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by ***William A. Ambrose,*** *Bureau of Economic Geology, University of Texas at Austin*
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Upper Miocene and Pliocene Gas and Oil Plays in the Macuspana Basin, Southeastern México

The Bureau of Economic Geology and Pemex Exploración y Producción conducted an integrated study of the geological, geochemical and play framework of the upper Miocene and Pliocene in the Macuspana basin, Mexico, using a variety of well, core and 2-D and 3-D seismic data (Fig. 1). Structural controls for the plays consist of deep-seated faults that tap Mesozoic thermogenic gas sources, areas of intense shale diapirism and folding and areas with structural inversion that could enhance trapping and reservoir productivity. Early Neogene thrusting south of the basin triggered evacuation of Oligocene shale along northwest-dipping listric faults in the eastern and southeastern margin of the basin. These faults are associated with large-scale rollover structures and thick (>500 m) upper Miocene shoreface and wave-dominated, deltaic complexes. Traps occur as both four-way and three-way structural-stratigraphic combinations. Reservoir seal is provided by a 100- to 300-m lower Pliocene transgressive shale. Downdip pinch-out of reservoir-quality shoreface sandstones is a key risk factor in the upper Miocene in the onshore part of the basin. In contrast, the offshore, upper Miocene section consists of deep water slope systems downdip of an inferred clastic-carbonate source associated with the Yucatán Platform. Thin, calcareous, turbidite sandstones lapped onto a major turtle structure, potentially providing updip-porosity pinch-outs.

Fig. 1. (a) Location of the Macuspana Basin, with structural elements. (b) Well control and distribution of 3-D surveys and principal 2-D seismic lines used in the study.

Trap formation and enhancement in the southern basin margin are linked to late Miocene-to-Pliocene inversion.

A second phase of extension in the early Pliocene formed a set of broad, southeast-dipping listric faults in the western basin, controlling thick accumulations of stacked Pliocene shoreface deposits. Sandy Pliocene shoreface depocenters formed in shale-withdrawal sub-basins, primarily in the northwestern part of the basin. Trap formation and enhancement in the southern basin margin are linked to late Miocene-to-Pliocene inversion. Unlike in the more productive upper Miocene, reservoir seal is a major risk factor in upper and middle Pliocene reservoirs having few thick upper bounding shales. **International Explorationists** *continued on page 17*

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Three petroleum systems (Mesozoic, Paleogene/Lower Neogene and Upper Miocene/Pliocene) contributed to the hydrocarbon accumulations and to hydrocarbon generation and migration in the basin. Principal Upper Jurassic/Lower Cretaceous source rocks generated wet thermogenic gases and oil. Secondary, lower Tertiary source rocks generated predominantly dry, biogenic gases. Mixtures of the two gas types are common. Numerous deep-seated growth faults and other faults serve as pathways for Mesozoic-sourced hydrocarbons. Surface seeps and abundant gas shows suggest that hydrocarbons are being generated today.

This study was published in the September 2003 Bulletin of the American Association of Petroleum Geologists (volume 87, number 3, p. 1411–1435). AAPG members can access the text and figures at the AAPG website: http://www.aapg.org/.

Biographical Sketch

William A. Ambrose received a Bachelor of Science degree in 1979 and a Master of Arts degree in geological sciences from the University of Texas at Austin. While at the University of Texas, he worked on sedimentological studies of lower Pennsylvanian coal-bearing strata in the southern part of the Illinois Basin.

His research interests have focused mainly on clastic sedimentology and stratigraphy applied to the characterization and development of energy. Ambrose joined the Research Planning Institute in 1984 and was involved in regional subsurface studies of the Yegua and Vicksburg Formations and the Wilcox Group in the Texas Gulf Coast. In 1987 he joined the Bureau of Economic Geology and was initially involved in studies of co-production of gas and hot brine from the geopressured Frio Formation in Galveston County. In 1988, his research interests took a new direction by evaluating the coalbed methane potential of major Rocky Mountain basins, with emphasis on the San Juan basin. Since 1992 Ambrose has pursued international oil and gas studies, including the Bureau's first international reservoir characterization project in the LL-652 Area of Lake Maracaibo, Venezuela, as well as six other oil and gas projects in Venezuela, the Cooper basin in Australia and several regional play-analysis studies of the Gulf Coast in Mexico, ranging from the Burgos to Macuspana basins.

Ambrose has been active in various geological and geophysical societies and is currently the councilor for the Gulf Coast section of the Energy Minerals Division of AAPG. His contact information is email: william.ambrose@beg.utexas.edu, telephone: 512-471-0258, address: Bureau of Economic Geology, The University of Texas at Austin, University Station, Box X, Austin, TX, 78713-8924.