The Science to Find Energy Lecture Series

Earth Modeling: How Shale is Changing the Way We Think About Geology and Resource Modeling

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11:00–13:00 EGI* Conference Room #334

*RSVP to Peggy Nish for lunch reservations at EGI

15:00 – Warnock Engineering Building, College of Engineering

ABSTRACT

As we approach the end of the second decade of the second millennium, the drive for U.S. energy independence and becoming the top hydrocarbon-producing nation in the world is within our grasp; all tied directly to domestic shale resources. Even with strong oil and gas prices, the cost of this development is not trivial, driving some companies to question whether or not it can be economically sustainable in light of fluctuating prices and lack of knowing what makes these plays tick; half of what we know about these shales has been written in the last five years. Hydraulic fracturing (fracing), roughly 50% of the well construction cost, is not guaranteed to produce profitable hydrocarbons without knowing where to place the wellbore and then where and how to frac. Current practice involves horizontal drilling of closely spaced wells with relatively little attention to well placement within the complex and heterogeneous reservoirs, and then frac along the borehole in stages that are equally spaced. When this process involves repetitive drilling and completion to optimize efficiency, it is often referred to as, “factory” drilling. Some of the lessons we have learned indicate that horizontal wells, factory drilled or not, do not guarantee success. Understanding the geology and mechanical properties of the shale can lead to a better understanding of where and how to drill the wells within the reservoir and where and how to frac. The challenge is to unmask these mysteries in the next five or so years, not like conventional plays where we have had 100+ years to practice. So, where does earth modeling fit in?

Earth models can provide the “where to drill and where to frac” by characterizing the size, shape, orientation, composition and internal arrangement of a reservoir, similar to the objectives of any reservoir model. The challenge is to identify the combination of variables that compose what we can informally call a “sweet spot.” This approach has been successful for conventional reservoirs for more than 25 years, and earth models are a requirement as input into flow simulators for most reservoir management projects. However, unlike conventional reservoirs where sweet spots can be identified by combinations of specific facies, rock properties, and trapping mechanisms, favorable shale conditions are not well understood. Complicating the equation are some obvious differences like the reservoir is the source rock, the distribution of static fluid properties, geomechanics and the distribution of mechanical properties. Some computational challenges exist as well. The requirement for detailed

resolution will necessitate large numbers of elements, extending computational time. Further, where costs are sensitive to the drilling cycle-time, decisions will need to be made on the fly, pushing the technology to operate in the real-time or on-time environment. Finally, while resource models do not generally require complex structural frameworks they do require the integration of natural fractures and ultimately induced fractures to simulate production and optimize frac designs. This will challenge traditional geocellular topology requiring an alternative approach such as unstructured gridding and compatibility with simulators that can consume them. In light of these and many other challenges, is earth modeling up to the challenge?

Undoubtedly, characterizing shale resources and keeping pace with development will push the earth modeling limits. It is not a question of whether earth modeling is up to the challenge, the need to for energy independence and the economic effects of domestic shale production will drive this initiative to the next state of evolution. As a result, earth modeling will find itself playing a more flexible and central role in the modeling world. What once was considered a novel 3D mapping tool, and currently the best method for integrated reservoir characterization, earth modeling will likely evolve into a sophisticated engine for modeling conventional and unconventional resources, and a repository for continuously updated information that can be leveraged by geoscientists and engineers making decisions in the field. This presentation reviews the technology and workflows around earth modeling along with its past, present, and future impact on the geoscience and geoengineering communities involved in hydrocarbon resource exploitation.

BIOGRAPHY ... *from Jeff's EarthModelingSimplified.com blog site*

"Dr. Yarus obtained his Ph.D. from the University of South Carolina in 1977 before joining Amoco Production Company where he worked as an exploration geologist in the Gulf of Mexico. From 1981 until 1988, he worked in exploration and production as an independent in a variety of basins throughout the Rocky Mountain States. In 1988, Jeffrey joined Marathon Oil Company's Petroleum Technology Center in Littleton, Colorado where he introduced the company to geostatistical reservoir characterization.

Since moving to Houston in 1996, he worked as a technical manager and executive for GeoMath, a subsidiary of Beicip-Franlab, Smedvig Technologies (Roxar), and Knowledge Reservoir, Inc. In August of 2001, Jeffrey along with Dr. Richard L. Chambers, started Quantitative Geosciences, LLP, a consulting firm specializing in reservoir characterization and geostatistics. In 2006, Jeffrey, along with the QGSI staff, moved to Landmark Graphics Corporation, a division of Halliburton, where he is now the Senior Product Manager for Earth Modeling. Jeffrey is well known throughout the industry for his seminars and lectures which he has given in Europe, Malaysia, the Middle East, South America, and the USA.

Jeffrey has served as Chair on a number of AAPG's committees including the Computer Applications and Publications committees, and has authored many papers and abstracts on geostatistics. Along with Richard L. Chambers, he co-edited the 1995 and 2006 AAPG volumes on Stochastic Modeling and Geostatistics, and the chapter on Reservoir Characterization and Geostatistics, in the SPE Petroleum Engineering Handbook, volume 6."