

Exploration watch

Wells to watch in 2017

Since the oil price crash of 2014, exploration has been particularly badly hit as companies looked to trim expenditure. Wood Mackenzie estimates that 2017 exploration will account for 8% of upstream expenditure, down from historic norms of 14%. In this more difficult environment, any surviving exploration has tended to be led by majors, for example ExxonMobil's giant Liza discovery offshore Guyana in 2015. In this Exploration Watch, we highlight wells due to spud in 2017 that involve independent companies, with resource estimates greater than 100mmboe. Our exception is the much anticipated multi-billion barrel potential Korp fjell prospect in the Barents Sea offshore Norway, which is operated by Statoil and partnered by major companies.

Concentrated across underexplored basins

The majority of the seven wells that we have chosen to highlight here are located in underexplored basins where success either nearby or in an analogous basin has focused attention on the region. These wells include the **Araku** prospect offshore Suriname and to the east of Liza, and the **Druid/Drombeg** well in the Porcupine Basin, which is an area attracting interest following success in the analogous Flemish Pass Basin. Similarly, the **Ayame** well offshore Côte d'Ivoire is looking to replicate the success in Jubilee, 600km to the east. Other wells are in areas only recently opened up for exploration. **Korp fjell** sits in the Barents Sea but in a licence close to the Russian maritime border that was offered for the first time in the Norwegian 23rd round in 2016, while the **Zama** prospect offshore Mexico was awarded in 2015 after the country opened up its upstream sector to private investment for the first time in 75 years. However, two of the wells are located in the mature UK North Sea, where both **Partridge** and **Verbier** are targeting over 100mmbbls in a region where the average discovery size is 20mmbbls.

Use of 3D seismic crucial

Every prospect covered here has been de-risked with modern 3D seismic, and the impact of this, together with advanced interpretation techniques, has been crucial in optimising the robustness of each well. Most of the targets discussed are stratigraphic traps, or contain a stratigraphic element, and so cannot be accurately defined without 3D. In the North Sea, the use of modern seismic has also allowed a fresh look at a mature basin, throwing up new ideas in well-drilled areas.

Exploration set to increase in 2018

Wood Mackenzie estimates that oil and gas exploration expenditure will fall to \$37bn in 2017, down from \$100bn in 2014. This is expected to improve going into 2018 when expenditure is anticipated to reach about \$50bn, growing further to \$60bn by 2020.

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Tullow Oil

EXPLORATION WATCH

A periodic look ahead from our in-house petroleum engineer, Elaine Reynolds, focusing on interesting exploration activities with significant potential impact on E&P equities.

Wells to watch in 2017

Exhibit 1: Summary of wells in report

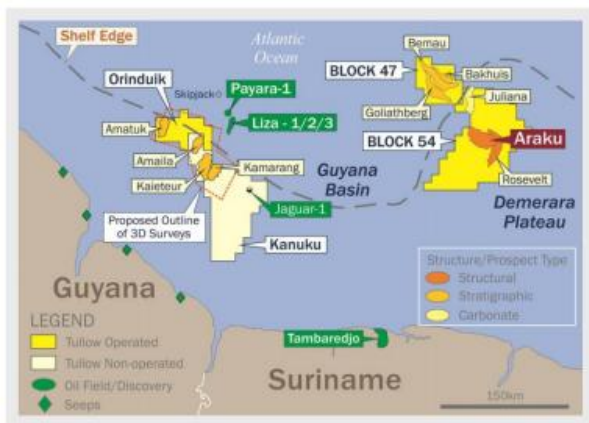
Prospect	Region	Operator	Operator resource estimate	Estimated spud 2017
Korpfjell	Barents Sea	Statoil	Multi-billion bbls	April
Araku	Suriname	Tullow Oil	500mmbbl	H2
Zama	Mexico	Premier Energy	300mmbbl	May
Ayame	Côte d'Ivoire	Ophir Energy	234mmbbl	May
Druid/Drombeg	Porcupine Basin	Providence Resources	5bnbbl (in place prospective resources)	Summer
Verbier	North Sea	Statoil	118mmboe	Summer
Partridge	North Sea	Azinor Catalyst	119mmboe	August

Source: Edison Investment Research

Guyana Suriname basin: Industry hotspot

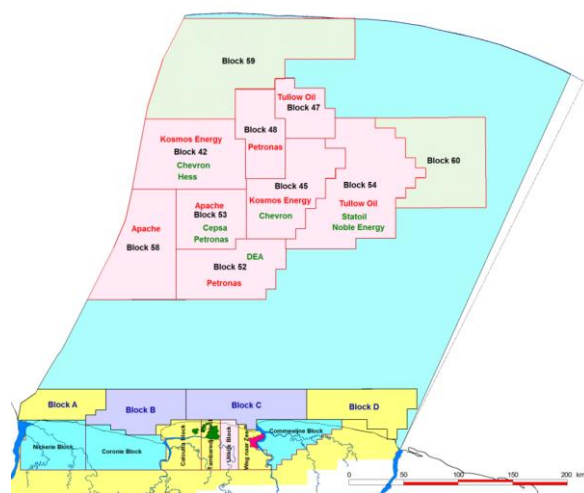
The Guyana Suriname basin has been an exploration hotspot since ExxonMobil's discovery of the giant Liza field in the Stabroek Block offshore Guyana in 2015. With three wells drilled on the structure, the company estimates that the field holds over 1bnboe. The Upper Cretaceous reservoir is described as being very high quality with good porosity and permeability, and good deliverability on test. Appraisal well Liza-3 has also encountered hydrocarbons in a deeper previously untested reservoir that is estimated to hold 100-150mmboe. The well also found the oil water contact in these deeper sands, which will increase the accuracy of resource evaluations. The company's most recent exploration well in the region, Payara-1, approximately 16km north-west of Liza, encountered similar high-quality, oil-bearing reservoir in January 2017. Wood Mackenzie has estimated that Payara contains between 300mmboe and 500mmboe. The co-venture partners in Stabroek (ExxonMobil 45%, Hess 30%, CNOOC Nexen 25%) plan to continue the appraisal of Liza and Payara together with exploration drilling in 2017. The Stena Carron drillship has now moved 10km south of the original discovery well to drill the Snoek prospect, which will test a stratigraphic trap similar to those found in Liza and Payara.

Exhibit 2: Guyana/Suriname



Source: Tullow Oil

Exhibit 3: Suriname licence map



Source: Staatsolie

The success at Liza has renewed interest in the Guyana Suriname basin and 2017 will see a return to drilling activity offshore Suriname. Apache is due to spud Kolibri-1 in Block 58 imminently to the west of Block 53 where it drilled Popokai-1 in 2016, which is believed to have encountered non-

commercial hydrocarbons. Kosmos carried out a 6500km² 3D seismic acquisition across its Block 42 during Q416 and may drill there from late 2017 onwards. Meanwhile, Tullow is planning to drill in Suriname for the first time in H217 on its Araku prospect in Block 54.

Araku: 500mmbbl potential to the east of Liza

Tullow has built up an acreage position covering over 10,800km² across Block 47 and Block 54 around 200km offshore Suriname and sitting to the east of Liza. In addition to the success at Liza, oil seeps onshore Guyana and the oil-producing Tambaredjo field onshore Suriname indicate the migration of oil to shore across the basin. The Araku prospect is located in Block 54 in around 1,000m of water and is operated by Tullow (WI 30%) with partners Statoil (50%) and Noble (20%). The prospect sits on the Demerara Plateau and on the edge of the basin near the shelf edge break. It is described by Tullow as being one of its strongest prospects in the last decade and is estimated to have a resource potential of over 500mmbbls. Araku covers over 330km² and is a four-way, dome-shaped structural closure with an Upper Cretaceous Maastrichtian target. A 3D seismic survey was acquired in 2015 and has provided high-fidelity data that indicate good seismic amplitude support across the prospect. The company has been particularly encouraged by the precise conformance between the prospect area as indicated by both structural mapping and geophysics, thereby giving a good indication of hydrocarbon presence.

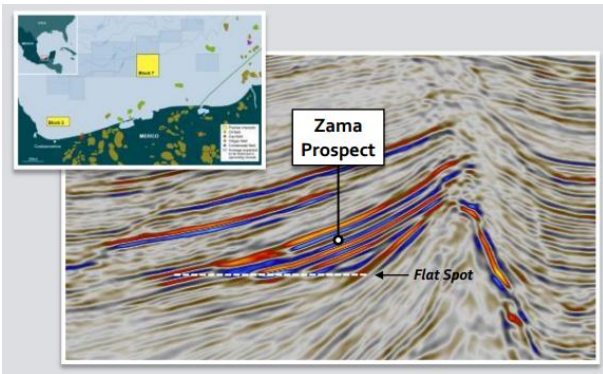
If Araku is successful, Tullow has a number of follow-up prospects across both its blocks and covering stratigraphic and carbonate prospects. A rig is currently being sourced for the well, which is expected to cost \$14m net to Tullow to drill. The gross cost estimate of \$40-45m is at a significant cost reduction to the \$100m cost estimate before the current low-cost oil environment.

Tullow also holds acreage offshore Guyana and sitting updip of Liza. The company will carry out a 3D seismic programme over its Orinduik and Kanuku blocks (Exhibit 3) in 2017, with a view to drilling here in 2018/19.

Mexico: One of the first wells since entry of international companies to the region

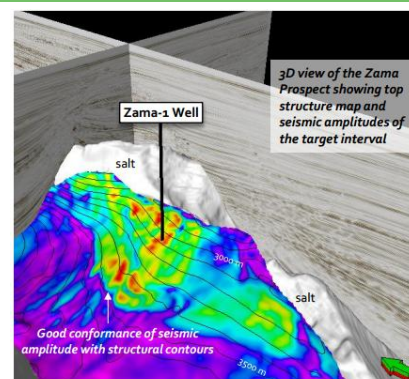
Premier entered Mexico in July 2015, when it was awarded a 10% interest in Blocks 2 and 7 in the offshore Sureste Basin and the company has subsequently exercised its option to increase its interest in Block 7 to 25% (the remaining partners are operator Talos Energy and Sierra Oil & Gas, both backed by Riverstone). The Sureste Basin is Mexico's main producing area and contains the Cantarell field, which was discovered in 1976 and produced at a rate of 1.18mmb/d in 1981. The basin remains underexplored, however, and Block 7 sits in one such area, the Salinas sub-basin. Block 7 contains the Zama prospect sitting in 165m of water. Zama is a three-way dip closure, sealed against a salt feature and targeting light oil in the Tertiary.

Exhibit 4: Zama seismic



Source: Premier Oil

Exhibit 5: 3D view of Zama



Source: Premier Oil

The prospect is supported by the presence of a well-defined flat spot on 3D seismic and good conformance of seismic amplitude with structural contours, resulting in the prospect being classified as low risk. Premier estimates that Zama contains 300mmbbl and although the company has not provided a GCoS it has classified the well as low risk. The well is planned to take around 50 days to drill and is expected to commence drilling in May.

West Africa: Beyond Senegal/Mauritania

Recent successes offshore West Africa have been concentrated in the Mauritania/Senegal/Gambia/Bissau/Conakry (MSGBC) basin, with BP/Kosmos Energy's Tortue gas development project straddling Mauritania and Senegal and Cairn Energy's ongoing appraisal of its 473mmbbl SNE oil field offshore Senegal, discovered in 2014.

A drilling campaign is currently ongoing at SNE where the Stena DrillMAX drillship is moving to commence operations on the Vega-Regulus (VR-1) exploration and appraisal well. Sitting below SNE and around 5km west of SNE-1, VR-1 will target the lower Albian reservoirs of SNE, but will also investigate the deeper Albian reservoir by intersecting four stacked targets here. The discovery well, SNE-1, also targeted the Lower Cretaceous Albian without success, although residual hydrocarbons were encountered. Cairn now believes that the crest of the Albian is to the west of SNE-1 in the area of VR-1 and estimates a gross consolidated GCoS in one of the four horizons at 30% and estimated mean prospective resources of more than 100mmbbls. Note that as the GCoS is a consolidated figure, it cannot be applied to the 100mmbbl figure.

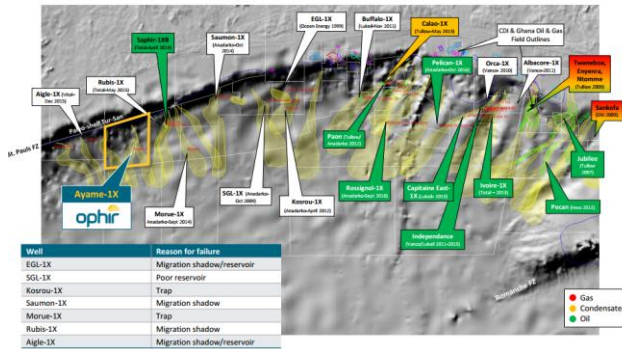
Elsewhere in West Africa, we highlight the drilling of the Ayame well offshore Côte d'Ivoire. This area has had high expectations due to its location to the west of the Jubilee field. Successes at Paon and Saphir have been countered by recent disappointments such as Total's Rubis and Vitol's Aigle-1 exploration wells.

Ayame: Looking to extend discoveries in Côte d'Ivoire

The Ayame prospect sits in deepwater offshore Côte d'Ivoire in Block CI-513. It is due to be drilled from mid-May 2017 by operator Ophir Energy (WI 45%) and partners African Petroleum (45%) and Petroci (10%). According to Ophir, the well will target Pmean recoverable resources of 234mmbbls (African Petroleum assigns 352mmbbls) and success would open up the region to the west of Total's Saphir-1XB oil discovery.

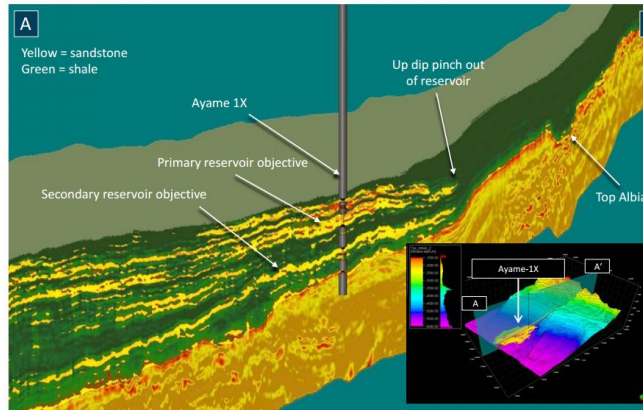
The block is located at the western end of the Tano-Ivorian basin, which also contains the Jubilee and TEN discoveries offshore Ghana, around 600km to the east. The region is underexplored, with historical wells restricted to areas closer to the coast in shallower water; however, in April 2014 Total announced that it had discovered oil in its Saphir-1XB well in Block CI-514, adjacent to CI-513. The well encountered 40m of net oil pay in Upper Cretaceous Turonian sands with good-quality 34° API oil. This proved oil charge in the region, which had previously been assessed as being a key risk. Further to the east of Saphir, Anadarko has also encountered oil in several wells with analogous geology to CI-513. The company has been appraising its 2012 Paon discovery, with the most recent appraisal well Paon-5A encountering 30m net pay and producing 9000b/d and 21mmscf/d during an equipment-restricted 2016 test. In addition, the company drilled two exploration wells to the south of Paon during 2016 and straddling Blocks CI-527, 528 and 529. Pelican-1X encountered 21m of net oil pay over two intervals and Rossignol-1X found oil in well-developed sands, although net pay was just under 5m.

Exhibit 6: Ayame location with previous basin drilling activity



Source: Ophir Energy

Exhibit 7: Seismic line with reservoir objectives



Source: Ophir Energy

Ayame is an Upper Cretaceous slope fan located in a water depth of around 2,830m. This is downdip from prospects such as Saphir-1XB, which is a channel sand that feeds a deepwater fan. Ophir is strong on basin modelling and has brought with it a focus on charge access and trap configuration. Quantitative geophysical analysis has been carried out in the area, which now has a number of wells available for seismic calibration, and this has lifted the GCoS to 23%. The focus is on traps in a down dip position since modelling points to better reservoir on the basin floor, as well as with better access to charge. The prospect is well defined on 3D seismic acquired in 2012, and has an anomalous seismic amplitude suggesting reservoir development. Seismic also points to an updip trap formed by pinch-out against the slope break and faulting; however, as is common to stratigraphic prospects, trap remains the key risk. Ayame sits across a ridge that the partners hope will somewhat mitigate against the seal and trap risk. If successful, a number of other prospects will be de-risked and will be recalibrated and reprioritised.

Anadarko's experience with Paon is encouraging for Ayame. The company calibrated the seismic response from the Paon wells with Rossignol and Pelican and was then prepared to drill at a high equity of 85% and succeeded. These discoveries sit in the updip parts of a lobe opening out into a fan, but at a similar distance from the boundary fault as Ayame.

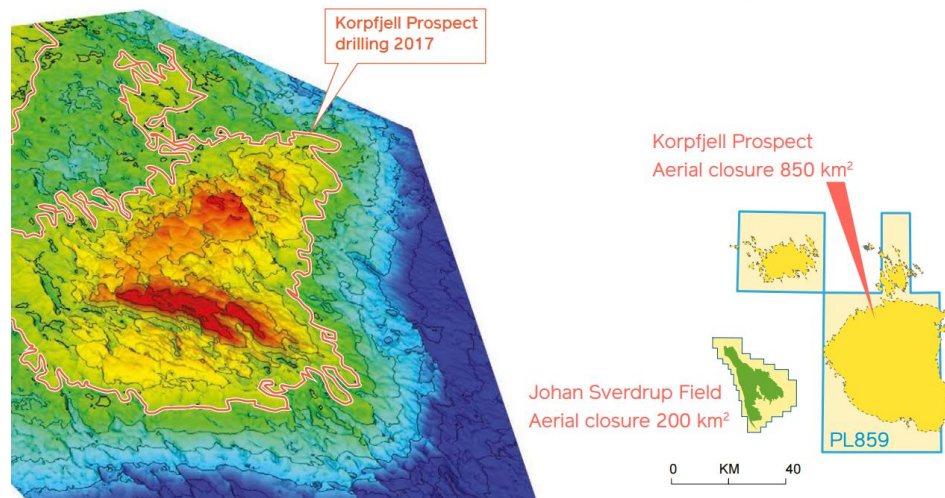
The well is expected to cost under \$35m and the tendering process for a rig was initiated at the end of 2016. African Petroleum is looking to farm down its interest further in CI-513 to fund the drilling of Ayame, and reports that it is in active discussions with interested parties.

Norway

Korpfjell: Most anticipated of 2017

The most closely watched exploration well this year is likely to be Korpfjell, a multi-billion barrel resource potential prospect in the south-eastern Barents offshore northern Norway and close to the Russian maritime border. Korpfjell sits in PL859 and was awarded to operator Statoil (WI 30%) as part of the Norwegian 23rd round in 2016. According to the Norwegian Petroleum Directorate, (NPD), PL859 was the most sought-after licence in the round. The licence is very large, covering 12 blocks and was awarded to a group of experienced Barents players: Det Norske (20%), Chevron (20%), Lundin (15%) and ConocoPhillips (15%), in addition to Statoil.

Exhibit 8: PL859 map



Source: Lundin Petroleum

The prospect was identified from 3D seismic acquired in 2014 but, despite being highly anticipated, very little public information is available. Partner Lundin believes that Korpfjell has a structural closure of 850km², over four times the size of that found in Johan Sverdrup, which is estimated to contain gross 1P and 3P reserves of 1.65bnboe and 3.02bnboe resources respectively. The well is expected to spud in early April.

The well will be the most northerly well to be drilled offshore Norway. However, the reservoir is shallow, so that Statoil estimates that the well will cost \$25m and sees it as one of the most competitive in its global portfolio.

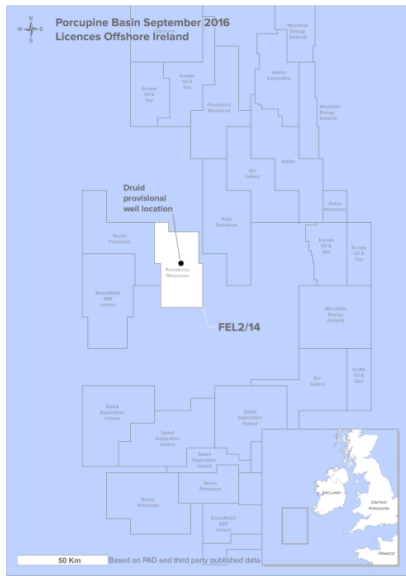
Southern Porcupine Basin: Only one well drilled to date

The Druid/Drombeg prospect is located in FEL 2/14 in the Southern Porcupine Basin, an area that has become a focus of attention for major companies since Statoil's 2013 Bay du Nord Jurassic discovery in the analogous Flemish Pass Basin offshore Canada. A number of companies, including Statoil, entered the Southern Porcupine in the 2015 Atlantic Margin licensing round, although to date only one well, the 44/23-1 Dunquin North exploration well, has been drilled in this part of the basin. The well, drilled by ExxonMobil with partners that include Providence Resources, targeted a Middle Cretaceous carbonate platform and encountered 250m of water-wet reservoir. Initial petrophysical studies indicated the presence of a c 44m residual oil column thereby demonstrating the existence of oil in the basin; however, Providence has subsequently announced a further third-party, post-well analysis, which supports the presence of residual oil across the entire 250m drilled interval.

Druid/Drombeg: Cairn entry means high-impact frontier well-funded for both targets

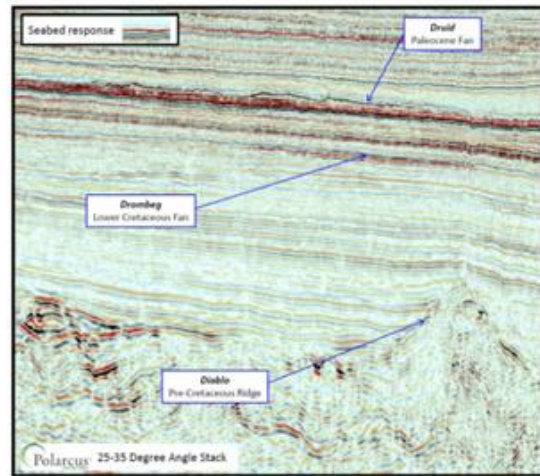
FEL 2/14 is operated by Providence Resources (WI 56%), and the company planned to drill the 53/6-A exploration well targeting Druid in summer 2017. In March 2017, Providence signed an agreement to farm out a 30% WI to Cairn Energy (operating here as Capricorn Ireland), with the remaining 14% WI held by Sosina. As a result of this farm-out, the funding is now in place to target both Druid and the underlying Drombeg in the 53/6-A well.

Exhibit 9: FEL 2/14 location



Source: Providence Resources

Exhibit 10: Druid/Drombeg 3D seismic



Source: Providence Resources

Both Druid and Drombeg are large stacked deepwater fan systems located updip from a potential fluid escape feature in the underlying Diablo Ridge. Both were originally identified with AVO anomalies on 2D seismic, which were further investigated with a 3D seismic survey acquired in 2014. Providence analysed these data as part of a collaborative project with Schlumberger and estimated in place mean unrisks prospective resources of 3.18bnbbl for Druid and 1.915bnbbl for Drombeg.

Druid consists of two Paleocene fans estimated to contain mean unrisks prospective resources of 0.984bnbbl and 2.196bnbbl respectively, while Drombeg is a Lower Cretaceous deepwater fan sitting around 1,000m below Druid. Providence interprets the seismic anomaly seen in Druid as an oil water contact, although Cairn sees more uncertainty regarding the fluid phase and estimates that Druid/Drombeg could contain around 0.6bnbbls or >3TCF Pmean recoverable resources.

The well is expected to be spudded in June 2017 and will be drilled to a TD of around 5,200m in 2,200m of water by the Stena IceMAX drillship. Providence estimates that the well will cost around \$50m. Under the terms of the farm-out, Cairn will pay 45% of the costs of drilling 53/6-A up to a gross well cap of \$42m, together with a cash payment of \$2.82m in back costs. In the event that the JV decides to drill an appraisal well in FEL 2/14, Cairn will pay 40% of the appraisal well costs, again to a gross well cap of \$42m, and have the option to become operator.

UKCS: Fresh look at a mature basin

Exploration in the mature UK North Sea has been at historically low levels, with 13 exploration wells drilled in 2015 and 14 in 2016. Current forecasts indicate that a similar number will be drilled in 2017 at between 13 and 16 wells. However, five of these will be drilled by supermajor BP, a step up from the one exploration well it has drilled per year in the region for the last three years. Details are not available for all these wells, but are likely to include the Craster gas and condensate prospect with operator Nexen West of Shetland, and Jock Scott with operator Statoil. Statoil has also announced that it will drill three exploration wells in the North Sea, namely a heavy oil prospect near Mariner, Jock Scott and the Verbier prospect with independent Jersey Oil & Gas, which we discuss here.

The recent focus of attention in the region has been on the Greater Lancaster area West of Shetland, operated by fractured basement specialist Hurricane Energy. A pilot well and horizontal

sidetrack drilled in Lancaster in 2016 have increased recoverable resource estimates in the field from 200mmbbls to 333mmbbls, while results from the 2016 Lincoln basement discovery have the potential to contain more than 250mmbbls of recoverable oil. Results from the final well in the programme, Halifax, are due imminently and, if successful, could indicate further significant volumes along the Rona Ridge. Hurricane plans to release a CPR updating the Lancaster resources by the end of Q117.

Beyond these wells, there has been limited activity from independents operating in the area. Here we highlight two prospects planned in 2017 with independent involvement: the Azinor Catalyst-operated Partridge and Statoil's Verbier well. Both wells are targeting more than 100mmbbls in areas with a history of extensive drilling, and have applied modern seismic acquisition and analysis to identify new targets.

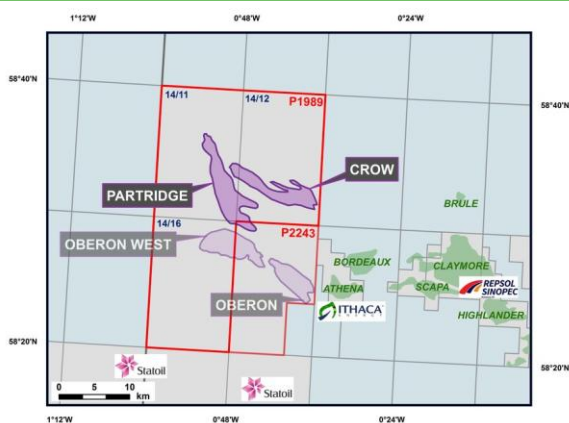
Partridge: New seismic in mature oil area

The Partridge prospect is 100% held by Azinor Catalyst, a private E&P company focused on the UK North Sea and backed by Seacrest Capital. The prospect sits in the P1989 licence in the Jura Sub-Basin in the Outer Moray Firth and adjacent to the producing Athena, Scapa and Claymore fields. The well is scheduled to be drilled in August 2017.

Partridge will target Pmean resources of 119mmboe in the Lower Cretaceous Scapa sandstone, a proven oil-prone reservoir at the nearby Scapa and Athena fields. The company views this to be a conservative estimate as it does not assume fill to spill and the upside is estimated to be 260mmboe. The Lower Cretaceous is underexplored in the UKCS; however, over the last eight years it has delivered an average GCoS of 60% and a CCoS of 40% with an average discovery size of 46mmboe, well above the average for the basin of 20mmboe. The Lower Cretaceous in Claymore North and Scapa contain 164mmboe and 122mmboe respectively.

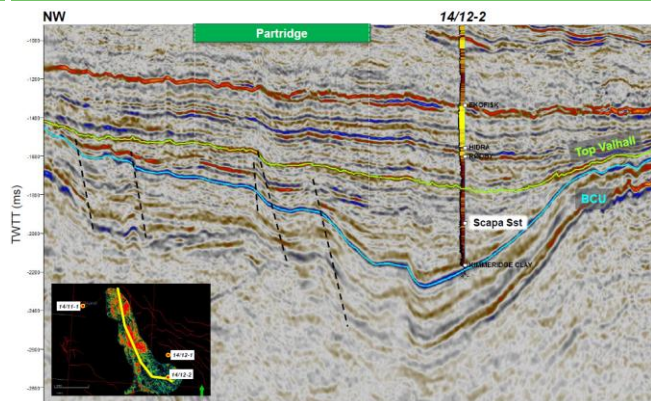
Azinor has used new broadband 3D seismic acquired in 2013 and only delivered in 2015 to look again at a mature oil area. The prospect is a structurally controlled stratigraphic trap and consists of a basin floor fan system with dip closure to the east and stratigraphic pinch-out of sands to the north and west. The company has identified a direct hydrocarbon indicator (DHI) that is calibrated on the same data set across an area containing plenty of wells for calibration purposes.

Exhibit 11: Partridge location map



Source: Azinor

Exhibit 12: Partridge fullstack Geostreamer 3D 2013



Source: Azinor

The DHI exhibits similar characteristics to those seen in the Lower Cretaceous oils in the Scapa and Claymore fields. Nearby well 14/12-2 encountered good-quality sands but no hydrocarbons. The key risk, in common with other stratigraphic prospects, is trap and seal. However, Azinor estimates a GCoS of 40% for the well.

The company sees further potential in the Lower Cretaceous play in the area and has applied for further licences as part of the 29th licencing round to target additional prospects. The results of the 29th round are expected around the end of Q117.

In addition to Partridge, Azinor has identified three Upper Jurassic prospects: Crow, to the east of Partridge and Oberon and Oberon West to the south in licence P2243, in which Azinor acquired a 50% interest in December 2016. These prospects are all structural traps, with the reservoir proven by the nearby Claymore field, and are seen as good tie back opportunities in the event of success at Partridge.

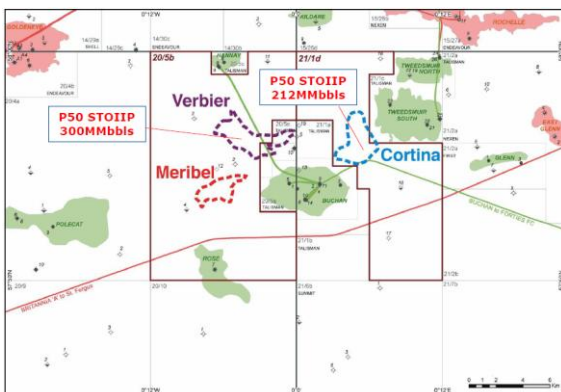
In preparation for drilling Partridge, the company has completed a site survey and is preparing to tender for a rig. The company is looking to farm down its interest in the licence to up to 50% before drilling. However, it is prepared to drill the well on a sole basis having benefited from the significant reduction in drilling costs seen in the market. The well is expected to cost \$8-9m and take 25 days to drill to a depth of around 2,200m. In the event of success, this would rise to 44 days to include testing, and an estimated cost of \$15.1m.

Verbier: Attracted Statoil to farm-in

Jersey Oil & Gas (JOG) holds a working interest of 18% in licence P2170 covering blocks 20/5b and 21/1d, having successfully farmed down its original 60% WI to Statoil in 2016. The licence contains the Verbier prospect, which operator Statoil (WI 70%) is planning to drill in the summer of 2017. The remaining 12% WI is held by CIECO, the E&P arm of ITOCHU.

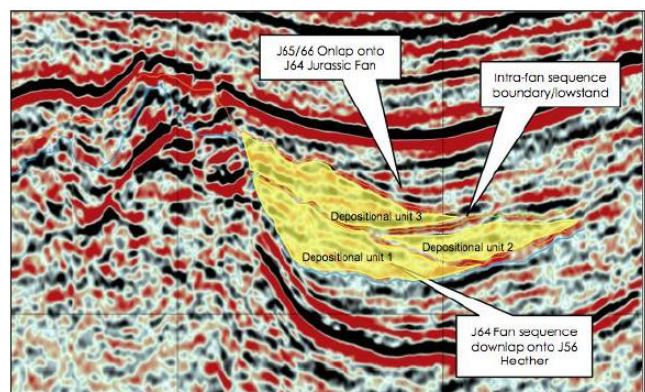
Verbier is located to the north-west of the Buchan field and will target an Upper Jurassic submarine turbidite fan system, including the J64 Buzzard sandstone. The prospect is a combination structural/stratigraphic trap identified by JOG on 3D seismic and is estimated to contain Pmean recoverable resources of 118mboe. Although Verbier sits in an area that is surrounded by proven light oil production from the Upper Jurassic, most of the historical oil discoveries here are structural traps.

Exhibit 13: Verbier location



Source: Jersey Oil & Gas (resource estimates are JOG management)

Exhibit 14: Verbier seismic



Source: Jersey Oil & Gas

In 2006, the Buchan field operator Talisman drilled the 20/5a-10Y well to the north west of Buchan and adjacent to Verbier. Talisman was primarily interested in targeting the deeper Jurassic Sgiath formation, but the well also tested younger Late Jurassic sands of an equivalent age to those interpreted to be in the Verbier prospect at 4804b/d and 2.6mmscf/d. It is therefore possible that the 10Y well tagged the edge of Verbier and that this has de-risked the prospect. The key risk to the play is considered to be the lateral seal, with the Kimmeridge Clay source established in the region and good reservoir found in 20/5a-10Y. The company estimates a GCoS of 26% for the well.

The well location is not yet finalised, but will target the thickest sands in the fan system. A site survey has been completed and a rig tender process is underway. The well will have a TD of 3,400m in a water depth of 125m. Under the terms of the farm-out, Statoil will carry the well costs up to a cap of \$25m, at a value to JOG of \$4.5m. In addition, JOG benefits from a further 10% carry from CIECO for a two-well programme. If successful, JOG has identified a further Buzzard sandstone submarine fan to the east of Verbier, Cortina, with a P50 STOIP of 212mmbbls.

JOG is also connected to Azinor's Partridge well, since it farmed down its interest in P1989 to Azinor in December 2015 in return for conditional future payments of up to \$4m, with the first \$2m due after any discovery.

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