Structural Uncertainty and Scenario Modeling for Fault Seal Analysis

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Evaluating the impact of structural uncertainty underpins reservoir modeling and prediction. Despite progress in sub-surface imaging technologies the creation of viable 3-D structural models remains a critical challenge and carries important uncertainties. The ability to evaluate the impact of uncertainties in the geometry and properties of faults (seals or leaks) is vital to reservoir management. We present a methodology for directly capturing the geological uncertainty associated with evaluating seal prediction. The process is based on utilizing 3-D reservoir simulation grids and uses an extensive database and knowledge base of fault properties. The interaction of multi-parameter uncertainties is defined and mapped through the prediction process and forms the basis for tracking risk assessment. Multiple realizations are used to model the impact of parameter variability and uncertainty and to assess the probability of critical outcomes. The key range of input parameters and outcomes are tracked using 'critical result traps', which allow the chances of specific scenarios to be addressed. For example, 'what are the parameter combinations and the probability of an economic column height being trapped?', or 'where do the retardation criteria (hydraulic resistances or transmissibility multipliers) combine to create a high probability of isolated compartments?' Each instance of a defined 'critical result' is captured and the process repeated for every reservoir grid cell associated with a fault so that the probability of a critical event occurring can be mapped. This methodology provides an independent and objective means of fault seal evaluation/risking and identifying effective combinations of empirical and deterministic approaches.