Wednesday, May 24, 2006

Petroleum Club • 800 Bell (downtown)
Social 11:15 a.m., Lunch 11:45 a.m.

Cost: $30 with advance reservations, $35 for walk-ins, space available ($15 for Emeritus and Honorary).

The HGS prefers that you make your reservations on-line through the HGS website at www.hgs.org. If you have no Internet access, you can e-mail reservations@hgs.org, or call the office at 713-463-9476 (include your name, e-mail address, meeting you are attending, phone number and membership ID#).

by ***M. Shane Long (speaker), C. Edward Helsing, David C. Berman, Danielle L. Deemer, and Richard Albert***
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Tectono-Stratigraphic History of Greater Mississippi Canyon, U.S. Gulf of Mexico

The tectono-stratigraphic history of the Mississippi Canyon Area has been analyzed based on a multi-year study utilizing extensive seismic and well databases. Key third-order sequence boundaries, from the acoustic basement through the water bottom, were interpreted over approximately 6,300 square miles, providing the basis for generating regional paleogeographic maps. These data were used to more accurately understand the distribution of reservoir/seal facies and thereby evaluate remaining hydrocarbon potential within the area.

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One aspect that sets this study apart from previous reports is the documentation of a complete tectono-stratigraphic cycle that started with autochthonous, sheet-like evaporites (Middle Jurassic). These formations were loaded initially by primary withdrawal depocenters (Middle Jurassic-Middle Miocene), then secondary withdrawal depocenters (Lower Miocene-Pliocene), into increasingly mature salt stocks, tongues and then canopies (Upper Miocene-Pliocene). This allowed the cycle to be repeated as a second generation of primary withdrawal depocenters began forming directly over these salt canopies (Plio-Pleistocene).

This study also documents that where Mesozoic sediments are thick, Cenozoic sediments tend to be relatively thin and sand-poor and conversely, where Mesozoic sediments are thin, Cenozoic sediments tend to be relatively thick. This inverse relationship reflects the dependent nature of sediment accommodation on the presence or absence of underlying salt (i.e., where salt is evacuated at an early stage, limited accommodation space remains) and allows maps from any third-order interval to be used as predictive tools for sediment trends within deeper or younger sections. The observations and methods developed during this study can be applied to similar settings where data are more limited.

Mesozoic History

As the Yucatán pulled away from North America with the opening of the Gulf of Mexico (Late Triassic–Early Jurassic), it left in its wake a "basin and range" province defined by NW-SE-trending strike-slip faults. Thousands of feet of pre-Upper Jurassic Louann salt accumulated in the deeper portions of the basin during prevailing arid conditions. This "basin and range" fabric, coupled with the presence of salt, played a critical role in establishing the general location and orientation of subsequent sediment pathways and salt structures through the present day. Middle Jurassic–Lower Cretaceous fairways, trending NE-SW, transported sediment from as far as the ancestral Appalachians into the aforementioned grabens, developing large, fan-shaped depocenters. These depocenters loaded Louann salt into incipient pillows and stocks, then eventually inverted to form four-way and three-way turtle structures, representing structural highs through much of the Cenozoic. Collectively, they comprise a depositional system within the Mississippi Canyon Area that is thickest and most amalgamated in the northeast and thinnest and least amalgamated in the southwest.

Although there are no Mesozoic well penetrations within the study area, regional data record lithologies that vary from Middle Jurassic aeolian sands (Norphlet) to Upper Cretaceous chalks, marls and shales. This succession records not only the deepening of the Gulf of Mexico, but also a profound climatic shift from arid conditions during the Middle Jurassic to greenhouse conditions through much of the Cretaceous. This trend toward greenhouse conditions led first to the development of a long-lived carbonate bank that traversed the northeast portion of the study area from NW-SE, then eventually to a prolonged flooding of the shelf that continued to the Paleogene. Sediments during that time

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were largely stored within the Cretaceous interior seaway, causing the study area to be blanketed by a relatively thick succession of marl and condensed shale. Because the shelf edge was not well developed until the Lower Cretaceous, early clastic deposition (e.g., Norphlet, Cotton Valley, Hosston, etc.) most likely extended into the study area over a ramp-like margin, representing an untested play.

Cenozoic History

Miocene: Deposition of marl and condensed shale continued within the study area until the Lower Miocene. The entire condensed package represents a 40–70 MY hiatus (Cretaceous-Paleogene), during which a major shift in continental drainage patterns reflected the development of the proto-Mississippi river, a shift from ancestral Appalachians to Rockies mineral provenance took place, and the climate changed from greenhouse to icehouse. Active sedimentation returned to the area during the Early Miocene along fairways oriented west to east. These depositional systems transported sediment from the Rockies across an ever-broadening shelf margin during periods of major sea level lowstand, into lower slope depocenters in central and southern Mississippi Canyon. The rate of sedimentation increased dramatically during the Middle Miocene as fairways swept across the study area from west to east along NW-SE-trending pathways, most likely reflecting continued up-lift of the Rockies and an eastward shift of the ancestral Mississippi delta. For the first time since the Mesozoic, major depocenters developed in the central and eastern Mississippi Canyon Area.

Sediment from both Lower and Middle Miocene fairways continued to deflect salt away from the center of active mini-basins toward the flanks, feeding increasingly mature, dominantly NW-SE-oriented salt stocks. As a consequence, accommodation in the center of these mini-basins became more limited, causing sediments to stack compensationally, resulting in an increasing number of secondary depocenters near ascending salt. Though the Upper Miocene experienced little change in fairway orientation, the rate of sedimentation decreased significantly, allowing salt to form coalesced tongues and canopies.

Pliocene: Regional work indicates that, by the Pliocene, the focus of sedimentation had shifted back to the west, causing the rate of deposition to further diminish within the study area. Only a few significant depocenters developed up-dip of ascending salt, allowing canopies to reach their maximum aerial extent. Otherwise, sand development was confined within relatively narrow, NW-SE-oriented channel complexes, generally reflecting upper-slope conditions over the area. However, during the Pleistocene, depositional rates were sufficient to overwhelm and eventually cover salt canopies. Sedimentation was largely restricted to a series of fan-shaped deposits (primary withdrawal depocenters) directly overlying salt canopies in the southwest portion of the study area, signifying the beginning of a second tectono-stratigraphic cycle. ■

Biographical Sketch

Shane Long completed both his BS and MS in geology from Brigham Young University and began working for Exxon Exploration Company in 1999. Since that time he has been assigned to a number of projects in Trinidad, Congo, Nigeria and the Gulf of Mexico—spanning both deep- and shallow-water environments. Over the last five years, he has received intensive training in shallow marine, deepwater and process sedimentology via numerous field, classroom and laboratory exercises. Shane is also involved in geoscience recruiting, field course instruction and new-hire mentoring.