SHELF-MARGIN DELTAIC SEDIMENT DEPOSITED ON A DIAPIR-CONTROLLED SLOPE: THE PLEISTOCENE OF THE GARDEN BANKS AREA, NORTHWESTERN GULF OF MEXICO

J. F. Zaengle[1]

ABSTRACT

Pleistocene sediment in the Texas-Louisiana outer-shelf and upper-slope salt basin (including the outer West Cameron and Garden Banks offshore lease areas) can be related to glacial/interglacial events. Integration of well logs, biostratigraphic data, cores, and conventional 2-D and 3-D seismic data demonstrates that depositional patterns are inseparably linked to the timing and style of structural deformation associated with delta progradation onto a diapir-controlled slope.

Isopach, sand isolith, and structure maps compiled for individual depositional sequences indicate a seaward and east-southeast migration of deltaic depocenters and the shelf margin during the Pleistocene. Delta systems prograded in a step-like fashion through time. Growth-faulting controlled the position of depocenters and confined sedimentation along the shelf margin and upper slope. Shifts in the position of major depocenters occurred abruptly in response to variations in sea level, sediment supply, and basin subsidence history.

Broad, gentle, salt swells and shale anticlines developed in areas of low overburden pressures basinward of the early Pleistocene shelf-margin, forming interdomal basins of varying size and shape. Continued sedimentation and concurrent deformation during the middle and late Pleistocene created irregular masses, stocks, and ridges in the Garden Banks area. These controlled the position of dip-aligned, northwest- to southeast-trending structural and depositional troughs that directed downslope transport of shelf-margin deltaic sediments. Vertical stacking and ponding of sediments occurred where depositional troughs were blocked by salt or where shelf-margin deltas fed sediment directly to salt-withdrawal basins. Renewed progradation of slope systems occurred where (1) shelf-margin deltas shifted position, seeking a gradient advantage in adjacent bathymetric lows, or (2) rapid sedimentation relative to basin subsidence filled salt basins, resulting in the override of bathymetric highs.

Sediments of the Garden Banks Field (Blocks 192, 193, 236, and 237) were deposited in an upper-slope salt-withdrawal basin located 15 miles (24 km) downdip of a late Pleistocene (glacial stage) shelf-margin delta complex. Reservoir sands are deltaic sediments redistributed to the slope by slumping and sediment gravity flows. Two genetically related sand body types are recognized: (1) channelized gravity flow sequences characterized by elongate sand bodies oriented parallel to paleoslope; and (2) progradational lobes deposited adjacent to channels, that offlap in a basinward direction. Sand bodies stack vertically and onlap the flanks of the salt ridge that encloses the field to the east, west, and south. The overall retrogressive vertical sequence indicates salt-ridge growth coeval with deposition of the sequence. The rapid lateral variation in reservoir sand thickness and sequence character are related to deltaic deposition in an unstable basin, where mass transport deposits are diverted or blocked by salt-controlled bathymetric highs. The complex geometry and the restricted size of salt-withdrawal basins and submarine troughs in the Garden Banks slope area contrast sharply with deep-sea fans that spread sediment across broad, unrestricted basin plains (e.g., Mississippi Canyon/Fan).

In any one portion of the study area, the vertical succession of facies and structural styles indicate an evolution from (1) relatively stable slope to (2) unstable shelf-margin to (3) increasingly stable (shelf) environments as fault-bounded basins filled and the shelf-margin prograded through time. This evolution controled the distribution and geometry of Pleistocene sediments, as well as the position and character of potential reservoir intervals. Regional shifts in depocenter position create dramatic differences in sequence character and depositional history along the shelf margin. This study indicates that sand development in Pleistocene slope environments is best in structural lows along the flanks of penecontemporaneous salt features and residual shale masses. However, details of sedimentation history and basin evolution vary with geographic location and stratigraphic position in the basin.

Gulf Coast Association of Geological Societies Transactions, v. 35, pp. 533

[1] Chevron Oil Field Research Co., 3282 Beach Boulevard, La Habra, CA 90631