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International Explorationists Dinner Meeting

by ***Mario Wannier*** *(speaker),* ***Fred Keller, Charlie Lee and Bruce Mitchell***
Shell International E&P Inc., Houston, TX

The Hydrocarbon Potential of the Agadir-Tarfaya Deep Water Basin, Offshore Morocco

The stratigraphic framework of the Agadir-Tarfaya basin is characterized by six major mega-sequences that correspond to the major tectonic episodes that shaped the Mesozoic–Cenozoic history of the basin. These mega-sequences record the development of major phases of source, reservoir and trap development in the deep water Atlantic Margin, offshore Morocco. Multiple terrigeneous-clastic reservoir and source rock intervals in the Jurassic, Cretaceous and Paleogene sections produce stacked reservoirs and source, with numerous migration pathways and traps defined by abundant deep and shallow salt structures. Shell is operator in two deep water blocks in the basin and is preparing to spud the first wildcats early in 2004. Drilling results of earlier exploration campaigns over the last 20 or so years on the shelf— supplemented by DSDP and outcrop data—provide the control points to calibrate some 7000 km^2 of 3D seismic.

The overall structural style of the basin is controlled by its original rift-margin architecture, while the timing of defined salt structures broadly spans the entire Jurassic to recent depositional history of the basin (Figure 1). Development of isolated salt diapirs, including a central belt of more laterally connected salt stock canopies with local salt overhangs, characterizes the structure of the bulk of the deep-water basin. A regionally extensive salt nappe moved more than 10 km basinward over the toe-of-slope to abyssal plain setting along the distal, seaward edge of the original salt basin. The up-dip margin of the basin is characterized by a series of salt-cored inversion structures developed during convergent to transpressional movements along the steep, northwestward-facing structural edge of the basin. These later movements are associated with the Atlas orogenic episode, beginning during the Late Cretaceous and extending into the Tertiary.

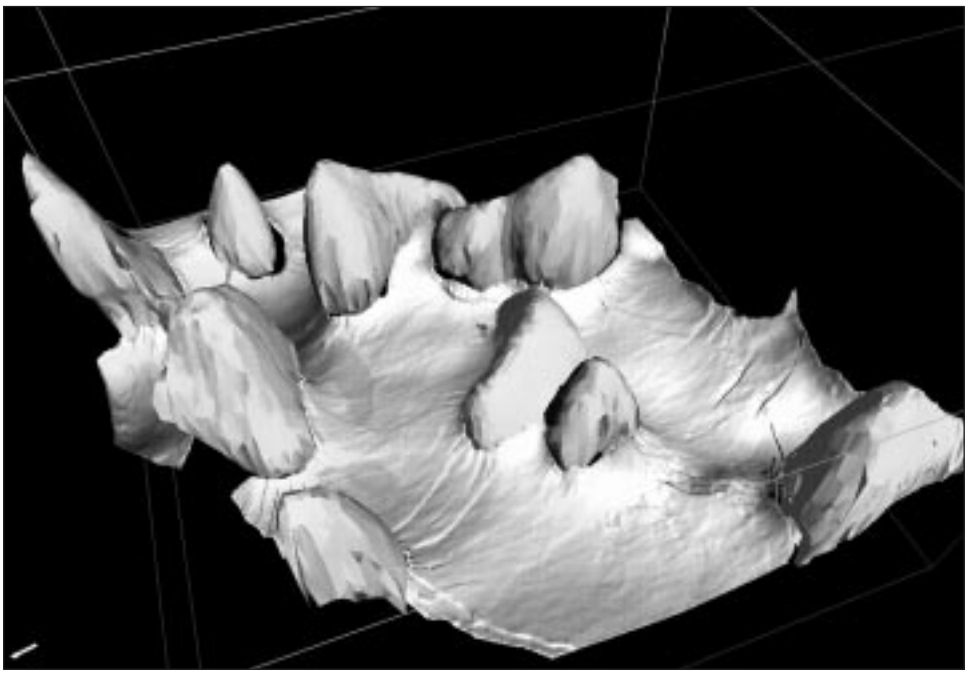

Figure 1. 3D visualization of a Cretaceous horizon showing the associated salt structures.

Current work focuses on prospect maturation—i.e., structural mapping of salt and traps and reservoir de-risking through seismic facies and geophysical analyses. Amplitude (AVO) analysis and additional seismic attributes (e.g., seismic facies classification, spectral decomposition techniques, semblance or coherency volumes) provide useful tools for detecting and imaging the external geometries of potential reservoir bodies such as channels, as well as other depositional features such as mass-transport complexes. These analyses have revealed several reservoir-prone intervals in the Cretaceous and lower Tertiary and have enabled identification of *continued on page 19*

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numerous large submarine slide complexes containing abundant kilometer-scale rafted sediment blocks that some explorers had previously interpreted on 2D seismic as channelized, reservoir-prone sections. The Agadir-Tarfaya basin is a promising unexplored deep water area; the wildcats to be drilled in 2004 will be critical to test its deep water hydrocarbon potential. ■

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Biographical Sketches

Mario Wannier holds a PhD in earth sciences from Basle University, with a specialty in micropaleontology. He has 24 years experience with Shell International E&P, Inc. and has worked in a variety of exploration projects in Southern and Northern Europe, Africa and Southeast Asia. Mario is currently Team Leader for Deep water New Ventures at Shell International E&P, Inc. in Houston.

Fred Keller holds a PhD in geology and has more than more than 27 years of professional experience in both academics and the petroleum industry. Fred taught stratigraphy and sedimentology as an assistant professor at the University of Tennessee-Knoxville prior to joining Shell in 1981, where he since has had numerous assignments as an explorer in a variety of both global and domestic U.S. deep water basins, as an applied researcher in turbidite-seismic stratigraphy and reservoir architecture and as an instructor and coordinator of geologic training in the Shell Oil E&P training department. His specialty area is deep-water depositional systems, which he has studied both in the field and subsurface in a variety of tectonic settings, including onshore and deep-water fold belts, strike-slip basins and salt-deformed mini-basins. Fred is currently Subsurface Coordinator for the Morocco exploration project at Shell International E&P, Inc. in Houston.

Charlie Lee received a BSc (Hons.) in applied geology from the University of New South Wales, Australia, in 1993. He worked as a field geologist, wellsite geologist and engineering geologist in southeast Asia from 1993 to 1995, before joining Shell in 1996. Since then he has worked extensively on regional and prospect evaluation in Malaysia, Brunei and Morocco. He joined Shell Deep water Services in 2001 and is currently active in the evaluation of deep water Morocco. Charlie is also a keen fossil collector and has a large collection of Miocene marine fossils, in particular fossil crabs, from northern Borneo.

Bruce T. Mitchell, a senior staff geophysicist, has been working at Shell Oil Company for over 18 years. His experience includes almost 12 years of interpretation and field appraisal in the Gulf of Mexico as well as assignments in the Rocky Mountains, Brazil and Offshore Morocco. Mr. Mitchell received his bachelor's degree in geology from Calvin College in Grand Rapids, Michigan and his master's degree in geophysics from the University of North Carolina, Chapel Hill.