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Exploring Brazil's Southeast Atlantic Margin Basins: What Are the Geologic Keys to Success?

Approximately 13 billion barrels of oil and equivalent gas have been discovered in Brazil's southeast Atlantic margin basins, with the overwhelming majority coming from 10 fields in a 12,000 square kilometer area in the central Campos Basin. Many in industry have speculated that this "sweet spot" is not an anomaly, and that others will be found along trend in the neighboring Espirito Santo and Santos Basins. Indeed, the components of the Lagoa Feia—Carapebus petroleum system, responsible for a large part of these world-class accumulations, can be mapped with some degree of confidence across a large portion of the southeast basins. The pre-salt rift section (containing the Lagoa Feia Formation) is, in many places, well imaged on seismic data with anomalously thick areas in comparison with the central Campos. This potential source rock distribution, coupled with maturation models and kitchen maps, highlights large areas that could be conducive to hydrocarbon generation and expulsion. Salt welds exist in many areas creating avenues for migration from the source to the overlying reservoir section. Additionally, this salt movement has provided paths for deepwater reservoir transport and deposition as well as creating geometries favorable for both structural and stratigraphic trap development.

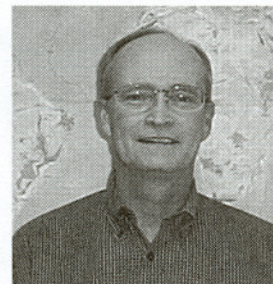
As a result of the distribution of these regional petroleum system elements in the southeast basins, industry has invested heavily since 1998, including an estimate of over US\$200 million in Round 0 farmout bonuses, approximately US\$632 million in lease bonuses (1st through 4th bid rounds) and an estimated US\$500 million in exploratory well drilling (not including Petrobras' 100% activities on its "blue blocks"). Even though it is still somewhat early days in this cycle of exploration, industry results from these expenditures have been anything but stellar. Only a handful of discoveries have been made in recent years and the significance and commerciality of most of these are in question mainly owing to the presence of heavy oil. Because of these results, many in industry are scaling back on previously aggressive campaigns. Several Round 0 and Round 1 blocks have

been fully relinquished because a lack of success, and activity at the last bid round was low compared with the first three. The only post-1997 discoveries that appear to be truly commercial are the ones made by Petrobras on blue block BC-60 and Shell, Petrobras, and ExxonMobil on BC-10, one of the original Round 0 blocks. Announcements by these operators indicate that over 1 billion barrels of recoverable oil has been found on these blocks, with API gravities ranging from 16° to 24°.

In this presentation we will focus on the southeast basins of Brazil and show 1) status of the current competitive environment, 2) GIS maps describing the distribution of the regional elements of the primary and secondary petroleum systems, 3) seismic lines over some of the key discoveries and dry holes, and 4) a discussion of BHP Billiton's maturation/migration modeling and biodegradation index work that may provide new insight into one of the key risks of the trend. ■

Biographical Sketch

RONALD B. MEERS, a geological advisor with BHP Billiton Petroleum in Houston, Texas, has over 25 years of exploration experience and is currently a member of the New Ventures exploration team. He received a BS (1974) in geology from West Texas State University and an MS (1976) in geology from Texas Tech University. Ron started his career in Midland, Texas, with Gulf Oil Corporation and then Northern Natural Gas Company. He joined BHP Billiton in 1985 and transferred to Houston the following year. Prior to his assignment with the New Ventures team, Ron was a member of the deepwater Gulf of Mexico exploration group. He is a Certified Petroleum Geologist and an AAPG delegate.

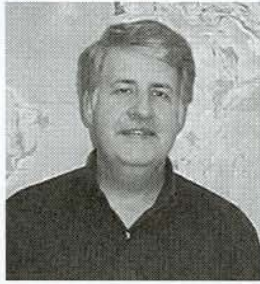


PETER E. GALE is a principal interpreter with BHP Billiton Petroleum in Houston, Texas, and has over >

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18 years of experience in petroleum exploration and petroleum systems analysis. Prior to joining BHP Billiton Petroleum, Peter worked as a petroleum geologist for British-Borneo Exploration and Shell Deepwater Development. Peter earned a BA (1982) in earth sciences from Western Connecticut State University and an MA (1985) in geology from Harvard University. Peter has co-authored several papers on topics related to regional play analysis and petroleum exploration. Peter is a member of the AAPG.



Daqing Petroleum Institute and a PhD (1992) in geology at the University of South Carolina. Alan has co-authored numerous papers in the areas related to basin modeling and petroleum exploration. He has been a member of AAPG since 1990.

ALAN Z. YU is a basin-modeling specialist with BHP Billiton Petroleum in Houston, Texas. He has 16 years of experience in petroleum exploration and basin modeling including software development and application worldwide. Along with the petroleum system analysis, he has been developing and applying basin modeling for pore pressure pre-drill and fluid quality predictions. Alan earned a BS (1982) in petroleum geology from the

