Monday, April 28, 2003

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*by **Bill H. Hart** and **Martin L. Albertin**, BP, Houston, Texas*

Subsalt Type Archetype Classification: A Diagnostic Tool for Predicting and Prioritizing Gulf of Mexico Subsalt Traps

Many Gulf of Mexico subsalt traps remain poorly imaged on even the best depth-migrated seismic datasets, necessitating the use of geologic models to help guide prospect evaluations. We introduce a subsalt trap classification scheme to address a long-standing industry need for a comprehensive and practical method of characterizing subsalt traps according to their structural merits. Designed for exploration applications, the classification helps interpreters recognize and, in the case of ambiguous seismic data, infer the presence of key trap attributes that improve or diminish subsalt prospectivity. This trap assessment tool is based on the following tenets:

We introduce a subsalt trap classification scheme to address a long-standing industry need for a comprehensive and practical method of characterizing subsalt traps according to their structural merits.

- The full spectrum of Gulf of Mexico subsalt structural styles can be effectively described by a finite number of trap archetypes, each connoting a particular set of trap risk factors.

- Ribbon truncation closures and upwardly flexed subsalt stratal crests increase trap risk, whereas downwardly flexed and inverted stratal crests generally improve trap viability.

- Within Gulf of Mexico multi-tiered salt systems, subsalt trap geometries manifest the kinematic linkage (or lack of linkage) between targeted strata and underlying autochthonous and allochthonous salt bodies.

- Although deep salt tectonic sequences can be complex and varied, their net effect on subsalt stratal geometry can be described by four constituent deformation modes: rotation, counter-rotation, upward flexures, and downward flexures.

- Subsalt stratal deformation modes are, in turn, impacted by the underlying salt root type; autochthonous roots, fore-ramping allochthonous roots, and back-ramping allochthonous roots each impose a distinctive suite of stratal motions and flexural styles on overlying subsalt strata. These three root types define genetic subsalt trap families that exhibit characteristic ranges in geometry and prospectivity.

- Traps formed against sutured salt base highs are a fourth trap family, often remaining kinematically unlinked to deep salt roots and thus preserving their pre-suture stratal truncation patterns.

The four trap families are qualitatively ranked for overall trap risk and play value, a ranking that is affirmed by Gulf of Mexico subsalt drilling results. Contractional, extensional, and passive subsalt anticlines occur almost exclusively above deep autochthonous salt, and traps of the top-ranked autochthon rooted play family have yielded the largest subsalt discoveries to date. Although subsalt traps underlain by back-ramping allochthonous salt roots lack anticlinal closures, they often exhibit inverted, flat-crested sigmoid folds and may present the best play opportunities updip of the autochthon rooted subsalt trends. The family of subsalt traps underlain by fore-ramping allochthonous roots is relegated to a third-place ranking because of the generic risk of upwardly flexed trap crests, although specific variations (e.g., piggyback sills with subsalt inversions) may remain highly prospective. Lastly, sub-suture traps often retain their pre-suture stratal synclines, forming bi-lateral ribbon truncation closures. These high-risk traps remain problematic for the industry. ■

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North American Dinner

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Biographical Sketch

Bill Hart is a geologist in BP's Deepwater Gulf of Mexico Exploration Business Unit, where he currently works extrasalt and subsalt plays in the Perdido fold belt. Upon joining Amoco in 1980, he became an ardent student of salt-sediment dynamics, a natural result of his early assignments exploring and appraising numerous Louisiana salt domes. Since the late 80s, he has leveraged this experience toward emerging Gulf of Mexico subsalt play trends, generating prospect inventories from coastal Louisiana to the deepwater protraction areas.

Bill holds a MS in geology from the University of Massachusetts, as well as a BS in geology from San Francisco State University. He is an active member of HGS, NOGS, and GCSSEPM, and currently serves as Program Advisory Committee Co-Chair of the 2004 GCSSEPM conference on salt-sediment interactions.

Martin L. Albertin is a geophysicist with BP, in its Deepwater Gulf of Mexico Exploration Business Unit. Martin joined Amoco in 1988, and has worked on depth imaging, subsalt exploration, and pressure prediction projects worldwide. Martin has a BS in geology from Indiana University of Pennsylvania (1985) and an MA in geology from the University of Texas at Austin (1989).