figure 15 – PEDL 183 – Location

Location PEDL 183

Source: OGA, ESRI & SPA data

The licence was awarded in the 13th onshore bidding round on May 28, 2008, and originally covered approximately 241,000 acres. All associated licence obligations were satisfied, and in June 2016 the term was extended to July 2019 with a minimal 27% relinquishment.

[1] Petroleum Exploration and Development Licence

Targets

The Faminor has undertaken a significant amount of work to date in the licence area, identifying a number of prospects and leads. Consequently, in addition to the appraisal of the Kirkham Abbey Shoal at the West Newton location, there is also prospectivity at differing locations and horizons; these are summarised in Table 24.

Table 24 – PEDL 183 – Targets

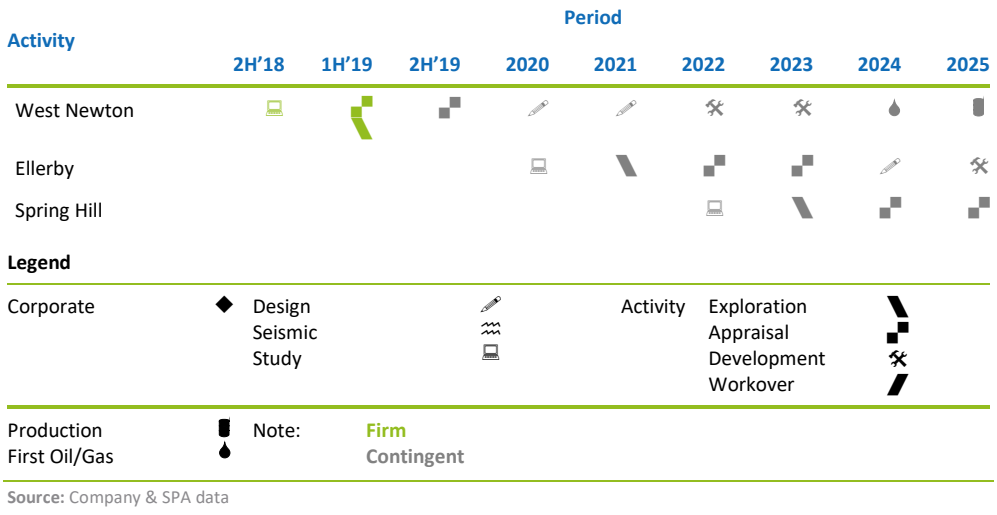
Location	Horizon	Structural Type	SPE PRMS Maturity	Comment
West Newton	Kirkham Abbey	Shoal	Appraisal	Only the shoal will be tested by the WN-02 well
		Slope	Exploration	
	Cadeby	Reef	Exploration	To be tested by the WN-02 well
Ellerby	Kirkham Abbey	Shoal	Exploration	-
	Cadeby	Reef	Exploration	-
Spring Hill	Kirkham Abbey	Shoal	Exploration	-
	Cadeby	Reef	Exploration	-

Source: Deloitte, Company & SPA data
See Figure 21 (Page 32) for the regional stratigraphy

Work Programme

Currently, the operating partners have confirmed drilling of the WN-02 well, with the remainder currently contingent. Our outlook for the Company's work programme is illustrated in Figure 16.

Figure 16 – Core Work Programme



Source: Company & SPA data

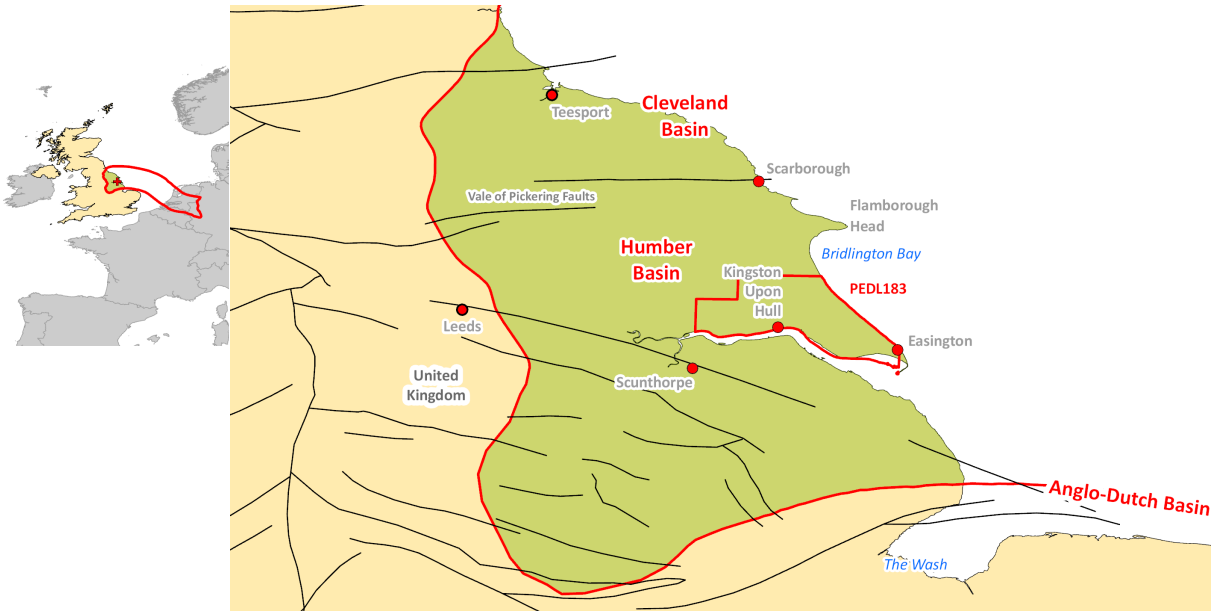
Geology

Introduction

PEDL183 is located in the North east of the United Kingdom in what is colloquially identified as the Humber Basin ("HB"), illustrated in Figure 17, which is the onshore segment of the wider Southern North Sea Gas Basin ("SNSB").

Figure 17 – Humber Basin – Location

Location of the Humber Basin within the Anglo-Dutch Basin

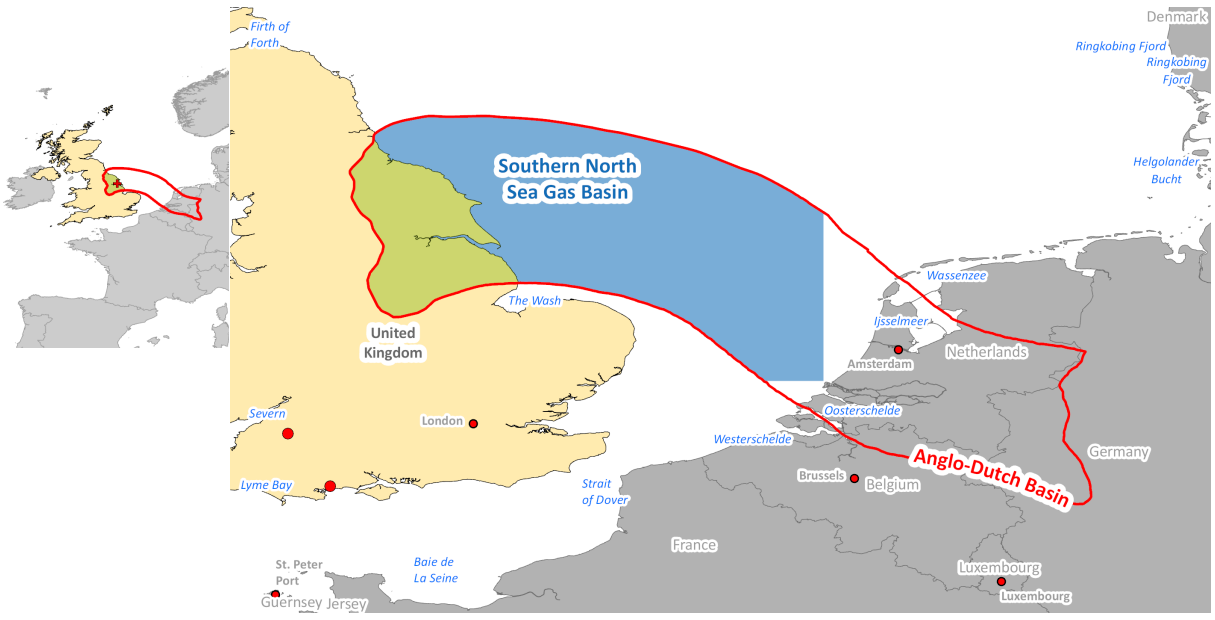


Source: USGS, BGS, OGA, ESRI & SPA data

Like the Humber Basin, SNSB (Figure 18) is not defined by any set geographic features. It is deemed to be located north-east of the English Channel wholly within the wider Anglo-Dutch Basin ("ADB") and delineated by UK offshore Quadrants 41 to 57; the ADB extends in to mainland Europe (Figure 19).

Figure 18 – Southern North Sea Area

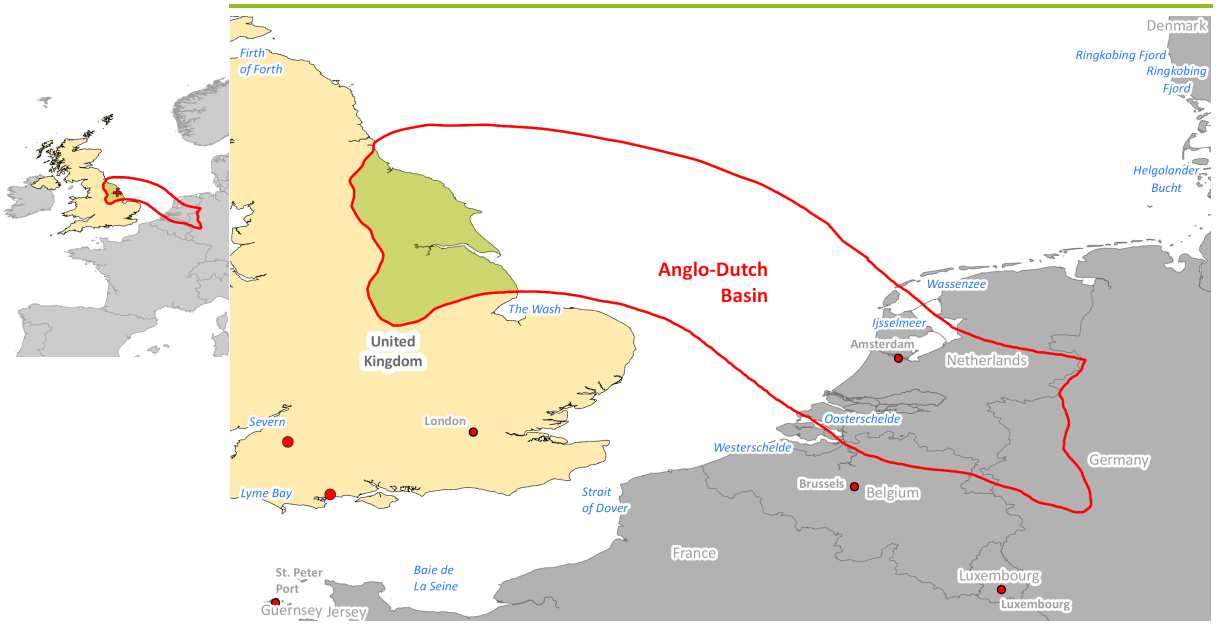
General outline of the Southern North Sea Basin



Source: USGS, ESRI & SPA data

Figure 19 – Anglo-Dutch Basin – Location

Location of the wider Anglo-Dutch Basin



Source: USGS, ESRI & SPA data

Basin Structure

The extent of the UK onshore portion of the ADB, of which the HB is a contributory element, is bounded by the extent of thermally mature Carboniferous source rocks and related gas and oil accumulations in the onshore area of the East Midlands Province (Figure 17). The Basin is complex structurally, being a Jurassic to early Cretaceous basin, which was inverted during the Tertiary Alpine Orogeny.

ADB was formed in the Late Carboniferous to Early Permian, then located in the arid subtropical belt of Northern Pangea. During the early Zechstein marine transgression, the subsiding basin was flooded with normal marine seawater from the Panthalassa world ocean (the “World Ocean”) to form the vast epicontinental Zechstein Sea.

The ADB is comprised of a series of sub-basins extending from eastern England across the North Sea into Poland and southern Lithuania, a distance of approximately 1,700km (Figure 19). Significant hydrocarbon accumulations of economic importance are contained in the ADB.

It is likely that in both phases of Early Carboniferous and Early Jurassic extension, faults on the northern margin on the onshore segment of the ADB were dominant. The most important in the context of the UK onshore portion of the ADB is the south-dipping Butterknowle Fault, which reaches the North Sea coast north of Hartlepool.

This fault also controlled the development of the Carboniferous Stainmore Basin half graben to the west of the HB. This and related faults separate the outcropping Northumberland and Durham Coalfield to the north from the concealed Carboniferous of the Basin.

The faults were reactivated as reverse faults during the end-Carboniferous Variscan inversion. There are some shows in deep boreholes in Teeside, encouraging the belief that hydrocarbons, where trapped, are likely to fault dominated.

Stratigraphy

The ADB was subject to periodic intense evaporation and exhibits depositional facies similar to most Paleozoic, epicontinental basins in arid paleoclimates that are subject to silling and separation from the World Ocean. Five carbonate-evaporite cycles (EZ1 – EZ5) are correlated basinwide.

In the HB, the EZ1 is made up of platformal carbonates, predominantly subtidal, deeper water wackestones and laminates with occasional grainstones related to storm driven deposition. The platform can be divided into two zones, a proximal zone closer to the shelf containing thicker platformal deposits and a distal zone with thinner platformal deposits and deeper water affinities.

Within the proximal zone, areas of increased carbonate deposition are created by the development of coalescing patch/pinnacle reef complexes that are visible on 2D seismic. In outcrop in Germany and in the subsurface in Poland, where platformal reef developments are well documented, the EZ1 aged reef complexes are dominated by bioclastic carbonates and the actual volume of in-situ boundstone represents only 5-10% of the overall reef mass.

The reef mass still exhibits a shallowing upward/brining upward profile with the progression of delicate fenestral/dendroidal bryozoans, in a low energy environment, giving way to more robust higher energy forms of encrusting bryozoans and cyanobacterial mats.

Ultimately, in a hypersaline environment only the cyanobacterial mats remain. This profile is expressed in two stages in NE England, with subaerial exposure and associated vadose process marking the end of each stage.

Early to mid-Carboniferous, Dinantian and Namurian strata subcrop the end-Carboniferous Variscan unconformity across the region (Figure 20). Westphalian strata are restricted to some outliers, but they are more extensive both to the south (Selby Coalfield) and north (Durham Coalfield) of the onshore portion of the ADB.

The reef mass exhibits a whaleback configuration in response to the prevailing Permian winds direction from the northeast. The eastern margin of the reef mass is swept clean of detritus by wave action, and more importantly, the wave action creates a phreatic pumping of seawater through the windward edge of the reef which promotes early submarine cementation in the form of authegenic calcite cement.

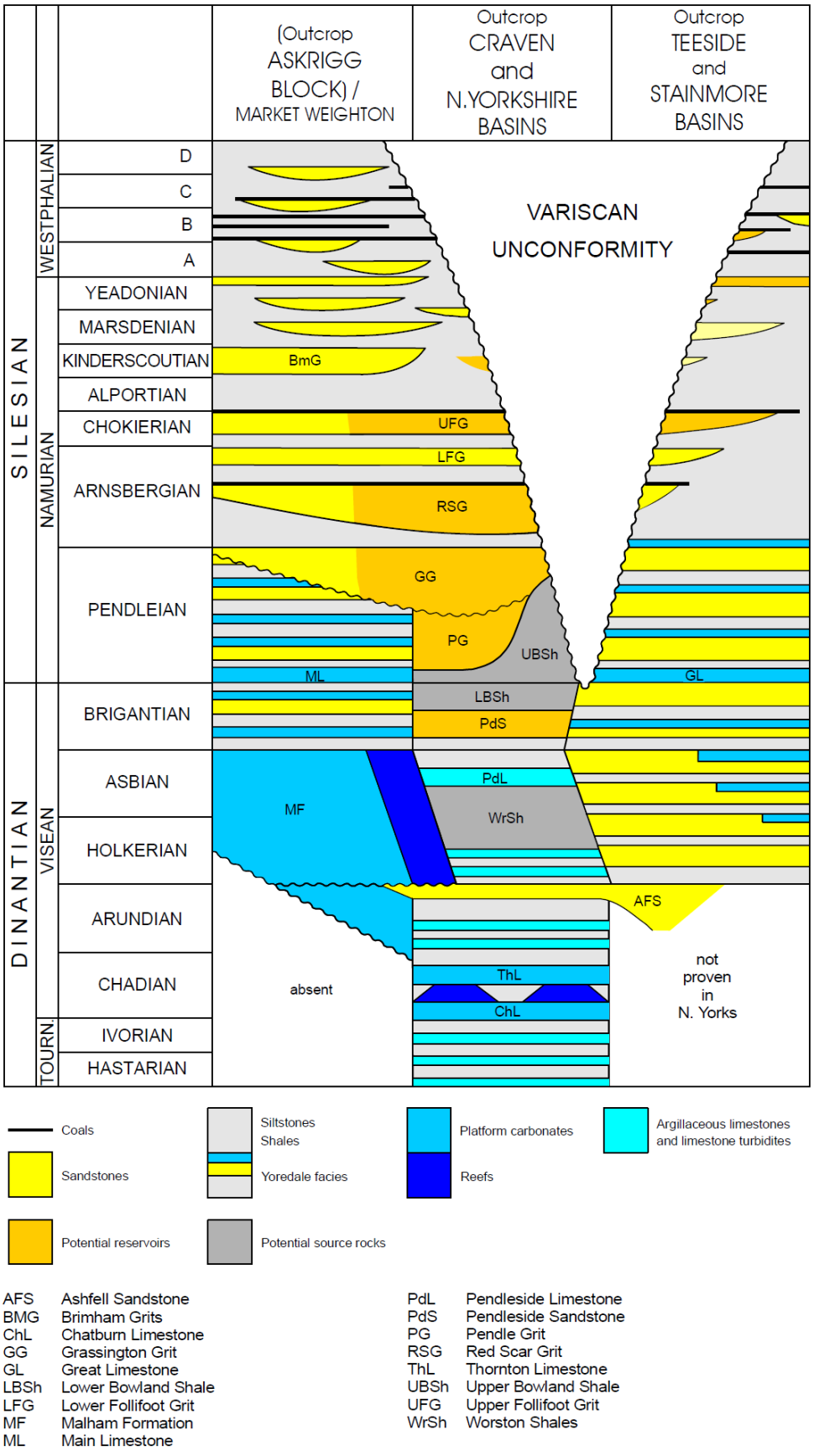
The early submarine cementation allows for the development of a steep windward profile on the reef front. On the leeward side of the reef mass, without the benefit of wave washing, more detrital material and muds are deposited, which is expressed with a much lower angle of repose.

At the end of each stage, with sea levels dropping due to evaporative drawdown, the top of the reef is exposed and the cyanobacterial communities migrate down the flanks of the reef. The deposition of the cyanobacterial mats, in conjunction with the evaporative drawdown, results in the original reef mass being surrounded by an asymmetric halo of mat (stromatolite).

Upon burial and the decomposition of the mat, the magnesium bound up in the photosynthetically generated chlorophyll within the mat is released creating a mechanism for early dolomitization. This early dolomitized cyanobacterial halo around the reef creates the groundmass that hosts the metasomatic anhydrite (nodular mosaic anhydrite) that surrounds and seals the reef.

Figure 20 – Anglo-Dutch Basin – Carboniferous Stratigraphy

Carboniferous stratigraphy of the source rocks and reservoirs of the UK onshore section of the ADB



Source: BGS & OGA

The EZ2 cycle, a restricted marine carbonate-evaporite couplet, is comprised of two formations: the Fordon Evaporite composed of anhydrite and salt, and the Kirkham Abbey, a carbonate section composed of a diverse series of facies associated with supratidal, intertidal, subtidal shelf, slope, base of slope and basin deposition.

Within the HB the Kirkham Abbey Formation can be divided into two members:

- Roker Member: Consisting of intertidal and subtidal shelf depositional systems; and

- Concretionary Limestone Member: represented by slope, base of slope and proximal basin depositional systems.

The Roker is comprised of dolomitized pisolithic grainstones with algal sheets (intertidal/supratidal) which pass into lagoonal pelleted dolomitic mudstones with ostrocods that pass basinward into finely oolitic, cross laminated, dolomitized grainstones (shoal).

The depositional patterns presented by the Roker Member of the Kirkham Abbey Formation are closely comparable with the belt of cycle 2 shelf carbonates in the Netherlands, Germany and Poland, along the southern margin of the ADB; the wider Post Carboniferous stratigraphy is illustrated in Figure 21.

The Hauptdolomite, Stassfurt or Main Dolomite would be the equivalents of the Roker Member in the three countries. Given the large number of well penetrations associated with the development of 25tcf in numerous gas fields, a number of inferences about Kirkham Abbey deposition and diagenesis can be drawn from the continent.

The Hauptdolomite Member consists of an interbedded sequence of dolomitized oolitic, pelletoidal and bioclastic grainstones with occasional pisolithic grainstone development near the top of the succession. The Hauptdolomite represents an oolitic grainstone barrier (shoal/lagoon complex) that was developed on top of the underlying Z1 (Werra Anhydrite/Zechsteinkalk) platform edge.

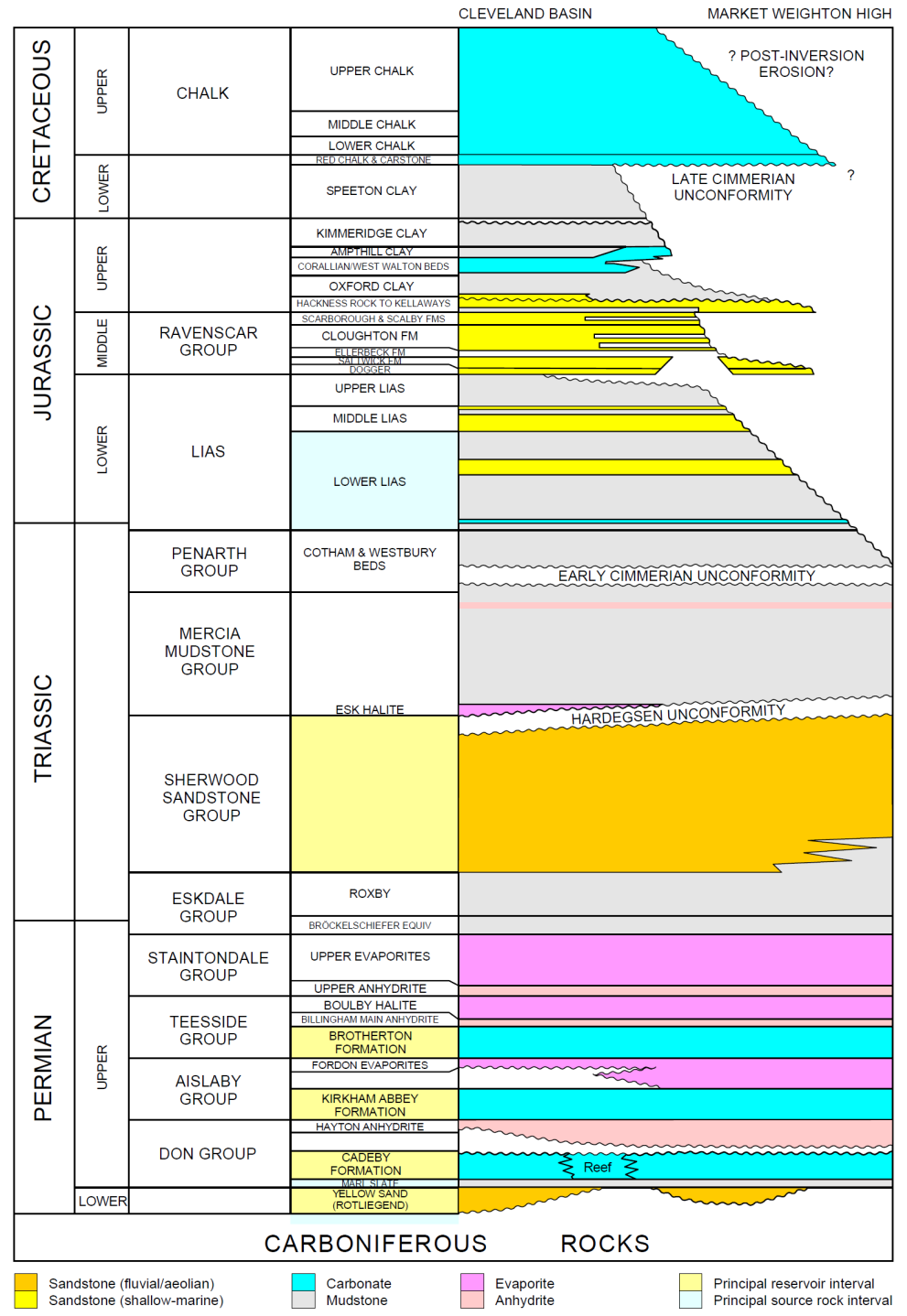
In the Netherlands and Germany deposition of shelf carbonates in the EZ2 cycle, with respect to the underlying platform edge, are described as either prograding or aggrading depending on whether the shelf is in a leeward or windward position relative to the Permian palaeotrade winds (NE).

The HB at the PEDL183 has a windward position, shelf deposition was in an aggrading position and is likely tightly constrained by the underlying Hayton/Cadeby (Z1) platform edge. Similar to the Netherlands, the principle subtidal depositional elements are an open marine shelf comprised of pelletoidal grainstones, packstones and mudstones; barrier (shoal) complexes of oolitic grainstones; and intertidal and supratidal pisolithic and pelletoidal grainstones.

The oolitic grainstone facies, which forms the most important reservoirs of the shelf assemblage, is comprised of medium to coarse grained ooids that are considered to have been deposited in an intensely agitated shallow marine environment. In fields such as Emmen and Schoonebeek (Netherlands) multiple stacked shoals are developed.

Figure 21 – Anglo-Dutch Basin – Post Carboniferous Stratigraphy

Post Carboniferous stratigraphy of the Cleveland Basin



Source: BGS & OGA

The oolitic grainstone reservoirs have been dolomitized, but also have suffered from some occlusion by anhydrite cements. In the Netherlands, this occlusion has been offset by fracturing associated with wrench fault systems. On the Humber licence, two prominent transpressional wrench fault systems are mapped in close proximity to the Greater West Newton project area, which should provide fracture enhancement to the permeability of the reservoir.

The Concretionary Limestone Member of the Kirkham Abbey consists of three main rock types. The first, which occurs in the lower slope environment, consists of finely laminated,

calcitic, dolomitic, lime mudstone with carbonaceous laminae. The second type, which occurs in the upper slope consists of fine grained, unlaminated dolomite. The third rock type is fine grained or oolitic dolomite which occurs in lenses or beds within the other two facies. The third type is lithologically and faunally similar to shelf facies and probably represents turbiditic deposits.

The pattern presented by the Concretionary Limestone Member closely pattern those displayed by the Stinkdolomite member associated with the deep-water slope and basin plain deposits the Z2 cycle carbonate systems in the Netherlands, Germany and Poland.

The most important rock type in the Stinkdolomite, from a reservoir perspective, is the turbiditic grainstone facies. This facies is composed of oolitic, pelletoidal and bioclastic grainstones in which grading is evident as well as convolutions and load structures. In upper slope areas these facies could represent storm graded deposits while in the lower slope/base of slope areas they probably represent turbidite deposits. In Poland these facies represent the best-preserved porosity, up to 40%, of any EZ2 carbonates. The Humber seismic data set, specifically the West Newton three component 3D volume, shows indications that conditions for the development of these types of reservoirs are present.

The Roker and Concretionary Limestone members of the Kirkham Abbey Formation are overlain, and to a lesser extent laterally encased, by the anhydrites and salts of the Fordon Evaporites. The Fordon would represent an effective seal for Kirkham Abbey reservoirs.

Petroleum Systems

Source rocks

The maturity of the source rocks in the onshore sector of the ADB is very high, as suggested by exposed source rock. Study has suggested that Middle Jurassic coals with vitrinite reflectance values of 0.82 – 0.87%, whereas even Westphalian coals in the Durham Coalfield to the north have values of only about 0.4%, and Namurian shales at Richmond, 0.7%.

Lower Jurassic shales lie within the oil window, which may account for the shows of oil in the basin. The Lower Jurassic Jet Rock may be the source of the oil shows in the Jurassic of Fordon-1 well and, less certainly, of the 30bpd tested from the Namurian in this well. Several shallow wells and Fordon-2 were drilled here by BP, without success.

The Carboniferous rocks of the Cleveland Basin lie beyond the wet gas window. Westphalian source rocks are largely absent from the basin, except for the Robins Hood Bay borehole, where an offshore outlier trending NW-SE terminates nearby. Westphalian strata north of the ADB in Durham are immature for gas; the southerly areas of the UK onshore sector of the ADB are likely to have been buried sufficiently to reach the gas window, especially in the Westphalian.

Reservoir rocks

Hydrocarbons have been found in rocks of Namurian and Jurassic age. Gas is dominant (as in the adjacent Southern North Sea Basin). The main reservoirs (Figure 21) are Upper Permian (Zechstein) limestones, the basal Permian Rotliegend (Yellow Sandstone) and Namurian sandstones.

Traps

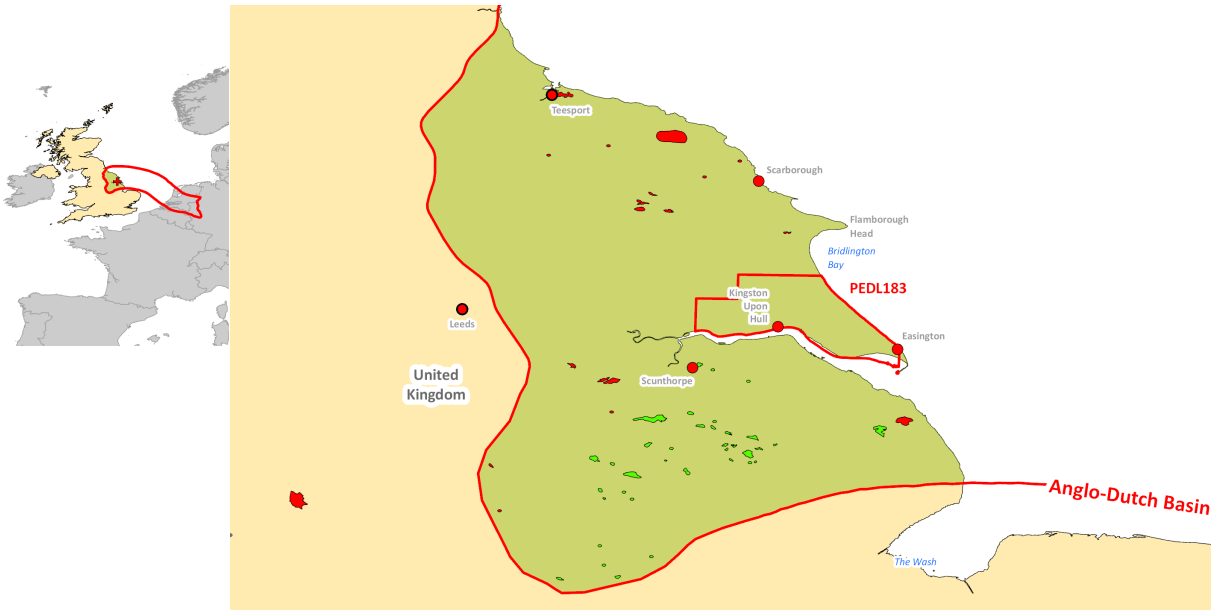
It is postulated that there are both stratigraphic and sedimentological elements to the Carboniferous traps. Carboniferous succession is less well imaged on seismic data than the overlying Permian and Mesozoic, and production from it is so far restricted to deeper levels in productive Permian wells.

There are fault traps along the southern margin of the Cleveland Basin formed by E-W trending Jurassic to early Cretaceous syn-sedimentary faults. These faults cut across the N-S trending Upper Permian facies boundaries and isopachs. Yellow Sands (Rotliegend equivalent) are only greater than 10 m thick to the south of this line of faulting. Above the late Cimmerian unconformity, the Upper Cretaceous cover is relatively unfaulted, and a similar inversion history and trap configuration can be invoked for the remainder of the ADB as in the Wessex and Weald basins.

While discoveries in the onshore portion of the ADB, such as Malton, Kirby Misperton and Pickering (Figure 22) are concentrated along a N-S trend, this contrasts with the NE-SW trending for the wider Southern North Sea Basin (Figure 23)

Figure 22 – Anglo-Dutch Basin – Key Fields

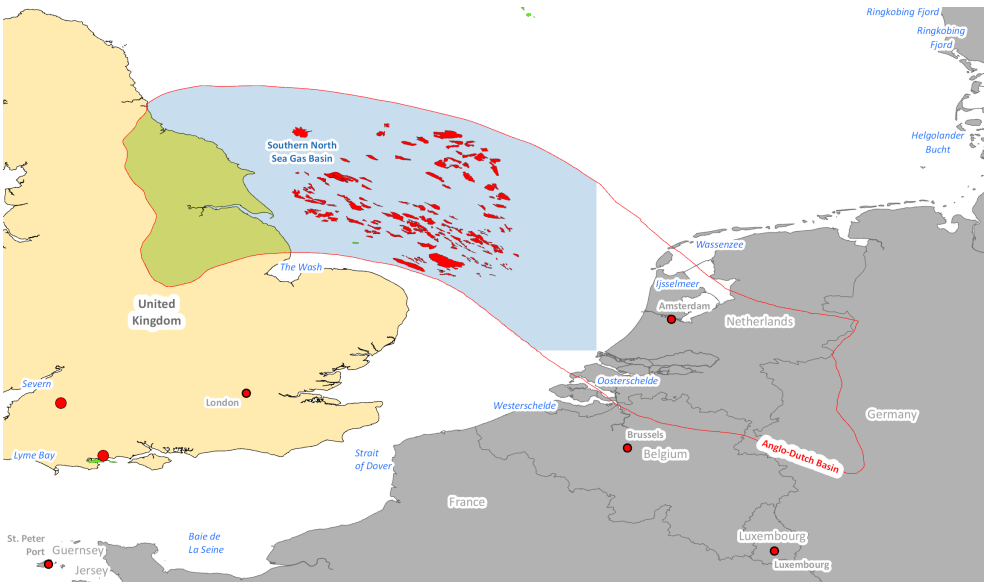
N-S trending fields within the onshore portion of the ADB



Source: OGA, ESRI & SPA data

Figure 23 – Anglo-Dutch Basin – Southern North Sea Basin General Field Trend

Southern North Sea Basin NE-SW trending fields within the Anglo-Dutch Basin



Source: OGA, ESRI & SPA data

Generation and Migration

Carboniferous basins are interpreted to underlie large parts of the Jurassic Cleveland Basin directly. To the south of the Cleveland Basin, Westphalian coals are only marginally mature for gas generation. Therefore, the most likely source of gas within the basin is from deeply buried Namurian shales.

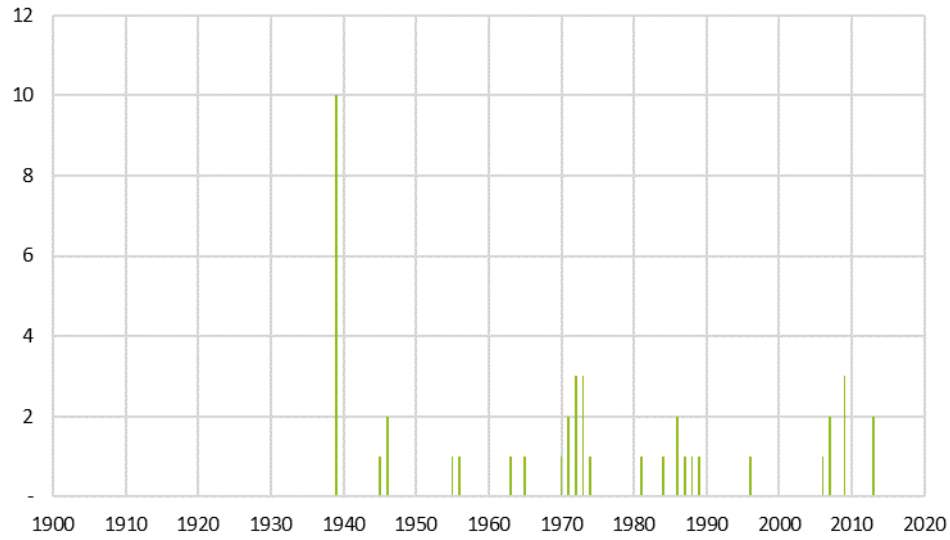
Jurassic and early Cretaceous migration of hydrocarbons was towards the southern margin of the basin, towards the high formed by the postulated Market Weighton Granite. Migration to the north was also possible. After Tertiary inversion, some re-migration may have taken place northwards towards the axis of the basin from its southern margin.

Exploration History

Exploration for gas in the Cleveland Basin has been limited and best articulated as sporadic (Figure 24), starting, unintentionally, near Middlesbrough in 1891 with a blowout of a salt borehole; the gas was observed to contain H_2S, unlike the regional analogues, which contain high N_2 content. The second was identified and drilled successfully by BP at Eskdale in 1937.

Figure 24 – Anglo-Dutch Basin – Exploration History

Exploration wells in the UK onshore sector of the Anglo-Dutch Basin



Source: OGA & SPA data

One of the first hydrocarbon prospectivity reports for the Basin was conducted by BP, who eventually drilled Robin Hood's Bay well in 1957. While little is known of the results, the most likely reservoirs identified would be Permian carbonates, which produced gas on test.

There is little doubt that exploration in the basin was aided, tangentially, by the search for potash minerals by ICI, Fisons and RTZ. However, the next discovery was made by Home Oil of Canada in 1966 at Lockton, where BP had drilled a shallower well previously. Eskdale and Lockton fields produced for 7 and 3 years respectively, before water cut increased.

A further influx of newer operators and improved seismic reflection profiling has led to further prospects being drilled along the southern faulted margin to the basin. Exploration by Taylor Woodrow was successful at Kirby Misperton, where Namurian sandstones have proved productive.

Research Disclosures

Zac Phillips

Zac has in excess of 20 years' experience in Oil & Gas and finance, working for companies such as BP, Chevron, Merrill Lynch and ING Barings, where he undertook finance or finance related roles. Given his Chemical Engineering degree and PhD, Zac's career has focused on the economics of investment, and its assessment, on a range of projects from process change implementation, to operating plants and companies.

Zac's extensive Oil & Gas financial and technical experience has ably lent itself to the valuation of exploration and producing Oil & Gas assets, especially where complex financial structures define companies' access to the economic benefits of ownership. Latterly, Zac was the CFO to Dubai World's Oil & Gas business (DB Petroleum), with responsibility for risk management, valuation and the authoring of investment proposals. During this time, Zac valued in excess of 152 transactions with a combined transaction value of in excess of $60bn.

Zac has an Honours Degree in Chemical Engineering from Wales and a PhD in Chemical Engineering from Bath University. He is a member of the Society of Petroleum Engineers, Institute of Chemical Engineers, American Association of Petroleum Geologists, the Association of International Petroleum Negotiators and is an Approved Person under the Financial Conduct Authority in the United Kingdom.

+44 (20) 3470 0470
Zac.Phillips@SPAngel.co.uk

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Notes

SP Angel Contact List

Sales

Richard Parlons
+44 20 3470 0472
richard.parlons@spangel.co.uk

Jonathan Williams
+44 20 3470 0471
Jonathan.williams@spangel.co.uk

Research

Zac Phillips
+44 20 3470 0470
zac.phillips@spangel.co.uk

Corporate Finance

Richard Hail
+44 20 3470 0483
richard.hail@spangel.co.uk

Richard Redmayne
+44 20 3470 0470
richard.redmayne@spangel.co.uk

SP Angel Corporate Finance LLP
Prince Frederick House
35-39 Maddox Street
London, W1S 2PP
United Kingdom
Tel: +44 20 3470 0470
Web: www.spangel.co.uk