Multi-Scale Heterogeneity Within Deep-Lacustrine, Partially-Confined, Slope-Apron Turbidite Fans: Examples From the Early Cretaceous, North Falkland Basin

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ABSTRACT

As a whole, ancient deep-lacustrine turbidite deposits remain poorly understood and are rarely documented in current literature. In recent years, these sedimentary deposits have demonstrated a capacity to form extensive, good-quality hydrocarbon reservoirs. The early Cretaceous Sea Lion Fan represents the deposits of a deep-lacustrine, partially-confined, slope-apron turbidite fan, intercalated with organic-rich source rocks in the North Falkland Basin. The fan forms compensationally-stacked, sheet-like, tabular expressions in conventionally-processed, 3D seismic data. RMS amplitude maps display intricate depositional architectures, which are interpreted to represent geologically-associated heterogeneities. These include partially-confined, high-sinuosity feeder channels, outwards branching geometries, terminal mouth bars, flow-necking and high-sinuosity distributary channels. A successful period of hydrocarbon exploration and appraisal drilling of the Sea Lion Fan occurred in 2010-2011, resulting in the collection of 455 m of conventional core. Sedimentological analysis on these cores has been completed in order to test and confirm the seismic-based interpretations of the depositional architectures. These interpretations confirm that heterogeneity exists, not only at the inter-fan level, but also at the intra-fan scale and that deep-lacustrine turbidite fans are internally complex, laterally discontinuous systems. These interpretations have resulted in the construction of a model for reservoir sandstone distribution that suggests a previously un-appreciated degree of multi-scale heterogeneity within ancient deep-lacustrine turbidite deposits. Modelling these heterogeneities, particularly within a 3D environment and at a range of scales, is crucial to understanding such systems. This is particularly important considering their increasing importance as hydrocarbon reservoir lithologies both in the North Falkland Basin and globally.