Changes in Sediment Provenance, Sandstone Composition and Reservoir Quality Through Time: An Example From Taranaki Basin, New Zealand

Karen E. Higgs[1] and Peter R. King[1]

[1]Petroleum Geoscience, GNS Science, Lower Hutt, New Zealand.

ABSTRACT

Sandstone reservoir quality is dependent upon a large number of inter-related variables, and it is therefore challenging to predict reservoir properties with any accuracy away from well control. However, detailed geological studies and a good understanding of sedimentary source areas and depositional systems will significantly reduce uncertainties associated with reservoir quality prediction. In this paper we present an approach to reservoir quality assessment from Taranaki Basin, a moderately explored hydrocarbon province. Petrographic data collected from both traditional methods and newer automated techniques have been integrated with data from other advanced petrographical methods and burial history reconstructions to improve our understanding of the controls on sandstone reservoir quality. Clastic reservoirs occur throughout the Cretaceous-Cenozoic formations of Taranaki Basin, with discoveries from a range of terrestrial, shallow marine and deep marine facies. The oldest reservoirs are a result of Cretaceous rifting related to the breakup of eastern Gondwana, with basin fill comprising Late Cretaceous to Late Oligocene transgressive deposits. The overlying Neogene is composed of thick foreland thrust belt / back-arc deposits that represent a regressive phase of basin development, resulting from subduction at the Australian-Pacific plate boundary. Sediments that formed during these two phases of basin history display distinct characters stemming from changes in primary provenance, textural / mineralogical maturity and depositional settings. The observed compositional and textural trends through time have had a significant impact on the quality of Taranaki reservoirs and are overprinted by a complex range of secondary (diagenetic) factors. Diagenesis is most advanced within the more deeply buried transgressive system deposits, with the type and abundance of authigenic minerals and secondary pores linked to the original sedimentary texture / composition, facies and burial / fluid history. Results from our integrated studies demonstrate how sediment provenance, depositional facies and diagenesis have all affected reservoir quality in Taranaki and are, to some degree, predictive. These approaches and techniques used in Taranaki could be applied to clastic basins in other areas in order to better understand reservoir quality and ultimately improve reservoir quality predictions.