# **Regional overview Cenozoic shallow gas fields**

Cenozoic sediments in the Dutch North Sea host abundant seismic amplitude anomalies, or bright spots, of which many are proven to be related to hydrocarbons and the majority exhibit a DHI characteristic of gas emplacement.



The Netherlands was the first country in the North Sea region in which these accumulations have been developed. Currently, four Dutch shallow fields are producing, and additional fields are planned to come on stream in the coming years. The play has proven to be a valuable **resource** and with several tens of undrilled shallow leads, largely covered by 3D seismic data, it is worth further evaluating the development potential of the play.

### **Geological setting**

Most of the shallow anomalies in the area occur in formations that are deposited in a Mio-Pliocene fluvial-deltaic system, generally referred to as the Eridanos Delta. The Delta system covers a large part of the current Southern North Sea and comprises an alternation of shales and clean-to-shaly sands. These stacked sandy layers form the reservoirs, sealed by intermittent shales. The gas column height within each sand is controlled by the critical fracture pressure of overlying shale layer, increase of the column height results in seal breach and venting of gas into shallower layers. Shallow gas primarily has a biogenic origin, there are however also indications that also gas with a thermogenic origin has entered the system.



## Shallow gas play elements in the Northern Dutch offshore

Risking of shallow gas lead F09-P6					
Structure	90%	<ul> <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 DHI's suggest underfill</li> </ul>			
Charge & migration	100%	<ul> <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>			
Seal presence & efficiency	<b>70</b> %	<ul> <li>Intermittent clay layers present in the Pliocene section act as effective seal for these 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>			
Reservoir presence	100%	<ul> <li>Presence of continuous stacked sands with sufficient thickness, N/G and porosity (20-25%) verified by seismic and wells nearby.</li> </ul>			

# Shallow gas Lead F09-P6

The undiscovered F09-06 lead is mapped in the open F09 offshore block. This lead could be developed with a single well, possibly in combination with nearby oil leads F09-Stelvio and F08-Ventoux.



#### **Volumetric Assessment**

Conformable hydrocarbon related "bright spot" present in Cenozoic fluvio-deltaic **intercalated** sands and shales (Eridanos delta) @ depth of circa 650m

For volumetric GIIP assessment "Standard" shallow gas parameters are used for porosity (20-25%), thickness and Sg (~50-80%) (from producing fields shallow gas A12-FA and F02a-B Pliocene).

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

#### **Work Program Requirements**

- Apply for an exploration license
- Study additional potential in block on deeper targets:
  - F09- Stelvio, Jurassic oil prospect, Lower Graben sands (STOIP 18-49 MMbbl)
  - F08-Ventoux, Jurassic oil lead, Lower and Upper Graben sands and Kimmeridgian sands (STOIP 15-65 MMbbl)
- Gas saturation (Sg) can be potentially be de-risked using CSEM and/or gravity measurements.
- The shallow depth of the opportunity lends itself to a simple low-cost well penetration to de-risk N/G and Sg using standard logging tools.





#### POSg : 63%

**Key Risk:** Gas saturation Sg can be as low as circa 10% and give similar DHI response

### **Economic Overview**

- Single well development
- Accumulation is located 29km from the nearest platform.
- Based on existing producing shallow gas fields a RF of 65% can be assumed.
- Shallow gas accumulations typically comprises 99% methane.
- Marginal field tax allowance: 25 (40% probably from 1.1.2020)
- Stand-alone development maybe marginally economically attractive and could require other discoveries nearby
- Key Risks: Sand production.