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Abstract

DAVID JOHNSTON

ExxonMobil Exploration Company

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4D Seismic in the Deepwater – Challenges and Rewards

Time-lapse or 4D seismic data has proven value in reservoir management, increasing reserves and recovery by locating bypassed and undrained hydrocarbons and optimizing infill well locations and flood patterns. 4D seismic can also decrease operating costs by reducing uncertainty in the reservoir geologic model and flow simulation, optimizing completions, and minimizing the number of dry holes. 4D is simply the use of multiple seismic surveys shot over a producing field. Changes in the seismic response typically occur because of production-induced changes in saturation and pressure. Successful 4D projects have been carried out in a wide range of geographical areas, geological settings, and depletion scenarios.

To maximize the value of a 4D seismic project, planning for 4D is a critical part of an overall field lifecycle strategy. In exploration, assets can be screened for potential 4D application. Early in development planning, 4D seismic models based on reservoir flow simulations and geologic models are used to estimate the magnitude and interpretability of the 4D response, evaluate optimal survey repeat times, and assess potential business impact. Once the field is under production, effective 4D project execution requires collaboration among asset team geoscientists, engineers, and field operations with geophysical acquisition and processing specialists.

Fields in West Africa and the Gulf of Mexico demonstrate that the deepwater production environment presents unique opportunities and challenges for 4D projects. Issues range from the impact of surface facilities on data quality to contending with ongoing field operations. In addition, aggressive drilling schedules dictate a rapid turnaround of 4D data. But these fields have high drilling and well intervention costs and 4D seismic may be the only available field-wide reservoir surveillance tool. This presentation shows how 4D seismic technology can be used in deepwater reservoir management and discusses some of the challenges faced in its application.

American Association of Petroleum Geologists
An International Geological Organization
P.O. Box 979 • Tulsa, Oklahoma 74101-0979 USA
(918) 560-2621 • Fax; (918) 560-2678 • email: kdotts@aapg.org

David Johnston

Education:

1978 Massachusetts Institute of Technology, PhD –
1973 Massachusetts Institute of Technology, BSc – Earth Science

Experience:

2002-Present ExxonMobil Exploration Co; Sr. Geophysical Advisor, 4D Seismic Applications
2000-02 ExxonMobil Upstream Research Co; Research Geophysicist
1979-2000 Exxon Production Research Co; Research Geophysicist
1978-79 Massachusetts Institute of Technology; Post-doctorial research

Publications and Awards:

Authored and co-authored over 25 external publications, numerous publications internal to ExxonMobil, and presented over 50 technical papers at conferences including AAPG, SEG, SPE, and OTC.

1981 Co-editor of Seismic Wave Attenuation, published by the SEG
1990 SEG Secretary/Treasurer
1992 Co-editor of Reservoir Geophysics, published by the SEG
1992-93 SPE Distinguished Lecturer
1993 SEG Best Presentation Award
1999 SEG Distinguished Lecturer
2003 Geophysical Society of Houston Honorary Membership
2004 SEG Honorary Membership
2005 SEG Best Paper Award for *The Leading Edge*

Professional Memberships

American Association of Petroleum Geologists
Society of Exploration Geophysicists
Society of Petroleum Engineers
American Geophysical Union

Professional Interests:

Interests include all aspects of reservoir characterization using seismic data. Building from a fundamental basis in rock physics, seismic data can provide strong inter-well constraints on static reservoir properties such as facies and porosity. More recently, through the use of time-lapse measurements, seismic data supplies information on dynamic reservoir properties such as saturation and pressure that can be used to evaluate reservoir connectivity and to update reservoir flow simulation models. These methods have been applied in a wide range of geographical areas, geological settings, and production scenarios.