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Technical Evaluation of Resource Plays

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Abstract

Technical evaluation of a resource play is critical to understanding long term economics and generating meaningful forecasts of future production. Producing wells often exhibit transient flow behavior for extended periods, have limited drainage areas, and produce a majority of their recoverable reserves at low rates. Often closeology or rules of thumb are used with a depressing lack of science in companies' development plans. These mistakes can result in significant economical damage that may take years to materialize. Equally, resource plays can provide a long-term supply of oil and gas to help meet energy demands while providing oil companies with a predictable return and production forecast.

The initial production from the Bakken Formation of North Dakota began in 1950's as a back up zone should other primary targets fail to be productive. The play experienced two further development periods prior to the most recent burst of activity as a resource play. Examples of evaluation from the Bakken shale will be considered in this paper.

Why conduct technical analysis?

Several myths permeate the industry regarding the technical evaluation of resource plays. The first and most often heard is that statistical plays do not require technical evaluation. The fallacy of this logic is that a statistical distribution with the mean below what is considered economic will result in a obviously failed development. Evaluating the likely distribution then becomes key, which can only be done intelligently using technical analysis.

The next often heard objection is that in an absence of unique solutions, technical evaluation is unable to give a meaningful guide to critical reservoir and completion properties. This argument has a grain of truth, as technical evaluation technique's will not yield a 100% unique result. However, consistent application of techniques from pressure transient well testing, analytical production analysis, and numerical simulation will narrow that range of uncertainty significantly. It must also be remembered that more conventional reservoir development have historically provided plenty of surprises for operators during the development phase. This indicates that a trait of working under limited data is the potential to fail to correctly identify the extremes of the reservoir property ranges, a constant hazard in our industry.

The author proposes in this paper that consistent application of a range of modeling methods can reduce the lack of uniqueness issue to a tolerable level in resource play developments. This will allow for economic decisions to be made intelligently. Technical analysis is also key to achieving realistic reserve estimations and production forecasts based on a knowledge of the uncertainty in future production. Without understanding the reservoir properties and the physical ranges associated with them, an informed stochastic range can never be generated.

The technical analysis approach for resource plays is divided into the following three levels in this paper. The well level, conducting analytical and numerical simulation analysis to understand reservoir and completion properties for further optimization and reserve estimation. The field level analysis considering trends in data pertaining to development options and finally the play level, considering analogue and historic play data.

Bakken Shale Case Study

The recent resource play development of the Bakken shale is located primarily in the North Dakotan and Eastern Montanan section of the Williston Basin[1] (See Figure 1). Like many formations currently under development as a resource play previous phases of activity have occurred associated with oil price or technological changes.

Geology of the Bakken

The Bakken formation in North Dakota consists of an upper organic rich shale, middle tight sandstone/siltstone member and lower organic shale member. The most recent resource play development is based on horizontal wells targeting the Middle Bakken interval. The Middle Bakken member is a Devonian/Missippian marine sandstone or siltstone throughout the North Dakota area. The Middle Bakken has a clastic framework of quartz, feldspar, and reworked fossiliferous carbonate grains. The North Dakota Middle member typically