Gulf of Mexico Basin Depositional Synthesis: Mapping Neogene Sediment Dispersal Patterns of the Northern Gulf Continental Margin

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Introduction

A Regional understanding of salt/sediment interaction is a key factor in evaluating exploration risk in the Gulf of Mexico. An important geologic phenomenon that results from this interaction is the minibasin. This study categorizes these minibasins into groups based on their morphology and their interaction with salt. To accomplish this the structural setting in which minibasins reside is described using a large, recently acquired, seismic dataset covering the outer shelf and slope. Salt emplacement models are outlined and these, for the most part, explain the observed characteristics and evolution of salt and associated minibasins.

A comprehensive industry-sponsored synthesis of the Cenozoic depositional history of the Gulf of Mexico basin has integrated well data from the basin margin with Feng's 1995 seismic stratigraphic interpretation of the deep basin. Ten Neogene genetic stratigraphic sequences (Lower Miocene 1; Lower Miocene 2; Middle Miocene; Upper Miocene; Miocene-Pliocene Bul. 1; Pliocene Glob. Alt.; Pliocene Lent. 1; Pliocene Ang. B; Pleistocene Trim. A; and Pleistocene pre-Sangamon fauna), recording major depositional episodes (depisodes) of the northern and northwestern Gulf basin, have been defined and mapped. For each sequence, interpretative data include thickness, lithofacies, depositional systems, and stratigraphic architecture. In addition, major stratigraphic features, including paleoshelf margins, local depocenters, depositional system outlines, mapped submarine canyons, and continental-margin embayments have been compiled from published sources. These data are stored in a digital format (ARC/INFOTM).

A series of isopach and interpretative maps showing the depositional setting, total thickness, and gross sand thickness for each of ten sequences reveal patterns of sand transport down slope and onto the basin floor.

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Interpolation of transport pathways between basin-margin delta, shore-zone, and shelf systems and sandy seismic facies on the basin floor defines exploration fairways in deep water and beneath intruded salt. Principal reservoir-bearing systems include delta-fed autochthonous and retrogressive allochthonous aprons. Basin-flooring submarine fan systems persist through several millions of years.

Major observations from this synthesis include:

1. The early Miocene was characterized by relatively uniform progradation across the northwestern Gulf of several shelf-margin deltas and delta-fed aprons. Subregional, short-lived slope embayments were created by massive salt evacuation along the Louisiana paleocontinental margin.

2. During the middle Miocene depisode multiple fluvial/deltaic axes continued to nourish an extensive, prograding delta-fed apron. In the eastern Gulf, a large muddy submarine fan developed at the margin of the deltaic depocenter and its east-flanking shore zone and sandy shelf. Deep geostrophic marine currents became active in the Gulf, and the first of a succession of mid-Miocene through Quaternary contourite drift deposits accumulated along the western basin floor.

3. The late Miocene depisode records focus of sediment input into the Mississippi-Mobile axes. An extensive delta-fed slope and basin-floor apron extends beneath the deep central Gulf. The submarine fan system, now sandy, continued to build on the eastern Gulf floor.

4. The uppermost Miocene--Pliocene *Bul.* A sequence contains deposits of a single large delta system developed along the Mississippi and Mobile axes. The submarine fan system, so prominent on the Miocene basin floor, was replaced by a broad delta-fed apron across the highly progradational slope and adjacent basin floor.

5. Early through early late Pliocenc *Glob. alt*. sequence deposits reflect a dramatic reduction in sediment input to the Gulf. An initial retreat of the Sabine margin caused by a single megaslide nearly 100 miles in breadth was rapidly healed by apron offlap. However, the eastern margin experienced long-term retreat that was accompanied by slope retrogradation and bypass that nucleated a new, muddy submarine fan system.

6. Renewed supply during late Pliocene reestablished margin offlap along a broad, sandy delta-fed apron. Along the eastern margin of the delta depocenter, much sandy sediment continued to bypass the slope, creating a second phase of relatively sandy fan system aggradation on the east-central Gulf floor.

7. Along the western front of the latest Pliocene *Trim.* A depocenter, continental margin offlap by deposition of a sandy delta-fed slope apron was

renewed. At the eastern margin rapid subsidence and foundering of the older delta platform caused slope retrogression and resedimentation of a broad autochthonous slope apron on the adjacent basin floor. Later, as delta progradation partially reconstructed the foundered margin, continued slope bypass nourished a newly formed eastern Gulf fan system-the precursor of the Quaternary Mississippi fan.

The 1.6 Ma Pleistocene history of the Gulf includes ongoing margin outbuilding in front of the central Gulf deltaic depocenter, progressive eastward migration of the axes of slope bypass and deposition of the Mississippi fan system, appearance of unique, large, cross-shelf submarine canyons and creation of a second fan at the mouth of salt-controlled Bryant canyon.