STRUCTURAL STYLE OF SALT/MINI-BASIN SYSTEMS: LOWER SHELF AND UPPER SLOPE, CENTRAL OFFSHORE LOUISIANA

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ABSTRACT

A complex array of deformed salt bodies and localized salt-withdrawal depocenters termed "mini-basins" dominate the subsurface central Louisiana lower shelf and upper slope. In general, each allochthonous salt body forms a "salt/mini-basin" structural system that is about 30 miles in mappable dip extent and 10–15 miles in strike extent. Individual salt bodies climb basinward as a hydraulically connected series of horizontal tablets ("sills") supplied by vertical to basinward leaning "feeders". Each level of salt remobilization and emplacement is overlain by a predictable association of stratigraphic and structural features which occurs repetitively in space and time due to progradation of Miocene to recent shelf margins. On a regional scale there 15 a general basinward increase in the quantity of salt in the subsurface possibly caused, in part, by the progressive redistribution or "rollerpinning" of large amounts of salt ahead of the advancing shelf- margin load. The resultant basinward increase in the quantity of salt amplifies the amount of salt available for later loading through time.

Vertical subsidence of deepwater sediment onto thick salt on the slope results in the formation of circular to elliptical (in map view) "slope" mini-basins. Slope mini-basins are often almost entirely bounded by bathymetrically-high, shallow-seated salt massifs. The internal structure within slope mini-basins is characteristically simple, relatively unfaulted, and varies from monoclinal and basinward-dipping in more proximal positions to symmetric and synclinal in more distal positions. Ancestral slope mini-basins on the present day Louisiana shelf are usually buried to a considerable depth and obscured and/or structurally modified by younger, shallower structural features.

Salt displaced out of slope mini-basins is loaded by the advancing shelf margin initiating formation of shelf mini-basins. Shelf mini-basins are circular to elliptical (in map view) with a 5–20 mile diameter. Shelf mini-basins have well defined fault/piercement salt boundaries on their strike and updip margins and north-dipping salt feeders and counter-regional growth faults on their downdip margins. The internal structure is characteristically strongly monoclinal, south-dipping, and contains a tremendous expanded sequence (>10,000′) of sand-rich, shelf margin facies "ponded" by salt withdrawal. Salt displaced downdip by shelf mini-basin loading forms salt tablets ("sills") that intrude slope strata at a shallow depth beneath the sea floor (<6,000′), probably at or above the salt/sediment density inversion level.

Subsequent deltaic loading of this tabular salt often results in a secondary level of structure detaching on an allochthonous salt withdrawal surface ("Roho") Depending on the overall style of sedimentation, the resultant structure can be either an organized system of nested down-to-the-basin detachment growth faults and edge-ridge salt bodies or a disorganized system of random faults and chaotic salt structure.

The deformation history of each salt/mini-basin system is largely driven by the interplay of regional differential loading (regional bathymetry) and density inversion. Regional differential loading is the dominant mechanism driving early salt deformation on the slope. Density inversion increases in relative importance in shallower water as overburden strata become thicker and more compacted.

Salt/mini-basin systems exert a profound influence on hydrocarbon distribution. Current production occurs mainly in traps associated with shelf mini-basins. Additional production occurs in traps found above reactivated salt sills ("Rohos") on the shelf. Industry exploration is presently focused on identification of traps in the slope mini-basin setting.

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