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Abstract

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Issues and Approaches for Integrated Hydrocarbon Systems Analysis in Tertiary Deltas - What We have Learned: Examples from Deep Water Nigeria

One consequence of the search for new exploration opportunities has been a push into higher-risk areas of known hydrocarbon provinces such as Tertiary deltas. We are testing new plays in deeper water and older strata, and using that experience to push into deeper plays in shallow water. Given this activity, it seems an appropriate time to examine how our paradigms for hydrocarbon systems in Tertiary deltas have shifted through ongoing successes and failures, and use that knowledge to exploit newer opportunities more effectively. This presentation explores elements of what we have learned, via an integrated plate to molecular-scale approach to hydrocarbon systems analysis, with emphasis on alternate scenarios, and on what we might have overlooked.

Evolution in both technologies and approaches to hydrocarbon systems analysis in Tertiary deltas has been driven by a major goal of predicting liquids, though this objective is now changing as natural gas acquires greater economic value. Efforts to accomplish this goal have led to the development of technologies that improve our ability to quantify the volumes and types of hydrocarbons entering and leaving a trap. We use source facies distribution and maturity, structure timing, and the PVT properties of generated hydrocarbons to constrain the inflow of hydrocarbons to a trap. These variables are amenable to quantitative evaluation, assuming a good genetic understanding of the processes controlling basin formation and fill, including regional tectonics, climate, and sediment supply, assisted by understanding of molecular clues from rocks and oils. We use structural style, physical properties of seals, regional continuity of major aquifers, and the PVT properties of reservoired hydrocarbons to constrain the outflow of hydrocarbons from a trap. These variables can also be quantified and related to one another using a series of molecular- to regional-scale tools.

But how have the ongoing efforts to quantify hydrocarbon type and distribution modified our overall hydrocarbon systems models for Tertiary deltas? Early models tended to predict a relatively simple hydrocarbon distribution, controlled largely by the presence of higher maturity source rocks in depositional thicks. That simple paradigm has evolved to a model in which complex migration histories and trapping mechanisms are now thought to be a major control on hydrocarbon type and distribution. In addition, timing of hydrocarbon charge relative to trap development has always been recognized as an important factor in predicting hydrocarbon type and quality, but the tools developed over the past several years enable us to quantify those relationships and better predict hydrocarbon distribution. Finally, our understanding of how fluid pressures and seal properties constrain the type and distribution of hydrocarbons has also evolved significantly. This presentation illustrates the evolution of these tools and approaches, with examples of evolving hydrocarbon systems models from deep water Nigeria, and potential application to other deltaic systems.

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1979 University of Rochester, New York; B.S. degree

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Research:

Integrated hydrocarbon systems analysis, fluid flow and basin modeling, fluid inclusions and clastic diagenesis. 1990 - present: research scientist and team lead for hydrocarbon migration and basin modeling technical teams; currently team lead on a research project targeting new exploration opportunities through integration of technologies related to basin formation, fill, and evolution.

Memberships:

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Publications:

Summa, L. L., Goodman, E. D., Richardson, M., Norton, I. O., and Green, A. R., 2003, Hydrocarbon systems of eastern Venezuela: plate through molecular scale-analysis of the genesis and evolution of the Eastern Venezuela Basin, Marine and Petroleum Geology, v. 20. P. 323-349.

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