Ireland's Porcupine Basin: Drilling Time?

30,000 km² of 3D seismic data acquired offshore western Ireland since 2013 have yielded numerous prospects in a range of plays. Is it time the industry started to test these ideas with the drill bit?

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The Porcupine Basin is a Late Jurassic rift off the west coast of Ireland, roughly congruent with the bathymetric deep (Figure 1). In simple terms it may be divided into a low-stretch, low-subsidence north section and a high-stretch, high-subsidence south. These two areas of broadly west-north-west – east-south-east extension are likely separated by transfer elements, sometimes informally referred to as the 'Dunquin Transfer Zone'.

Porcupine Exploration

A total of 26 exploration wells were drilled in the North Porcupine between 1977 and 2001, resulting in three non-commercial oil discoveries (Connemara, Spanish Point and Burren).

Only four wells have been drilled in the South Porcupine. The first (Esso 62/7-1, 1982) is not actually in the Porcupine Basin at all, but on the Goban Spur, the relative bathymetric shallow which extends south-west from the Celtic Sea, underlain by a labyrinth of small Mesozoic sub-basins and intra-basinal highs. Well 62/7-1, on one of these highs, was an extraordinary well for its time. Drilled in nearly 1,000m of water, 230 km from the Irish mainland, it had minor oil shows in a very thin Middle Jurassic sandstone. However, its main relevance to the Porcupine story is in proving that the thick and locally source-prone Lower Jurassic ('Lias') of southern England and the Celtic Sea extended at least this far west prior to Upper Jurassic rifting.

The first well in the South Porcupine proper was BP 43/13-1 (1988), which reached a TD of 5,128m MD, targeting a North Sea-style tilted fault block. Modern seismic and biostratigraphy shows that it did not exit the thick Kimmeridgian sequence, let alone penetrate the pre-Oxfordian stratigraphy that we would now call 'pre-rift'. It did, however, establish the presence of Kimmeridgian and Tithonian source rocks in the South Porcupine, and had intriguing shows in thin Kimmeridgian sandstone stringers which can be typed to a slightly more mature version of the source rocks found in the well.

Renewed Interest

The latest wave of interest in the South Porcupine began with the 2011 Licensing Round. This was led by junior oil companies, mostly chasing post-rift submarine fan stratigraphic traps in the excitement following analogue discoveries in the South Atlantic (e.g. Jubilee, offshore Ghana). Almost 14,000 km² of 3D was shot on this acreage, delivering amazing images of submarine fan development – although in most cases not where the fans had been predicted on the legacy 2D!

The next licensing round, in 2015, saw the arrival of the majors. In the main, they seem to have been less excited by the fans than by the analogy between the Porcupine Basin and its conjugate: Flemish Pass, offshore Newfoundland. Statoil had made a series of discoveries in late syn-rift structures here, notably Bay du Nord (2013). Cash bids totalling about $1.9 bn were placed in the 2015 Flemish Pass Round and Irish bidding was similarly competitive, with many successful applicants proposing the immediate acquisition of large 3D surveys. Licensing Options over almost all of the basin margin open acreage were awarded at this stage, and by 2017 the total modern 3D seismic coverage had risen to some 30,000 km².

Drilling continued to be much more circumspect. ExxonMobil proved once again willing to place a big bet on an unusual concept. Its 2013 well, 44/23-1 (Dunquin) tested a Cretaceous atoll, possibly perched atop a volcano extruded from the transfer lineament between the North and South Porcupine. The trap appears to have been breached, but they found a significant residual oil column, providing yet more evidence of a working source rock in the basin. It is notable that, despite withdrawing from the Dunquin licence, Exxon made significant new applications in the 2015 licensing round, demonstrating continuing faith in the South Porcupine.

In 2017 Providence Resources became the first company to drill into the heart of the basin and test one of the key plays. The company had two targets: Druid, a Palaeocene fan, and Drombeg, a mid-Cretaceous fan. Both fans proved dry, though Providence reports signs of bitumen from Drombeg. Were they drilling too distally? Was up-dip seal adequate? The basin continues to tantalise.

A Diversity of Plays

Successive rounds of licensing, huge amounts of 3D seismic, but very few wells (Figure 2) mean that companies are now carrying untested plays and prospects representing billions of barrels of potential resources – as well as representing the changing enthusiasms of explorers over decades.

No pre-rift tilted fault block has been penetrated south of the Dunquin Transform, though large and spectacular blocks (e.g. Figure 3) occur on both sides of the basin. Fault blocks in the North Porcupine have

The Porcupine Basin lies about 200 km south-west of the Beara Peninsula in the far south-west of Ireland.

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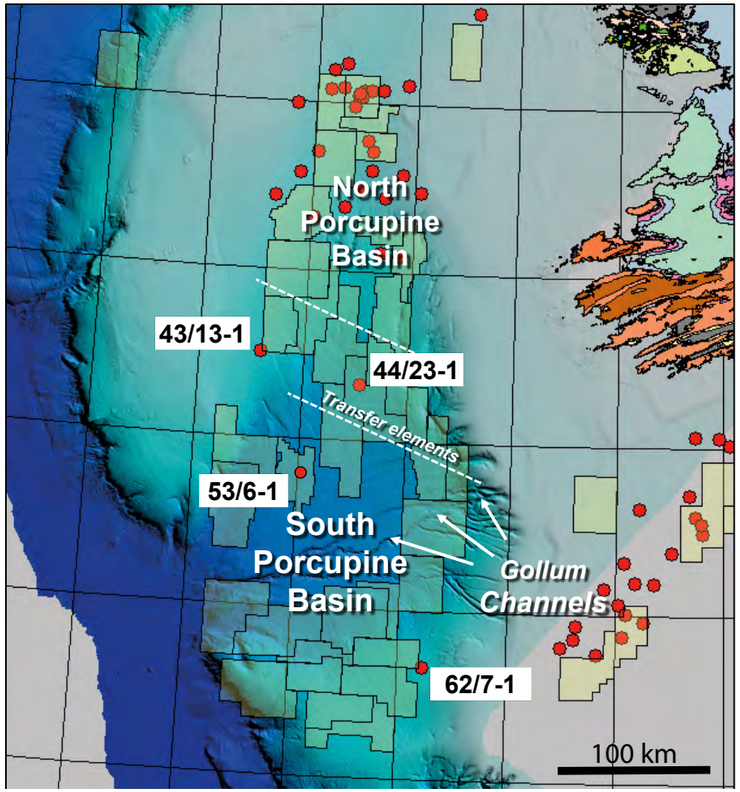


Figure 1: Offshore south-west Ireland: bathymetry, wells and current authorisations. Named wells are discussed in text. (Bathymetry from INFOMAR, onshore geology from Geological Survey of Ireland.)

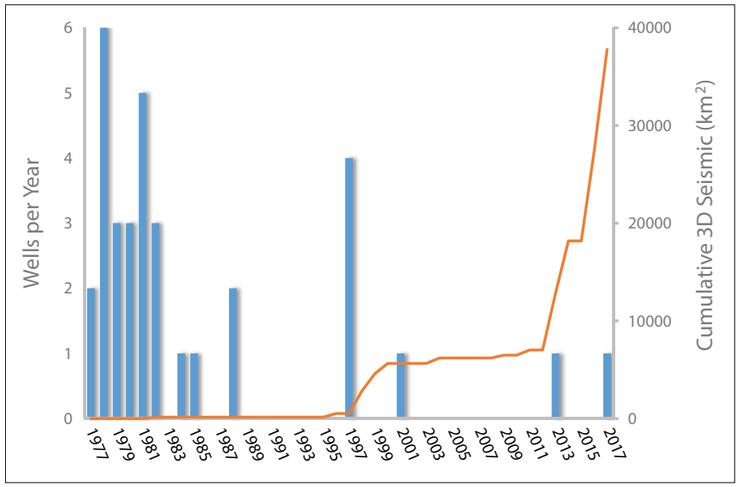


Figure 2: Drilling and 3D seismic acquisition history. (Based on Irish DCCAE published data.)

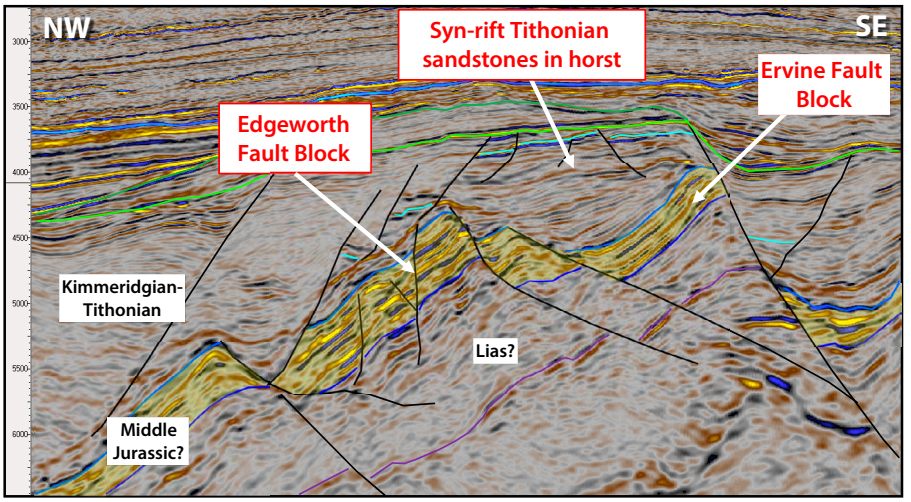


Figure 3: Pre-rift tilted fault blocks and syn-rift horst, SE Porcupine Basin. (Europa 2017 PSDM, Full Stack).

proved oil-bearing, but a combination of modest overall oil-in-place and poor quality, largely non-marine, reservoirs mean that no discovery has yet proved commercial. That said, we do not know if shallow marine reservoirs are present in the south. The Porcupine Basin is some 400 km long and a Middle-Upper Jurassic marine connection to the south is likely. Middle-Upper Jurassic well control is available only over the most proximal 100 km. The Porcupine Basin is comparable in size to the North Viking Graben of the North Sea, and there is plenty of room to put the Brent Province (which occupies little more than a Quad in total) into the more distal undrilled blocks (Figure 1).

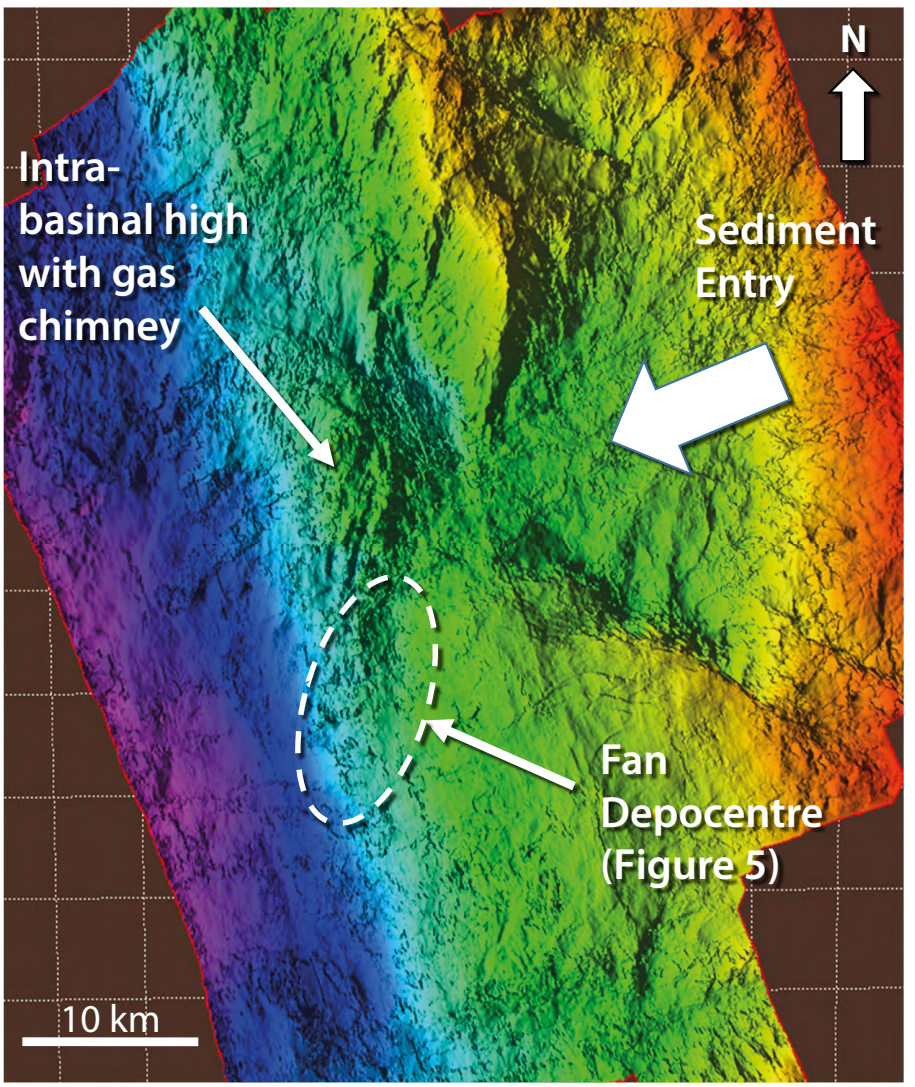
Success in the Flemish Pass came not from pre-rift blocks, but from younger traps in the Tithonian-Berriasian shallow marine sandstones of the late syn-rift. Again, sandstones of comparable age have yielded oil in the North Porcupine (Spanish Point discovery). Seismic character suggests these sandstones are also present in the South Porcupine and potential trapping configurations have been mapped (Figure 3).

Various deepwater systems are revealed by the 3D data in the post-rift. In the north-east 'corner' of the South Porcupine there is a canyon entry point set up by Jurassic rifting (Figure 4) which persists through the Lower Cretaceous and, indeed, can be thought of as the ancestor of the Gollum Channel system which feeds sediment off the south-west Irish Shelf and into the Atlantic Abyss today (Figure 1). At the mouth of this entry point we see structurally restricted fans of lowermost Cretaceous – perhaps Hauterivian – age (Figure 5). At broadly the same time, on the opposite side of the basin, we have slope-apron deposits.

In later Cretaceous (Aptian-Albian) times, possibly associated with the regional lowstands, we have less well-confined fans on both sides of the basin. Those in the west (such as Providence's Drombeg, mentioned above) are commonly fed by long sinuous slope channel systems. Those in the east are at the foot of steeper slopes and therefore may be better candidates for detachment. More fans occur in the Palaeocene, now broadly fed from the north rather than from the east and west flanks of the basin.

Finally, there is Dunquin South: the more southerly twin of the Cretaceous atoll referred to above, but this time without a gas chimney, so hopefully sealed. This is a tremendous prospect for the ENI-led partnership in Frontier Exploration Licence 3/04.

Figure 4: Base Cretaceous structural interpretation in the south-east Porcupine showing sediment entry point and submarine fan depocentre. (Europa interpretation from proprietary PSDM data.)



Easy to Procrastinate

In the last two Porcupine Rounds, concessions have been first granted as two-year Licensing Options which may subsequently be converted to Frontier Exploration Licences ('FELs'). A FEL lasts for 15 years, typically in four phases: a Phase 1 of three years and three subsequent Phases each of four years. A well commitment is not required until Phase 2. Most of the licences in the South Porcupine (Figure 1) entered FEL Phase 1 this year, so a commitment to drill will not be required until 2021 and the well need not be drilled until 2025: though clearly this would leave little scope for well evaluation and for planning the next move.

High (sometimes 100%) equities are an issue, in that many licencees will seek a farminee before drilling. We know that this can be a long process in the current commercial climate. Given the exposed Atlantic setting, most operators will also seek to drill between May and August, which means a maximum of two wells per rig per season.

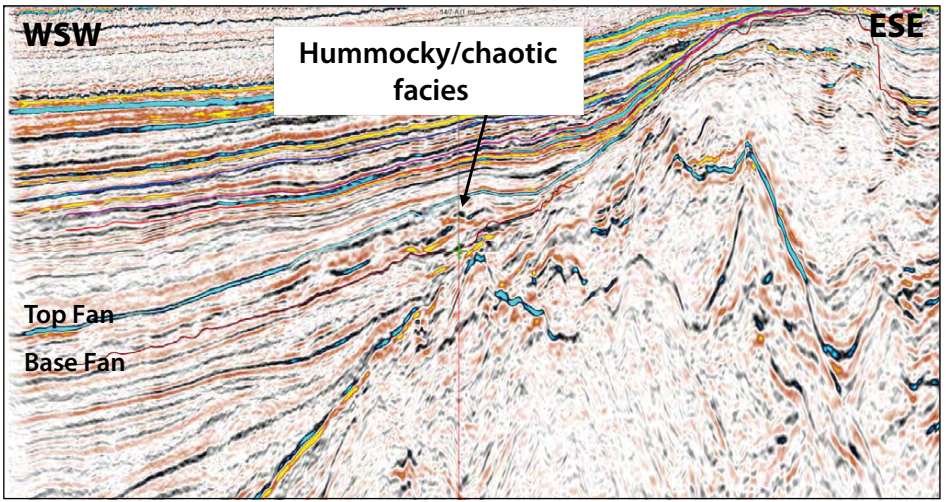


Figure 5: Lowermost Cretaceous submarine fan on the east side of the South Porcupine. (Europa proprietary PSDM data.)

These equity and practical issues, together with limited overall exploration budgets, make it all too easy to procrastinate. Yet rates for appropriate deepwater drilling units are uniquely low and there are few genuine frontier basins which offer such strong evidence for working hydrocarbon systems, combined with such attractive tax terms in a politically stable environment.

To date, only Nexen has acquired a site survey for a planned 2019 spud. Providence has also acquired a survey, but for a prospect on the Goban Spur. So, it seems that most Porcupine drilling will happen in the window 2020–2024. Does a major hydrocarbon province lie beneath the South Porcupine? We still await the critical exploration wells which will really give us the answer. ■