A Multi 1-D Modeling Approach for Complex Basins: An Example from Taranaki Basin, New Zealand

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Multi-1D, or pseudo-3-D, basin models allow basin evolution and expelled petroleum volumes to be rapidly quantified for input to flowpath or full 3-D basin flow simulators. The multi-1D BM1D code has been developed from a 1D finite-element conductive heat flow code, and parallelised to permit stochastic modeling with Monte Carlo methods for probabilistic assessment of petroleum prospects. Run times are significantly shortened from single 3-D basin simulations by use of a PC-cluster or supercomputer (up to 1000 nodes). While a large number of input maps or grids are required, with isopachs, lithologic composition, depositional ages, and paleo-bathymetric data (all input as grids), the approach provides a detailed basin evolution model accurately accounting for the effects of time-transgressive deposition, volcanic intrusions and erosional unconformities.

New Zealand's Taranaki Basin has a complex history, including rift transform, passive margin, foreland fold-thrust belt, arc volcanics and back-arc rift elements. The modeling of petroleum systems within such complex polyphase basins therefore requires a specialist modeling code. Regional models are presented from BM1D for the Taranaki Basin illustrating how this diverse input data-set can rapidly characterise basin evolution and quantify volumes of petroleum phases expelled from source rocks through time. The data is available for direct input to map-based flowpath or full 3-D fluid flow models for fluid-migration and prospect charge assessment.

This approach provides a sensitivity analysis for input parameters, considerably enhancing prospect risk assessment, and can relatively rapidly produce (pseudo) 3-D structural or generation history models for petroleum exploration in complex sedimentary basins.