

## **South Viking Graben, Norway – Play Potential of Deep Upper Jurassic Mass Transport Deposits Revealed by Multi-Azimuth Seismic Data**

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### **Abstract**

Along the Norwegian Southern Viking Graben flank multiple Triassic-Eocene reservoir sections have been proven prolific on the Utsira High and Heimdal Terrace. The intervening Vana Sub-Basin has received less attention due to the marginal developed Paleocene sands and great depths of Jurassic targets. Wells in this area explored structural traps at the basin margin but found only non-commercial reserves in highly heterogeneous and segmented Jurassic reservoirs.

Multi-azimuth (MAZ) multisensor towed streamer seismic data provides improved imaging of basin margin flanks and associated structure and sedimentary facies. Massive mass transport deposits (MTD) were dislodged and transported across the Gudrun Terrace into the Vana Sub-basin during the Upper Jurassic. Near the head scarp zone, intense faulting and diagenesis render reservoirs highly heterogeneous and laterally discontinuous. Wells drilled repeat sections in what is an otherwise extensional regime and well tests demonstrated the small scale compartmentalization of the reservoirs along with limited reserves the traps in this position hold. Down-dip of the slope scarps the MTDs form an intermittent apron at the base of slope. MTD geometry and associated sand facies in the compressional toe zone and ponded sands deposited in accommodation space on the back of the compressional zones are interpretable in unprecedented detail. Toe thrusts are clearly visible in the MAZ data and are mappable along the basin margin allowing delineation of the geomorphology of the MTD system from head scarp to depletion and accumulation/compressional zones including the terminal ramps. The MTD facies belt is covered by Upper Jurassic organic rich Draupne Formation source rocks and later subsided rapidly as attested by a thick overlying Lower Cretaceous section.

The Upper Jurassic MTDs are buried now at depths >4 km and are closely linked to Upper Jurassic source rocks which provide petroleum charge over small migration distances. Compressional MTD zones and ponded sands are mappable parallel to the paleo-slope and suggest considerable connected sand gross rock volumes.

Additional potential of outboard deep water sands that were transported into the basin through gaps between individual slides and slumps are expected. These outboard deep water fan systems may have been proven in a significant recent discovery (awaiting confirmation of well results).

Pre-stack MAZ quantitative seismic attributes are interpreted in the context of MTD seismic facies and support assessment of reservoir presence (lithology cubes) and quality (porosity cube) at depth greater than 4 km. Deep petroleum plays associated with basin margin MTDs may prove laterally extensive in the Norwegian Southern Viking Graben and offer a prolific new play in this mature area. The petroleum

system can serve as an analogue in similar plays along extensional, rapidly subsiding basin flanks of the Norwegian Continental Shelf and other extensional margins.