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Fluid Flow Behavior of Faults: Critical Variables, Uncertainty Limits and Prediction

Prediction of fault behavior involves the evaluation of a mutli-component system where it is unusual for the variables to be defined in detail. Definition of uncertainty ranges, uncertainty distribution types for different geo-settings and geohistories is the key to robust and realistic prediction. Interpretation of fault behavior requires; a) the construction of databases on the key properties, b) the generation of flexible knowledgebases or 'advisor systems' that highlight the primary uncertainties, identify likely outcomes, provide probability estimates and quantify the impact of the uncertainties, and c) the calibration of behaviors. There are four critical aspects of fault behavior uncertainty; Geometric Uncertainties: sedimentary architectures, fault zone geometries and trap geometries. Geostatistical information and multi-realization models are used to evaluate uncertainty. Fault Rock Property Uncertainties. The influence of geohistories and fault rock clay content on permeabilities and threshold pressures is reviewed. We will also illustrate the importance of the uncertainty in measuring and predicting the clay content of faults and highlight the value of new quantitative X-Ray diffraction techniques. The use of an Effective Shale Gouge Ratio (ESGR) algorithm that provides a basis for assessing uncertainty is reviewed. Modeling / Upscaling Uncertainties. Including the location, and size of windows on the fault planes and the probability distributions of representative values for the fault rock properties. Competing Geo-Scenario Uncertainties where the possibility of top seal or sedimentary facies influences is incorporated. We illustrate the use of databases and 'advisors' and highlight the current limitations of fault behavior interpretations with examples from exploration production.