Introduction

Despite the relative maturity of exploration across many parts of NW Europe, 2019 saw the highest levels of HI exploration in the region in the last 12 years, with 27 high impact wells completed. Commercial success rates have not been impressive, however, with only seven commercial discoveries being made over the last five years from 69 HI wells recorded in Westwood’s Wildcat Database.

Post well failure analysis in the 2015-19 period has been carried out. This has highlighted gaps in the understanding of elements of the petroleum systems leading to high numbers of failures and non-commercial discoveries.

Activity Levels

Between 2015 and 2019, 69 high impact exploration wells were drilled in NW Europe (UK, Ireland and Norway). High Impact activity levels in NW Europe reached their highest level in the last 12 years in 2019 when 27 HI wells were completed (Figure 1). The largest proportion of these wells were in the North Sea (13 wells). 40 wells were drilled in mature and maturing plays and 29 were in frontier and emerging plays. The most frequently targeted plays were the Middle Jurassic of the Barents Sea and the Upper Jurassic of the Central and Northern North Sea.

![Figure 1 High Impact Exploration Activity by year](image)

Exploration Performance

Over the five-year period between 2015 and 2019 technical success rates were extremely high at 70% but only 1 in 7 of the discoveries made were big enough to be considered commercial. The commercial success rate was therefore only 10%, similar to the global commercial success rate for frontier exploration.
Commercial success rates were highest in the North Sea and Norwegian Sea, at c. 18% (Figure 2), whilst there have been no commercial successes in the last five years in the Barents Sea, the Porcupine Basin or the Southern North Sea.

**Failure Analysis**

Possible reasons for the failure for an exploration well to find commercial volumes of hydrocarbons were assessed from public post-well announcements by companies and regulators. This is not always unambiguous and often a definitive single cause cannot be established.

Investigation of failure mechanisms of all unsuccessful high impact exploration wells across NW Europe suggests that 35% of wells failed due to the absence of good quality reservoir, 17% failed due to charge / migration failure and 7% failed due to trap failure. An additional 20% failed due to a combination of charge / migration and / or trap failure. The dataset of 69 HI wells drilled in NW includes 40 wells testing plays considered to be frontier or emerging and 29 wells in mature or maturing plays. The distribution of failure mechanisms by play maturity shows some distinct differences.

![Figure 2 High Impact Exploration Performance by Basin](image)

![Figure 3 High Impact Exploration Failure Analysis](image)
Figure 4 Well failure analysis by play maturity

Whilst the proportion of reservoir and trap related well failures is fairly similar across play maturities, unambiguous failures due to charge / migration are significantly higher in frontier and emerging plays (23%) than in mature and maturing plays (10%).

In the emerging Barents Sea basin (Figure 4), where the most high impact wells were drilled, failure mechanisms vary according to the reservoir target which is being tested. Absence of good quality reservoir resulted in significant numbers of failures in wells targeting the Lower Cretaceous, Permian and Triassic, whilst migration / source failure was the primary failure mechanism in the Lower Jurassic.

Figure 4 Barents Sea Failure Analysis

Conclusions

Despite the relatively high level of exploration maturity of many of the offshore basins of NW Europe the industry continues to target prospects with large pre-drill success case volumes (>100 mmbbls or 1tcf). The commercial success rates of these wells, however, is very low and compares to the success rates in global frontier plays. Failure mechanisms for these prospects are dominated by combinations of
charge and reservoir failure, with the proportion of prospects being unsuccessful due to trap failure being less.
Failure analysis of high impact wells in NW Europe suggests that further understanding of petroleum systems is required especially reservoir quality and charge prediction.
Realistic estimates of success case volumes pre-drill, informed by rigorous, objective post well analysis and calibration using offset wells are key to improving commercial success rates.