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Delineation of a Diagenetic Trap Using P-Wave and Converted-Wave Seismic Data in the Miocene McLure Shale, San Joaquin Basin, CA

by Robert Kidney, John Arestad, Anne Grau and Robert Sterling EOG Resources Inc., Denver CO

North Shafter and Rose oil fields, located in California's San Joaquin basin, produce hydrocarbons from a subtle stratigraphic trap within the Miocene Monterey Formation. The trap-reservoir system was created during burial of a thick diatomaceous shale sequence that forms various diagenetic facies. Integration of well and 2D P-wave seismic data shows that a significant amplitude anomaly is present over both the reservoir (quartz) and seal (Opal-CT) facies making delineation of the updip edge problematic. The porosity of the Opal-CT and reservoir quartz facies ranges from 24–50%.

Petrophysical analysis and seismic modeling result in the following conclusions. Opal-CT and hydrocarbon-saturated quartz have nearly the same acoustic impedance. Opal-CT is low density while hydrocarbon-saturated quartz is low velocity. The presence of gas-saturated oil in the quartz reduces the interval velocity in a manner similar to the Gasmann effect in high-porosity sandstones. The down-dip wet quartz interval is not associated with a seismic amplitude anomaly because its impedance is similar to that of the bounding shales. Finally, converted-wave data, that chiefly image lithology rather than fluids, can be used to delineate the low-density Opal-CT from the higher density quartz.

Based on these conclusions, 2D converted-wave data were acquired to complement P-wave data. From these data sets the regional Opal-CT-to-quartz phase transformation boundary was

mapped and a matrix of amplitude signature verses facies was constructed. This work formed the basis for mapping the hydrocarbon-saturated quartz facies. ■

Biographical Sketch

ROBERT KIDNEY received a BS in geology from the University of Illinois CC in 1979 and an MS in geophysics from the Colorado School of Mines in 1982. He started his career in the petroleum business with Tenneco Oil in Denver, exploring the Rocky Mountain basins. While with Tenneco Bob also worked in Houston in a staff position and in Lafayette, LA, exploring in the Gulf of Mexico. After the sale of Tenneco in 1988, Bob worked for Oryx Energy in both Dallas and London. While with Oryx Bob was a member of the HCI Services Group, which provided prospect evaluation support on a world-wide basis; provided exploration, development and equity determination support in the London, UK, office; and was the Gulf of Mexico Geophysical Manager for both development and exploration. Since joining EOG Resources in 1996 Bob has worked on both exploration and development teams in the California, western Wyoming and New York. His professional interests include seismic reservoir characterization and using seismic data as a risk-reducing tool. Bob is the 2003 President of the Denver Geophysical Society.

