Wood Mackenzie
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November, 2020

Kavango Basin Review & Global Benchmarking

ReconAfrica

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Executive Summary

The Kavango Basin formed through a combination of rifting and shearing, most likely in the Permian to Triassic period. According to ReconAfrica and studies on the basin, the basin represents one of the largest onshore undeveloped hydrocarbon basins in the world. Based on a tight grid aeromagnetic survey, up to 30,000 feet of sedimentary fill has been estimated. Up to 6,000 feet of which could be a Permian age petroleum system. According to ReconAfrica, extrapolation from a control well indicates that source rocks should be present in the lower intervals of the Permian. Modelling has shown that this potential source rock is overlain by classic tilted fault block traps, which have provided the basis for conventional traps in other hydrocarbon rich basins. Geochemical and other studies have estimated that the basin could have significant in place volumes of hydrocarbons, further details of which can be found on ReconAfrica's website (www.reconafrica.com).

A number of the characteristics identified in the basin to date indicate that the basin could have the right combination of factors to have a working petroleum system. Further exploration is required to determine if this is the case, which ReconAfrica is scheduled to undertake in Q1 2021 (2D seismic campaign & 3 exploration wells). However, should that exploration be successful, it is useful to consider how exploration and development has progressed in other basins that have some of the same characteristics as the Kavango Basin.

Wood Mackenzie undertook a process to identify a number of these basins. The selected basins are shown in the table below alongside their rationale for inclusion.

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Project Overview

ReconAfrica is the sole acreage holder in the Kavango Basin, a large acreage position across Namibia and Botswana. In addition to its acreage position ReconAfrica has the necessary financing for an initial exploration drilling and 2D seismic campaign. This initial exploration campaign will test whether or not the basin has a working petroleum system. As part of increasing the overall understanding of its potential position, ReconAfrica has requested that Wood Mackenzie compiles a report to show the evolution and value contribution from other basins that are potential analogues to the Kavango Basin.

Whilst the current geological understanding across the Kavango Basin is immature, there are preliminary indicators that, should the presence of a working petroleum system be proved, it could provide abundant opportunities for further exploration and appraisal. It is not the purpose of this report to revisit the work carried out to date and geological models that have been published by ReconAfrica. The purpose of this report is to identify analogous basins and show the evolution of hydrocarbon exploitation in those areas. Following conversations with ReconAfrica it is our understanding that should they be successful the basin will likely evolve in a similar way to other hydrocarbon basins, namely exploitation of *conventional opportunities will be prioritized*.

In addition to these basin analogues we show how the fiscal terms for onshore Namibia compare on a global stage. Whilst we recognize the priority is to prove the existence of a working petroleum system, it is prudent to show whether or not the commercial terms will help to facilitate development in the case of exploration success.

Summary of selected analogous basins

Basin	Summary of Basin	Factors analogous to the Kavango Basin	Peak Production (million boe/d)* and year in brackets	Estimated Overall Development Value (US$bn)**
US - Midland Basin (Permian) **"Focus Basin"**	The Midland Basin is within the mature oil producing Permian basin of Texas. The basin has been a prolific production area with first production in 1930s from conventional reservoirs, the first peak of production from the basin was in 1972. Latterly, the basin has been at the forefront of unconventional production in the US.	The development of the basin during the Permian period is analogous to the formation of the Kavango Basin, with a number of sub-basins and intrabasinal highs.	**3.8 mmboe/d (2035)**	**540 US$bn*** (oil only)**
Netherlands/UK Southern North Sea Basin**	The Southern North Sea Basin is one of the most prolific gas producing areas in the world with the main phase of its exploration starting in the 1960s. The basin extends from the UK to the Netherlands and the majority of its production comes from Permian age sandstones.	Rift and shear elements and the tilted fault blocks seen in the extensional regime in the North Sea are anticipated in the Kavango Basin. In addition to these structural similarities there are similarities in the age of basin formation and sedimentary deposition.	**2.4 mmboe/d (1977)**	**234 US$bn**
Chad Doba Basin	The Doba Basin is located in the south of Chad and is part of the Cretaceous age Central African Rift Basin. The basin was first explored in the 1970s with commercial production commencing in 2003 once the Chad-Cameroon Pipeline was completed.	Similarities have been noted between the Central African Shear Zone and the Southern Trans African Rift and Shear System, important elements in the formation of the Doba and Kavango Basins respectively. The Central African Rift Basin is filled by up to 7,500m of clastics, so has a similar depth to basement as the Kavango Basin.	**0.2 mmboe/d (2005)**	**14 US$bn**

** Boe – Barrel of oil equivalent*

***Money of the day: historical cashflows as incurred: future cashflows using Wood Mackenzie's assumptions at a $50/bbl long-term Brent oil price*

****Refers to estimated oil value only. Midland Basin historical crude oil production derived as a proportion of total Texas crude oil production. Historical operator margin based upon Wood Mackenzie's current assumption of operator margin.*

***** The basin expands into neighbouring geographies, but the majority of hydrocarbon accumulations are in the Netherlands and UK*

Whilst it is hard at this stage to draw direct comparisons from the selected basins to what could happen in the Kavango Basin, a number of key takeaways have been observed:

- All of the basins have exploited conventional resources first and it is only the Midland Basin where commercial production has more recently occurred from unconventional resources;
- Availability of infrastructure has been the key trigger to the realization of commercial production from the basins, once exploration has proved the potential for commercially viable hydrocarbon accumulations; and
- Should the petroleum system in the Kavango Basin mirror that of any of the analogue basins the potential exists to generate significant value and material production.

Should exploration be successful the fiscal terms in Namibia will help to support the realization of commercial developments. Compared to other onshore regimes Namibian terms rank favourably with a relatively low Government Share % of Pre-Share NPV, particularly if profits are reinvested into the permit to the extent that no Additional Profit Tax is due.

Methodology

In order to identify analogous basins to the Kavango Basin a number of factors have been taken into consideration to narrow the 700 plus basins around the world to a more manageable subset. The primary controls for this process have been the age of the formation of the Kavango Basin, rifting occurring during the Permian, and the sedimentary depth. Once an initial list of basins was identified, these were discussed with ReconAfrica's experts. Those basins that had localized conditions not comparable to those seen in the Kavango Basin, either during basin formation or after, were removed. From the remaining basins the selected basins were those that demonstrate a meaningful global scale and where elements that might be analogous to those of the Kavango Basin can be clearly explained.

Basin 1 – US Permian - Midland Basin

The Permian Basin is a mature oil producing region, covering portions of West Texas and southeastern New Mexico. It has come to prominence in recent years due to the exploitation of its vast unconventional potential. But, for decades prior to the advent of the exploitation of unconventionals the basin was an important conventional oil and gas basin and a significant contributor to global hydrocarbon production, ~7% of global production in 1972 came from Texas onshore.

Permian Basin Structure

The Permian Basin is made up of a number of structural features which include the Midland, Delaware, and Val Verde basins as well as the Central Basin Platform and Ozona Arch. Burial depth varies significantly between basins and uplifted areas.

The individual basin and uplift features developed along the extreme southwestern margin of the North American craton during the Carboniferous (Late Mississippian-Pennsylvanian) and early Permian.

Four of the five significant source rocks across the basin are within the overpressured systems, which helps provide an increase of fluid volume.

Permian Basin Stratigraphy:

Early and Middle Paleozoic: primarily shallow-water carbonate deposition, interrupted by shale sedimentation during the Middle Ordovician (Simpson), Late Devonian (Woodford) and Early Mississippian (Barnett). All three contain major hydrocarbon source rock intervals.

Early Pennsylvanian: Widespread siliciclastic sediments in the deeper basins including deposition of grey-black shale source rocks.

Permian: development of carbonate shelves and margins around the edges of foreland basins. Lower Permian Wolfcampian shales and Bone Spring shales deposited in deeper basins. These are significant hydrocarbon source rocks and unconventional targets.

Oil and gas reservoirs are present throughout the entire stratigraphic section.

The development of the basin during the Permian period is thought to be analogous to the way the Kavango Basin has formed.

Midland Basin Overview:

The Delaware and Midland Basins are the most important basins in the Permian. The key plays in the Midland are the Wolfcamp and the Sprayberry which overlies the Wolfcamp.

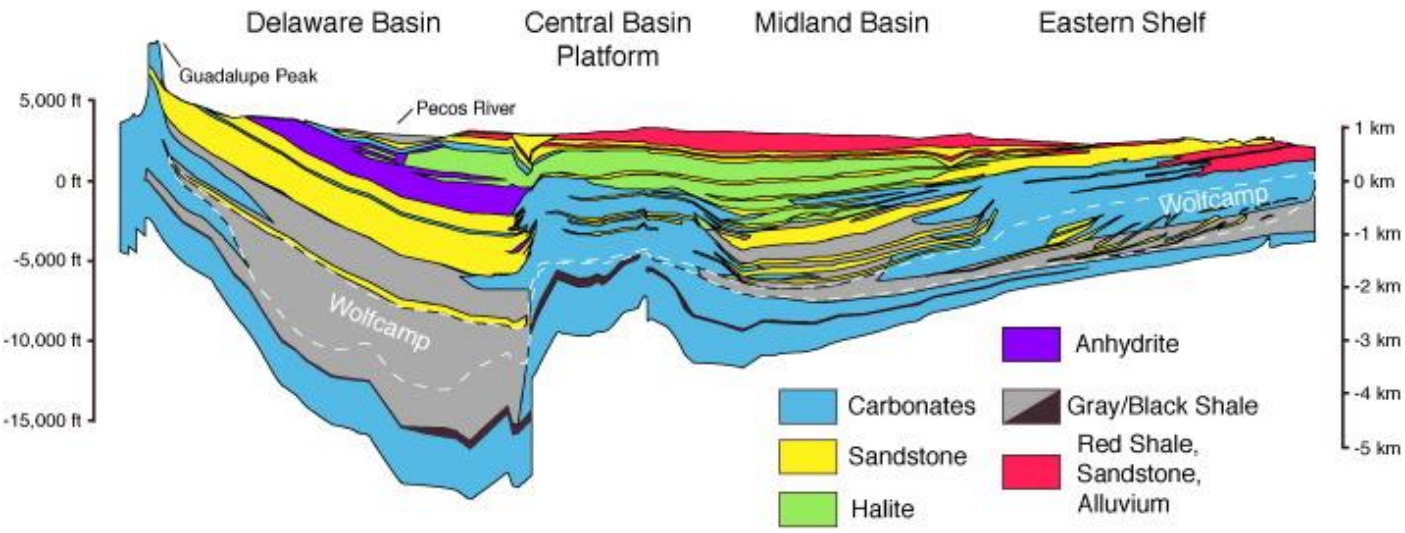
In the 1990s, with the use of new stimulation methods, companies began to commingle production from the Spraberry, Dean and Wolfcamp in a single vertical wellbore, giving rise to the hybrid “Wolfberry” reservoir moniker. The Wolfberry remains the most active vertical play in the basin.

The Midland Basin’s Wolfcamp Shale is one of the most active plays in the US Lower 48. The Wolfcamp consists of four benches: the A, B, C and D (also referred to as the Cline Shale). To date, most activity in the Midland Wolfcamp has been focused on the A and B benches.

The Wolfcamp was initially developed across the Ozona and Southern Fairway sub-plays in Upton, Reagan, Irion, Crockett and Schleicher counties. By 2013, activity moved into the prolific Deep Basin sub-play located in Midland, Martin and Howard counties. Activity is still concentrated here today.

The Cline Shale (Wolfcamp D bench) extends along the eastern edge of the Midland Basin with the most promising results focused in Glasscock county. However, overall Cline activity has been limited, and drilling has slowed as operators favor the more proven and repeatable Wolfcamp.

Generalized geologic cross-section of the Permian Basin along a transect:



Source: Engle et al., 2016

Midland Basin History:

1921 – First Permian well: The first commercial well drilled in the Midland Basin was completed in Mitchell county. This proved to be the discovery well of the Westbrook field. Wartime led to an urgent need for oil and more deep wells were drilled in West Texas. One of the largest accumulations of oil and gas was found in the Spraberry Trend in the 1940s.

Pre-2000 – Discovery: The Wolfcamp shale was thought to be thin or absent in the Midland Basin. For decades, operators in the area drilled into and collected log data for the deeper Canyon, Strawn and Ellenburger gas formations. It was assumed that the shale was not part of the basin deposits and instead extended outside the basin across the Ozona Arch to the southern edge of Crockett County and middle part of Sutton County. As companies re-evaluated historical technical data, it was determined that the Wolfcamp Shale was present in a 300 - 450 metre (1,000-1,500 foot) thick stacked column formed after the Ouachita thrusting.

2000s – Vertical Wolfberry development: As part of the Spraberry formation development in the Midland Basin, operators started to drill deeper to commingle into (and test) the Wolfcamp Shale. These wells became known as part of the Wolfberry play. Wolfberry well activity in the first five years focused on Midland and Upton counties.

2009 – 1st Horizontal Wolfcamp well: Broad Oak drilled the first horizontal well in the Wolfcamp Shale in Reagan County. In November 2009, EOG drilled the second well in the play (NoelkeA 1H) with a peak IP of just 29 boe/d.

2010 – Deeper Wolfcamp discovery: In an investor presentation, Approach Resources presented information from well logs showing that the Wolfcamp Shale was actually present in the southern Midland Basin and had the geologic characteristics to be a good oil source formation.

2011 – Operators open the floodgates: EOG emerged as a leader in the new play, drilling the highest number of wells throughout the year. El Paso, Approach, and Laredo remained active. Companies continued to optimize well designs to improve recoveries, with a few wells reaching 24-hour IP rates of over 1,000 boe/d.

2012 – De-risking Wolfcamp benches: Operators continued to test and appraise acreage throughout the Permian, extending beyond the southern Midland Basin into the northern Midland and southern Delaware Basins. In addition to different areas, companies were testing the A and C benches of the Wolfcamp.

2014 - Shift towards Northern Midland: Development continued to increase in the northern Midland Basin, with strong well results being reported out of the Midland, Martin, and even Howard counties.

2016 – Permian resilience in commodity downcycle: The Wolfcamp was the most resilient play in the Lower 48, with over 94 rigs running in the Midland Basin at year end 2016, compared to just 34 in the Eagle Ford. Operators were focused on decreasing lease operating costs, improving efficiencies, and consolidating their positions in the play.

2018 – Takeaway capacity and high GOR slow growth: The basin showed first signs of wavering due to takeaway capacity constraints. Growth forecasts were slightly reduced due to widening Midland differentials. Higher than expected GORs also caused operators to cut growth forecasts

2019 – Gas in excess: Midland gas production continued to exceed takeaway capacity, with concern rising over the adequacy of planned capacity. Since 2016, gas volumes grew 5.6 bcfd, outpacing the growth of the Haynesville. With increasing pressure to reduce flaring, alternative uses for the excess gas became a priority.

Basin Dashboard:

Exploration & Production	
First Exploration Well	1920
First Discovery	1921
First Commercial Production	1930s
Peak Production (expected)	2035, 3.8 million boe/d

Value & Reserves	
Overall Development Value*	$540 Bn**
Remaining Liquid Reserves	23 Bnboe
Remaining Gas Reserves	26 Tcf

**Money of the day: historical cashflows as incurred: future cashflows using Wood Mackenzie's assumptions at a $50/bbl long-term Brent oil price.*

***Refers to estimated oil value only. Midland Basin historical crude oil pro derived as a proportion of total Texas crude oil production. Historical operator margin based upon Wood Mackenzie's current assumption of operator margin.*

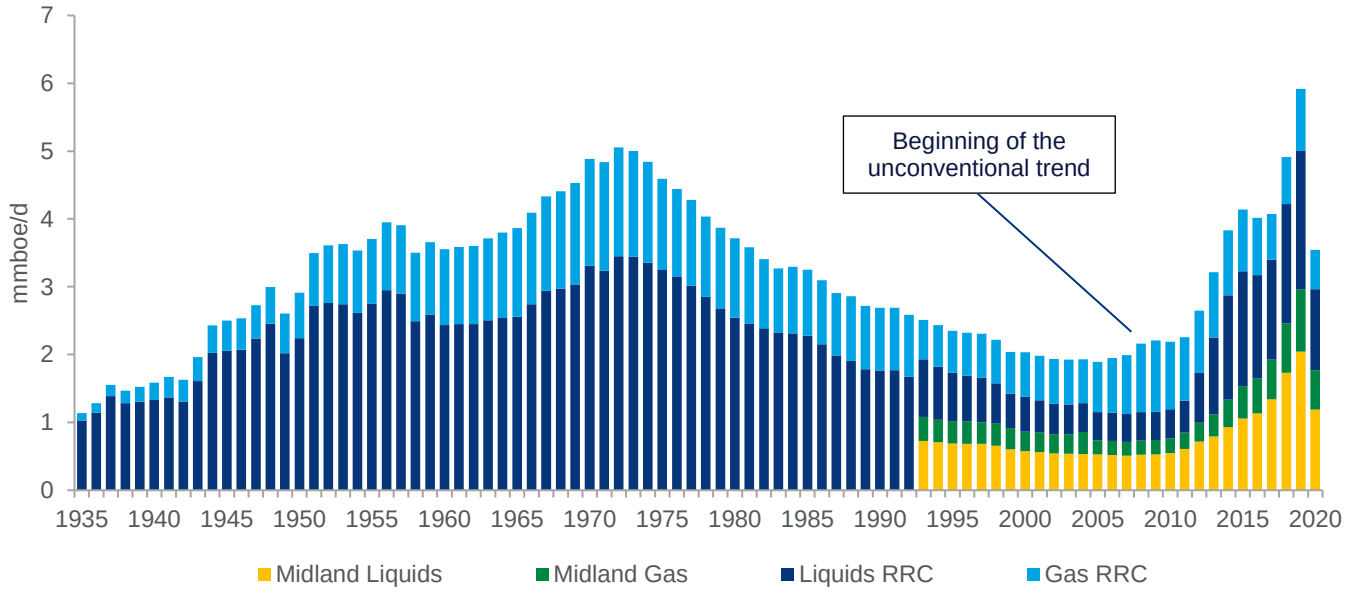
Key Play Characteristics:

Metric	
Key Plays	Canyon, Strawn and Ellenburger (Conventional) Wolfcamp and Spraberry (Unconventional)
Primary reservoir period	Permian, Carboniferous, Silurian
Primary hydrocarbon phase	Oil

The Midland Basin production has had a dual-peak in production, firstly fueled by conventional plays, and more recently unconventional exploitation.

The Midland Basin started production in the 1930s. Early production was conventional and peaked in the 1970s, at which time total Texan production comprised around 7% of production globally. Production declined through to the mid-2000s until the unconventional revolution and the exploitation of the Wolfcamp and Spraberry plays.

Texas Oil & Gas Production (million barrels of oil equivalent / day)



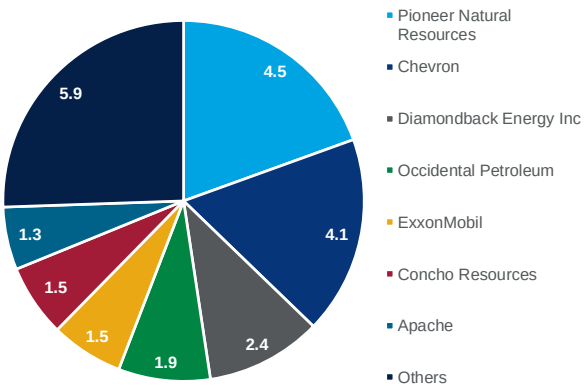
Note: The Railroad Commision of Texas (RCC) contains production data for the State of Texas (100% inclusive of the Midland Basin). This has been merged with Wood Mackenzie's Midland Basin from 1993 - 2020.

Source: Wood Mackenzie UDT September 2020

Pioneer Natural Resources has the largest position in the Midland Basin, with drilling activity and production forecast to increase through 2030.

After Pioneer Natural Resources, Chevron, Diamondback Energy, Occidental Petroleum and ExxonMobil make up the top 5 reserve holding companies in the basin.

Remaining Reserves Top Players (bnboe)



Source: Wood Mackenzie UDT September 2020

Basin 2 – Netherlands/UK Southern North Sea Basin

The Southern North Sea Basin is one of the most prolific gas producing areas in the world with its main phase of exploration starting from the 1960s. The basin extends from the UK to the Netherlands and the majority of its production comes from Permian age sandstones.

Formation: The gas-prone Southern North Sea Basin is a Post-Rift Sag type basin, extending from the London Brabant Platform in the south, to the Mid North Sea High in the north. The Southern North Sea Basin developed as a result of a long and complex history of basinal subsidence. This has been punctuated by discrete episodes of uplift and widespread erosion during the end Silurian ('Caledonian Unconformity'), Late Carboniferous ('Variscan Unconformity'), Late Jurassic ('Cimmerian Unconformity'), Late Cretaceous and at several times during the mid-Cenozoic.

There are a number of elements that are similar between the Southern North Sea Basin and the Kavango Basin. Both have rift and shear elements and the tilted fault blocks seen in the extensional regime in the North Sea are anticipated in the Kavango Basin. In addition to these structural similarities, there are similarities in the age of basin formation and sedimentary deposition.

Source Rock: The Carboniferous, in particular the Westphalian Coal Measures, provides the principal source-rock interval.

Reservoir Rocks: Two main plays have been identified within the basin, the Carboniferous Westphalian sands, and the Early Permian Rotliegendes sands.

Around 85% of all gas production has been from Permian aeolian dune sandstones, and 13% from Triassic fluvial sandstones. Much of the remaining production has been from Carboniferous fluvial sandstones.

Seal and Trap: The Permian Rotliegendes sediments are frequently overlain by Zechstein evaporites. The preservation of large volumes of gas testifies to the efficiency of the seal provided by the Permian evaporite-rich succession.

Basin Status: The basin is ultra-mature, offering progressively smaller volumes. The geology is well understood, meaning recent discoveries have required minimal appraisal. Water depths are shallow, and the operating environment is benign compared to northern sectors of the North Sea.

The undiscovered prospective volumes are weighted towards the prolific Permian play, where over eight billion barrels of oil equivalent have already been discovered. In recent years, there have been a number of sizeable gas discoveries in the basin, including Pegasus and Wingate in the Carboniferous play and Tolmount in the Permian play. These suggest there are still discoveries to be made in the Southern North Sea.

Basin Dashboard:

Exploration & Production	
First Exploration Well	1906
First Discovery	1937
First Commercial Production	1963
Peak Production	1977, 2.4 million boe/d

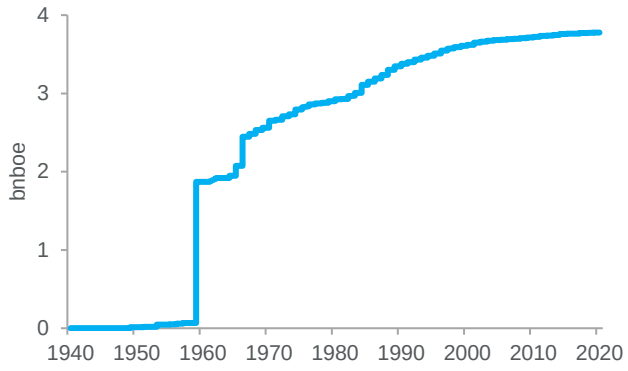
Value & Reserves	
Overall Development Value*	$234 Bn
Remaining Liquid Reserves	360 mmbbl
Remaining Gas Reserves	32 tcf

**Money of the day: historical cashflows as incurred: future cashflows using Wood Mackenzie's assumptions at a $50/bbl long-term Brent oil*

Key Play Characteristics:

Metric	
Key discoveries	Groningen Field, Leman West, Leman East, Hewett, and Indefatigable West
Primary reservoir period	Permian, Carboniferous, Triassic
Primary hydrocarbon phase	Gas
Liquids Gas Ratio	4.5%

Cumulative Resource Build-Up (bnboe)

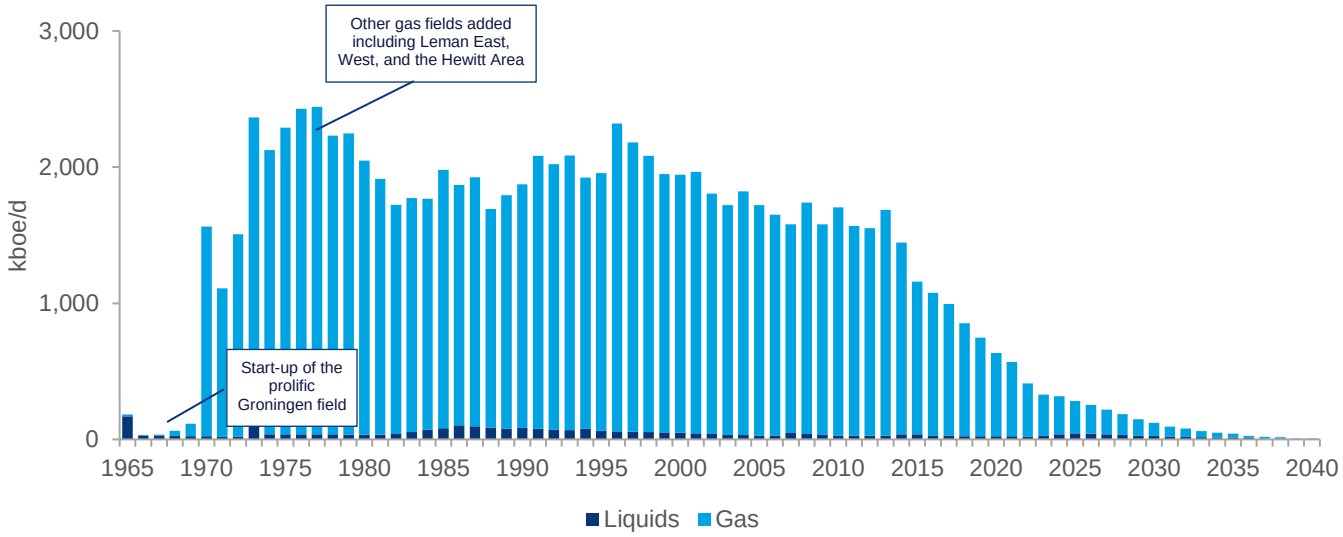


Source: Wood Mackenzie UDT September 2020

Before 1950, the basin had only proved up minor resources. This changed in 1959 when the prolific Groningen field was discovered by the Slochteren-1 well. The well discovered an estimated 1.8 bnboe of commercial reserves and was the starting gun for further exploration in the basin.

In 1966, 8 new discoveries were made, proving up 0.4 Bnboe, including Barque, Blythe, Hewett 1, Hewett 2, Newsham, Indefatigable West, Leman West, Leman East and Ann. Since the 1970s there has been an incremental increase in reserves as the basin has been drilled out.

Oil & Gas Production (kboe/d)

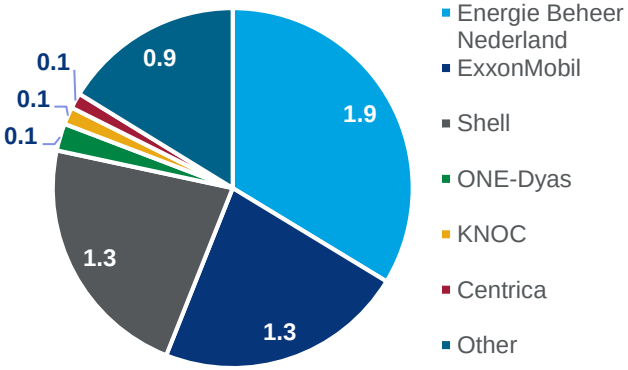


Source: Wood Mackenzie UDT September 2020

The largest resource holders in the basin are Energie Beheer Nederland, ExxonMobil and Shell. This is due to their participation in the main Groningen field , which is the largest gas field in Europe and one of the largest in the world.

The Groningen Concession dwarfs other fields in the Southern North Sea Basin. Notable other operators in the basin include ONE-Dyas who operate a portfolio of gas fields within the L and M blocks, and KNOC who have numerous interests via its subsidiary Dana Petroleum.

Remaining Reserves by Player (bnboe)



Source: Wood Mackenzie UDT September 2020

Basin 3 - Chad Doba Basin

The Doba Basin is located in the south of Chad and is part of the Cretaceous age Central African Rift Basin. In Chad, in addition to the Doba Basin, the Central Africa Rift Basin also contains the Bongor Sub-basin and the Doseo Sub-basin. The Central African Rift basin is filled by up to 7,500m of mainly early Cretaceous continental clastics, so has a similar depth to basement as that seen in the Kavango Basin. Whilst a different age to the Kavango Basin, the basin formation can be considered analogous and similarities have been noted between the Central African Shear Zone and the Southern Trans African Rift and Shear System, important elements in the formation of the Doba and Kavango basins respectively.

Source Rocks: The source rocks are Lower Cretaceous (Aptian-Albian) grey to black lacustrine shales. The gross source interval can exceed 2,000m, but normally consists of a few hundred aggregate metres or less of thin-bedded organic-rich shales. Organic matter is mostly derived from plant materials.

Reservoir Rocks: The reservoir rocks are primarily Cretaceous fluvial sandstones and siliclastic sediments. Individual reservoir intervals are normally less than five metres thick. Oil discovered in the Doba Basin is trapped at two levels. Approximately 90% of discovered resources are in high-quality Upper Cretaceous sandstones. These hydrocarbons are relatively heavy (17-25° API). The remaining 10% of resources are lighter (30-50° API) and are contained in laterally discontinuous Lower Cretaceous sediments. In the Doseo Sub-basin, reservoirs are mainly Lower Cretaceous fluvial, fluvio-deltaic and turbiditic sandstones.

Seal and Trap: The hydrocarbons are sealed by interbedded lacustrine and flood plain shales. The structural styles range from simple tilted fault blocks to complex strike-slip flower structures. Structural traps of the Doba Sub-basin are in the form of rotated fault blocks, transpressional anticlines and rollover structures. Traps in the Doseo Sub-basin are transtensional or transpressional flower structures and drag folds.

Basin Dashboard:

Exploration & Production	
First Exploration Well	1974
First Discovery	1975
First Commercial Production	2003, Doba Oil Project
Peak Production	2005, 173 kb/d

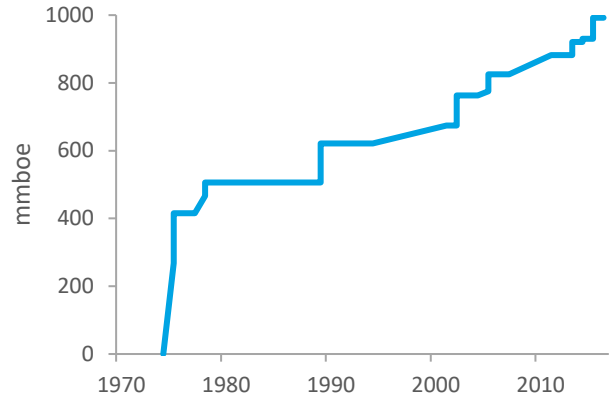
Value & Reserves	
Overall Development Value*	$14 Bn
Remaining Liquid Reserves	354 mmbbl
Remaining Gas Reserves	20 Bcf

**Money of the day: historical cashflows as incurred: future cashflows using Wood Mackenzie's assumptions at a $50/bbl long-term Brent oil price.*

Key Play Characteristics:

Metric	
Key discoveries	Doba Oil Project (7 fields), Benoy Project (3 fields), Krim, Mangara-Badila
Primary reservoir period	Cretaceous
Primary hydrocarbon phase	Oil

Cumulative Resource Build-Up (mmboe)

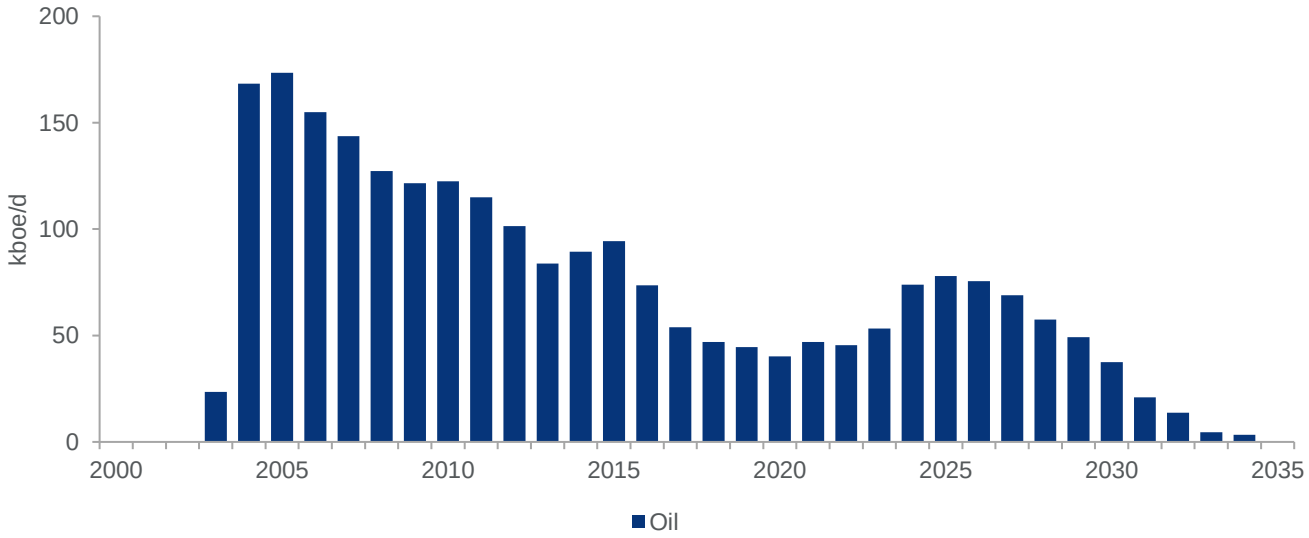


Conoco was the first company to explore for oil reserves in the Doba Basin in the early 1970s. The company was successful, discovering the Kome, Miandoum, Mangara and Belanga fields between 1975 and 1978. This was followed by the discovery of Bolobo by Exxon in 1989.

Regional unrest through the 1990s led to limited exploration activity, before a period of successful exploration through the 2000s. Further exploration work carried out by ExxonMobil over the South Chari Block resulted in the Moundouli and Nya oil discoveries in 2004. The Maikeri and Timbre fields were discovered in 2005. Wood Mackenzie understands that unconventional potential may exist in shale formations within the basin.

Source: Wood Mackenzie UDT September 2020

Oil & Gas Production (kboe/d)



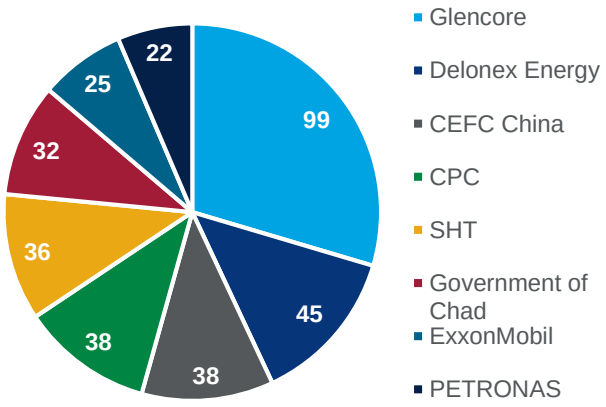
Source: Wood Mackenzie UDT September 2020

Glencore holds 99 mmboe through its majority stake in the Mangara-Badila-Krim development.

Other players hold reserves through various stakes in the Doba Oil Project (operated by ExxonMobil) and the Benoy Development (operated by CPC).

Delonex operates the undeveloped Belanga and Lara fields and is the second highest reserve holder in the basin as a result, though has no onstream production.

Remaining Reserves by Player (mmboe)



Source: Wood Mackenzie UDT September 2020

Benchmarking of Fiscal Competitiveness

Using Wood Mackenzie's propriety Fiscal Benchmarking Tool, the government share % of pre-share NPV10 (NPV10 of revenues less costs) has been benchmarked for a model field with the following criteria:

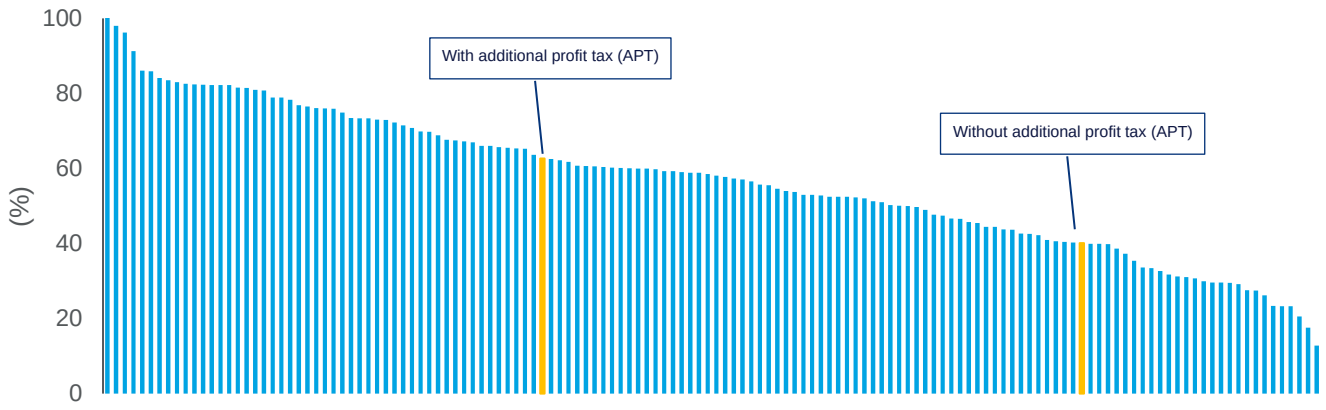
- **Price**: $60; **Discovery Product**: Oil; **Size**: 50 mmbbls; **Cost**: Medium; and **Environment**: Onshore

Two versions of government share % of pre-share NPV are presented below for Namibia (orange columns):

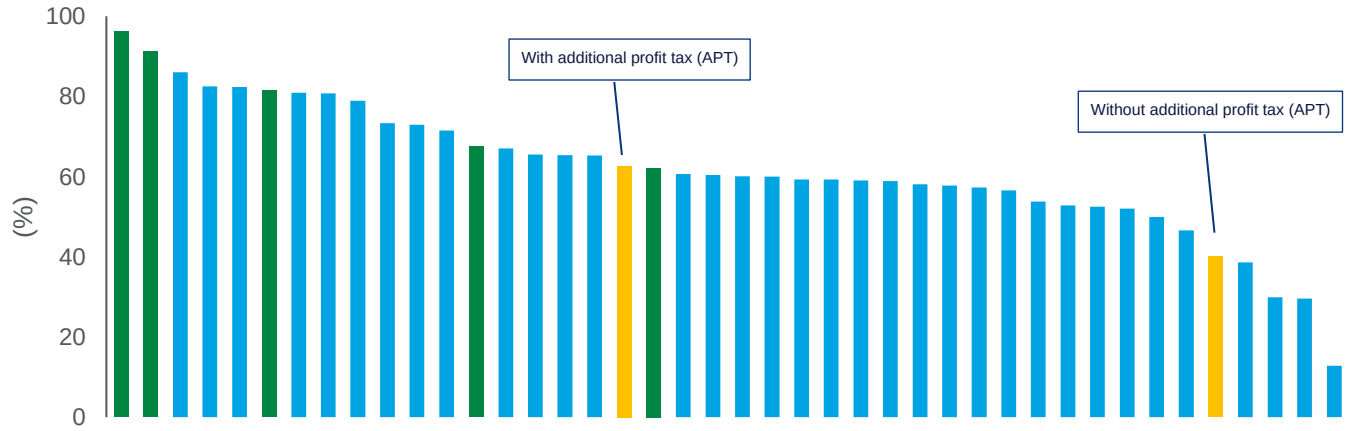
- A standalone field where profits are not reinvested in the permit, and the permit is liable for Additional Profit Tax (APT) - Global Government Share % of Pre-Share NPV of 62.7%;
- A standalone field where profits are reinvested into the permit to the extent that no APT is due - Global Government Share % of Pre-Share NPV of 40.1%

Namibia compares favorably to the top 5 producing countries in Africa, and provides an attractive government share % when benchmarked globally.

Global Government Share % Pre-Share NPV (10% discount rate) – Namibia Concession shown as orange columns



Africa Government Share % of Pre-Share NPV (10% discount rate) - Namibia Concession shown as orange columns (defined as above), top 5 producing countries in Africa shown as green columns



Conclusion

From the characteristics identified in the Kavango Basin, Wood Mackenzie identified three analogous basins, and evaluated their evolution. The basins evaluated included the Midland Basin, the Southern North Sea Basin and the Doba Basin. Key value and reserve metrics were provided, as well as production profiles over the basins' life. Should exploration undertaken by ReconAfrica in the Kavango Basin be successful, the details of how exploration and development has progressed in these three basins provides a useful benchmark as to what basin evolution may look like.

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