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Petroleum Systems Modeling in Unconventionals

J. Granados Hernandez* (Schlumberger)
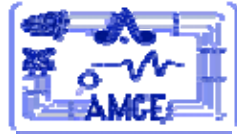
Summary

The success of any exploration campaign depends on the convergence of crucial geologic elements/processes and requires a methodology to predict the likelihood of success given the available data and associated uncertainties. Basin and petroleum system modeling allows geoscientists to examine the dynamics of sedimentary basins and their associated fluids to determine if past conditions were suitable for hydrocarbons to fill potential reservoirs and be preserved there.

More than 50 years ago, geologists began building the foundation for a concept that has since evolved into such a predictive methodology. The concept connects the past—a basin, the sediments and fluids that fill it, and the dynamic processes acting on them—to the present: Petroleum Systems Modeling. This area of study, applies mathematical algorithms to seismic, stratigraphic, paleontologic, petrophysical, well log and other geologic data to reconstruct the evolution of sedimentary basins.

The application of these methodologies has been successful during years; however, with the emergence of unconventional plays, it has become common practice to extrapolate methodologies applied historically in conventional fields for non-conventional areas. This assumption can be extremely risky considering the great differences between these plays and the economic decisions that this analysis of potential may have.

Introduction

The success of any exploration campaign depends on the convergence of crucial geologic elements/processes and requires a methodology to predict the likelihood of success given the available data and associated uncertainties.

Basin and petroleum system modeling allows geoscientists to examine the dynamics of sedimentary basins and their associated fluids to determine if past conditions were suitable for hydrocarbons to fill potential reservoirs and be preserved there.

The best way to reduce investment risk in oil and gas exploration is to ascertain the presence, types and volumes of hydrocarbons in a prospective structure before drilling.

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Method and/or Theory

Unlike Conventional Petroleum Systems, where we are interested in the hydrocarbons that have been ejected from the rock, in Unconventional Petroleum Systems, we are interested in the hydrocarbons that have been retained in the source rock, or migrated in the shale layers, rich in organic matter.
There are 3 methods for the analysis of this Unconventional plays: Mechanic Models, Source Rock Models and Fluids Flow Models.
During this presentation, a general explanation of these methods are presented and some examples are used to demonstrate the differences.

Conclusions

Recent improvements in basin modelling have been developed to be applied in Unconventional Plays. Some of these improvements are:
- Coupled Effort-Pressure models to improve the prediction of porosity and rock failure.
- Advanced kinetic mother rock for the generation of C15+ components
- Fluid flow models for expulsion / migration

References

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Hamechan, A., Acevedo, A., Koley, M., Bryant, I., Laver, R., An optimal Approach to Shale Gas and Oil Exploration Beyond North America. SPE 167799. 2014.