Structural and Sedimentological Controls on Petroleum Systems in Deep-Lacustrine Basins: Examples from the North Falkland Basin

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Abstract

Fault structures at rift margins are important points of sediment input to basins; with sedimentation directed across bounding faults during the syn-rift, and diverted along relay ramps during the early post-rift. These deposits can comprise turbidite fans and other clastic sediments, which can be mapped from the basin flank to the basin floor. The role of deep-lacustrine turbidite fans as hydrocarbon reservoirs is becoming better characterised, while their role in forming potential hydrocarbon conduits from the deep basin to shallower basin margin traps remains less understood. By characterising the interaction of sediment transport pathways and faults structures at rift basin margins, potential migration pathways can be better constrained, improving the viability of basin flank exploration. The North Falkland Basin (NFB), situated 40 km north of the Falkland Islands, comprises a set of extensional sub-basins with a proven petroleum system hosting stratigraphic and combined structural-stratigraphic traps (Liz, Zebedee, Sea Lion, and Isobel/Isobel Deep discoveries). The N-S trending Eastern Graben exhibits variation in along-strike structural configuration, due to a splay in the structure that occurs between the locations of the Sea Lion and Isobel discoveries. To the north (around Sea Lion) fault behaviour is less complex with large displacements consolidated along a single faulted margin. To the south, the eastern flank is more structurally complex with displacement shared between two faulted margins that exhibit fault bends, breached relays and relaying segments. The change in structural style has resulted in the development of the Sanson Terrace, located up-dip from the Isobel discovery. Using high quality 3D seismic data, channel and fan systems

can be mapped from the Sanson Terrace, down and across a large NE-SW trending breached relay segment, and into the Eastern Graben. Detailed fault interpretation and amplitude mapping, allows insight into the interaction of deposition and complex fault structures, as well as fault displacement and juxtaposition. These relationships can account for potential hydrocarbon migration pathways from the source kitchen located in the Eastern Graben up to shallower prospects located on the Sanson Terrace. These findings have implications for hydrocarbon exploration in other deep-lacustrine rift basins where a viable charge mechanism is required between source kitchens in the basin centre and shallow, basin-margin prospects.

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