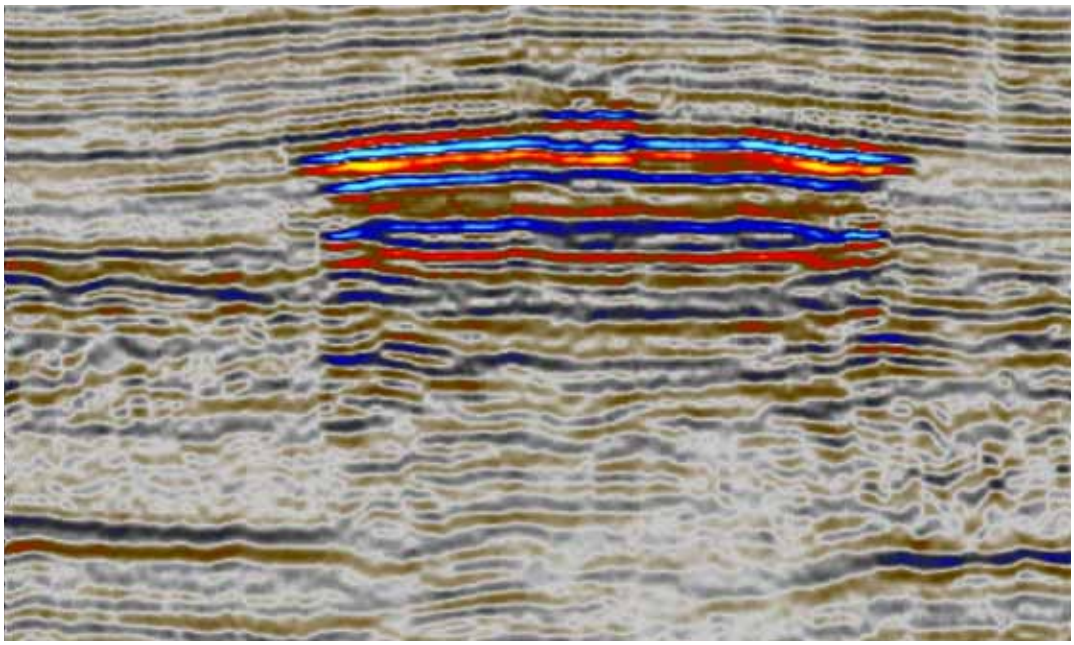
CENOZOIC ERIDANOS DELTA HYDROCARBON SYSTEM



TNO innovation for life

Shallow (<1 km) gas accumulations on the Dutch shelf were recognized in the 1970s but were never developed because of low reservoir pressures and unconsolidated sand issues. Current interest in these accumulations comes forth from a stronger demand on the gas market and the availability of newer production techniques. Therefore, many operators re-explore the potential of the North Sea's shallow gas. Currently five such operators are pooling data in a TNO joint industry sponsor project.

SHALLOW GAS – WHAT DO WE KNOW

Shallow gas occurs in unconsolidated, Cenozoic sediments on the Dutch continental shelf, particularly in shallow marine to continental (deltaic) deposits of the Plio-Pleistocene Eridanos delta. The shallow marine to continental deposits accumulated both from deep thermogenic sources and from biogenic sources in shallower strata. They are either structurally trapped in anticlines associated with rising salt domes or occur in stratigraphic or depositional traps. The gas accumulations may be economically attractive, especially if located near existing infrastructures. The Dutch thermogenic, biogenic and mixed shallow gas systems are highly dynamic. Gas chimneys, acoustic turbidity and blanking, pockmarks and stacked bright spots, as well as methane dissolved in groundwater, all indicate ongoing and/or recent migration and leakage of shallow gas. Shallow gas

Seismic amplitude data of the Eridanos delta, showing reflection anomalies ('bright spots') indicative of shallow gas accumulations.

Locality of the Tertiary-Pleistocene Eridanos river (yellow) and delta (orange) system.

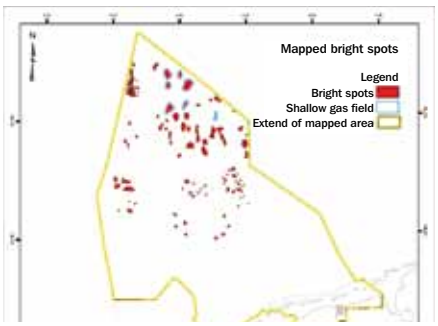
production in the Dutch offshore is still limited by a lack of familiarity with the shallow gas systems, especially with respect to the unclear relationship between anatomy of the delta and charging/trapping conditions at specific stratigraphic intervals.

KEY QUESTIONS

Direct hydrocarbon indicators for shallow gas occurrences include bright spots and several other types of velocity anomalies, which are well known by offshore operators as they may strongly affect the correct imaging of deeper subsurface (energy absorption, ray distortion, etc). Their study and characterization have important industry applications, both in geohazard identification and in exploration of deeper levels. E&P would clearly benefit from an increased understanding of how the distribution of these environments is related to external (climate, tectonics, sea-level) and internal (delta-lobe switching, avulsion) processes. A sequence-stratigraphic framework should provide critical information about the architecture and reservoir properties of these not yet well-understood reservoirs and the continuity of sealing clays.

OBJECTIVES

The main objective of the study is to develop a workflow that assesses the potential of seismic bright spots as indicators for shallow gas occurrences.



This will be achieved by constructing a 3D, basin-scale reservoir model of the shallow gas systems contained in the Cenozoic Eridanos delta. Key external controls will be linked directly to depositional elements (fans, valley fills, clinoforms and topsets) calibrated by extensive well data, providing bio- and chronostratigraphic, geochemical and paleoenvironmental information. The established reservoir model—in combination with reconstruction of the areas of origin of biogenic and thermogenic gases and the charging, preservation and pressure conditions in these reservoirs—forms the basis for improved prediction of other potential shallow gas occurrences offshore the Netherlands, either economic profitable or hazardous.

TNO

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