Structural History of Keathley Canyon Type Salt Keels, North-Central Deepwater Gulf of Mexico

Holdaway, Steven [1] (1) North America Exploration and Production, Chevron, Houston, TX.

Structural lows in the base of allochthonous salt sheets, commonly referred to as salt keels, are an important trapping component for several sub-salt exploration plays in the deepwater Gulf of Mexico. Salt keels can be formed by several mechanisms including early canopy emplacement surrounding diapirs that feed the allochthonous salt canopy, withdrawal of autochthonous or deeper allochthonous salt after initial canopy emplacement, and extension of sub-salt sediments after canopy emplacement. Keathley Canyon type salt keels are asymmetrical lows in the base of the salt canopy where sub-salt strata terminate against the salt keel on the steep up-slope side and are sub-parallel to the base of the salt keel on the more gently-dipping down-slope side. Shallower sub-salt strata beneath the keels are below regional elevation, while deeper sub-salt strata are near regional with missing section in-between. Early expectations of structural history in the area favored diapir related models based on analogy to other areas of the northern Gulf of Mexico, but the unique geometries observed in early seismic data have been confirmed by more recent seismic and well data.

Alternative models for the structural history of Keathley Canyon type salt keels have significant implications for exploration plays in the area. Models can be tested by comparing their predictions to the interpreted map-view pattern of sub-cropping ages at the base of the salt canopy and the surface representing the missing section. Listric normal-faulting above an intra-Oligocene detachment is consistent with the sub-crop patterns of strata beneath the salt canopy and the detachment surface. Small to moderate displacement normal faults can be explained by outer arc extension during folding related to withdrawal of autochthonous salt and isostatic tilting after initial canopy emplacement, but larger displacements require another mechanism. Detached contractional structures and deformation of the flanks of salt diapirs after initial salt canopy emplacement can balance local increases in extensional strain but require decoupling of the sub-salt section from topographically driven gravitational loading. The regionally extensive salt canopy provides a mechanism for decoupling of sub-salt and supra-salt deformation.

Understanding the structural history of Keathley Canyon type salt keels is one of the keys to accurately characterizing the risk profile of prospects in the area.