AAPG Annual Meeting
March 10-13, 2002
Houston, Texas

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Pragmatic Considerations for Reservoir Modeling Using Geostatistical Techniques

Geostatistical techniques are routinely used to build multi-million cell reservoir models that are generally scaled-up to fluid flow simulation models with at most a few hundred thousand active cells. Reservoir models include data from many sources, including well logs, core data, seismic attribute data, production data, and 'interpreted data' such as facies and/or lithology in an effort to generate the best possible, or least uncertain, reservoir model. In many cases, complex and detailed reservoir models are generated by incorporating data that adds little to the overall distribution of porosity and permeability in a reservoir model. Examination of porosity and permeability distributions, cross plots, and semivariograms during data analysis often reveals what and how many facies or lithology classes are important and the appropriate amount of data to incorporate in a reservoir model. For example, reservoir models have been built using data classed into as many as eight lithofacies to capture geological detail when two classes (e.g. pay and non-pay) would have been sufficient to capture fluid flow characteristics.

During reservoir model scale-up, the low permeability and high permeability zones are preserved while other zones are homogenized. Overzealous scale-up will result in the loss of the important low and high permeability zones that are often key to understanding and/or predicting reservoir performance. Comparison of 3D streamtube-based fluid flow results for detailed reservoir models and corresponding models scaled-up by factors ranging from 2 to 100 show that that the 'appropriate' limit to scale-up varies significantly for carbonate and clastic reservoirs.