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Louann Salt Advances with Variable Deposition Rates from Highstand to Lowstand and Impacts on Geologic Processes in Deep-Water Northern Gulf of Mexico

Allen Lowrie[1], Susan J. Moffett[2], Thomas Klekamp[3], Ian Lerche[4], and Neil M. Sullivan[5]

[1] 238 F. Z. Goss Road, Picayune, MS 39466
[2] 2144 Crestwood Drive, Picayune, MS 39466
[3] El-Con Exploration, Inc., 1011 North Causeway Boulevard, Suite 38, Mandeville, LA 70471
[4] Department of Geological Sciences, University of South Carolina, Columbia, SC 29208
[5] President, GAPCO, Inc., 9900 Memorial Drive, Suite 31, Houston, TX 77024

ABSTRACT

The purpose of this paper is multifold: (a) to focus awareness on major geologic processes and (b) to present preliminary notions of synergy between processes in deep-water, subsalt, and fan-fold belt environments. With as much as a thousand-fold variation in deposition rates from highstand to lowstand during the Quaternary, and probably during the Neogene, the rates at which processes operate over time are highly variable. Synergy between processes, including those related to specific zones, *i. e.*, subsalt and basement, is connected via the sedimentation rate variation and the rate and extent of Sigsbee Salt migration as the ever-growing, salt-floored subbasin advances basinward through the northern Gulf of Mexico continental margin.

Synergistic geologic processes among deep-water, subsalt, and fan-fold belt are compiled: hydrates and hydrodynamics of hydrate stability zones, earthquakes and paleofracture zones with thermal anomalies and contained fluids, fracture development and gas expansion/contraction, fan-fold belt development, subsalt pressure compartments, major deposition rate variations and implications of salt-floored subbasins.

Salt has twice to triple the thermal conductivity of alternating sand and shale sediment. Salt massifs, ridges, and diapirs can be as much as 20° to 40° C hotter than surrounding sediments. The advancing salt-floored subbasin can thermally mature organics that have been deposited and make them available for accumulation in reservoirs as commercial hydrocarbons.

A passive margin, such as that along the northern Gulf of Mexico, can be characterized by generally high deposition rates, although highly variable in amount and sediment type and made increasingly unstable by containing semiplastic salt. Most deposition occurs along the shelf and slope, overlying the potentially dynamic salt. The entire shelf-slope wedge appears to be leisurely sliding downslope, overriding the finer-grained and more evenly-deposited continental rise and abyssal plain sediments. The rapid prograding of the shelf-slope wedge steepens the overall margin, increasing regional instability. The semi-plastic Louann Salt serves as a lubricated surface along which the shelf-slope wedge slides basinward and downslope.

The advancing wedge forces creation of fan folds beneath and in front of the advance, advancing compression the causative force. The same advance also may create shear zones that lie above basement and below the salt, pressure compartments, fracture development in front of the advance with gas expansion/contraction, and changes the distribution (laterally and thickness) of hydrates and underlying free gas. Variable deposition rates appear to be the principal driver of the advance.

In the case of plate convergence, the relative advance of continental crust accumulates/offscrapes sediments from the subducting oceanic crust to form a critical Mohr-Coulomb-tapered wedge. This tapered wedge is self-sustaining as new sediments accumulate on the “bow” of the wedge with erosion along the wedge base. The dynamic tapered-wedge concept employs the varying geometry of the sedimentary wedge as a way to describe, at least preliminarily, the internal tectonics and sediment budget.

The same dynamic tapered-wedge concept may be applied to the above Louann Salt sediments. The advancing shelf-slope wedge, riding above the semiplastic salt, incorporates sediments onto the wedge bow with additional sediments descending from the shelf. Accumulating sediments enlarge the tapered wedge with time. As envisioned, there may be no sediment loss along the wedge base. The changing of the sediment wedge geometry could serve as an index to overall internal tectonics and provide another investigative tool to northern Gulf of Mexico geology.