Kiskunhalas Trough, Southern Hungary: Seismic-Driven Appraisal Program Unlocks Low-Permeability, Syn-rift, Gas-Condensate Play

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Abstract

This paper presents a comprehensive appraisal of the tight-gas sand play in the Kiskunhalas Trough, southern Hungary, leveraging new propriety, bespoke 3D seismic data and re-evaluation of existing legacy wells.

The Pannonian super-basin of central Europe has produced over 10 billion barrels of oil equivalent, from multiple conventional objectives. Significant gas/condensate resource potential exists in the under-developed, high- temperature high-pressure Neogene basins of southern Hungary, the bulk of which is unconventional.

The Kiskunhalas Trough is a medium-sized, strike-slip sub-basin, within the greater Pannonian system. The basin is structurally complex with highly discontinuous reservoir units. Multiple, stacked low-permeability reservoirs attaining a gross thickness of 1,150m are located at depths exceeding 2.5km. Legacy wells demonstrate an operating petroleum system with proven play elements (including source, seal, reservoir, trap, maturation/timing, and preservation). The syn-rift early Miocene phase includes both source and reservoir intervals, with combination traps and a 2,000m gas column. A thick post-rift section pushed this target interval into the wet-gas window, before strong (Alpine) inversion and erosion uplifted the interval to optimal drill depths, whilst preserving over-pressure.

Predicting reservoir distribution and reservoir quality within the Kiskunhalas Trough is the key technical challenge for field characterization and appraisal. Observed variability is principally controlled by the depositional system, with basin-margin facies comprising a series of large-scale fan-deltas. Basin-floor fans and re-worked submarine channels are the primary reservoir target, with localized gravity-driven flows and debrites constituting secondary targets. The sub-basin is dominated by high-angle faults, with late-stage reactivation and associated fractures. Reservoir units are located adjacent to, and downthrown from these fault strands, with local point sources within relay ramp junctions. Newly acquired 3D seismic data, with acquisition and processing specifically parameterized to image the Miocene section, enables these elements to be defined with confidence. This 200-fold survey replaces the legacy 12-fold data that was acquired in the late 1980s and yields significant insights for both existing well results and future well locations. Older 2D and 3D seismic data were unable to image these faults nor detect the main reservoir units. Consequently, wells drilled using these older data failed to adequately appraise the field. The new 3D seismic is a high-fold, broadband, full-azimuth, high-density, long offset survey. A depth migration resolves the fault strands that define and bisect the field, while logs and core inform a deterministic inversion, which constrains reservoir trends and identifies the main productive zones.

This paper presents the results of an integrated tectono-stratigraphic model for the evolution of the Kiskunhalas Trough. The resultant model and interpretations provide a significant improvement to the characterization of the syn-rift basin-fill and provides an opportunity to high-grade sweat-spots across the play. This study demonstrates significant recoverable unconventional gas resource of over 2Tcf, within this mature area whilst reducing uncertainty for well location and geohazards. Collectively, this seismic-driven appraisal program and workflow may benefit analogous syn-rift basins globally.