

Mapping Undiscovered Resources – Basin Analysis and Models for Petroleum Resource Assessment

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Petroleum explorers armed with accumulation paradigms, the results of previous exploration, and a variety of geoscience surveys seek to predict undiscovered petroleum plays and prospects with sufficient geographic and volumetric precision to locate wells and suggest economic viability. Competition among petroleum exploration opportunities and land use alternatives have led to an increased use of regional appraisals of undiscovered petroleum resources as an instrument of corporate and public policy. There are three major methods of regional undiscovered petroleum appraisal:

- petroleum systems analysis
- probabilistic play analysis and
- drilling exhaustion.

Each method has strengths and weaknesses, but all are geographically imprecise compared to methods of play and prospect generation. Using North American examples, we illustrate these techniques, their strengths, and their shortcomings. Petroleum systems analysis is an effective method for characterizing volumes of petroleum generated, but there are great uncertainties in the description of secondary migration and entrapment efficiencies. Play-based probabilistic analyses can be applied to plays at various stages of exploration and development. "Volumetric" methods are commonly applied to immature plays, while "discovery-process" methods are applied once several discoveries are made. Both methods assist economic evaluation by predicting the size of undiscovered pools. Discovery process models can also be extended to entire basins for the purpose of predicting conceptual play potential. As probabilistic methods are play-based they carry some geographical information, but individual probabilistic assessments cannot be combined to give a geographic description of the undiscovered potential. A geographic description of undiscovered potential, the map of undiscovered petroleum pools is a desirable and, perhaps, attainable goal. The construction of such a map bears some resemblance to "drilling-exhaustion" analysis, but it is distinguished by the attempt to describe how the undiscovered resource is distributed within the untested region. We are exploring three techniques for the construction of such maps:

- an Integrated Mapping approach
- a Markov Chain Monte Carlo method, and
- a Fractal Model of spatial petroleum occurrence.

Application of these three techniques to a Middle Devonian reef play in Western Canada illustrates the potential of such approaches for reducing exploratory risk and improving the geographic description of undiscovered potential.

References

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