SUBMARINE CANYON CUT AND FILL MORPHOLOGY AND FACIES IN THE UPPER PLIOCENE OF THE TEXAS SHELF

Kenneth J. Thies[1], Bruce E. Bowen[1], John H. Beard[2] and Mathew L. Bognar[3]

Abstract

The processes responsible for both the formation and subsequent infill of submarine canyons are significant to the exploration for hydrocarbons in the sediments funneled through them. These processes can be better understood through detailed mapping of both the canyon geometry and the infill sediment facies.

TGS Geophysical Company and GECO Geophysical Company have completed a sequence-stratigraphic study of the Plio-Pleistocene and Upper Miocene sediments of the High Island and eastern Galveston south additions of offshore Texas. Approximately 5,000 miles of seismic data in a 2×2 mile grid were interpreted. Sequence boundaries, system tracts and facies within the system tracts were delineated. These seismic interpretations were supported with well logs from nearly 200 wells. Additional control included biostratigraphic data based on detailed analysis of nannofossils and planktonic forminifera from approximately 30 of these wells. We identified and mapped several major submarine canyon features in the upper Pliocene strata in detail using a 1×1 mile seismic data grid. Problems in mapping these canyons come from the difficulty in determining their boundaries. Additionally, partial reactivation of the canyons during subsequent sealevel falls results in downcutting and new episodes of deposition that mask the boundaries. Canyon margins were defined by the lateral limits of chaotic infill. We also recognize a transition one characterized by slump faults in the older shelf sediments.

Canyon development is the result of two predominant submarine processes. Initial formation occurs during sealevel fall as a result of slope failure. This initial slumping creates a pathway for the concentration of sediment gravity flows including turbidity currents and grain flows. Continued downcutting by these transport mechanisms destabilizes the canyon margins promoting slumping of the canyon walls. This serves to both enlarge the areal extent as well as infill the canyon.

The canyon fill is predominantly sediments of the slope fan system tract with lesser amounts of prograding wedge and highstand system tracts. The sediments of the slope fan system tract are slump block, depositional mounding, channel-levee complexes, overbank deposits and small scale cut and fill features. They are recognized on seismic data by reflection patterns which range from chaotic with imbedded "gull wing" configurations to subparallel and semi-continuous. Well log patterns show irregular fining upward sequences with occasional thin to blocky sands. The overlying sediments of the prograding wedge and highstand system tracts exhibit prograding clinoforms or laterally continuous subparallel reflections.

The distribution of depositional facies within the canyon is to a large extent controlled by the canyon formation mechanisms as well as the canyon geometry. The updip generally narrower portion of the canyon is filled with slump block is associated debris flows. The broader middle and lower canyon fill is composed of gravity flow deposits that exhibit depositional morphologies generally associated with slope fans.

[1] Calibre Consulting Services Inc., 333 Clay, Suite 3900, Houston Texas. 77002
[2] Stratavision Energy Inc., P.O. Box 2079, Onalaska, Texas 77360
[3] GECO Geophysical Company, 1325 S. Dairy Ashford, Houston, Texas 77077