

# Shallow Gas

## Explore for bright opportunities

Cenozoic sediments in the northern Dutch offshore host several proven hydrocarbon accumulations. There are over 150 seismic anomalies or bright spots present at the interval of 300–800m depth. Traps are generally provided by low relief 4-way dip anticlines formed by underlying salt diapirs, whereas intercalating clays provide the necessary sealing capacity.

Key factors for a successful development of shallow gas accumulations are:

- Distance to existing infrastructure
- Gas saturation
- Flow and storage capacity

A challenge remains in the prediction of the presence of mobile gas and estimating gas saturation prior to drilling. Seismic attributes do not distinguish between high and low saturation or even lithological effects.

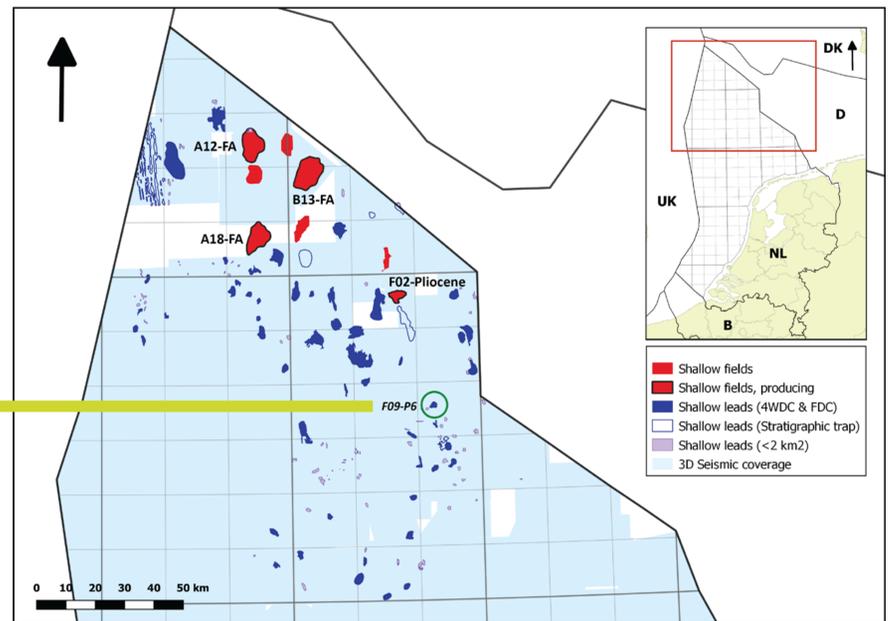


Figure 1. Study area showing the 8 shallow fields (red) and identified shallow leads. The 3D seismic data coverage in the area is shown in blue.

## Shallow gas opportunity F09-P6

POSg: 63%

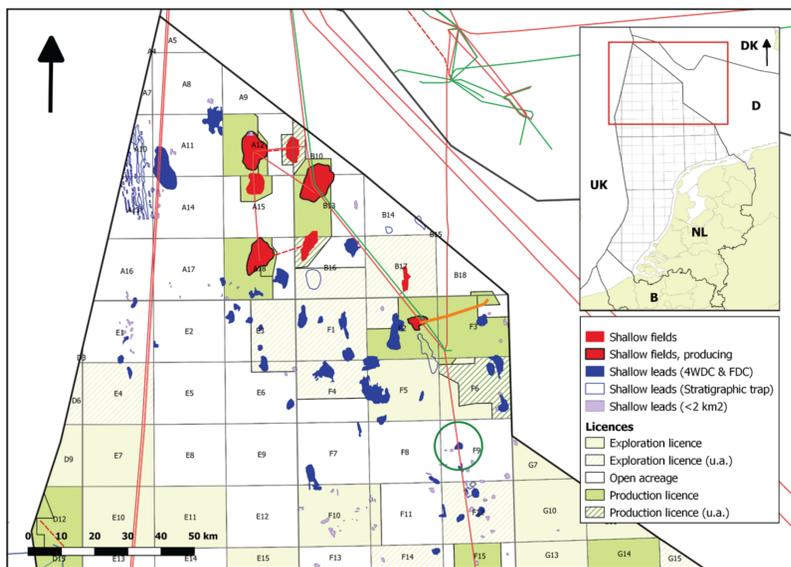


Figure 2. Shallow fields and leads.

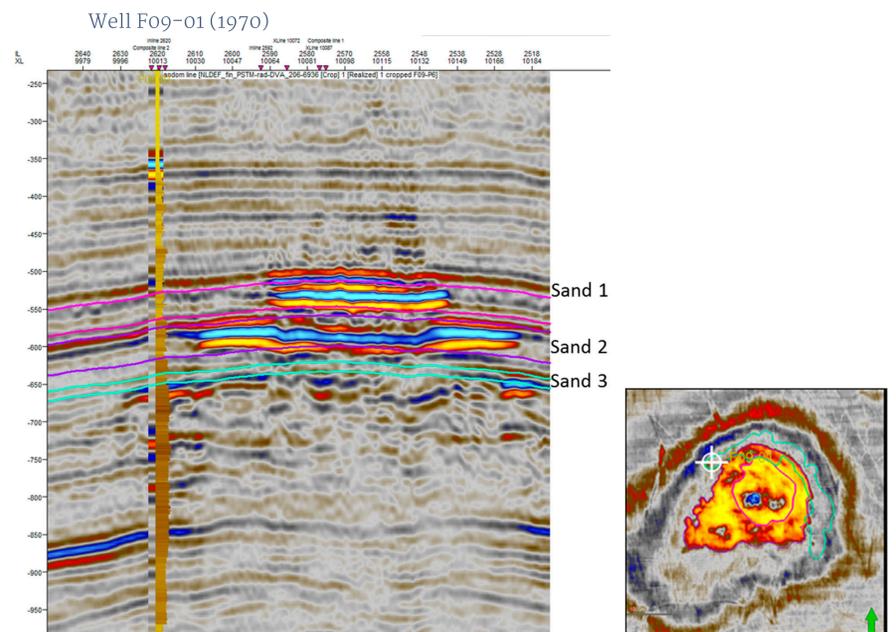


Figure 3. Seismic section of lead F09-P6.

## Economic overview

- Single well development
- Accumulation is located 29 km from the nearest platform
- Based on existing producing shallow gas fields a Recovery Factor of 65% can be assumed
- Shallow gas accumulations typically comprise 99% methane
- Marginal field tax allowance: 25% (40% expected in 2020)
- Stand-alone development may be marginally economically attractive and could require other discoveries nearby
- Key risks: Sand production and gas saturation

GIIP (bcm)	P90	P50	P10
F09-P6	0.4	0.7	1.2

## Probability of success shallow gas lead F09-P6

- |                                       |      |                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Structure</b>                      | 90%  | <ul style="list-style-type: none"> <li>• Seismic data hosts abundant amplitude anomalies or bright spots that indicate the presence of gas</li> <li>• 4-way dip closure, presence of seismic amplitude anomalies and DHIs suggest underfill</li> </ul>                                                                                        |
| <b>Charge &amp; migration</b>         | 100% | <ul style="list-style-type: none"> <li>• Well F09-01 (drilled next to bright spot) has gas shows up to 2%. Attributed to the rich organic content of the clays</li> <li>• Amplitude partly conform structure</li> <li>• Pull down, gas shows in well next to bright spot</li> </ul>                                                           |
| <b>Seal presence &amp; efficiency</b> | 70%  | <ul style="list-style-type: none"> <li>• Intermittent clay layers present in the Pliocene section act as effective seal for the stacked reservoirs</li> <li>• Hydrocarbon column heights dynamically controlled by critical fracture pressure of intermittent shale layers acting as seal, thus controlling the level of underfill</li> </ul> |
| <b>Reservoir presence</b>             | 100% | <ul style="list-style-type: none"> <li>• Presence of continuous stacked sands with sufficient thickness, N/G and porosity (20–25%) verified by seismic and wells nearby</li> </ul>                                                                                                                                                            |