Preface

As a company reservoir geologist in the mid-1980s, I still remember an incident when I jumped at the opportunity to geologically evaluate one of the largest oil fields in North America for equity re-determination. A younger colleague was displaced from an exploration group and assigned to help me on this project. He viewed this as a serious, though hopefully temporary demotion. His first comment to me was: “I was hired as an explorationist, and not to sift through oily dirt!” (The reservoir consists of unconsolidated oil sands). Such was the general feeling of geologists and geophysicists at the time—exploration was glamorous and required big, conceptual thinking, while reservoir description was, as the name implies, descriptive, mundane, and perhaps sufficiently numerical that it should be left in the hands of engineers, particularly since they are responsible for production from fields discovered by explorationists.

Fortunately, during the mid-late 1980s, some of the petroleum giants—such as the late Robert Sneider—were promoting the methods and applications of integrated reservoir characterization through society courses, publications, and sound business practices. In my own mind, the turning point from which “reservoir characterization” became something for geologists to avoid, to becoming a scientific discipline in its own right, was inauguration in 1990 of the ***Archie Conference*** series, vigorously pushed by Bob, and ultimately co-sponsored by American Association of Petroleum Geologists (AAPG), Society of Exploration Geophysicists (SEG), Society of Petroleum Engineers (SPE), and Society of Professional Well Log Analysts (SPWLA). The ***1st Archie Conference*** and resulting Proceedings volume were titled ***The Integration of Geology, Geophysics, Petrophysics, and Petroleum Engineering in Reservoir Delineation, Description, and Management***. This conference was not only an attempt to show the upstream petroleum community that professionals and their societies could work together, but to acknowledge the added value to the petroleum industry of discipline-integration. This conference provided the springboard from which the integration of disciplines in reservoir characterization evolved. Of course, the end-of-decade downturn in the industry also prompted professionals to take their skills from the exploration scale down to the reservoir scale.

Since the ***1st Archie Conference***, many additional conferences have been held, proceedings published, and books and papers written on the topic of reservoir characterization. Today, the stature and value of integrated reservoir characterization is well established and has become the norm in the global industry’s attempt to produce more hydrocarbons from existing fields. Company annual operating budgets now include a substantial component for exploitation, in addition to increasingly-expensive exploration. This strategy by companies is important, if not critical. For example, one recent estimate of global production predicted a decline

of 2-5%/year, which translates into an additional 10-19MMBOPD of additional production required by the year 2010 just to stay even. Much of this added production will have to come from mature or maturing fields, because they already have infrastructure in place, and because they typically retain more of their hydrocarbon supply than they release to producers. To accomplish this lofty goal, steady improvements in the ability to extract more hydrocarbons from existing fields at a reasonable cost are essential, rather than simply being good business practice.

This ***26th Annual GCSSEPM Foundation Bob F. Perkins Research Conference*** is a solid testimonial to how far we have advanced over the past 15 years in the technologies and practices of reservoir characterization for improved hydrocarbon recovery. The Call for Papers on the theme ***"Reservoir Characterization: Integrating Technology and Business Practices"*** was met with a wide range of presentations from outcrop studies to advanced numerical modeling of reservoir systems. A number of general observations can be made about the quality of the work being conducted within industry and academia, as revealed at this Conference:

- The majority of studies are now cooperative amongst the disciplines and clearly demonstrate the degree of discipline-integration that has evolved over the past 15 years;
- A variety of workflows have been developed by individual organizations for dealing with large datasets and diverse reservoirs, but a general theme of them all is discipline-, people- and data-integration;
- A comprehensive, useable characterization involves a major effort in terms of computing power and people's time, irrespective of the size of the reservoir under study;
- There is generally universal acceptance of the fact that reservoirs are almost always complex and compartmentalized;
- Outcrop analogs now provide an important input component to a characterization; lateral bed continuity and vertical connectivity in 3D space are particularly important to quantify;
- Proper characterization requires examination and study of a reservoir at all scales from the pore level to the field level; this can be a major challenge owing to time constraints in many fields and organizations;
- A variety of depositional processes and environments, as well as post-depositional burial processes, have resulted in a spectrum of reservoir types through geologic time; it is important that these different reservoir types be recognized and characterized at all scales. Generalized depositional models may exclude local heterogeneities that affect reservoir performance;
- 3D and even 4D seismic does not always provide the desired answer to reservoir performance. Features which control fluid flow are often beneath the resolution of normal seismic reflection volumes. However, advances continue to be made in forward and inverse seismic modeling to improve the information extracted from seismic;
- There are many risks and uncertainties associated with exploiting a reservoir, but the rewards can be

substantial, though perhaps not as glamorous as a new exploration discovery;

- No matter how closely-spaced wells are, even in mature fields, there is still significantly more undrilled rock volume between and beyond the wells than has been drilled within the confines of the field. Thus, there is always a degree of uncertainty in predicting structural and stratigraphic features away from a wellbore.
- 3D geological modeling has attained a high level of sophistication, in terms of the modeling workflow, input parameters, and output used to simulate reservoir performance and develop a workable exploitation strategy. Improvements in 3D modeling and reservoir simulation software and computer horsepower/cost are major contributors to this improved sophistication in characterization and modeling. As demonstrated in some papers, 3D geocellular and reservoir simulation models being used today in large fields would not have been possible just a few years ago.

In an attempt to optimize knowledge transfer throughout the Conference, the thirty-seven, high-quality papers for presentation both orally and as companion posters have been grouped into six sessions. The first session begins after opening remarks and a thought-provoking introductory paper on the relative value of exploration and exploitation. The sessions, in their agenda order, are as follows.

Session I: Integrated Characterization of Developing Fields contains eight papers which describe the delineation and early exploitation phases of reservoirs in China, U.K. and Norwegian North Sea, Saudi Arabia-Kuwait neutral zone, Colombia, Venezuela, Mexico, and Indonesia. A variety of techniques, workflows and strategies are presented to resolve a variety of reservoir issues;

Session II: Geophysical Imaging for Characterization contains five papers dealing with seismic imaging and one paper dealing with borehole imaging. All papers combined present advanced processing and imaging procedures, and demonstrate the direction in which geophysical imaging continues to advance.

Session III: Integrated Characterization of Mature Fields contains five papers ranging from full-field modeling of the giant Prudhoe Bay Field to characterization of smaller gas-condensate reservoirs on the Texas gulf coast. Since there is not a universal definition of a 'mature field', I have single-handedly applied an 'age-since-discovery' factor in categorizing the fields for inclusion into this session.

Session IV: Outcrops and Modern Environments as Analogs for Characterizing Reservoirs contains six papers on both clastic and carbonate outcrops and sediments. This session demonstrates the level to which geoscientists working in surface environments have reached in their use of a variety of techniques to quantify stratigraphic properties for application to subsurface reservoirs. "*Seeing is believing*" is the key principle behind surface characterization, because subsurface

techniques cannot image all of the potentially-important heterogeneities within a reservoir.

Session V: Modeling for reservoir development and assessment of uncertainty and risk contains nine papers which collectively demonstrate the high level of efficiency and cooperation that have been achieved in the quest for quantitative 3D geological models for reservoir performance simulation and exploitation management. Papers include the application of integrated datasets/people, geostatistics, upscaling, history matching, and sedimentary process-response modeling, with emphasis on quantitative 3D geological models. The variety of approaches being utilized in this model-building endeavor are both informative and thought-provoking. Comparing the current state of 3D geological modeling with efforts of just a few years ago makes one wonder what will be the next incremental and/or quantum advancement in modeling, and how far the science can excel.

Session VI: Improvements in reservoir characterization and well planning is the closing session. It contains three informative papers summarizing recent, specific advances in aspects of well planning and characterization that may not be familiar with the majority of attendees and readers.

The planning committee for this Conference is confident that its goals have been met. New ideas, workflows, and methodologies are provided which can not only be used daily in the workplace, but equally important, which can provide the foundation for the next generation of advances in the science of reservoir characterization. Some of the thoughts for future work that I came away with after organizing and reading each contribution are the need for:

- advances in computing power so that less upscaling is required for simulation;
- continued progression of geophysical imaging technology in order to capture important “sub-seismic scale” features;
- continuation of 3D quantitative outcrop characterization for geologic modeling;
- significantly more integration of high-resolution biostratigraphy and geochemistry into the reservoir characterization workflow;
- continuation of the phenomenal growth and abilities of quantitative 3D static and dynamic geological modeling;
- improved realization by company management that completion of a proper characterization requires more time than is often allotted (i.e. the industry-wide’ 80% rule’ may not be sufficient when reservoir performance is controlled by hard-to-pinpoint heterogeneities);
- a better understanding of ‘what really matters’ in reservoir characterization.

The only minor disappointment was the relatively small number of papers that included discussion of the business side of reservoir characterization, as was requested by the title of the Conference. However, technical people are what they are, and the technical advances in the science of reservoir characterization that are presented at this Conference bode well for the

future, as more focus is placed upon enhanced hydrocarbon recovery from existing reservoirs.

Finally, I and the organizing committee would like to take this opportunity to thank all of the contributors to this Conference who took time away from their busy work schedules to prepare papers. We also thank Carol Drayton for her layout and editing expertise, Andrew Slatt for re-drafting a number of graphics that required touchup for this Proceedings volume, Gail Bergan for formatting and completing the Proceedings volume, and Norm Rosen, as Executive Director of GCSSEPM, for his monumental effort at guiding this Conference to success. Reviews of first draft papers were completed by organizing committee members.

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The cover image chosen for this year's conference is from van Hoek and Salomons: "Understanding the Seismic Expression of Complex Turbidite Reservoirs Through Synthetic Seismic Forward Modeling: 1D-Convolutional Versus 3D-Modeling Approaches," Figure 4A, this volume.

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